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**Brief Evidence Reviews for the Well Child
Tamariki Ora Programme**

Report submitted to MoH on 11 December 2019

***Whakapūpūtia mai ō mānuka,
kia kore ai e whati***

*Cluster the branches of the manuka,
so they will not break*

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Brief Evidence Reviews for the Well Child Tamariki Ora Programme

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Suggested citation: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019.

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Foreword

The Ministry of Health is responsible for the development of policy advice on children's health and the future direction of the Well Child Tamariki Ora (WCTO) programme. The WCTO programme is the universal health service in New Zealand, which is responsible for protecting and improving the health and wellbeing of children from birth to 5 years of age. This is achieved through health and development screening and surveillance, whānau care and support, and health education.

The current programme is based on the evidence available at the time of the last programme update in 2007. Therefore, the Ministry of Health is reviewing the current WCTO Framework and associated Schedule (developed in 2002) to ensure that WCTO services meet the current needs of children and their whānau, and address the issues they face. The present review was initiated in 2019 and is the second review of the programme, as the first was carried out in 2006. In preparation for this review, the Ministry of Health has commissioned an evaluation of the recent literature on some of the new and emerging issues for preschool children, as well as possible ways to address them.

The purpose of this review includes ensuring that the programme is underpinned by the latest research and evidence. This is particularly pertinent to the current Schedule of Universal Contacts delivered, and one of the work-streams of the review is to consider the timing, content, and intensity of the Schedule, and associated additional contacts. This work stream will support the development of an integrated framework of universal wellbeing contacts for the pregnancy to 24 years of age life course.

The Ministry of Health require the brief evidence reviews (BERs) to synthesise relevant evidence about what works in key areas for children, including development, vision, hearing, emotional and mental health, and growth. The BERs adopted He Awa Whiria – Braided Rivers approach and include consideration of what will work for Māori tamariki and whānau, and Pasifika children and families within each domain. The BERs have helped to identify any knowledge gaps where further work and research may be needed, to inform further development of the WCTO programme.

The WCTO review is a key health contribution to the Government's Child and Youth Well-being Strategy. It forms part of the Ministry of Health's work programme to transform its approach to supporting maternal, child, and youth well-being.

The Ministry of Health have commissioned A Better Start: E Tipu E Rea National Science Challenge to undertake 11 health related BERs that will inform the WCTO review and decision making on the future core service schedule, and additional health and social services for children in New Zealand. The aim of the BERs is to ensure that decisions are grounded in, and informed by, up-to-date evidence. BERs are intended to synthesise available evidence and meet time constraints of health care decision makers. Internationally health technology agencies have embraced rapid reviews, with most agencies internationally offering these alongside standard reviews. These 11 BERs that we have conducted have been completed in a very short time which was a very challenging task.

A Better Start is a national research programme funded by the Ministry of Business Innovation and Employment (MBIE). The objective of A Better Start is to improve the potential for all young New Zealanders to lead a healthy and successful life. To achieve this, A Better Start is researching methods and tools to predict, prevent, and intervene so children have a healthy weight, are successful learners, and are emotionally and socially well-adjusted. A Better Start consists of more than 120 researchers across 8 institutions.

The BERs cover 11 domains critical to the WCTO programme, which are: neurodevelopment (#1); parent-child relationships (#2); social, emotional, and behavioural screening (#3); parental mental health problems during pregnancy and the postnatal period (#4); parental alcohol and drug use (#5); excessive weight gain and poor growth (#6); vision (#7); oral health (#8); adverse childhood experiences (#9); hearing (#10); and family violence (#11). The BERs have synthesised relevant evidence about what works in key areas for children across these domains, which were assessed with careful consideration of what will work for Māori tamariki and whānau and Pasifika children and families. They have also identified knowledge gaps where further work and research may be needed to inform further development of the WCTO programme.

Within each domain, a series of 6–14 specific questions were drafted by the Ministry of Health, and subsequently refined with input from the large team of researchers assembled by A Better Start. A Better Start established discrete writing teams to undertake each BER. These teams largely consisted of a post-doctoral research fellow and specialty expert, often in consultation with other experts in the field. Subsequently, each BER was peer reviewed by at least two independent experts in the field, as well as two Māori and a Pasifika senior researcher. In addition, senior clinical staff from the Ministry of Health have reviewed each BER. These were then revised to address all the feedback received, checked by the editors, and finalised for inclusion in this report.

Whilst each of these domains are reviewed as discrete entities, there is considerably inter-relatedness between them. In particular, neurodevelopmental problems can be impacted by parent-child relationships, parental mental health, and pre- and postnatal drug exposure. Similarly, children who have problems with growth, vision, or oral health may also have neurodevelopmental disorders.

Most of the evidence available for these BERs comes from international studies with limited data from New Zealand, in particular there is limited information about Māori, Pasifika, and disadvantaged families. These are the tamariki and whānau in whom the WCTO Programme services are more scarce, yet could potentially offer the greatest benefit.

The criteria for screening include the requirement for an effective and accessible intervention; the corollary is that screening should not be offered if there is no benefit to the individual being screened. The essential issue is therefore to identify those infants and preschool children and their whānau who would have better outcomes following intervention; this includes better outcomes for the whānau.

The current WCTO programme has had a greater emphasis on surveillance rather than screening. Many of the questions in the BERs address screening. A change in the WCTO programme that further extends into screening will require substantial upskilling of many WCTO providers, as well as redirection of resources. Importantly, Māori whānau, hapū, and iwi, and Pasifika communities' views must be considered before any new screening programmes are to be included.

It should be noted that a shift towards screening rather than surveillance may prevent health and behavioural problems. The economic benefits of prevention and early intervention are well documented, with early interventions showing that for every dollar spent there are substantial savings to health, social services, police, and special education resources.



Professor Wayne Cutfield
Director of A Better Start National Science Challenge
On behalf of the editors, authors and reviewers of the brief evidence reviews

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1. Neurodevelopmental screening and surveillance

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Suggested citation: Saraf R, Marks R. Neurodevelopmental screening and surveillance. In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019; p. 7-51

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: The authors have no financial or non-financial conflicts of interest to declare that may be relevant to this work.

Abbreviations

AIMS	Alberta Infant Motor Skills
ASD	Autism spectrum disorder
ASQ	Ages and Stages Questionnaire
B4SC	B4 School Check
BDI	Battelle Developmental Inventory Screening Test
BOT	Bruininks-Oseretsky Test of Motor Proficiency
BSITD	Bayley Scales of Infant and Toddler Development
CAT/CLAMS	Clinical Adaptive Test/Clinical Linguistic Auditory Milestone Scale
CP	Cerebral Palsy
DDST	Denver Developmental Screening Test
ELMS	Early Language Milestone Scale
FASD	Fetal alcohol spectrum disorder
GMs	General Movement Assessment
LDS	Language Development Survey
MABC	Movement Assessment Battery for Children
MAI	Movement Assessment of Infants
MCHAT	Modified Checklist for Autism in Toddlers – original and revised with follow-up versions
NDD	Neurodevelopmental disorder
NSMDA	Neurological Sensory Motor Development Assessment
NZ	New Zealand
PDMS	Peabody Developmental Motor Scales
PEDS	Parent Evaluation of Developmental Status
PLASTER	Paediatric Language Acquisition Screening Tool for Early Referral
PLC	Parent Language Checklist
SKOLD	Screening Kit of Language Development
SRST	Sentence Repetition Screening Test
TGMD	Test of Gross Motor Development
TIMP	Test of Infant Motor Performance

Executive Summary

- Limited evidence is available on the prevalence of neurodevelopmental disorders (NDD) in New Zealand children. Best estimates suggest a prevalence of between 3 and 10%; this is an underestimate for Māori and Pacific peoples. Having prospective cohort studies would be beneficial in providing robust national data on NDD prevalence and change over time. Identification of children with neurodevelopmental disorders is an important issue.
- Very limited information is available on the priorities for screening neurodevelopmental disorders. Expert consensus is that language development and hearing, FASD, ASD, Global Developmental Delay and Motor disorders (including cerebral palsy) are the top five neurodevelopmental screening priorities for New Zealand children under six years. Vision is also a priority but has been considered separately.
- One small study in Auckland has confirmed that Māori and Pacific children living in neighbourhoods of deprivation have a high incidence of neurodevelopmental problems¹.
- The current surveillance system using PEDS is not working for NZ Māori and Pacific peoples, and its use as a screening tool should be reviewed.
- Translation of the screening tools into commonly spoken languages in New Zealand e.g. Te Reo and Pacific Island languages and validation of these translated versions would prove to be beneficial for the culturally and linguistically diverse populations in New Zealand.
- There is a wide range of screening tools for use with children who may have neurodevelopmental problems. No one tool stands out as a comprehensive option for screening across the preschool age range for the wide range of neurodevelopmental problems. Tables of the sensitivities, specificities and utility of the various tools are provided.
- Families/whānau should receive information about screening so that they can make an informed decision about their child's participation.
- Screening processes need to be flexible to meet the needs of different populations.
- Timing of screening needs to be manageable for children/tamariki, families/whānau and screening providers. Therefore, information from all the domains covered by the review needs to be linked coherently. This needs to be collated and clear age points for screening identified.
- Potential harms of screening include inappropriate reassurance if screen is a false negative, and causing anxiety and stress if screen is a false positive. The failure of services to provide intervention in a timely way or through rationing of services is very stressful for families/whānau whose child has been identified as having a neurodevelopmental concern.
- Secondary screens may be appropriate when the primary screen has not provided a clear result. However, there needs to be rapid escalation to appropriate assessment and intervention when a significant deviation from normal development is identified.
- There is evidence that intervention is effective; choice of intervention for specific neurodevelopmental conditions is outside the scope of this review.

Abstract

Early development of motor and language skills is a useful indicator of a child's overall development and cognitive ability and is related to school success. Identification of young children at risk for developmental delay or related problems should lead to intervention services and family support, to ensure optimum opportunities for good outcomes. This evidence review was undertaken to evaluate the strengths and limits of primary and/or potential secondary screening and interventions for neurodevelopmental disorders, including motor dysfunction and speech & language delay in preschool-aged children, to determine the adverse effects of routine screening (if any) and what is known about screening in Māori and Pacific children. Studies reported wide ranges of sensitivity and specificity when compared with reference (sensitivity 22%-100%; specificity 55%-100%). The tools can be administered by a health professional, parent or a preschool teacher or a combination of any of these screeners. The shortest time to administer the screen was 5-10 minutes with some screens taking up to 60-90 minutes. It was found through this review that several aspects of screening have been inadequately studied to determine optimal methods, including which instrument to use, the age at which to screen, and which interval is most useful. PEDS Developmental Milestone (PEDS: DM), Ages and Stages Questionnaire (ASQ), and Brigance Early Childhood Screen may be used as secondary screening tests following a positive primary screen. No other evidence on secondary screening could be found. Interventional studies reported significantly improved motor and speech & language outcomes compared with control groups. However, the studies were small and long term effects are unknown. With the current surveillance system, Māori and Pacific peoples are underserved. Culturally appropriate approaches are needed to address this issue.

1.1 Introduction

Although there is no set definition for neurodevelopmental disorders (NDDs), it is often described as impairments in the functioning of the brain that affect a child's behaviour, memory or ability to learn. Examples of NDDs in children include attention-deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), learning disabilities, intellectual disability (previously known as mental retardation), conduct disorders, cerebral palsy, and impairments in vision and hearing. Genetic factors often contribute to these disorders. However, most NDDs are complex and have multiple contributors rather than one clear cause². These disorders may likely result from a combination of genetic, biological, psychosocial, and environmental risk factors as well as behavioural risk factors. Environmental factors that may affect neurodevelopment include maternal use of alcohol, tobacco, and illicit and prescription drugs during pregnancy; prenatal or childhood exposure to some environmental contaminants; lower socioeconomic status; preterm birth; and low birthweight³. Children with NDDs often experience difficulties with language and speech, motor skills, behaviour, memory, learning, or other neurological functions². While symptoms and behaviours of NDDs often change or evolve as a child grows older, some impairments are permanent. Identification of children at risk for developmental delay or related problems can lead to intervention services and family support at a young age when these are most likely to be effective⁴. Early intervention to address difficulties experienced by the child can reduce the risk or severity of certain types of neurodevelopmental disorders and improve developmental, emotional, academic and social outcomes.

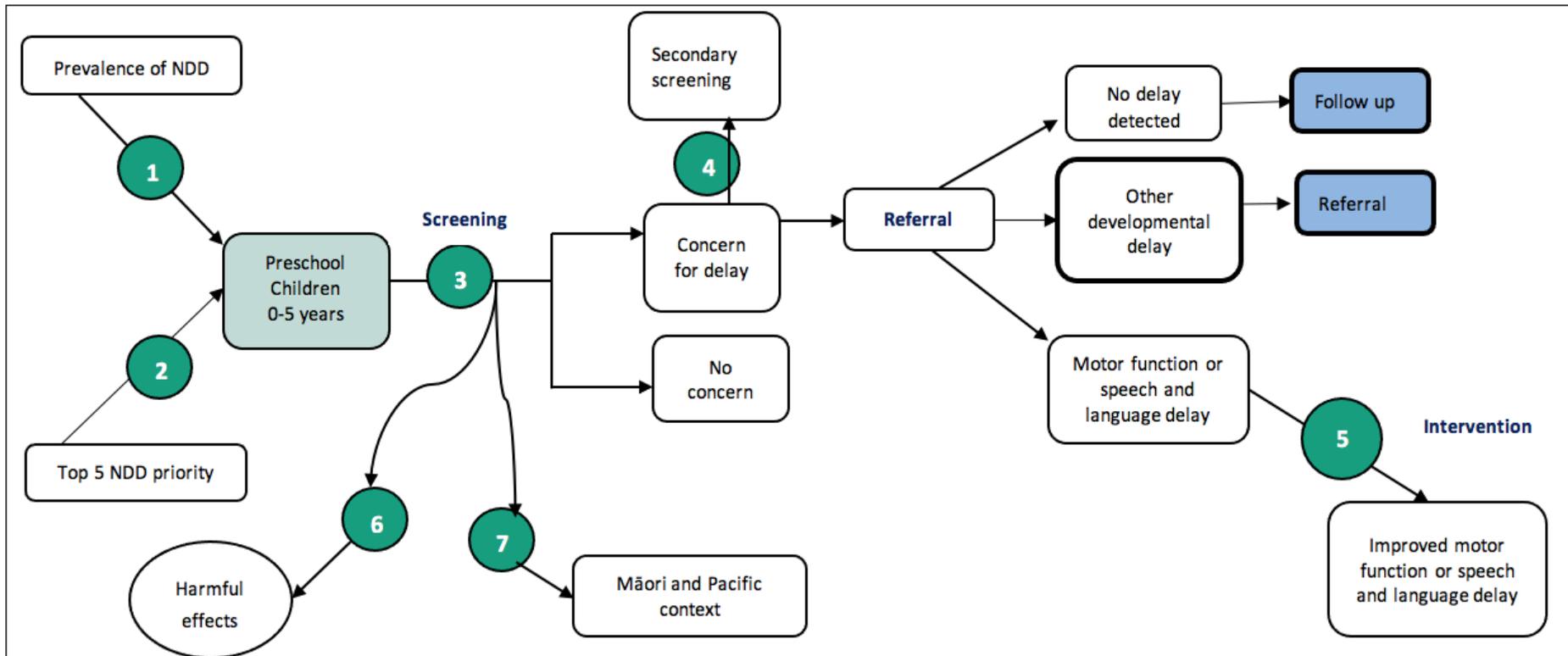
1.1.1 Key Questions

This review covers seven key questions (Figure 1.1). The key questions examine the evidence on the epidemiology of neurodevelopmental conditions including top five priority for NDDs in NZ children (key questions 1 and 2), about the effectiveness, accuracy and feasibility of screening children aged 5 years and younger for NDDs. (key question 3), secondary neurodevelopmental screening tests following a positive neurodevelopmental screen (key question 4), effectiveness of interventions for children identified with NDDs (key question 5), adverse or harmful effects of screening (key question 6), and screening from a Māori and Pacific perspective (key question 7).

1.1.2 Literature Search and Selection

Relevant studies were identified from multiple searches of MEDLINE (OVID), Embase and Cochrane library databases (1980 to August 2019). The following search terms were used: 'neurodevelopmental disorders', 'global developmental delay', 'disability', 'language delay', 'learning difficulty', 'intellectual difficulty', 'screening, surveillance', 'follow-up', 'referral', 'intervention', 'NZ children', 'NZ infants', 'NZ preschoolers', 'young children', 'under six years'. Searches for each term were combined using Boolean operators. Articles were also obtained from recent systematic reviews⁵⁻⁸, reference lists of pertinent studies, reviews, editorials, grey literature and by consulting experts. Some materials are not generally available and must be purchased, which limited the evidence review to published articles. All abstracts identified were reviewed and eligibility of full-text articles were determined based on several criteria. However; main criteria were availability of papers in English language, articles limited to screening / surveillance tools for gross motor, fine motor and language skills, and provision of primary data relevant to the seven key questions. A total of 86 full-text articles from searches and an additional six non-duplicate articles from reference lists met eligibility criteria and were reviewed. Data were extracted from each study and entered into evidence tables. Raw data was reported, and no statistical analyses were performed due to the heterogeneity of the studies.

Figure 1.1. The seven key questions representing an outline of the evidence review. It includes the epidemiology and top five neurodevelopmental disorders in NZ children aged under six years, screening tools, interventions, adverse effects of the screening process and screening in Māori and Pacific children.



1. Prevalence of Neuro-Developmental Disorders (NDDs) in New Zealand children.
2. The top five NDDs that need screening in NZ children in early childhood (0 to 5 years).
3. Tests available to conduct primary NDD screening/ surveillance (accuracy, administration of screening instrument, associated costs and optimal time for screening).
4. Secondary NDD screening tests (if any) recommended following a positive screen and prior to an assessment.
5. Effective interventions following early detection and whether these interventions lead to significant improvements later in childhood / adolescence.
6. Any adverse / harmful effects from screening for an NDD during childhood.
7. What is known from a Māori and Pacific perspective about NDD screening in early childhood?

1.2 Prevalence of neurodevelopmental disorders in NZ children

It is challenging to accurately report the prevalence of neurodevelopmental disorders in pre-school aged children in New Zealand due to limited number of published papers in this area. Key sources include: Ministry of Health⁹⁻¹¹ & Statistics NZ Disability reports¹², publications from the Pacific Islands Families Study¹³⁻¹⁶, Dunedin Multi-disciplinary Child Development Study¹⁷, three studies in Hawkes Bay region¹⁸⁻²⁰, one by Gray²¹ from the Counties Manukau Region, two in a provincial North Island city sampling 15 primary schools^{22,23}, and from a recent Master's project in Tamaki area¹. The data from the Growing Up in New Zealand Study would have been valuable but was unavailable at the time this review was undertaken.

The Dunedin Multi-disciplinary Child Development Study reported 7.6 % and 10.4% of children born in 1972-1973 with language delays at 3 and 5 years of age respectively¹⁷. Results from the NZ Health Survey showed that 10.2% of children aged 3 to 4 years had emotional and behavioral difficulties in 2014-2015¹¹. Two studies drawing data from the same cohort exploring outcomes for the B4 School Check (B4SC) in Hawkes Bay, found 7% of children (13% of referrals), had developmental concerns^{18,19}. Another study on preschool children using the B4SC data in the Counties Manukau Region found that 3.4% had been identified with developmental concerns²¹.

Data from the Pacific Islands Families Longitudinal Study depicts very high prevalence of developmental delays in 2-year olds (35%)¹³, 16.8% internalising and 6.7% externalising behavioural problems in 2-year olds¹⁴, and 26.9% of children having otitis media effusion at 2 years¹⁵, with 2% of these children at increased risk of moderate to severe hearing loss at 11 years¹⁶, The Welcome to School Study (WTS) in Tamaki, where 95% of children are Māori or Pacific, showed 22% of these children at 5 years, had developmental problems¹.

Across the five papers that reported the prevalence of developmental concerns or difficulties, the rate of variation was from 3.4 to 10.4%. There are limitations in using these data to estimate the burden of neurodevelopmental difficulties in NZ children due to the heterogeneity of the studies: prevalence is reported in different age groups, year of reporting is different and different assessment tools have been used. As demographic factors such as living in socio-economically deprived areas amongst others influence the rate of NDD, the prevalence of NDD is higher in Pacific children (6.7-35%) and the prevalence of 3.4-10.4% is an underestimate. It seems the prevalence rate in NZ preschool population may be somewhat similar to the USA (13.8%)²⁴. More evidence is needed to provide more accurate prevalence data; this may become available from the Growing Up in New Zealand study.

1.2 Summary

Limited data is available on prevalence; based on the data that is available the prevalence of NDDs in New Zealand preschool aged children is between 3-10%. These values could be significantly underestimated as higher prevalence has been reported in Pacific children (6.7-35 %).

1.3 Priority for top five NDD screening in NZ children (0-5 years)

Only two data sources were found containing suitable data on NDD: NZ Disability 2013 survey¹² and Ministry of Health Report on the health of young people²⁵. These sources were reviewed to determine the top five neurodevelopmental disorders that need screening in NZ children under six years of age. However, these sources contain limited and inconsistent data which is not specific to the 0-5 age group which is the focus of this review, but for a broader age range: 0-14 years. From these reports the priority of NDD screening is as follows:

1. Developmental delay including language delay, impaired social and cognitive skills, fine / gross motor skills
2. Psychology / psychiatric including behavioural, emotional and mental disorders
3. Physical impairments including cerebral palsy and other pervasive disorders
4. Intellectual disability
5. Hearing and Vision impairments

These priorities are in keeping with international literature. However in view of the lack of adequate data for the age range 0-5 years, the response to [key question 2](#) was further developed in consultation with Developmental and Community Paediatricians (Dr Colette Muir and Dr Alison Leversha, personal communication 2019). Psychology / psychiatric including behavioural, emotional and mental disorders has been removed as this is covered in another Rapid Evidence Review (Domain 3). Vision is covered in Domain 7 of another Rapid Evidence Review. Our experts identified the conditions most commonly presenting to secondary care for further evaluations. The top five priorities for NDD screening in New Zealand children aged 0-5 years according to expert opinion are as follows:

1. Language development especially language deprivation, and including hearing screening
2. Fetal Alcohol Spectrum Disorder (FASD)
3. Autism Spectrum Disorder (ASD)
4. Global Developmental Delay; this term is preferred to Intellectual Disability as more appropriate to the preschool age group
5. Motor disorders including Cerebral Palsy (CP)

1.3 Summary

The top five NDDs that require primary screening in NZ children are language development and hearing, FASD, ASD, Global Developmental Delay and Motor disorders (CP).

1.4 Primary screening tools for NDDs, age of screening, cost, administration and accuracy

Even though we acknowledge that children with NDDs often experience an array of difficulties such as motor dysfunction, language & speech deprivation, problems with behaviour, memory, learning and other neurological functions, this brief evidence review mainly covers screening for motor skills (gross and fine) and speech and language delay. Key developmental abilities in the preschool years include vision, hearing, language, cognitive, social, emotional, and motor skills. Vision is considered in

Domain 7, and social, emotional, and behavioural development is discussed in Domain 3, therefore this review focusses on language (combined with hearing) and motor development and screening.

A total of 24 screening tools: 13 gross motor function and 11 speech & language delay screens have been identified through the literature search. An additional screen for Autism (M-CHAT) has been identified (Table 1.1):

Motor function screens

1. Alberta Infant Motor Skills (AIMS)^{26,27}
2. Bruininks-Oseretsky Test of Motor Proficiency (BOT-2)²⁸
3. Bayley Scales of Infant and Toddler Development (BSITD III)²⁹
4. General Movement Assessment (GMs)³⁰⁻³²
5. Movement Assessment Battery for Children (MABC II)³³
6. Movement Assessment of Infants (MAI)^{34,35}
7. Parent Evaluation of Developmental Status (PEDS)³⁶
8. Neurological Sensory Motor Development Assessment (NSMDA)^{37,38}
9. Peabody Developmental Motor Scales (PDMS II)³⁹
10. Test of Infant Motor Performance (TIMP)^{40,41}
11. Test of Gross Motor Development (TGMD)⁴²
12. Ages and Stages Questionnaire (ASQ)³⁶
13. Infant Development Inventory (IDI)⁴³

Social Communication, Speech & language screens

1. Battelle Developmental Inventory Screening Test (BDI II)
2. Battelle Developmental Inventory Screening Test (BDI II) Clinical Adaptive Test/Clinical Linguistic Auditory Milestone Scale (CAT / CLAMS)⁴⁴
3. Denver Developmental Screening Test – II (DDST II)⁴⁵
4. Early Language Milestone Scale (ELMS)^{46,47}
5. Fluharty Preschool Speech and Language Screening Test⁴⁸⁻⁵⁰
6. Language Development Survey (LDS)⁵¹⁻⁵³
7. Levett-Muir Language Screening Test⁵⁴
8. Parent Language Checklist (PLC)⁵⁵
9. Pediatric Language Acquisition Screening Tool for Early Referral (PLASTER)⁵⁶
10. Screening Kit of Language Development (SKOLD)⁵⁷
11. Sentence Repetition Screening Test (SRST)^{50,58}
12. Modified Checklist for Autism in Toddlers (M-CHAT) – original and revised with follow-up versions⁵⁹

1.4.1 Reported accuracy of the identified screening instruments

Health professionals require standardised tools to identify, classify and diagnose developmental problems in children. Screening tools are either criterion referenced tests (the child passes if they achieve a specified criterion) or norm referenced tests (child's results are reported in relation to a specific population). The characteristics of the normed population should be considered as environmental and cultural differences have been found to affect development (motor).

These measurement features should be considered when selecting a developmental screener:

- Primary purpose: discrimination (normal vs abnormal), prediction (whether the child has a future risk of NDD or delay) or evaluation (monitor changes in development over time)
- Validity (content, construct and criteria- normally shown by factor analysis)
- Reliability (sensitivity, specificity, test-retest, inter, intra-reliability)
- Clinical utility (costs, time taken for administration, method of administration, screening age and whether training is required)

Validity and reliability characteristics are normally grouped as psychometric properties. Even though we acknowledge that all of the 4 characteristics stated above are important, the discussion on accuracy of the screening tool is mainly focussed on clinical utility and reliability (sensitivity and specificity).

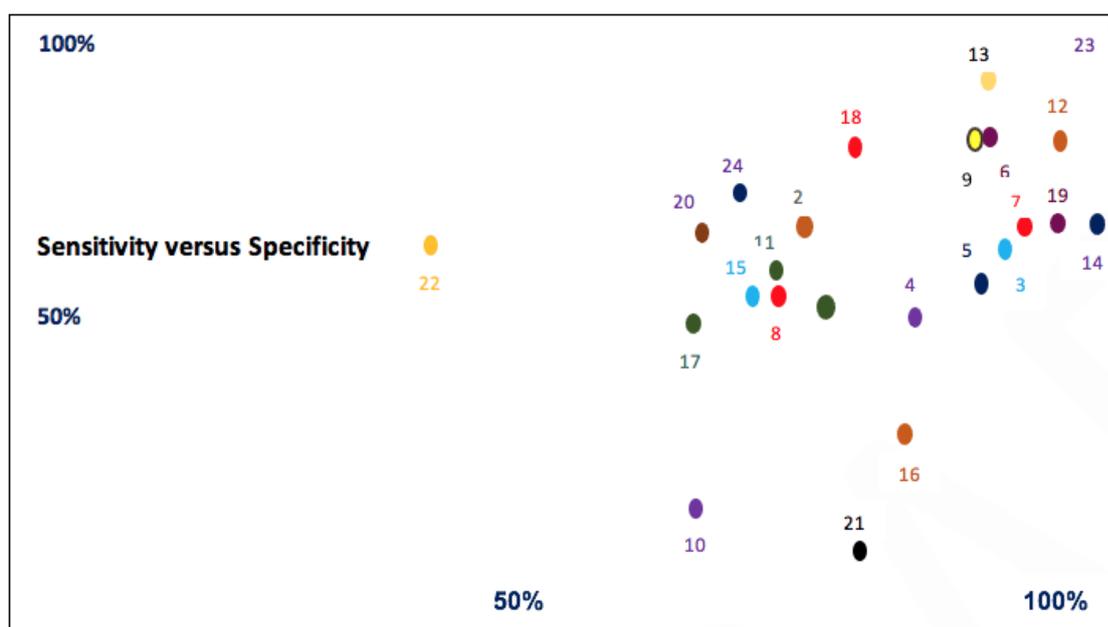
1.4.2 Psychometric properties

The sensitivity and specificity of most of the screening tools are good or excellent, except for Bruininks-Oseretsky Test of Motor Proficiency (BOT-2), Pediatric Language Acquisition Screening Tool for Early Referral (PLASTER), Denver Developmental Screening Test – II (DDST II) screens that have satisfactory sensitivity and specificity (Table 1.1 and Table 1.2 and Figure 1.2). Sensitivity ranged from 22% to 100% and specificity from 55% to 100%. Nine studies reported sensitivity and specificity of 80% or more using the General Movement Assessment (GMs)²⁹, Bayley Scales of Infant and Toddler Development (BSITD III)³⁰, Modified Checklist for Autism in Toddlers (M-CHAT)⁴¹, Infant Developmental Inventory⁴³, Early Language Milestone Scale (ELMS)^{46,47}, Battelle Developmental Inventory Screening Test (BDI II), Language Development Survey (LDS)^{51,52}, the Clinical Linguistic and Auditory Milestone Scale (CLAMS)⁵³, and Levett-Muir Language Screening Test⁵⁴.

Studies utilising seven screening tools also provide evidence of the ability to discriminate between particular ages, which can be considered to support their content validity. The study of Neurological Sensory Motor Development Assessment (NSMDA) reported higher sensitivity / specificity at 8 months (83%/84%) compared to 1 (69%/73%), 4 (80%/57%), and 12 months (59%/94%)^{37,38}. Similarly NSMDA^{37,38}, Test of Infant Motor Performance (TIMP)^{40,41} and Movement Assessment of Infants (MAI)^{34,35} screens have shown to have greater accuracy at 8 months, 9 months and 8 months respectively (Table 1.1). The study of the Clinical Linguistic and Auditory Milestone Scale reported higher sensitivity/specificity at age 14 to 24 months (83%/93%) than 25 to 36 months (68%/89%) for receptive function, but lower sensitivity/specificity at age 14 to 24 months (50%/91%) than 25 to 36 months (88%/98%) for expressive function⁴⁴. A study testing expressive vocabulary using the Language Development Survey indicated higher sensitivity/specificity at age 2 years (83%/97%) than at age 3 years (67%/93%)⁵³. The study of the Screening Kit of Language Development reported comparable sensitivity/specificity at ages 30 to 36 months (100%/98%), 37 to 42 months (100%/91%), and 43 to 48 months (100%/93%)⁵⁷.

For the motor function screens, studies have also reported the content validity and structural validity of BSITD III²⁹, BOT-2²⁸, Movement Assessment Battery for Children (MABC II)³³, Peabody Developmental Motor Scales (PDMS II)³⁹, Test of Gross Motor Development (TGMD)⁴² to range from good to excellent, which indicated that these screens were actually measuring what they were supposed to^{6,8}.

Figure 1.2. The sensitivity and specificity of the screening tools.



1= AIMS (73, 81.7), 2=GMs (83.3, 80), 3=NSMDA (58.8-82.4, 56.9-93.3), 4=PEDS(73-96, 73-86), 5=MABC II (79, 93), 6=TIMP (33-91.7, 75.7-94), 7=BSITD II (83, 94), 8= MAI (73.5-96, 62.7- 78.2), 9= PDMS (36.1-91.7, 52.3- 93.8), 10=BOT-2 (42.5-55.1, 65.7-72.6), 11= ASQ (82, 78), 12= MCHAT (91, 96), 13= ELMS (97, 93), 14= BDI-II (83, 100), 15= DDST II (73, 76), 16= PLASTER (53, 86), 17= SKOLD (73, 66), 18= LDS (91, 87), 19= CLAM (83, 97), 20= LDS (80, 67), 21= DDST (22, 88), 22=PLC (87, 47), 23=Levette- Muir Language Screening Test (100,100). 24=IDI (85, 77)

Table 1.1. The accuracy (sensitivity and specificity) of motor function screening tools.

Instrument	Age tested	Sensitivity	Specificity (%)	Outcome
AIMS ^{26,27}	0 to 18 mo	73.10%	81.7	Normal versus abnormal development Cerebral palsy
GMs ³⁰⁻³²	0 to 4 mo	83.30%	80%	
NSMDA ^{37,38}	1 mo to 6 yr	68.8% (1 mo) 80.0% (4 mo) 82.4% (8 mo) 58.8% (12 mo)	72.6% (1 mo) 56.9% (4 mo) 83.7% (8 mo) 93.3% (12 mo)	Motor outcome- chance of walking
PEDS ^{60,61}	0 to 7–11 yr	73– 96%	73– 86%	
MABC-II ³³	3 to 16 yr	79%	93%	Motor impairment
TIMP ^{40,41}	32 wk to 4 mo	33% (1 mo) 50% (2 mo) 72% (3 mo) 62.5% (6 mo) 91.7% (9 mo)	94% (1 mo) 86% (2 mo) 91% (3 mo) 77.4% (6 mo) 75.7% (9 mo)	
BSITD-III ²⁹	1 mo to 3 yr	83%	94%	Motor impairment
MAI ^{34,35}	0 to 12 mo	73.5 (4 mo) 83.3 (4 mo) 96.0 (8 mo)	62.7 (4 mo) 64.5 (4 mo) 78.2 (8 mo)	Cerebral palsy
PDMS-II ³⁹	0 to 5 yr	36.1 (4 mo) 91.7 (8 mo)	93.8 (4 mo) 52.3 (8 mo)	Normal versus abnormal development
BOT-2 ²⁸	4 to 21 yr	55.1 (4 yr) 42.5 (8 yr)	72.6 (4 yr) 65.7 (8 yr)	Motor Delay
MCHAT ^{59*}	16 to 30 mo	91%	96%	Autism
IDI ⁴³	0 to 6 yr	85%	77%	Motor delay

mo, month(s); wk, week(s); yr, year(s)

* M-CHAT is neither a motor nor a speech and language screener.

Table 1.2. The accuracy (sensitivity and specificity) of language & speech delay screening tools.

Instrument	n	Reference Standard	Speech & language domains	Subjects	Setting	Screeener	Sensitivity	Specificity	Ref
Parent Evaluation of Developmental Status	157	Clinical assessment	Expressive language, articulation	From outpatient clinic or private practice; 78% Caucasian; 54% male; 6-77 months	Clinic	Psychologist or Special education	72%	83%	^{60,61}
Early Language Milestone Scale Clinical assessment	191	Clinical assessment	Expressive and receptive language	From private practices and pediatric outpatients of hospital; 80% Caucasian; 50% male; 0-36 months	GP clinic	Medical students	97%	93%	⁴⁷
Early Language Milestone Scale	48	Receptive Expressive Emergent Language Scale, Bayley Scales of Infant Development	Expressive and receptive language	From low SES socioeconomic groups; 8-22 months	Pediatric clinic	Not reported	83%	100%	⁴⁶
Denver Developmental Screening Test II (communication components)	89	Battery of measures	Fine motor, adaptive, personal social, gross motor, and language	From 5-day care centres; 52% male; 7-70 months	Day care centres	Psychologist	73%	76%	⁴⁵
Pediatric Language Acquisition Screening Tool for Early Referral (PLASTER)	173	Early Language Milestone Scale	Expressive and receptive language	123 high risk infants; 50 normal controls; 3-36 months	<i>High risk:</i> neonatal developmental follow-up clinic <i>Control:</i> speech and hearing clinic	Speech & language pathologist	53%	86%	⁵⁶
Bayley Infant Neurodevelopmental Screener	78	Bayley Scales of Infant Development II	Expressive and receptive language	Randomly selected from those presenting for routine neonatal high-risk follow-up; 54% male; 62% African American; 6-23 months	GP office	Developmental Paediatrician	73%	66%	⁶²
Language Development Survey	306	Infant Mullen Scales of Early Learning	Expressive vocabulary	Toddlers turning 2- years old during the study in Wyoming; 52% male; 24-26 months	Home	Parent	91%	87%	⁵¹
Language Development Survey	64	Infant Mullen Scales of Early Learning	Expressive vocabulary	Children turning 2 years in a specific month in an area of Wyoming.	Home	Parent	83% (2 yr) 67% (3 yr)	97% (2 yr) 93% (3 yr)	⁵²

Instrument	n	Reference Standard	Speech & language domains	Subjects	Setting	Screener	Sensitivity	Specificity	Ref
Language Development Survey	422	Bayley Scales of Infant Development, Stanford-Binet, Reynell Developmental Language Scales	Expressive vocabulary Delay 1: <30 words and no word combinations Delay 2: <30 words or no word combinations Delay 3: <50 words or no word combinations	Toddlers in four towns of Delaware County, PA turning 2-years old during the study	Home	Parent and research assistant	Delay 1 Bayley 70%; Binet 52%; Reynell 67% Delay 2: Bayley 75%; Binet 56%; Reynell 89% Delay 3 Bayley 80%; Binet 64%; Reynell 94%	Delay 1 Bayley 99%; Binet 98%; Reynell 94% Delay 2 Bayley 96%; Binet 95%; Reynell 77% Delay 3 Bayley 94%; Binet 94%; Reynell 67%	53
Clinical Linguistic and Auditory Milestone Scale	99	Sequenced Inventory of Communication Development	Syntax, pragmatics	Infants turning 1 or 2 years old during study; 55% male; 0-36 months	Home or school for the deaf	Speech and language pathologist	Receptive: 14-24 months: 83% 25-36 months: 68% Expressive: 14-24 months: 50% 25-36 months: 88%	Receptive: 14-24 months: 93% 25-36 months: 89% Expressive: 14-24 months: 91% 25-36 months: 98%	44
Denver Developmental Screening Test II (communication components)	89	Battery of measures	Physical, self-help, social, academic, and communication	Children from five day care centres; 52% Male; 7-70 months	Day care centres	Psychologist	22%	86%	45
Parent Language Checklist	2,590	Clinical judgement	Expressive and receptive language	All children turning 36 months; 52% male; 41% urban	Home (mailed)	Parent	87%	47%	55
Structured Screening Test	376	Reynell Developmental Language Scales	Expressive and receptive language	Children from 2 low SES counties in London; Mean age 30 months	GP clinic	Health visitor	Severe: 66% Needs therapy: 54%	Severe: 89% Needs therapy: 90%	58
Levett-Muir Language Screening Test	140	Reynell Developmental Language Scales, Goldman-Fristoe Test of Articulation, Language Assessment and Remediation Procedure	Receptive language, phonology, syntax	Private practice population; 34-40 months	GP Clinic	Medical practitioners	100%	100%	54
Fluharty Preschool Speech and Language Screening Test	279	Arizona Articulation Proficiency Scale Revised, Test of Language Development Primary	Expressive and receptive language, articulation	46% male; 74% Caucasian; 86% rural; 24-72 months	Preschool	Teacher	Speech & Language: 43% Speech: 74% Language: 38%	Speech & Language: 82% Speech: 96% Language: 85%	50

Instrument	n	Reference Standard	Speech & language domains	Subjects	Setting	Screeener	Sensitivity	Specificity	Ref
Fluharty Preschool Speech and Language Screening Test	421	Test for Auditory Comprehension of Language Revised, Templin Darley Test of Articulation	Expressive and receptive language, articulation	52% male; 75% Caucasian; 24-72 months	Preschool	Teacher	Speech & Language: 31% Speech: 43% Language: 17%	Speech & Language: 93% Speech: 93% Language: 97%	⁵⁰
Hackney Early Language Screening Test	1,205	Reynell Developmental Language Scales	Expressive language	Children attending routine developmental check-ups; mean age 30 months	Home	Health visitor	99%	69%	⁶³
Fluharty Preschool Speech and Language Screening Test	90	Developmental Sentence Scoring	Expressive and receptive language, articulation	Children referred for speech and/or language assessment and intervention and controls; 24-72 months	Speech and hearing clinic in western Ontario	Clinician	10th percentile: 36% 25th percentile: 30%	10th percentile: 95% 25th percentile: 100%	⁴⁹
Screening Kit of Language Development	602	Sequenced Inventory of Communication Development	Expressive and receptive language	From day care centres in Detroit; 30-48 months	Speech and language hearing clinic, day-care, GP clinic	Speech and language pathologists	30-36 months: 100% 37-42 months: 100% 43-48 months: 100%	30-36 months: 98% 37-42 months: 91% 43-48 months: 93%	⁵⁷
Fluharty Preschool Speech and Language Screening Test	182	Sequenced Inventory of Communication Development	Expressive and receptive language, articulation	From day care programs; 36- 47 months	Clinic	Speech and language pathologists	60%	80%	⁴⁸
Sentence Repetition Screening Test	76	Speech and Language Screening Questionnaire	Receptive and expressive language, articulation	Children registering for kindergarten; 48% male; 65% Caucasian; 54- 66 months	School	Non- specialists or school speech and language pathologists	Receptive and expressive: 62% Articulation: 57%	Receptive and expressive: 91% Articulation: 95%	⁵⁰
Test for Examining Expressive Morphology	40	Kaufman Assessment Battery for Children, Structured Photographic Expression Language Test II	Expressive vocabulary, syntax	20 impaired and 20 unimpaired; 52% male; 73% Caucasian; 48- 67 months	School or clinic	Speech and language pathologists	90%	95%	⁵⁶

1.4.3 Administration of the screening instruments (Table 1.3 and Table 1.5)

Most of the screening tools need to be administered by health professionals such as GPs, Paediatricians, Developmental Paediatricians, Nurses, Occupational or Speech and Language Therapists. Training is not needed to administer the screens that are conducted in clinical settings by health professionals; however, familiarity with the screen is required before administration. Some screening tools are completed by parents; these are the PEDS, ASQ, M-CHAT, IDI, LDS, and PLC and for the GMs screen, the child's video can be taken by the parent but all of these need to be scored by a health professional. For the parental-reported screens, it is important that parents are aware of developmental terms and milestones so that they are able to identify a developmental problem or concern; this is especially important for parents from culturally and linguistically diverse backgrounds. Two language and speech tools can be administered by preschool teachers (Fluharty Preschool Speech and Language Screening Test and SRST). Three screens can be performed in a school setting and teachers can assist the health professional with the screening of the child concerned (TGMD, MABC II, TIMP).

Table 1.3. Shows the method of administration of the screening tools.

Instrument	Administration of screen			Training
	Health professionals	Parents	Teachers	
AIMS	✓			x
GMs	✓	✓		✓
NSMDA	✓			x
TGMD	✓		✓	✓
PEDS		✓		x
MABC II	✓		✓	x
TIMP	✓	✓	✓	x
BSITD III	✓			✓
MAI	✓			✓
PDMS	✓			x
BOT-2	✓			x
ASQ		✓		x
MCHAT		✓		x
IDI		✓		x
BDI-II	✓			x
CAT / CLAMS	✓			x
DDST II	✓			x
ELMS	✓			x
Fluharty*			✓	x
LDS		✓		x
Levett-Muir**	✓			x
PLC		✓		x
PLASTER	✓			x
SKOLD	✓			x
SRST			✓	x

* Fluharty Preschool Speech and Language Screening Test.

** Levett-Muir Language Screening Test.

1.4.4 Costs with each identified screening

Most of the assessment tools need to be purchased. The costs associated with purchasing these instruments range from \$20 to \$1650 and are provided in US dollars (Table 1.5). Prices could not be found for some tools. For three gross motor function screens (BOT-2, BSITD III, MABC II) and 1 language & speech screen (BDI-II), comprehensive kits need to be purchased containing examiner guides, manuals, scoring sheets, and activity equipment hence costs is high.

1.4.5 Optimal time or times to conduct screening test (Table 1.4 and Table 1.5)

Two screening instruments can only be used from birth to the first few months of life (GMs, TIMP), while two can be used from birth to the first year of life (MAI, CAT/CLAMS), and three from birth to the first few years of life (AIMS, PDMS, ELMS), and three from birth to beyond the preschool years (IDI, PEDS, BDI-II)

Table 1.4. Shows the reported age of screen administration.

Instrument	Birth to 6 months	6 months to 1 year	1 to 2 years	2 to 3 years	3-4 years	4-5 years	5-6 years	>6 years
AIMS	█	█	█					
GMs	█							
NSMDA*		█	█	█	█	█	█	
TGMD					█	█	█	█
PEDS	█	█	█	█		█	█	█
MABC II					█	█	█	█
TIMP	█							
BSITD III**		█	█	█				
MAI	█	█						
PDMS	█	█	█	█	█	█		
BOT-2						█	█	█
ASQ					█	█	█	
M-CHAT		█	█	█				
IDI	█	█	█	█	█	█	█	
BDI-II	█	█	█	█	█	█	█	█
CAT / CLAMS	█	█						
DDST II		█	█	█	█	█	█	█
ELMS	█	█	█	█				
Fluharty					█	█	█	
LDS			█	█				
Levett-Muir					█			
PLC				█				
PLASTER		█	█	█				
SKOLD				█	█	█	█	█
SRST						█	█	

* NSMDA recommended time of screening is from 1 month to 6 years (not from 6 months).

*** BSITD III recommended time of screening is from 1 month to 3 years (not from 6 months).

There are screening instruments that been used from the first few months of life to: (1) first few years of life (BSITD-III, M-CHAT, PLASTER), (2) 5 to 6 years of age (NSMDA), (3) beyond six years of age (DDST-II). Three tools have been reported to have been used past infancy (TGMD, MABC II, ASQ, Fluharty Preschool Speech and Language Screening Test, Levett-Muir Language Screening Test, PLC, SKOLD, SRST).

The administration time varied between different assessments with some studies noting that the older the child, the longer it takes for assessment⁸. PEDS, M-CHAT, ASQ, ELMS, Fluharty Preschool Speech and Language Screening Test, LDS, Levett-Muir Language Screening Test, PLC, PLASTER, SKOLD and SRST take the shortest time to administer (5-18 minutes). AIMS, GMs, and NMDSA, take 10-30 minutes, while TGMD-II and CAT/CLAMS are close with 15-20 minutes. TIMP and MABC-II take 20-40 minutes while IDI, BOT-2 and DDST-II take 20-30 minutes. The rest (BSITD III, MAI, PDMS II, BDI-II) take longer to administer (30-90 minutes).

1.4 Summary

The 25 assessment tools identified through the literature search are all appropriate for measuring motor development and speech & language delay in the preschool years. The most important step in identifying the best tool is to identify the purpose of the assessment and then choose a test that has been validated. One may wish to consider tools such as BSITD-III, PEDS, ASQ and DDST II that are appropriate to use for more than one function (motor function and language delay). Some tools such as GMs and BSITD-III require standardised training and may be costly, although this may improve the reliability and validity of screening. AIMS should be considered if an easy, accessible tool is needed that requires minimum handling and less time to administer.

Table 1.5. The clinical utility of the screening instruments identified through the literature search.

Tool	Short form	Age range	Time required (minutes)	Subscale measured	Method of Administration	Administrator	Costs
Alberta Infant Motor Skills ^{26,27}	AIMS	0-18 mo	20-30	Prone (21 items) Supine (9 items), Sitting (12 items) Standing (16 items).	Norm referenced. Therapist observes spontaneous activity in each of the subscales. Each Item is scored as least or most developmental mature, all items in between are marked as the “window period”. Developmental maturity are scored as percentile scores.	Does not require specific training. Experienced therapists familiar with motor development and movement analysis are reliable testers. Non-therapists should receive training.	Scoring sheets are required. A pack of 50 sheets cost \$48.95
Bruininks-Oseretsky Test of Motor Proficiency 2 nd ed. ²⁸	BOT-2	4 yr to 21:11 yr	Complete: 45-60 Each composite: 10-15 Short: 15-20	Fine-motor precision, fine motor integration, manual dexterity, bilateral coordination, balance, running speed and agility, upper extremity coordination, strength.	Norm referenced. Clinician administered. Performance items including fine motor tasks, such as copying and tracing, and gross-motor tasks, such as sit-ups and running speed.	Preferably these tool should be administered by Paediatric health professionals, early childhood specialist. Formal training not required.	Comprehensive manual / kit: \$1650. Test kit provides most equipment.
Bayley Scales of Infant and Toddler Development 3 rd ed. ²⁹	BSITD III	1 mo to 3 yr	30-90	Assesses development in 5 areas: 1.Cognitive 2.Language 3.Motor 4.Social-emotional 5.Adaptive behaviour	The child is given tasks to measure cognitive skills, observed for receptive and expressive communication (language), assessed for motor skills, parental input is required for social-emotional and adaptive behavioural skills.	Preferably: Paediatric health professionals, early childhood specialist. Formal training not required. DVD, webinars and workshops available.	Comprehensive manual/ kit \$1322. Test kit provides most equipment.
General Movement Assessment ³⁰⁻³²	GMs	0 to 20 wk corrected	3-5 to video 20 for interpretation by trained professional	Gross movements, writhing movements, fidgety movements	General movements are assessed with the infant awake, lying on their back. The child should be calm and awake. The infant is videoed for 3-5 minutes and assessment is scored from the video.	Therapist, Allied health professionals can be trained to perform this assessment.	Comprehensive manual with DVD \$80. Special video equipment needed.
Movement Assessment Battery for Children 2 nd ed. ³³	MABC- II	3-6 yr 7-10 yr 11-16 yr	20-40	8 Tasks related to 3 specific areas: 1.Manual dexterity 2.Ball strikes 3.Balance (static and dynamic)	Assessment can take place at home, school or clinic. Movement is assessed in everyday situations. The examiner can assess groups of children in classroom situations, obtain parents or teachers views on child movement and measure the extent to which a child’s attitudes and feelings about motor tasks are situation specific.	Can be performed by psychologists, speech therapists, physiotherapists, occupational therapists, mental health professionals, health practitioners, and education professionals. No additional specialised training is required.	Comprehensive manual / kit \$1446. Test kit provides most equipment.

Tool	Short form	Age range	Time required (minutes)	Subscale measured	Method of Administration	Administrator	Costs
Movement Assessment of Infants ^{34,35}	MAI	0-12 mo	30-60	Four assessment domains: 1.Muscle tone 2.Primitive reflex 3.Automatic reactions 4.Volitional movement	Therapist observes and administers items in four assessment domains: 1.Muscle tone 2.Primitive reflex 3.Automatic reactions 4.Volitional movement	Physical therapist, occupational therapists, physicians, nurses, psychologists and others who have a good knowledge base in infant development. Special training to administer this exam is strongly recommended.	Cost not available.
Parent Evaluation of Developmental Status ^{36,60,61}	PEDS	0-7:11 yr	5-7	Testing items include questions on: 1.Development 2.Speech & Language 3. Learning & Cognition 4. Gross / fine motor skills 5.Social and emotional behaviour	10-item questionnaire that is completed by parents.	Health professionals. Training on how to administer PEDS Screen is offered.	Kit costs \$66. Each kit has a scoring guide, 1 PEDS pad (x50) and scoring + interpretation form x50
Neurological Sensory Motor Development Assessment ^{37,38}	NSMDA	1 mo to 6 yr	10-30	Test items include: 1.Posture supine 2.Support on arms 3.Rolling 4.Prone Progression Creeping 5.Crawling hands and knees	The physiotherapist or clinician assess problems of posture, movement and coordination. An overall functional score is calculated in the grades in each of the 5 areas. Assessment forms available for ages: 1, 4, 8, 12, 18, 24, 36, 48, and 60 months.	Recommended for use in clinical setting therefore training in use of test is not essential but can be provided by accredited instructor.	Basic manual \$20. Specific toys required but easily accessible.
Peabody Developmental Motor Scales 2 nd ed. ³⁹	PDMS II	0-5 yr	30-60	Composed of 6 sub-tests: 1.Reflexes (reaction to stimulus) 2.Stationary (stand still) 3.Locomotion (crawl, hop, run, jump) 4.Object manipulation (throw, catch) 5.Grasping (ability to use hands) 6.Visual-motor integration	The screen is a combination of task-related activities in each of the 6 subsets and recording of observations by the examiner of the child while doing the tasks.	Anyone can administer as long as they have knowledge on gross and fine motor functions and they can get training in how to use the screen.	\$530 for the kit which has manual / guide to administer and score booklets.
Test of Infant Motor Performance ^{40,41}	TIMP	32 wk to 4 mo	20-40	Tests include: 1.Head control in supported sitting 2.Postural control in supine position 3.Righting reactions during tilting 4.Side-lying 5.Postural control in standing	Consists of 42 items in the 5 test areas. The examiner observes infant and then administers elicited items in standardised procedures.	Examiners can be teachers, health professionals (Occupational Therapists, Physiotherapists and doctors). No formal training is required.	Comprehensive manual / kit \$60. Test kit provides most equipment.
Test of Gross Motor Development 2 nd ed. ⁴²	TGMD II	3 yr to 10 yr	15-20	The tool is made up of 12 skills / tasks in 2 subsets: 1. Locomotor (run, hop, jump, slide etc.) 2. Object Control (catch, throw, kick etc.)	Standardised procedure. The examiner observes and scores the tasks.	TGMD-2 be administered by special physical educators, psychologists, occupational therapists, or physical therapists. Training is recommended.	Complete TGMD II Kit includes manual and 50x record forms \$155.

Tool	Short form	Age range	Time required (minutes)	Subscale measured	Method of Administration	Administrator	Costs
Infant Developmental Inventory ⁴³	IDI	0 to 18 mo	20-30	1. Social 2. Self-Help 3. Gross Motor 4. Fine Motor 5. Language	The parent observes the child and scores the 5 areas. Recommended to start scoring from half the child's age.	Administered by caregivers.	\$45 for the questionnaire and development chart.
Parent Evaluation of Developmental Status ^{36,60,61}	PEDS	0-7:11 yr	5-7	Testing items include questions on: 1. Development 2. Speech & Language 3. Learning & Cognition 4. Gross / fine motor skills 5. Social and emotional behaviour	10-item questionnaire that is completed by parents.	Health professionals. Training on how to administer PEDS Screen is offered.	Kit costs \$66. Each kit has a scoring guide, 1 PEDS pad (x50) and scoring + interpretation form x50
Neurological Sensory Motor Development Assessment ^{37,38}	NSMDA	1 mo to 6 yr	10-30	Test items include: 1. Posture supine 2. Support on arms 3. Rolling 4. Prone Progression Creeping 5. Crawling hands and knees	The physiotherapist or clinician assess problems of posture, movement and coordination. An overall functional score is calculated in the grades in each of the 5 areas. Assessment forms available for ages: 1, 4, 8, 12, 18, 24, 36, 48, and 60 months.	Recommended for use in clinical setting therefore training in use of test is not essential but can be provided by accredited instructor.	Basic manual \$20. Specific toys required but easily accessible.
Peabody Developmental Motor Scales 2 nd ed. ³⁹	PDMS II	0-5 yr	30-60	Composed of 6 sub-tests: 1. Reflexes (reaction to stimulus) 2. Stationary (stand still) 3. Locomotion (crawl, hop, run, jump) 4. Object manipulation (throw, catch) 5. Grasping (ability to use hands) 6. Visual-motor integration	The screen is a combination of task-related activities in each of the 6 subsets and recording of observations by the examiner of the child while doing the tasks.	Anyone can administer as long as they have knowledge on gross and fine motor functions and they can get training in how to use the screen.	\$530 for the kit which has manual / guide to administer and score booklets.
Test of Infant Motor Performance ^{40,41}	TIMP	32 wk to 4 mo	20-40	Tests include: 1. Head control in supported sitting 2. Postural control in supine position 3. Righting reactions during tilting 4. Side-lying 5. Postural control in standing	Consists of 42 items in the 5 test areas. The examiner observes infant and then administers elicited items in standardised procedures.	Examiners can be teachers, health professionals (Occupational Therapists, Physiotherapists and doctors). No formal training is required.	Comprehensive manual / kit \$60. Test kit provides most equipment.
Test of Gross Motor Development 2 nd ed. ⁴²	TGMD II	3 to 10 yr	15-20	The tool is made up of 12 skills / tasks in 2 subsets: 1. Locomotor (run, hop, jump, slide etc.) 2. Object Control (catch, throw, kick etc.)	Standardised procedure. The examiner observes and scores the tasks.	TGMD-2 be administered by special physical educators, psychologists, occupational therapists, or physical therapists. Training is recommended.	Complete TGMD II Kit includes manual and 50x record forms \$155.
Infant Developmental Inventory ⁴³	IDI	0 to 18 mo	20-30	1. Social 2. Self-Help 3. Gross Motor 4. Fine Motor 5. Language	The parent observes the child and scores the 5 areas. Recommended to start scoring from half the child's age.	Administered by caregivers.	\$45 for the questionnaire and development chart.

Tool	Short form	Age range	Time required (minutes)	Subscale measured	Method of Administration	Administrator	Costs
Ages and Stages Questionnaire ³⁶	ASQ	40-60 mo	12-18	Contains 30 items and is available for assessment at 4, 5, 8, 12, 16, 18, 20, 24, 30, 36, 48 months. 30 items covering 4 areas: 1. Gross motor skills 2. Fine motor skills 3. Problem solving 4. Personal-social skills	Parent completed questionnaire as a general developmental screening tool.	Allied Health professionals. Training is provided through the Publisher.	\$199 for the complete ASQ system (questionnaires and user guide)
Battelle Developmental Inventory Screening Test 2 nd ed.	BDI II	0 to 7:11 yr	40-60	5 developmental domains assessed in any order: 1. Adaptive (ADP) 2. Personal- Social (P-S) 3. Communication (COM) 4. Motor (MOT) 5. Cognitive (COG)	Test administrators will use 3 different formats to obtain information about each child: (1) structured activities for direct assessment, (2) observation of child's natural environment such as home, day-care or school and (3) interviews with parents, caregivers and / or teachers.		The cost is approximately \$1200 for the initial kit & set manipulatives. Additional scoring sheets can be ordered.
Clinical Adaptive Test/Clinical Linguistic Auditory Milestone Scale	CAT/ CLAMS	0-36	18-30	Includes psychometrics and speech and language milestones. CAT: 19 age sets with 12 instruments and 57 items for visual motor skills. CLAMS: 19 age sets with 3 instruments up to 24 months and 4 instruments after 24 months, includes 43 items for language skills	The test is focused on expressive, receptive, and visual language, primarily through parent report with occasional direct testing of the child.	Speech or language therapist.	
Denver Developmental Screening Test - II	DDST II	2 wk to 6 yr	20-30	Domains include: 1. Language (39 items) 2. Fine motor-adaptive (29 items) 3. Personal-social (25 items) 4. Gross motor (32 items)	Administered in a standardised manner with fine motor- adaptive activities delivered first followed by language, personal-social and gross motor activities.	Designed to be used in a clinical setting by a variety of professionals.	
Early Language Milestone Scale	ELMS	0-36	1-10	43 items covering 3 areas: 1. Auditory expressive 2. Auditory receptive 3. Visual (expressive and receptive)	Responses are obtained from a combination of parental/caregiver report, examiner observation, and direct testing. This assessment has three sections: auditory expressive, auditory receptive, and visual.	Developed for use in pediatric clinical setting as a brief screen for language abilities in <3 years. Administered by speech and language specialists.	Complete kit with manual and record forms (x100) \$398
Fluharty Preschool Speech and Language Screening Test		3 to 6:11 yr	10	35 items separated into 3 sections (A, B, C) including identification of 15 common objects (phoneme), nonverbal responses to 10 sentences (syntax), and imitation of 10 one sentence picture descriptions. Assess identification, articulation, comprehension, and repetition	Activities involve articulation, repeating sentences, following directions, answering questions, describing action and sequencing events. Teacher questionnaire is also available.	Easy to administer. Examiners can be trained on how to score the items.	Complete kit \$212. Each kit has 2 manuals, 2 picture books, 25x record forms and 12 blocks

Tool	Short form	Age range	Time required (minutes)	Subscale measured	Method of Administration	Administrator	Costs
Language Development Survey	LDS	18-35 mo	10	310 words arranged in 14 semantic categories. Parents indicate which words their child has spoken and describe word combinations of 2 or more words that their child has used.	Uses parents' reports of vocabulary and word combinations to identify language delays.	Can be completed independently at home by a parent.	
Levett-Muir Language Screening Test		34-40 mo	5-6	1. Receptive 2. Language, 3. Phonology, 4. Syntax	Test is divided into 6 sections: 1) Comprehension - child is asked to pick toys from group. 2) Vocabulary - child's ability to name the toys. 3) Comprehension - using pictures child is required to respond to questions. 4) Vocabulary - child's ability to name what's in the pictures. 5) Comprehension & representation - child's ability to answer "what" and "who" questions. 6) Overall - child is asked to explain the detailed composite picture.	Health professionals can administer this screen in a clinical setting.	
Parent Language Checklist	PLC	36 mo	5	12 questions for parents about their child's receptive and expressive language including one question assessing hearing problems	It can be completed independently at home by the parents.	Parents	
Pediatric Language Acquisition Screening Tool for Early Referral	PLASTER	3-36 mo	5-10	Communication development milestones by age with 7 individual areas. Each area contains 10 questions (5 relate to receptive language and 5 expressive language).		Speech and language pathologist.	
Screening Kit of Language Development	SKOLD	2.5 to 4 yr	10	Vocabulary comprehension, story completion, sentence completion, paired sentence repetition with pictures, individual sentence repetition with pictures, individual sentence repetition without pictures, auditory comprehension of commands.		Allied professionals or language and speech therapists.	
Sentence Repetition Screening Test	SRST	54-66 mo	10 or less	15 sentences repeated one at a time by the child after demonstration by the tester.	In a school setting (kindergarten)	Non- specialists or school speech and language pathologists.	
Modified Checklist for Autism for Toddlers	MCHAT	16-30 mo	5-10	Most widely used Autism Spectrum Disorder (ASD) Tool. Used to identify impairments in social interactions and communication and the presence of repetitive and restrictive behaviours. Some children may benefit from a more through developmental and Autism screening.	Initially parent administered and if a positive screen is obtained- follow up screening is performed with a health professional. Scored by health professionals	Parent and / or health professional.	Free

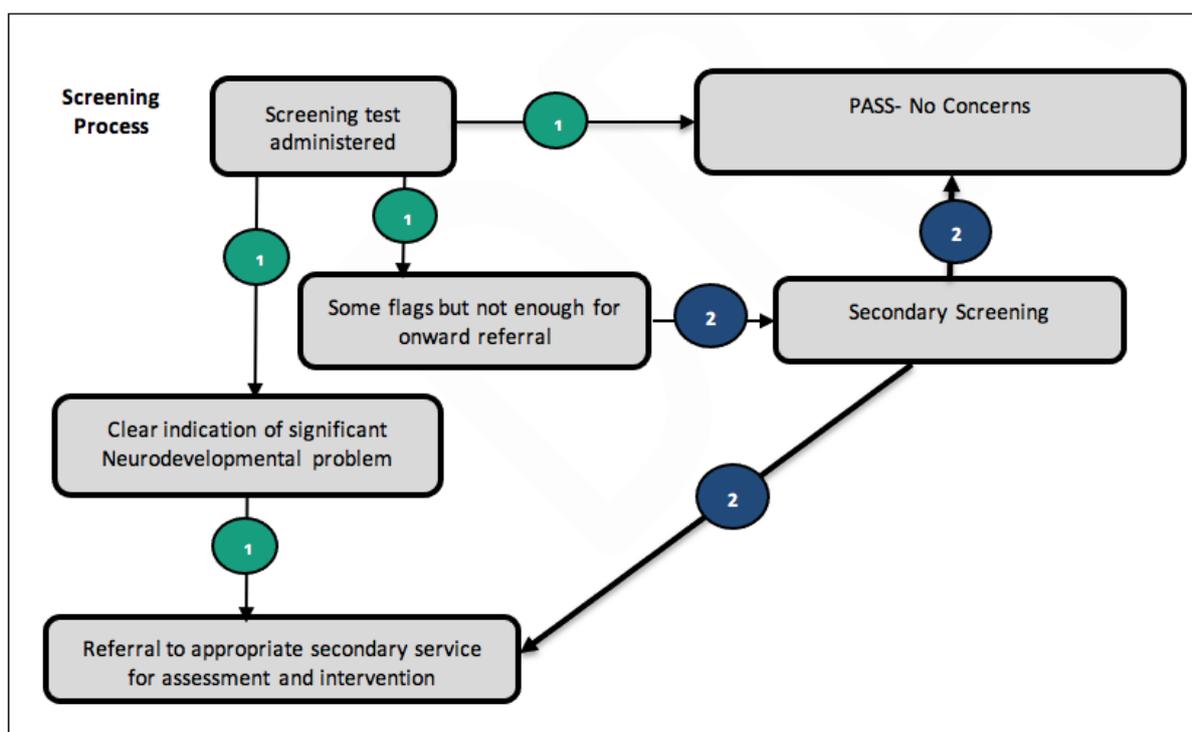
mo, month(s); wk, week(s); yr, year(s).

1.5 Secondary NDD screening tests following a positive screen

No international studies were found that addressed this question. On Royal Children’s Hospital Melbourne website, there is information that if a concern is identified through PEDS as a primary screening instrument, a secondary screening tool may also be used as part of the assessment. The secondary screening instruments recommended are: PEDS: Developmental Milestones (PEDS: DM), the Brigance Early Childhood Screen and the Ages and Stages Questionnaire (ASQ).

According to Ministry of Health’s recommendation, a secondary screen needs to be performed if a significant concern is highlighted in PEDS¹. However not all B4SC staff have been trained to undertake this process. This was supported by two studies^{21,64}, who found that a second check for children identified with a potential issue was not offered. Wills (2010)¹⁹ noted that in Hawke’s Bay DHB, nurses were trained to conduct the Ages and Stages Questionnaire (ASQ) if predictive concerns were highlighted in the PEDS however; they did not report on whether this was done or on the outcome of the study¹⁹.

Figure 1.3. The NDD screening pathway.



1.5 Summary

No evidence could be found on secondary NDD screening following a positive primary screen. Even though Ministry of Health recommends secondary screening following a positive PEDS screen, it is not clear whether this is done or how effective the process is. It should also be considered how a child who has been identified as having a potential developmental issue from the primary screen will benefit from a secondary screening when he/she should be directly referred to appropriate secondary services (Figure 1.2). A secondary screen should only be performed if some ‘flags’ are not enough for onward referral. This will prevent additional burden on the health care system.

1.6 Interventions leading to improved outcomes in early childhood

Twenty studies⁶⁵⁻⁸² were identified from the literature search as interventional studies; mainly randomised controlled trials. Studies were included if they used intention-to-treat analysis, method of randomization was reported, and there were more than 10 subjects in intervention or comparison groups. Limitations of studies, in general, include small numbers of participants (only 5 studies enrolled more than 50 subjects), lack of consideration of potential confounders, and disparate methods of assessment, intervention, and outcome measurement. As a result, conclusions about effectiveness are limited. Although children in the language and speech interventional studies ranged from 18 to 75 months of age, most studies included children aged 2 to 4 years old. Children in the motor function interventional studies were mostly older: 3 to 11 years (Table 1.6 and Table 1.7). Thus, the results do not allow for determination of optimal ages of intervention.

Studies evaluated the effects of individual or group therapy directed by clinicians and/or parents that focused on specific motor function (gross and fine) or speech & language domains. For motor function: these include locomotor, balance, object control and rhythm activities as well as activities on fine motor skills such as scissors cutting and shoelace tying. For speech and language domains: these include expressive and receptive language, articulation, phonology, lexical acquisition, and syntax. Several studies on speech & language delay, used established approaches to therapy, such as the HANEN principles^{72,74}. Others used more theoretical approaches, such as focused stimulation^{71,72}, auditory discrimination⁷³, imitation or modelling procedures⁷⁷, auditory processing⁶³, and play narrative language^{75,80}. Some interventions focused on specific words and sounds, used unconventional methods, or targeted a specific deficit.

Outcomes were measured by subjective reports from parents^{71,72,75} and by scores on standardized instruments, such as the Reynell Expressive and Receptive Scales^{71,76}, the Preschool Language Scale⁷⁰, the MacArthur Communicative Development Inventories⁷⁵, and motor function scores obtained from MABC, PDMS II and NSMDA^{65-69,83}. The most widely used outcome measure for language and speech improvement was mean length utterances, used by 3 studies^{71,75,82} and object control and locomotor function used by 3 studies reporting motor function improvement^{66,67,69}.

A 12-month intervention (10-minute weekly sessions) in 18-42 months children as a treatment for receptive auditory comprehension led to significant improvement for the intervention group compared with control group, however, results did not differ between groups for several expressive and phonology outcomes⁷⁰. Four studies evaluated speech and language interventions for children who were 2 to 3 years old^{71,72,74,75}. Studies reported improvement on a variety of communication domains including clinician-directed treatment for expressive and receptive language⁷⁵, parent-directed therapy for expressive delay^{71,72} and clinician-directed receptive auditory comprehension⁷⁰. In 2 studies, there were no between group differences for clinician-directed expressive⁷⁰ or receptive language therapy⁷⁰, or parent-directed phonology treatment⁷⁴. Five studies reported significant improvements for children 3 to 5 years old undergoing interventions compared with controls^{70,76,77,79,80}. For motor function interventional groups, significant improvements were observed for balance, object control and locomotor function^{65-69,83}.

1.6 Summary

In general, studies of interventions were small and heterogeneous, may be subject to plateau effects, and reported short-term outcomes based on various instruments and measures. As a result, long-term outcomes are not known, interventions could not be compared directly, and generalization is questionable.

Table 1.6. Interventional studies to improve gross motor functions.

Motor skill assessment tool (s)	n	Age	Intervention Type	Intervention frequency and duration	Primary Outcome measures (s)	Results
Movement Assessment Battery for Children (MABC) ⁶⁹	76	5-8 yr	Kinder-kinetics-in-training (perceptual activities-locomotor, rhythm, balance and laterality-unilateral, bilateral and cross-lateral activities.	30 mins / 2 times per week for 8 weeks.	MABC-2: Manual dexterity, aiming and catching, balance	Balance increased in exposed group (p=0.05), whereas manual dexterity (p=0.797), aiming and catching (p=0.252), showed no significant changes.
Peabody Development Motor Scales (PDMS II) ⁶⁶	149	54 mo	Skill based lesson plans were specifically designed to target stationery, locomotion, object manipulation, grasping and visual-motor integration skills for children in the experimental group. 16x lessons to target gross motor and 16x for fine motor.	16 weeks of 50 mins motor intervention (e.g. 25 min fine motor and 25 min gross motor)	Gross and fine motor skills	A repeated measure analysis of variance revealed a significant difference between the experimental and control group children on stationery (p<0.01) and visual-motor subsets (p<0.05) after the 16 weeks intervention.
Test of Gross Motor Development Assessment (TGMDA) ⁶⁵	27	3-5 yr	Parents tutored their children on academic readiness skills such letter, number, and colour recognition and on fine motor skills such as scissors cutting and shoelace tying.	Two 45-min lessons per week for 8 weeks delivered by the children's parents.	Gross and fine motor skills	The experimental group improved significantly in the object-control subscale score from pre-test to post-test (p<0.001), whereas the control group did not change.
Test of Gross Motor Development Assessment (TGMDA) ⁶⁷	59	4 yr	Skill intervention program consists of the following areas: 1. Hopping and galloping 2. Jumping 3. Ball bouncing 4. Striking 5. Kicking 6. Catching and throwing	24 instructional sessions (45 mins each) during a 12-week period.	Fine motor skills	Compared to the control group, the motor skill intervention group revealed significantly higher locomotor (p=0.000) and object control (p=0.000) scores following the intervention than prior to the intervention.
Test of Gross Motor Development Assessment (TGMDA) ⁶⁸	53	4-11 yr	The intervention group received the typical 'Successful Kinesthetic Instruction for Pre-schoolers' program and instructional motor skill program.	2 times a week for 9 weeks.	Locomotor and object control skills	The intervention group performed significantly better than the comparison group from pre to post-test for both locomotor (p<0.001) and object control skills (p<0.001).
Test of Gross Motor Development Assessment (TGMDA) ⁷⁰	40	4-5 yr	Each session consisted of: 1. A 2-3 min warm-up activity 2. 24 min of motor skill instruction for two object control skills 3. 2-3 min closure activity Two Mastery motivational climate (MMC) object control skills sessions were conducted each day.	30 mins session for 2 days per week for 9 weeks totalling 18 motor skill sessions.	Object control (OC) Perceived Physical Competence (PCC)	Both Object control skills and Perceived Physical Competence skills showed improvement after the 9 weeks intervention: PCC: p<0.001 OC: p<0.001

mo, months; yr, years

Table 1.7. Randomised controlled trials of interventions for speech & language delay.

Speech and language domains	n	Age (months)	Interventions	Speech and language outcome	Ref
Expressive and receptive language and phonology	159 in 2 groups	18-42	Clinician-directed individual intervention routinely offered by the therapist for 12 months vs. none	Improved auditory comprehension in intervention vs. control group; no differences for expressive language, phonology error rate, language development, or improvement on entry criterion	75
Expressive language	36 in 2 groups	27-39	Parent-directed individual therapy 60-75 minutes every other week for 6 months vs. none	Improved scores on several measures for intervention vs. control group	73
Expressive language	25 in 2 groups	23-33	Parent-directed individual focused stimulation intervention 150 minutes per week for 11 weeks vs. none	Larger vocabularies, use of more different words, more structurally complete utterances and multiword utterances in intervention group vs. control; no differences in several other measures	74
Expressive and receptive language	21 in 2 groups	21-30	Clinician-directed individual therapy 150 minutes per week for 12 weeks vs. none	Improved mean length of utterances, total number of words, lexical diversity, vocabulary size, and percentage of intelligible utterances in intervention group vs. control	76
Expressive language	25 in 3 groups	27-39	Clinician-directed individual therapy 60-75 minutes every other week for 6 months vs. parent-directed 60-75 minutes every other week for 6 months vs. none	Improved scores on all 5 measures for parent-directed group vs. control; improvement on 2 measures for clinician-directed group vs. control; improvement on 1 measure for parent vs. clinician group	71
Expressive language and lexical acquisition	10 in 2 groups	32-39	Clinician-directed individual therapy for 3 weeks vs. none	Improved multiword utterances from baseline in intervention group; no between group differences reported	77
Lexical acquisition and phonology	25 in 2 groups	23-33	Parent-directed individual therapy eight 150-minute sessions and 3 home sessions for 11 weeks vs. none	Improved level of vocalizations and inventory of consonants for intervention group vs. control; no differences in the number of vocalizations	80
Expressive and receptive language	39 in 2 groups	37-43	Clinician-directed interactive language therapy for 40 minutes weekly for 6 months (traditional group) vs. 40 minutes for 4 days per week for 3 weeks in two 3-month blocks (intensive group)	Improved expression score on Reynell scale for intensive group vs. weekly (or traditional) therapy group; no difference in comprehension scores, both improved	78
Expressive language	36 in 3 groups	47-83	3 clinician-directed approaches are compared for 5 months: mimicry, clinician modelling, 3 rd person modelling for 5 months	Increased number of correct responses in modelling groups vs. mimicry group	79
Expressive and receptive language	30 in 3 groups	44-61	2 clinician-directed play groups with language impairments (treatment vs control) with normal peers for 20 minutes per week for 3 weeks	More words used, greater verbal productivity, more lexical diversity, and more use of linguistic markers by normal peer play group (not normal group, treatment group with language impairment) vs. control	82
Expressive and receptive language and phonology	159 in 2 groups	<42	Clinician-directed for 12 months vs none	Improved receptive language in intervention group vs. control; no differences between groups for 4 other measures	70

Speech and language domains	n	Age (months)	Interventions	Speech and language outcome	Ref
Phonology	26 in 2 groups	33-61	Clinician-directed individual therapy two 30-minute sessions per week for 4 months vs none	Higher scores on 3 of 4 measures for intervention vs. control group	81
Phonology	48 in 2 groups	50 (mean)	Clinician-directed individual therapy 30-40 minutes per week for 12 weeks; compares interventions for phonemes that differ (most knowledge/early developing group vs. least knowledge/latest developing group)	Improved scores on measures from baseline for both intervention groups; greater improvement for most knowledge/early developing phonemes group vs. comparison (least knowledge/latest developing) group	84
Phonology and syntax	26 in 3 groups	44-70	Clinician-directed sessions (individual and group) for 3 hours per week for 20 weeks vs. parent-directed sessions for 8 hours per week for weeks 1-12 (includes intensive parent training) then 4 hours per week for weeks 13-20 vs. none	Improved grammatical output (developmental sentence scores) for both intervention groups vs. control; no significant difference between groups for phonological output (percentage consonants correct)	72
Phonology	27 in 3 groups	42-66	Clinician-directed individual therapy 45 minutes per week for 6 weeks; compares 3 groups listening to different sets of words	45 minutes per week for 6 weeks; compares 3 groups listening to different sets of words Improved scores on measures for 2 intervention groups vs. third group	73
Syntax	28 in 3 groups	44-70	Clinician-directed vs. parent-directed vs. none for 5 months continuing from prior study	Improved some developmental sentence scores from baseline in both intervention groups vs. control; no between group comparisons reported, except that clinician-directed treatment groups had larger and more consistent gains than parent-directed treatment groups or control	71

1.7 Any adverse or harmful effects from screening for an NDD

No studies addressed this question. Potential adverse effects include false-positive and false-negative results. False-positive results can erroneously label children with “normal” development (speech, language and motor function), as impaired, potentially leading to anxiety for children and families and further testing and interventions. False-negative results would miss identifying children with impairment, potentially leading to progressive speech, language delay and motor function delay and other long-term effects including communication, social, and academic problems. In addition, once delay is identified, children may be unable to access services because they are past the specific age the interventions or services are targeted at.

Other adverse effects include the impact of time and cost of interventions on clinicians, parents, children, and siblings, loss of time for play and family activities, stigmatization, shame and labelling of the child and families with concerns or delays. Screening may also uncover a genetic disorder that has implications for other family members. There is also a risk that screening will identify more children than can receive intervention. This would be distressing for families/whānau and would create moral distress for clinicians and service providers.

1.7 Summary

One of the main adverse effects of NDD screening is the false-positive and false-negative test results which may cause anxiety and stress on the families and place additional burden on the health care system.

1.8 Screening from a Māori or Pacific perspective

In New Zealand, early detection of developmental and behavioural problems depends primarily on Well Child Tāmariki Ora providers (WCTO) with Parental Evaluation of Developmental Status (PEDS) used at 3 to 4, 5 to 7, 9 to 12, 15 to 18 months, 2-3 years and 4 years and Strength and Difficulties Questionnaire (SDQ) at 4 years. Both are being used as part of the “Before School Check (B4SC)” at 4 years. Recent data from four studies that were completed as part of the “Welcome to School (WTS)” study examining the health and development of children starting school in Tamaki, a multicultural community in Auckland where 95% of the children are Māori or Pacific, confirm the current developmental surveillance system using PEDS assessment tool is not working¹.

Study 1: Twenty out of the 93 children assessed, who had no concerns identified at the B4SC had concerns identified in the WTS study and, of which 13 were significant concerns¹.

Study 2: Reports that children starting school have low language skills which is a huge concern and parental reporting of language competence and language difficulties identified by PEDS, Early Childhood Education and Care (ECEC) and B4SC are not reliable⁸⁵. The study identified the need for reliable language screening tools for NZ children, particularly those with Māori and/or Pacific heritage living in areas of deprivation.

Study 3: A third study exploring the nurses’ perspectives on the B4SC indicates that the current utility of the B4SC is questionable and there is a need for better screening tools which are culturally appropriate, and which are delivered in a holistic manner⁸³.

Study 4: A fourth study evaluating whether the PEDS tool used in B4SC was achieving its purpose found that, of the 80% of children identified as having developmental concerns only 10.8% of these children were identified in the B4SC PEDS. The majority of those who were identified with the B4SC did not receive appropriate follow-up⁸⁶. These findings suggest the PEDS which relies on parental concerns about development, may not be an effective tool for the NZ context; especially for Māori and Pacific peoples⁸⁶.

Cultural, linguistic or developmental literacy, or a combination of all three, are possible reasons for the inaccurate identification of children amongst Māori and Pacific peoples.

Cultural: Living in an area of high deprivation, where many children (more than 1 in 5 in WTS study¹) demonstrate developmental delays, some parents may not have ‘concerns’ as comparisons are made with other children in their cultural groups who are developmentally similar. In addition, families/whānau may be more accepting of difference and diversity than the predominantly European ethnic majority. They just accept that “Sione is Sione” (Dr Alison Leversha, personal communication 2019).

Linguistic: Many children with language delay from culturally and linguistically diverse backgrounds are not identified because their delay is attributed to bilingualism rather than impairment⁸⁷. This applies to our Pacific peoples.

Developmental literacy: Difficulties have been reported with the administration of PEDS with families where English is a second language and / or literacy levels are low¹. Very few parents reported concerns about their child’s development at the B4SC and school entry, potentially signalling that among vulnerable communities such as Māori and Pacific communities, parents may not be aware of ‘normal’ development or have different understandings of development and are therefore less likely to recognise developmental delay^{1,85,86}. Recognition of development and developmental delay is important as children living in a disadvantaged community during infancy are at increased risk of neurodevelopmental deficits (subtle problems in sensory motor and autonomic development that may be clinically unremarkable) but could interfere with child’s adaptation and learning⁸⁷. It has been noted that in the PEDS assessment there were hardly any children allocated to pathway D (parental difficulties understanding the questions) however in a population with high numbers of Pasifika families where English is a second language, the predicted numbers for pathway D could be higher⁸³.

PEDS as an assessment tool may not be culturally appropriate for the Māori and Pacific peoples. Despite being used in the WCTO schedule in NZ, PEDS has not been translated or validated for NZ populations. It would be beneficial if PEDS is translated into the commonly spoken languages in New Zealand e.g. Te Reo and Pacific Island languages.

1.8 Summary

With the current surveillance system, Māori and Pacific populations are underserved and there is an urgent need for culturally appropriate approaches. If the need for culturally appropriate approaches are not addressed, developmental concerns and delays in Pacific and Māori children will continue to be missed.

1.9 Conclusion

Studies are not available addressing the key question on recommended secondary screens following a positive neurodevelopment screen (key question 4), and adverse effects of screening (key question 6). Relevant studies are available regarding primary screening tools available for neurodevelopmental screening (key question 3), and effectiveness of early interventions on speech, language and motor function outcomes for children identified with delay (key questions 5) and screening in Māori and Pacific children (key question 7). Limited and inconsistent NZ studies were available to determine the prevalence and top five screening priority in New Zealand children under 6 (key questions 1 & 2).

Approximately 3-10% of New Zealand children under six years of age have neurodevelopmental disorders. However it is difficult to determine prevalence rates with accuracy as data is very limited and it's highly likely that this rate is under ascertained in Māori and Pacific peoples.

Language development and hearing, FASD, ASD, Global Developmental Delay and Motor disorders (CP) should be considered as the top five neurodevelopmental screening priority for New Zealand children under six years.

Fetal Alcohol Spectrum Disorder (FASD) is an umbrella term describing the range of physical, cognitive, behavioural and neurodevelopmental disabilities that can result from alcohol exposure during pregnancy. There is no NZ data on the prevalence of FASD, but international studies suggest that around 3% of births or around 1800 infants a year in NZ may be affected⁸⁸.

While maternal alcohol use should be picked up by screening for drug and alcohol use in pregnancy (covered in another Rapid Evidence Review-Domain 5), some women do not present to health providers until they are in labour. Also, we know that people often do not admit to alcohol use/amount of alcohol use. WCTO providers should be alert to the need to consider referral for secondary level assessment for FASD in a child who has poor growth and reduced head circumference; behavioural concerns; especially attention and retention of information; and/or developmental delay. So, we do not screen for FASD specifically but for developmental and behavioural issues with or without the context of poor growth. A further question that needs to be considered by the Advisory Group is whether children whose mothers disclose alcohol use should be screened/monitored. Note that not all fetuses exposed to alcohol in utero develop FAS or FASD⁸⁸.

Vision is considered in another Rapid Evidence Review (Domain 7), so we have included hearing with language. There may be a case for consideration of hearing screening in a separate domain. The Newborn Hearing Screening should be offered to all newborn infants in New Zealand. Parents may decline screening, and some infants may miss screening for other reasons. Children with normal hearing at birth may develop hearing loss later as a result of middle ear disease or as the result of a congenital infection such as cytomegalovirus (CMV).

There is an overlap between neurodevelopmental concerns and behavioural concerns. Some children / tamariki with ASD may initially present with challenging behaviours. Conversely some children present primarily with developmental concerns which are the result of Adverse Childhood Experiences (ACEs). It is important that potential issues are picked up and routed to relevant services. Some re-routing between secondary services may be needed.

Although brief evaluations are available and have been used in a number of settings with administration by professional and nonprofessional individuals, including parents, the optimal method of screening for

motor skills and speech & language delay has not been established. Studies reported wide ranges of sensitivity and specificity when compared with reference standards (sensitivity 22% to 100%; specificity 55% to 100%). In these studies, the instruments providing the highest sensitivity and specificity included the General Movement Assessment (GMs), Bayley Scales of Infant and Toddler Development (BSITD III), Modified Checklist for Autism in Toddlers (M-CHAT), Early Language Milestone Scale (ELMS), Battelle Developmental Inventory Screening Test (BDI II), Language Development Survey (LDS), the Clinical Linguistic and Auditory Milestone Scale (CLAMS), and Levett-Muir Language Screening Test. Most of the evaluations, however, were not designed for screening purposes, the instruments measured different domains, and the study populations and settings were often outside primary care. No gold standard has been developed and tested for screening, reference standards varied across studies, few studies compared the performance of 2 or more screening techniques in 1 population, and comparisons of a single screening technique across different populations are lacking.

There is limited evidence on secondary screening so expert consensus input is needed. This is where the expertise of the primary screener becomes crucial; for example, midwives are expected to check the “red reflex” in newborn baby’s eyes as a screen for congenital cataract. It is difficult to do this so there is a high rate of referral of false positives through to DHB ophthalmology services.

Randomised Controlled Trials of multiple types of interventions reported significantly improved motor function and speech & language outcomes compared with control groups. Improvement was demonstrated in several domains including object control, balance, locomotor function, articulation, phonology, expressive language, receptive language, lexical acquisition, and syntax among children in all age groups studied and across multiple therapeutic settings. However, studies were small, heterogeneous, may be subject to plateau effects, and reported short-term outcomes based on various instruments and measures. As a result, long term outcomes are not known, interventions could not be directly compared to determine optimal approaches, and generalizability is questionable.

There are many limitations of the literature relevant to screening for motor and speech & language delay in preschool-aged children including lack of studies specific to screening as well as difficulties inherent in this area of research. This evidence review is limited by use of only published studies of instruments and interventions. Data about performance characteristics of instruments, in particular, are not generally accessible and are often only available in manuals that must be purchased. Interventions vary widely and may not be generalizable. In addition, studies from countries with different health care systems, such as the U.K., and U.S may not translate well to NZ practice.

Although motor skill and speech & language development is multi-dimensional, the individual constructs that comprise it are often assessed separately. Numerous evaluation instruments and interventions that accommodate children across a wide range of developmental stages have been developed to identify and treat specific abnormalities of these functions. As a result, studies include many different instruments and interventions that are most often designed for purposes other than screening. Also, studies of interventions typically focus on 1 or a few interventions. In clinical practice, children are provided with individualized therapies consisting of multiple interventions. The effectiveness of these complex interventions may be difficult to evaluate. Adapting results of this heterogeneous literature to determine benefits and adverse effects of screening is problematic. Also, behavioural interventions are difficult to conduct in long-term randomized trials, and it is not possible to blind parents or clinicians. Randomizing children to therapy or control groups where clinical practice standards support therapy raises ethical concerns.

Identification of speech and language delay may be associated with benefits and adverse effects (mainly false positives / negatives) that would not be captured by studies of clinical or health outcomes. The

process of screening alerts physicians and caretakers to developmental milestones and focuses attention on the child's development, potentially leading to increased surveillance, feelings of caregiver support, and improved child self-esteem. Alternatively, caretakers and children may experience increased anxiety and stress during the screening and evaluation process. Therefore, it is important to consider whether counselling or appropriate and consistent information is offered to parents before screening. Detection of other conditions during the course of motor skill and speech & language evaluation, such as hearing loss, is an unmeasured benefit if appropriate interventions can improve the child's status.

1.10 Recommendations for further action

Policy and planning

- Translation of the screening tools into commonly spoken languages in New Zealand e.g. Te Reo and Pacific Island languages and validation of these translated versions would prove to be beneficial for the culturally and linguistically diverse populations in New Zealand.
- The current surveillance system using PEDS is not working for NZ Māori and Pacific peoples. A review of the current system is warranted to evaluate what is working and what is not, using this tool. Consideration should be given to the translation and validation of the PEDS tool in commonly spoken languages in New Zealand.
- Further policy work to determine the ages at which infants and children should be screened for NDDs should be coordinated with information from the Rapid Evidence Reviews for other domains. Screening instruments should be selected on the basis of the best ways of coordinating the varying screening processes.

Future research

- Future research should focus on determining optimal approaches of identifying preschool children with motor function and speech & language delay in primary care settings who would be appropriate candidates for further evaluations and possibly motor, speech & language interventions. These approaches should be integrated into routine developmental surveillance practices of clinicians caring for children.
- Studies that evaluate the effectiveness of validated brief screening instruments that include child and caretaker components could lead to a more standardized approach.
- Studies of specific motor, speech & language components of currently available broad developmental screening instruments, such as Ages and Stages Questionnaire, would be useful.
- Incorporation of risk factors and parent report in studies of screening approaches could provide information about their added value.
- Additional studies that compare screening instruments and methods in large primary care populations could lead to defining gold standards and acceptable referral criteria. Evaluating these criteria in different populations of children (e.g. Māori and Pacific) would minimize cultural and language biases.
- Additional work about the effectiveness of interventions, including motor, speech & language domain-specific results, may provide new insights.

- School-based efforts could be designed to complement strategies developed for young children improving long-term outcomes. Results of these studies may help determine optimal ages and intervals for screening. Functional long-term outcomes such as school performance, high school graduation rates, in-grade retention, special education placement/duration, and social adjustment need to be addressed more thoroughly.
- Cost-effectiveness evaluations of effective approaches that consider cost of treatment, the time that caregivers spend at treatment locations, the time they spend participating in the program on site or in the home, and long-term outcomes, among other factors, would be useful.

1.11 Graded evaluation of screening tools and interventions

We examined the strength and quality of evidence for neurodevelopmental outcomes to support the effectiveness of universal screening (Tables 1.8 and 1.9). Evidence found through a literature search was graded as “good”, “fair” or “poor” according to the definitions developed by the U.S. Preventive Services Task Force.⁸⁹

For assessment of evidence for screening tools: a study was defined as “good” if a relevant available screening test was evaluated, a credible reference standard was used, reference standard was independently interpreted of the screening test; reliability of test was assessed and if the paper included a large sample size (more than 100) with a broad-spectrum patients. Evidence were treated as “fair” if relevant available screening test was evaluated, used reasonable although not best standard, reference standard was interpreted independent of screening test, had moderate sample size (50 to 100 subjects) and a “medium” spectrum of patients. “Poor” studies were those that had important limitations such as inappropriate reference standard; screening test improperly administered; biased ascertainment of reference standard; very small sample size of very narrow selected spectrum of patients.

For interventional studies- good studies were those where reliable and valid instruments were used, comparable groups were formed initially and maintained throughout the study, interventions were clear, important outcomes were considered and appropriate attention given to confounders in analysis. Others were categorised as poor or fair depending on the limitations.

For both screening tool and interventional studies, good studies were categorised as having high levels of certainty regarding net benefit; while fair studies as having moderate and “poor” studies as having low levels of net benefit.

Table 1.8. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening Tools	Grade	Estimated Net Benefit	Level of Certainty	Recommendation
Motor Function Screens				
Alberta Infant Motor Skills (AIMS)	C	Moderate	Moderate	This tool has been validated in large samples and cut-off established for abnormal motor development in 8-12 months old children. Therefore compares development with a norm-referenced group. It is an observational tool (takes 10-15 minutes to complete) so can be considered if there is a need for minimum handling.
Bruininks-Oseretsky Test of Motor Proficiency (BOT-2)	D	Moderate	Moderate	Evidence shows that BOT-2 is able to discriminate the motor development of infants as being normal or atypical. However the assessment is very lengthy-can take between 60-90 minutes and the scoring system is complicated. There is a shorter version of BOT-2 that takes 15-20 minutes but the correlation between the complete form and short version is not clear. Training is essential and all these need to be considered.
Bayley Scales of Infant and Toddler Development (BSITD III)	C	Moderate	Moderate	Evidence shows that BSITD III is the best practice tool for diagnosing developmental delay. BSITD III provides a comprehensive picture of the child's development (differentiate between receptive and expressive language, cognitive skills such as visual perceptual skills and play, fine motor manipulative skills, and gross motor skills). However an Australian study found that composite scores cannot be relied on for determining the degree of developmental delay (underestimates) and cultural issues alter the performance on individual items. Valuable tool if composite scores are revised and screen validated in common spoken NZ languages. However, takes 30-90 minutes to administer so may not be suitable for use with every child.
General Movement Assessment (GMs)	C	Moderate	Moderate	This tool can be offered to children who are at risk of neurodevelopmental disorders such as children born preterm, lack of oxygen, stroke or congenital heart disease. GMs is an observational tool and clinicians can be trained in the assessment technique. GMs tool may be valuable as evidence suggests that it can provide extra information on how a child's neurological system is developing.
Movement Assessment Battery for Children (MABC II)	C	Moderate	Moderate	Most commonly used tool to screen for motor function abnormalities. Can be used in three age groups: 3-6, 7-11 and 12-16. MABC-II can be used as an evaluative measure thus recommended for children in intervention programs (pre- and post- intervention) and if used for this purpose should be re-administered at a gap of at least 3 months from initial assessment. Evidence suggests that this tool may not be appropriate for certain ethnic groups for whom validation and translation may be required.
Movement Assessment of Infants (MAI)	C	Moderate	Moderate	Evidence shows that this tool provides the best information when administered to 4 month old infants. MAI can be offered to infants born at term who are at risk of neurodevelopmental delay. It can also help clinicians make decisions about intervention services.

Screening Tools	Grade	Estimated Net Benefit	Level of Certainty	Recommendation
Motor Function Screens				
Parent Evaluation of Developmental Status (PEDS)	B	High	High	PEDS is a simple, 10 item questionnaire completed by the parent and currently used as part of the WCTO programme in NZ. Evidence suggests that PEDS is a feasible developmental screening tool however three are concerns about the cultural appropriateness of PEDS; this needs further evaluation in a New Zealand context. It is highly recommended that PEDS be translated in common NZ languages and validated. Evidence also suggests that PEDS be used with secondary screening tool such as Parent Evaluation of Developmental Status: Developmental Milestones (PEDS: DM).
Neurological Sensory Motor Development Assessment (NSMDA)	B	Moderate	Moderate	Even though NSMDA can be used to assess motor development in children 1 month to 6 years of age, evidence shows the tool performs best at ages 8-12 months. Evidence shows that NSMDA measure is predictive-assessments done at early infancy can predict neurodevelopmental difficulties in preschool years (NSMDA measurements taken during infancy should be confirmed by another screen in the preschool years such as PEDSQL).
Peabody Developmental Motor Scales (PDMS II)	D	Moderate	Moderate	PDMS II screen is more complex and time consuming. Evidence shows that PDMS II is based on norm references. There is lack of agreement between development measures of PDMS II and BSID III. Approximately half the children who showed appropriate total motor performance on the PDMS II were classified as delayed on the BSID II Motor Scale. Therefore PDMS should be used with caution or in combination with a second screen.
Test of Infant Motor Performance (TIMP)	B	Moderate	Moderate	There is fair evidence that TIMP provides a reliable and valid measurement that can be used for evaluation of motor function in term and preterm infants. Measurements are strongest in early infancy (aged 4 months or less). TIMP is highly reliable (highly sensitive and specific with the follow-up examination of BSID II) and has sufficient test-retest reliability. TIMP screen has the ability to discriminate among infants with differing risks for motor developmental delay. This screen can be recommended to all infants (risk or no risk).
Test of Gross Motor Development (TGMD)	B	Moderate	Moderate	There is fair evidence to say that TMGD II is reliable and appropriate assessment tool for assessing gross motor skill development of preschool children. The screen can be recommended for children with risk of neurodevelopment disorders as several validity studies have demonstrated TGMD's ability to differentiate children with cognitive impairments and autism spectrum disorder from typically developing children.

Screening Tools	Grade	Estimated Net Benefit	Level of Certainty	Recommendation
Motor Function Screens				
Ages and Stages Questionnaire (ASQ)	A	High	High	Evidence shows that ASQ are most cost effective, reliable way to screen children for developmental delays in the first 5.5 years of life. This parent completed screen has shown to correlate well with clinician’s assessment. ASQ is been used worldwide and has been translated into many different languages. This will allow establishment of norm datasets from diverse ethnic groups. This screen can be recommended for use together with PEDS or SDQ.
Infant Development Inventory (IDI)	I	Moderate	Moderate	IDI is a brief questionnaire for use with children from birth to 18 months and takes approximately 10-15 minutes to complete. There is some evidence to indicate the accuracy of IDI- whether the tool correctly identifies children at risk for developmental problems (sensitivity) as well as accuracy with which the tool identifies the children not at risk. There is insufficient information to make any recommendations.

Screening Tools	Grade	Estimated Net Benefit	Level of Certainty	Recommendation
Social Communication, Speech & Language Screens				
Battelle Developmental Inventory Screening Test (BDI II)	C	Substantial	High	There is good evidence that this tool is effective in identifying children with a disability or developmental delay. However, the time taken to administer and cost need to be taken in to consideration in its use to screen the whole population.
Clinical Adaptive Test/Clinical Linguistic Auditory Milestone Scale (CAT / CLAMS)	C	Moderate	Moderate	There is evidence that CLAMS could be used as a screening tool to detect children who have language delays quickly and easily. This tool can be considered for screening 1 to 3 year olds as it takes approximately 10 minutes to administer.
Denver Developmental Screening Test – II (DDST II)	D	Moderate	Moderate	There is fair evidence that this tool can be used to screen children in fine motor, adaptive, personal, social, gross motor and language domains and is able to detect children with or without problems. However this tool has high false positives.
Early Language Milestone Scale (ELMS)	C	Moderate	Moderate	There is fair to poor evidence that this tool is effectively able to identify children with expressive or receptive language difficulties and delays. This screen is recommended for children in the 2 to 3 years age group.
Fluharty Preschool Speech and Language Screening Test	D	Moderate	Moderate	There is evidence that Fluharty screen can be used to identify children with articulation impairments but the evidence suggests that Fluharty is too insensitive to be relied on for screening programs aimed at identifying preschool children with language disorders.
Language Development Survey (LDS)	C	Small	Moderate	There is good to fair evidence that the LDS screening tool has excellent sensitivity and specificity for identifying language delay at age 2 but somewhat lower levels for predicting developmental status one year later.

Levett-Muir Language Screening Test	I	Moderate	Moderate	Limited evidence presented was fair. The tool screens for receptive language, phonology and syntax. More evidence is needed to say whether this tool maybe suitable for NZ children.
Parent Language Checklist	A	Moderate	Moderate	There is good evidence that Parent Language Checklist may be used for prioritising children for referral to speech therapy services.
Paediatric Language Acquisition Screening Tool for Early Referral (PLASTER)	C	Moderate	Moderate	The evidence provided is fair. PLASTER is moderately successful in identifying children aged 3-60 months within normal limits for language development. Test-retest reliability was reported to be high. However sensitivity of PLASTER is poor.
Screening Kit of Language Development (SKOLD)	B	Moderate	Moderate	This tool has been validated in 2.5-4 year olds. There is fair evidence that this tool is able to identify a non-standard speaker from an impaired speaker. With NZ's diverse population, this tool may be important in identifying non-standard vs. impaired speakers once it has been translated and validated in common NZ ethnic populations.
Sentence Repetition Screening Test (SRST)	D	Moderate	Moderate	There is fair evidence that SRST tool is able to identify children with receptive, expressive and language articulation difficulties but the sensitivity of the tool has been reported as less than 70%. At this point this tool cannot be recommended for NZ preschool population.
Modified Checklist for Autism in Toddlers (M-CHAT)- original and revised with follow-up versions	A	Moderate	Moderate	From the evidence- M-CHAT revised version (M-CHAT-R) has shown to have greater utility than M-CHAT original. There is good evidence that M-CHAT-R detects Autism Spectrum Disorder (ASD) at a higher rate compared to M-CHAT and children who were diagnosed were 2 years younger than the national medium age of diagnosis. Implementation of M-CHAT-R as part of WCTO screening program can lower the age of ASD diagnosis by 2 years, increasing time for early intervention.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty.](#)

Table 1.9. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated Net Benefit	Level of Certainty	Recommendation
Motor function interventions				
Motor Skill intervention program	I	Moderate	Moderate	Various types of movement-based interventions (balance / and or strength exercises, adapted play training, handball techniques, computerised games, a developmental physical education program, a therapeutic sensorimotor training programme, a intensive motor skills training programme, a physical therapy programme, and vestibular stimulation exercises) have shown to improve motor skills in children but the level of improvement differs from study to study. More evidence is needed through intervention studies to identify best motor function intervention, to examine sustainability of changes, and to examine the impact of intervention on other physical, health, social and emotional outcomes.
Parent assisted motor skills based intervention	B	Moderate	Moderate	Evidence shows that intervention outcomes could be enhanced if parents assist with the motor skills intervention program. Assistance could in the form of providing instructions during the program or home-based program delivery. Since the WCTO PEDS questionnaire is currently completed by parents. Having a parent-assisted motor skills intervention program could be considered for NZ children.
Teacher directed motor skills based intervention	I	Moderate	Moderate	Evidence suggests that interventions delivered by teaching staff maximises sustainability of the program, enhances participation and young children are more likely to be physically active when in school environment with peers. There is insufficient information as interventions of this sort places additional burden on teachers and are not usually encouraged. However teacher directed interventions could be undertaken in partnership with clinicians and researchers and may prove to be valuable.
Mastery Climate Motor Program	I	Moderate	Moderate	Insufficient information is available on whether mastery climate improves motor skills in children with developmental delays by increasing student engagement and addressing diverse learning needs of children. More evidence is needed.
Physical Activity or Language-enriched physical activity intervention.	B	Moderate	Moderate	Physical activity interventions such as Nintendo Wii Fit training, Martial arts training- Taekwondo, Trampoline and Table Tennis or language enriched physical activity intervention can be recommended to preschool children based on evidence available. However evidence suggests that physical activity motor skill programs should be underpinned by a sound theoretical framework.

Intervention	Grade	Estimated Net Benefit	Level of Certainty	Recommendation
Interventions for speech and language delay or disorder				
HANEN Approach	I	Moderate	Moderate	This could be parent or educator facilitated program to facilitate communication development in children. Targets language delays (It takes two to talk program), late talking (Target Word), Autistic Spectrum Disorder (More than words), and Asperger's (TalkAbility). There is moderate evidence that shows that benefits from HANEN intervention are similar to those from more traditional speech and language therapy. Insufficient evidence to make any recommendations for NZ children.
Imitation or Modelling	I	Moderate	Moderate	In this intervention program children were asked to mimic words vs. those who were taught grammatical rules. Fair-poor evidence suggests that different interventions work for different groups of children. Mimicry worked best in children with development impairment but teaching grammatical rules works better in children with typical development. More evidence is needed regarding this intervention.
Auditory language interventions	I	Moderate	Moderate	These are direct treatment approaches to influence children's ability to process speech and language such as speech-in-noise treatment, auditory recognition / discrimination, auditory system stimulation or modification of acoustic stimuli). There is lack of compelling evidence that auditory interventions would make significant contributions to auditory, language or academic outcomes of school aged children with auditory or speech and language impairment.
Verb focussed language intervention	C	Moderate	Moderate	Fair evidence shows that this intervention is effective in increasing the verb vocabulary of late talkers. It is not clear whether gains are sustainable over time.
Focussed Stimulation	B	Moderate	Moderate	A speech therapy where a child is asked to repeat a word or phrase multiple times in a conversation. Evidence shows that focussed stimulation improved child vocabularies and had a positive effect on language development. This intervention works well in children with expressive vocabulary delays or in late talkers. Vocabulary targets could be individually tailored for each toddler based on child's phonetic repertoire and parent report of vocabulary development.
Narrative Language Intervention	I	Moderate	Moderate	The intervention is provided in narrative language. Although the results presented in the papers were generally positive, each of the studies had limited number of participants, limited experimental controls and considerable variation in the methodology used. Insufficient evidence to make recommendations.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty.](#)

1.11 Summary

Clear recommendations can only be made in the context of future policy in relation to Well Child Tamariki Ora services. Screening tools can be divided into three broad groups: those that are completed by parental report, those that can be administered by people with minimal training and those which require specialist knowledge and training. The time taken to administer the various tools varies from 5 – 90 minutes. Tools vary in their sensitivity and specificity as well as with optimal age range for use, and all factors need to be considered in the context of timing of screening, workforce and access.

The evidence in relation to interventions is more challenging. As we discussed previously identification of a neurodevelopmental problem should lead to onward referral by the WCTO provider for verification (the secondary screen), in-depth assessment to ascertain the child's needs and establish the goals of intervention, and provision of an intervention programme to meet those needs. The population of children with neurodevelopmental problems is heterogenous with multiple aetiologies and trajectories. Therefore, comparisons are difficult.

One reasonably consistent group is children with cerebral palsy. Again, these children have multiple aetiologies for their impairment, and widely varying severity of impairment making comparisons difficult. Systematic reviews are available; however these become out of date rapidly because of development of new interventions.

The provision of interventions lies outside the current Well Child Tamariki Ora Framework, and policy formulation will need close collaboration with Child Development Services provided through Health and Early Intervention Services provided through Education.

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A BETTER
START

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2. Parent-child relationships, including caregiving and attachment

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Suggested citation: Richards N, Cargo T. Parent-child relationships, including caregiving and attachment. In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019; p. 52-72.

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: N Richards has no financial or non-financial conflicts of interest to declare. T Cargo coordinates Training in Parent-Child Interaction Therapy, but has no other conflicts of interest to declare.

Acknowledgement: The authors are grateful to Dr Denise Guy for her valuable input.

Abbreviations

ASD	Autism Spectrum Disorder
ASQ-SE	Ages and Stages Questionnaires-Social-Emotional version
CHDS	Christchurch Health and Development Study
DSED	Disinhibited Social Engagement Disorder
MCAST	Manchester Child Attachment Story Task
MICS	Mother-Infant Communication Screening
NBO	Newborn Behavioural Observation
NCAS	Nursing Child Assessment Satellite Training
PCIT	Parent Child Interaction Therapy
PIRGAS	Parent-Infant Relationship Global Assessment Scale
RAD	Reactive Attachment Disorder
UK	United Kingdom
VIPP	Video-feedback Intervention to promote Positive Parenting

Summary

- The quality of the first relationship between parent and child can promote or hinder emotional development and influence later health and personality development.
- Parent-child relationship problems may be identified by observing the interaction between the parent and the infant in addition to considering potential risk factors for relationship problems.
- There is poor evidence for the use of screening tools to specifically identify parent-child relationship difficulties.
- Diagnostic tools such as the Strange Situation Procedure have good reliability and validity however their use requires significant specialist training and they are most appropriate in clinical settings.
- There are a number of interventions available in New Zealand with robust evidence that directly address the parent-child relationship, including Parent-infant psychotherapy, 'Watch Wait Wonder', Circle of Security, Newborn Behavioural Observation System and Video-feedback Intervention to promote Positive Parenting.
- Interventions that directly address parenting capacity (parenting programmes) include Mellow Parenting, Parent Child Interaction Therapy (PCIT), the Incredible Years programme and the Triple P programme.
- Disorganised attachment is a significant predictor of later psychopathology however it is still unknown whether interventions in infants lead to significant improvements in childhood/adolescence.
- Potential harms of screening include the assumption that a disorganised attachment pattern is a sign of child maltreatment.
- There is very limited research addressing Māori and Pacific peoples parent-child relationships.

Foreword

Parent-child relationship difficulties are not specifically screened for in the current Well Child Service. However, there is evidence that the quality of the first relationship between parent and child can promote or hinder social-emotional development and influence later health and personality development. Given the importance of this first relationship, a focus on supporting and promoting warm, loving, and sensitively responsive parenting should be a priority. Here, options for recognising relationship problems early and interventions suitable for children under 5 years of age are discussed. It should be noted that term 'parent' is used throughout the text, and encompasses any primary caregiver of an infant/child, including mother, father, and foster/adoptive parents.

2.1 Background

There is now substantial evidence that the quality of the first relationship¹ between parent and child can promote or hinder social-emotional development and influence later health and personality development²⁻⁴. Given the importance of this first relationship, a focus on supporting and promoting warm, loving and sensitively responsive parenting should be the priority^{4,5}. Interventions can occur right from birth, fit within a strengths based^{6,7} and whānau ora approach⁸, and are economically more viable and effective delivered early in the life cycle^{9,10}.

Bowlby's (1969) theory of attachment¹¹ proposed that the bond between a mother and her infant is based on an emotional connection. When an infant becomes fearful or distressed, his primary attachment figure(s) serve as a source of protection and comfort, and he learns to turn to that person(s) in times of need. Complementary to the theory of attachment is the caregiving system. This system is activated by cues associated with situations that the parent perceives as frightening, dangerous, or stressful for the child, motivating them to provide assistance, comfort, and support¹².

Types of attachment

Ainsworth¹³ a student of Bowlby, developed a system based on the different patterns of attachment infants' show to specific attachment figures (Table 2.1). Disorganisation is the most detrimental and requires specialist interventions. Bakermans-Kranenburg and colleagues (2005) conducted a meta-analysis (15 interventions; 842 children) to investigate whether disorganised attachment could be prevented. Interventions which started after the infant was 6-months-old and where the focus was on sensitivity showed a small but positive effect size¹⁴, while other interventions showed either no effect or a negative effect size. Later Cyr and colleagues (2010) conducted a meta-analysis, with 55 studies (4,792 children) and found that maltreated children and children exposed to five or more socioeconomic risks were less secure and more disorganized than other high-risk children¹⁵.

Table 2.1. Attachment behaviours

	Approximate prevalence*	Characteristic behaviours
Secure attachment (B)	60%	<ul style="list-style-type: none"> • comforted by their caregivers when distressed • use their caregiver as a 'secure base' from which to explore their environment
Insecure avoidant attachment (A)	20%	<ul style="list-style-type: none"> • manage their own distress and do not strongly signal a need for comfort • avoid contact with the caregiver after a brief separation
Insecure ambivalent attachment (C)	15%	<ul style="list-style-type: none"> • are not quickly calmed when comfort is offered and are less confident at exploring their environment • very distressed and may be angry when they are separated from a caregiver and then resist contact when the caregiver returns
Disorganised attachment (D)	5%	<ul style="list-style-type: none"> • contradictory behaviour with caregiver; possible episodes of freezing, apprehension and fear • distressed by separation but then does not seek out caregiver when they return

Table based on Ainsworth 1979¹³ and a 2015 report from the British Psychological Society and The Royal College of Psychiatrists¹⁶.

** Cultural variations have been identified.*

2.2 How do you identify parent-child relationship difficulties and disorders in infancy and early childhood?

In order to maintain a focus on promoting warm, loving and sensitively responsive parent-child relationships a traffic light approach is taken. In this approach the focus can be on promotion (green light) prevention (orange light) or intervention (red light).

Table 2.2. Infant and parent risk factor screening

FACTORS	GREEN LIGHT	ORANGE LIGHT	RED LIGHT
Parental	<ul style="list-style-type: none"> • Mentally Well • Confident as a parent • Appropriate emotion responsivity • Ability to talk and resolve problems, including reflective capacity • Ability to provide warm, sensitive caregiving 	<ul style="list-style-type: none"> • Showing signs of mental stress/distress • Some emotional lability • Difficulties with communication and/or problem solving • Caregiving environment appears anxious 	<ul style="list-style-type: none"> • Mental health diagnosis, substance misuse^{17,18}, personality disorder^{19, 20}, abuse or trauma^{21,22}, psychotic disorders²³ • Little self-reflective capacity²⁴ • Caregiving environment is inconsistent²⁵
Infant	<ul style="list-style-type: none"> • Resilience²⁶ • Easy temperament²⁷ 	<ul style="list-style-type: none"> • Fussy and difficult to soothe • Crying without resolution • Difficult regulatory processes 	<ul style="list-style-type: none"> • Prematurity²⁸ • Chronic conditions²⁹ • History of abuse or severe adversity³⁰ • Temperamental factors^{31,32} • Behavioural problems³³
Environmental	<ul style="list-style-type: none"> • Liveable income • Higher education • Family support • Access to support services 	<ul style="list-style-type: none"> • Changeable income • Limited opportunities for educational improvement • Unstable family support • Few community services available 	<ul style="list-style-type: none"> • Poverty^{34,35} • No parenting education³⁶ • Family stress³⁷ • No community services
Cultural	<ul style="list-style-type: none"> • Strong cultural identity • Ability to speak your own language • Cultural supports 	<ul style="list-style-type: none"> • Insecure cultural identity • Limited cultural supports 	<ul style="list-style-type: none"> • Lack of cultural identity³⁸ • Transgenerational trauma³⁹ • Unable to access cultural supports • Exposure to racism⁴⁰
Relational Qualities	<ul style="list-style-type: none"> • Mutually responsive interactions and emotional availability^{41,42} • Warm tone and connectedness^{1,43} • Security^{4,44} • Reciprocity observed in relationship⁴⁵ 	<ul style="list-style-type: none"> • Missed opportunities for mutual gaze • Limited warm interactions • Few 'delight in each other' moments • Interactions are mistimed • Cues are responded to intermittently 	<ul style="list-style-type: none"> • No or very few moments of mutual interaction⁴⁵ • Insensitivity⁴² • Inability to resolve distress⁴⁶ • Intrusive interactions⁴⁷

2.2.1 Identify parent-child relationship problems by observing the interaction between the parent and the infant

Relationship problems can also be assessed indirectly by examining the primary caregiver's sensitivity to the child, particularly in response to the child's distress or fear, because a significant association has been found between maternal sensitivity and a child's security of attachment¹⁶.

Maternal behaviour that is warm, consistent, sensitive and predictable promotes secure attachment relationships. 'Atypical' parenting behaviours during the postnatal period are associated with attachment problems and may be observed while seeing a mother and baby. These include communication errors (e.g. mother positive while infant distressed), disorientation (frightened expression or sudden complete loss of affect) and negative-intrusive behaviours (mocking or pulling infant's body)²². Disrupted (e.g. lack of response or insensitive), frightening, threatening or dissociative parenting behaviours have a strong association with disorganised attachment at 12 to 18 months of age⁴⁸.

Because of the importance of infants' primary caregiving relationships for development and psychopathology, the emphasis in assessing and treating young children includes a major emphasis on assessing the qualities of infants' primary caregiving relationships as useful indices of their overall psychological adaptation and well-being⁴⁹.

What suitable screening tools for parent-child relationship difficulties are available?

There are some potential screening tools that could be used to examine the relationship further. However there is poor evidence for their use and limited specificity for parent-child relationship difficulties.

The Ages and Stages Questionnaires-Social-Emotional version (ASQ-SE)⁵⁰ is a promising screening measure of social-emotional-behavioural competencies and problems designed for a wider age range, from birth to 66 months. It covers self-regulation, compliance and affect, among other domains and is in routine use by family nurses in the UK⁵¹. The ASQ-SE is sufficiently sensitive to detect social emotional/ behavioural problems in community samples⁵² and has been designed to be completed by a range of individuals, including primary care health workers and caregivers. While it does not specifically identify attachment or relationship difficulties, a high score may indicate a concern⁵³.

The Parent-Infant Relationship Global Assessment Scale (PIRGAS; Zero to Three, 1994) provides a continuously distributed scale of infant-parent relationship functioning, ranging from 90 (well adapted) to 10 (dangerously impaired). The PIRGAS also assesses three components of the infant-parent relationship: behavioural quality of the interaction, affective tone and psychological involvement. It seeks to capture the functioning of the mother and child independently. There have been small studies which have used the PIRGAS such as a predictive measure⁵⁴ as a comparison measure⁵⁵ and as part of a multimodal assessment⁵⁶.

The Parenting Stress Index (a short form version also exists)⁵⁷ evaluates the extent of stress parents experience in the childrearing role. It has been used widely in research and this has shown that elevations on the PSI suggest increased stress in parent-child interactions and an increased likelihood of the child displaying or developing behaviour problems in this parents' care.

The NCAST Teaching Scale (NCAT) is a possible option for screening parent-child interactions during infancy and toddlerhood in a timeframe and manner that could be feasible for brief clinical encounters⁵⁸.

What assessments are available for diagnosing attachment difficulties and disorders?

Attachment disorders such as Reactive Attachment Disorder (RAD) and Disinhibited Social Engagement Disorder (DSED) are defined in the DSM-5. Disordered attachment is defined by specific patterns of abnormal social behaviour in the context of “pathogenic care”⁵⁹. These disorders are rare and are mostly only observed in children who have experienced extreme neglect or institutional care. Diagnosing attachment disorders requires serial observations of the parent-child interactions, observations of the child with unfamiliar adults, and a comprehensive history of the child’s early caregiving environment (including corroborating evidence from other sources e.g. doctors, teachers, social workers)⁶⁰.

The most commonly used clinical measures of attachment are: the Strange Situation Procedure⁶¹; the Attachment Q-Sort^{16,62}; the Preschool Assessment of Attachment⁶³; the Emotional Availability Scales⁴² and the Manchester Child Attachment Story Task (MCAST)⁶⁴. All require a high level of specialist training.

2.2 Summary

- *Parent-child relationship problems may be identified by observing the interaction between the parent and the infant, in addition to considering potential risk factors for relationship problems.*
- *There is poor evidence for the use of screening tools to specifically identify parent-child relationship difficulties.*
- *Diagnostic tools such as the Strange Situation Procedure have good reliability and validity, but their use requires significant specialist training, and they are most appropriate in clinical settings.*

2.3 Are these screening and assessment tools appropriate for infants and young children with developmental concerns?

Some researchers have found that children with medical or physical problems (e.g. neurological abnormalities or Down’s syndrome) are at risk for elevated rates of disorganized attachment⁶⁵. However, although children with neurological problems may have some similar behaviour patterns to children with disorganised attachment, these behaviours occur for a different reason and can be a “false-positive” for disorganised attachment^{14,66,67}. Children identified as being delayed developmentally or with other potential health problems (e.g. early signs of autism) may require more advance assessment by a paediatrician or child psychologist. A systematic review⁶⁸ reported lower levels of secure attachment (47%) in young children with autism spectrum disorder (ASD), despite parents showing equally sensitive caregiving compared with parents of children without ASD. More severe ASD symptoms and developmental delay may be associated with less secure attachment. However the function of attachment is the same in children with ASD. Best practice assessment tools may still be appropriate, and both the caregiving and attachment systems should be assessed given the child’s developmental complexities. In addition, infants born with disabilities can create additional stressors for families as they have to come to terms with the challenges required for caring for an infant with special needs⁶⁹ and be able to maintain a reflective mental state³².

2.4 What interventions are effective for parent-child relationship disorders/difficulties?

Parenting interventions with robust evidence and those that are available in New Zealand are discussed below.

2.4.1 Interventions that directly address the parent-child relationship

Parent-infant psychotherapy aims to improve the parent-child relationship by means of a psychotherapist listening to and observing the parent-child interaction and enabling the parent to respond more freely and sensitively to their infant⁷⁰. A systematic review evaluated the effectiveness of parent-infant psychotherapy in improving parental and infant mental health and the parent-infant relationship. They included eight studies comprising 846 randomised participants including women with postpartum depression, anxious or insecure attachment, maltreated, and prison populations. They compared parent-infant psychotherapy with no treatment or to other kinds of parent based or relationship based treatment and found that although parent-infant psychotherapy appeared to be a promising model of improving infant attachment security in high risk families, there were no significant differences for other outcomes⁷⁰.

‘Watch Wait Wonder’ is a programme that encourages the parent to ‘Watch, Wait, Wonder’ about their infants’ play and interactions. The therapist helps the mother clarify and alter distorted perceptions and to link her current experience of motherhood with her childhood experience, via observation and explanations⁷¹. Watch, Wait, Wonder is effective for improving the parent-child relationship (attachment assessed), child regulation and development, reducing parenting stress, reducing parent-infant conflict, and maternal intrusiveness. Gains were held at 6 months follow-up^{71,72}.

Circle of Security involves the use of video feedback techniques. The interaction between parent and baby is filmed. The tape is then viewed by the therapist and parent and the therapist uses the videotape to point out examples of positive parent-infant interaction (there is also a group based model) A meta-analysis examined the efficacy of the Circle of Security intervention in relation to child attachment patterns, quality of caregiving, caregiver self-efficacy, and caregiver depression. A total of 10 studies (428 parents) were included for analysis. They found a medium effect size for the efficacy of the intervention for child attachment security, quality of caregiving and reduction of caregiver depression. There was a significant large effect for improved caregiver self-efficacy. However the findings from this meta-analysis are limited by the lack of treatment versus control analysis⁷³.

Mellow Bumps is an antenatal group programme that aims to improve the mother-infant relationship. There is currently only qualitative evidence of participants’ experiences of the programme suggesting that parents find it beneficial^{74,75}.

The Newborn Behavioural Observation (NBO) System involves brief demonstrations (7-10 minutes) of the infant’s perceptual and interactive capabilities by a trainer. A recent meta-analysis assessed the effects of the NBO system for improving caregiver-infant interaction and related outcomes in caregivers and newborn babies. They included 16 RCTs in the review but all were at high risk of bias. They found evidence for the effectiveness of NBO in terms of improving parent-infant interaction for mostly low-risk, first-time caregivers and their infants, however this was based on very low-quality evidence⁷⁶.

Video-feedback Intervention to promote Positive Parenting (VIPP) targets parents and infants that are at risk of an insecure attachment relationship. Videotaped interactions between mothers and their 6-

month-old infants are reviewed with a therapist and then discussed with the parent, emphasising positive interactions. Four studies found a significant impact on maternal sensitivity but there is less evidence that it improves children's attachment security⁷⁷⁻⁸⁰.

2.4.2 Interventions that directly address parenting capacity (parenting programmes)

Mellow Parenting was designed for hard to reach mothers, particularly those living in poverty, or who are depressed and socially isolated⁸¹. It uses videos, parent-child activities and a parenting workshop with practitioners working with parents to build strengths. One meta-analysis calculated an effect size based on five studies (95 parent-child dyads and 55 comparison dyads). There was evidence of a medium effect size in favour of Mellow Parenting compared with the control on maternal well-being and child problems. However, data were heterogeneous and there was evidence of methodological bias⁸¹.

Parent Child Interaction Therapy (PCIT) is an evidence-based intervention for a range of child behaviour and emotional problems for children aged 2-12 years of age. It involves two components: a child directed interaction; and a parent directed interaction component. One large meta-analysis evaluated PCIT and Triple P, individually and against each other. Both interventions reduced parent-reported child behaviour and parenting problems. The effect sizes for PCIT were large when outcomes of child and parent behaviours were assessed with parent-report⁸². PCIT also has Toddler version for 12-24 month old infants. A pilot study of 29 children aged less than 2 years showed a range of positive child and parental outcomes including, reduced disruptive child behaviours, decreased parental depression and high levels of consumer satisfaction following the PCIT-Toddler treatment program⁸³.

There are three different versions of the Incredible Years programme, the Baby Programme, Toddler Programme, and the Preschool Programme. The intervention aims to improve parent-child interactions, build positive parent-child relationships and attachment, improve parental functioning and encourage less harsh and more nurturing parenting. A meta-analysis of the Incredible Years parent training programme examined 50 studies that included 4,745 participants. It found improvements in both children's disruptive behaviour and prosocial behaviour. However the review included studies that involved children older than five years⁸⁴.

The Triple P system incorporates five levels of intervention with the aim of preventing and treating social, emotional, and behavioural problems in children by enhancing the knowledge, skills, and confidence of parents. A large systematic review and meta-analysis of the multilevel Triple P-Positive Parenting Program system included 101 studies and 16,099 families with children ranging in age from birth to 18 years (mean 5.85 years)⁸⁵. They found significant positive effects on child and parent outcomes including children's social, emotional and behavioural outcomes, parenting practices, parenting satisfaction and efficacy, and parental relationships. Significant effects were found for all outcomes measured long-term. Targeted and treatment approaches were associated with larger effect sizes than universal studies, although significant effect sizes were reported for preventative programmes as well. Another review of Triple P⁸⁶ examined 33 studies, the majority (29/33) included children aged 2-5 years. The results showed a significant improvement in behaviour for maternally-reported outcomes but not paternally-reported outcomes. The authors noted a number of sources of potential bias in the included studies. Population approaches of the Triple P programme have been shown to be cost-effective in reducing social and emotional problems of children^{87,88}.

A Cochrane review⁸⁹ investigated whether group-based parenting programmes (including studies of the Incredible Years and Triple-P programmes) are effective in improving the emotional and behavioural

adjustment of young children and in the primary prevention of emotional and behavioural problems. They included 24 trials (n=3,161 parents and their young children; mean age three years and 11 months). Overall, they found low quality evidence that group-based parenting programmes (universal and targeted) can improve the overall emotional and behavioural development of young children however methodological concerns such as unclear risk of bias and small sample sizes mean more research is required to determine whether benefits continue over time.

2.4 Summary

- *There are a number of interventions available in New Zealand with robust evidence that directly address the parent-child relationship, including Parent-infant psychotherapy, 'Watch Wait Wonder', Circle of Security, Newborn Behavioural Observation System, and Video-feedback Intervention to promote Positive Parenting.*
 - *Interventions that directly address parenting capacity (parenting programmes) include Mellow Parenting, Parent Child Interaction Therapy (PCIT), the Incredible Years programme, and the Triple P programme.*
 - *PCIT, the Incredible Years and Triple P programmes have robust evidence supporting their use.*
-

2.5 What is the long-term outcome following identification of a parent-child relationship disorder/difficulty in infancy and early childhood, with and without therapeutic intervention?

In populations at low risk of relationship problems, most infants demonstrate a secure attachment style. Some infants (approximately 35%) show some form of insecure attachment pattern, but few go on to develop psychopathology. However, disorganised attachment is a significant predictor of significant later psychopathology⁹⁰. Children with disorganized attachment have been found to have highly significant negative mental health sequelae. Longitudinal studies have suggested that disorganised attachment is linked to hostility and hyperactivity, aggression and oppositional defiant disorder in children, and to dissociative symptoms in 17- and 19-year-olds⁹⁰. Attachment disorders⁹¹ are known to have increased comorbidity with conduct disorders, developmental delay, attention deficit hyperactivity disorder and post-traumatic stress disorder⁹⁰.

2.6 Does early intervention lead to significant improvements later in childhood/adolescence?

If a child with disorganised attachment is left untreated the impacts are significant. The Christchurch Health and Development Study (CHDS) found that more frequent parental separation in childhood and adolescence was associated with lower levels of parental sensitivity and warmth, greater over reactivity, and an increased use of physical punishment as a parent, after controlling for a wide range of family socioeconomic and psychosocial factors, and individual child characteristics⁹². Additionally, the attachment style of a parent often predicts the attachment style of the infant⁹³.

2.6.1 Outcomes in adolescence following intervention

Olds et al.⁹⁴ followed up children at age 15 who were involved in the Nurse Family Partnership, which is considered to be an attachment based intervention. In contrast to adolescents born to poor, unmarried women in the control group, those visited by nurses during pregnancy and infancy reported fewer instances of running away, fewer arrests, fewer convictions/ violations of probation, fewer lifetime sex partners, fewer cigarettes smoked per day, and fewer days having consumed alcohol in the last 6 months.

Webster-Stratton et al.⁹⁵ examined long-term outcomes for the Incredible Years intervention. Rates of adolescent behaviours (e.g. for indicators such as delinquent acts, substance use, school expulsion rates, and involvement with the criminal justice system) in children from the Incredible Years programme were reported to be consistent with US-based age-related norms for children ages 12 to 19. However, this study was limited by not including an untreated control group, therefore there was no direct comparison of similar children who did not receive the Incredible Years intervention.

2.6 Summary

- *Disorganised attachment is a significant predictor of later psychopathology, but it is still unknown whether interventions in infants lead to significant improvements in childhood/adolescence.*
 - *While some studies have shown a reduction in negative adolescent behaviours following intervention, more research is required.*
-

2.7 Are there known harms from screening for parent-child relationship difficulties?

While disorganised attachment is sometimes associated with maltreatment, care has to be taken to ensure that identifying disorganised attachment patterns does not result in the false assumption that a child is being maltreated. Making this assumption is likely to selectively harm already disadvantaged families (e.g. those raised in socioeconomically deprived households, those of cultural or ethnic minorities, those with dysfunction or with functional impairments). Removal of a child from his/her family should not be considered solely due to a child's disorganized attachment to a caregiver⁹⁶. In addition Blank et al. (2015) argue that any tool that is likely to adversely impact on Māori needs to ensure that the social justice issues have been fully addressed⁹⁷.

There is also a potential risk that a diagnosis of RAD for a child in care may lead their alternative caregiver (e.g., foster parent) to believe that their child is incapable of forming attachments.

2.7 Summary

- *Care is required when screening for parent-child relationship difficulties, because assuming that a disorganised attachment pattern is a sign of child maltreatment could potentially harm already disadvantaged children.*
-

2.8 What do we know from a Māori and Pacific knowledge basis about assessment and intervention in this domain?

We were unable to find any kaupapa Māori studies on Māori attachment, Māori parent-child relationships and no quantitative studies on Māori parenting. However a consistent message across qualitative Māori studies is the requirement that any assessment and intervention for Māori must be generated from within a kaupapa Māori framework⁹⁸. In addition infants must be considered in the context of their whānau^{7,99,100} and support services are best serviced by a whānau ora approach¹⁰¹⁻¹⁰³.

Cram (2019) addresses the need for a Māori child wellbeing measure, which is based on kaupapa Māori principles. It is also agreed that the individual child must be viewed within the context of whānau so any assessments must be able to incorporate a whānau systems approach¹⁰⁴. To date this does not exist within the attachment research although it has been considered^{97,105}. She provides a possible framework, for tracking wellbeing, infants and the parent-child relationship is not considered.

The ability to recognise that the infants first experience of themselves as cultural figures come about through their parent-child relationship¹⁰⁶. So ensuring culturally responsive assessment and intervention is important so that principles of kaupapa Māori practices are supported⁹⁸.

In New Zealand non-Māori, evidence-based parenting programmes have been culturally adapted and have shown similar positive outcomes as non-Māori. The Mellow Parenting programme has been culturally adapted as Hoki Ki Te Rito¹⁰⁷ and is currently undergoing an open trial. It is the only programme that can be used with 0-3 infants. Parent-Child Interaction Therapy (PCIT) is currently undergoing an open trial after having been trialled with Māori clinicians and whānau¹⁰⁸. Incredible Years has been culturally adapted as Ngā Tau Miharo¹⁰⁹ and Te Whānau Pou Toru is the name given to cultural adaptation of Triple P, which was evaluated in an RCT.¹¹⁰

The values and beliefs of Pacific parents have been described as having a strong focus on obedience without question, and respect for adults^{111,112} and a desire for their children to retain their cultural values within their host country. Less is known about how Pacific families define the values associated with their infants.

The Pacific Island Families (PIF) study, provided a longitudinal look at Pacific parenting practices, using researchers who were cultural appropriate and bilingual. Borrows and colleagues (2011) found that those with strong alignment to Pacific culture had significantly better infant and maternal risk factor outcomes than those with weak cultural alignment¹¹³. The Tapuaki pregnancy and parenting programme was piloted between November 2013 and April 2014 in three sites in the Auckland region to test its effectiveness in improving pregnant Pacific women's their partners' and families' knowledge and confidence about pregnancy and parenting. The study reported that parents felt that they increased their knowledge¹¹⁴ although there is no evidence that this lead to any behavioural or change in relationship factors.

The studies that have been conducted in Māori and Pacific communities tend to be on qualitative aspects of parenting with very few studies having ever been conducted using quantitative methods. Given the over representation of Māori and Pacific infants who live in socioeconomically deprived communities it is crucial that effectiveness studies are conducted on assessment tools and interventions which are based on kaupapa Māori principles.

2.8 Summary

- *There is very limited research addressing Māori and Pacific peoples parent-child relationships, but qualitative research indicates positive outcomes for culturally adapted programmes.*
- *Further research into appropriate interventions for Māori and Pacific families is required.*

2.9 Recommendations for further action

Further research

We recommend that further research is carried out in the following areas:

- Screening tools appropriate for use in primary care.
- Outcomes in later childhood/adolescence.
- Assessments and interventions appropriate for Māori and Pacific populations.

2.10 Graded evaluations

2.10.1 Screening Tools

- In the early years parent child relationship problems are best identified by observing the interaction between a child and parent in addition to considering risk factors for relationship problems.
- A number of screening tools have been considered but many either have only low grade evidence or those with more evidence supporting their use have less specificity for identifying relationship problems.
- Screening tools that identify parental factors that contribute to relationship difficulties such as stress are more commonly used.
- Diagnostic tools such as the SSP have strong evidence supporting their use however they require significant training and are more appropriate in clinical settings.

Table 2.3. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
ASQ-SE	C	Moderate	Low	Well-studied screening tool however does not directly assess relationship or attachment difficulties. May identify potential problems in the parent-child relationship when being utilised to assess other aspects of a child's development.
PSI	C	Moderate	Moderate	Useful indicator of parenting stress and relationship difficulties.
PIRGAS	I	Insufficient	Low	Not suitable as a universal screening tool as it requires significant training.
NCAT	I	Insufficient	Low	Not suitable as a universal screening tool as it requires significant training.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty.](#)

2.10.2 Interventions

- Interventions target different aspects of the child-parent relationship including attachment, parental sensitivity, parenting skills and frightening parental behaviour.
- Many have good evidence supporting their use and choosing the most appropriate programme will depend on the age of the child, the presenting problems, and the availability of interventions and comprehensive services.

Table 2.4. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Child-Parent Psychotherapy	B	Moderate	High	Aimed at parents with young children (aged 0 to 5 years) who may have experienced relational trauma or abuse. Shown to have a short-term positive impact on child outcomes. Minimal availability in New Zealand.
PCIT	A	Moderate	Moderate	Available for parents with children aged 2 to 12 years. Improves positive parenting, reduces negative parent behaviour and improves child behaviour. Shown to have a short-term positive impact on child outcomes.
Incredible Years (Toddler)	C	Small	Low-Moderate	An effective parenting programme with evidence of short-term positive impact on child behaviour. Research is needed to show improvements in the parent-child relationship.
Incredible Years (3-6 years)	A	Moderate	Moderate	An effective parenting programme with evidence of improved parenting skills and reduced child behaviour problems. Research is needed to show improvements in the parent-child relationship.
Triple P	C	Moderate	Moderate	An effective parenting programme for encouraging positive child behaviour and aimed at infants up to teens. There is evidence of short-term positive impact on child behaviour. Research is needed to show improvements in the parent-child relationship.
Watch Wait and Wonder	C	Moderate	Low-Moderate	Directed to the parent-child relationship, delivered to parents with young children (aged 0 to 4 years). Improved child outcomes for social, emotional and cognitive problems and disorganised attachment. Further research is required.
Circle of Security – parenting	C	Moderate	Low-Moderate	Directed to the parent child relationship. Evidence shows improved inhibitory control and maternal response to child distress. More research is required.
Circle of Security – intervention	C	Moderate	Low-Moderate	Evidence shows increased attachment security in preschool children however other child outcomes are less clear. More research is required.
Mellow Parenting	C	Moderate	Low-Moderate	Hoki te Rito, the kaupapa Māori Mellow Toddler programme, has been found to be culturally acceptable.
Mellow Bumps	I	Insufficient	Low	There is insufficient evidence to determine whether this programme is effective. Currently being used in New Zealand.
NBO System	C	Moderate	Low	Low level evidence supporting this programme’s use for first-time parents at low risk.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
VIPP	C	Moderate	Low-Moderate	Evidence shows improved maternal sensitivity and a reduction in the rate of disorganised attachment in at-risk populations. The use of video to promote positive parent-child interaction is widely used in infant and early childhood mental health.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

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A BETTER
START

E Tipu e Rea

3. Social, emotional, and behavioural mental health screening – including adverse childhood experiences

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Suggested citation: Thorn LM, Guy D. Social, emotional, and behavioural mental health screening – including adverse childhood experiences. In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme. A Better Start National Science Challenge*. Auckland, New Zealand; 2019; p. 73-95.

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: L M Thorn reports no conflicts of interest. D Guy coordinates Training in Watch, Wait and Wonder in Australasia; she is also currently President of Infant Mental Health Association Aotearoa New Zealand (IMHAANZ), and the organisation providing training to implement Facilitating Attuned Interaction (FAN) in New Zealand.

Abbreviations

ACEs	Adverse Childhood Experiences
ACE-Q	Adverse Childhood Experiences Questionnaire
ASQ-SE	Ages and Stages Questionnaire – Social Emotional
BITSEA	Brief Infant Toddler Social Emotional Assessment
CBCL	Child Behaviour Checklist
CYW	Child Youth and Wellness Centre
EIF	Early Intervention Foundation
FAN	Facilitating Attuned Interaction
IECMH	Infant and Early Childhood Mental Health
IY	Incredible Years programme
NGO	Non-government organisation
NZ	New Zealand
PCIT	Parent Child Interaction Therapy
SEB	Social, Emotional, Behavioural
SDQ	Strengths and Difficulties Questionnaire
US	United States of America

Summary

Infancy and early childhood are unique developmentally, and studies demonstrate significant social, emotional, and behavioural problems (SEB)^{1,2}, and adverse childhood experiences (ACEs)³. While there are no comprehensive studies estimating prevalence of ACEs in New Zealand (NZ), approximately 10-15% of 1-2-year-old children^{2,4}, and 10% of 3-4 year children have SEB problems⁵, which includes a disproportionate number Māori and Pacific children^{4,5}. Without intervention SEB problems can persist⁴, and ACEs can accumulate, causing long term problems including mental and physical illness^{3,6,7}.

This report provides a review of the latest research and evidence for screening of SEB problems and ACEs to inform decision making for health and social services. The strengths and difficulties questionnaire (SDQ) is currently used for universal screening of SEB difficulties among 4 year old children in NZ⁸. There is no ACE screening tool in use in NZ, however there is an acceptable ACE questionnaire (ACE-Q) in use in the United States, which records the number of childhood adversities⁷.

Ideally, children above the threshold for concerning SEB scores or number of ACEs are referred for further assessment and intervention, such as a non-government organisation (NGO) programme or an infant and early childhood mental health (IECMH) service. Available interventions effectively improve parenting and the parent-child relationship, and reduce SEB problems⁹⁻¹¹. However, there is a severe lack of IECMH services in NZ.

NZ needs regular screening of SEB difficulties starting as early as possible, and to establish screening for ACEs, in line with Well Child Tamariki Ora checks. There needs to be more IECMH services and NGO programmes available with up-to-date training of staff, and a referral pathway tailored to the interventions available in each area to ensure all children receive appropriate interventions before developing significant difficulties and disorders.

Literature search

Electronic databases searched in order to identify relevant studies included: PubMed, Scopus, Cochrane Database of Systematic Reviews, and Google Scholar. Searches were conducted using key words or free text words depending on the database. Each search was limited to studies published between 1990 and 2019, and in the English language. In addition to databases, reference lists of relevant articles were manually searched. Furthermore, experts in the field were consulted, and government and other organisation websites were searched for relevant journal articles and grey literature. Additional information is found in Appendix 1.

3.1 What is the prevalence of social, emotional and behavioural problems in infants and children (0-5 years) in New Zealand?

An estimate of New Zealand (NZ) prevalence is derived from the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997); a tool used to identify social, emotional, and behavioural (SEB) problems among children aged 3-16 years^{1,12}. The SDQ has five subscales: emotional symptoms, peer interactions, hyperactivity, conduct, and prosocial behaviour^{12,13}. Children are categorised as either unlikely to have difficulties (normal), medium likelihood of difficulties (borderline), or high likelihood of difficulties (concerning/abnormal)¹².

Pooled data from the 2012/13, 2014/15, and 2015/16 New Zealand Health Survey, showed that 10.2% of children aged 3-4 years had a concerning total SDQ score (score of >15/40), which was higher than children aged 5-9 years (6.9%) or 10-14 years (8.4%) (score of >16/40)^{5,13}. The proportion is similar to a finding from the D'Souza et al. (2019) study, which used a cohort of 5896 children from the Growing Up in New Zealand study and found that 11.3% of the children at 4 year olds had a concerning total SDQ score⁴.

There is limited research in NZ around SEB problems among children aged 2 years, and no research for children under 2 years. D'Souza et al. (2017) studied the use of the SDQ among 2 year olds in NZ and found satisfactory factor structure and reliability, supporting its use for screening, however an evaluation of validity is required¹⁴. D'Souza et al. (2019) found that 9.5% of children aged two years had a concerning total difficulties score (score of >15/40)^{4,13}. This finding is similar to studies in other countries, which have found that around 6-18% of 1-2 year old children experience SEB difficulties^{2,15,16}.

3.1 Summary

- *The SDQ is a tool used to identify SEB problems among children aged 3-16 years, and provides an estimate of prevalence data in NZ.*
 - *10-11% of 3-4 year old children have a concerning total SDQ score, which is higher than among older age groups.*
 - *There is limited research on SEB problems among children aged 2 years and under.*
 - *D'Souza et al. used the SDQ among 2 year olds and found that 9.5% of children aged 2 years had SEB problems.*
-

3.2 What are the long term outcomes following identification of a social, emotional and/or behavioural problems during childhood, with and without therapeutic intervention?

3.2.1 Without intervention

If untreated, SEB difficulties in early childhood may have short and long-term effects on an individual's emotional, cognitive, social and physical health, behaviour, parent-child relationship, and education^{6,17-20}. These poor outcomes affect the individual, their family, and society. Without intervention, approximately 35-50% of children with social, emotional and behavioural problems continue to have persisting difficulties throughout early childhood^{4,21,22}.

Outcomes differ depending on the problem and its severity, the parent-child relationship, associated adversities for parents and children, and environmental factors. For example, regulatory problems in the first year, with excessive crying as a symptom, are associated with developing behavioural problems⁶.

3.2.2 With intervention

Studies have shown post-intervention improvements in infant and early childhood SEB difficulties and maintenance of the improvements²³⁻²⁷. For example, children at risk of developing conduct disorders, show significant improved behaviour after parenting-based programmes, and maintain the improvements 18 months after the intervention²³. Currently, there are few studies that investigate outcomes past a couple of years. Interventions during the first months and years of life have also been shown to be effective^{28,29}.

3.2 Summary

- **35-50% of children who have recognised SEB problems persist with these problems throughout childhood.**
 - **Without intervention, SEB problems cause a wide range of poor effects on health and wellbeing in the short and long term.**
 - **Interventions, such as parenting programmes, improve SEB difficulties in infancy and early childhood, and children maintain these improvements.**
-

3.3 What are the long-term impacts of Adverse Childhood Experiences with and without intervention?

3.3.1 Without intervention

Adverse childhood experiences (ACEs) are stressful or traumatic experiences that occur during early childhood or adolescence³. When children experience strong and frequent adversity without adult support, the normal function of the brain and other organs can be disrupted, leading to toxic stress^{30,31}. Felitti et al. (1998) developed a questionnaire with ten ACEs grouped into categories including abuse: physical, emotional, and sexual; neglect: physical and emotional; and household dysfunction: substance abuse by parent/partner, mental illness of parent/partner, intimate violence of parent/partner, incarceration of parent/partner, and separation/divorce or parent³. Researchers since have used the retrospective ACE questionnaire developed by Felitti for adults, or a modified questionnaire, for prospective studies and screening.

Early life adversity is associated with poor health outcomes in the short and long term, including mental health problems, violence, substance abuse, and poor physical health^{3,32-40}. ACEs accumulate throughout childhood, and have a dose-response relationship, with more ACEs increasing the risk of poor outcomes^{3,7}. Children exposed to four or more ACEs, irrespective of which ACEs, have an increased risk of poor health outcomes³⁹.

3.3.2 With intervention

Reducing initial exposure to ACEs has cognitive benefits for children⁴¹, however, there is little research on the effects of intervention after exposure to ACEs during early childhood. Researchers have identified factors that are associated with resilience to adversities^{42,43}. For example, the effects of toxic stress on young children can be reduced by improving the parent-child relationship⁴⁴, therefore interventions improving this relationship may help prevent the poor outcomes. ACEs are risk factors for SEB problems^{34,39}, therefore interventions for SEB problems may also reduce poor outcomes associated with ACEs.

3.3 Summary

- *ACEs accumulate throughout childhood and are associated with poor mental and physical health outcomes in the short and long term.*
- *ACEs have a dose-response relationship with more ACEs increasing the risk of poor outcomes.*
- *Improving the parent-child relationship can reduce toxic stress, therefore interventions directed to improving the relationship could be used for children with ACEs.*

3.4 What suitable screening tests are available to conduct social, emotional, and behavioural screening, including Adverse Childhood Experiences (ACEs), during infancy and early childhood?

An acceptable screening tool needs to have internal consistency, retest reliability, and validity^{45,46}. In addition, the tool should have acceptable readability, response format, completion time, and be easy to interpret⁴⁶. The Ages and Stages-Social Emotional questionnaire (ASQ-SE), the Brief Infant Toddler Social Emotional Assessment (BITSEA), and the Child Behaviour Checklist (CBCL) are tools designed to screen for SEB difficulties among children^{47,48}. The ASQ-SE is being used in NZ as a pre and post measure for the Ministry of Education Incredible Years Toddler programme pilot evaluation (personal communication, Dr Denise Guy). The CBCL is too long for implementing as a universal screening tool, and as shown in Table 3.1, all three tools cost to purchase from the developer, so are not suitable for a universal screening tool⁴⁹⁻⁵¹.

Table 3.1: Tools for screening for social, emotional, and behavioural problems including adverse childhood experiences, among children aged 0-5 years.

	Number of items	Age group	Administration time	Cost
Ages and Stages -Social Emotional ⁴⁹	19-33 items	6-60 months	10-15 minutes	Proprietary
Brief Infant Toddler Social Emotional Assessment ⁵⁰	42 items	12-36 months	7-10 minutes	Proprietary
Child Behaviour Checklist ⁵¹	99-items	1.5-5 years	15-20 minutes	Proprietary
Child Youth Wellness ACE Questionnaire ⁷	17 items	0-12 years	5 minutes	Free
Strengths and Difficulties Questionnaire ^{8,13}	25 items	2-4 years 4 -16 years	10 minutes	Free

As discussed in Section 3.1, the SDQ is used in NZ as a universal screening tool for children aged 4 years⁸. The questionnaire is reliable, comprehensive, and appropriate for use in NZ¹. The SDQ for 3-4 year olds is the pre-school SDQ, and 4-16 year olds use a school age SDQ¹³. A version of the SDQ adapted for children aged 2 years has been used in a study of NZ children, although needs validation¹⁴. There are also parent and teacher versions of the SDQs available⁸. This report will discuss the SDQ and no other SEB screening tools, as the SDQ is currently used for universal screening, is freely available, and has been found to be acceptable.

Currently in NZ there is no ACE questionnaire used for screening children aged 0-5 years. The Child Youth and Wellness (CYW) Centre in the United States (US) developed the ACE-Questionnaire (ACE-Q) to use as a screening tool in primary health care and are validating the screening tool⁷. The ACE-Q includes the original ten ACEs (Section 3.3.1) and a separate seven ACEs relevant to the community, for example: was your child ever in foster care⁵². In addition, a stress related symptom checklist is completed with the primary health provider⁵².

3.4.1 What is the reported accuracy of the identified screening instruments?

Sensitivity and specificity levels of 70% to 80% have been deemed acceptable for developmental screening tests⁵³. The SDQ has an approximate sensitivity of 63% and specificity of 94%⁵⁴ among 4-16 year olds, and agreement between the SDQ result and clinical judgement was highly significant⁵⁵. The SDQ identifies more false positives than false negatives and over 70% of those with difficulties were identified^{54,55}. There are very few studies looking at sensitivity and specificity among 3-4 year olds, however one found that the SDQ has acceptable reliability and validity among children aged 3-4 years⁵⁶.

A validity study on the SDQ in NZ showed that the internal consistency of the subscales was low, possibly due to ethnicity and cultural differences, parent's difficulties understanding the questions, and the context in which to answer the questions^{57,58}. A conversion table, as suggested by Kersten et al. (2018), may help to account for score bias by ethnicity group, and therefore improve internal consistency⁵⁸. The SDQ uses a scale that is subjective to each person filling it out⁵⁹. Parents that have a low understanding of normal development and social norms, or have cultural differences, may identify their child as having difficulties when they do not have any⁶⁰ and parents with depression or anxiety may experience their child as more difficult⁶¹, highlighting the need for face to face support from providers of the SDQ⁵⁷.

The CYW ACE-Q was found to have validity and acceptability in the primary health care setting in San Francisco, US, although needs further evaluation on reliability^{7,52}. An evaluation of the reliability, validity, and acceptability of an ACE screening tool needs to be conducted in the NZ population.

3.4.2 How is the screening instrument administered?

In NZ, the pre-school SDQ is administered as a part of the Well Child Tamariki Ora B4 school check, carried out by a registered nurse or other health care provider when the child is 4 years old⁸. A pre-school or other teacher will also be asked to complete an SDQ-T⁸. The parents are given the SDQ to take the home, complete, and return, or given the option to complete the form with the help of the provider⁸.

The SDQ provider scores the SDQ as 0-2 for 'not true', 'somewhat true', and 'certainly true'⁸. The scores are calculated for each subscale, then all subscales except the pro-social scale are combined to create a total difficulties score⁸. A scoring sheet indicates which scores are normal, borderline, or concerning in the general population⁸. Currently, British threshold values are used for scoring, although they may be

too high for the NZ population, which would cause under identification of children with problems^{57,62}. Further research may need to be done to consider different thresholds specific to the NZ population⁵⁷.

An ACE-Q screening tool could also be administered as a part of Well Child checks. For the CYW ACE-Q, a parent states to the provider or fills in the number of ACEs that apply to their child on a form. To create a total ACE score for referral, the provider of the ACE-Q combines the number of ACEs from the original ten ACEs, and from the second section. As discussed in section 3.4., the parent is interviewed to identify the presence or absence of stress related symptoms⁵². Other services may choose different approaches to collecting the ACE score, which is an area requiring further research.

3.4.3 What costs (if any) are associated with each identified screening instrument?

Completing the SDQ and ACE-Q have minimal demands on time and resources^{5,52} and are freely available^{13,52}.

3.4.4 When is the optimal time (or times) to conduct the screening test?

Infant development can be compromised in the early weeks and months of life^{4,16,21}. The current screening at 4 years of age is too late. In a review for the Ministry of Education, Church (2003) summarised that interventions for antisocial behaviour were less effective among school age children than pre-school children⁶³. CYW ACE-Q screening begins at nine months of age, 24 months, then each year until the child is 19 years old⁵². In NZ, it may be advantageous to follow the CYW model and screen for SEB difficulties and ACEs throughout infancy and early childhood in line with Well Child checks, to ensure difficulties are addressed as early as possible. Screening among children under 2 years could be done with the ACE-Q as ACEs can lead to SEB problems, or despite cost, other tools such as the BITSEA or ASQ-SE are appropriate for children aged 6 months to 2 years^{49,50}.

3.4 Summary

The SDQ

- *The SDQ is a valid, accurate, acceptable, and free tool used for universal screening of 4 year old children as a part of the Well Child Tamariki Ora B4 School check.*
- *A study in NZ showed that internal consistency of the subscales was low, possibly due to ethnic differences and parents having difficulty understanding the SDQ questions and their context.*
- *Well Child Tamariki Ora provide the parents, and teachers, with the SDQ, which they can complete with the providers or at home.*
- *The provider scores the SDQ and a sheet indicates if the child's scores are normal, borderline, or concerning.*
- *Screening for SEB problems at 4 years is too late.*

The ACE-Q

- *No ACE tools have been developed for use in NZ.*
 - *The ACE-Q, a multiple section tool, was developed and validated in the US for use as a screening tool by the CYW Centre.*
 - *ACE-Q section one – 10 ACEs developed by Felitti, section two – seven ACEs relevant to the community. Child symptoms are recorded.*
 - *ACE-Q screens children aged 9 months and continuing periodically to 19 years.*
-

3.5 What assessment(s) should follow positive screening for ACEs, and/or social, emotional and behavioural problems?

The SDQ is not a diagnostic tool¹. Referral processes for further assessment need to be in place, as well as effective interventions¹. In NZ, children with a concerning total score on the SDQ should be referred to either infant and early childhood mental health (IECMH) services or to NGO intervention programmes⁸. With limited IECMH services children are more likely to be referred to community based programmes. Children with a borderline score on the total SDQ or children with a concerning subscale score may also be referred to home visiting and parenting programmes⁸. The decision on where the child is referred depends on the availability of services, and on the preference of family and whānau who attend with the child¹.

The ACE-Q score and the child's symptoms determines if a child needs intervention in the CYW screening model. If a child has 1-3 ACEs with no symptoms, they are not referred for specialty intervention, however their parents are asked to monitor symptoms⁵². If symptoms arise, the parents could notify the Well Child Tamariki Ora provider or the child's doctor. If the child has 1-3 ACES with symptoms, or 4 or more ACES, they are referred for assessment and intervention⁵².

3.5 Summary

- *Screening should provide a pathway for interventions.*
 - *Concerning total SDQ score - referral to IECMH services or non-government organisation intervention programmes.*
 - *Borderline total SDQ score or concerning subscale score - possible referral to home visiting programmes or community based programmes*
 - *1-3 ACEs with no symptoms - monitored by parents*
 - *1-3 ACEs with symptoms - referred to interventions*
 - *4 or more ACEs - referred to interventions*
-

3.6 What interventions or additional support are effective following early detection?

Screening for SEB problems and current number of ACEs could provide a pathway between primary care providers and interventions for children and their family. There are three tiers of interventions in NZ: universal care (Tier 1) including Well Child Tamariki Ora, targeted preventive care (Tier 2) including non-government organisations (NGOs) and Early Intervention services, and intensive specialty care (Tier 3) including infant and early childhood mental health (IECMH) services^{64,65}. However, interventions can sit across multiple tiers.

Improving the parent-infant relationship is central to early intervention with SEB problems and moderating the effects of ACES^{66,67}. Socioeconomic factors and household adversity also need to be addressed for children with ACES⁶⁸. Individual interventions are uncommon in this age group. The following interventions and programmes are a sample of what has been found effective in improving parental sensitivity and responsiveness and reducing SEB problems.

Home visiting are Tier 2 programmes that aim to address issues such as children’s behaviour, cognitive and language development and parenting⁶⁹. Family Start is an example of a home visiting programme for families of children aged 0-5 years that offers the most intensive support for families with adversity in NZ⁹. Family Start has shown reduced infant mortality, increased utilisation of health services and early education, and increased utilisation of addiction services for mothers^{9,69}, while the Early Start programme has shown reduced behaviour problems at age 3 years⁷⁰. Further research is needed to investigate long term results.

Parenting Programmes are educational programmes offered across Tier II and III, and include Incredible Years Parenting programmes (IY), Circle of Security-Parenting, Triple P Positive Parenting Programmes and Mellow Parenting. IY has programmes for parents of children from 0-12 years, and improves SEB difficulties for children, and is recommended for children with conduct problems¹⁰. The Early Intervention Foundation (EIF) found that the Incredible Years programmes for children aged 3-6 years had evidence from more than one study of a positive impact (rating 4+), while the programme for toddlers needs more research⁷¹. There is also evidence of improvement in parental wellbeing and behaviour^{11,72-74}. There is some evidence that parenting programmes are effective among children under 3 years old⁷⁵, although more research is needed on long term effects.

Infants and young children with a high total SDQ score, subscale, or ACE score should be indicated for specific IECMH services. These children need referral to services providing a comprehensive assessment with attention to observations of the parent-child relationship, and interventions directly focused on improving the relationship. Examples of Tier 3 interventions include Circle of Security-Intervention, Watch, Wait and Wonder, Video Feedback to Promote Positive Parenting, Video Interaction Guidance, and Parent Child Interaction Therapy (PCIT). PCIT is an empirically validated intervention that is effective at reducing behavioural problems for children from 3 years⁷⁶⁻⁷⁹. Watch, Wait and Wonder (EIF 2+, positive outcome from one quality study) focuses on parental sensitivity and attachment to improve child emotional problems such as disorganised attachment among 0-4 year olds^{71,80,81}. These interventions can be offered in a community setting but often without the comprehensive assessment.

While the interventions discussed are available in some areas of NZ, there are improvements needed in the provision of IECMHS and intervention programmes. Comprehensive perinatal and infant mental health services for complex, ‘high risk’ caregivers are rare in NZ. Infants and young children at clear risk of adverse mental and physical health outcomes need to receive appropriate consultation and management. Additionally, services need appropriately trained and supervised providers that can connect and support families. The Facilitating Attuned Interaction (FAN) approach⁸² is a conceptual model and practical tool for practitioners to build relationships and develop reflective practice. Providers in NZ, including those working for Plunket, Well Child Tamariki Ora, and home visiting programmes are positive about FAN. FAN has had good uptake, and is successful in reducing parental stress, increasing parent satisfaction and provider confidence and reducing provider burnout.

3.6 Summary

- *Improving the parent-child relationship is key to moderating SEB difficulties and ACEs.*
 - *Home visiting programmes for families of children aged 0-5 have shown reduced infant mortality, increased use of health services, and improved behaviour problems.*
 - *Parenting programmes, such as Incredible Years programmes, improve SEB difficulties and parent wellbeing and behaviour.*
 - *There are limited IECMH services in New Zealand.*
-

3.7 Are there any known harms from screening for Adverse Childhood Experiences and/or social, emotional, and behavioural problems?

There are no identified harms from the SDQ or ACE-Q screening tools themselves. However, there are barriers that could prevent children from being screened, or prevent children and families from receiving necessary interventions. Parents have reported difficulties understanding the purpose of the SDQ, the context of the questions, and it can raise anxieties about their child^{8,57}. Some parents have a problem with the sexual abuse and violence questions in the ACE-Q, even though parents do not need to state which ACEs their child has, just the total number of ACEs⁷. Training health care providers to discuss the purpose of the screening tools and provide assistance as the parents complete the questionnaires helps parents understand the value of screening^{8,57}. If parents and teachers choose to complete the questionnaires at home, an online questionnaire with automated reminders and help boxes could be developed to help parents understand the questions from home.

Screening will identify children that require further assessment and intervention, however, there are resource difficulties, a limited skilled workforce, and a lack of services for providing appropriate interventions. Furthermore, resources will be unnecessarily limited when false positives are referred to interventions. IECMH services are scarce in NZ, with only two full time services, both in Auckland, and only three part-time services available in either Auckland, Waikato, or Canterbury⁶⁴. While NGO and community programmes are more widespread, they are not available everywhere, with fewer interventions available outside main cities. Online parenting programmes could be investigated to reach families in rural areas, however more research into their efficacy is needed⁸³.

Infants, young children, and their families are potentially harmed when difficulties are identified but no intervention is offered or available. Difficulties may persist with increasing impairment until a service is available at an older age. Integrated approaches are needed to map services, provide early childhood interventions, address workforce concerns, and have clear pathways from screening to intervention to ensure children that have a concerning SDQ and/or ACE score are referred to the appropriate services.

3.7 Summary

- *Parents reported trouble understanding the SDQ questions and their context.*
 - *There are limited IECMH services and NGO and community programmes in NZ. Some children with difficulties, and their families, may not receive interventions.*
 - *There is no clear pathway for referral between screening and interventions.*
-

3.8 What do we know from a Māori and Pacific knowledge basis about screening in this domain?

Māori children aged 3-14 years are approximately 1.79 times more likely to have a concerning total SDQ score than non-Māori children¹. Pacific children aged 3-14 years had a higher proportion of concerning total SDQ scores compared to non-Pacific children, although the difference was not statistically significant¹. Additionally, children with mothers whose prioritised ethnicity was Māori or Pacific were more likely to have persistent difficulties from age 2 to age 4 than children with non-Māori or non-Pacific parents⁴. However, these rates may be an underestimate as Māori and Pacific children were 1.6 to 1.7 times more likely to not complete the B4 school checks, which includes the SDQ, than non-Māori and non-Pacific children respectively⁸⁴. Additionally, Kersten et al. (2017), found that the threshold

values for concerning scores may be set too high for Māori children, therefore some children with problems may not be classified as concerning from the SDQ results⁶².

A 2014 review of the SDQ found that some parents from Māori, Pacific, Asian, and new immigrant backgrounds thought that the SDQ did not consider cultural differences⁵⁷, which may be the reason for poor completion of B4 school checks. To ease language barriers and improve cultural appropriateness, different language SDQs are available including a Te Reo Māori version, and a Samoan version is being created⁸⁵. Some Māori and Pacific parents commented that they would prefer a discussion with the provider rather than completing the questionnaire themselves⁸⁶. The ACE-Q has a second section for questions on adversity that is common among the community. If ACE screening is established in NZ, the second section provides an opportunity to ensure the screening considers children in a Māori and Pacific cultural context.

As Māori and Pacific children are disproportionately represented among children with concerning total SDQ scores, DHBs with high populations of Māori and Pacific children need to have adequate, culturally appropriate, resources for interventions. Hoki te Rito is the kaupapa Māori Mellow Toddler programme and with Mellow Bumps has been found to be culturally acceptable, effective, and an appropriate service for Māori families⁸⁷. Incredible Years Parenting Basic for children aged 3-7 years is also effective for reducing SEB difficulties among Māori and Pacific children, and their families and whānau reported that they were satisfied with the programme⁷².

3.8 Summary

- *Māori and Pacific children have higher rates of SEB difficulties than non-Māori and non-Pacific children respectively*
 - *Some parents from Māori, Pacific, Asian, and new immigrant backgrounds thought that the SDQ did not consider cultural differences*
 - *Mellow Toddler and Incredible Years Parenting are effective and culturally acceptable interventions for Māori and Pacific families.*
-

3.9 Recommendations for further action

Policy and practice

- We recommend that children are screened for SEB difficulties and ACEs multiple times throughout infancy and early childhood, beginning earlier than 4 years old. The screening could coincide with Well Child checks.
- Consider changing the SDQ scoring thresholds to ones more appropriate for the NZ population.
- Improve access and cultural acceptability of screening for Māori and Pacific children.
- Health care providers offering different language tools may help parents understand the purpose of screening and feel supported.
- Face to face assistance and support for parents completing the SDQ or ACE-Q may improve difficulties understanding the questions and their context.
- Intervention providers need to be trained to engage appropriately and support parents. The FAN approach will help with this.
- Developing an online version of the SDQ with automatic reminders and information boxes may help some parents to complete the SDQ and reduce missing responses.
- New Zealand needs increased IECMH services and appropriate NGO programmes available in all regions to ensure all children that need help will receive treatment. These services need to be culturally acceptable for Māori and Pacific families.
- There needs to be an established and clear pathway from screening to interventions.

Further research

- Validation of the SDQ for 2 year old children.
- Identification of an appropriate universal screening tool that can be used for children under 2 years old.
- Research is needed to identify prevalence of SEB difficulties for children under 2 years, and for ACEs among children aged 0-5 years in New Zealand.
- More research is needed for programmes aiming at children aged 0-3 years.
- Research is needed to identify the outcomes for children with ACEs after intervention.
- An ACE screening tool based on the CYW ACE-Q needs to be studied for validity, reliability, and acceptability among New Zealand children. A second section with questions tailored to the New Zealand population should be culturally appropriate.

3.10 Graded evaluations

Table 3.2: Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
SDQ: 4-5 years	B	Moderate	Moderate-High	Should be used as a universal screening tool for all children aged 4-5 years.
SDQ: 3-4 years	B	Moderate	Moderate	Should be used as a universal screening tool for all children aged 3-4 years.
SDQ: 2-3 years	C	Small	Moderate	Has adequate factor structure and reliability but needs further validation. Should be offered for selected children of concern aged 2-3 years.
ACE-Q	C	Small	Moderate	Has not yet been validated, but captures childhood adversity. Interventions that promote resilience including parent-child relationship and parenting capacity are available, although outcomes in children with ACEs have not been assessed.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 3.3: Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Home visiting: Family Start	C	Moderate	Low	Should be provided to families of all children who need it.
Home visiting: Early Start	B	Moderate	Moderate	Should be provided to families of all children who need it.
Group-based: Incredible Years (3-6)	A	Moderate	High	Should be provided for families of all children 3-6 years and above who need it.
Group-based: Incredible Years - Toddler	C	Small	Moderate	Could be provided to families of all children aged 1-3 years who need it. Needs more research for social and emotional problems.
Group-based: Mellow Parenting	C	Moderate	Low-Moderate	Should be provided to families of all children who need it. Hoki te Rito, the kaupapa Māori Mellow Toddler programme, has been found to be culturally acceptable.
Dyadic: Parent Child Interaction Therapy	A	Moderate	Moderate	Should be provided for families of all children 3 years and above with behavioural difficulties.
Dyadic: Watch, Wait, Wonder	C	Moderate	Low-Moderate	Could be provided for children aged 0-3 years with disorganised attachment. Improves social, emotional, and cognitive problems. Needs more research.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

3.10 Summary

- *The SDQ was examined for screening social, emotional, and behavioural problems as it is currently used for universal screening in New Zealand.*
 - *While there are many tools available for screening for adverse childhood experiences, only the ACE-Q, was appraised in this review.*
 - *Screening using the SDQ tools should continue in primary care settings in NZ to support decision-making for further assessment and intervention [grade B]. The SDQ has low acceptability among Māori and Pacific parents and there is no tool for children under 2 years.*
 - *An SDQ is available but has not been validated among children aged 2-3 years [grade C].*
 - *Screening with the ACE-Q is promising, but has not yet been validated [grade C].*
 - *Home visiting programmes such as Family Start [grade C], and Early Start [grade B] have shown reduced infant mortality and increased use of health services, and improved behaviour problems, respectively. Both need more research for long term outcomes and for children under 3 years.*
 - *Group-based programmes, such as Incredible Years (3-6 years) [grade A] and Mellow Parenting [grade C] improve SEB difficulties and parent wellbeing and behaviour. Hoki te Rito, the kaupapa Māori Mellow Toddler programme, has been found to be culturally acceptable, although like Incredible Years Toddler [grade C], needs evidence from more high quality studies.*
 - *Programmes for the child and parent (dyadic) include PCIT [grade A] and Watch, Wait, Wonder [grade C]. PCIT has empirical evidence that it improves behavioural difficulties. Watch, Wait, Wonder only has evidence from one quality study showing improved social, emotional, and cognitive improvements.*
-

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Appendix 1 - Search history

Scopus

Social emotional behavioural problems: 1,383

(TITLE-ABS-KEY ("social emotional behavioural problems" OR "social emotional behavioural difficulties" OR "infant mental health" OR "early childhood mental health")

AND

(TITLE-ABS-KEY ("child" OR "children" OR "infant" OR "preschool" OR "pre-school" OR "paediatric")

AND PUBYEAR > 1989 (LIMIT-TO (LANGUAGE , "English"))

Other addition: 260

AND (TITLE-ABS-KEY (screening OR questionnaires)

ACEs: 486

((TITLE-ABS-KEY ("adverse childhood experiences")

AND

(TITLE-ABS-KEY ("child" OR "children" OR "infant" OR "preschool" OR "pre school" OR "paediatric"))

AND

(TITLE-ABS-KEY (screening OR questionnaires))

AND PUBYEAR > 1989 (LIMIT-TO (LANGUAGE , "English"))

Cochrane reviews

Social emotional behavioural problems: 17

Title-Abs-Key (social emotional behavioural problems AND ("infant" or "child" or "pre-school"))

AND PUBYEAR > 1989

NCBI – PubMed

Social emotional behavioural problems:

- mental health; child; infant; social emotional behavioural problems (filters 1990-2019, humans, English, child: birth to 18, infant) – **62**
- strengths and difficulties questionnaire (filters 1990-2019, humans, English, child: birth to 18, infant) – **2018**
- strengths and difficulties questionnaire New Zealand (filters 1990-2019, humans, English, child: birth to 18, infant) – **45**

ACEs:

- Adverse Childhood Experiences, child abuse (filters 1990-2019, humans, English, child: birth to 18, infant) – **815**
- Adverse Childhood Experiences, child abuse, health (filters 1990-2019, humans, English, child: birth to 18, infant) – **577**
- Adverse Childhood Experiences, health status child abuse (filters 1990-2019, humans, English) – **172**

- adverse childhood experiences questionnaire (filters 1990-2019, humans, English, child: birth to 18, infant) – **604**

Medline/Ovid

Social emotional behavioural problems:

▼ Search History (13) View						
# ▲	Searches	Results	Type	Actions	Annotations	
1	emotional problems.mp.	3786	Advanced	Display Results More ▼		
2	Social Problems/	7992	Advanced	Display Results More ▼		
3	behavioural problems.mp.	2299	Advanced	Display Results More ▼		
4	1 or 2 or 3	13952	Advanced	Display Results More ▼		
5	Infant/	768920	Advanced	Display Results More ▼		
6	Child/	1634864	Advanced	Display Results More ▼		
7	Child, Preschool/	889833	Advanced	Display Results More ▼		
8	5 or 6 or 7	2082644	Advanced	Display Results More ▼		
9	Mass Screening/	99224	Advanced	Display Results More ▼		
10	5 and 7	463984	Advanced	Display Results More ▼		
11	New Zealand/	37763	Advanced	Display Results More ▼		
12	4 and 8 and 9	80	Advanced	Display Results More ▼		
13	11 and 12	2	Advanced	Display Results More ▼		

ACEs:

# ▲	Searches	Results	Type	Actions	Annotations
1	Child/	864	Advanced	Display Results More ▼	
2	Infant/	920	Advanced	Display Results More ▼	
3	Child, Preschool/	833	Advanced	Display Results More ▼	
4	1 or 2 or 3	644	Advanced	Display Results More ▼	
5	Adverse Childhood Experiences/	283	Advanced	Display Results More ▼	
6	4 and 5	158	Advanced	Display Results More ▼	
7	limit 6 to (english language and humans and yr="1990 -Current")	155	Advanced	Display Results More ▼	

Grey literature sources

- Ages and Stages Questionnaire, website.
- Brief Infant and Toddler Social Emotional Assessment, website.
- Centre for Youth and Wellness, website.
- Dr Denise Guy, personal communication and a presentation on infant mental health interventions.
- Early Intervention Foundation, UK, website.
- Google Scholar, search engine.
- Ministry of Health, New Zealand, website.
- Ministry of Social Development, New Zealand, website.

- National Institute of Clinical Excellence (NICE), London UK, website.
- National Scientific Council on the Developing Child, Harvard University, website.
- Oranga Tamariki – Ministry for Children, New Zealand, website.
- The Families Commission, New Zealand, website.
- Well Child Tamariki Ora Programme, New Zealand, website.
- Youth in Mind, website for researchers and professionals about the SDQ.

A BETTER
START

E Tipu e Rea

4. Parental mental health problems during pregnancy and the postnatal period

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Suggested citation: Maessen SE, Wright T, Wouldes T. Parental mental health problems during pregnancy and the postnatal period. In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019; p. 96-119.

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: The authors have no financial or non-financial conflicts of interest to declare that may be relevant to this work.

Abbreviations

AND	Antenatal depression
ADHD	Attention deficit hyperactivity disorder
CBT	Cognitive behavioural therapy
EPDS	Edinburgh Postnatal Depression Scale
EPDS-3A	Edinburgh Postnatal Depression Scale Anxiety Subscale
HVP	Home visiting program
IH-CBT	In home CBT
IPT	Interpersonal psychotherapy
K-10	Kessler Psychological Distress Scale
LMC	Lead maternity carer
MGMQ	Matthey generic mood questionnaire
PHQ-9	Patient health questionnaire
PMH	Perinatal mental health
PND	Postnatal depression

Summary

Parental depression during pregnancy and in the first year after birth is a significant public health problem that has serious consequences for the parent and the developing child. A higher proportion of Māori, Pacific and Asian mothers are at risk in New Zealand. There is extensive evidence linking child outcomes to maternal depression and anxiety. There is less research to inform us about Māori, Pacific and Asian women, or the long term impact of mental health problems for fathers. However, evidence shows identifying parental mental illness early is associated with better outcomes for parents and their children.

- Depression and anxiety in women is common perinatally, particularly for Māori and Pacific women. Fathers also experience depression and anxiety, but New Zealand-specific prevalence is not known
- Women with a history of mental illness are at high risk for relapse during the perinatal period, but the prevalence of mental health problems other than depression and anxiety perinatally is not clear.
- Mental health problems can affect parents' ability to engage in positive parenting behaviours.
- Parental mental health problems put children at risk for long-term adverse effects on social-emotional and behavioural development, particularly if there is severe illness or additional life stressors.
- All women should be asked about their mental health history at the first opportunity antenatally.
- In NZ it is not clear which tools are most appropriate for screening for depression and anxiety.
- There are barriers which result in poor uptake of interventions for people with screen-detected mental health problems in the perinatal period.
- Non-pharmacological and pharmacological treatments for depression and anxiety are effective in perinatal populations. There are potential benefits for child outcomes but these are less well understood.
- Mild-to-moderate illnesses may have culture-specific solutions.
- More research informed by Māori and Pacific values is needed to explore barriers to uptake of care, culture-specific interventions, and validation of screening tools.

4.1 Introduction

4.1.1 Background

Poor perinatal mental health (PMH) can have life-long consequences for the parent and the developing child. The main predictor of PMH is a past history of mental illness, but it may also occur for the first time during pregnancy or postnatally¹. Susceptibility to mental health problems in both mothers and fathers is influenced by co-occurrence of stressful life experiences such as poverty, unemployment, physical illness, substance abuse, relationship breakdown and social isolation²⁻⁵. In addition, the level of stressful life events combined with the stressors of being a new parent may increase the severity and duration of the parent's mental illness⁶.

Maternal suicide is associated with PMH and in New Zealand (NZ) is the leading cause of maternal death in pregnancy or during the 6 weeks after birth or termination of a pregnancy⁷. Maternal suicide is seven times higher in NZ than in the United Kingdom (UK), and disproportionately affects young Māori women^{7,8}. Pregnancy and immediately after birth is a period in which common mental health problems occur at increased prevalence, including relapses^{9,10}, increased risks of both suicide and infanticide¹⁰, and in some instances mental health-related hospitalisation¹¹.

Parents with a range of mental health problems may have difficulties with parenting^{12,13}, and their children may be more likely to have social, behavioural, and emotional issues later in life^{14,15}. Until recently, research has concentrated on the effects of maternal mental health. However, there is an increasing recognition that fathers' mental health during the perinatal period may play a unique role in their child's development and their family's well-being¹⁶⁻¹⁸. Importantly, poor outcomes are not inevitable for the parent or the child and may vary depending on the severity and duration of illness, access to culturally appropriate mental health services, and the timing and delivery of interventions^{6,19,20}.

PMH care may require access to several services including primary care, maternity care, substance use or addiction services, specialist mental health services, and social services. A culturally appropriate integrated care pathway involving communication between these services to create consistent care with equitable access was recommended in 2012²¹. This recommendation is consistent with international guidelines and has subsequently been endorsed by several NZ stakeholders^{7,22}. There have since been some changes to services and training of healthcare professionals which prioritise maternal mental health and cultural competency in line with these recommendations^{7,8}. However, the latest Perinatal and Maternal Mortality Review Committee report demonstrates that there have not yet been any downstream benefits of these changes for Māori maternal suicide prevention⁷.

Although a range of mental illnesses can occur during pregnancy, most common are depression and anxiety²³⁻²⁵. Therefore, to address questions posed by the Ministry of Health as part of a review of the Well Child Tamariki Ora programme, these illnesses, during pregnancy and in the first year after birth, are the focus of this rapid review.

4.2 Search Methods

Systematic searches were conducted between 1 and 30 August 2019 using PubMed, Ovid Medline, the Cochrane Library, Embase, and PsycINFO (EBSCO). Our search was also broadened to include grey literature reports, as well as searches using the Informit database, the New Zealand Ministry of Health and Statistics New Zealand websites, and Google. All searches were limited to English language publications and human subjects.

Searches varied slightly depending on the database, but all included the search terms 'pregnancy', 'pregnant', 'prenatal', 'antenatal', 'perinatal', 'postnatal', 'postpartum', 'birth' AND 'mental health', 'mental disorders', 'depression', 'mood disorders', 'anxiety disorders', 'bipolar disorder', 'psychotic disorders'. All searches were initially conducted including 'New Zealand' as a search term. Where this search did not provide enough information to address a question, the 'New Zealand' search term was removed and the search expanded to include meta-analyses and systematic reviews published after 1 Jan 2010.

4.3 What is the prevalence of common mental health problems (depression, anxiety, psychosis, bipolar disorder) for parents during pregnancy and in the first year postnatally?

4.3.1 Prevalence of depression and anxiety in mothers and fathers

Depression is common during this period, often co-occurring with anxiety. As rates vary between studies, an accepted estimate is that it affects one in five mothers worldwide^{26,27}. This is in part explained by the different measures used to detect depression, as well as varying socio-economic determinants. In NZ, there are no studies which quantify the prevalence of depression or anxiety according to clinical criteria. However, recent studies using the Edinburgh Postnatal Depression Scale (EPDS) screening tool²⁸ suggest rates of 12-15% during pregnancy^{4,29,30} and 8% of mothers at 9 months postpartum⁵. Māori have higher rates than non-Māori, with recent data indicating 22% of Māori women screen positive for depression late pregnancy^{4,31}. The prevalence for Pacific Island women is possibly even higher³², but rates vary depending on the Pacific culture of origin: from 7.6% for Samoan, to 30.9% for Tongans, and also on the extent of assimilation³³.

It is estimated that around 30% of NZ women have significant anxiety during pregnancy³⁴, which may diminish postnatally, as one NZ study reports that only 7.7% of women had moderate or severe symptoms of anxiety nine months after their child's birth³⁵. However, these two studies used different anxiety screening tools, which may account for some of the variation in prevalence between the two time points.

Prevalence data for other mental health problems in the perinatal period are scarce, but in 2017, 4,448 NZ women were referred to maternal mental health services during pregnancy or in the first postpartum year for severe or persistent mental health issues (approximately 7% of total births)^{36,37}.

Bipolar disorder is present in nearly 5% of NZ women aged 16-44, and affects more Māori and Pacific Islanders than other ethnicities²³. Women who are taking medication for mood stabilisation may discontinue medication on recognition of pregnancy if concerned about its safety for fetal development²¹. Discontinuation is associated with a high risk of relapse. Meta-analysis suggests that two thirds of women with bipolar disorder who are medication-free will have a relapse postnatally, and

17% will have a severe episode²⁴. Psychosis is rare in the general population (0.1-0.5%), but is significant perinatally, as women with schizophrenia are at high risk for psychotic relapse in the postpartum period (37.5% in one meta-analysis)¹³.

The worldwide prevalence of perinatal depression in fathers is estimated to be 8%³⁸, but in New Zealand lower rates have been identified, varying between 2.3% antenatally and 4.3% postnatally³⁹. Rates are likely to be higher among men whose partner has a depressive disorder⁴⁰⁻⁴². An Australian study reported that 9.7% of first-time fathers likely meet criteria for an anxiety disorder at 6-8 weeks postpartum⁴³.

4.3 Summary

- *Perinatal depression and anxiety are common in NZ mothers, particularly for Māori and Pacific women.*
 - *Lower levels of perinatal depression have been reported in NZ fathers than internationally, but there are few NZ studies of paternal mental health.*
 - *Perinatal anxiety in NZ fathers is unknown, but Australian prevalence data suggests that nearly 10% of first-time fathers may meet criteria for an anxiety disorder in the early weeks after birth.*
 - *There is no information available to determine if illnesses are newly diagnosed pre- or post-birth, or a relapse of an existing illness for any diagnosis.*
-

4.4 What is the impact of the common parental mental health problems on (1) parenting, including on the parent-child relationship/attachment? and (2) child outcomes (cognitive, behavioural, social, and emotional)?

PMH problems are associated with a variety of effects on the offspring's behaviour, cognition and emotional development^{6,44-48}. These problems are not observed universally, but depend on the duration and severity of illness, and genetic and environmental factors^{2,6,19,49,50}. Research generally focuses on maternal mental health^{49,51-53} but emerging evidence suggests associations between the father's mental health and child outcomes as well.

4.4.1 Fetal and birth outcomes

A recent meta-analysis that examined birth outcomes in women with untreated depression (not receiving any pharmacological or non-pharmacological treatment) found depressed women were at higher risk of preterm delivery (<37 weeks and <32 weeks of gestation) and having a low birth weight infant (<2500 grams) compared to non-depressed women. A trend for greater risks with more severe maternal depression was also observed⁵⁴. Symptoms of depression in pregnancy have also been associated with physiological changes that render the infant more vulnerable due to an altered stress response and lowered immunity, and more vulnerable than average to intrusive, hostile or withdrawn parental interactions⁵⁵.

4.4.2 Parenting and attachment

Healthy infant brain development depends on the interaction between genes and early experiences, and essential to these experiences are responsive interactions with adult caregivers. The extent of these interactions over time build neuronal connections in the brain that support early social development and a secure attachment to the caregiver and provide a strong foundation for later learning, behaviour and health⁵⁶⁻⁵⁸. Attachment is when a young child uses a caregiver as a secure base from which to explore and, when frightened or distressed a source of comfort and support⁵⁹. A parent or caregiver's mental illness has been shown to interfere with these interactions when parents are non-responsive or withdrawn or through hostile, insensitive or intrusive responses^{12,13}. Multiple studies have shown that secure patterns of attachment are related to more optimal cognitive, social and behavioural outcomes across childhood, whereas two meta-analyses^{60,61} found maternal mental illness is associated with disorganised attachment (a form of insecure attachment). Clinically diagnosed postnatal depression (PND) is associated with an increased likelihood of insecure attachment⁶ and in severe cases with rejection of the infant⁶².

Both depression and anxiety in the perinatal period have been associated with lower maternal parental self-efficacy (self-confidence in parenting ability)⁶³, which in turn can predict parental competence, adjustment, and child outcomes⁶⁴. Mothers and fathers with symptoms of depression are less likely to engage in positive parenting behaviours⁶⁵. Compared to non-depressed parents they display less verbal, physical and eye contact with their infants, are less likely to follow healthy sleep and feeding practices and may breastfeed for a shorter duration, and less frequently engage in activities such as singing, reading and playing outside with their child⁶⁵⁻⁶⁷. Mothers with depression score poorly on measures of maternal sensitivity compared to those who are not depressed, and are more attuned to negative emotions and less to positive emotions in their infants^{66,68}.

4.4.3 Child outcomes of parents with perinatal depression and anxiety

Meta-analysis indicates that maternal postnatal depression (PND) increases the odds of a child being hospitalised, and almost doubles their risk of death in the first year of life⁶⁹. Further differences between offspring of women with and without depression begin in infancy, with depressed women's children less likely to express joy and rated as being more fearful and fussy^{70,71}. This finding may contribute to bonding difficulties between mother and infant.

Children of mothers with depression or anxiety that occur during pregnancy or depression that occurs in the postnatal environment remain at increased risk for behavioural difficulties throughout childhood and adolescence^{44,47,48,71}. A number of studies have examined the effects of both antenatal depression (AND) and PND on child cognitive, social and emotional development and internalising and externalising behaviour. Social development is the development of a child's social skills such as perspective taking, empathy and cooperation. Emotional and behavioural research in older children is usually associated with internalising and externalising problems with internalising referring to symptoms or diagnoses of depression and anxiety and externalising referring to attention deficit hyperactivity disorder (ADHD), oppositional defiant disorder and conduct disorder or symptoms of these.

Longitudinal studies have shown that AND is associated with an increased risk for child emotional problems; both maternal self-reported symptoms and depressive disorder are associated with increased risk of clinical depression in late adolescence. Infants of mothers with PND have an increased risk of difficulties in early emotional regulation and social behaviour^{44,47}. Associations later in childhood may depend on concurrent maternal depression⁷¹. Longitudinal studies also show associations between PND

and social and emotional outcomes across a number of developmental domains and age ranges^{6,72,73}, including internalising disorders, poor social competence in school years, and an increased risk of depression during adolescence.

Multiple studies have reported associations between AND and difficulties in child externalising behaviour including ADHD, oppositional defiant disorder and conduct disorder or symptoms of these. Longitudinal studies provide evidence that symptoms and disorders of PND are associated with child externalising behaviour, particularly ADHD up to age 16^{6,73}. Self-reported symptoms of maternal anxiety both antenatally and postnatally are associated with externalising disorders in childhood⁷⁴.

Meta-analyses demonstrate a relatively small negative association between maternal perinatal depression and offspring cognition throughout childhood^{6,44-46}, with some corresponding effects on school achievement in adolescence, particularly for boys⁷¹. Many studies describe a negative association between maternal depressive symptoms and child language development, potentially as a result of changes to parent-child interactions early in life⁷⁵.

Although the recognition of the importance of father's mental health is emerging, there is little evidence to date. Fathers can affect child outcomes through genetics, and also of importance are the quality of his interactions with the child, support to the mother, and contributions to the family environment. Both AND and PND show some evidence for poorer outcomes, and although there is evidence that paternal and maternal depression in the postnatal period have similar effects on behavioural outcomes, maternal depression has a greater risk for child emotional outcomes⁶.

Most studies focus on psychological effects of parental mental health problems, but there is some evidence that maternal depression in the perinatal period is associated with preschool-age obesity⁷⁶. However, there is a lack of high-quality data to elucidate the contributions of environmental factors to this relationship.

4.4.4 Anxiety

Anxiety and depression commonly co-exist, and few studies examine the individual effect that anxiety may have on child outcomes. Antenatal anxiety has been associated with increased offspring anxiety, internalising and externalising behaviour and emotional difficulties in childhood^{6,50,77}, while effects of postnatal anxiety have been observed as greater distress, hyperactivity and emotional problems for infants up to two years of age^{6,50,53}. One systematic review reported no evidence that anxiety in the perinatal period is related to child cognition⁶, but measures of perceived stress during pregnancy have been associated with an increased risk of depression for offspring 11 years later, with children born small for gestational age particularly vulnerable to this effect⁷⁸.

4.4 Summary

- *Mental health problems in the perinatal period can affect parents' ability to engage in positive parenting behaviours.*
 - *Parental mental health problems put children at risk for long-term adverse effects on their social-emotional development and internalising and externalising behaviour and to a lesser extent cognitive development.*
 - *Child outcomes vary depending on the severity of depression and anxiety and the extent of other life stressors.*
-

4.5 What is the reported accuracy of screening tools to detect antenatal and postnatal mental health problems?

A history of mental health problems is the strongest predictor of poor PMH⁷⁹. If this history can be identified antenatally, there is an opportunity to refer preventatively for women at risk of deterioration in mental health, including those with bipolar disorder and psychotic illnesses, for whom illness recurrence may heighten the risk for mother and baby^{37,80,81}.

Early detection of depression and anxiety during the perinatal period using a standardized screening tool results in better outcomes than simple clinical assessment⁸²⁻⁸⁴. For instance, lead maternity carers' (LMC) estimations of mothers' distress correlate poorly with mothers' self-report⁸⁵. While screening is desirable for fathers and any primary caregiver, regardless of their biological relationship to a child, antenatal care and the relationship with the LMC offers an opportunity to do this systematically. However, at this point there is no universal screening for maternal mental health and LMCs reports and research suggest there are a number of barriers to universal screening at this time⁸⁶⁻⁸⁸.

Given the transience of mood and anxiety in the perinatal period, repeat screening is recommended for early identification and to ensure help is sought for enduring distress⁸⁹. International guidelines suggest that antenatal screening should be undertaken as early as practical in pregnancy and repeat screening at least once later in pregnancy. Postnatal screening is recommended 6–12 weeks after birth and again at one further time within the first postnatal year⁸⁰.

Diagnostic assessment may be an important part of screening follow-up⁸⁰ as some women who screen positive for depression may have non-specific distress or other psychiatric disorders including bipolar disorder rather than unipolar depression^{90,91}.

4.5.1 Screening for depressive disorders

Four screening tools for depression in the antenatal and postnatal period are commonly cited: the Edinburgh Postnatal Depression Scale (EPDS), the depression module of the Patient Health Questionnaire (PHQ-9), the Whooley Questions and the Kessler Psychological Distress Scale (K-10)⁸⁰. In New Zealand, research has been conducted using the EPDS, the K-10, and the PHQ-9.

The EPDS is the most widely used perinatal screening tool^{26,82} and the most commonly recommended in international guidelines^{80,92}. The scale consists of 10 questions relating to symptoms of depression and has a maximum score of 30 (Appendix I). Cut-off scores vary, but ≥ 12 is most common and has good sensitivity and specificity for identifying people with probable depression^{29,90,93}. The final question of the EPDS enquires about self-harm and a positive response to this question could indicate maternal risk even with a low overall score.

In many cases elevated EPDS is transient, and around half of women who have an elevated score in pregnancy will no longer score above the cut-off two weeks later^{26,51,89,94}. In contrast, two elevated scores at different time points are more likely to predict those who will go on to seek mental health treatment^{51,90}. Nausea and fears of miscarriage are common in the first trimester of pregnancy and may contribute to transient elevated EPDS scores⁸⁹.

The EPDS has been used to estimate prevalence of AND in NZ fathers³⁹, but lower cut-off scores are recommended as depression presents differently in men, with greater anger and irritability, as well as being masked by interpersonal conflict, and drug and alcohol use¹⁷.

The PHQ-9 consists of nine questions that assess the presence of depressive symptoms (Appendix I). Studies which compare it to the EPDS suggest high concordance⁹⁵. There are fewer studies which examine its use in the perinatal period, but it is in common use in primary care and has been demonstrated to perform adequately in a NZ population⁹⁶. It has also been used in NZ in an electronic format for patients who screened at risk for depression on an 'eCHAT' online screening tool⁹⁷. Electronic self-administration can overcome poor screening practices, facilitate disclosure and improve dialogue with clinicians⁹⁷.

Use of pen-and paper to undertake screening is at risk of significant scorer error (up to 29% in one study⁹⁸, and a small number of studies have demonstrated that electronic screening (e-screening) may have several advantages. In addition to greater reliability, e-screening has been described as helping with poor literacy, overcoming concerns about privacy and is time-efficient^{99,100}. Despite the appeal, e-screening remains within the research space, as it does not overcome high false positive rates and high costs of screening¹⁰¹.

4.5.2 Screening for anxiety disorders

There are many aspects of anxiety in the perinatal period which set it apart from anxiety in the general population, including fear of childbirth and worry about being a good mother. Furthermore, physiological symptoms of anxiety may be missed in pregnancy, and sleep deprivation may exacerbate symptoms. As a result, few screening tools for anxiety have been validated for perinatal use¹⁰² and none are currently recommended in current international guidelines⁸⁰.

Though not specifically designed to detect anxiety disorders, the EPDS includes three items that relate to symptoms of anxiety, which create an anxiety subscale, known as EPDS-3A^{103,104}. This has been shown to be a better predictor of an anxiety disorder diagnosis than four other anxiety screening tools with the exception of the Matthey Generic Mood Questionnaire (MGMQ)¹⁰⁴.

4.5 Summary

- *Asking about a history of mental illness is essential at the first antenatal visit.*
 - *The Australasian COPE guidelines suggest routine screening should be conducted as early as practical antenatally and at least once later in pregnancy. After delivery, screening should be undertaken again in the first six to twelve weeks, and again later in the first postnatal year.*
 - *Both the EPDS and the PHQ-9 have been used as screening tools in New Zealand studies. The EPDS has a larger, international evidence base, has been evaluated in Pacific women and may also have value in detecting anxiety disorders. However, a high score on the EPDS is not diagnostic, but suggests that a further assessment needs to be undertaken.*
 - *E-screening using the PHQ-9 may be feasible in primary care settings in NZ to support decision-making for further assessment and intervention. This has not been tested in a perinatal setting.*
 - *There are a range of general anxiety and pregnancy-specific anxiety screening tools, but more research is needed to determine the best approach.*
-

4.6 Are there effective interventions for screen detected mental health problems antenatally and postnatally, and do they improve child outcomes?

While approaches to the prevention and treatment of mental health conditions during the perinatal period do not differ greatly to interventions at other times in a woman's life, potential for harm to the fetus and the breastfed infant must be balanced against the potential harms associated with untreated illness. Mothers with depression are often younger, less well-educated, socially isolated and more burdened by substantial family conflict than mothers without depression. Mothers who report chronic depression are more likely to experience more adversity including intimate partner violence, poorer health, and to have co-morbid anxiety and substance abuse problems^{2,4,26,33,105-107}. Therefore, more complex interventions may be required to target different ages and treat multiple risks.

4.6.1 Barriers to treatment

Despite identification of PMH problems through screening, there is a low uptake of follow-up appointments and recommended interventions⁸⁰. Only half are likely to attend follow-up appointments^{80,108}. NZ data indicate that around 30% of those scoring >12 on the EPDS either do not want help or do not know how to access it⁹³. Poor access to resources, transport, and social support, as well as perceptions of stigma and cultural inadequacy of services suggest that those at highest risk for mental health problems may be least likely to access care¹⁰⁹.

Fathers in general have fewer opportunities or expectations to engage with healthcare services in the perinatal period. Further, many value self-reliance and believe that mental health problems are something they should 'just deal with'¹¹⁰.

4.6.2 Non-pharmacological Interventions

Non-pharmacological intervention should be considered first line for mild-to-moderate mental health problems, particularly in early pregnancy⁸⁴. There is good evidence that psychoeducation, support, sleep hygiene, physical activity and guided self-help approaches can have positive effects on symptoms of mild to moderate PND¹¹¹.

4.6.3 Psychological Interventions

For people who have not responded to the psychosocial interventions, or with more severe symptoms, there are several psychological interventions for treating depression, of which cognitive behavioural therapy (CBT) and interpersonal psychotherapy (IPT) appear to have the most robust evidence base¹¹¹ and produce the largest effects on symptoms of depression in the perinatal period¹¹². Both IPT or CBT are more effective than treatment as usual in reducing depression diagnosis, but long-term effects are more equivocal²². Behavioural activation, couples' therapy and mindfulness-based therapies are recognised alternatives, though there is perhaps less evidence of effectiveness at this stage¹¹¹.

IPT had no significant effect on parenting when women with AND were targeted¹¹³, but was associated with a higher likelihood of secure attachment and higher intelligence scores in one study of toddlers of women with PND¹¹³. There is some evidence that antenatal CBT improves child behaviour and self-regulation at 9 months when delivered antenatally¹¹³, but effects were not sustained into childhood in this study.

Home visiting programmes (HVP), have been successful in helping mothers develop sensitive, responsive parenting skills that facilitate infant development, particularly among low-income mothers, but are less successful with depressed mothers¹¹⁴. However, an adaptation of HVP, In Home CBT (IH-CBT) has shown promising outcomes. In an ethnically diverse sample of mothers and 5 month-old babies randomly assigned to HVP or IH-CBT, mothers receiving IH-CBT were less likely than mothers receiving HVP alone to meet diagnostic criteria for major depressive disorder at posttreatment (IH-CBT 29.3% vs home visiting 69.8%), reported fewer depressive symptoms 20.5% vs 52.6%, and obtained lower clinician ratings of depression severity.

A meta-analysis of programmes targeting fathers in the perinatal period found a lack of support and tailored treatment options for men. Of the limited options available, CBT, group work and blended delivery programmes, including e-support approaches were most effective in helping fathers with perinatal depression and anxiety¹⁷. There is no current data to indicate how many fathers with mental health problems in the perinatal period engage with treatment services in NZ.

4.6.4 Pharmacological interventions for depression and anxiety

Prescription of any psychiatric medication during pregnancy or breastfeeding should involve discussion of risks and benefits to the mother and baby and, ideally, consultation with maternal mental health services^{80,84,92}.

Antidepressants are a first-line treatment for adults with moderate-to-severe depression, including pregnant women^{92,111}. Though long-term effects have not been fully clarified in the literature¹¹⁵, most selective serotonin reuptake inhibitors (SSRI) and some tricyclic antidepressants are considered safe during pregnancy^{92,116,117} and breastfeeding^{92,118}. For women already taking antidepressants when they begin pregnancy, continuation of medication is recommended to prevent relapse of illness¹¹⁹, however there may be need to consider the appropriateness of specific medications¹¹⁸.

There is good evidence for the efficacy of antidepressants¹¹¹, however, there are few high-quality longitudinal studies comparing antidepressant use perinatally to alternative or no treatment for depression, and most published data focusses on the safety of medications rather than potential benefits of successful treatment^{80,120,121}. One meta-analysis reported an increased likelihood of behavioural difficulties in children of women who took antidepressants compared to women who were healthy during pregnancy, but not compared to women with untreated mental health problems¹¹⁷. However, they did not compare mothers' treatment outcomes with later child outcomes.

Moderate-to-severe anxiety disorders may also be managed with SSRIs in the perinatal period, based on evidence that they are effective for managing anxiety in general adult populations¹¹¹ and appear to be safe during pregnancy and breastfeeding^{80,92,116,117}. Very few studies of perinatal SSRI use include participants with anxiety, so little is known about their long-term effects on child development. Antidepressants in combination with CBT can produce better results than either approach alone for treatment of either depression or anxiety¹¹¹, and CBT is often introduced once antidepressant drug effects are established⁸⁰.

4.6.5 Other considerations

It is important to note that many women will decline, or chose to discontinue, medication in pregnancy regardless of healthcare providers' recommendations¹²², and international data suggest that few of these women will access non-pharmacological treatment as an alternative¹²³.

4.6 Summary

- *People who screen positive for mental health problems in the perinatal period may not attend further appointments for assessment or intervention.*
 - *Non-pharmacological and pharmacological treatments are effective in perinatal populations and some show promise for improving child outcomes, however, women often choose to stop taking prescribed medications during pregnancy and don't replace medications with non-pharmacological interventions.*
-

4.7 What do we know from a Māori and Pacific knowledge basis about screening (including consent process, reliability and construct validity), as well as cultural perspectives on assessment, diagnosis and treatment?

Māori, Pacific (and Asian) women have higher rates of mental health problems in the perinatal period^{4,5,93} and also experience the poorest maternal and fetal outcomes⁷. No data is available on the mental health of fathers and non-parental caregiving.

4.7.1 Screening

Ensuring psychometric and cultural validity of perinatal screening tools is also needed. It is recognised internationally that the EPDS has a highly variable sensitivity (34%–100%) and specificity (44%–100%) amongst different ethnic groups internationally¹²⁴. The psychometric properties of the EPDS have been validated in a Pacific population¹²⁵, but not in Māori. In addition, cultural validation has not been performed for any perinatal screening tools. Qualitative studies of other pen-and-paper questionnaires suggest that this may be culturally inappropriate, and a general conversation and relationship building are needed prior to disclosure of sensitive information¹²⁶.

4.7.2 Cultural perspectives on assessment, diagnosis and treatment

To date, there is no published research which informs our understanding of this area. There are epistemological, theoretical, and political aspects to the delivery of mental health care, which would be expected to be of seminal importance to the care of parents and infants.

Persistent stigma about mental illness reduces help-seeking in people who are experiencing distress. Negative experiences of health care professionals¹⁰⁵ and a reliance on seeking advice from friends and family rather than services¹²⁷ also contribute to lower rates of seeking advice from health professionals.

Incorporation of cultural beliefs and values into mental health practices has been actively pursued since the 1980's, as a biomedical model of diagnosis and interventions are not satisfactory for Māori, for

whom identity and relationships can be central to healing¹²⁸. Practices to address mental illness which are inclusive of families have been reported to be of significance to women of many ethnicities¹²⁹, but are central to care provision for Māori and Pacific, for whom family are central in providing support and advice¹³⁰.

International evidence shows that only one third of women find taking antidepressants during pregnancy an acceptable treatment option¹³¹. Lower rates of antidepressant use in Māori has been identified generally¹³², which suggests that undertreatment may be a significant issue when Māori women are seeking help. The Eleventh Perinatal and Maternal Mortality Review Committee report⁸ had a specific focus on Māori women. In this, the Māori Caucus made recommendations about the urgent need to improve awareness, responsiveness and introduce antenatal screening for risk.

As the perinatal period is a time of heightened cultural significance¹³³, the need for more research into delivery of PMH care is needed, particularly research employing kaupapa Māori methodologies.

4.7 Summary

- *Higher rates of PMH problems are seen in Māori, Pacific and Asian populations*
 - *Screening is recommended but evaluation of cultural validity is incomplete*
 - *Mild-to-moderate illnesses in particular may have culture-specific solutions*
 - *Access to health services and evidence-based interventions for serious illness is lower for Māori than for Non-Māori.*
-

4.8 Recommendations for further action

Policy and practice

- Universal screening is needed to identify depression and anxiety at the first antenatal visit, and repeatedly over the course of pregnancy and in the first year after birth.
- Prevention services are needed which improve maternal symptoms of depression, anxiety and distress antenatally, as intervening before birth appears to have greater positive effect on child outcomes.

Further research

- Research is needed to validate and determine the acceptability of measures of mental illness in Māori and Pacific that might include the EPDS and/or PHQ-9.
- More research is needed to determine the barriers to the uptake of PMH care, particularly in Māori, Pacific, and Asian populations.
- More longitudinal research into interventions specifically designed to treat depression and anxiety are needed, including interventions that are informed by Māori and Pacific cultures and parenting practices, and the unique needs of fathers in general.

4.9 Graded evaluations

Table 4.1. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
EPDS	C	Moderate	Moderate	Recommended for women and is in wide use internationally. There are concerns about using it in men and in different cultural groups.
PHQ-9	B	Moderate	Moderate	Recommended for both parents, both perinatally and outside of the perinatal period. It needs to be validated to determine the optimal cut-off score for Māori, Pacific, Asian people.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 4.2. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Education	B	Moderate	Moderate	This should be available to all parents at first antenatal visit and links to website(s) for further information.
Cognitive behavioural therapy (CBT)	A	Moderate	High	Dependent on diagnosis and severity of illness. This intervention should be available for every person who needs it.
Interpersonal psychotherapy (IPT)	A	Moderate	Moderate	Dependent on diagnosis and severity of illness. This intervention should be available for every person who needs it.
Antidepressants	A	High	High	Dependent on diagnosis and severity of illness. This intervention should be available for every person who needs it.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

References

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Appendix I – EPDS and PHQ-9

EPDS

In the past 7 days:	
1. I have been able to laugh and see the funny side of things	As much as I always could Not quite so much now Definitely not so much now Not at all
2. I have looked forward with enjoyment to things	As much as I ever did Rather less than I used to Definitely less than I used to Hardly at all
*3. I have blamed myself unnecessarily when things went wrong	Yes, most of the time Yes, some of the time Not very often No, never
4. I have been anxious or worried for no good reason	No, not at all Hardly ever Yes, sometimes Yes, very often
*5. I have felt scared or panicky for no very good reason	Yes, quite a lot Yes, sometimes No, not much No, not at all
*6. Things have been getting on top of me	Yes, most of the time I haven't been able to cope at all Yes, sometimes I haven't been coping as well as usual No, most of the time I have coped quite well No, I have been coping as well as ever
*7. I have been so unhappy that I have had difficulty sleeping	Yes, most of the time Yes, sometimes Not very often No, not at all
*8. I have felt sad or miserable	Yes, most of the time Yes, quite often Not very often No, not at all
*9. I have been so unhappy that I have been crying	Yes, most of the time Yes, quite often Only occasionally No, never
*10. The thought of harming myself has occurred to me	Yes, quite often Sometimes Hardly ever Never

Response categories are scored 0, 1, 2, and 3 according to increased severity of the symptom. Items marked with an asterisk () are reverse scored (i.e. 3, 2, 1, and 0). The total score is calculated by adding together the scores for each of the ten items.*

PHQ-9

Over the last 2 weeks, how often have you been bothered by any of the following problems?
 (Use "✓" to indicate your answer)

	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

FOR OFFICE CODING 0 + + +
 =Total Score:

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Developed by Dr Robert L. Spitzer, Dr Janet B.W. Williams, Dr Kurt Kroenke and colleagues.
https://www.phqscreeners.com/sites/g/files/g10016261/f/201412/PHQ-9_English.pdf

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E Tipu e Rea

5. Parental alcohol, cannabis, methamphetamine, and opioid use during pregnancy

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Suggested citation: Maessen SE, Wouldes T. Parental alcohol, cannabis, methamphetamine, and opioid use during pregnancy. In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019; p. 120-140.

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: The authors have no financial or non-financial conflicts of interest to declare that may be relevant to this work.

Summary

Universal screening for maternal and paternal substance use should be undertaken at the first antenatal contact and subsequent antenatal visits to identify parents who may benefit from early brief interventions or require a referral to more comprehensive treatment.

Abbreviations

4P's Plus	Parents, Partner, Past, Present pregnancy: a substance use risk screening tool
ATS	Amphetamine type stimulants
AUDIT-C	Alcohol Use Disorders Identification Test (Consumption questions)
CNS	Central nervous system
FAS	Fetal alcohol syndrome
FASD	Fetal alcohol spectrum disorder
IDEAL study	The Infant Development Environment and Lifestyle study
IV	Intravenous
Meth	Methamphetamines
MIP study	Methadone in Pregnancy study
NZ	New Zealand
OST	Opioid substitution treatment
PCAP	Parent-Child Assistance Program
PUP programme	Parents Under Pressure programme
SCOPE study	Screening for Pregnancy Endpoints study
SURP-P	Substance Use Risk Profile-Pregnancy: a substance use risk screening tool
T-ACE	Tolerance, Annoyed, Cut down, and Eye-opener: an alcohol risk screening tool
THC	Delta-9-tetrahydrocannabinol: the psychoactive component of cannabis
TWEAK	Tolerance, Worried, Eye-opener, Amnesia, K/Cut down: an alcohol risk screening tool
US	United States of America

5.1 Introduction

5.1.1 Disclaimer

This review was prepared within a short timeframe. While efforts were made to comprehensively search and include relevant literature, high-yield search strategies were prioritised that may have missed some relevant research. There was no time to seek further expert guidance or feedback. TW is a prolific researcher in this field and is thus an author on many of the publications referenced. SM independently carried out initial literature search to reduce bias in publication inclusion.

5.1.2 Background

The personal, community, and treatment costs of substance use in New Zealand (NZ) is estimated to be close to 7 billion dollars¹. However, the associated financial costs to children through prenatal exposure is unknown. This brief evidence review aims to focus on prenatal exposure to the more commonly abused drugs available in NZ including alcohol, cannabis or marijuana, amphetamine type stimulants (ATS), predominantly crystalline methamphetamine (street names, ice, pure, 'P'), and opioids which are predominantly converted over the counter drugs containing codeine or diverted pain relief prescription opioids such as morphine sulfate tablets (street name MISTI) or oxycodone and opioids used to treat opioid dependence, methadone and buprenorphine.

Consequences of maternal use of alcohol, cannabis, Meth and opioids

It is well recognized that the above drugs cross the placenta and impact fetal development, however, methodological limitations in much of the research hamper our understanding of developmental outcomes for the offspring. The conceptual framework that is used to study prenatal alcohol and drug use is neurobehavioral teratology. This framework addresses the effect of prenatal exposure to a teratogen in this case (common drugs of abuse) on a child's central nervous system (CNS) and behaviour. A teratogen is any agent that causes abnormalities when there is fetal exposure. Teratogens can have effects that range from mild to severe and may depend on the timing of exposure during the pregnancy, and duration and level of exposure or dose, as well as genetics, the health of the mother and the fetal environment. This means damage to the CNS during the prenatal period may continue to have effects throughout fetal, neonatal, infant and childhood development; and CNS injury may result in *behavioural impairments* rather than *physical birth defects*². Therefore, the major challenges to determining the effects of prenatal exposure to alcohol and other drugs is the careful consideration of these moderating factors, particularly the timing and extent of exposure during pregnancy, and determining the intervening factors in the child's environment that may explain the long-term consequences of prenatal exposure.

Important, also, is the added stressors often associated with *illegal substance use* which includes abuse of a range of legal and illegal drugs prenatally, and other maternal characteristics that can result in fetal harm, including high stress, lack of prenatal care, sexually transmitted infections and infections as a result of needle sharing through intravenous (IV) drug use, and high-risk behaviours such as drug seeking and drug trading activities that expose mothers to violence³⁻⁵. Once the child is born, influences that may hinder development include low maternal IQ and verbal abilities, maternal mental illness, a chaotic lifestyle which may include ongoing drug seeking and involvement with child protective services.

At present, our knowledge of the effects of prenatal alcohol use are more extensive than for cannabis, Meth or opioids. This is largely due to the legal status of alcohol and the more recent increased use of

cannabis, Meth and opioids by women in NZ and world-wide. Typically men have outnumbered women in substance use, however, the gap is narrowing, particularly for stimulants such as Meth⁶. Evidence from the World Health Organization World Mental Health Surveys found female substance use and attitudes about the appropriateness of substance use have changed in cultures where gender roles are more equal, suggesting if these substances were equally available to men and women there would be no gap^{7,8}.

Alcohol

Alcohol is a known teratogen and prenatal alcohol exposure may affect the developing fetus in a dose-dependent manner, with heavier consumption leading to marked cognitive, social and emotional impairment, growth restriction, and the characteristic facial features of fetal alcohol syndrome (FAS)⁹⁻¹¹. The research examining low-to-moderate consumption of alcohol during pregnancy and binge drinking (typically 5 drinks per occasion) is more equivocal¹²⁻¹⁵, with some studies finding the risk for miscarriage increased with number of drinks per week¹⁵, but others finding no association of mild-to-moderate exposure and miscarriage, stillbirth, impaired fetal growth, low birth weight, preterm birth or malformations commonly seen in high levels of alcohol exposure¹⁴. Evidence for moderate exposure to alcohol and binge drinking, but not low exposure has been associated with poorer neurodevelopment^{12,13}. However, a recent study in NZ found low levels of exposure associated with infant and toddler temperament and behaviour¹⁶.

The primary limitation of the alcohol literature and evidence from systematic reviews is the inconsistencies of the methodologies employed in the studies included in the reviews, the wide age range of the children under study and the diverse measures of child health and developmental outcomes employed. For instance, some studies measured alcohol exposure in the first trimester, while others considered exposure as any alcohol use across the duration of pregnancy¹³. Therefore, findings that report no effects should be interpreted with caution¹².

Cannabis

In recent years, cannabis use has become more pervasive among pregnant and breastfeeding women. This is due to increasing social acceptability, perceptions that it is safe, and reports that cannabis reduces nausea in pregnancy and depression in the postnatal period^{17,18}. Although, cannabis use in pregnancy has been associated with still birth, fetal growth restriction, and neurodevelopmental consequences¹⁹⁻²¹, much of this evidence suffers from the same methodological limitations of the alcohol research²². For instance, one meta-analysis found no detectable effects after controlling for tobacco and other environmental factors²³. There are some well-designed longitudinal studies that found a range of long-term cognitive and neurobehavioural consequences associated with maternal use²⁴. However, since the prenatal data in these studies was collected, the quantity of delta-9-tetrahydrocannabinol (THC), the psychoactive ingredient in cannabis, has increased and cannabis is being consumed more frequently in a variety of ways that may increase the level and frequency of exposure to the fetus. Different modes of cannabis consumption are smoking, vaporizing, dabbing (which consists of using small quantities of highly potent concentrates made from hash oil and vaporized), oral consumption such as candies and snacks, and infused through skin products and suppositories²¹.

Methamphetamine ('P')

The problem of Meth in NZ is relatively new compared to alcohol and cannabis. Evidence from animal, cross sectional and neuroimaging studies have shown that Meth exposure may put the developing fetus

and developing child at risk for restricted fetal growth and increased incidence of birth anomalies, and neurodevelopmental problems. However, much of the early evidence comes from retrospective studies relying on hospital records, included only small numbers of cases, and lacked adjustment for other environmental factors²⁵. More recent evidence from the United States (US) and NZ Infant Development Environment and Lifestyle (IDEAL) Studies, the only prospective, longitudinal studies world-wide, provide the best current evidence for the effects of methamphetamine exposure to child development. The IDEAL Studies were designed to look at maternal methamphetamine use in the context of other factors that have been shown to affect child development, such as multiple drug use, domestic violence, socioeconomic status, maternal mental illness, education and ongoing drug use. These studies have followed US and NZ infants exposed to Meth *in utero* from birth through to childhood and found atypical reflexes and behaviour at birth²⁶, delayed motor development over the first 3 years of age²⁷, an increase in externalising and internalising problems, poorer cognitive outcomes and structural brain changes at 6-7 years^{28,29}. Yet, little is known about child outcomes beyond age 7 years⁶.

Prenatal opioid exposure

Although opioid use and treatment for opioid dependence during pregnancy dates back to the 1970s, there has been a significant lack of recent evidence investigating the effects of the abuse of prescription opioids or the effects of prescribed opioids (methadone and buprenorphine) for the treatment of dependence³⁰. In NZ the Methadone in Pregnancy (MIP) study, a prospective, longitudinal investigation of methadone maintenance treatment in the context of other environmental factors provides the best evidence for NZ children exposed to opioids and opioid treatment. When illicit opioids as well as the prescribed treatments for opioid dependence (methadone and buprenorphine) are used during pregnancy, neonates are at increased risk for atypical reflexes, disturbed regulatory behaviour, signs and symptoms of withdrawal (Wouldes & Woodward, under review), and altered brain development, which according to some reports may lead to ongoing cognitive and behavioural difficulties in childhood^{6,24}.

Of particular concern are women with alcohol or substance dependence, who are likely to continue to use substances throughout pregnancy, to use multiple substances, and to have a range of concomitant social problems that increase risks to their child's safety^{4,5,25,31,32}. Evidence suggests that women who use methamphetamine may be more vulnerable to destructive patterns of drug use transitioning to regular use and dependence more quickly than men, and that ovarian hormones may influence stimulant (cocaine and Meth) drug seeking behaviour and relapse^{6,33}. Illicit drug use, in particular of class A drugs such as Meth or opioids, is associated with a greater likelihood of domestic discord or abuse, poor mental health, unemployment, homelessness, poverty, and a history of criminal behaviour^{4,5,32,34}.

Consequences of paternal use of alcohol, cannabis, Meth and opioids

The consequences of paternal alcohol and drug use has largely been studied from the perspective of intergenerational addiction. Evidence is clear from twin, family and adoption studies that there is a major genetic component in alcohol, stimulant and opioid abuse with heritability estimates ranging from 39% to 72%. However, emerging evidence from animal and human studies suggest the father's substance use has a part to play in fetal and child health and development^{35,36}. Evidence for paternal effects in human studies come largely from studies in alcohol-exposed pregnancies. A systematic review found evidence that paternal alcohol consumption during conception or during pregnancy has an impact on maternal health and alcohol consumption during pregnancy, fetal outcomes, and infant health³⁶. The effects of paternal alcohol consumption occurred directly through lower sperm quality and spontaneous miscarriage, and through the impact of paternal alcohol consumption on facilitation of maternal

drinking and the quality of relationship. Paternal drinking is also likely to impact child development through modelling of drinking and drug use in the home later in development.

5.1 Summary

- *The effects of alcohol and other use in pregnancy are not well understood due to the methodological limitations of many of the studies for detecting the quantity, timing and frequency of drug use and factors in the fetal and postnatal environment that could worsen or protect the developing child.*
- *Pregnant women with substance use disorders or who use illegal drugs, particularly Meth or opioids, are likely to have significant social, health and psychiatric problems that may affect their child's development.*
- *Fathers' preconceptual drinking can have direct effects on pregnancy outcomes and increase the risk of their partner's use of alcohol during pregnancy.*

5.1.3 Aims of review

This brief evidence review aims to address six questions posed by the Ministry of Health as part of a review of the Well Child Tamariki Ora programme. These questions cover prevalence, screening, and intervention for parental use of alcohol and other drugs, as well as what is known from a Māori and Pacific knowledge base.

5.2 Methods for review

Systematic searches were conducted between 12 July 2019 and 26 July 2019 using PubMed, Ovid Medline, the Cochrane Library, Embase, and PsycINFO (EBSCO). Our search was also broadened to include grey literature reports, as well as searches using the Informit database, the New Zealand Ministry of Health and Statistics New Zealand websites, and Google. All searches were limited to English language publications, human subjects, and publication after 1 Jan 2000.

Searches varied slightly depending on the database, but all included the search terms 'pregnancy', 'pregnant', 'prenatal', 'antenatal', 'perinatal', 'fetal', 'foetal', 'fetus', 'foetus' AND 'substance-related disorders', 'alcohol', 'alcoholic beverages', 'ethanol', 'methamphetamine', 'cannabis', 'marijuana', 'opiate', 'opiod-related disorders'. All searches were initially conducted including 'New Zealand' as a search term, but with the exception of prevalence data, this limit was removed due to the low number of relevant results.

5.3 What is the prevalence of alcohol and other drug use in New Zealand during pregnancy and childhood?

The prevalence of alcohol and drug use during pregnancy in NZ and world-wide is difficult to estimate. Women who use alcohol and illegal drugs often do not report this behaviour due to the perceived stigma and/or fear of involvement by child protection services³⁷. The few NZ studies that have reported the prevalence of alcohol use were based on self-report, which is widely believed to underestimate actual use³⁸⁻⁴⁰. Cannabis users are more likely to report use than users of other illicit drugs^{41,42}, with occasional users of any drug more likely to report use than frequent users⁴¹. Therefore, prevalence statistics in this section should be considered conservative estimates.

Alcohol

More than a quarter and up to half of pregnant NZ women report alcohol consumption at some point during their pregnancy⁴³⁻⁵⁰. Though many women either reduce or cease alcohol consumption on recognition of pregnancy^{48,50-52}, around a quarter drink at levels likely to be harmful to the developing embryo before this point^{11,48,49}. It is estimated that 22-28% of NZ women continue to consume alcohol after recognising that they are pregnant^{44,47,51}, and 12-13% consume alcohol from the second trimester onwards^{48,49,51}. While some data indicate that few women drink more than one alcoholic drink per week in later pregnancy⁵¹, other research indicates that high risk drinking might be more common in Māori or Pacific mothers, those who concurrently smoke or take other drugs⁵, and those who were daily drinkers before becoming pregnant⁴⁴.

Cannabis

Cannabis is the most widely used illegal drug in NZ^{1,53}. Our search identified only one published report of the prevalence of cannabis use during pregnancy in NZ, in which 4.5% of participants self-reported they were cannabis users⁵⁰. Approximately half of these women stopped using cannabis prior to becoming pregnant, and a third of those who were still using cannabis quit in the first 15 weeks of pregnancy. As a result, at 20 weeks gestation only 0.5% of all women were still using cannabis⁵⁰. However, frequency and amount of cannabis use was not reported.

Methamphetamine

An increase in Meth use by NZ women during pregnancy was first identified through referrals to the Alcohol Drug and Pregnancy Team at National Women's Hospital, where Meth-related referrals increased from 10% of total referrals in 2001 to 59% in 2003⁵⁴. Since then, the best estimates of prevalence of maternal use of Meth come from ever-increasing reports by police, social workers, teachers and health practitioners, who are faced with treating the behavioural, social, and health problems of children exposed prenatally to Meth and living in environments where there is continued use. Although the SCOPE study reported that less than 0.6% of total participants had taken drugs (including Meth) in the three months prior to pregnancy or during pregnancy, it only included women who attended antenatal appointments prior to 15 weeks gestation⁵⁰. On average, women who use Meth and other illegal drugs in NZ access antenatal care later in pregnancy than non-users²⁶.

No studies in NZ have reported the prevalence of opioid use by pregnant women or by women of child bearing age. However, it is estimated that approximately 9,980 people are opioid dependent in NZ with approximately half that number (5,500) receiving opioid substitution treatment (OST)⁵⁵. The recommended OST treatment for women during pregnancy is daily doses of methadone and more recently buprenorphine. Women who are pregnant are given priority to OST, however, despite being enrolled in treatment services, two NZ studies have shown that women continue to use other opioids, cannabis, benzodiazepines and stimulants during pregnancy^{3,4}.

5.3 Summary

- **Many pregnancies are affected by drug and alcohol use in NZ, but exact numbers are not known.**
-

5.4 What suitable test(s) are available to screen for alcohol and other drug use among pregnant people and caregivers?

5.4.1 Self-report screening tools

No screening tools to detect substance use during pregnancy have been validated in NZ. However, several screening questionnaires have been designed or adapted to identify high-risk alcohol use in pregnant populations. The AUDIT -C has been recommended by the NZ Ministry of Health and World Health Organisation, with a score of 0-3 indicating low risk drinking and a score 4 or higher indicating moderate-high risk of requiring referral to specialist services⁵⁶. In one study the AUDIT-C was demonstrated to have the lowest sensitivity for identifying pregnant women who had recently consumed alcohol when using a cut-off score ≥ 3 , despite being the only screener analysed that directly asks about frequency and volume of alcohol consumption⁵⁷. This is consistent with a study of low income women in the US, where an indirect screen correlated more strongly with biological screens for illicit drug use than direct self-report⁴². The T-ACE and TWEAK both screen for risk of alcohol use. Each comprises four and five questions respectively, with a score of two or more on either typically used to identify people likely to be at-risk drinkers (Appendix I). A comparison of these two screeners, using a cut-off of ≥ 3 for the TWEAK and ≥ 2 for the T-ACE, suggested they are equally sensitive for identifying problem drinkers but the TWEAK has a lower false-positive rate⁵⁸. These are generally completed by the patient on paper or electronically, meaning that no training and few resources are required. Other screening tools, such as the 4P's Plus and SURP-P screen for drug use as well as alcohol, and have been evaluated in pregnant populations⁵⁹. The 5P's, an adaptation of the 4P's, additionally screens for intimate partner violence and emotional health and is in wide use in the US (Appendix I).

5.4.2 Biological markers of maternal substance use

The evidence is equivocal for biological markers of drug and alcohol use, and they have generally been shown to have low sensitivity for identifying use during pregnancy⁶⁰⁻⁶². Maternal tests using blood and urine can be used to detect only recent substance use⁶⁰⁻⁶², while new born meconium and hair can only identify use in the last trimester of pregnancy, with some evidence suggesting low sensitivity for detecting alcohol, cannabis and methamphetamine use even when self-report indicates heavy use throughout pregnancy^{11,25,62-64}. Because of the difficulty of validating biological screens when self-report is unreliable, it is unknown whether false positives are a significant concern for many of these methods. Despite evidence that biological markers may be useful in combination with self-report for detecting fetal exposure^{25,65}, until further research establishes their reliability in practice there are ethical and monetary constraints to using these at a population level⁶⁶.

5.4 Summary

- *Standardised tools are better than self-report for substance use screening, but have not been validated in NZ populations.*
 - *Biological markers of maternal substance use are not currently recommended for detecting fetal exposure to substances due to low reported sensitivity and ethical challenges.*
 - *Some evidence suggests on-line questionnaires could provide an acceptable option for collecting alcohol and substance use in parents.*
-

5.5 What interventions or additional support for alcohol and other drug use are effective following detection of risk?

Due to the relationships between drug use, unintended pregnancy, and late recognition of pregnancy^{26,44,67,68}, increased access, education and encouragement to use effective contraception alongside advice about substance use is effective in reducing the likelihood of substance-exposed pregnancies in at-risk groups^{69,70}. This approach includes improving engagement with family planning services for women who have already had one or more substance-exposed pregnancy, and has been incorporated into more comprehensive interventions discussed below.

Brief interventions and motivational interviewing are popular approaches for addressing mild-to-moderate substance use problems. However, while effectiveness has been established for brief interventions in middle-aged men, there is little research involving pregnant women. Existing studies are mostly of poor quality, with conflicting results about whether either technique is effective in reducing substance use by pregnant women⁷¹⁻⁷⁵. These trials may be confounded by the effect that assessment can have in reducing substance consumption, particularly as the majority of parents who use substances casually are motivated to reduce the risk of harm to their child⁷⁶. Conversely, those with substance use disorders likely need additional support to improve their offspring's outcomes. Similarly, motivational interviewing can lead to reductions in substance use, but effects in pregnancy are not as clear from existing data⁷⁷. However, computer-based screening and brief interventions based on motivational interviewing principles have been associated with improved birth outcomes, and reduced alcohol and cannabis consumption in pilot studies^{42,78}.

Electronic screening has the potential to address some of the challenges of screening face-to-face or on paper. It can save time if administered before an appointment, is more acceptable to women who may be reluctant to report substance use, and can include audio and visual components to overcome literacy difficulties^{42,79}. Further, it can incorporate personalised computer-based interventions, which reduce training needs and time commitment for health professionals and have the potential to reduce barriers to screening and intervention for communities where trained substance abuse specialists are not easily available. However, further development and research into cultural acceptability of such interventions in NZ is lacking at present.

Home visiting programs can incorporate a range of services and vary considerably in duration, content, and reported outcomes. These are multi-faceted interventions that aim to improve the home environment to encourage healthy child development, rather than simply addressing substance use issues. A meta-analysis suggested that many fail to reduce maternal substance use, though none of the included studies had any significant antenatal intervention⁸⁰. However, among women with drug or alcohol problems, common outcomes of home visiting programmes included reductions in child injury (including non-accidental injury) and increased use of contraception⁸⁰. The Family Spirit intervention in a high-risk group of Native Americans included seven antenatal visits and successfully reduced illicit drug use among parents, but had no effect on alcohol consumption⁸¹.

The Parent-Child Assistance Program (PCAP) targets women in the postpartum period with significant intergenerational substance abuse and family dysfunction. Using paraprofessionals and an intensive case management model that extends over a 3 year period, mothers enrolled in the program had fewer drug-exposed babies, 92% had completed alcohol/drug treatment, 76% were abstinent from alcohol and drugs for 6 months or more during the program, 68% were using family planning, 57% had attended classes to extend their education and 80% of children were living with their own family⁸²⁻⁸⁵.

5.5 Summary

- *Improved access to long-acting contraceptives in high-risk groups may reduce the risk of substance-exposed pregnancies.*
 - *Brief interventions are effective for reducing substance use in some populations but evidence in pregnant women is more equivocal.*
 - *Home visiting programs can mitigate some of the effects of parental substance use on child development and safety, particularly for high-risk populations where there is a history of ongoing substance use in multiple pregnancies.*
-

5.6 Does early intervention lead to significant improvements later in childhood/ adolescence?

In general, intervention in early childhood has the potential to set lifelong trajectories toward better outcomes, with earlier intervention likely to offer greater economic benefits⁸⁶. In the field of substance use during pregnancy, longitudinal studies are rare. Thus, little is known about the long-term effects of interventions designed to reduce substance use.

The Early Start program delivered home visits for up to five years to Christchurch families facing stress and difficulty. Visit frequency was weekly to monthly depending on the family's needs. Substance use was one of several indicators of stress specified by researchers. At 36 months of age, children in the Early Start group had increased engagement with healthcare, including dentists and well child visits, fewer hospital visits for injury and poisoning, and parents reported favouring a more positive parenting style over a punitive style⁸⁷. At a 9-year follow-up, parents in Early Start reported less child problem behaviour and physical abuse. Outcomes were similar between Māori compared to non-Māori families, though there was a trend for program effects to be stronger for both Māori and families facing multiple disadvantage^{87,88}. There were no apparent benefits to maternal well-being or family relationships⁸⁸.

Similarly, a comprehensive home visit intervention in the US reported few effects on family or maternal outcomes, but positive effects for child safety and development. Among other findings, children from the home visit group were less likely to have used alcohol, tobacco, or cannabis at age 12, and had fewer internalising disorders compared to children whose families did not receive home visits⁸⁹⁻⁹¹. The Family Spirit intervention included mothers with multiple levels of disadvantage, and is one of few to report improvements in maternal mental health and drug use alongside positive effects on child psychological and behavioural outcomes⁸¹. Overall, home visits are resource intensive and are likely to be most effective when reserved for the most vulnerable families.

Parents Under Pressure (PUP), a programme developed in Australia aimed at supporting parenting and parenting-interactions has been shown to reduce child abuse potential, rigid parenting attitudes and child behaviour problems in substance using parents in Australia and the UK, and in an adapted version useful for parents of children with FASD⁹².

5.6 Summary

- *There are few intervention studies for parental substance use with long-term follow up.*
 - *Intensive early interventions have shown potential for improving some child outcomes through to age 12.*
-

5.7 Are there any known harms from screening for alcohol and other drug use?

The only harm from screening for alcohol and other drug use suggested in the literature is potential anxiety or guilt for parents following discovery of the harmful effects on their child's health⁹³. Use of poorly validated biological screens could result in legal consequences for parents if misused.

5.8 What do we know from a Māori and Pacific knowledge basis about screening in this domain?

Similar to research in non-pregnant women, the prevalence of any alcohol consumption during pregnancy is similar between Māori and non-Māori, and low among Pacific women, but the likelihood of heavy or high risk drinking is higher for Māori women^{44,52}. Little is known about the use of illegal substances during pregnancy among Māori or Pacific women, but results from the NZ Infant Development, Environment And Lifestyle (IDEAL) Study show that Māori women are more likely to use Meth intravenously, which predicts poorer neurobehavioural outcomes for infants at 24 months of age⁹⁴. Māori boys are more at risk for motor and cognitive delay over the first 3 years of age²⁷, and Māori boys and girls exposed to methamphetamine in combination with alcohol do more poorly on measures of general and verbal IQ at 4.5 years of age (unpublished data, from NZ IDEAL Study).

Meth and cannabis use are both higher in Māori populations than other New Zealanders^{53,95}, and Māori women make up more than half of women accessing pregnancy and parenting services at the Waitemata District Health Board Community Alcohol and Drug Service⁹⁶. Some evidence suggests that Māori may be less likely to seek help for substance use problems due to normalisation of use within whānau⁹⁷, but it is not clear from existing research whether this includes use during pregnancy.

It is therefore important that all research and interventions be guided by Māori in accordance with Te Tiriti o Waitangi. He Awa Whiria (Braided Rivers Model) acknowledges both Western Science and Kaupapa Māori as being important when developing programmes and interventions⁹⁸. According to this model both Western Science and Kaupapa Māori methodologies have a bidirectional role and both are able to inform programmes developed in each domain.

5.8 Summary

- *Māori women who drink alcohol during pregnancy are at risk for harmful use.*
 - *Children of Māori women may be at particular risk for adverse effects of prenatal substance exposure.*
 - *Programmes for reducing substance use should be guided by Kaupapa Māori alongside Western Science methodologies in accordance with Te Tiriti o Waitangi.*
-

5.9 Conclusion

Despite the methodological limitations of the available literature, it is clear that maternal drug use during pregnancy can have serious consequences for the fetus, the infant and the developing child. However, it is also important to recognize that paternal preconception use of alcohol and other substances and the home environment may have a part to play in pregnancy and child health outcomes³⁶. Therefore, decisions about alcohol and other drug use during preconception and pregnancy are not the sole responsibility of women but occur within the context of the home and the broader social environment, and require more complex policy to assist in reducing alcohol and other drug-exposed pregnancies and increasing the potential for fetal health and infant and child outcomes.

Lacking is prevalence data for drug use during pregnancy and published outcomes of prevention or intervention studies completed in NZ. It is also unclear whether screeners are regularly used in practice to identify maternal alcohol and substance use. These research gaps are not unique to NZ, but those on the front line (educators, health care professionals, social workers, the police) increasingly report poor outcomes for children born to and/or living with parents who are substance dependent. Thus, it is time for research and policy to address these gaps.

5.10 Recommendations for further action

Policy and practice

- Introduce universal maternal and paternal screening for substance use and related problems (domestic violence, mental illness) at the first antenatal visit and continue to screen at subsequent visits and postnatally. This should be followed by a brief intervention for women screened to be at risk.
- Referral to secondary services should be considered for pregnant women screened to be at high risk for substance use.

Further research

- Determine whether interventions and/or health services that treat both psychiatric and substance use disorders together result in better outcomes for women and their children.
- Determine the proportion of women in NZ who are able to access substance use treatment, particularly treatment that is acceptable to Māori and Pacific women, and availability of services in rural areas.
- Determine whether universal screening can discriminate between high-risk and low-to-moderate risk use of alcohol and drugs and;
 - whether brief interventions can be effective in those women who report low-to-moderate alcohol and/or drug use; and
 - whether referrals to treatment after women are identified as high-risk actually seek treatment.
- Develop and/or support well-designed, prospective longitudinal studies that can inform interventions for children exposed prenatally to alcohol and drugs.

5.11 Graded evaluations and recommendations

Table 5.1. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
TWEAK	B	Moderate	Moderate	TWEAK or T-ACE are the best screeners for screening for alcohol, however they do not screen for other drug use. A score of ≥ 2 is positive for problem alcohol use.
T-ACE	B	Moderate	Moderate	As above
4Ps	B	Moderate	Moderate	All parents should be screened for alcohol and drug use. 4Ps has been validated.
5Ps	B	Moderate	Moderate	Reworded adaptation of 4Ps not validated, but 5Ps used widely in clinical practice in a number of US states (Appendix I). Recommend all parents be screened for alcohol, drugs, well-being and interpersonal or domestic violence.
E-screening	B	Moderate	Moderate	Recommended all parents be provided this option using 5Ps
Biological Screeners	I	Low	Low	Only in cases where drug use is suspected and a caregiver is unavailable or unable to self-report drug use.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 5.2. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Education	B	Moderate	Moderate	All parents should receive information about the effects of alcohol and drug use, parental mental illness and violence in the home at their first antenatal visit or through websites that provide latest evidence for the effects on their child.
Computer-based screening and motivational interviewing	B	Moderate	Moderate	Recommended for parents at low to moderate risk
Early Start Home Visiting	B	Moderate	Moderate	Recommended for high risk parents who report ongoing drug use during pregnancy or history of previous drug use pregnancies and multiple risks such as parental mental illness
Comprehensive Home Visiting such as Family Spirit Intervention	B	Moderate	Moderate	As above
Parents Under Pressure	B	Moderate	Moderate	As above
Parent-Child Assistance Programme	C	Moderate	Moderate	Recommended for high risk parents with intergenerational substance use disorders

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

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Appendix I – T-ACE, TWEAK, 4P’s and 5P’s

T-ACE Screener Questions and Scoring

T-ACE	QUESTIONS	POINTS
Tolerance	How many drinks does it take to feel the first effect? _____	3 or more = 2 points
Annoyed	Have people ever annoyed you by criticizing you about your drinking?	Yes = 1 point
Cut down	Do you sometimes feel the need to cut-down on your drinking?	Yes=1 point
Eye-opener	Do you sometimes take a drink in the morning when you first get up?	Yes = 1 point

TWEAK Screener Questions and Scoring

TWEAK	QUESTIONS	POINTS
Tolerance	How many drinks does it take to make you feel high? _____	3 or more = 2 points
Worry	Have close friends or relatives worried or complained about your drinking in the past?	Yes = 2 points
Eye-opener	Do you sometimes take a drink in the morning when you first get up?	Yes = 1 point
Amnesia	Are there times when you drink and afterwards can’t remember what you said or did?	Yes = 1 point
Kut-down	Do you sometimes feel the need to cut down on your drinking?	Yes = 1 point

TWEAK and T-ACE: Summary of sensitivity, specificity and postive predictive value (PPV)

	TWEAK			T-ACE		
	PPV	Sensitivity	Specificity	PPV	Sensitivity	Specificity
2 or more	0.54	100	36	0.48	100	19
3 or more	0.54	99	43	0.51	93	34

Score of ≥ 2 recommended cut-off for screening positive for risk drinking on either 4Ps Questionnaire

4Ps Questionnaire

DOMAIN	QUESTION	
Parents	Did any of your parents have problems with alcohol or other drug use?	Yes/No
Partner	Does your partner have a problem with alcohol or drug use?	Yes/No
Past	In the past, have you had difficulties in your life because of alcohol or other drugs?	Yes/No
Present	In the past month, have you drunk any alcohol or used other drugs?	Yes/No

Any “yes” should result in follow-up questions about educational material or referral

5Ps Questionnaire Adapted from 4Ps to include emotional well-being and interpersonal violence

DOMAIN	QUESTION	
Smoking	Have you smoked any cigarettes in the past 3 months?	Yes/No
Parents	Did any of your parents have a problem with alcohol or other drug use?	Yes/No
Peers	Do any of your friends have a problem with alcohol or other drug use?	Yes/No
Partner	Does your partner have a problem with alcohol or other drug use?	Yes/No
Past	In the past, have you had difficulties in your life due to alcohol or other drugs, including Prescription medications?	Yes/No
Present	In the past month, have you drunk any alcohol or used other drugs? 1. How many days per month do you drink? ____ 2. How many drinks on any given day? ____ 3. How often did you have 4 or more drinks per day in the last month? ____	Yes/No
Well-Being	Over the last few weeks, has worry, anxiety, depression, or sadness made it difficult for you to do your work, get along with people, or take care of things at home?	Yes/No
Violence	Are you currently or have you ever been in a relationship where you were threatened, controlled, physically hurt, or made to feel afraid?	Yes/No

Adapted from 4Ps and used in a number of states in the US no charge for its use.

<http://www.centerforchildwelfare.org/kb/subabuse/PregWomenW-SubAbuse2010.pdf#page=29>

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START

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6. Excessive weight gain and poor growth

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: L Daniels has no conflicts of interest to declare. BJ Taylor and WS Cutfield are well known researchers in the area of child growth, so L Daniels conducted the initial literature search for this report to reduce any bias on the inclusion of their published work.

Abbreviations

B4SC	B4 School Check
BMI	Body mass index
ISS	Idiopathic short stature
NZ	New Zealand
SDS	Standard deviation score (identical to z-score)
WCTO	Well Child / Tamariki Ora
WHO	World Health Organisation
WHtR	Waist-to-height ratio

Definitions

Early childhood – young children between 0 and 5 years of age

Growth – for the purpose of this report “growth” includes measures of weight and linear growth

Major centile line – the space between major percentile lines (such as between the 25th and 50th percentiles) that represents a change of two thirds of a standard deviation (or 0.67 of a SDS)

Obesity – refers to children who are classified as obese only

Overweight – refers to children who are classified as overweight only

Overweight and obesity – refers to children who are classified as overweight and/or obese

Summary

The aim of this review was to summarise the current evidence regarding the prevalence, long-term adverse outcomes and effective interventions for poor (underweight and short stature) and excessive (overweight and obesity) growth in early childhood (0-5 years), as well as summarizing the assessment tools and harms of growth screening in this age group.

Current evidence suggests that while the prevalence of obesity in New Zealand pre-school children appears to be declining slightly, there remains a large proportion of children who are considered obese. This is a concern due to the growing evidence for increased health risks into adulthood from childhood obesity. Recent concerns are also expressed regarding rapid weight gain trajectories, which are reported to also be associated with negative health outcomes later in life. The prevalence of underweight is much lower than for overweight and obesity in New Zealand children, and appears to have remained stable over time. It is unlikely that the prevalence of short stature has recently changed, but the number of children treated with growth hormone suggests recognition and treatment of children with short stature, if anything, is improving.

There is a need for improved recognition of excessive weight gain throughout the Well Child / Tamariki Ora (WCTO) setting to enable early detection and prevention of the development of an unhealthy weight. The key recommendations from this review which are based on current evidence are: 1) the use of BMI alongside weight and length/height growth charts for *all* children (birth to 5 years), for the identification of abnormal growth and the prevention of obesity, 2) develop, and require all WCTO providers to use a standardized protocol for clothing worn during weight measurements in the cooler months, and 3) provide appropriate interventions following a positive growth screen for *all* children, to prevent any long-term adverse outcomes.

Aim

The aim of this review is to summarise the current evidence for growth / obesity screening and surveillance in early childhood (birth to 5 years).

Review approach

A literature search was performed in the following databases: Cochrane, Medline (Ovid), PubMed and Google Scholar, with a focus on articles published between 2006 and September 2019. The search was conducted using various combinations of the terms: *young children, infant, child, Pacific, Māori, growth, weight, body mass index, overweight, obesity, adiposity rebound, underweight, failure to thrive, faltering, abnormal, rapid gain, linear, short stature, trajectories, screening, monitoring, surveillance, harm, view, belief, practice, intervention, prevention, treatment, management*, using Boolean operators: AND and OR. Key references from identified articles were also included, where appropriate. Literature was prioritised by *type*: 1) Meta-analyses, 2) Systematic reviews, and 3) Other key papers with methodological rigour; *country*: 1) New Zealand, 2) Australia, Canada, United Kingdom, United States, Europe, and the OECD; and *age range*: 1) Birth to 5 years, 2) >5 years. The search was limited to studies published in English.

6.1 Early childhood prevalence (ages 0-5 years)

6.1.1 Overweight and obesity

From the New Zealand (NZ) Health Survey, the prevalence of those overweight and/or obese has not changed in children aged 2-14 years over time between 2011/12 and 2018/19 (Table 6.1).

Table 6.1. Unadjusted prevalence of overweight and obesity in New Zealand children over time

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Overweight (%)^a								
2-4 years	21.4	23.6	21.4	20.0	21.6	21.4	20.3	21.3
All: 2-14 years	21.1	21.7	23.2	21.7	21.2	21.2	19.8	19.8
Obese (%)^b								
2-4 years	10.0	10.4	7.8	9.5	6.6	9.6	10.0	7.8
All: 2-14 years	10.7	10.5	9.9	10.8	10.2	11.3	11.5	11.3

Source: New Zealand Health Survey data¹.

^a Overweight was classified as the equivalent of an adult BMI of between 25 and 29.9 kg/m² using IOTF standards².

^b Obesity was classified as the equivalent of an adult BMI of ≥30 kg/m² using IOTF standards².

From a larger national dataset (collected as part of the NZ B4 School Check (B4SC) programme), the prevalence of both overweight and obesity in 4-year-olds between 2010 and 2016 shows a downward trend (by 2.2% and 2%, respectively) after making adjustments for sex, ethnicity, deprivation and area (Table 6.2)³. Worldwide rates of childhood obesity have also reported to have plateaued in high-income countries⁴. The obesity prevalence of very young children (<2 years) is unknown, because classification using BMI is not currently recommended for this age group.

Table 6.2. Prevalence of overweight and obese 4-year-old New Zealand children over time

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Overweight or obese (%)^a	35.0	34.3	33.5	33.3	33.6	32.8*
Obese (%)^b	16.9	16.1	15.6	15.3	15.5	14.9**

Source: Shackleton et al. (2018)³.

^a Overweight or obese was classified as BMI-for-age ≥85th percentile (includes obese and extremely obese), using WHO standards.

^b Obesity was classified as BMI-for-age ≥95th percentile, using WHO standards.

* Significant decreased trend between 2010/11 and 2015/16: RR = 0.989; 95% CI = 0.988-0.990 per year.

** Significant decreased trend between 2010/11 and 2015/16: RR = 0.979; 95% CI = 0.977-0.980 per year.

Overall, the prevalence of obesity was highest for Pasifika and Māori children reported in the NZ Health Survey from 2018/19 and the B4SC during the 2015-2016 fiscal year (Table 6.3).

Table 6.3. Prevalence of obesity in New Zealand children, by ethnicity

Obesity (%)	European	Pacific	Māori	Asian
2-14 years^a	8.2	28.4	15.5	9.9
4 years^b	12.7	30.2	20.0	8.1

^a New Zealand Health Survey data; obesity was classified as the equivalent of an adult BMI of ≥30 kg/m² using IOTF standards².

^b Shackleton et al. (2018)³; obesity was classified as BMI-for-age ≥95th percentile, using WHO standards.

Differences in obesity prevalence between Māori and New Zealand European and other (NZEO), and Pacific and NZEO has been reported to be significantly influenced by the socio-economic position of the family and area of deprivation level⁵.

Rapid weight gain is common in NZ preschool children. In the Prevention of Overweight in Infancy (POI) study, 351 (54%) of 678 children were considered to have abnormally rapid BMI increase between 6 and 24 months of age and of these, 148 (23%) were considered to be extremely rapid⁶. Rapid increase and extreme rapid increase in BMI was assessed and defined as a change in BMI Standard Deviation Score (SDS) greater than 2/3 and 4/3, respectively⁶. Forty percent of the children had a BMI \geq 85th percentile at 2 years of age⁶.

6.1.2 Underweight

From the NZ Health Survey, the prevalence of underweight (thin) children aged between 2-14 years has remained stable between 2011/12 and 2018/19 (Table 6.4).

Table 6.4. Unadjusted prevalence of underweight over time in New Zealand children

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
2-4 years (%)	3.7	7.2	7.0	5.2	4.6	5.0	6.4	6.6
All: 2-14 years (%)	4.0	4.8	4.3	4.4	4.3	4.2	4.5	4.8

Source: New Zealand Health Survey data¹.

Underweight was classified as the equivalent of an adult BMI of \leq 18.5 kg/m² using IOTF standards².

The larger numbers available from the B4SC suggests that the prevalence of underweight/possible undernutrition (BMI-for-age below the 2nd percentile) has remained stable between the 2012 and 2016 period (0.71%; 0.55%; 0.61%; 0.60%; 0.52%, for 2012 to 2016 respectively)⁷.

6.1.3 Short stature

The NZ Health Survey data does not report prevalence of short stature, only mean height¹. A crude guide to the prevalence of marked short stature receiving clinical attention is reflected in the number of children treated with growth hormone for a growth disorder. Treatment is for children with growth hormone deficiency or a disorder characterised by short stature, including extreme short stature (height SDS <-3). During 2017/18, 336 children (<18 years of age) received growth hormone treatment for a growth disorder (Table 6.5). Of these, the majority ($n=156$) of cases were for the treatment of growth hormone deficiency (Table 6.6). The number of growth hormone treated children has increased by 30% over the past 10 years (Table 6.5) and this is largely attributed to increased numbers of treated children with idiopathic short stature (height SDS <-3). During this period, it is unlikely that there has been a decrease in childhood growth rates and adult stature. It is far more likely there is greater awareness and concern in families about short stature leading to referral for short stature assessment and management.

Table 6.5. Growth hormone (somatropin) dispensing over time in New Zealand children (<18 years)

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Total (n)	240	244	256	281	275	296	296	307	336

Source: PHARMAC⁸.

Table 6.6. Indication for approval of growth hormone (somatropin) dispensing in New Zealand children (<18 years) between 2014/15 and 2017/18

Indication (n)	2014/15	2015/16	2016/17	2017/18
Growth hormone deficiency	130	140	146	156
Short stature without growth hormone deficiency	87	98	109	114
Turner syndrome	52	48	40	46
Prader-Willi syndrome	32	31	35	34
Specific pre-approval	7	12	12	13
Short stature due to chronic renal insufficiency	10	10	7	9
Exceptional circumstances	2	5	5	5

Source: PHARMAC⁸.

Note: Approval may occur under more than one indication, leading to double counting.

6.1 Summary

The prevalence of overweight and obesity in NZ children is high (21.3% and 14.9%, respectively) but in 4-year-old children appears to have declined over the past 5-6 years. The prevalence of underweight is much lower (6.6%) and appears to have remained static over the past 5-6 years. Of note is the high prevalence of rapid and extremely rapid infancy BMI growth trajectories in a NZ study. Although it is unlikely that the prevalence of short stature has changed in recent decades the prevalence of those treated with growth hormone for marked short stature has increased by 30% over the past 10 years.

6.2 Long-term adverse effects

6.2.1 Overweight and obesity

It is well known that childhood obesity is associated with obesity during adolescence and adulthood⁹ and that later reversal of obesity through interventions is difficult^{10,11}. There is now also a large body of evidence describing the adverse consequences of childhood overweight and obesity on adult morbidity and mortality. Systematic reviews of evidence have reported that childhood overweight and obesity increases the risk of poor cardiovascular health (diabetes, hypertension, ischaemic heart disease, and stroke), a range of cancers, and premature mortality^{12,13}. This now includes an increased incidence of childhood asthma¹⁴.

While there has been a worldwide focus on BMI centiles and cut-offs for determining overweight and obesity, these measures are arbitrarily defined. More recent work suggests that a BMI even within the “normal” range (50th-74th percentiles) during adolescence is associated with increased mortality in adulthood¹⁵. While the data is limited to adolescence, it suggests that there is an important increased risk of mortality across the spectrum of higher BMI ($\geq 50^{\text{th}}$ percentile), not just those classified as overweight and obese ($\geq 85^{\text{th}}$ percentile) through cut-offs.

6.2.2 Underweight

There are many terms used to define underweight in young children, including: 'failure to thrive', 'faltering growth', 'growth faltering', or 'weight faltering'. Data from a meta-analysis showed that infants classified as having failure to thrive had poorer cognitive outcomes than control infants¹⁶, which has been shown to continue into later childhood¹⁷. Failure to thrive is also associated with short stature in late childhood¹⁸.

6.2.3 Short stature

Early studies reported behavioural, cognitive and socialization issues among short children^{19,20}, which led to the justification of treating markedly short healthy children with growth hormone (to promote greater adult height and therefore improved well-being). However, these early findings are not supported in more recent population studies²¹. A summary of the current evidence is that many studies of children with short stature report lower IQ's compared with control children²², although it is unknown if this is causative. It is possible that these findings may not be clinically relevant as the lower IQ's are still reported to be within the normal range and short children are more likely to have other health and learning problems²². There is limited evidence for any physical limitations related to short stature, other than in some competitive sports²².

Poor linear growth is a non-specific marker for underlying conditions (medical conditions, hormone deficiencies, genetic disorders and medications). An unrecognised chronic illness may lead to poor linear growth and ultimately short stature. For example, poor linear growth is a common presentation of coeliac disease which occurs two years before clinical diagnosis in 57% of girls and 48% of boys²³.

6.2.4 Sustained rapid weight gain

Crossing upwards two or more major centile lines (CDC growth charts) for weight-for-length between birth and 24 months of age is associated with a high prevalence of obesity at ages 5 and 10 years, with the highest risk being when this occurs in the first 6 months of life and for infants starting between the 75th and 90th percentiles²⁴. The association between rapid weight gain and the development of childhood obesity has been well researched and consistently reported in meta-analyses and systematic reviews²⁵⁻²⁷. In a NZ study of Pasifika children, early rapid weight gain (increased weight SDS trajectories) from 2.5 years to 14 years of age was associated with measures of metabolic risk (including high insulin, cholesterol, blood pressure and abnormal liver function) at age 14 years, and risk of metabolic syndrome²⁸.

It has been consistently reported that rapid weight gain in infancy (up to 2 years) is related to obesity risk later in life²⁹. Increased weight velocity from 1 year of age, and between 9 months and 5 years of age are predictors of adult BMI, waist circumference and abdominal diameter³⁰. Similarly, higher BMI growth trajectories (ascending 50th-75th and 97th percentiles) between birth and 10 years of age were reported to be associated with higher adult BMI and waist circumference³¹.

While the trajectory of rapid growth has generally been the focus of attention, a systematic review reported that while rapid BMI growth trajectories were significantly associated with higher adult body measures, similar findings were reported for children with stable high BMI trajectories (e.g., stable 75th percentile tracking), therefore, it is possible that outcomes in the long-term may be similar for high steady BMI trajectories as is for rapid BMI trajectories³².

BMI percentiles decline after infancy and then rise between the age of 3 and 7 years until adulthood. Adiposity rebound (AR) is defined as the nadir or the inflexion point of BMI percentiles with age. An early adiposity rebound is associated with overweight and obesity in adulthood³³. The mean age of an early adiposity rebound (in obese subjects) occurs around 2-3 years of age, as opposed to 6 years, and is the result of faster gains of fat mass³⁴, and is associated with later insulin resistance and coronary heart disease³³.

6.2.5 Risk factors for childhood obesity

There is growing evidence for the impact of maternal characteristics on a child's weight/BMI trajectory, including the development of childhood obesity. Systematic reviews have reported several maternal and infant factors which are associated with the development of childhood obesity^{27,32}.

There is strong evidence for maternal factors associated with the development of childhood overweight or obesity that include: higher pre-pregnancy BMI, excess gestational weight gain and tobacco use during pregnancy^{27,32}. Also, accelerated weight gain in infancy and larger birth weight were associated with an increased risk of overweight and obesity in childhood^{27,32}. Other important factors with fewer supporting studies are: gestational diabetes, low socio-economic status, and childcare attendance, with some other potentially modifiable factors such as: shorter infant sleep, inappropriate bottle use, and antibiotic use in infancy²⁷. An observational study by Carling et al.³⁵ also reported in a risk analysis that greater duration of any breastfeeding (>4 months compared with <2 months) was beneficial in reducing the odds of rapid weight gain in their infant³⁵. Although, evidence from a systematic review of 49 breastfeeding studies suggests that the impact of breastfeeding on childhood overweight is inconsistent²⁷, which may be a result of differences in defining breastfeeding status (e.g., partial, exclusive, predominant etc.) or other mediating factors not assessed in these studies. A NZ study found that less rapid early infant weight gain (between 0-9 months) was a mediating factor in the association between longer duration of breastfeeding and lower BMI in adulthood³⁶.

6.2 Summary

There is growing evidence for the increased risk of adverse effects in adulthood across the spectrum of higher BMI (>50th percentile), not just those who are overweight or obese. Also, children with rapid weight gain may have similar long-term outcomes as those with stable high weight. Long-term negative effects of underweight/failure to thrive is a poorer cognitive outcome and an association with short stature in later childhood. While there is limited evidence for the long-term physical implications of short stature, poor linear growth may be an early feature of unrecognised chronic disease, in which early detection could improve health outcomes.

6.3 Suitable assessments and tests for growth and obesity screening/surveillance during childhood

The approach to the measurement of growth for screening/surveillance should be equivalent to those used to establish the growth charts³⁷. Measurements of weight, length/height, head circumference and the calculation of BMI are the most common assessment methods of growth used in young children. Best practice is to take two measurements and then if these differ by more than 0.5 cm for height/length, 0.5 kg for weight, or 1 cm for waist circumference then a third measurement should be taken. The final measurement reported should be the average of the two closest measures^{37,38}. The

measurement protocol used within the Well Child context in NZ is reported in the Practitioner's Handbook³⁸.

6.3.1 Weight

Measurement of weight requires an electronic scale on a firm surface. Weight should be taken naked for infants and children under 2 years. After 2 years of age children should be measured in light clothing only. Weight and BMI measures collected as part of the B4SC are reported to be higher than those collected for research purposes³⁹. Weight measurements were recorded to be significantly higher (mean of 0.45 kg heavier) during colder temperatures and therefore subsequent BMI was also higher (mean of 0.41 kg/m² greater)³⁹. The authors recommend that standardized protocols for subtracting an average clothing weight from the child's weight would help to improve the accuracy of the measurement, particularly during the cooler months. Weight scales should be regularly calibrated to ensure they are reading accurately.

6.3.2 Length (<2 years) and height (>2 years)

Imprecision of the measurements for length and height is high and attention to detail and adherence to protocols is required to obtain accurate measurements. Supine length measurement is performed to two years of age and requires a properly calibrated length board. Footwear and clothing (including a nappy) should be removed before measuring the infant. Standing height is performed on children >2 years of age and should be conducted using a rigid stadiometer placed upon a hard surface. Children should stand with their back to the stadiometer and head in the Frankfort Plane. Shoes, heavy clothing and any hair equipment that could interfere with the measurement should be removed prior. Stadiometers should be regularly calibrated.

6.3.3 Waist circumference

Waist circumference is not commonly assessed in the primary care setting. However, there is some evidence to suggest a waist circumference measurement alongside BMI may be beneficial for identifying children in need of further investigation for cardiometabolic risk⁴⁰, which may be more beneficial at the secondary care level. It is important that the waist measurement protocol is standardized as there are differing methods for measurement. The most appropriate method is to find the approximate mid-point between the top of the iliac crest and the lower margin of the last palpable rib, with arms relaxed at the sides, and without clothing⁴¹. Using a measuring tape, the measurement should be read at the end of the child's normal expiration⁴¹.

6.3.4 Waist-to-height

The waist-to-height ratio (WHtR) (calculated as: waist circumference (cm) divided by height (cm)) is an emerging screening tool for cardiometabolic risk⁴⁰. It is a valuable tool for identifying abdominal adiposity which is a risk factor for metabolic syndrome⁴². A recent study found that 55% of Swedish 5-year olds, with a normal BMI, had a WHtR ≥ 0.51 (recommended cut-off for abdominal obesity is 0.5)⁴². Therefore, when using BMI alone these children with elevated WHtR would be missed.

6.3.5 BMI

BMI is considered to be the best screening tool to identify overweight and obese children. There are several ways BMI can be reported: BMI, BMI percentage, BMI SDS, or BMI centile⁴³. Currently, in the NZ

Well Child / Tamariki Ora (WCTO) setting BMI is assessed by BMI centile, which is calculated using the child's height and weight centiles and plotted appropriately on the growth chart³⁸, although knowledge of whether this practice is done on a regular basis through all WCTO visits is unknown. The BMI centile approach is reported to be accurate as it does not require the direct calculation of BMI⁴⁴ and has been reported to be successfully used amongst United Kingdom (UK) public health nurses⁴⁵. However, it is important to note that while a single BMI centile measurement is useful for determining adiposity, it is not suitable for measuring change in adiposity⁴³.

In a recent study, BMI (using BMI SDS) was shown to be a better predictor of obesity than the emerging WHtR and therefore may be appropriate for use in clinical practice for identifying children who are overweight or obese⁴⁰. Converting BMI to an SDS allows for changes in BMI to be tracked overtime as they are calculated relative to the age and sex of the child⁴⁶. However, some care should be taken if using BMI SDS to track progress over time in obese children due to the compression effect of high SDS occurring above the 95th percentile^{47,48}. This has led to a recommendation in the United States of America (USA) of using an alternative method of tracking which expresses BMI either as a percentage of the 95th percentile, or the difference from the 95th percentile, for these children⁴⁷. Other suggestions have been made that would be suitable for use in electronic growth charts⁴⁹.

Alternative methods for assessing adiposity in children that are more accurate such as dual energy x-ray absorptiometry (DXA)^{50,51} are not practical at the population level for screening due to the cost. DXA can also provide a measure of abdominal fat.

6.3 Summary

Due to findings of higher weight and BMI measurements during the cooler months of the year, standardized protocols should be developed for calculating and adjusting for clothing in the clinical setting. There is growing evidence for the use of WHtR for assessing cardiometabolic risk. The use of a single chart for tracking BMI SDS during childhood (0-5 years) should be considered in the WCTO setting. However, some discussion is required around the use of percentage above the 95th percentile for children who are being followed over time with a high BMI.

- *Standardized protocols for subtracting clothing weight worn during weight measurements in cooler months will improve measurement accuracy in the primary care setting [grade C].*
- *There is limited evidence for use of the waist-to-height ratio to screen for cardiometabolic risk in the primary care setting [grade I].*
- *Screening and tracking BMI may be feasible in primary care settings in NZ to support decision-making for further assessment and intervention [grade B].*

6.4 Optimal ages to assess and identify abnormal growth trajectories

Measures of weight and length/height should be conducted and plotted at all WCTO visits so identification of any abnormal growth (both height and weight) can be detected and managed in a timely manner. Regular growth measurement up to 5 years of age is important for the early detection of any growth concerns⁵². Inadequate growth may be a sign of a medical concern and therefore early detection is beneficial and warrants a referral for further investigation⁵³.

6.4.1 BMI

The use of BMI as a measure of nutritional status for those under 2 years is being debated⁵⁴, however it is probably superior to using weight-for-length^{51,55} (described in Section 6.4.2). BMI is reported to be better at predicting both later obesity⁵⁶, and current body composition compared with weight-for-length measures at 1-2 months of age^{57,58}. Certainly, over the age of 2 years BMI gives a useful indication of overweight or obesity.

BMI assessed in early childhood is predictive of overweight and obesity by 5 years of age⁴⁰. Specifically, BMI SDS at 0-1 months and change in BMI SDS between 0-1 to 12 months and 18 to 48 months has been shown to be predictive of overweight or obesity at age 5 years⁴⁰. Other research has also supported the assessment of early BMI trajectories (before the age of 6 years) for the prevention of obesity^{47,55,56,58,59}.

In the United States, BMI centiles are only assessed in approximately half of children during Well Child visits after 2 years of age⁶⁰, while we do not have NZ specific data on this, it is likely that the same would be found in our population, especially considering primary care electronic systems do not have BMI charts loaded, including Plunket's ePHR system (K Morrissey, personal communication 2019). This may lead to a missed opportunity of identifying children at risk of obesity before becoming obese. The American Academy of Pediatrics recommend plotting BMI on growth charts annually for children 2 years of age and older⁶¹.

6.4.2 Weight-for-length

While the World Health Organisation (WHO) recommends the use of weight-for-length for screening under and over nutrition in children under 2 years of age⁶², recent work suggests that BMI use in under 2-year olds is more predictive of obesity than weight-for-length⁵⁷.

6.4 Summary

There is a need for improved BMI tracking (at every WCTO visit) and implementation of BMI growth charts in the primary care setting (made available to all WCTO providers). The type of BMI chart (centiles, SDS, or other) for implementation requires further discussion. Although still under debate, the use of BMI in very young children (<2 years) would be beneficial for identifying rapid weight gain for the prevention of obesity.

- *Screening and tracking BMI may be feasible in primary care settings in NZ to support decision-making for further assessment and intervention [grade B].*

6.5 Follow-up assessments after identification of abnormality

6.5.1 Short stature or sustained poor growth

In general, any child with measurements of length/height that are below the 2nd percentile³⁸ or that cross downwards over a major centile line on the WHO growth chart over at least a 6 month period after the first year of life, should undergo a clinical review and possible referral to secondary care services. These children are more likely to have an underlying disorder affecting growth and less likely to have normal variant short stature (familial short stature or constitutional delay of growth and development)⁶³. Children with normal variant short stature display a slow growth rate until about a year

of age, after which the child's growth rate becomes normal. Also, for weight, a referral to secondary care is warranted when a consistently low BMI SDS of <-2 is recorded or poor weight gain (downward crossing of two major centile lines).

6.5.2 Rapid weight gain or obesity

In general, growth chart measurements (weight, length/height) that cross over two major centile lines (SDS change >0.67) upwards over time, or a BMI SDS of consistently >2 should instigate a referral to primary care services for clinical review of diet, activity and sleep patterns. Rapid increase in BMI SDS is occurring in a large proportion of young NZ children⁶ and is currently not routinely assessed as part of the WCTO programme, regardless of recommendations in the clinical guidelines for weight management⁶⁴. Young children whose BMI is rapidly increasing (which may predict later obesity) should also be offered brief food, activity and sleep advice⁶⁴ and a pre-emptive discussion about their growth (understanding the meaning of BMI, interpretation of, and health consequences of their growth). Those with extreme increase in BMI SDS (a change in BMI SDS greater than $4/3$) may warrant further investigation. Children with stable high BMI ($>75^{\text{th}}$ percentile) are also of concern, and should also be offered brief food, activity and sleep advice as for those trending towards the 91^{st} percentile⁶⁴.

6.5 Summary

Children with poor linear growth or short stature require secondary referral for clinical assessment. The inclusion of monitoring of young children who are rapidly gaining weight (using BMI growth charts for tracking, at all WCTO visits) is recommended, which is consistent with the clinical guidelines for weight management. Children with rapid weight gain (change in BMI SDS greater than 0.67) and stable high BMI ($>75^{\text{th}}$ percentile) should also receive brief food, activity and sleep advice and a pre-emptive discussion about their growth for the prevention of later obesity.

- *Monitoring for poor growth (weight and length/height measurements) should be completed at all Well Child visits, for all children [grade A]*
- *Screening and tracking BMI may be feasible in primary care settings in NZ to support decision-making for further assessment and intervention [grade B]*
- *Pre-emptive discussions and brief food, activity and sleep advice should be given to children with rapid weight gain and stable high BMI [grade B]*

6.6 Interventions for sustained poor growth or short stature

6.6.1 Efficacy

Sustained poor growth

There are well established guidelines for the investigation and management of failure to thrive (e.g., BMJ Best Practice, 2018⁶⁵). They primarily involve a careful clinical history to establish feeding patterns and social factors that might contribute to inadequate intakes in infants⁶⁶. In approximately 10% of children, an underlying illness requiring specific treatment is found.

Short stature

For over 90% of secondary care referrals for short stature, idiopathic short stature (ISS) is diagnosed⁶⁷. Treatment for severe ISS with recombinant growth hormone in childhood is consistently reported to improve short term growth and reverse growth failure^{67,68}. No serious adverse effects of recombinant growth hormone treatment in children have been reported⁶⁸.

6.6.2 Long-term efficacy (later in childhood/adolescence)

Sustained poor growth

To date, there is little evidence for the later impact of early interventions for poor weight gain. A recent study reported successful early intervention of children with failure to thrive which resulted in normal IQ, schooling, and home behaviour in later childhood¹⁸. However, they remained shorter and lighter than normal¹⁸.

Short stature

A Cochrane review on the use of recombinant growth hormone in children with ISS concluded that while treatment resulted in children gaining a height which was taller than that of their untreated control peers, they still remained relatively short when compared with normal stature controls⁶⁸. A recent review also reported that recombinant growth hormone treatment has modest long-term effects on improving height in children with ISS⁶⁷.

6.6 Summary

While early interventions for poor growth (failure to thrive) appear to prevent any potential long term negative effects on cognition and behaviour, growth outcomes (length/height and weight) appear to still be lower in those with failure to thrive and short stature when compared with healthy controls even after appropriate effective interventions are conducted.

- *Early intervention requiring a clinical review and possible referral to secondary care for children with poor growth for the prevention of long-term negative effects [grade A].*

6.7 Interventions for sustained rapid weight gain or obesity

An effective intervention should be available for children following a positive abnormal growth screen. However, there is still large debate regarding which interventions are the most effective for prevention and treatment of obesity in children under 5 years of age.

6.7.1 Prevention

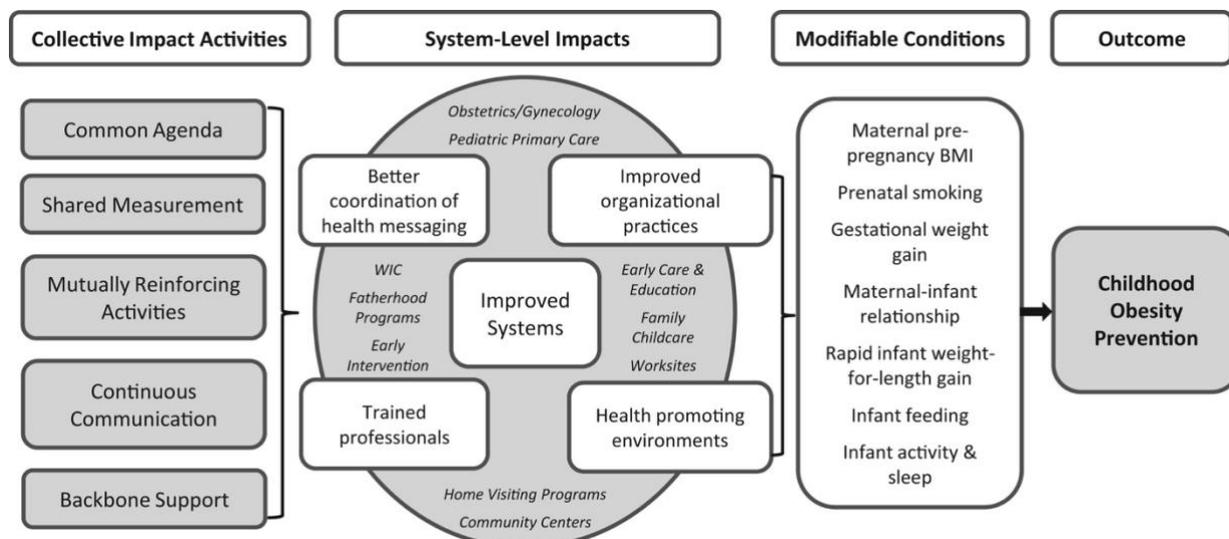
Obesity prevention interventions that begin in early childhood may have the greatest impact on prevention of obesity⁶⁹. A recently updated systematic review reported overall improved BMI and BMI SDS (reducing the risk of obesity) with combined dietary and physical activity interventions, when compared with a control group, in children aged 0-5 years⁷⁰. Neither dietary alone or physical activity alone interventions were reported to be successful in this age group⁷⁰. Studies assessing the

preschool/childcare setting also do not appear to successfully influence obesity related behaviours (healthy eating and physical activity)^{71,72}.

The most recent promising results of interventions for obesity prevention to date are those from the Prevention of Overweight in Infancy (POI)⁷³ and the Intervention Nurses Start Infants Growing on Health Trajectories (INSIGHT) studies⁷⁴. Results from the POI study, indicated that those children who received a brief sleep intervention (prevention of the development of sleep problems in the first 6 months and a modified extinction programme for those with sleep problems between the age of 6 months and 2 years⁷⁵) reduced the risk of obesity compared with children who did not receive the sleep intervention⁷³, an effect which remained apparent at 5 years of age, despite no intervention having occurred for at least 3 years⁷⁶. As this study was based in NZ it is directly relevant to the Well Child context and could easily be implemented nationwide. The INSIGHT study, from the US, reported that infants in their responsive parenting intervention were less likely to have a weight-for-length $\geq 95^{\text{th}}$ percentile at 1 year of age compared with the control group⁷⁴.

Another systematic review reported that while the most effective obesity prevention interventions in childhood are those that focus on individual or family behaviour change, very few intervention studies have looked at the impact on the social context that drives behaviour⁶⁹. There is a worldwide drive for support of a systems level approach (see Figure 6.1) for obesity prevention^{69,77}. The WHO commission (ending childhood obesity) called on governments to act responsibly in ensuring that all children gain a healthy start to life⁷⁷ and the WCTO system provides a unique opportunity to support this type of systems level approach, including further recommended actions by the WHO commission⁷⁷.

Figure 6.1. Example of a systems level approach.



Reproduced from Blake-Lamb et al.⁶⁹, with permission from Elsevier.

While we know the prevalence of obesity is higher in Māori and Pasifika children³, there is very little evidence for effective obesity prevention interventions in Indigenous populations. There is a small amount of evidence suggesting that the most effective interventions in pre-school children who identify as Māori and Pasifika are those which are predominantly parent/whānau focused, use behaviour change techniques, focus on skills, and link in with social networks and community⁷⁸.

6.7.2 Treatment

While the quality of evidence to date for the effectiveness of obesity treatment interventions is low, a systematic review reported that the most successful interventions in preschool children (<6 years of age) were those which included multiple-components (diet, physical activity and behaviour) when compared with a control group, rather than interventions which focused on one component alone (i.e. diet)⁷⁹. A systematic review of studies in children and adolescents aged between 2 and 18 years reported that treatment interventions that involved at least 26 hours contact time were more effective in reducing weight related changes than a control group after 6 to 12 months⁸⁰.

While the evidence regarding parental involvement in the treatment of overweight and obesity in children (5 to 11 years) is low and limited, a systematic review reported that parent-only interventions were more effective than waiting list control groups and were as effective as parent and child interventions in reducing BMI outcomes⁸¹, however, it is unknown what influence parent-only interventions have on weight related outcomes in overweight and obese children under 5 years of age.

Currently, there is a lack of knowledge regarding which specific treatment intervention components are most effective and affordable for implementation at the population level⁸². However, a NZ study reported that any treatment intervention (multi-disciplinary, medical alone, medical and dietary, medical and physical activity) resulted in small but significant reductions in BMI SDS in children and adolescents aged between 3 and 16 years⁸³.

While the use of surgery and drugs are other means of treatment for obesity, these are not discussed in this review due to its lack of appropriateness and the very small amount of evidence in this area in children^{84,85}.

6.7.3 Currently implemented New Zealand intervention (prevention and/or treatment) programmes

Green Prescription Active Families (for children aged 5 to 18 years) is a nationwide programme for obesity intervention based on physical activity. The Green Prescription Active Families programme was evaluated in 2010 in a subsample (n=55) of children from three North Island locations. They reported a significant decrease in BMI of 1.0 kg/m² from baseline to 6 months, however, when this was split by sex this remained significant only for males⁸⁶. A further report of the programme's performance was conducted in 2016 demonstrating overall a high degree of acceptance of participating children and families⁸⁷.

Throughout NZ there are a number community-based obesity intervention programmes targeted towards young children and families. Two programmes with reported success are Whānau Pakari and Project Energize. Whānau Pakari is a home-based multidisciplinary programme aimed at children aged 5 to 16 years in the Taranaki region with reported success in lowering obesity in participants⁸⁸. Project Energize in the Waikato area which has also had success in reducing percentage body fat in young children, and long-term reductions in BMI have been reported⁸⁹. Another small programme showing promise is the Toddler Better Health Programme in Nelson⁹⁰.

6.7.4 Long-term efficacy (later in childhood/adolescence)

There is a lack of studies assessing what the long term (beyond 1 year) impact is of early interventions on later weight status, yet what we do know is that reversing obesity through interventions in later

childhood and adolescence is challenging^{10,11}. One study reporting improvement in later childhood was the POI study, where an early (from 0-2 years) sleep intervention reduced the risk of obesity at 5 years of age, compared with those who did not receive the sleep intervention⁷⁶.

6.7 Summary

To date, the most appropriate interventions for obesity prevention in young children (0-5 years) are those combining diet and physical activity. This multi-component approach appears to be also the most effective for the treatment of obesity in this age group, as well as those interventions with longer contact time. Although, what is unknown is the effectiveness and affordability of these interventions at the population level and the long-term impact on weight status. Recent NZ and USA studies suggest a sleep intervention can be even more effective with a halving of obesity prevalence 3 years after the intervention finished.

- *Obesity prevention interventions (diet, physical activity and sleep advice) should be available for young children at high risk of future obesity [grade B].*
- *Treatment of young children with rapid weight gain and/or obesity may be feasible if it includes multi-components (diet, physical activity and behaviour), and sufficient contact time [grade C].*
- *There is promising but limited evidence for the use of a sleep intervention for obesity prevention in the primary care setting [grade B].*

6.8 Known harms from screening for poor growth

While there is a potential for harm from growth screening, there is very little recent evidence to support this. There is a small amount of evidence for weight screening and the impact on parents and children. However, there is no evidence of harm from screening for linear growth.

In the UK, two studies have reported on potential harms after weight feedback was sent to parents from the national school-based weight screening programme. One study of children aged between 6-7 years and 10-11 years reported that few children found the process distressing (particularly older overweight children), and there was evidence of parental dietary restriction of overweight girls⁹¹. Another study in children aged 4-5 and 10-11 years reported no harms (no difference in weight-related teasing or low self-esteem) after providing weight related feedback to parents following screening of their child's weight⁹².

Growth charts are reported to be easily misunderstood by parents⁹³. However, it is important to provide feedback to parents and children to encourage awareness and monitoring of their child's growth. However, this should be done in a way that prevents any harm. For parents, acceptance of their child's weight status has been shown to be a positive experience when the healthcare professional discussing this with them is non-judgmental and empathetic⁹⁴.

It is important to consider that there is also possible harm from growth screening if there is no appropriate intervention available following a positive screen, which is the case in some (often rural) areas of NZ. There is also potential harm if the information given is neither non-judgemental or empathetic, which can discourage families from engaging with healthcare providers in general. Therefore, more training and support for primary healthcare professionals who conduct routine growth screening is required to ensure they gain confidence in delivering information appropriately.

6.8 Summary

There is limited evidence regarding harms which are related to growth screening in childhood and no evidence of any reported harms in early childhood (<5 years). In the NZ context, it is important to consider the potential harm caused by not providing an appropriate intervention when a growth screen is positive, or if the information is given in a judgemental or non-empathetic manner. More training and support for healthcare professionals conducting growth screening is required.

6.9 Known harms from screening for excessive weight gain

There is concern that harm may be caused from screening for obesity, for example psychological (disordered eating behaviours), social (stigmatisation and bullying) or physical (impaired growth) harms. A systematic review on screening for obesity reported that there is no evidence of harm in screening children for excess weight, however, it is important to note that this statement was generated from the fact that there were no studies assessing harm (based on their inclusion criteria), rather than there being no harm detected⁸⁰. Further work is needed to determine whether there are any potential harms (physical, psychological, social, or ethical) associated with obesity screening in childhood.

As mentioned in Section 6.8 harm could be caused when there is no appropriate intervention available following a positive screen for obesity or if the information is given in a judgemental or non-empathetic manner. Through personal communication⁹⁵ there are also reports of concerns amongst parents of obese ($\geq 98^{\text{th}}$ percentile) children regarding inconsistent messages from healthcare professionals and stigma around weight and health status, affecting further engagement with healthcare professionals and obesity interventions. Support for training primary healthcare professionals who conduct obesity screening is required to improve communication of this sensitive information.

6.9 Summary

While it has been reported that there is no harm from obesity screening in childhood, this was because of a lack of studies reporting and collecting data on potential harm. Further work is required in this area. As discussed in Section 6.8, it is important to consider the potential harm caused by not providing an appropriate intervention when obesity is detected, or if information is given in an unsympathetic manner, suggesting further training of healthcare professionals is needed to improve the delivery of this information.

6.10 Is clinical diagnosis of short stature in childhood currently well managed in New Zealand, following a positive screen?

There is currently no data available regarding the management of growth disorders following a positive screen in NZ children. However, it is assumed that diagnosed growth disorders (i.e. short stature and failure to thrive) are well managed in NZ as District Health Boards (DHBs) must follow specific service specifications for children and young people⁹⁶, although this has not been evaluated to date. As a benchmark, the number of children treated with growth hormone over the past 10 years has increased

by 30%⁸, which is likely a reflection of improved awareness, assessment and management, rather than increasing prevalence of short stature.

6.10 Summary

While there is no reported data on the management of short stature in NZ, it is assumed to be well managed in the secondary care setting due to the requirements of service by DHBs and increasing numbers of children treated with growth hormone over the past 10 years.

6.11 Is clinical diagnosis of obesity in childhood currently well managed in New Zealand, following a positive screen?

There is evidence that the conversation with caregivers about the diagnosis of obesity in NZ is poorly handled, with reports of health professionals providing inconsistent messages and weight stigmatization⁹⁵. This points to the need for enhanced professional education and support in this area.

A retrospective study of children presenting to secondary care (Southern District Health Board) between 2010 and 2015 reported that of the children who were obese by measurement, only 45% were given a diagnosis of obesity, however, it was noted that not all practitioners used the term “obesity” but alternatives for example “overweight”, “high BMI”, “weight issues”⁹⁷. Furthermore, investigations were performed on approximately 25% of those children diagnosed as obese, and approximately 73% were given a management plan⁹⁷. In a survey of Waikato primary healthcare professionals, it was reported that while obesity in children was a concern, only half conducted assessments (i.e. height, weight, BMI) in children, and few followed obesity management guidelines⁹⁸.

A NZ study of overweight and obese children aged 3 to 16 years, who were referred to secondary care for obesity intervention, reported small reductions in BMI SDS across their methods of intervention (paediatrician only, paediatrician and dietitian, paediatrician and external programme, or multidisciplinary)⁴⁵.

The key issue for all obesity management programmes is engagement. Almost all studies describe better results for those that engage fully and complete the programme. In the obesity area, there is also a problem with engagement after referral to the programme as >50% of NZ parents see their overweight or obese child as having a normal weight⁹⁹, with this especially so for younger children. Thus, home based programmes with a strong engagement ethos are important^{88,100-102}.

6.11 Summary

There is room for improvement in the diagnosis and management of childhood obesity in NZ. Consistent use of WHO growth standards in both primary and secondary care systems, the regular use of BMI growth charts, and when identified, empathetic and non-judgemental information giving is important. Programmes that focus on parental engagement and retention and that address both nutrition and activity are important.

6.12 Māori and Pacific views, practices, and beliefs about childhood screening

6.12.1 Poor growth / short stature

There is no reported literature regarding the views, practices, and beliefs about screening for poor growth or short stature in both Māori and Pacific Island populations.

6.12.2 Rapid weight gain

There appears to be no specific reported data on the Māori and Pasifika views, practices, and beliefs about childhood screening for rapid weight gain. What we do know is that the growth rates for both Māori¹⁰³ and Pasifika^{104,105} children appears to be much steeper than it is for reference children. Furthermore, a focus away from weight and instead on children's happiness is important to Māori parents and caregivers¹⁰⁶.

6.12.3 Obesity

Recent evidence has found that Pasifika families are less likely to participate in an intervention for obesity treatment after weight screening compared with NZ European families¹⁰⁷. One study reported a relatively low level of concern amongst Pasifika parents regarding the weight status of their children and therefore interventions targeting parental awareness and then family support may be the most beneficial¹⁰⁸.

Among a group of Māori parents, knowledge of obesity appeared to be low with very little concern for obesity in children (under 5 years of age), as parents reported obesity to be “only applied to people who were seriously overweight”¹⁰⁶. There was reported concern that weight stigmatization in children would lead to bullying, discrimination and the development of eating disorders¹⁰⁶.

The acceptability of using prediction models for determining obesity risk in children under 5 years was reported in a study which included 437 Māori and 125 Pasifika parents and caregivers¹⁰⁹. Of the caregivers, 59% of Māori and 62% of Pasifika “definitely or probably” would like to know information about their child's obesity risk¹⁰⁹.

6.12 Summary

To date, we know very little regarding the views, practices and beliefs of Māori and Pacific Island populations regarding childhood growth screening. However, there does appear to be some concerns regarding the impact of weight stigmatization amongst Māori parents.

6.13 Recommendations for further action

Further research

- What harms are associated with obesity screening in New Zealand children?
- Determine effective interventions for the prevention of overweight and obesity in Māori and Pasifika children.
- Identify possible modifiable factors of excess weight gain in early infancy for the prevention of later obesity, particularly for Māori and Pasifika children.
- Determine the long-term impact of early interventions on growth related outcomes in New Zealand children.
- New Zealand parents and healthcare professionals' attitudes and beliefs regarding weight screening and weight status during childhood.
- Views, practices and beliefs of weight screening and weight status during childhood in Māori and Pacific Island populations.
- Develop and determine the appropriateness of New Zealand ethnic-specific cut-off points for defining overweight and obesity in children under 5 years of age.
- Evaluation of the management of diagnosed growth disorders (short stature and failure to thrive) following a positive screen in New Zealand children.

6.14 Graded evaluations

Table 6.7. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
Standardized protocol for subtracting the weight of clothing worn during weight measurement	C	Small	Moderate	This protocol should be used during the cooler months and/or when removal of clothing for weight measurement is not appropriate/possible.
Waist-to-height ratio for assessing cardiometabolic risk	I	Insufficient	Low	Insufficient evidence for routine use of the waist-to-height ratio in young children in primary care.
Monitoring for poor growth	A	Substantial	High	All children should have weight and length/height measured at every Well Child visit.
BMI tracking chart (SDS)	B	Moderate	Moderate	BMI screening/tracking should be completed for all children.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 6.8. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Pre-emptive discussion, and brief food, activity and sleep advice	B	Substantial	Moderate	This intervention should be provided to all children with rapid weight gain and stable high BMI, where appropriate.
Early intervention for poor growth (clinical review in primary care and possible referral to secondary care)	A	Substantial	High	Children with poor growth* should undergo a clinical review and possible referral to secondary care for early intervention. * Poor linear growth: <2 nd percentile, or crossing one major centile line over 6 months. * Poor weight gain: consistently low BMI SDS <-2, or downward crossing of two major centile lines.
Obesity prevention interventions including diet and physical activity	B	Moderate	Moderate	Children with high risk of future obesity should receive brief food, activity and sleep advice.
Treatment for young children with rapid weight gain and/or obesity should be multi-component and provide sufficient contact time	C	Small	Low	Children with rapid weight gain* and/or obesity should be <i>offered</i> an appropriate multi-component (diet, physical activity and behaviour) intervention. * Rapid weight gain: change in BMI SDS greater than 0.67.
Sleep intervention for obesity prevention	B	Substantial	Moderate	If a sleep intervention is offered, patients should understand that the evidence, while promising, is limited.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

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A BETTER
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E Tipu e Rea

7. Vision screening in infancy and childhood

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Suggested citation: Hamm LM, Findlay R, Black JM. 7 Vision screening in infancy and childhood. In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019; p. 168-216.

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Vision is a potentially very broad domain encompassing a range of aetiologies and clinical presentations. The most common childhood vision conditions are refractive error and amblyopia which are suitable targets for universal screening. For this report, the authors were asked to focus on amblyopia (the main focus of the current population wide screening program in New Zealand), which can be severe and impact both eyes, but most often causes mild to moderate vision loss in one eye. Conditions that affect specific populations such as retinopathy of prematurity and cerebral visual impairment are beyond the scope of this review.

Conflicts of interest: Although unlikely to constitute a conflict, each author has a viewpoint from which they approached this work. Lisa Hamm is a vision science researcher involved in amblyopia research and development of open access resources for paediatric vision testing. Rebecca Findlay is an optometrist based at Counties Manukau DHB and PhD candidate at the University of Auckland. Joanna Black is an optometrist, vision science researcher, and Senior Lecturer based at the University of Auckland with interests in the areas of paediatric vision, amblyopia and refractive error.

Acknowledgement: The authors would like to thank all of those who provided feedback on various drafts through this process, including the helpful feedback from the anonymous reviewers.

Abbreviations

B4SC	Before School Check
DHB	District health board
LMC	Lead maternity carer
RCT	Randomised controlled trial
VA	Visual acuity
VHT	Vision and hearing technician
VIP	Vision in pre-schoolers

Definitions

Amblyopia	Reduction in visual acuity in the presence of a risk factor and the absence of pathology
Anisometropia	Difference in prescription between the two eyes creating asymmetric focus
Astigmatism	Irregular curvature of the cornea or lens creating an unfocussed, distorted image
Hypermetropia	Long sightedness – when the eye is not in focus creating the need for excess ocular accommodation particularly when involved in near tasks
Myopia	Short-sightedness – when the eye is out of focus and distance vision is blurred
Strabismus	Abnormal ocular alignment or “squint”

Note: Definitions, including cut-off values and measurement protocols, differ between studies.

Summary

Childhood vision conditions should be detected and treated promptly to prevent amblyopia (abnormally developed visual pathways) and maximise educational outcomes. This report collates evidence about childhood vision screening, with a focus on amblyopia.

Internationally, the prevalence of amblyopia ranges from 0.5 to 5.3% with previous estimates from NZ of 3.5%. To prevent or minimise amblyopia, screening should be conducted as close to birth as possible using the red reflex test (to detect cataract), and during the preschool years, using visual acuity screening and/or autorefractors or photo screeners (to detect refractive error and potentially strabismus). These tests are non-invasive and fast, but test selection matters, and each test requires some training to conduct accurately. Following detection, initial treatment requires removal of risk factors, and spectacle correction. Moderate residual amblyopia is effectively treated with patching or atropine penalisation. Earlier treatment has better results and reduces distress associated with treatment. Although it appears that unilateral amblyopia has an impact, and that screening for and treatment of amblyopia is cost effective, more evidence is needed. There is stronger evidence for the impact and cost effectiveness of detecting and treating bilateral vision impairment.

Expanding the targeted conditions for screening warrants consideration; non-amblyogenic hypermetropia and astigmatism are currently not targets for screening, but there is growing evidence that when left untreated they are associated with reduced developmental and educational outcomes. For myopia, which develops later in childhood, prompt detection and treatment can reduce progression and the likelihood of future ocular pathology. Equity is a particular concern; although screening coverage overall is good, Māori and Pacific whānau are less likely to successfully participate in vision screening, and barriers appear to exist for referral and treatment.

Childhood vision screening can prevent or minimise amblyopia and promote educational outcomes. Improving our current vision screening programme could help us achieve these outcomes for all New Zealand children.

Literature search and selection

We carried out our search in August 2019. Databases and search terms as well as date and language restrictions used are summarised in Appendix I. In the first phase of the selection process, two authors independently reviewed the title and abstract of each of the 2274 unique results, leaving 365 potentially relevant documents. In the second phase of the selection process, two authors independently reviewed the full text of each potentially relevant document using inclusion/exclusion criteria which prioritised systematic reviews, randomised controlled trials and work done within New Zealand. In both phases of the selection process conflicts between authors were resolved by discussion or by input from a third author. Due to the wide range of topics addressed in the questions, we ran a supplemental (unstructured) search for individual questions to capture additional potentially relevant sources. The timeframe did not allow meta-analysis or robust quality checks. The overview of this process and details extracted from included documents are presented in Appendix I.

7.1 Background

7.1.1 What is vision screening intended to identify?

Vision impairment has a substantial impact on how a child interacts with the world, but poor vision may not be apparent to a child or their whānau. Early detection and treatment are important for learning and development¹. Failure to detect reduced vision can prevent normal development of the visual pathways resulting in amblyopia^{2,3}. The most common risk factors for amblyopia are refractive (blurred vision due to uncorrected refractive error), strabismic (unmatched retinal images due to ocular misalignment) and less frequently, deprivation (obstruction of the passage of light to the retina, for example cataract or ptosis)². Amblyopia is less likely to develop, and more amenable to treatment if risk factors are treated promptly^{2,4}.

Screening programmes can be designed to identify amblyopia and its risk factors, non-amblyogenic treatable vision impairment (such as refractive error alone), and/or non-amblyogenic risk factors for general health (such as retinoblastoma, a rare vision and life-threatening malignancy). Targeted conditions and screening practices vary internationally^{5,6}, and can depend on availability of eye care for children⁷. Childhood visual impairment meets WHO criteria for population screening because vision impairment is an important health problem, it has an early symptomatic stage during which screening tests are acceptable, and there is acceptable treatment⁸. Although the value of detecting and treating severe bilateral vision impairment is well established, the value of population wide pre-school screening (which predominantly detects unilateral amblyopia, the more common form) is debated^{7,9}. Due to the lack of research designed to compare screened to unscreened populations, Cochrane reviews have, to date, concluded that there is insufficient evidence for the effectiveness of childhood vision screening^{10,11}, while policy statements tend to cite sufficient indirect evidence to recommend universal screening¹².

7.1.2 Current screening practice in New Zealand

Current vision screening in New Zealand (NZ) includes formal vision screening at birth, six weeks, four years and eleven years¹³ (Table 7.1). Surveillance questions for parents in the Well Child Tamariki Ora My Health Book are included in [Appendix II](#).

Table 7.1. Vision screening appointments in current Well Child Tamariki Ora schedule

Screening	Age	Health practitioner	Test used
Newborn vision and eye examination	0-7 days	Lead maternity carer (LMC)	External examination, red reflex test, parent questionnaire
Six-week vision examination	6 weeks	General practitioner	External examination, red reflex test
Well Child checks	6 weeks –3 years	Well Child nurse	Review of questions in well child book with parents
B4 School Check (B4SC)	4-5 years	Vision and hearing technician (VHT)	VA test using Parr chart
Year 7 Vision Screening	11-12 years	Vision and hearing technician/school nurse	VA test using Snellen chart

The stated aims of the initial two checks are to detect and refer children with congenital eye abnormalities (newborn) and identify suspected visual impairment (six weeks). The aim of the B4SC is to identify children with amblyopia and those children unable to complete Visual Acuity (VA)

measurement¹³. The Year 7 vision screening is intended to identify any missed functional vision impairment, or newly developed conditions.

VA screening identifies vision impairment due to amblyopia but also due to some non-amblyogenic refractive errors. Hypermetropia and astigmatism tend to be present at birth or develop early in life, but are not always captured by the current VA test whereas myopia tends to develop during the school years. Strabismus is not directly screened for (large angle strabismus will often be detected by whānau, while functionally significant smaller angle strabismus is likely to be detected by decreased VA at the B4SC)¹⁴.

7.1.3 Aims of this report

This brief evidence review attempts to collate evidence about childhood vision screening, as specified through nine questions provided by the Ministry of Health. As for vision screening overall, for many of the questions there is insufficient evidence to make conclusions with certainty, in these cases we have attempted to summarise *available* evidence in a balanced manner. Other groups have conducted more comprehensive evidence reviews addressing similar questions (many including robust quality checks beyond what the timeframe of this rapid review allowed). Of note are the 2004¹⁵, 2011¹⁶ and 2017¹⁷ reports from USA, the 2018 policy statement from the American Academy of Ophthalmology⁸, a 2008 report from the UK¹⁸, and a 2010 report from Australia¹⁹.

7.2 Question 1: What is the prevalence of amblyopia in infants and children aged 0-5 years?

We do not know the current prevalence of amblyopia or its risk factors in New Zealand (NZ), but available estimates²⁰ are presented in Table 7.2. The B4SC is targeted to detect amblyopia, but it also identifies other conditions which cause reduced VA (including non-amblyogenic refractive error, strabismus and pathology), together these conditions were estimated to impact 4.5% of preschool children (study conducted in Auckland)³.

Table 7.2. Prevalence estimates.

	NZ estimates	Australian estimates	International estimates
Amblyopia	1.8% / 3.5% ²⁰	1.4% to 3.6% ¹⁹	0.5% to 5.3% ¹⁹ (no bilateral ²¹ to 3:1 ²² unilateral to bilateral)
Amblyopia risk factors			
Refractive errors		1.0% to 14.7% ¹⁹	0.5% to 34.2% ¹⁹
Strabismus		0.3% to 7.3% ¹⁹	1.0% to 14.7% ¹⁹
Deprivation (cataract)			0.0032% to 0.229% ²³ (~2:1 bilateral to unilateral ²⁴)

The NZ estimate reports the prevalence of amblyopia within a cohort of 1037 people born in Dunedin in the 1970s. Prevalence for the NZ study is reported for 2 different VA cut-offs: 1) 6/12 or worse in at least one eye or a 2-line difference between eyes, and 2) 6/9 or worse in at least one eye. Australian and international estimates include varying cut-offs.

Although there are no randomised clinical trials (RCTs) designed to compare prevalence between screened and unscreened populations^{10,11}, indirect evidence suggests screening decreases prevalence, particularly for bilateral amblyopia^{21,25}. For example, the prevalence of amblyopia in Denmark fell from 1.78% before population wide screening to 0.44%²¹, and the prevalence in Sweden dropped from 3.3% to 0.9%^{22,25}.

7.2 Summary

Internationally, the prevalence of amblyopia ranges from 0.5 to 5.3%. Estimates from NZ suggest 3.5%.

7.3 Question 2: When is the optimal time(s) to screen for amblyogenic factors?

Early detection and treatment of amblyopia and its risk factors result in the best visual outcomes. Optimal timing and appropriate tests for screening depend on the amblyogenic factors being targeted and the sensitive periods for visual development.

7.3.1 Newborn

Screening for congenital eye conditions should take place as close to birth as possible¹⁹. Unilateral congenital cataracts are most effectively treated in the first six weeks of life and bilateral cataract within the first ten weeks due to the severity of amblyopia caused by delayed treatment²⁶. Additionally, screening early in the neonatal period facilitates the early diagnosis and treatment of retinoblastoma²⁷.

7.3.2 Preschool

There are no RCTs directly comparing screening for refractive or strabismic amblyopia in different age groups, however there is strong evidence for improved outcomes with amblyopia treatment before 7 years of age⁴. Systematic reviews have reported indirect evidence supporting screening in children aged 3-5 years, to facilitate early treatment. Currently, there is insufficient evidence for, or against screening and testability can be limited in asymptomatic children less than 3 years old^{16,17,19}. In a NZ study, Goodman et al²⁸ found no evidence of benefit from screening children at age two years, as test results were poorly predictive of visual impairment at age four years.

7.3 Summary

There are two key times for vision screening in children to prevent amblyopia: in the neonatal period (as close to birth as possible and during the preschool years (age 3-5 years)).

7.4 Question 3: What tests are available to screen for amblyogenic factors in infants and children (0-5 years)?

7.4.1 Newborn

The red reflex test is performed to detect media opacities such as cataract or retinoblastoma²⁷. This test can have acceptable sensitivity and specificity when performed by trained specialists²⁷. However, in NZ it appears less accurate, with high false positive rates and some cases of congenital cataract may be missed^{29,30}. Some of the LMCs conducting these tests have highlighted the need and desire for more training^{30,31}.

7.4.2 Preschool

Systematic reviews argue methodological variation precludes test recommendation^{16-18,32}, but guidelines promote certain VA tests and certain auto-refractors and photo screeners^{8,33} (which provide automated detection of refractive error, and in some cases strabismus). The Vision in Pre-schoolers (VIP) study directly compared several screening tests and found that the Lea Symbols VA test and two auto-refractors were the most accurate when used as a stand-alone screening tests³⁴⁻³⁶ (although VA tests took longer)^{34,35}. A 2019 meta-analysis found that two current photo screeners (Spot and Plusoptix) were both accurate for children under the age of 7 years³⁷. A 2017 systematic review concluded that a combination of tests is likely to be more effective than any isolated test¹⁷.

In contrast to the Lea Symbols VA test, as well as certain auto-refractors and photo screeners, there is little evidence for the accuracy of the Parr VA test, currently used at the B4SC. There is an ongoing study comparing the accuracy of the Parr VA test to the Lea Symbols VA test and the Spot vision screener, in NZ preschool children.

7.4.3 Comment on innovation

New approaches to vision screening include the use of the infrared reflex³⁸ and RetCam images³⁹ as alternatives to the red reflex test, the use of simple cameras for automatic detection of refractive error^{40,41}, and the use of electronic VA tests⁴²⁻⁴⁴ (including inferring VA from reflexive eye movements⁴⁵). These options are appealing, particularly when they can help prevent common errors made during testing⁴⁶ and can improve referral processes. Some of these innovations are being developed⁴⁴⁻⁴⁶ and tested³⁹ in NZ.

7.4 Summary

The red reflex at birth, and either a VA screening or automated vision screening (auto-refraction or photo screening) at age 3-5 years, are effective to detect amblyopia and its risk factors.

7.5 Question 4: What interventions are effective for amblyopia and its risk factors?

Treatment of the amblyopia risk factor is the first step of amblyopia treatment, accomplished by surgery and/or providing spectacle correction. Glasses alone are an effective first line of treatment for strabismic and anisometropic amblyopia, with a mean resolution rate of 32% of unilateral⁴⁷, and at least 73% of bilateral cases⁴⁸.

If amblyopia persists after optical treatment, there is good evidence from several RCTs that patching the stronger eye is effective to improve VA^{4,17,49,50}. Atropine drops to blur the stronger eye are equally as effective⁵¹ and can be tolerated moderately better than patching⁵² (but can have side effects, such as light sensitivity)⁵³. The benefits of both patching and atropine remain over the long-term^{53,54}. Although used clinically, there is currently insufficient evidence to establish whether or not these additional treatments are effective for bilateral amblyopia⁴⁹ or deprivation amblyopia⁵⁵.

7.5.1 Comment on Innovation

Since adherence is often a challenge for conventional treatment⁵³, more engaging binocular treatment options (based on watching movies and playing games) are the subject of extensive research^{56,57}. Currently however, there is insufficient evidence to say whether these treatments are effective⁵⁸, and results from recent clinical trials (one based in NZ⁵⁶) are less promising than hoped^{56,57}.

7.5 Summary

Treatment of amblyopia requires removal of risk factors, and spectacle correction. Patching or atropine drops are both effective for treatment of residual unilateral amblyopia.

7.6 Question 5: What are the long-term impacts of amblyopia?

Bilateral vision impairment is known to impact on children's learning, development and quality of life,^{1,17} and if left untreated can result in permanent visual disability due to bilateral amblyopia.⁴⁹

The impact of unilateral vision impairment is less clear^{18,59}. Unilateral amblyopia is associated with impairments in grasping, walking, driving and reading⁶⁰, increased risk of bilateral vision impairment due to injury or disease in the less-affected eye^{59,61} and possible lower academic standing⁶¹ (although a study in NZ did not find differences in education or income measures)²⁰. Although population studies tend to show low impact at a group level^{20,61}, growing evidence points to a more substantial impact⁶²⁻⁶⁴, in particular for individuals interested in pursuits requiring refined VA or stereopsis⁶⁴. Whether these factors translate to a quantifiable decrease in quality of life (or 'utility') requires more research. One study of adults with unilateral amblyopia found, on average, a decrease in utility of 3.7% (using the time trade-off method)⁶⁵.

When balanced against the relatively subtle adverse impact of unilateral amblyopia, the impact of penalisation treatment is an important consideration. Although systematic reviews agree that patching can lead to social distress^{29,66} and bullying¹⁸, most conclude that rigorous studies are needed to understand the factors involved in these phenomena^{16-18,59}. Earlier treatment (to reduce likelihood of patching or atropine at school^{18,67}) and innovative binocular treatments (if found to be effective) are likely to reduce the potential adverse impact of treating amblyopia.

7.6 Summary

Bilateral vision impairment negatively impacts a child's quality of life. Although it appears that unilateral amblyopia has an impact on quality of life, more research is needed. Treating amblyopia likely causes some distress, which can be minimised by early treatment.

7.7 Question 6: Should we consider screening for non-amblyogenic vision disorders such as refractive error (myopia, hypermetropia, astigmatism)?

While the B4SC VA screening is effective for detecting amblyopia, early-onset myopia and some vision impairment, it is not targeted to detect hypermetropia or astigmatism. A recent study conducted full eye examinations in a group of 114 mainly Māori and Pacific children who had, 2 years prior, completed the B4SC. At 6 years of age, 3.5% had myopia, 6.1% had hypermetropia and 24.1% had astigmatism. Approximately half of these children with refractive error passed the B4SC (*study in preparation for publication*).

Uncorrected refractive error and reduced visual acuity have been found to impact academic performance¹. The VIP study found uncorrected hypermetropia is associated with reduced VA and stereoacuity, development of strabismus and amblyopia⁶⁸, deficits in attention⁶⁹ and reduced preschool early literacy scores⁷⁰. Recent studies report an association between astigmatism and poorer academic readiness in pre-schoolers⁷¹ and with poorer performance on cognitive, language and fine motor tasks⁷². In a longitudinal study, Bruce et al⁷³ found children with refractive error who were compliant with spectacle wear had improved VA and early literacy compared with those who were non-compliant.

Although the B4SC detects early-onset myopia, most myopia develops in school-aged children⁷⁴. Myopia is critically important because it is a leading cause of distance visual impairment worldwide⁷⁵, prevalence is increasing rapidly⁷⁵ and more cases are progressing to 'high myopia' which increases the risk of ocular disease including cataract, glaucoma and retinal conditions⁷⁶. There are now treatments to reduce myopia progression⁷⁷ and uncorrected myopia is associated with myopia progression⁷⁷; making prompt detection and treatment important to maintaining quality vision and eye health. Correction of moderate myopia has also been shown to improve self-reported visual functioning in children⁷⁸.

7.7 Summary

Non-amblyogenic refractive errors are associated with reduced educational outcomes.

Prompt detection and treatment of myopia is likely to reduce progression and the likelihood of future ocular pathology.

7.8 Question 7: Are there any known harms associated with vision screening?

Many NZ children who are referred for further assessment after the B4SC do not have amblyopia. Some of these children have refractive error (which may or may not be amblyogenic), whereas others have normal vision. The proportion of children with normal vision who are referred has been estimated at 31% and 47.4% in Counties-Manukau District Health Board (DHB)^{3,79}, 56.7% in the Southern DHB and 58.1% in Tairāwhiti DHB⁸⁰. These studies suggest that very few children with amblyopia pass the B4SC vision test^{3,80}, although none have measured this directly. Suggestions for decreasing the number of unnecessary referrals include changing the referral criteria and/or the screening test^{3,79,80}.

One downside of over-referral is waste; in the form of time, resource and parental concern. Systematic reviews addressing the potential harms of screening found insufficient evidence linking false positives with negative health outcomes^{17,59,81}. Although over-prescription could be a concern⁸², so could be under-prescription. As noted in Question 6, correction of non-amblyogenic refractive error can improve academic outcomes, but are not currently targeted by the B4SC. The mismatch between targeted conditions and public perception about a 'pass' means, can result in children who might benefit from glasses being less likely to receive them.

Another potential harm is screening without a process for referral and treatment; concern that NZ children failing the B4SC may not find their way to an eye examination has been raised⁸⁰.

7.8 Summary

Clarifying targeted conditions and matching these with appropriate referral cut-offs is important to balance the potential harms of over- and under-referral.

Poor referral processes can prevent children who fail from accessing further assessment or treatment.

7.9 Question 8: What is the cost-effectiveness of vision screening in childhood?

The impact of a condition on quality of life, or 'utility', is required for analysis of cost-effectiveness. From Question 5, we know that an estimate of 3.7%⁶⁵ may be reasonable for unilateral amblyopia, but more evidence is needed. Assuming a utility of 1 to 4%, amblyopia treatment appears to be cost effective^{83,84}. Cost-effectiveness is more complex when screening is included as part of the analysis due to variability in screening protocol. A UK report addressing this complexity concluded that VA screening at age 3 or 4 years is likely cost-effective if utility of 2% is assumed¹⁸. A model using similar data suggested this remains true even with a utility of only 1%⁸⁵. However, overall the evidence is weak because of the uncertainty of utility estimates^{9,18}.

A model of school-based screening later in childhood demonstrated that detection of refractive error and provision of refractive correction is highly cost effective when considered against the expected years lost due to disability associated with bilateral visual impairment⁸⁶. A recent review supports this finding, demonstrating the significant improvement in health utility gained through refractive correction for amblyopia or refractive error⁸⁷.

7.9 Summary

There is a lack of evidence around the cost effectiveness of vision screening for unilateral amblyopia, but stronger evidence for the cost effectiveness of detecting bilateral vision impairment and provision of glasses.

7.10 Question 9: What do we know from a Māori and Pacific knowledge basis about vision screening?

There is a paucity of evidence relating to vision screening in Māori and Pacific children. We do know that across NZ, Māori and Pacific children are less likely to participate in the B4SC⁸⁸; 14.0% of Māori and 15.1% of Pacific children did not receive a vision screening in the period 1 July 2011 to 20 June 2015, compared with 9% of European and 8.7% of Asian children (Appendix III). Among screened children, it appears the test further disadvantages these groups; 3.6% of Māori and 2.7% of Pacific children are unable to complete the VA test (compared to 1.9% of European and 1.7% of Asian children – Appendix III). Note that the Parr test is available in English and Te Reo versions, but it is not clear when each is used, or if they have similar sensitivity and specificity.

More generally, whānau of Māori and Pacific ethnicity are overrepresented within areas of high socioeconomic deprivation. Internationally, low income increases the likelihood of a childhood vision disorder, reduces attendance at screening programmes, and poses barriers to diagnosis and appropriate treatment⁸⁹.

7.10 Summary

Māori and Pacific whānau are less likely to participate in vision screening, and more likely to be untestable when they do, despite potentially higher likelihood of a vision disorder.

7.11 Summary of evidence for graded recommendations

Overall, the evidence within this rapid review suggests that childhood vision screening can prevent or minimise amblyopia and promote educational outcomes. Quantifying this conclusion facilitates action on a policy level. As such, after completion of the review, we were asked to grade recommendations based on estimated net benefit, and the associated level of certainty. The process through which the grades were generated is outlined in [Appendix IV](#), and the summary is provided in Table 7.3.

Table 7.3. Graded evaluation of vision screening and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Newborn vision screening with the red reflex test for congenital eye conditions	B	Moderate	Moderate	We recommend universal birth and 6 week ocular health screen for all newborn babies.
6-month to 3-year vision screening with vision screeners for amblyopia and its risk factors	I	Moderate	Low	There is currently insufficient evidence to support universal implementation of this screening intervention.
3 to 5-year vision screening with VA tests and/or vision screeners for amblyopia and its risk factors	B	Moderate	Moderate	We recommend universal vision screening between 3 and 5 years of age.
3 to 5-year vision screening with VA tests and vision screeners for non-amblyogenic refractive error	I	Moderate	Low	There is currently insufficient evidence to support universal implementation of this screening intervention.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

To recommend a screening intervention, we needed at least moderate certainty that the answers to three questions were yes; 'Does the condition matter?', 'Are the tests acceptable?', and 'Is there an effective treatment?'. Overall, this was the case for screening newborns for congenital eye conditions using the red reflex test, and screening preschool children for amblyopia and its risk factors with VA tests and/or suitable automated vision screeners. In NZ, we currently complete these two recommended screenings, however, implementation should be improved to achieve these potential benefits. Recommendations for improvement are provided in the next section.

For 6-month to 3-year old screening for amblyopia and its risk factors, we questioned evidence about the accuracy of screening tests, leading to a current conclusion of 'insufficient evidence'. With innovation and continued research, screening tools will continue to improve, and will likely lead to an updated recommendation in the future.

For non-amblyogenic refractive error screening there was insufficient evidence at this time to support universal screening in the 3-5 year old age group. However, refractive error (particularly myopia), becomes increasingly prevalent later in childhood and its correction (with spectacles) improves educational outcomes. We have not sufficiently reviewed the evidence to make a recommendation about the benefits or level of certainty around vision screening for refractive error in school aged children. This needs further consideration and needs to be considered alongside pre-school aged vision screening.

The recommendations for amblyopia screening from 6 months through to 5 years are consistent with the 2017 recommendation from the US Preventive Services Task Force in the USA¹² (note that neither newborn screening, nor screening for non-amblyogenic refractive error were considered by USPSTF).

7.12 Recommendations for further action

Policy and practice

Prevalence and impact

- Regular review of the prevalence and impact of targeted conditions and optimal timing for vision screening.

Screening Protocols

- Improve training for LMCs and VHTs to ensure tests are being carried out correctly across the country.
- Update the B4SC VA test to one with a stronger evidence base.
- Consider adding an auto-refractor or photo screener to the B4SC screening protocol.
- Ensure that referral cut-offs are well-defined and reflect screening goals.
- Regular review of screening protocols to allow integration of innovative tools.
- Reconsider the timing/test selection of the year 7 vision screening, to identify non-amblyogenic refractive errors which become more prevalent later in childhood (> 5 years), particularly myopia.
- Changes should be piloted by LMC/VHTs within sufficiently diverse communities to ensure the testing and protocols are as accurate as possible across NZ.

Systems and barriers

- Ensure screening and referral processes are consistent within and between DHBs.
- Ensure children who are not screened (or had uncompleted rescreens) complete vision screening on school entry.
- Centralise referral pathways and data systems to facilitate the transition between a failed screen and full assessment.
- Increase access to treatment (such as spectacles) by improving subsidies.

Equity

- Ensure the screening tests used are appropriate for all children.
- Consider additional screening (timepoints and/or tests) for children from Māori and Pacific and low socioeconomic whānau.
- Promote diversity of our screeners and health care providers and consider implementing health care models which consider wider social context, such as Meihana90.

Further research

Prevalence and impact

- More data on prevalence of refractive error, visual impairment and amblyopia and its risk factors are needed.
- Investigate the impact of each of these conditions on educational and developmental outcomes, as well as quality of life.
- Prevalence and impact should be investigated across different ethnicities, socio-economic and geographic regions of NZ.

Screening Protocols

- Research comparing current protocol to established VA tests, as well as auto-refractors and photo screeners, including analysis of optimal referral cut-offs.
- Continuation of NZ-based innovation in vision screening assessment tools, and research which enables transition of these tools to population-wide use.
- Accuracy and suitability of tests should be investigated across different ethnicities, socio-economic and geographic regions of NZ.

Systems and barriers

- Evaluate current processes within and between DHBs.
- Research into integration of screening and clinical referral pathways.
- Research into barriers to access to screening, referral and treatment.

Equity

- Research into the specific barriers Māori and Pacific whānau face that prevent them from accessing screening
- Investigate appropriateness of screening tests across ethnicities
- Explore how Māori and Pacific health care models could be translated into more effective vision screening, referral and treatment.

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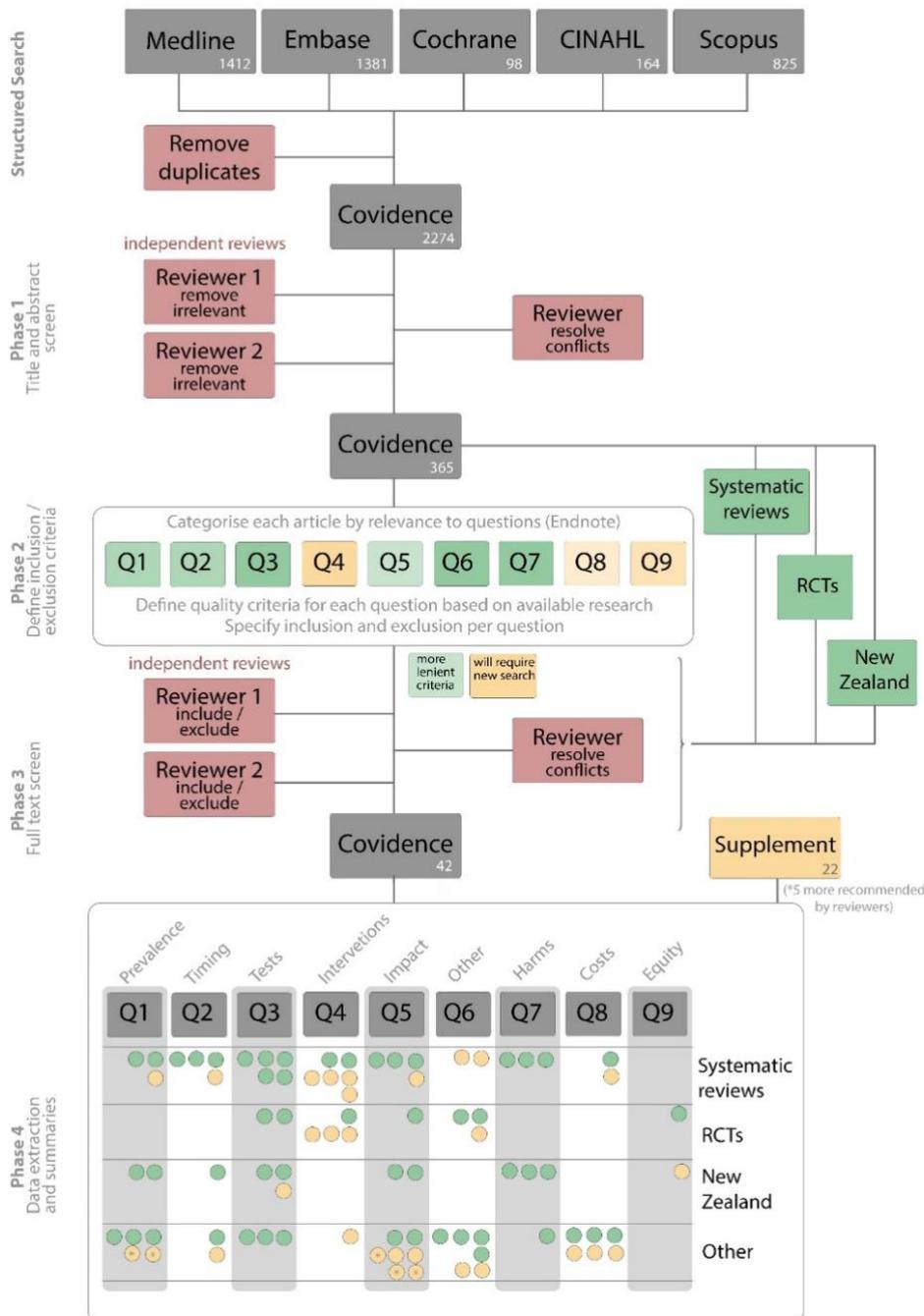
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Appendix I: Review methods

Overview

Although we did not have time for a systematic review, we did run a structured search as outlined in the main document. Due to the wide range of topics addressed in the questions, we ran a supplemental (unstructured) search for individual questions to capture available sources. The overview of this process is presented Figure 7.1. Details about included studies presented in the tables, and the search strategy is included after the tables.

Figure 7.1. Overview of literature search methods.
 (Covidence is a software developed to facilitate systematic reviews)



Question 1: What is the prevalence of amblyopia in infants and children aged 0-5 years

First author	Year	Type	Location	Age range	Sample size	Targeted conditions	Screening Protocol in area	VA cut off or definition	Reported prevalence	Strengths	Limitations	Comments
Wilson ²⁰	2013	Prospective, longitudinal birth cohort study	Dunedin, NZ	Multiple measures at different ages	1,037	amblyopia, possible amblyopia and recovered amblyopia	No screening when cohort was 3-5 years old	1) 6/12 VA in at least one eye, or a two-line difference 2) 6/9 VA in at least one eye	1) 1.8% and 2) 3.5%	excellent design and important local data	mostly European and started in the 1970s, so may not be current	key prevalence data from NZ
Langeslag-Smith ³	2015	Retrospective audit	Auckland, NZ	3-5 year olds	556	amblyopia and its risk factors, refractive error and pathology	universal screening	various cut offs for VA, refractive error and strabismus angle	4.5%	Local data	potential false positives not included in prevalence	
Mathers ¹⁹	2010	Systematic review	International (Australia)	children	NA	amblyopia, refractive error and strabismus	varied	not stated	Listed in table		not an structured meta-analysis	Data from other sources
Powell ¹⁰	2009	Systematic review	International (UK)		0	anisometropic and strabismic amblyopia	NA	NA	NA	rigorous review	no studies met inclusion criteria (RCTs of screened vs unscreened populations)	very specific question with an inconclusive answer
Powell ¹¹	2005	Systematic review	International (UK)		0	anisometropic and strabismic amblyopia	NA	NA	NA	rigorous review	no studies met inclusion criteria (RCTs of screened vs unscreened populations)	very specific question with an inconclusive answer
Hoeg ²¹	2015	population-based cross-sectional study	Denmark	tested in adulthood Group 1: no screening, Group 2: screened	3,826	amblyopia	only for one group	worse than 6/12 VA in at least on eye and at least a 2 line difference between eyes	no screening: 1.78%, Screening: 0.44%	estimated prevalence in screen and unscreened population	not RCT	no one in screened population had bilateral amblyopia

First author	Year	Type	Location	Age range	Sample size	Targeted conditions	Screening Protocol in area	VA cut off or definition	Reported prevalence	Strengths	Limitations	Comments
Thorisdottir ²⁵	2019	population-based cross-sectional study	Sweden	tested in adulthood Group 1: no screening, Group 2: screened	Group 1: 1500 Group 2: 2626	amblyopia	only for one group	6/9 VA or worse in at least on eye and at least a 2 line difference between eyes	no screening: 3.3%, Screening: 0.9%	estimated prevalence in screen and unscreened population	not RCT	only 2 people in the screening group (out of 23) had bilateral amblyopia
Dikova ²²	2018	Cross-sectional	Bulgaria	4-10 years	1,675	amblyopia	none in country	VA 6/12 or worse in at least one eye	2.5% (73% unilateral, 27% bilateral)	included, and reported on bilateral cases		
Sheeladevi ²³	2016	Systematic meta-analysis	International (UK)	<18 years	24 studies included	childhood cataract	varied	clinical diagnosis of cataract	congenital: 0.63 to 9.74/10,000 childhood: 0.32 to 22.9/10,000	Excellent meta-analysis		
Nagamoto ²⁴	2015	Questionnaire	Japan	<19 years	521	childhood cataract	not reported	clinical diagnosis of cataract	reported on proportion bilateral (65.8%) and unilateral (34.2%)	study design relied on reporting from facilities		

Question 2: When is the optimal time(s) to screen for amblyogenic factors?

First author	Year	Type	Location	Age range	Sample size	Targeted conditions	Screening Protocol used (tests)	Outcome/Recommendation	Comments
Cagini ²⁷	2017	Primary Cross-sectional	Italy	1-3 days	22,885	Ocular abnormalities	Red reflex	High false positive rate, however useful test for detection of congenital eye disease	Relatively small numbers for a rare condition
Mathers ¹⁹	2010	Systematic review	Australia	Neonatal period	N/A	Congenital abnormalities	Red reflex, external inspection, pupil exam	Recommend screening in neonatal period, inconsistent evidence 6 months to 3 years, Supports vision screening in children 3-5 years	Recommendation in neonatal category based on expert opinion
Chan ²⁶	2012	Review	International review	0-12 months	N/A	Congenital cataract		Unilateral intervention before 6 weeks gives optimum VA outcome, Bilateral intervention before 10 weeks reduces poor visual outcomes	
Chou ¹⁶	2011	Systematic review	International review (USA)	Strict quality check	N/A			Lack of evidence to support screening in this age group 6 months to 5 years, lower testability in younger children, Supports vision screening in children 3-5 years	
Jonas ¹⁷	2017	Systematic review	International review (USA)	Strict quality check	N/A			Lack of evidence to support screening in this age group, lower testability in younger children	
Goodman ²⁸	2018	Prospective cohort	NZ	2-4.5 years	355	Reduced visual acuity		Do not support vision screening in this age group, testing at 2 years poorly predictive of vision impairment at 4-5 years	Special population – infants born at risk of neonatal hypoglycaemia (may not be applicable to general population)
Holmes ⁴	2011	Meta-analysis of RCTs	USA	3-13 years	996	Unilateral amblyopia	Patching, atropine, Bangerter filters	Amblyopia is more responsive to treatment in children <7 years	

Question 3: What tests are available to screen for amblyogenic factors in infants and children (0-5 years)?

Newborns

First author	Year	Type	Location	Sample size	Instrument	Screeener (who?)	Strengths	Weaknesses	Summary
Cagini ²⁷	2017	Cross-sectional	Italy	22,884	red reflex	neonatologist or paediatrician (trained specifically on red reflex screening)	calculates sensitivity (100%) and specificity (97.7%)	Although sensitivity is reported, not directly measured	suggests that the red reflex is an appropriate test to screen for cataracts and retinoblastoma (when screeners are well trained)
Fry ³¹	2005	Survey	Nelson-Tasman, NZ	117	red reflex	NA	excellent uptake within region		suggests that much more training is needed
Hamm ²⁹	2019	Qualitative	Auckland, NZ	20	red reflex	NA	qualitative work - interviewing families of children with cataracts		some children with cataracts in NZ missed by red reflex test
Raouf ³⁰	2016	Survey	Auckland, NZ	483	red reflex	NA	large online questionnaire to assess practices and attitudes about the red reflex screening test.		suggests that more training helpful

6 months to 5 years

First author	Year	Type	Location	Age range	Sample size	Instrument	Targeted conditions	Strengths	Weaknesses	Summary
Carlton ¹⁸	2008	Systematic review	International (UK)		NA	many	Amblyopia and its risk factors	Comprehensive summary		Many different tests may be useful, but auto-refraction improved screening efficiency
Chou ¹⁶	2011	Systematic review	International (USA)	1-5 years	NA	many	Impaired visual acuity and amblyopia	Structured review, excellent quality		Several tests have utility to detect vision problems in preschool children, but are generally less effective in toddlers because of testability
Jonas ¹⁷	2017	Systematic review	International (USA)	6 months to 5 years	40 studies, 34,709 subjects	many	amblyopia and its risk factors	used highest quality available evidence with rigorous checks.	could not do quantitative meta-analysis because of heterogeneity of studies	1) insufficient evidence for screening at between 6 months and 3 years 2) Indirect moderate evidence for screening between 3 and 5 years with several different tests

First author	Year	Type	Location	Age range	Sample size	Instrument	Targeted conditions	Strengths	Weaknesses	Summary
Cotter³³	2015	Guidelines	USA	36 to <72 months	NA	many	amblyopia and its risk factors	Practical recommendations for practice.	Expert panel not systematic review or meta-analysis	Recommend Lea, HOTV, and/or some auto refractors
Wallace⁸	2018	Guidelines	USA	0-6 years	NA	many	many	Recommendations for practice. Weakness: Expert panel not systematic review or meta-analysis	not a systematic review, between review and guidelines	Recommend Red reflex (from birth), Lea, HOTV or Sloan letters
Schmucker⁸¹	2009	Systematic Review	International (Germany)	0-6 years	2 studies met inclusion criteria	many	amblyopia	rigorous inclusion/exclusion	too few studies met criteria to perform meta-analysis	Concludes there is not sufficiently rigorous definitions and protocols to compare screening tests between studies.
Zhang³⁷	2019	Systematic Review	International (China/USA)	All ages (but we report sub-analysis of children <7 years)	21 studies including 5022 subjects	Spot and Plusoptix Vision Screeners	amblyopia and its risk factors	completed a meta-analysis to calculate sensitivity (Spot=91.7%, Plusoptix=90.2%) and specificity (Spot=82.6%, Plusoptix 93.0%)	many variables within included papers, and there were not enough children under 3 to evaluate the 6 month-3 year age range.	Suggests that both Spot and Plusoptix Vision Screeners are effective for detecting amblyopia in children under 7 years of age
VIP Group³⁴ (Schmidt)	2004	RCT	USA	3-5 years	2588	compared many tests	Three groups defined by clinical relevance	Excellent RCT, allowed direct comparison of many screening tests (Lea test 89% specificity at 90% sensitivity)		excellent evidence for use of Lea, Retinomax and SureSight
VIP Group³⁵	2005	RCT	USA	3-5 years	2588	compared many tests	four groups: (amblyopia, strabismus, refractive error, and reduced VA)	excellent RCT, allowed direct comparison of many screening tests (Lea 85% sensitivity at 94% specificity)		excellent evidence for use of Lea, Retinomax and SureSight
Anstice⁷⁹	2012	Retrospective audit	Auckland, NZ	3-5 year olds	131	uncrowded Parr	amblyopia and its risk factors, refractive error and pathology	local data	retrospective and do not know about children who passed, or did not attend follow up appointments	report positive predictive value of 47.4% (many false positive referrals)
Langeslag-Smith³	2015	Retrospective audit	Auckland, NZ	3-5 year olds	556	crowded Parr	amblyopia and its risk factors, refractive error and pathology	local data	retrospective and do not know about children who passed, or did not attend follow up appointments	report positive predictive value of 31% (many false positive referrals)

First author	Year	Type	Location	Age range	Sample size	Instrument	Targeted conditions	Strengths	Weaknesses	Summary
Muller ⁸⁰	2019	Retrospective audit	Gisborne and South Island, NZ	4 year olds	116	Parr	amblyopia and its risk factors refractive error and pathology	local data, estimated sensitivity from 54.7%-94.7% and specificity at 93.8% to 95.7%	retrospective and do not know about children who passed, or did not attend follow up appointments	estimate positive predictive value between 29.5 and 51.1% (many false positive referrals)

Examples of innovative tools (across all ages)

First author	Year	Location	Age range	Sample size	Instrument	Reference instrument	Targeted conditions	Who conducted the test	Outcome	Summary
Duret ³⁸	2019	UK	infants to 13 years	200	infrared reflex using prototype device (smartphone with co-axial IR-emitting diode and IR camera)	Red reflex with ophthalmoscope	neonate and childhood cataract	medical students (IR and R), and experienced midwives (R)	better outcome for IR than red reflex	suggests infrared light and cameras may be improve currently used Red reflex test
Simkin ³⁹	2019	Auckland, NZ	Infants	346	Retcam images reviewed by ophthalmologist	NA	ocular abnormalities, including retinal haemorrhages.	technician took images, paediatric ophthalmologist graded all images	primarily reported prevalence of ocular anomalies	suggests the red reflex exam has problems, and more comprehensive options feasible
Peterseim ⁴¹	2018	USA	6 months to 7 years	206	GO Check Kids Vision Screener' smartphone app photo screener	Full eye exam	amblyopia and amblyogenic risk factors	medical students	Sensitivity 76%, specific 67%	suggests automated screening for amblyopia risk factors improves testability
Sangi ⁴⁵	2015	Auckland, NZ	2-year-olds	5	optokinetic nystagmus test using video (not eye trackers)	manual detection of optokinetic nystagmus	none	researcher	Sensitivity 89%, specificity 99% (compared to manual detection)	suggests measuring an ocular reflex to moving targets may be a feasible option to explore
Aslam ⁴²	2016	UK	4-16 years	112	tablet VA test using Landolt "C" (gamified)	EDTRS VA chart	none - just interested in comparing VA measures across range of conditions	automated (child completed the test alone in a booth)	Agreement with reference tests +/- 0.208 logMAR	suggests childhood self-assessment is feasible
Hamm ⁴⁴	2018	Auckland, NZ	5-12 years	121	tablet VA system using TAO symbols	full eye exam/EVA system	amblyopia and amblyogenic risk factors	researcher	Agreement with reference test: TAO Regular =0.14 logMAR, TAO Vanishing = 0.15, Parr = 0.15 logMAR	suggest a different VA test may be an improvement over currently used PARR test

First author	Year	Location	Age range	Sample size	Instrument	Reference instrument	Targeted conditions	Who conducted the test	Outcome	Summary
Hamm ⁹¹	2019	Auckland, NZ	7-year-olds	33	tablet VA test with distance tracking	NA	none	lay screener	tests at 150cm or closer should account for test distance to test	suggests tracking distance with webcam is feasible and important if testing at or closer than 150cm
Bani ⁴⁰	2013	India	adults	138	consumer digital camera with 10x optical zoom, images taken and graded	existing diagnosis	amblyopia and amblyogenic risk factors	researcher/ clinician	sensitivity 86%, specificity 85%	suggests consumer grade equipment can function as a photo screener

Question 4: What interventions are effective for amblyopia and its risk factors?

First author	Year	Type	Location	Age range	n	Amblyopia type	Intervention	Outcome	Strengths	Weaknesses	Adverse effects
Asper ⁴⁷	2018	Systematic review (invited)	International (Australia)	3-17 years	29 studies (20 used for effect size calculation)	anisometropia, strabismus and combined	glasses (optical treatment or refractive adaptation)	Glasses alone works to improve VA	Could complete quantitative meta-analysis	first round of screening not independent	none reported
Clarke ⁵⁰	2003	RCT	UK	3-5 years	177	anisometropia, strabismus and combined	1) glasses + patching, 2) glasses alone, 3) no treatment	Glasses + patching, then glasses alone are best if VA starts worse than 6/9	Compared 3 groups from screening through to treatment	only followed up for short time (because cross over design)	none reported
Jonas ¹⁷	2017	Systematic review	International (USA)	6 months - 5 years	2 RCTs, 240 participants	anisometropia, strabismus and combined	patching	Patching works to improve VA (mean 1-2 lines)	Rigorous overview		none reported
Holmes ⁴	2011	Systematic review	International (USA)	3 to 13 years	4 RCTs	unilateral amblyopia	patching	VA improvements higher in children less than 7 than in children older than 7 (1-5 lines)	Meta-analysis on age as a factor for effectiveness of treatment		none reported
Taylor ⁴⁹	2012	Cochrane systematic review	International (UK)	any age	0 RCTs found	bilateral amblyopia	glasses and patching	Not enough evidence	Rigorous methodology	insufficient evidence for bilateral amblyopia (no RCTs)	NA
PEDIG ⁵¹	2002	RCT	USA	3-7 years	419	anisometropia, strabismus and combined	either patching or atropine	Patching and atropine are equally effective (1-3 lines)	Direct comparison of patching to atropine		reports of mild skin irritation (patching) and light sensitivity (atropine)
PEDIG ⁵²	2003	RCT follow up	USA	3-7 years	364 of 419 completed questionnaire	anisometropia, strabismus and combined	either patching or atropine	Although atropine and patching were both tolerated well, patching performed worse overall and on all 3 subscales	Direct comparison of patching to atropine	questionnaire measures have flaws (ie limited to questions asked)	patching had higher scores than patching for adverse effects compliance, and social stigma

First author	Year	Type	Location	Age range	n	Amblyopia type	Intervention	Outcome	Strengths	Weaknesses	Adverse effects
Repka ⁵⁴	2014	RCT follow up	USA	15 years	147 participants took part in this follow up	anisometropia, strabismus and combined	either patching or atropine	Gains from original treatment were maintained in both groups	Long-time follow up on 2002 PEDIG study		not noted
Antonio-Santos ⁵⁵	2014	Cochrane systematic review	International (USA and UK)	any age	0 RCTs found	stimulus deprivation amblyopia	patching or atropine	not enough evidence	Rigorous methodology	Insufficient evidence for stimulus deprivation amblyopia (no RCTs)	NA

Question 5: What are the long-term impacts of amblyopia?

Impact of bilateral amblyopia

First author	Year	Type	Location	Targeted conditions	Outcome/Recommendation	Strength	Weakness
Jonas ¹⁷	2017	Systematic review	International (USA)		Without treatment vision loss can become irreversible		Not primary topic of review
Hopkins ¹	2019	Invited review	International (Australia)	Visual acuity, refractive error	Association between both visual acuity and refractive error and academic performance	Convenient summary	Not systematic, may have bias
Taylor ⁴⁹	2012	Cochrane review	International (USA and UK)	Unilateral and bilateral refractive amblyopia	Poor improvement in VA when non-compliant with refractive correction	Rigorous methodology	Not about impact directly

Impact of unilateral amblyopia

First author	Year	Type	Age range	n	Location	Setting	Outcome/Recommendation	Strength	Weakness
Carlton ¹⁸	2008	Systematic review	Children and adults	NA	International (UK)		Lack of paediatric specific data on QoL with amblyopia	Comprehensive	No quality check
Solebo ⁵⁹	2015	Systematic review	4-5 years	NA	International (UK)			Comprehensive	No quality check
Grant ⁶⁰	2011	Review	Children and adults	NA	International (UK)	Lab-based	Unilateral amblyopia associated with impairments in reaching, grasping, driving and reading	Compiles lots of primary studies	Study selection may be biased
Wilson ²⁰	2013	Prospective longitudinal Population-based survey	Adults followed up from childhood	1,037	New Zealand (Dunedin)	Clinical	No evidence of poorer motor development, lower self esteem or reduced adult SES in participants with amblyopia	Generalizable metrics (Child: motor control, Teen: stress, Adult: SES)	Measures may be insensitive to vision specific loss
van de Graaf ⁶⁵	2010	Utility Estimation for amblyopia (TTO and SC)	Adult	135	The Netherlands	Clinical		Asked participants to quantify impact of amblyopic vision loss	Large gap between TTO results (3.5%) and SC results (0.0006%)
Chua ⁶¹	2004	Prospective longitudinal Population-based survey	Adults	3654	Australia (Blue Mountains)	Clinical	Amblyopia did not affect occupation but fewer completed university degrees, increased risk bilateral visual impairment	Used generalizable factors	Measures may be insensitive to vision specific loss

First author	Year	Type	Age range	n	Location	Setting	Outcome/Recommendation	Strength	Weakness
Webber ⁶⁴	2018	Invited review	All ages	NA	International (Australia)		Amblyopia results in poorer outcomes on tests of skills required for everyday tasks and which relate to childhood academic performance	Convenient summary	Not systematic, may have bias
Birch ⁶²	2019	Cross-sectional	3-7 years	110	USA	Lab-based	Amblyopia associated with lower self-perception and reduced physical competence		Lab-based, not population
Birch ⁶³	2019	Cross-sectional	8-13 years	81	USA	Lab-based	Amblyopia associated with lower self-perception, slower reading speed and reduced motor skills		Lab-based, not population

Impact of unilateral amblyopia treatment

First author	Year	Type	Location	Strength	Weakness
Jonas ¹⁷	2017	Systematic review	International (USA)		
Solebo ⁵⁹	2015	Systematic review	International (UK)	Comprehensive	No quality check
Carlton ¹⁸	2008	Systematic review	International (UK)	Comprehensive	No quality check
Hrisos ⁶⁶	2004	RCT follow up	USA	Compared 3 groups from screening through to treatment	Did not get data from all participants (81% of surveys returned)
Hamm ²⁹	2019	Qualitative	NZ	Parents reflected on treatment experience	Subjective experience, did not try to quantify Convenient sample
Williams ⁶⁷	2006	Commentary	UK	Reflection by authors of ALSPAC study (RCT) – so used in the context of that RCT	Type: Commentary does not meet inclusion criteria

Question 6: Should we consider screening for non-amblyogenic vision disorders such as refractive error (myopia, hypermetropia, astigmatism)?

First author	Year	Type	Location	Age range	Sample size	Participant details	Targeted conditions	Cut-offs (definition)	Measure of impact	Outcome/Recommendation
Hopkins ¹	2019	Invited review	International (Australia)	School age	N/A		Visual acuity, refractive error		Academic performance	Association between both visual acuity and refractive error and academic performance
Kulp ⁶⁸	2014	RCT (VIP)	USA	3-5 years	4040	Low income	Hyperopia and strabismus/amblyopia	>+3.25	Strabismus, Amblyopia	Children with hyperopia higher prevalence amblyopia and strabismus
Kulp ⁶⁹	2017	RCT (VIP)	USA	4-5 years	493	Low income	Hyperopia	≥+3.00	Attention	Hyperopia associated with reduced attention scores
Orlansky ⁷¹	2015	Cohort study	USA	3-5 years	122	Low income	Astigmatism	≥0.50	Academic readiness	Astigmatism associated with lower scores for tests of academic readiness
Harvey ⁷²	2018	Cohort study	USA	12-35 months	26	Recruited from well child screening failures	Astigmatism (moderate to high)	>2.00	Cognitive and language tasks	Astigmatism associated with poorer performance on cognitive, language and fine motor tasks
Bruce ⁷³	2018	Longitudinal study nested within birth cohort study	UK	4-5 years	801		Refractive error correction	Hyperopia ≥+1.00 Myopia ≤-0.50 Astigmatism ≥1.00	VA, Literacy	Children adherent to spectacle wear greater improvements in VA and improved early literacy
Kulp ⁷⁰	2016	RCT (VIP)	USA	4-5 years	492	Low income	Hyperopia	≥+2.00	Early literacy	Hyperopia ≥+4 or ≥+3 to ≤+6 with reduced near VA or reduced stereo acuity associated with reduced early literacy
Esteso ⁷⁸	2007	Cohort study	Mexico	12 years	88		Myopia	≤-1.25	Self-reported visual functioning	Improvements in self-reported functioning with spectacle correction

Question 7: Are there any known harms associated with vision screening?

First author	Year	Type	Location	Age range	Sample size	Targeted conditions	Screening method	Cut-offs (definition referral)	Cut-offs for eye exam	Outcome/Recommendation
Anstice ⁷⁹	2012	Retrospective audit	New Zealand	4-5 years	3273	Amblyopia	VA Parr chart	6/12 or worse either eye, or 6/6 one eye 6/9	Presence of ocular condition including refractive error (non-amblyogenic)	
Langeslag-Smith ³	2015	Retrospective audit	New Zealand	4-5 years	5572	Amblyopia	VA Parr chart	6/12 or worse either eye, or 6/6 one eye 6/9 other eye	Presence of ocular condition including refractive error (non-amblyogenic)	High rate of false positives
Muller ⁸⁰	2019	Retrospective audit	New Zealand	4-5years	2344	Amblyopia	VA Parr chart	6/12 or worse either eye, or 6/6 one eye 6/9 other eye	Presence of ocular condition including refractive error (non-amblyogenic)	High rate of false positives
Donahue ⁸²	2004	Retrospective audit	USA	1-5 years	102,508	Amblyogenic factors	MTI Photoscreener		Amblyopia risk factors	Spectacles prescribed for 19.5% of false positive referrals from screening (no amblyogenic factors)
Schmucker ⁸¹	2009	Systematic review	International (Germany)	<6 years	N/A					No adverse effect of false positive screenings found
Solebo ⁵⁹	2015	Systematic review	International (UK)	4-5 years	N/A					No adverse effect of false positive screenings found
Jonas ¹⁷	2017	Systematic review	International (USA)	6 months-5 years	N/A					High false positive rates in studies with low prevalence

Question 8: What is the cost-effectiveness of vision screening in childhood?

First author	Year	Type	Location	Strength	Weakness
Carlton ¹⁸	2008	Systematic Review to cost-utility analysis	UK	Includes screening through to treatment	
Rein ⁸⁵	2012	Model (assumed gain from treatment to be 0.99/1%)	USA	Includes screening through to treatment	
Baltussen ⁸⁶	2009	Model	The Netherlands	Includes screening through to treatment	Does not consider preschool age group
van de Graaf ⁶⁵	2010	Utility study	The Netherlands	Uses TTO and SG to estimate utility	
Membreno ⁸⁴	2002	Cost-utility analysis (assumed utility gain from treatment to be 3%)	USA	Includes surgical intervention. Still cost effective	Does not consider the costs of screening
Konig ⁸³	2004	Cost-utility analysis (Assumed utility of unilateral vision impairment at 0.96/4%)	Germany	Starting treatment at 3 years old (so relevant to screening)	Does not consider the costs of screening
Malvankar-Mehta ⁸⁷	2018	Systematic review of cost to families of glasses	Canada	Discusses all amblyogenic factors (deprivation and strabismus are the most costly)	Does not consider factors outside costs of glasses
Harstall ⁹	2012	Government report	Canada	Cost effectiveness analysis of preschool screening	Insufficient data

Question 9: What do we know from a Māori and Pacific knowledge basis about vision screening?

First author	Year	Type	Location	Age range	Sample size	Subject specifics	Ethnicity	Socio-economic status	Targeted conditions	Screening Protocol used (tests)	Outcome/Recommendation
Majeed ⁸⁹	2008	RCT	UK	7 years old	8,271	ALSPAC cohort	88.9% White, 1.8% non-White	wide range of parental social class scores	amblyopia and refractive error	full eye exam	Prevalence of eye conditions higher in the lower SES groups. However, children from lower socioeconomic status groups were less likely to see an eye care specialist or to use screening services.
Gibb ⁸⁸	2019	Observational study	NZ	3-5 year olds	252,273	National level NZ data, linked with birth stats, so can calculate who is missing screening	reflects NZ demographics	reflects NZ demographics	amblyopia and its risk factors	Parr VA test	System further disadvantaging groups who need the most support

Search strategy

Scopus: 825

(TITLE-ABS-KEY ("vision screening" OR "visual screen*" OR "vision screen*" OR "population vision screen*" OR "red eye reflex" OR "red reflex" OR "infra-red reflex")
 AND
 TITLE-ABS-KEY ("visual acuity" OR "vision disorders" OR amblyop* OR amblyopia OR strab* OR strabismus OR astigmatism OR hyperopia OR "lazy eye" OR "distance perception" OR ptosis OR rop OR "deprivation amblyop*" OR refract* OR "refractive error")
 AND
 TITLE-ABS-KEY (child OR children OR infant OR preschool OR pre-school OR newborn OR paediatric OR kindergarten))
 AND
 PUBYEAR > 2003 AND (LIMIT-TO (LANGUAGE , "English"))

Cochrane Reviews: 98

(TITLE-ABS-KEY ("vision screening" OR "visual screen*" OR "vision screen*" OR "population vision screen*" OR "red eye reflex" OR "red reflex" OR "infra-red reflex")
 AND
 TITLE-ABS-KEY ("visual acuity" OR "vision disorders" OR amblyop* OR amblyopia OR strab* OR strabismus OR astigmatism OR hyperopia OR "lazy eye" OR "distance perception" OR ptosis OR rop OR "deprivation amblyop*" OR refract* OR "refractive error")
 AND
 TITLE-ABS-KEY (child OR children OR infant OR preschool OR pre-school OR newborn OR paediatric OR kindergarten))
 AND
 PUBYEAR > 2004
 Reviews: 3
 Trials: 101

CINAHL Plus 164

Search ID#	Search Terms	Search Options	Actions
<input type="checkbox"/> S5	S1 AND S2 AND S3	Limiters - Publication Year: 2004-2019 Search modes - Find all my search terms	View Results (164)
<input type="checkbox"/> S4	S1 AND S2 AND S3	Search modes - Find all my search terms	View Results (186)
<input type="checkbox"/> S3	(MM "Vision Screening") OR (MH "Vision Tests") OR "red eye reflex" OR "red reflex"	Search modes - Find all my search terms	View Results (2,185)
<input type="checkbox"/> S2	(MM "Amblyopia") OR (MH "Eye Abnormalities") OR (MM "Refractive Errors") OR (MM "Cataract") OR (MM "Astigmatism") OR (MM "Myopia") OR (MM "Hyperopia") OR "ptosis" OR "strab*" OR anisometropia OR "ocular motility" OR "lazy eye" OR "deprivation amblyopia"	Search modes - Find all my search terms	View Results (9,128)
<input type="checkbox"/> S1	(MH "Infant") OR (MH "Child")	Search modes - Find all my search terms	View Results (476,272)

Medline/Ovid: 1412

<input type="checkbox"/>	# ▲ Searches	Results	Type
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<input type="checkbox"/>	2 Vision Tests/	10030	Advanced
<input type="checkbox"/>	3 Mass Screening/	98420	Advanced
<input type="checkbox"/>	4 (visual adj2 screen*).ti,ab,kw,kf.	1119	Advanced
<input type="checkbox"/>	5 (vision adj2 screen*).ti,ab,kw,kf.	1264	Advanced
<input type="checkbox"/>	6 ((ocular or ophthalmic or eye) adj2 screen*).ti,ab,kw,kf.	878	Advanced
<input type="checkbox"/>	7 (red reflex or redreflex or infrared reflex or infra-red reflex or ir-reflex).ti,ab,kw,kf.	216	Advanced
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<input type="checkbox"/>	9 Visual Acuity/	71226	Advanced
<input type="checkbox"/>	10 Vision Disorders/	26436	Advanced
<input type="checkbox"/>	11 Refraction, Ocular/	12893	Advanced
<input type="checkbox"/>	12 Amblyopia/	6529	Advanced
<input type="checkbox"/>	13 exp Strabismus/	15604	Advanced
<input type="checkbox"/>	14 Astigmatism/	6843	Advanced
<input type="checkbox"/>	15 Myopia/	16127	Advanced
<input type="checkbox"/>	16 anisometropia/ or hyperopia/	3821	Advanced
<input type="checkbox"/>	17 ocular motility disorders/	3670	Advanced
<input type="checkbox"/>	18 (refracti* or amblyop* or strabism* or myopi* or astigmat* or anisometrop* or hyperop* or hypermetrop*).ti,ab,kw,kf.	81033	Advanced
<input type="checkbox"/>	19 ((vision or visual) adj2 (disorder* or acuity)).ti,ab,kw,kf.	62961	Advanced
<input type="checkbox"/>	20 (lazy adj3 eye*).ti,ab,kw,kf.	56	Advanced
<input type="checkbox"/>	21 distance perception/	2800	Advanced
<input type="checkbox"/>	22 ((depth or distance) adj2 (perception* or perceive*).ti,ab,kw,kf.	2963	Advanced
<input type="checkbox"/>	23 ptosis.ti,ab,kw,kf.	8711	Advanced
<input type="checkbox"/>	24 ((eye or eyes or ocular) adj2 abnormal*).ti,ab,kw,kf.	4844	Advanced
<input type="checkbox"/>	25 (ROP or retinopathy of prematurity or retinoblastoma).ti,ab,kw,kf.	23196	Advanced
<input type="checkbox"/>	26 (cataract or cataracts or deprivation amblyop* or visual deprivation).ti,ab,kw,kf.	54989	Advanced
<input type="checkbox"/>	27 or/9-26	261670	Advanced
<input type="checkbox"/>	28 child, preschool/ or exp infant/	1518159	Advanced
<input type="checkbox"/>	29 (infant or infants or newborn* or new-born* or neonate? or neo-nate? or child or children or toddler* or pediatric* or paediatric* or kindergarten* or pre-school* or preschool*).ti,ab,kw,kf.	1734241	Advanced
<input type="checkbox"/>	30 28 or 29	2380181	Advanced
<input type="checkbox"/>	31 8 and 27 and 30	3388	Advanced
<input type="checkbox"/>	32 limit 31 to (english language and *humans only (removes records about animals*))	2818	Advanced
<input type="checkbox"/>	33 limit 32 to yr="2004 -Current"	1412	Advanced

Embase 1980 to current/Ovid: 1381

<input type="checkbox"/>	# ▲	Searches	Results	Type
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<input type="checkbox"/>	2	vision test/	7607	Advanced
<input type="checkbox"/>	3	(vision adj2 screen*).ti,ab,kw.	1492	Advanced
<input type="checkbox"/>	4	(visual adj2 screen*).ti,ab,kw.	1332	Advanced
<input type="checkbox"/>	5	((ocular or ophthalmic or eye) adj2 screen*).ti,ab,kw.	1287	Advanced
<input type="checkbox"/>	6	(red reflex or redreflex or infrared reflex or infra-red reflex or ir-reflex).ti,ab,kw.	256	Advanced
<input type="checkbox"/>	7	or/1-6	58829	Advanced
<input type="checkbox"/>	8	exp amblyopia/	8664	Advanced
<input type="checkbox"/>	9	amblyop*.ti,ab,kw.	7688	Advanced
<input type="checkbox"/>	10	myopia/	21649	Advanced
<input type="checkbox"/>	11	(lazy adj3 eye*).ti,ab,kw.	77	Advanced
<input type="checkbox"/>	12	exp strabismus/	20498	Advanced
<input type="checkbox"/>	13	(strabism* or squint* or refracti* or myopi* or astigmat* or anisometrop* or hyperop* or hypermetrop* or ammetropi*).ti,ab,kw.	74284	Advanced
<input type="checkbox"/>	14	((vision or visual) adj2 (disorder* or acuity)).ti,ab,kw.	79508	Advanced
<input type="checkbox"/>	15	(ptosis or cataract* or (deprivation adj3 amblyop*) or (visual adj3 deprivation)).ti,ab,kw.	72515	Advanced
<input type="checkbox"/>	16	(ROP or retinopathy of prematurity or retinoblastoma).ti,ab,kw.	27579	Advanced
<input type="checkbox"/>	17	or/8-16	230987	Advanced
<input type="checkbox"/>	18	exp child/	2323578	Advanced
<input type="checkbox"/>	19	exp infant/	882024	Advanced
<input type="checkbox"/>	20	(infant or infants or newborn* or new-born or neonate* or new-nate* or child or children or toddler* or pediatric* or paediatric* or kindergarten or pre-school or preschool*).ti,ab,kw.	1995174	Advanced
<input type="checkbox"/>	21	or/18-20	2880582	Advanced
<input type="checkbox"/>	22	7 and 17 and 21	2426	Advanced
<input type="checkbox"/>	23	limit 22 to (english language and "humans only (removes records about animals)")	2044	Advanced
<input type="checkbox"/>	24	limit 23 to yr="2004 -Current"	1381	Advanced

Total = 3880

First remove duplicates (exact) – left with 2304 (will be more duplicates)

Loaded into Covidence.org more refs removed – now = 2274

Appendix II Surveillance questions for parents included in Well Child Tamariki Ora my health book

24-48 hours assessment

- close relative with eye tumour at birth or during infancy or close relative with
 - congenital eye malformation
 - rubella (German measles), contact with rubella, or other congenital infection
 - such as CMV or toxoplasmosis during pregnancy
 - prematurity – less than 32 weeks or birth weight less than 1250 g
 - eye malformations (absent red reflex, bulging eye, abnormal pupil), failure to fix
 - or follow, or abnormal eye movements
 - newborn seizures, encephalopathy, or metabolic disease
 - trauma to eye or conjunctivitis that worsens or doesn't resolve
-

LMC final assessment

Can your baby see well? Do they...

- close their eyes against a bright light?
 - stare at people's faces when they are up close?
 - turn towards light?
 - smile at you without being touched or spoken to?
-

4-6 weeks assessment

Can your baby see well? Do they...

- close their eyes against a bright light?
 - stare at people's faces when they are up close?
 - turn towards light?
 - smile at you without being touched or spoken to?
-

8-10 weeks assessment

Can your baby see well? Do they...

- close their eyes against a bright light?
 - stare at people's faces when they are up close?
 - turn towards light?
 - smile at you without being touched or spoken to?
-

3-4 months assessment

Can your baby see well? Do they...

- close their eyes against a bright light?
 - stare at people's faces when they are up close?
 - turn towards light?
 - smile at you without being touched or spoken to?
 - look at their own fingers?
-

5-7 months assessment

Can your baby see well? Do they...

- follow a slow-moving, bright-coloured object with their eyes?
 - reach out for toys and other things?
 - hold them firmly and look closely at them?
-

9-12 months assessment

Can your baby see well? Do they...

- pick up small things like bits of fluff from the floor?
 - follow the movement of a dangling ball in all directions?
 - look for dropped toys?
 - watch what people are doing near them?
 - tilt their head sideways to look at things?
 - have a lazy eye, 'cross' eye or squint (when both eyes don't look straight at you most of the time)?
-

15-18 months assessment

Can your child see well? Do they...

- pick up small objects with their finger and thumb?
 - point to interesting things (like birds)?
 - watch everything that is going on around them?
 - search with their hands rather than their eyes?
 - bring objects up close to their eye?
 - have a lazy eye, 'cross' eye or squint (when both eyes don't look straight at you)?
-

2-3 years assessment

Can your child see well? Do they...

- recognise small details in picture books?
 - hold objects really close to look at them?
 - have a lazy eye, 'cross' eye or squint (when both eyes don't look straight at you)?
-

B4 School Check

Can your child see well? Do they...

- point to interesting things (like birds)?
 - run into things – high or low?
 - bring objects close to their eyes to look at them?
 - tilt their head in an unusual way to look at things?
 - have a lazy eye, 'cross' eye or squint (when both eyes don't look straight at you)?
-

Appendix III: B4 School Check vision outcomes for the period 1 July 2011 to 30 June 2015

Acknowledgements

As part of the review process, the authors were able to obtain vision screening data from the B4 School Check recorded in Stats NZ Integrated Data Infrastructure (IDI). This was possible thanks to Nick Bowden, Jesse Kokaua, Barry Milne, and Rick Audas who carried out this work very quickly.

Disclaimer

The results in this paper are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), managed by Statistics New Zealand. The opinions, findings, recommendations, and conclusions expressed in this paper are those of the author(s), not Statistics NZ or the University of Otago. Access to the anonymised data used in this study was provided by Statistics NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business, or organisation, and the results in this report, paper have been confidentialised to protect these groups from identification and to keep their data safe.

Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from www.stats.govt.nz. The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes. Any person who has had access to the unit-record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

Background

Current B4SC vision screening comprises a visual acuity screening using the Parr Chart which is performed by lay screeners in a community setting. There are three possible outcomes of screening; "Pass", "Rescreen" or "Refer". Additionally, families may decline the screening or may be unable to be contacted or scheduled for screening.

Methods:

Data were sourced from the Statistics New Zealand Integrated Data Infrastructure (IDI) including data from 1 July 2011 to 30 June 2015. The eligible population and B4SC coverage were determined using methods developed previously (Gibb).

Children unable to complete vision screening were identified by finding those children with a B4SC vision screening outcome of "Referred" or "Rescreened" for whom there was no vision measurement recorded.

Results:

B4SC Vision screening coverage

Vision screening coverage was high and completed screenings increased from 2011 to 2015 (Table 1). Children from whānau identifying as Māori or Pacific had reduced proportions of completed screenings. Specifically, more Māori (14.0%) and Pacific (15.1%) children compared with European (9%) and Asian (8.7%) children did not receive a vision screening. Māori and Pacific children were more likely to miss the vision check despite partially completing the B4SC, and Pacific families had a higher prevalence of declined screenings than other ethnicities (Table 2).

Table 1. Coverage of B4SC by year

	2011/12	2012/13	2013/14	2014/15	Combined
B4SC Coverage	88.7	90.0	91.8	92.9	90.8
Full B4Sc coverage	76.2	79.5	84.2	85.7	81.4
Vision Coverage	86.8	88.7	90.7	91.8	89.5

Table 2. B4SC Coverage for the 2011-2015 period by ethnicity, NZDep quintile and DHB.

	Children receiving vision B4SC (n)	Children receiving vision B4SC (%)	Children completing part B4SC but not vision (n)	Children completing part B4SC but not vision (%)	Declined vision (n)	Declined vision (%)
Overall	225,714	89.5	3,411	1.5	3,438	1.5
Sex						
Male	116,151	89.5	1,743	1.5	1,755	1.5
Female	109,566	89.5	1,668	1.5	1,680	1.5
Ethnicity						
Māori	68,889	86.0	1,395	2.0	1,272	1.8
Pacific	37,218	84.9	669	1.8	1,221	3.3
Asian	30,879	91.3	336	1.1	462	1.5
European	169,473	91.0	2,376	1.4	1,893	1.1
NZDep						
Q1	41,565	92.4	519	1.2	408	1.0
Q2	40,854	91.4	498	1.2	480	1.2
Q3	41,727	90.3	564	1.3	516	1.2
Q4	44,064	89.5	699	1.6	684	1.6
Q5	56,541	86.4	1,113	1.9	1,320	2.3
DHB Regions						
Auckland	20,664	88.1	309	1.5	882	4.3
Bay of Plenty	11,364	92.8	45	0.4	33	0.3
Canterbury	23,586	92.5	822	3.4	483	2.0
Capital and Coast	12,126	80.4	303	2.4	12	0.1
Counties Manukau	30,585	90.1	237	0.8	855	2.8
Hawke's Bay	8,739	92.7	288	3.2	33	0.4
Hutt Valley	7,317	85.4	141	1.9	12	0.2
Lakes	6,279	93.8	81	1.3	27	0.4
MidCentral	8,325	87.9	39	0.5	42	0.5
Nelson Marlborough	6,504	91.2	12	0.2	27	0.4
Northland	7,869	80.9	81	1.0	153	1.9
South Canterbury	2,679	96.4	36	1.3	9	0.3
Southern	14,040	92.6	180	1.3	72	0.5
Tairāwhiti	2,883	89.9	51	1.7	6	0.2
Taranaki	5,949	87.1	93	1.5	48	0.8
Waikato	21,285	93.9	156	0.7	144	0.7
Wairarapa	2,019	89.6	24	1.2	5	5
Waitemata	28,122	90.0	264	0.9	510	1.8
West Coast	1,461	85.3	15	1.0	9	0.6
Whanganui	3,048	86.9	225	6.9	51	1.7

Children referred or identified for rescreening

Overall 6.8% of children were referred for further assessment and 4.2% were awaiting rescreening.

Table 3. Children classified as rescreen or refer from B4SC by ethnicity, NZDep quintile and DHB

	Rescreen (n)	Rescreen (%)	Referred (n)	Referred (%)
Overall	9,531	4.2	15,318	6.8
Sex				
Male	5,061	4.4	7,935	6.8
Female	4,470	4.1	7,383	6.7
Ethnicity				
Māori	3,558	5.2	5,022	7.3
Pacific	1,905	5.1	3,057	8.2
Asian	1,113	3.6	2,628	8.5
European	6,528	3.9	10,152	6.0
NZDep				
Q1	1,554	3.7	2,271	5.5
Q2	1,449	3.5	2,430	5.9
Q3	1,623	3.9	2,661	6.4
Q4	1,842	4.2	3,099	7.0
Q5	3,009	5.3	4,797	8.5
DHB Regions				
Auckland	1,089	5.3	1,566	7.6
Bay of Plenty	597	5.3	546	4.8
Canterbury	1,746	7.4	1,557	6.6
Capital and Coast	1,014	8.4	909	7.5
Counties Manukau	903	3.0	3,150	10.3
Hawke's Bay	207	2.4	876	10.0
Hutt Valley	243	3.3	639	8.7
Lakes	174	2.8	699	11.1
MidCentral	489	5.9	837	10.1
Nelson Marlborough	126	1.9	93	1.4
Northland	597	7.6	372	4.7
South Canterbury	84	3.1	249	9.3
Southern	120	0.9	846	6.0
Tairāwhiti	78	2.7	186	6.5
Taranaki	84	1.4	645	10.8
Waikato	579	2.7	420	2.0
Wairarapa	216	10.7	195	9.7
Waitemata	783	2.8	1,275	4.5
West Coast	99	6.8	81	5.5
Whanganui	255	8.4	132	4.3

Children unable to complete vision screening

Of all children who had an outcome of “Referred” or “Rescreened” overall 20.5% did not have a vision measurement recorded. Inability to complete vision screening increased with increasing NZDep Quintile (1.26% Quintile 1 to 3.68% Quintile 5) and children of Māori ethnicity were less likely to achieve a vision measurement (3.59% unable) than other ethnicities. Considerable variation is recorded between DHBs.

Table 4. Children with no VA measurement compared to Referred or Rescreen outcome and total number screened by ethnicity, NZDep quintile and DHB

	No VA recorded for refer/rescreen (n)	Number of refer/rescreen (n)	No VA recorded % of refer/rescreen	Total screened (n)	No VA recorded % of total screened
Overall	5,091	24,849	20.5	225,714	2.26
Sex					
Male	2,964	12,996	22.8	116,151	2.55
Female	2,127	11,853	17.9	109,566	1.94
Ethnicity					
Māori	2,475	8,580	28.8	68,889	3.59
Pacific	993	4,962	20.0	37,218	2.67
Asian	525	3,741	14.0	30,879	1.70
European	3,258	16,680	19.5	169,473	1.92
NZDep					
Q1	522	3,825	13.6	41,565	1.26
Q2	567	3,879	14.6	40,854	1.39
Q3	819	4,284	19.1	41,727	1.96
Q4	1,062	4,941	21.5	44,064	2.41
Q5	2,079	7,806	26.6	56,541	3.68
DHB Regions					
Auckland	219	2,652	8.3	20,664	1.06
Bay of Plenty	261	1,143	22.8	11,364	2.30
Canterbury	624	3,306	18.9	23,586	2.65
Capital and Coast	405	1,920	21.1	12,126	3.34
Counties Manukau	573	4,056	14.1	30,585	1.87
Hawke's Bay	456	1,086	42.0	8,739	5.22
Hutt Valley	177	879	20.1	7,317	2.42
Lakes	273	873	31.3	6,279	4.35
MidCentral	174	1,326	13.1	8,325	2.09
Nelson Marlborough	84	219	38.4	6,504	1.29
Northland	363	966	37.6	7,869	4.61
South Canterbury	42	330	12.7	2,679	1.57
Southern	99	966	10.2	14,040	0.71
Tairāwhiti	72	264	27.3	2,883	2.50
Taranaki	102	729	14.0	5,949	1.71
Waikato	549	996	55.1	21,285	2.58
Wairarapa	51	411	12.4	2,019	2.53
Waitemata	276	2,055	13.4	28,122	0.98
West Coast	54	180	30.0	1,461	3.70
Whanganui	207	387	53.5	3,048	6.79

Appendix IV: Process of estimating graded recommendations

The search and selection strategy for this review were structured to address the questions provided by the Ministry of Health in the short time frame provided. After completion of the review, authors were asked to provide grades for recommendations within the review. Compliance with this request required compromise, as a new search and analysis with this new aim was not feasible. Within this context, to limit our bias in estimating graded recommendations, we used a semi-structured approach, outlined below.

Identifying key screening interventions

First, we established which screening interventions justified specific recommendations. Decisions were based on current screening practice and evidence gathered while answering the questions provided by the Ministry of Health. The age, targeted conditions, test and treatments considered for each screening intervention are listed in Table 7.X. Note that currently in NZ the specific VA test used (Parr) differs from those most used in the literature (Lea or HOTV), and we do not use automated vision screeners.

Table 7.4. Screening interventions for graded recommendations.

Age	Targeted conditions	Tests used most in literature	Treatments
Newborns	Congenital eye conditions	Red reflex	Cataract removal surgery and amblyopia treatment
6 month to 3-year	Amblyopia and its risk factors	vision screener	Spectacle correction and amblyopia treatment
3 to 5-year	Amblyopia and its risk factors	VA test and/or vision screener	Spectacle correction and amblyopia treatment
3 to 5-year	Non-amblyogenic refractive error	VA test and vision screener	Spectacle correction

Generating estimates of benefit and certainty

To estimate the net benefit for each the screening interventions outlined in Table 7.X, we considered how the questions provided by the Ministry of Health could be rephrased such that answering ‘yes’ reflected a benefit (Figure 7.2). Note that questions 2 (timing of screening) and 6 (targeted conditions) were used to delineate between screening interventions rather than to estimate net benefit. For each screening intervention, there was very little evidence for cost-effectiveness or impact for Māori and Pacific children (questions 8 and 9, respectively) so these were not included in the estimates of net benefit.

The remaining rephrased questions fit into three categories: 1) does the condition matter (blue), 2) are the screening tools acceptable (green) and 3) is there an effective treatment (yellow). We then reviewed the evidence from the rapid review to answer each of the re-phrased questions as either ‘no’, ‘maybe’ or ‘yes’, and estimated the associated level of certainty as ‘low’, ‘medium’, or ‘high’. We plotted estimated benefit (position on x-axis) and level of certainty (‘small’, ‘medium’ or ‘large’ dots reflecting ‘low’ ‘medium’ and ‘high’ certainty, respectively) for each rephrased question. Estimating benefit and certainty in this way is imprecise, however, making the process transparent allows key concepts and current debates to be highlighted. From these plots, we estimated overall net benefit and level of certainty for each of the four candidate screening interventions, described below.

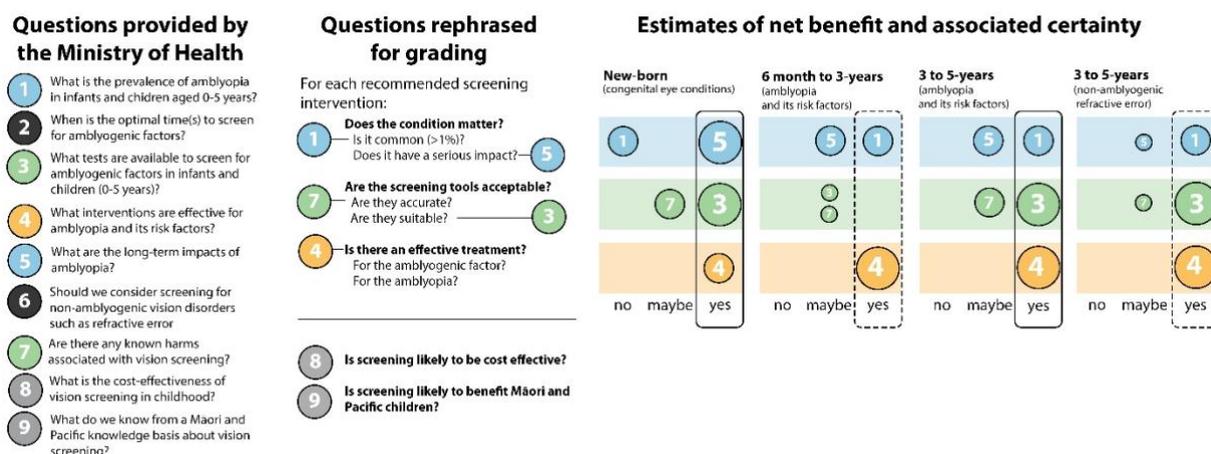


Figure 7.2. Relationship between rapid review questions and net benefit and associated certainty estimates. Justification for the position and size of each dot in the ‘estimates of net benefit and associated certainty’ section are summarised below.

Summary of estimated benefit and associated certainty

We estimated that screening newborns for congenital eye conditions with the red reflex test has a moderate net benefit, with moderate certainty.

Does the condition matter? Although the prevalence of these conditions is low (medium certainty), the impact is high due to the sight and life-threatening nature of congenital cataract and retinoblastoma, respectively (high certainty).

Are the tests acceptable? The red reflex test is non-invasive (high certainty), and acceptably accurate if performed by trained professionals (to detect severe congenital conditions such as cataract and retinoblastoma - medium certainty).

Is there an effective treatment? Although there is a current lack of research regarding patching and atropine to treat deprivation amblyopia, this is balanced by the well-established effectiveness of cataract removal surgery (together, medium certainty).

Grade B – All newborns should be screened for congenital eye conditions with the red reflex test.

We estimated that screening 3 to 5-year old children for amblyopia and its risk factors with VA tests and/or vision screeners has a moderate net benefit with moderate certainty.

Does the condition matter? Although debate exists about the impact (moderate impact, with medium certainty), the condition is relatively common (medium certainty), such that even a minor impact is likely beneficial at scale.

Are the tests acceptable? Lea symbols VA tests and certain vision screeners are suitable for children of this age (high certainty) and are sufficiently accurate with enough training, and appropriate referral criteria (medium certainty).

Is there an effective treatment? Treatment is well established to be effective (high certainty).

Grade B – All 3 to 5-year old children should be screened for amblyopia and its risk factors with VA tests and/or vision screeners.

We estimated that screening for amblyopia and its risk factors in younger children (6 months to 3-years) has moderate benefit but low certainty.

Does the condition matter and are there effective treatments? Prevalence, impact and treatment are similar to that in preschool children, suggesting moderate benefit.

Are the tests acceptable? Current screening tests are less accurate at this age, and fewer toddlers are able to complete the tests than pre-school children, therefore, currently we only have medium certainty that test are acceptable. Due to question about acceptable screening tests, overall, certainty that the benefits of screening at this age would be realised, was low.

Grade I – There is currently insufficient evidence to say whether or not 6 month to 3 year old children should be screened for amblyopia and its risk factors.

We estimated that screening for non-amblyogenic refractive error in 3 to 5-year old children has moderate benefit, but low certainty.

Is there an effective treatment? Treatment is well established and effective (high certainty).

Does the condition matter? Although debate exists about impact, there is growing evidence that non-amblyogenic refractive errors at least as impactful as unilateral amblyopia (however certainty remains relatively low).

Are the tests acceptable? Tests for VA and automated assessment of refractive error are acceptable, however, there is currently insufficient evidence about the accuracy of VA tests/vision screeners to detect non-amblyogenic refractive error in preschool children.

Overall, certainty that the benefits of screening for non-amblyogenic refractive error at this age would be realised was low.

Grade I – There is currently insufficient evidence to say whether or not 3 to 5-year old children should be screened for non-amblyogenic refractive errors.

A BETTER
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E Tipu e Rea

8. Oral health promotion and early preventive interventions in a community setting

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Suggested citation: Maessen SE, Derraik JGB, Broadbent JM. Oral health promotion and early preventive interventions in a community setting. In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019; p. 217-254.

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: The authors have no financial or non-financial conflicts of interest to declare that may be relevant to this work.

Abbreviations

ART	Atraumatic restorative technique
CAMBRA	Caries Management by Risk Assessment
Caries-free	Having no teeth affected by decay
COHS	Community Oral Health Service
dmft	Decayed, missing, and filled primary teeth
DMFT	Decayed, missing, and filled permanent teeth
ECC	Early childhood caries
ICCMS	International Caries Classification and Management System
ICDAS	International Caries Detection and Assessment System
PF	Prevented fraction
ppm	Parts per million
pufa	pulp, ulceration, fistula abscess
RCT	Randomised controlled trial
WCTO	Well Child Tamariki Ora programme

Definitions

dmft	The count of primary teeth with untreated caries, dental restorations, and missing due to dental caries
DMFT	The count of permanent teeth with untreated caries, dental restorations, and missing due to dental caries
ECC	Presence of ≥ 1 decayed, missing (due to caries), or filled tooth surfaces in any primary tooth ¹
Permanent teeth	Permanent teeth that replace the primary teeth
Primary teeth	Deciduous or 'baby' teeth that are lost when permanent teeth emerge
pufa	An index of tooth and soft tissue consequences of untreated caries

Executive summary

- The prevalence of dental caries among 5-year-old New Zealand children was 40% in 2018, and ECC remains a common condition.
- There are marked inequalities in oral health in New Zealand, with Māori and Pacific children at particularly high risk for dental caries.
- Though overall ECC prevalence has decreased in New Zealand, severe caries experience and hospital-based intervention have increased.
- Lift-the-lip is easy to perform by adults and should constitute the cornerstone of community screening. Identification of any visible sign or suspicion of ECC should result in prompt referral to dental services.
- Lift-the-lip should not replace comprehensive assessment by oral health practitioners but be used systematically and opportunistically during any health checks.
- Dental disease can only be ruled out with an examination by an oral health practitioner.
- Many risk factors for ECC are known, but no standardised screening tool for ECC risk has been validated or adopted in New Zealand.
- CAMBRA is an example of a caries risk assessment tool that has been taught in New Zealand dental training for a number of years, which could be adapted or abbreviated for use in screening for ECC risk in infants and preschool children in New Zealand.
- A toothbrushing programme should be implemented for infants and preschool children in New Zealand, involving provision of toothbrushes and toothpaste to young families, and introducing routine toothbrushing in preschools as well as demonstrations in Well Child visits.
- Fluoride varnish should be applied early (from age 12 months) and routinely (6 monthly) for children identified to have caries or at high risk of developing dental caries. This should be done by trained health practitioners (such as an oral health therapist) and may be applied in community or clinical settings.
- Treatment of established dental disease requires the involvement of oral health practitioners and cannot be performed in community settings.

- Treatment of dental decay is multifaceted and includes addressing patient factors such as oral health behaviours.
- Māori and Pacific children are at greater risk of dental disease, and so should be a priority for oral health screening, prevention, and treatment.
- Early access to care – detected early enough, dental caries can be arrested or reversed by sealing of affected tooth surfaces or use fluoride treatments, negating the need for costly restorative or surgical dental care. By detecting caries early through routinely ‘lifting the lip’ and ensuring children are referred and promptly seen for treatment, it may be possible to reduce New Zealand’s increasing rate of children requiring general anaesthetics for dental care.
- Increased investment in preventive care should be paired with healthy public policy – early childhood caries frequently occur very early in life, not long after the teeth have entered the mouth, and is directly attributable to an unhealthy or inappropriate diet.
- The Scottish Childsmile programme is a valuable model that is cost effective, reducing ECC, dental care spending, and inequalities in oral health; a similar strategy is likely feasible in New Zealand, but would require investment, including prioritisation and delivery of effective preventive dental care.
- It is unavoidable that we recommend regulation of marketing and sale of products known to cause dental caries.

8.1 Introduction

Early childhood caries (ECC), characterised by one or more tooth surfaces being affected by decay before the age of 6 years, is one of the most common diseases of childhood². A relatively good understanding of the risk factors and aetiology of ECC means that it is largely preventable^{3,4}. However, prevention efforts often do not reach those at highest risk, so that ECC has been described as a sensitive marker for economic and other stresses on individual households³.

Caries experience is often measured in epidemiological dentistry using the DMF index, referring to the number of **d**ecayed, **m**issing, or **f**illed teeth (dmft) or tooth surfaces (dmfs) as a result of decay^{5,6}. For those aged <30 years, teeth lost or restored due to traumatic injury are not typically included in the index⁵. Lowercase letters refer to the primary teeth (dmft or dmfs), while permanent teeth are represented by uppercase letters (DMFT or DMFS). A dmf index score ≥ 1 indicates the presence of ECC, while a child with a dmf of 0 is considered caries-free^{5,7}.

Despite the importance of oral health in the early years, children aged 2 to 4 years are less likely than older children to engage in recommended oral health behaviours, such as toothbrushing with fluoride toothpaste². This coincides with the age at which parents report the most difficulty engaging children in toothbrushing⁸. It seems that many parents also believe that caring for primary teeth (i.e. 'baby' teeth) is not a priority, because they do not feel that the health of primary teeth is related to health of permanent teeth⁹. This is an important misconception as caries on primary teeth are strong predictors of later decay in permanent teeth^{10,11}.

In New Zealand, Well Child Tamariki Ora (WCTO) is a programme that provides health assessments, referrals, and support services to children and their families from birth to age 5 years¹². As part of a review of this programme, the New Zealand Ministry of Health sought to review the oral health of children and infants in this age group, as well as the services available to them. Thus, this brief evidence review aimed at evaluating the most efficacious and cost-effective screening and intervention tools for dental caries in New Zealand, including those that are culturally appropriate. We also briefly examine the prevalence of dental caries among New Zealand children and the associated risk factors, as well as the potential adverse effects of screening and interventions.

8.2 Prevalence and distribution of dental disease in New Zealand infants and preschoolers

The main dental disease among New Zealand infants and pre-schoolers is ECC; other oral diseases include developmental defects of the teeth or other oral structures, as well as periodontal conditions or other soft tissue disorders. As ECC is by far the dominant disease in this population group, this review will focus on ECC.

Identifying ECC in the community is a challenge, as early decay may not be easily visualised on the tooth surface. While a comprehensive dental exam including bitewing radiographs will reliably detect caries^{10,13,14}, this is not practical in the context of large epidemiological studies or in community settings. In addition, bitewing radiographs only detect caries on the posterior teeth, and they involve exposure to ionising radiation (raising ethical issues for their use in research or screening among low-risk children). Therefore, prevalence estimates based on community-acquired data are likely to underestimate the actual number of children affected by ECC¹⁰.

ECC remains a considerable public health issue worldwide^{3,15,16}. There are marked differences in ECC prevalence between countries^{7,17}, with recent estimates among 5-year-olds ranging from 16.5% in Greece¹⁸, to 85% in China¹⁹ and 90% in Indonesia²⁰. According to Ministry of Health data, the prevalence of dental caries among 5-year-olds in New Zealand who accessed the Community Oral Health Service was 40% in 2018 (noting that in New Zealand this is reported inversely, i.e. as the proportion who were caries-free, in this case 60% with 0 dmft)²¹. There is some evidence that rates of ECC have decreased among preschoolers, with 52% of 5-year-olds reported to be caries-free in 2005 compared to 60% in 2018^{22,23} (Table 8.1). However, these data only represent children who were accessing care at this age, and approximately 30% of 5-year-olds were missing from the 2018 data set²¹.

Table 8.1. Proportion of 5-year-old New Zealand children (%) attending the Community Oral Health service who were caries-free (dmft=0) in 2005–2018

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total	52.0	52.9	51.4	57.0	55.6	57.2	59.6	58.9	57.5	58.7	59.5	59.6	60.6	59.7
Māori	30.2	31.1	28.7	36.2	34.6	38.3	41.1	39.2	37.4	39.7	39.2	41.1	42.1	40.8
Pacific	34.6	31.8	28.8	32.8	31.8	32.8	35.3	37.0	36.3	35.3	38.9	34.3	36.3	38.1
Other ethnicities	60.7	61.9	61.1	66.8	65.8	67.0	69.0	68.5	66.9	68.4	69.1	69.5	70.1	69.1

Data reproduced from Ministry of Health 2018²¹.

There is paucity of data on the oral health of very young children in New Zealand, as most of the reported data are on those aged ≥4 years. Nonetheless, the available data in children aged 4 to 5 years is still highly relevant for younger children/infants. Oral health conditions are chronic and cumulative, therefore the prevalence of caries or dmft count at ages 4 to 5 years represent the accumulation of the child's caries experience throughout their preschool years.

Data based on the quick visual ‘lift-the-lip’ examination from the B4 School Check data indicated that severe caries experience has increased in recent years, despite an overall reduction in ECC prevalence²². Further, the number of children receiving dental treatment under general anaesthesia increased markedly (+83%) over a similar period (from 4,646 in 2005 to 8,520 in 2013)^{24,25}, suggesting that rates of severe dental caries may be on the increase. Disease severity may not be the only reason for this increase; children’s behaviour and/or disability can contribute to a decision to refer for hospital treatment. A total of 8,758 children (18 years or younger) had dental treatment under anaesthetic in 2017/18, at a cost of \$22.4 million.

8.2.1 Oral health inequalities

Globally, there are well described inequalities in the prevalence of dental caries within individual localities, for example in association with socioeconomic status^{2,15,26,27}. Socioeconomic deprivation in particular is likely to be the most important factor underpinning the marked inequality in oral health among ethnic groups in New Zealand^{2,23}, reflected, for example, in the reported poor knowledge of basic oral hygiene among Pacific mothers and their children²⁸.

Over recent decades, improvements both in access to oral health services and prevalence of dental caries in some countries have been reported^{26,27}. Unfortunately, in New Zealand such improvements in access to oral health care have not been observed among adults at least². For New Zealand children, the reorientation of the School Dental Service to the Community Oral Health Service (COHS) was intended to lead to better access to care²⁹, but contemporary influences of workforce shortages in the

COHS may be leading to challenges in access to care³⁰. Dental care has a preventive focus, but access to preventive care is not necessarily proportionate to need, magnifying oral health inequalities among socioeconomic groups in some places²⁶.

While there have been improvements in child oral health across all ethnic groups, disparities in the prevalence of dental caries appear to remain largely unchanged³¹(Table 8.1), and may have worsened for young Pacific children^{22,31}. In general, there is a higher prevalence of ECC among Māori and Pacific children and those living in areas of high socioeconomic deprivation^{21,32}. These groups are also overrepresented among the large number of children requiring dental treatment under general anaesthesia in New Zealand²⁵. Not surprisingly, there is evidence to indicate that Māori and Pacific children, and those living in the most deprived areas are also more likely to miss oral health checks^{2,23}.

Of note, the timing of tooth eruption is variable, and the primary first molar teeth may emerge from as early as 13 months of age³³. There is some evidence that the timing of tooth eruption varies with ethnicity³⁴ and sex³⁵. Data for New Zealand children are lacking, but one study of permanent teeth showed that these emerged earlier among Pacific children and Māori children³⁶. This would place their teeth at risk from a younger age compared to other ethnicities, so that they may require earlier attention.

8.2 Summary

- *The prevalence of dental caries among children aged 5 years in New Zealand was ~40% in 2018, and ECC remains a common condition.*
 - *There are marked inequalities in oral health in New Zealand, with Māori and Pacific children at particularly high risk for dental decay.*
 - *Though overall ECC prevalence has decreased in New Zealand, severe caries experience and resulting hospital-based intervention have increased.*
-

8.3 Screening for dental disease and dental disease risk

8.3.1 Clinical oral health settings

While screening within clinical dental practices is outside the scope of this review, it is important to briefly cover this area. In these clinical settings, detection of caries is primarily visual, involving inspection of all soft and hard tissues, as well as bitewing radiographs depending on caries risk³⁷. Examination of pits and fissures in the teeth with a sharp explorer probe is still performed by a majority of New Zealand dental practitioners³⁸, but the use of a probe is usually unnecessary, and is also undesirable as it frequently causes cavitation of incipient carious lesions³⁹. The International Caries Classification and Management System (ICCMS)⁴⁰ aids decision making by incorporating patient risk factors with the *International Caries Detection and Assessment System* (ICDAS) system of rating caries severity based on visual appearance of carious lesions³⁷. ICDAS and ICCMS are part of the dental curriculum and are currently taught to students in the training program for dentists at the University of Otago as well as the oral health therapy programmes at Auckland University of Technology and University of Otago, but its uptake among established practising clinicians is low^{41,42}.

Dental assessment from an oral health practitioner is the best way to reliably diagnose tooth decay. Therefore, in New Zealand and internationally, it is recommended that a child should first see an oral

health practitioner by 12 months of age or shortly after their first teeth come through^{10,43-45}. In practice, screening at WCTO checks and other health check-ups can prioritise dental referrals for children at high risk for dental decay. For example, bitewing radiographs are recommended from age 5 years for children with a low risk of dental decay³⁷, while those at high risk should have dental radiographs taken by an oral health practitioner at 3 years of age³⁷.

8.3.2 Community screening for dental disease

Outside of the oral health practitioner setting, a visual inspection is also the best way to identify signs of dental disease. Of all methods for screening ECC in community settings, the 'lift-the-lip' examination is by far the most widely adopted⁴⁶⁻⁴⁹. The lift-the-lip is a quick and simple examination (usually 2-3 minutes long) that in New Zealand is recommended to be carried out as part of the WCTO health checks, by primary healthcare providers alongside other health assessments^{22,45,48}, or even by a parent. The health practitioner or parent lifts the child's lip to check teeth for visual signs of decay. While these signs can be rated in comparison to reference photographs for severity of decay from 1 (no visible caries) to 6 (severe caries including posterior teeth), in practice any sign of decay should result in a referral to an oral health practitioner^{22,45}.

Surprisingly, while the lift-the-lip is frequently mentioned as the chosen method in a large number of studies, there is in fact very little description in both peer-reviewed and grey literature as to what it entails. For example, Wilson's 2017 report focused entirely on the lift-the-lip but made only a passing referencing to "visual assessment of the upper anterior teeth particularly", with no adequate description of this technique⁴⁸. In New Zealand, it seems that the report *Healthy Smile, Healthy Child* may be one of the very few documents describing that the lift-the-lip check should include all teeth "as decay can occur on any tooth surface" (p.20)⁴⁵. We recommend that the lift-the-lip involves all teeth if the opportunity arises, but inability to examine the back teeth should not constitute a reason not to perform it; i.e. any examination of a child's teeth is better than none at all. In light of the paucity of description in the existing literature, the key steps to perform the lift-the-lip examination are described in Table 8.2. Note that some guidelines suggest assessing the gingiva for colour and moisture; while gums should be moist, intact, pale, and pink, the colour of gingiva will vary with skin colour⁴³. Periodontal conditions are rare among preschool children, however, redness or bleeding of the gums (indicated gingivitis due to excess plaque) should be an indication to refer for dental care.

As the lift-the-lip is very easy to perform by any adult, it should constitute the cornerstone of community screening (i.e. without the involvement of trained oral health practitioners). Identification of any visible ECC or other tooth surface changes should result in prompt referral to an oral health therapist or dentist (Table 8.2). Nonetheless, it should be stressed that early signs of tooth decay may be easily missed by practitioners not qualified in oral health assessment²². Therefore, lift-the-lip should not replace comprehensive assessment by an oral health practitioner, but instead should be employed opportunistically at any health check to identify and prioritise referral for high-risk patients.

Beyond the lift-the-lip examination, severe decay can also be further classified based on ECC complications using the pufa index¹¹. This index refers to **p**ulpal involvement, **u**lceration due to tooth or root fragments, **f**istula, and **a**bscess, as a result of decay of primary teeth¹¹. However, in practice, the pufa index is of little relevance for community screening, as any evidence of tooth decay (irrespective of its level) requires referral to an oral health practitioner, where a proper clinical oral health evaluation will be carried out.

Table 8.2. Step-by-step instructions for the lift-the-lip.

EXAMINATION	
1. Lighting	Ensure good lighting or have a pen torch ready
2. Position child	<ul style="list-style-type: none"> • Infant or toddler: parent and practitioner sit knee-to-knee with child facing the parent on their lap. The child is lowered onto practitioner's lap • Preschool child: Lie on examination table or sit on or in front of parent's lap facing practitioner • Other positions may be used, but these positions maximise viewing access for the practitioner, while ensuring the child is likely to be comfortable
3. Lift-the-lip	<ul style="list-style-type: none"> • Practitioner uses gloved hand to lift upper lip, if possible • If parent or child prefers that parent lifts their lip, an infant or toddler should be positioned with their head in the parent's lap (gloves may be used but are not essential)
4. Inspect anterior teeth (anterior surface)	<ul style="list-style-type: none"> • Inspect the upper anterior teeth, looking for: <ul style="list-style-type: none"> –Whitish lines on the teeth along the gumline –Chalky, white spots or patches –Yellow or brownish discoloration –Clearly visible cavity • If any of the above are present, child should see an oral health practitioner for further assessment or intervention • The practitioner should also note any visible plaque or food debris, as their presence may indicate poor diet, poor oral hygiene, or poor brushing technique; thus, the child should see an oral health practitioner for a formal caries risk assessment
5. Inspect anterior teeth (posterior surface)	<ul style="list-style-type: none"> • Use a mouth mirror (if available) to visualise the back of the upper anterior teeth, looking for the same signs of decay
6. Inspect all teeth	<ul style="list-style-type: none"> • Examine all teeth that can be visualised, using a pen torch (or any torch such as that on a mobile phone) and mouth mirror (if available) to assist • A tongue depressor or toothbrush can also be used to move the tongue to better visualize teeth • Suggested sequence: <ol style="list-style-type: none"> a. Biting surfaces of the teeth (pits & fissures) b. Between the teeth (proximal surfaces) c. Sides of the teeth (inside the cheeks and beside the tongue)
7. Check tooth eruption	<ul style="list-style-type: none"> • Examine whether tooth eruption is proceeding as expected: <ul style="list-style-type: none"> –Incisors from ~6 months onwards, initially 4, later 8 teeth; –First molar from ~12 months, 4 teeth; –Canines (eye teeth) from ~18 months, 4 teeth; –Second molars from ~24 months, 4 teeth
POST-EXAMINATION	
A. Referral	If any decay is detected or suspected, refer child to a dental clinic
B. Education	For all parents, emphasise the importance of oral health practices (e.g. regular toothbrushing, fluoride toothpaste, diet) and regular dental check-ups
C. Parental guidance	Instruct parents to: <ul style="list-style-type: none"> • Assist their child with brushing twice daily • Perform the lift-the-lip and inspect child's teeth monthly • Make a dental appointment straight away if any signs of decay are visible (or suspected)

Guidelines based on the New Zealand Dental Association's "Healthy Smile, Healthy Child" report⁴⁵, the NSW Ministry of Health guidelines⁴³, and the University of Washington lift-the-lip guide⁴⁷.

Importantly, aside from identifying need for prompt referral to dental services, lift-the-lip is an opportunity for oral health education for parents and children⁴⁸. It should involve an individualised conversation about diet, sugar, toothbrushing technique (Table 8.2), and the importance of attending oral health services⁴⁸. Parents should also be taught and encouraged to regularly look at their child's teeth for signs of decay at home using the lift-the-lip⁴⁵ (Table 8.2).

8.3.3 Community screening for dental disease risk

Assessment of risk for ECC should be done at the same time as a visual examination of the teeth. However, if it is not possible to view a child's teeth (e.g. due to behaviour), it can be possible to assess risk through a parent interview alone. This should take place as early in life as possible, as teeth are at risk of dental caries as soon as they emerge into the mouth. This may be particularly important in the first year of life, when risk identification may occur before the eruption of any teeth. It is also important to consider the past experiences of family members. Among families with at least two children, dental caries experience is strongly correlated between siblings⁵⁰ and children who require general anaesthetic for dental care frequently have siblings who require the same treatment in future⁵¹.

In 2008, the New Zealand Ministry of Health recommended that a standardised dental caries risk assessment form be developed for use in *WCTO* checks for infants aged 9-12 months of age⁵². However, to date no such tool has yet been developed for New Zealand⁴⁵, and *WCTO* checks do not commonly involve lifting of the lip or discussing oral health, except at the B4 School Check at age 4 to 5 years. To assess a child's risk for dental decay, the New Zealand Dental Association recommend asking about dietary habits, fluoridated water supply, toothpaste used, oral hygiene, and child and family oral health history⁴⁵. Factors indicating high risk include: regular intake of sugary foods and drinks; visible plaque, food, or debris in the mouth; not brushing or brushing infrequently; and current or previous dental decay in the child or family members⁴⁵.

Some systems used internationally also take into account the patient's socio-economic status and any existing barriers to access health services⁴⁰. For example, the Caries Management by Risk Assessment (CAMBRA) developed by the California Dental Association has been adapted for use from birth to age 5 years (Appendix I), and is taught to students in the Bachelor of Dental Surgery at the University of Otago, as well as to students in the Oral Health Therapy training programmes at both Auckland University of Technology (AUT) and the University of Otago. Certain elements of the full assessment (e.g. bacteriological evaluation) may be omitted when CAMBRA is applied as a screening tool. An adapted version for preschool children involves a short interview with the caregiver to rate the child's risk of caries development as low, moderate, or high based on risk factors, protective factors, and clinical findings^{53,54}.

This risk assessment tool had a reported sensitivity of 83.7% and specificity 62.9% for predicting oral health 12 months after assessment for 3-year-olds in Hong Kong⁵⁵. To our knowledge, this version of the CAMBRA has not been validated for use with children younger than 3 years of age or in New Zealand, and its potential for use in *WCTO* settings is unclear. However, dental caries is the same condition at any age, and when applied as a screening tool, the single-page assessment tool is the most systematic screening tool we were able to identify that is, at least, partially validated for use among preschool children. The risk assessment tool recommended by the American Academy of Pediatric Dentistry assesses caries risk based on similar risk factors to the CAMBRA, but includes a question about night-time bottle feeding⁵⁶. This could improve its sensitivity for detecting caries risk in very young children, but validity of the screening tool has not been assessed.

8.3 Summary

- *The lift-the-lip is very easy to perform by any adult and should constitute the cornerstone of community screening.*
 - *Identification of any visible sign or suspicion of ECC should result in prompt referral to dental services.*
 - *The lift-the-lip should not replace comprehensive assessment by oral health practitioners, but used opportunistically during any health checks.*
 - *Dental disease can only be ruled out with an examination by an oral health practitioner.*
 - *Many risk factors for ECC are known, but no standardised screening tool for ECC risk has been validated or adopted in New Zealand.*
 - *The single page CAMBRA screening form could be adapted and applied for use in screening for caries risk.*
-

8.4 Interventions for prevention of dental disease

New Zealand's Oral Health Clinical Advisory Network (OHCAN)³⁷ describe the four cornerstones of prevention:

- brushing twice a day with fluoride toothpaste
- fissure sealants
- dietary advice for food and drink intake
- other fluoride vehicles

Note that a summary of the available evidence from meta-analyses of randomised controlled trials is provided in Appendix II. While we focused on the evidence for primary teeth, it is important to note that the evidence on permanent teeth is still relevant; although the enamel of primary teeth is thinner, both teeth are of very similar composition (i.e. calcium apatite crystals)⁵⁷.

Early intervention is important for preventing dental caries in childhood and maintaining good oral health into adulthood⁵⁸. Accordingly, New Zealand's COHS has a strong focus on maintaining good oral health in early childhood through prevention and early treatment of dental disease²⁹. Untreated ECC has a number of adverse effects on child well-being that can have long-term consequences. Children with caries can experience pain that results in difficulty eating and sleeping, and may face self-esteem issues due to the appearance of their teeth^{10,24}. ECC requiring dental work predict further problems with dental disease, including increased risk of decay in permanent teeth^{10,11}. Severe ECC may require hospitalisation for tooth extraction and can lead to infectious complications^{11,24}.

8.4.1 Toothbrushing and fluoride toothpaste

Toothbrushing is an effective means for preventing dental caries primarily as a delivery mechanism for fluoride. Fluoride cannot reach tooth surfaces that are covered with thick plaque³⁷, and brushing with fluoride toothpaste removes surface plaque, improving delivery of fluoride to the tooth surfaces and reducing the bacterial load, thus reducing caries risk^{2,37,59}. It is not recommended to rinse after brushing as this can neutralise the benefits of brushing with a fluoride toothpaste⁶⁰. Unfortunately, according to the 2009 Oral Health Survey, only 15.3% of 2-4 year olds in New Zealand brushed daily with fluoride

toothpaste², despite brushing with fluoride toothpaste being associated with lower dmft among children^{59,61}.

Using fluoride toothpaste of at least 1000 ppm concentration reduces the development of dental caries in comparison to non-fluoride toothpaste⁶¹ (Table 8.3). Importantly, there is no robust evidence to show that lower fluoride toothpastes (≤ 550 ppm) have any benefit over placebo for ECC⁶¹ (Table 8.3) or for caries prevention on permanent teeth⁶¹ (Appendix II), despite being marketed as child-friendly and believed by many parents to be an optimal choice⁸. In New Zealand, mainstream toothpaste companies have recently withdrawn low fluoride concentration toothpastes from the market, but numerous non-fluoride toothpastes have recently been introduced by smaller companies. Conversely, there is some evidence that higher fluoride concentrations (above 1250 ppm) may have more beneficial effects for both children and adults^{61,62} (Table 8.3), and toothpastes with high fluoride concentrations (2800ppm) are sometimes prescribed for older children at high risk for caries¹⁰. However, based on the available evidence, in New Zealand it is recommended that toothpaste with 1000 ppm fluoride be used for children of all ages, although infants and children should use only a smear of toothpaste⁶³. While evidence-based, this guidance differs from other countries such as Australia and the UK. Nonetheless, this means that it is important that a small amount of toothpaste (a smear) be used for infants and young children and that any swallowing is minimized¹⁰. For this reason, and to ensure that proper brushing technique is used, young children should be supervised while brushing¹⁰. Of note, there is some evidence that powered toothbrushes are more effective in reducing plaque and improving gingivitis scores than manual toothbrushes in older children and adults⁵⁹, with very limited evidence for children aged 5 years or younger⁶⁴ (Table 8.3). Thus, it is still unclear whether there is any additional benefit from powered toothbrushes among young children, particularly if there is parental supervision of toothbrushing.

While toothbrushing frequency may vary between children, school programmes can reach a large number of children to encourage effective brushing. For example, a recent study in New Zealand found a toothbrushing programme to be effective at improving oral health-related quality of life among Northland children⁶⁵. Overseas, Childsmile is an evidence-based oral health programme (including community interventions) that was introduced in Scotland in 2006, aiming at reducing inequalities in oral health^{66,67}. It provides evidence that a preschool-based toothbrushing programme can be feasible, efficacious, and cost effective. Childsmile developed out of a programme that involved provision of free toothbrushes and toothpaste to all Scottish children under the age of 6 years since 2001. In addition, this programme includes free supervised daily toothbrushing for every 3- to 4-year-old who attends preschool, and for first- and second-year students at primary schools in the highest quintile for deprivation (the equivalent of decile 1 and 2 schools in New Zealand)^{67,68}. A cost-benefit analysis indicated that while the program cost just under £1.8 million per year to implement, the number of 5-year-olds with filled, decayed, or missing teeth halved between 2000 and 2010⁶⁸. This resulted in savings of £2 million in dental care spending within three years of implementation, and in 2009/2010, the estimated savings of the program were £4.7 million⁶⁸. Importantly, the greatest savings were due to a reduction in extractions among children from the most deprived neighbourhoods⁶⁸.

8.4.2 Fissure sealants

Fissure sealants are effective for preventing caries in the pits and fissures of children's teeth. Most available evidence focused on the permanent teeth, showing marked reduction in dental caries⁶⁹, with larger effect sizes reported when sealants and varnish was used together in comparison to fluoride varnish alone⁷⁰ (Table 8.3). Fissure sealants have long been used for prevention of pit and fissure caries in New Zealand⁷¹.

Table 8.3. Evidence for oral health interventions from meta-analyses.

Data focuses on evidence for primary teeth, but evidence on permanent teeth is provided if deemed appropriate.

Intervention	Type †	Source	Comparison	Study characteristics	Finding	Quality/ Certainty of evidence	Conclusions/Recommendations
Chlorhexidine	OHP	Walsh 2015 ⁷²	Chlorhexidine 0.12% gel vs no T _x	Meta-analysis 2 RCTs Follow-up 2 years n=487; aged 0–2 years at baseline Outcome new caries on primary teeth	RR 1.00 (0.36, 2.77)	Very low	No evidence of benefit
				Meta-analysis 2 RCTs Follow-up 2 years n=490; aged 0–2 years at baseline Outcome Streptococcus mutans	RR 1.26 (0.95, 1.66)	Very low	No evidence of benefit
Fissure sealants	OHP	Ahovuo-Saloranta 2017 ⁶⁹	Resin-based sealant versus no sealant	Meta-analysis of 7 RCTs 4-year follow-up n=1,322; aged 5–10 years at baseline Outcome: caries in permanent molars	OR 0.12 (0.08, 0.19)	Moderate	Benefits of resin-sealants were maintained throughout the 4-year follow-up
Fluoride gels	OHP	Marinho 2015 ⁷³	FG vs placebo/no T _x	Meta-analysis of 25 RCTs 1-5 years follow-up n=8,479 Outcome: D(M)FS	PF# 28% (19%, 36%)	Moderate	Large reduction in tooth decay in permanent teeth from moderate quality evidence
				Meta-analysis of 10 RCTs 1-5 years follow-up n=3,198 Outcome: D(M)FT	PF 32% (29%, 57%)	Moderate	Large reduction in tooth decay in permanent teeth from moderate quality evidence
				Meta-analysis of 3 RCTs 1- to 5-year follow-up n=1,254 Outcome: d(e/m)fs	PF 20% (1%, 38%)	Low	Large reduction in tooth decay in primary teeth from low quality evidence (few studies)
Fluoride in milk	Home/ PopW	Yeung 2015 ⁷⁴	180–200ml milk ~0.5ppm F ⁻ vs non-fluoridated milk	1 RCT Follow-up 3 years n=166; aged 3 years at baseline Outcome dmft	-0.13 (-0.24, -0.02) PF 76% (2%, 100%)	Very Low	Number of issues: very wide CI for PF; unpublished data; parents were unblinded; high baseline level of caries; and low fluoride levels in drinking water (0.18–0.20ppm F).
Fluoride supplementation (pregnant women)	Home	Takahashi 2017 ⁷⁵ on Leverett 1997 ⁷⁶	2.2mg NaF tablet (1mg F) daily vs placebo (from 4 th mo until delivery)	1 RCT ⁷⁶ Follow-up at 3 and 5 years n=938 and 798, respectively Outcome dfs	3yr RR 1.46 (0.75, 2.85) 5yr RR 0.84 (0.53, 1.33)	Very low	Only one RCT met inclusion criteria, and there was no evidence that maternal fluoride supplementation during pregnancy help prevent decay in primary teeth in the offspring.

Intervention	Type †	Source	Comparison	Study characteristics	Finding	Quality/ Certainty of evidence	Conclusions/Recommendations
Fluoride supplementation (children)	Home	Tubert-Jeannin 2011 ⁷⁷ on Lin 2000 ⁷⁸	NAF tablets/drops (0.25-0.50mg F) daily vs no T _x	1 RCT ⁷⁸ Follow-up 2-3 years n=115; aged 22–26 months at baseline Outcome d(m)fs	PF 73% (46%, 99%)	Very low	Evidence of very low quality from one relatively small study that showed a marked reduction in caries in primary teeth with fluoride supplementation. Population were children cleft lip and/or palate.
		Tubert-Jeannin 2011 ⁷⁷	NaF or APF tablets/drops (0.25-1mg F) daily vs no T _x	Meta-analysis 2 RCT Follow-up 2-3 years n=696; aged 22–26 months and 5.3 years at baseline Outcome d(m)ft	PF 46% (8%, 83%)	Very low	Two studies with high heterogeneity, results with a very wide confidence interval. Study populations unclear.
			NaF tablets (0.25 or 1mg F) vs topical F	Meta-analysis 2 RCTs Follow-up 2-3 years n=1,051; aged 3 and 6 years at baseline Outcome d(m)fs	PF 13% (-7%, 33%)	Moderate	Topical fluorides consisted of varnishes, toothpastes, and mouthwashes. There was no effect of fluoride supplementation, with this observation apparently unaffected by the type of topical treatment.
Fluoride toothpaste	Home	Walsh 2019 ⁶¹ on Fan 2008 ⁷⁹	1500ppm vs fluoride-free TP	1 RCT ⁷⁹ n=998 Outcome: dfs *	-1.86 (-2.51, -1.21)	Moderate	1500ppm toothpaste reduces tooth caries increment compared to fluoride-free toothpaste, from moderate-quality evidence (one study).
		Walsh 2019 ⁶¹	1055ppm vs 550ppm TP	Meta-analysis 2 RCTs n=1,958 Outcome: dmfs *	-0.05 (-0.38, 0.28)	Moderate	No difference in efficacy for 1055ppm TP vs 550ppm TP from moderate-quality evidence (two studies)
		Walsh 2019 ⁶¹ on Davies 2002 ⁸⁰	1450ppm vs 440ppm TP	1 RCT ⁸⁰ n=2,362 Outcome=dmft *	-0.34 (-0.59, -0.09)	Moderate	1450ppm TP led to slight reduction in caries increment compared to 440ppm, with moderate-quality evidence (one large study)
Fluoride varnishes	OHP	Marinho 2013 ⁸¹	FV 2 to 4x per year vs placebo/no T _x	Meta-analysis of 10 RCTs 1- to 2.5-year follow-up n=3,804 Outcome: d(e/m)fs	PF 37% (24%, 51%)	Moderate	ditto
				Meta-analysis of 2 RCTs Follow-up 'closest to 3 years' n=322 Outcome: d(e/m)ft	PF 65% (48%, 82%)	Moderate	ditto
Fluoride varnishes + Pit & fissure sealants	OHP	Ahovuo-Saloranta 2016 ⁷⁰	RBPfseal vs FV	Meta-analysis of 2 RCTs 2-year follow-up Outcome: permanent molar caries n=358; age 6–10 years	OR 0.69 (95%CI 0.50, 0.94) Decay 9.5% vs 13.2%	Low	Low-quality evidence suggestive: RBPfseal > FV alone at 2yr

Intervention	Type †	Source	Comparison	Study characteristics	Finding	Quality/ Certainty of evidence	Conclusions/Recommendations
		Ahovuo-Saloranta 2016 ⁷⁰ on Splieth 2001 ⁸²	RBPfseal+FV vs FV	1 RCT ⁸² 2-year follow-up n=92; age 5–8 years Outcome: caries in permanent teeth	Decay at 2yr: OR 0.30 (95%CI 0.17, 0.55); 7.9% vs 22.3%;	Low	Low-quality evidence suggestive: RBPfseal+FV > FV alone at 2yr
Silver diamine fluoride	OHP	Oliveira 2018 ⁸³	T _x : 38% SDF onto carious surfaces Control: placebo or no T _x (onto carious surfaces)	Meta-analysis 2 RCTs ^{84,85} Follow-up 2.5–3 years n=496 Outcome: dmft/dmfs	PF 77% (68%, 87%)	Moderate	Silver diamine fluoride effective in the prevention of dental caries in primary teeth.
		Oliveira 2018 ⁸³ on Chu 2002 ⁸⁴	T _x : 38% SDF Control: 5% NaF varnish (onto carious surfaces)	1 RCT ⁸⁴ Follow-up 2.5 years n=123 Outcome: dmft/dmfs	PF 54% (27%, 73%)	Low	Single study, but it was deemed to have mostly low risk of bias.
Toothbrush type	Home	Yaacob 2014 ⁵⁹ on Silverman 2004 ⁶⁴ Δ	Powered vs manual TBr	1 RCT ⁶⁴ Follow-up 6 weeks n=38; aged 4–5 years at baseline Outcome plaque & gingivitis scores	Plaque reduction -13% (-32%, 5%) Gingivitis reduction -55% (-4%, -100%)	Very low	Only RCT in children aged ≤5 years reported in Yaacob 2014 ⁵⁹ . Showed no effect on plaque, but a significant reduction in gingivitis scores at 6 weeks. However, very low quality evidence from a single very small trial.
Xylitol	Home	Riley 2015 ⁸⁶ on Milgron 2009 ⁸⁷	Xylitol syrup (8 g/day) vs Xylitol syrup (2.7 g/day)	1 RCT ⁸⁷ Follow-up 1 year n=94; aged 9–15 months at baseline Outcome no. decayed primary teeth	-1.10 (-2.03, -0.18) PF 58% (7%, 78%)	Low	A single RCT provided evidence of a 58% reduction in decayed primary teeth after 1 year with xylitol syrup at 8 g/day. RCT deemed at low-risk of bias, but evidence low quality due to small sample size (and wide confidence interval).
		Riley 2015 ⁸⁶ on Oscarson 2006	Xylitol tablets (0.5–1 g/day) vs no T _x	1 RCT ⁸⁸ Follow-up 2 years n=118; aged 2 years at baseline Outcomes d(m)fs; caries increment vs none/no change	-0.42 (-1.12, 0.28) [d(m)fs] PF 53% (35%, 80%) RR 0.72 (0.35, 1.45)	Very low	One RCT reporting no evidence of benefit on primary dentition with xylitol tablets. However, if the effect on caries increment was assessed as PF, there was indication of a 53% reduction with the treatment. Thus, the evidence is deemed to be very low quality.
		Riley 2015 ⁸⁶ on Taipale 2013 ⁸⁹	Xylitol tablets (200-600 mg/day) vs control (sorbitol) tablets [tablets delivered through pacifiers or spoons]	1 RCT ⁸⁹ Follow-up 4 years n=62; aged 1–2 months at baseline Outcome caries increment vs none/no change	RR 3.08 (0.69, 13.7)	Very low	No evidence of an effect, from very-low-quality evidence (low risk of bias but high attrition rate – 43% loss to follow-up).

Intervention	Type †	Source	Comparison	Study characteristics	Finding	Quality/ Certainty of evidence	Conclusions/Recommendations
		Riley 2015 ⁸⁶ on Zhan 2012 ⁹⁰	Xylitol wipes 3x/day (4.2 g/day) vs control wipes	1 RCT ⁹⁰ Follow-up 1 year n=44; aged 0.5–3 years at baseline Outcome d(m)fs caries increment vs none/no change ⁸⁶ ; Proportion with new d(m)fs ⁹⁰	RR 0.14 (0.02, 1.07) ⁸⁶ DiffProp -0.27 (-0.49, - 0.06) ⁹⁰	Very low	Riley 2015 ⁸⁶ reported no effect based on RR. However, Zhan 2012 reported in the original study a beneficial effect of xylitol wipes based on a Fisher's exact test (incidence of children with new d(m)fs). Nonetheless, the evidence derived from a very small sample size (22 per group).
Primary school-based behavioural interventions	Pre- school	Cooper 2013 ⁹¹ on Zanin 2007 ⁹²	T _x : intensive individual training on TBr technique and structured educational oral health programme (3-monthly) Control: Supervised group training on TBr technique once yearly.	1 RCT ⁹² Follow-up 15 months n=60; aged 4 to 7 years at baseline Outcome DMFS; plaque index	PF 65% (12%, 100%) DMFS [¶] PF 37% plaque index ⁹²	Low	Provided evidence of markedly improved oral health after the education programme. No information on data variability was provided, so it is not possible to assess the level of accuracy of results on plaque. Study also on a small population of children deemed high-risk, but it was deemed low risk of all biases (except allocation concealment that was assessed as unclear).
		Cooper 2013 ⁹¹	T _x : school-based education Control: no T _x	2 RCT ^{93,94} Follow-up 3 months n=419 at 3–4 months; aged 9–10 years at baseline Outcome: plaque index	-0.51 (-0.80, -0.21) PF 38% (15%, 59%) [¶]	Low	Substantial heterogeneity. One of the studies included (Saied-Moallemi 2009 ⁹³) showed best outcomes when parents were involved at home.

Population-wide interventions such as fluoridation of water⁹⁵ have been excluded.

Data on findings are means and respective 95% confidence intervals. Studies on adults were not included.

APF, acidulated phosphate fluoride; CI, confidence interval; d(e/m)fs, decayed (extraction indicated/missing) or filled primary surfaces; d(e/m)ft, decayed (extraction indicated/missing) or filled primary teeth; dfs, decayed or filled primary tooth surface; DFS, decayed or filled permanent tooth surface; OHP, oral health practitioner; D(M)FS, decayed (missing) or filled permanent surfaces; D(M)FT, decayed (missing) or filled permanent teeth; F, fluoride; FV, fluoride varnish; NaF, sodium fluoride; OR, odds ratio; PF, prevented fraction; PopW, population-wide intervention; RBPfseal, resin-based pit and fissure sealant; RR, relative risk/risk ratio; SDF, silver diamine fluoride; TBr, toothbrush(es)(ing); TP, toothpaste; Tx, treatment.

PF, prevented fraction is derived as [(mean caries increment in controls – mean caries increment in treated group) / (mean caries increment in controls)], where the caries increment is calculated as, for example, (final DMFS – baseline DMFS).

† Type refers to the setting in which a given treatment would be applied in the real world.

* Differences were expressed as caries increment, i.e. surface index d3fs or d3(m)fs or D3(M)FT adjusted for baseline value.

‡ Data provided as mg/L, and 1 mg/L = 1 ppm.

Δ Effect size calculated here using a two-sample t-test.

¶ The PF upper limit was corrected to 100%, as original PF provided by Cooper 2013⁹¹ was erroneous for including an upper limit >1, i.e. there were fewer caries on permanent dentition than children started with. This would be theoretically possible if the children had lost permanent teeth without accruing new caries on the permanent dentition, which is very unlikely to occur across of group of young children deemed to be high-risk.

8.4.3 Fluoride mouthwashes

Fluoride mouthwashes are largely unsuitable to target ECC in most children aged <5 years who would likely swallow them, putting these children at risk of fluorosis. Thus, there is a paucity of evidence on the efficacy of fluoride mouthwashes for primary teeth. However, a large meta-analysis of 35 RCTs on 15,305 children aged 6–14 years provided moderate quality evidence showing a prevented fractionⁱ of 27% (95% CI 23%, 30%) in DMFS, with findings largely unaffected by caries severity, background exposure to fluorides (e.g. water), fluoride concentration, or rinsing frequency⁹⁶. Thus, supervised fluoride mouthwashes may help prevent ECCs in those children old enough not to swallow them

8.4.4 Fluoride supplementation

Fluoride supplementation in the form of tablets, drops, or lozenges has been shown to have positive effects on child oral health outcomes in a small number of studies⁷⁷ (Table 8.3). However, the World Health Organization recommends that water, salt, or milk be the primary source of fluoride supplementation, as all have good evidence to support their use and have the potential to reach most if not all of a population^{97,98}. In New Zealand, universally fluoridated water would likely be the most cost effective way to pursue adequate fluoride supplementation in all communities⁹⁹.

8.4.5 Dietary advice and oral health education

Dietary habits play a key role in caries risk through exposure of the teeth to fermentable carbohydrates, especially monosaccharides (i.e. simple sugars). Consumption of carbohydrates leads to rapid reduction in the pH of biofilm on teeth (known as dental plaque), altering the tooth microbiome, and contributing to demineralisation of the tooth enamel^{2,4,37}. Bacteria or plaque dysbiosis alone will not lead to tooth decay, but free sugars in particular promote an environment of increased risk^{4,100,101}. Saliva protects teeth by diluting acids at the tooth surface, and normally contains calcium and phosphate (essential for remineralisation of tooth surfaces) and bicarbonate (essential for buffering oral acids). Saliva may also contain fluoride from toothpaste or dietary sources^{37,102}, which can prevent and reverse early caries¹⁰³.

A commonly cited review suggests that dental health education interventions can have a significant but temporary positive effect on oral hygiene, and that while educating parents may improve child oral health, there is little evidence that school-based programmes are effective¹⁰⁴. However, this review is more than 20 years out of date, and the evidence base has changed. Currently, there is moderate evidence that education and behavioural interventions based in primary schools (which may or may not include a ‘homework’ component involving parents) can reduce children’s plaque levels⁹¹. Cooper et al.’s Cochrane review from 2013 included one study that suggested an effect of preventing caries, and another that reported improved oral health knowledge among participating children⁹¹. One school-based oral health intervention in Iran reported that parental involvement was critical for the success of their programme⁹³.

Family engagement is especially important for oral health, as parents and caregivers can affect children’s oral health both directly and indirectly through their behaviours, knowledge, and attitudes^{9,105,106}, which can have an effect throughout life¹⁰⁷. Young mothers in general may have poor knowledge about disease prevention and the consequences of poor oral health¹⁰⁸. Motivational

ⁱ Calculated using the formulae:

$$\text{Caries increment} = \text{final dmfs} - \text{baseline dmfs}$$

$$\text{Prevented fraction} = \frac{\text{mean caries increment in controls} - \text{mean caries increment in treated group}}{\text{mean caries increment in controls}}$$

interviewing or education one-on-one in a dental setting may be effective for improving diets¹⁰⁹, and while such evidence is not child-specific, the composition of infant/child diets are determined by adult caregivers. Further, motivational interviewing has been successfully incorporated into a culturally-informed intervention for Australian Aboriginal children¹¹⁰, and has been adapted for use with Māori caregivers in an oral health setting¹¹¹.

Oral health changes during pregnancy (e.g. pregnancy gingivitis)¹¹² and education during this critical period can help establish the idea of good oral health as important for general health and wellbeing¹⁰. Further, dental care during pregnancy is a good time for anticipatory advice for infant and child oral health¹⁰, which has been demonstrated to improve expectant mothers' oral health knowledge and potentially child outcomes^{113,114}. Although it seems there are no data for New Zealand, provision of anticipatory guidance during pregnancy was associated with a reduction in the prevalence of severe ECC in young Australian children¹¹⁵, and oral health education for new mothers has been associated with improved child oral health internationally¹¹⁶. Conversely, there is likely to be no benefit of maternal fluoride supplementation during pregnancy on ECC risk in primary teeth among the offspring, and this has been verified through research^{75,76}.

Media campaigns have the potential to reach a wide audience, making them suitable for preventive education. The Baby Teeth Matter campaign aimed to promote oral health awareness, particularly among Māori, Pacific, or low income families of pre-schoolers, using a re-imagined Māori tooth fairy in TV, radio, social media, and other online advertisements¹¹⁷. The promotion was remembered by the majority of participants in an evaluation study. A third of those who saw the campaign had made changes to their child's dental care, most commonly by ensuring their child's teeth were brushed twice daily¹¹⁷.

It is important that health education interventions intended to result in behaviour modification are supported by regulation and health public policy. Children in New Zealand are regularly exposed to marketing of sugary drinks, fast food, confectionary, and snacks in home, school, and public settings¹¹⁸. Unhealthy food television advertisements are most frequent during peak times for child viewing¹¹⁹, and have an impact on children's food requests¹²⁰. In this context, an infrequent and perhaps rushed educational interaction with an oral health professional once every six months is likely to be undermined by parents and their children being frequently exposed to advertising for unhealthy products.

8.4.6 Childsmile and fluoride varnish

As well as the toothbrushing programme, Childsmile comprises several components, all of which include oral health education alongside other interventions⁶⁷. Childsmile begins with universal screening of infants at their 6-8 week health check to identify those who are at increased risk for developing dental caries⁶⁶. Families of these infants are encouraged to visit a dental service when their child is around six months of age, and to have six monthly checks thereafter. These visits provide opportunities to educate about diet and toothbrushing, and to administer appropriate clinical interventions based on the child's needs (e.g. fillings, fissure seals, fluoride varnish)⁶⁷. It is of note that no elements of Childsmile are 'new', and all elements are used in New Zealand to some extent. Childsmile simply takes well-established caries preventive and management strategies, but actually implements them on a wide scale, ensuring that staff are available, trained, and funded to reach out to communities.

Another key component of the Childsmile program is a targeted oral health intervention for children aged three years or older attending schools or preschools in the highest quintile for deprivation. All

children attending these schools regardless of individual risk are offered fluoride varnish to be applied to their teeth twice-yearly by mobile teams of specially trained dental nurses⁶⁷. Parental consent and a brief medical history are sought then revised by a dentist, who gives an individual prescription for the varnish unless it is contraindicated. The success of this intervention is thought to rely largely on parental consent⁶⁷. Consent varies considerably between educational establishments and may depend on the school/preschool's commitment to the program and ability to chase up parents who have not completed the consent form⁶⁷. The fluoride varnish programme has not yet been fully evaluated, but the number of children receiving fluoride varnish has increased since its implementation¹²¹. The proportion of three-and-four-year-old children receiving two applications in the 2013/14 school year was highest in those from the most deprived quintile¹²¹. However, only 40-50% of these children received the recommended applications¹²¹. In 2011 the fluoride varnish programme was extended by offering remuneration to all dental practitioners who apply varnish to children aged two to five years, but this had only a modest effect on practice for the majority of practitioners¹²².

Evidence from Sweden supports a targeted approach to fluoride varnish application. A three-year randomised controlled trial demonstrated no significant benefit of fluoride varnish application for children determined to have low risk for caries, while among high-risk children, twice-yearly application was associated with a 69% reduction in caries incidence¹²³. These children were aged 13 years at the beginning of the study, so the results may underestimate the potential of early intervention approaches. In New Zealand, targeting those who are likely to benefit most from fluoride varnish may be challenging as there is no standardised and validated screening tool available. The Childsmile approach of targeting those who live or go to school in the areas of highest deprivation may reach the majority of those who are at highest risk for ECC.

8.4.7 The New Zealand context

Dental caries is the same disease the world over, and at any age, and international experience can inform what happens in New Zealand. The key to reducing dental caries prevalence and severity is investment in prevention. There is ample evidence that strategies such as toothbrushing programmes, clinical preventive care and health policy measures can be effective. Historically, caries rates fell markedly among New Zealand children following the reorientation of New Zealand's School Dental Service in the 1970s at which time a greater focus on preventive care was introduced. School dental nurses were discouraged from doing as many fillings as they had been placing and were instead encouraged to provide preventive-only appointments. The number of restorations placed per child dropped from 5 restorations per year in 1965 to 1.5 restorations in 1981¹²⁴. Count of decayed, missing and filled teeth at age 5 years dropped rapidly reducing from 3.7 teeth in 1977 to 2.6 teeth in 1982¹²⁵. These improvements have been sustained, and advances in dental care mean dmft scores among five-year-old children has reduced further. However, the rate of improvement has largely stagnated, with only a modest improvement in mean dmft at age 5 over the past decade (from 2.0 in 2009 to 1.8 in 2009). Limitations of the dental service mean that clinicians must deal with problems that occur before a child ever reaches a dental clinic; this underlines the key role that WCTO could play in the front line of prevention of dental caries

8.4 Summary

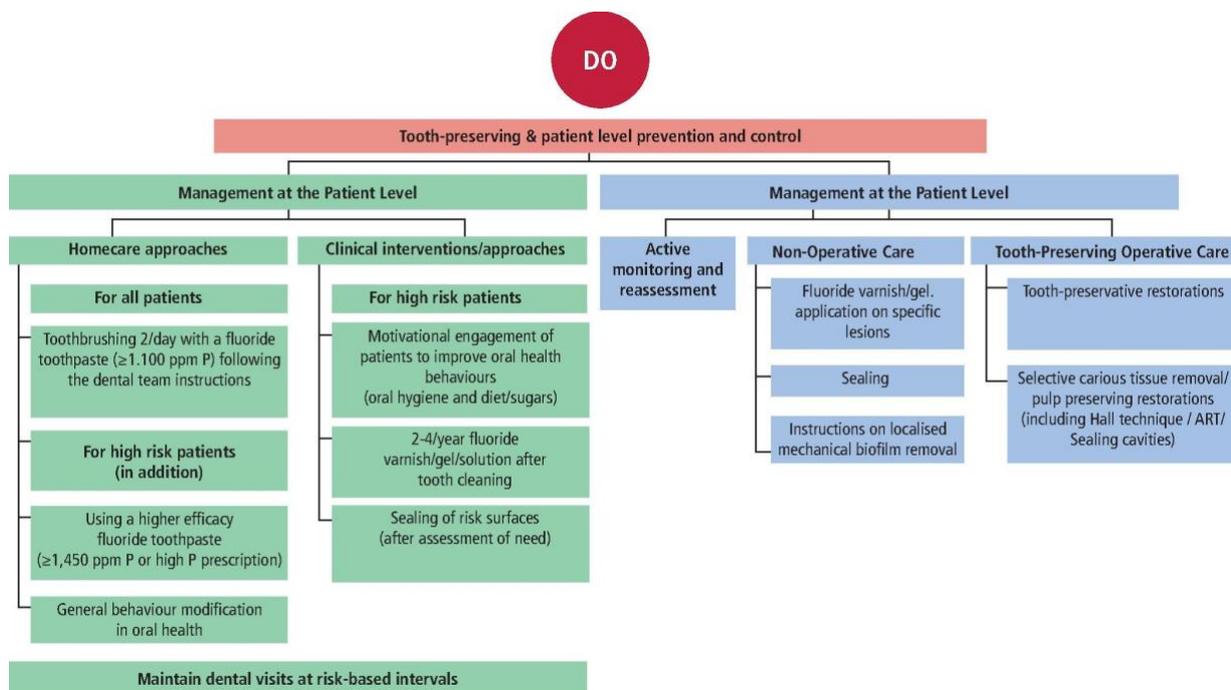
- **Key preventive measures for ECC are behavioural: toothbrushing twice daily with 1000 ppm toothpaste and reducing intake of sugary drinks and food.**
- **Interventions focussing on these behaviours can be successfully implemented in pre- and primary schools, especially when caregivers are involved.**

- *Universal water fluoridation is recommended.*
- *The Childsmile programme is a valuable model that has shown to be cost effective, leading to reductions in ECC, dental care spending, and inequalities in oral health among Scottish children.*
- *A similar strategy to Childsmile is likely to be achievable in New Zealand, but would require investment, including prioritisation and delivery of effective preventive dental care.*

8.5 Effective interventions following early detection of dental disease

Because of the preventive focus of dental care, there is considerable overlap between preventive strategies and ‘treatment’ interventions. Thus, almost invariably every effective preventive measure for dental disease would also be part of the management following detection of actual ECC. However, while preventive approaches can be administered at a community level, treatment of existing dental disease must be carried out by an oral health practitioner and is therefore beyond the scope of this review. Nonetheless, in general, the aim of dental treatment for decay is to restore decayed teeth and prevent further progression of the disease. The exact treatment plan depends on the practitioner’s clinical judgement, taking into account the child’s age and cooperation. The CariesCare practice guide, written by an international group of experts on dental caries has outlined how treatment and prevention may combine in patient care (Figure 8.1)¹³. The figure further demonstrates that motivational engagement to change patients’ health behaviours is an important part of dental care¹³. For children, family engagement using principles of motivational can improve both oral health knowledge and actual health behaviours¹⁰⁵.

Figure 8.1. Flowchart reproduced with permission from Martignon 2019¹³ showing tooth-preserving and patient level prevention and control.



Note: this figure is an illustration, not a specific prescription.

Population level interventions are beyond the scope of this review, but they have the potential to effect significant changes on behavioural risk factors for dental disease, such as dietary choices. Although it is recommended that sweetened beverages and juices should be avoided entirely by young children¹⁰ (or not be supplied to them), New Zealanders are among the top consumers of sugar worldwide, and in 2007 this country's annual per-capita consumption of sugar exceeded those in the USA, UK, Canada, and Australia¹²⁶. In this context, the World Dental Federation recommend higher taxation on sugar-rich foods and sugar-sweetened beverages¹²⁷. Health taxes have demonstrated positive effects on consumer behaviour¹²⁸, including a reduction in purchasing of sugar-sweetened beverages in Mexico and a restaurant chain in the UK after the introduction of a levy on these products¹²⁹. New Zealand data suggest that changes to packaging and prices of sugar-sweetened beverages are likely to affect purchasing decisions¹³⁰. A recent cost-benefit analysis suggested that a 20% tax on sugar-sweetened beverages in Australia could result in savings of at least \$666 million over 10 years due to reduced dental decay and subsequent dental treatment¹³¹.

8.5 Summary

- *Treatment of established dental disease requires the involvement of oral health practitioners and cannot be performed in community settings; however, ongoing preventive care should still be provided.*
- *If there is a lesion, oral health practitioners can consider silver diamine fluoride (even for very young children), which would delay the time to the first restorative intervention and minimise the risk that the child will require general anaesthetic for dental treatment.*
- *As dental disease such as caries is cumulative, it is important that children identified to have dental disease (or for whom a sibling experiences dental disease) should be classified as high risk and remain a target for preventive interventions.*
- *Treatment of dental decay is multifaceted and includes management of patient factors such as oral health self-care and diet.*

8.6 Potential harms from screening and/or early intervention

8.6.1 Screening

Due to the difficulty of visually identifying tooth decay in a primary care setting, it is likely that the lift-the-lip will lead to false negatives cases⁴⁸. Conversely, if early caries are missed by the assessor during the lift-the-lip, some parents may believe that their child is free of tooth decay and do not take their child to see an oral health practitioner as appropriate. Therefore, it should be clearly communicated to parents that the lift-the-lip examination is not a replacement for a comprehensive dental exam by a qualified oral health practitioner⁴⁸.

8.6.2 Fear of treatment

Many children and adults experience fear of dental procedures or dental practitioners; this may lead to avoidance behaviour and consequently to delayed diagnosis of tooth decay, requiring more extensive and more costly treatment^{8,10,132,133}. This is especially true for children who have previously suffered from toothache or had a painful experienced during dental treatment, or children whose parents who fear the dentist¹³².

It has been theorised that positive, early exposure to an oral health clinic environment before any treatment is necessary could reduce the likelihood of children developing such fears, as well as providing an opportunity for anticipatory guidance to help prevent oral health problems^{8,10}. Of note, techniques such as the Atraumatic Restorative Technique (ART) do not use electrical tools (i.e. 'drills'), and may be used to minimise the risk of young children having unfavourable experiences of dental care, although ART restorations last poorly relative to conventional dental treatment¹³⁴.

8.6.3 Fluoride

Excessive exposure to fluoride can result in fluorosis as permanent teeth develop during the first eight years of life⁹⁹. In its common mild form fluorosis may be observed as opaque white areas in the tooth enamel, which are of purely cosmetic significance. Moderate fluorosis involves mottling and discolouration on all teeth, while severe fluorosis may additionally cause pitting or a 'corroded' appearance of enamel. Severe fluorosis is rare in New Zealand⁹⁹, but it may be observed among individuals who immigrate from regions of the world where fluorosis is endemic. Developmental defects of enamel in permanent teeth are more likely if the primary tooth was carious¹³⁵. These are not associated with fluoride exposure, but may be misdiagnosed as fluorosis¹³⁶.

To minimise risk of dental fluorosis, it is recommended that excess fluoride toothpaste is not swallowed, and that children should use smaller amounts than adults^{10,63,137}. Children should also be observed while brushing their teeth to ensure that excess toothpaste is not swallowed. Acute fluoride poisoning is possible if a small child swallows a large amount of toothpaste (around 50 g depending on the child's weight), but in most cases symptoms will resolve quickly with no apparent long-term effects¹³⁸. Existing New Zealand guidance is that toothpastes of 1000 parts per million fluoride should be used by children of all ages⁶³.

There is a clear consensus in the scientific literature that fluoridated water is safe and effective for improving oral health at concentrations used in New Zealand⁹⁹. Some studies have reported high levels of fluoride to be associated with lower IQ scores, but the evidence that fluoride has effects on neurodevelopment at levels recommended for community water fluoridation is lacking^{99,139}. A recent Canadian study suggested that there may be sex-specific effects of maternal fluoride intake during pregnancy on offspring IQ score¹⁴⁰, but other studies have had contradictory findings^{139,141}.

Community water fluoridation has the potential to provide greater benefit at lower cost than other interventions due to its wide reach, but only half of New Zealanders receive fluoridated water^{99,142} (Appendix III). Although community water fluoridation is less cost-effective in some areas than others, uptake of a Ministry of Health subsidy for fluoridation was low, suggesting that when the barrier of cost is addressed there is still reluctance to implement this public health measure¹⁴².

Anti-fluoride groups are a barrier to community water fluoridation, as local government is currently responsible for both decision-making on this issue and legal fees if challenged by anti-fluoride activists^{142,143}. A bill currently awaiting its second reading in the New Zealand Parliament proposes transferring water fluoridation decision-making to District Health Boards as a reflection of its importance as a wider public health measure rather than a matter for local government. Minimal fluorosis has been reported in New Zealand in areas receiving fluoridated water supplies. Those at highest risk are infants who consume formula constituted with fluoridated water and therefore may have exceeded recommended limits⁹⁹ until their revision¹⁴⁴. However, even in this higher risk group, fluorosis causing cosmetic concern is rare, and benefits for oral health are thought to far outweigh this risk⁹⁹.

8.6.4 Other interventions

The majority of intervention studies for dental disease do not report whether or not participants experienced adverse outcomes. Studies that report on adverse events are summarised in .

Table 8.4, noting that studies on infants and preschoolers that report adverse events are rare. Further, even though some studies included in the table reported adverse events, most did not provide detail such as the proportion of participants who experienced them. Importantly, no serious adverse events have been reported (Table 8.4).

Table 8.4. Recorded adverse events in association with oral health interventions*

Intervention	Study	Study characteristics	Adverse events	Comments
Chlorhexidine varnish	Walsh 2015 ⁷²	4 RCTs n= 1146 Age: 0-5 years, 1 study mean 13.2 years	Nil	No adverse events reported
Fluoride gels	Marinho 2015 ⁷³	3 RCT or quasi-RCTs n= 609 Age: 6-15 years	Nausea, vomiting	Very low quality evidence, proportion affected unclear
Fluoride mouthwashes	Marinho 2016 ⁹⁶	6 RCT or quasi-RCTs n= 3325 Age: ~7-13 years (some reported only mean age)	Tooth staining	Data incompletely reported; majority reported no adverse side effects.
Fluoride tablets	Tubert-Jeannin 2011 ⁷⁷	1 RCT n= 640 Age: mean 6.6 years	Fluorosis	One child had moderate fluorosis and fewer than 1% had mild fluorosis. No severe fluorosis reported.
Fluoride toothpaste	Walsh 2010 ⁶²	14 RTs n= 16364 Age: 4-13 years	Tooth staining	Majority of studies reported no adverse events. Tooth staining was only reported in data collected before 1975.
Fluoride varnish	Marinho 2013 ⁸¹	3 RCT or quasi-RCTs n= 200 aged 1-4 years, 758 aged 13-16 years, 16 aged 22-30 years	Nil	No adverse events reported
	Ahovuo-Saloranta 2016 ⁷⁰	3 RCT n=1180 Age: ~6-10 years	Nil	Note: same studies as above (resin-based and resin-modified glass ionomer fissure sealant)
Powered and manual toothbrushes	Yaacob 2014 ⁵⁹	40 RCTs n=? Age: mostly adults	Soft tissue damage	Absent in most studies, no apparent difference in risk of soft tissue damage between manual vs powered toothbrush use.
Resin-based fissure sealants	Ahovuo-Saloranta 2016 ⁷⁰ & 2017 ⁶⁹	2 RCTs n=853 Age: 6-10 years	Nil	No adverse events reported
Resin-modified glass ionomer fissure sealant	Ahovuo-Saloranta 2016 ⁷⁰ & 2017 ⁶⁹	1 RCT n=327 Age: mean 7 years	Nil	No adverse events reported
Silver diamine fluoride	Seifo 2019 ¹⁴⁵	8 systematic reviews n=? Age: primarily adults	Black staining of carious lesions White painful lesions in oral mucosa	The proportion of patients affected by staining is not clear. Staining was not of concern to the majority of participants. Lesions were due to accidental contact of mucosa with silver diamine fluoride, proportion affected unclear.
Topical fluoride	Wong 2010 ¹⁴⁶	2 RCTs, 1 cohort study, 6 case-control studies, 16 cross-sectional surveys n= 27,868 Age: 12 months to 17 years	Fluorosis	Only toothpaste evaluated. Brushing with fluoride toothpaste before 12/14 months associated with increased fluorosis risk, no evaluation of severity.

Intervention	Study	Study characteristics	Adverse events	Comments
Xylitol candy	Riley 2015 ⁸⁶	1 RCT n= 252 Age: mean 8 years	Nil	No adverse events reported
Xylitol fluoride toothpaste	Riley 2015 ⁸⁶	2 RCTs n= 4214 Age: 7-12 years	Nil	No adverse events reported
Xylitol syrup	Riley 2015 ⁸⁶	1 RCT n= 94 Age: 9-15 months	Loose stools and diarrhoea. Nil serious adverse events	Similar rates of loose stools and diarrhoea between different dose groups.
Xylitol wipes	Riley 2015 ⁸⁶	1 RCT n= 44 Age: 6-35 months	Nil	No adverse events reported

* Note that in light of the paucity of published data on adverse events in young children, we have listed some evidence reported for older children and in some cases adults.

8.6 Summary

- *The use of fluoride toothpaste is safe and effective, but young children require supervision to minimize any swallowing.*
- *The quantity of toothpaste placed on a brush should be limited to a smear, owing to the high fluoride concentration in toothpastes recommended for use among children in New Zealand.*
- *Minimally invasive treatments may reduce fear associated with dental treatment.*
- *While some adverse events have been associated with specific oral health interventions, most were rare and/or of minor concern.*

8.7 Māori and Pacific knowledge about screening and intervention for dental disease

The prevalence of ECC among non-Māori and non-Pacific New Zealanders is similar to rates reported in other high-income countries, but prevalence among Māori and Pacific children is consistently reported to be twice as high^{2,32,143}.

Many complex social and political factors contribute to poor oral health experienced by Māori and Pacific children^{3,143}. Poverty creates an environment of high risk for poor oral health, and disproportionately affects Māori and Pacific families in New Zealand¹⁴³. During early life, when children are dependent on others for their health needs, oral health is strongly related to both the knowledge and beliefs of parents and their economic circumstances⁹. Poor oral health literacy has been reported among Māori and Pacific parents and those from neighbourhoods with high deprivation^{8,28}. Māori and Pacific children consume much more sugary drinks than children from other ethnic backgrounds¹⁴⁷, and qualitative data from two studies suggest that convenience and affordability are key factors in food choices for Māori caregivers^{111,148}.

Pacific Islanders living in New Zealand are a diverse group with different cultures, languages, and traditions, but overlapping social circumstances¹⁴⁹. Ethnic subgroups within Pacific ethnicity are associated with oral health practices^{28,149}. In particular, Tongan children are less likely to brush their

teeth as recommended, less likely to be supervised while brushing, and more likely to snack immediately before bed compared to other Pacific children^{28,149}.

The extent to which Pacific mothers feel aligned with Pacific Island or New Zealand culture also predicts oral health behaviours¹⁵⁰. Children whose mothers identify strongly with Pacific but not New Zealand culture were less likely to be enrolled in the school dentist service, or to brush their teeth regularly compared to those with other cultural orientations¹⁵⁰. This association between oral health and cultural orientation was not as strong as other individual and societal influences on oral health, but highlights the importance of oral health services and education that are culturally acceptable to those they target. Data from a qualitative study suggests that cultural connectedness and tradition are important in decision making around oral health for Māori women¹¹¹. Many felt that oral health was important for avoiding the pain and cost associated with dental problems in adulthood, but that attempts to provide healthy food for their children could be easily undermined by whānau giving young children sweet treats, and the cost and inconvenience of preparing healthy meals. They saw the value of education efforts that came from within their own communities, and felt that it was important to have access to Māori oral health providers¹¹¹.

Although the number of Māori oral health practitioners appears to be slowly increasing, they still comprise a small proportion of the workforce in comparison to the general population¹⁵¹. Furthermore, Māori oral health providers were consulted during the reorientation of the COHS, but many felt that their input was largely disregarded³⁰. They saw the reorientation project as an opportunity to bring oral health services more in line with the values of community and whānau ora. Instead, the changes made to mainstream services (e.g. mobile clinics) were systems that were already in use by Māori oral health providers in some areas and had failed to address widening inequalities for Māori children³⁰.

Research informed by kaupapa Māori principles that empowers whānau to find solutions within their own communities, and better access to culturally competent care will likely help to improve oral health for Māori children¹¹¹. However, interventions that ignore the root causes of health inequality for Māori and Pacific families (i.e. poverty) are unlikely to close the oral health gap between Māori and Pacific children and other New Zealanders^{111,148}.

When screening or treating patients of any ethnicity, it is important to be sensitive to their cultural beliefs and practices. The Dental Council of New Zealand provides a statement on best-practice for providing care to Māori, which was produced in consultation with Te Ao Marama (the Māori Dental Association). These guidelines provide specific advice for supporting Māori patients in dental setting. For example, Māori consider the head to be tapu, and dental screening and treatment involve touching of the head, so permission of a child's parent/caregiver should be asked before doing so. In more general terms, as whānau are extremely important in Māori culture, it is important that clinicians consider whether a patient may wish for whānau members to be present in an oral health setting; clinicians should not exclude family members against the wishes of their patient.

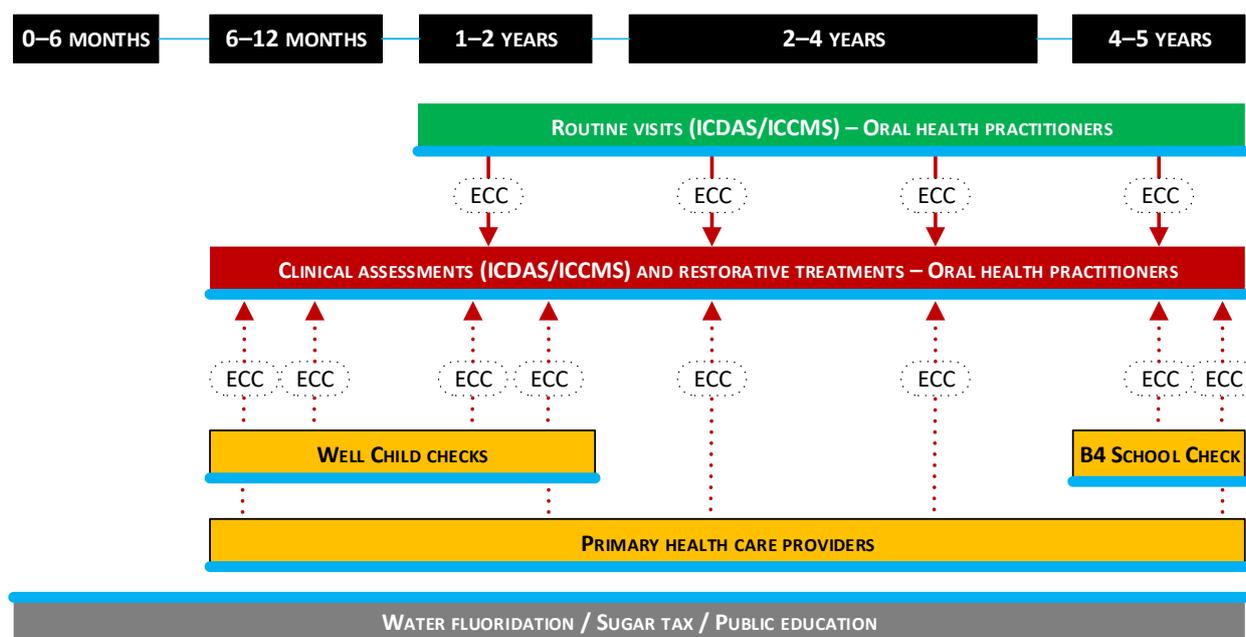
8.7 Summary

- *Māori and Pacific children are at greater risk of dental disease, and should be a priority for oral health screening, prevention, and treatment.*
 - *It is important to develop Māori and Pacific oral health workforce.*
 - *Screening and treatment should be sensitive to Māori and Pacific cultural beliefs and practices.*
-

8.8 Conclusion

Adequate oral health screening and intervention requires a multifaceted approach. Such an approach for New Zealand is summarized in Figure 8.2.

Figure 8.2. – Proposed oral health care system for New Zealand children aged 0–5 years.



- Grey box – recommended population-wide measures that are outside the scope of this study, but which are nonetheless represented as important parts of a national oral health care system.
- Orange boxes – instances where the lift-the-lip screening tool should be performed. If any there is any evidence or suspicion of early childhood caries (ECC), the child should be referred (dotted red lines) to an oral health practitioner for proper assessment and, if necessary, restorative treatment. It must be emphasized that the settings illustrated by the orange boxes are not sufficiently diagnostic of ECC, which must be done by oral health practitioners.
- Blue lines – opportunities where oral health education should be provided to caregivers and/or their children.
- Green box – routine visits to oral health practitioners that should occur at least once-yearly after child completes 1-year of age; if any ECC is identified during an assessment, the child should be referred (solid red arrows) for treatment (red box).
- Red box – restorative treatment administered by oral health practitioners, with more serious cases requiring referral to specialist dental surgeons.

Both assessments and preventive and restorative work by oral health practitioners should be guided by best practice, i.e. the ICDAS (International Caries Detection and Assessment System) and ICCMS (International Caries Classification and Management System). While these are outside the scope of this review, these are important parts of an effective system that requires adequate funding to support best practice.

8.9 Recommendations for further action

Policy and practice

- Deployment of a caries risk assessment tool. The existing CAMBRA tool, known to newly-graduated oral health practitioners in New Zealand could be a starting point for a screening tool to be adapted and applied for use in WCTO screenings for caries risk.
- Incorporation of the lift-the-lip as part of any health screening, by any health practitioner; this tool would serve to better integrate oral health care with general health care services, which will foster conversations with parents about healthy diets, oral self-care, and routine use of dental services.
- Increased investment in preventive dental care – dental caries is a preventable disease and there are many effective strategies. One of the most effective means of preventing dental caries is the brushing of the teeth with fluoride toothpaste. A programme should be implemented to ensure these products are made available to young families at no cost. Dental caries rates can be greatly decreased by application of fissure sealants and fluoride varnish to the teeth of at-risk children. Childsmile provides an example of increasing the reach of fluoride varnish through application in a community setting.
- Early access to care – detected early enough, dental caries can be arrested or reversed, negating the need for costly restorative or surgical dental care. By detecting caries early through routinely ‘lifting the lip’ and ensuring children are referred and promptly seen for treatment, it may be possible to reduce New Zealand’s increasing rate of children requiring general anaesthetics for dental care.
- Increased investment in preventive care should be paired with healthy public policy – early childhood caries frequently occur very early in life, not long after the teeth have entered the mouth, and is directly attributable to an unhealthy or inappropriate diet.
- The Scottish Childsmile programme is a valuable model that is cost effective, reducing ECC, dental care spending, and inequalities in oral health; a similar strategy is likely feasible in New Zealand, but would require investment, including prioritisation and delivery of effective preventive dental care.
- It is unavoidable that we recommend regulation of marketing and sale of products known to cause dental caries, in particular sugary drinks.
- Māori and Pacific children are at greater risk of dental disease, and so should be a priority for oral health screening, prevention, and treatment.

Further research

- Evaluation, including analyses of cost savings, should be incorporated into any changes to the New Zealand oral health system.

8.10 Graded evaluations

Table 8.5. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
Lift-the-lip	B	Moderate	Moderate	This screening tool should be provided to all children.
CAMBRA – preschool	B	Moderate	Moderate	This screening tool should be provided to all children.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 8.6. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Community toothbrushing programme – community setting	A	Substantial	High	This intervention should be provided to all children attending community childcare settings.
Fluoride varnish programme – community and clinical settings	A	Substantial	High	This intervention should be provided to all children identified in screening to be at high risk for dental caries.
Fissure sealants – clinical setting	B	Substantial	High	This intervention should be provided to all children identified in screening to be at high risk for dental caries.
Fluoride mouthwashes – clinical setting	C	Insufficient evidence	Low	This screening intervention should be provided for selected patients depending on individual circumstances.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

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Appendix I – CAMBRA caries risk assessment tool

Updated CAMBRA* Caries Risk Assessment Form for Patients Aged 0 to 5 (January 2019)**
 (Available in its original form as a patient download at cda.org/CAMBRA4 and on page 40.)

Caries risk component	Column 1	Column 2	Column 3
Biological or environmental risk factors*		Check if Yes**	
Frequent snacking (more than three times daily)			
Uses bottle/nonspill cup containing liquids other than water or milk			
Mother/primary caregiver or sibling has current decay or a recent history of decay (see high-risk description below)			
Family has low socioeconomic/health literacy status			
Medications that induce hyposalivation			
Protective factors**			Check if Yes**
Lives in a fluoridated drinking water area			
Drinks fluoridated water			
Uses fluoride-containing toothpaste at least two times daily – a smear for ages 0–2 years and pea sized for ages 3–6 years			
Has had fluoride varnish applied in the last six months			
Biological risk factors – clinical exam*		Check if Yes**	
Cariogenic bacteria quantity – Not currently available			
Heavy plaque on the teeth			
Disease indicators – clinical exam	Check if Yes**		
Evident tooth decay or white spots			
Recent restorations in last two years (new patient) or the last year (patient of record)			
Final Score:	Column 1 total	Column 2 total	Column 3 total
Yes in Column 1: Indicates high risk			
Yes in columns 2 and 3: Consider the caries balance			
Final overall caries risk assessment category	High <input type="checkbox"/>	Moderate <input type="checkbox"/>	Low <input type="checkbox"/>

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*Biological and environmental risk factors are split into a) question items, b) clinical exam.

**Check the "yes" answers in the appropriate column. Shading indicates which column to place the appropriate "yes."

Determining the caries risk as high, moderate or low

1. High risk. If there is a "yes" in column 1 (one or both disease indicators), the patient is at high risk. Even if there are no "yes" disease indicators the patient can still be at high risk if the risk factors definitively outweigh the protective factors. Mother or caregiver with current or recent dental decay most likely indicates high caries risk for the child. Use the "yes" checks for each of the risk factor and protective factor columns to visualize the caries balance as illustrated below. The balance clearly to the left indicates high caries risk, whereas clearly to the right the risk level is low.

2. Moderate risk. If there are no disease indicators and the risk factors and protective factors appear to be balanced, then a moderate caries risk determination is appropriate. If in doubt, move the moderate to a high classification.

3. Low risk. If there are no disease indicators, very few or no risk factors and the protective factors prevail, the patient is at low risk.

Any items checked "yes" may also be used as topics to modify behavior or determine additional therapy. Use the following modified caries balance to visualize the overall result and determine the risk level:

Additional caries-related components for caregiver/patient counseling

- Frequency of use of fluoride toothpaste and amount
- Use of silver diamine fluoride in appropriate cases
- Dietary counseling to reduce frequency and amount of fermentable carbohydrates, especially sucrose, fructose (high-fructose corn syrup) and continual fruit juice (e.g., apple juice)
- Bottle used continually, bottle used in bed or nursing on demand
- Child has developmental problems/child has special care needs (CHSCN)
- Inadequate saliva flow and related medications, medical conditions or illnesses

Self-management goals (discussed and agreed with parent/caregiver)

1. _____
2. _____

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Appendix II – Fluoride toothpaste for permanent teeth

Meta-analyses reported by Walsh 2019^[1] on the efficacy of fluoride toothpaste at various concentrations for caries prevention in permanent teeth. All results below are reported with a follow-up "closest to 3 years".

Comparison	Number of RCTs	n	Outcome	Finding	Quality of evidence
250 ppm vs fluoride-free	3	1,738	DMFS	-0.15 (-0.25, -0.05)	Low
440–550 ppm vs fluoride-free	2	1,092	DMFS	-0.12 (-0.31, 0.07)	Low
440–550 ppm vs fluoride-free	2	1,092	DMFS	-0.18 (-0.41, 0.04)	Low
1000–1250 ppm vs fluoride-free	55	38,666	DMFS	-0.28 (-0.32, -0.25)	High
1000–1250 ppm vs fluoride-free	41	25,953	DMFT	-0.26 (-0.31, -0.21)	High
1450–1500 ppm vs fluoride-free	4	4,600	DMFS	-0.36 (-0.43, -0.29)	Moderate
1450–1500 ppm vs fluoride-free	4	4,600	DMFT	-0.39 (-0.49, -0.28)	Moderate
2400–2800 ppm vs fluoride-free	3	2,026	DMFS	-0.41 (-0.49, -0.33)	Low
2400–2800 ppm vs fluoride-free	2	1,244	DMFT	-0.39 (-0.52, -0.25)	Low
1000–1250 ppm vs 250 ppm	7	4,039	DMFS	-0.14 (-0.24, -0.04)	Low
1000–1250 ppm vs 250 ppm	3	1,769	DMFT	-0.15 (-0.31, 0.00)	Low
1450–1500 ppm vs 1000–1250 ppm	10	15,626	DMFS	-0.08 (-0.14, -0.01)	Moderate
1450–1500 ppm vs 1000–1250 ppm	4	8,137	DMFT	-0.13 (-0.23, -0.02)	Low
1700–2200 ppm vs 1000–1250 ppm	5	12,731	DMFS	-0.03 (-0.12, 0.06)	Low
2400–2800 ppm vs 1000–1250 ppm	6	12,990	DMFS	-0.12 (-0.25, 0.01)	Low
2400–2800 ppm vs 1450–1500 ppm	2	7,082	DMFS	-0.05 (-0.14, 0.05)	Moderate

Findings are expressed as caries increment, adjusted for baseline value, with data provided as means and respective 95% confidence intervals. Statistically significant effects are shown in bold.

DMFS, decayed (missing) or filled permanent surfaces; DMFT, decayed (missing) or filled permanent teeth; RCTs, randomized controlled trials.

[1] Walsh et al. Fluoride toothpastes of different concentrations for preventing dental caries. *Cochrane Database Syst Rev* 2019;(3):CD007868.

Appendix III – Proportion of New Zealand's population exposed to fluoridated water.

According to ESR data, currently 61.4% of the 4,094,680 people in New Zealand that are on networked or specified self-supplies receive fluoridated water^[1].

Thus, 61.4% of 4,094,680 = 2,514,134 people.

Stats New Zealand estimated the country's population at 4,957,400 in March 2019^[2].

As a result, 2,514,134 people or 50.7% of 4,957,400 people had access to fluoridated drinking water supplies.

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A BETTER
START

E Tipu e Rea

9. Adverse childhood experiences

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: Louise Thorn reports no conflict of interest. Dr Denise Guy coordinates Training in Watch, Wait and Wonder in Australasia and is currently President of IMHAANZ, the organisation providing training to implement FAN in New Zealand. Trecia Wouldes reports no conflict of interest.

Abbreviations

ACEs	Adverse Childhood Experiences
ACE-Q	Adverse Childhood Experiences Questionnaire
BARC	Bay Area Research Consortium
BCEs	Benevolent Childhood Experiences Scale
Counter-ACEs	Advantageous Childhood Experiences
CYW	Child Youth and Wellbeing
DHB	District Health Boards
FAN	Facilitating Attuned Interaction
IECMH	Infant and Early Childhood Mental Health
GUINZ	Growing Up in New Zealand study
NGO	Non-Government Organisation
NZ	New Zealand
PEARLS	Paediatric ACEs Screening and Resiliency Screener
PIF	Pacific Island Families study
RCT	Randomised Controlled Trial
US	United States of America
WHO	World Health Organisation

Literature search

Electronic databases searched in order to identify relevant studies included: PubMed, Scopus, Cochrane Database of Systematic Reviews, and Google Scholar. Searches were conducted using key words or free text words depending on the database. Each search was limited to studies published between 1990 and 2019, and in the English language. In addition to databases, reference lists of relevant articles were manually searched. Furthermore, experts in the field were consulted, and government and other organisation websites were searched for relevant journal articles and grey literature. Additional information is found in Appendix I.

Summary

Current research shows approximately half to two-thirds of adults have experienced at least one and 12-14% four or more ACEs¹⁻⁴. The long-term effect of these early experiences is linked to a range of chronic illnesses, poor mental health, and poor health behaviour outcomes in a dose-dependent manner^{1,4-6}, which amounts to a significant cost (Appendix II).

In a NZ study of over 5000 children, half had been exposed to one ACE and 2.6% to four or more prior to 4.5 years according to parental report⁴. This may be an underestimate as only 8 rather than 10 of the ACEs were recorded. Children exposed to ≥ 4 ACEs compared to children with no ACEs, irrespective of which ACEs, have been shown to have poorer health, mental health and developmental outcomes⁷.

Many screening tools have been developed to collect ACEs among children, but as yet none have been validated. Most screeners include the following, along with a second section that asks about social determinants that have been related to child outcomes.

Abuse:

- Emotional: recurrent threats, humiliation
- Physical: beating, not spanking
- Sexual: contact sexual

Neglect:

- Physical
- Emotional

Household Dysfunction:

- Mother treated violently
- Household member was drug or alcohol abuser
- Household member was imprisoned
- Household member with chronic mental illness
- Not raised by both biological parents

Before universal screening for ACES is established for NZ children aged 0-5 we need the following:

- A screener that reflects the adversity specific to the NZ population and is acceptable to Māori and Pacific.
- A health care system with clear pathways for referral and more interventions that target children aged 0-5 and their families and are available throughout NZ.
- A health care work force that is skilled in screening, and recognising the effects of, adversity in children aged 0-5.
- A national health literacy programme that focusses on improving the understanding of the links between ACES in children and poor outcomes across the life course with a focus on research, education, practice, and policy.

In the interim, screening during pregnancy for those risk factors that have been shown to impact health and development across the life course, and where there are adequate services, such as perinatal mental health, should be instituted. This may require further research and development of antenatal screening protocols, targeted interventions and more integrated services specific to this age group.

9.1 What are the long term impacts of Adverse Childhood Experiences without intervention?

Adverse childhood experiences (ACEs) are stressful or traumatic experiences that occur during early childhood or adolescence¹. In the seminal ACE Study, Felitti et al. (1998) developed a questionnaire to investigate the effect of ACEs on the health of adult members of a large health maintenance organisation in Southern California¹. The questionnaire asked about childhood exposure to ten ACEs grouped into three categories including: abuse—physical, emotional, and sexual; neglect—physical and emotional; and household dysfunction—substance abuse by parent/partner, mental illness of parent/partner, intimate violence of parent/partner, incarceration of parent/partner, and separation/divorce of parent¹. The number of responses were then compared to participants health records and self-reported health risks¹. The results showed that as the number of childhood ACEs increased there was a corresponding increase in leading health risk factors including: smoking, severe obesity, physical inactivity, injecting drug use, depressed mood, and suicide attempts. There was also a dose response relationship between number of ACEs and disease conditions including, ischemic heart disease, cancer, chronic bronchitis or emphysema, history of hepatitis or jaundice and skeletal fractures¹.

Subsequent studies using these 10 ACEs, or broader definitions^{4,8}, have found that between half to two thirds of people have experienced at least one ACE^{1-3,9,10}, around 25% have experienced two or more ACEs¹, and 12-14% have experienced four or more ACEs^{2,10}. In New Zealand (NZ), several longitudinal studies have collected data on adversity and the effects of cumulative risk on child development, however, none have collected data on exposure to all 10 ACEs and linked them to health risk or disease conditions in adulthood. Walsh et al. (2019) found that among 5,500 children aged 2-4.5 years in the Growing Up in New Zealand (GUINZ) study, more than half experienced at least one ACE, and 2.6% experienced four or more ACEs by 4.5 years old⁴. The ACEs were obtained from parent-report of isolated questions and the Patient Health Questionnaire Depression Screener⁴. Walsh et al. collected exposure to 8 ACEs, including: parental depression, problem drinking, drug abuse, criminal history, intimate partner violence, separation; and child physical or emotional abuse⁴. As data on sexual abuse, and physical or emotional neglect was not obtained and parental mental illness was limited to a measure of depression, prevalence may be underestimated.

Research exploring the mechanisms of adversity and poor physical and mental health outcomes have shown that when children experience substantial, stressful, and frequent adversity without predictable nurturing adult care, the endocrine, nervous, and immune systems become chronically activated and overloaded¹¹. This includes the persistent elevation of immune markers, which cause chronic inflammation⁸ and affects the developing architecture and function of the brain and other organs. These changes to the physiology of the child have been termed “toxic stress”^{7,8}. ACEs, with toxic stress, is associated with a range of poor outcomes in the long term, including mental health problems, physical health problems, and behavioural problems such as violence and substance abuse^{1,7,8,12-18}. ACEs are associated with specific outcomes such as infections^{19,20}, cognitive and developmental delays^{4,21,22}, asthma^{23,24}, sleep disturbance²⁵, school absences²⁶, social withdrawal²⁶, obesity²⁷, and suicide related behaviours^{5,28}.

Poor outcomes from ACEs can affect the individual, their family, and the community. Furthermore, outcomes from ACEs can impact justice, education, welfare, and health systems. Some long-term outcomes have intergenerational consequences for the individual’s family and their children. For example, adults who experienced one or more ACE during childhood were at higher risk of intimate partner violence²⁹, which is an ACE for their children. Another study found that children aged 0-17 years

with parents who reported 4 or more ACEs were more likely to have social, emotional and behavioural problems, than children whose parents reported no ACEs³⁰. ACEs also incur significant financial costs (Appendix II). For example, the cost of depression attributed to ACEs costs approximately \$46 Billion US per year³¹.

Some ACEs, such as sexual abuse and physical abuse, have stronger evidence of negative effects than others³². However, there is substantial evidence that ACEs and poor outcomes have a graded relationship, with each additional ACE increasing the risk of poor outcomes^{1,4-6}. Children exposed to four or more ACEs, irrespective of which ACEs, have an increased risk of poor health outcomes⁷. In a 2012 study of 125,123 12-17 year olds enrolled in Medicaid in Washington, children with ≥ 5 ACEs were at increased risk of mental health problems in adolescence, compared to those with no ACEs³³.

A number of New Zealand longitudinal studies have measured adversity and the associated outcomes in a range of populations. The Christchurch Health and Development Study found that self-reported childhood sexual abuse was associated with a higher risk for a psychiatric disorder and initiation of sexual intercourse earlier in females³⁴. The Dunedin Multidisciplinary Health and Development Study found that children who had experienced social deprivation, maltreatment and social isolation were more likely to have poor adult health including depression and inflammation⁸. The longitudinal Pacific Island Families (PIF) study found that poor maternal mental health was associated with internalising problems for children at age 2 years³⁵. Data from the PIF study also found that mothers who were physically abused by their fathers during childhood were more likely to be in a relationship that involved intimate partner violence, which is an example of the intergenerational impact of ACEs³⁶.

9.1 Summary

- *Adverse childhood experiences are stressful or traumatic experiences that occur during early childhood or adolescence.*
- *The ACE Study, created a 10-item questionnaire to retrospectively measure ACEs and health outcomes.*
- *Subsequent research suggests between half to two thirds of people have experienced at least one ACE.*
- *Severe and frequent adversity without adult support can lead to toxic stress.*
- *ACEs are associated with poor outcomes in the short and long term including mental health problems, physical health problems, and behavioural problems.*
- *The impacts of ACEs are intergenerational.*

Longitudinal studies in NZ, such as the Dunedin Study, the Christchurch Health and Development Study, and the PIF Study, have also found that adversity is associated with poor health, mental health and behavioural outcomes.

9.2 What suitable test(s) are available to screen for Adverse Childhood Experiences during pregnancy and during early childhood?

To our knowledge no standardised screening tool is currently being used to screen for ACEs among children of any age. Worldwide, there are a number of questionnaires in use for screening ACEs but few

that include 0-5 year olds in the target population, take less than 10-15 minutes to complete, and require only minimal training to administer. The Child Youth and Wellness (CYW) Centre in the United States (US) developed two ACE-Questionnaires (ACE-Q) to use in primary health care³⁷, including the ACE-Q Child (0-12 years) and the ACE-Q Teen (13-19 years) versions³⁷. The ACE-Q includes the ten ACE study items (section 1.3.1) and a separate list of seven ACEs relevant to the community³⁷. In addition, a stress related symptom checklist is completed by the primary health provider³⁷. The ACE-Q has been in use since 2015³⁸. Oh et al (2018) reviewed 32 ACE measurement tools and recommended tools such as the Childhood Trust Events Survey³⁹, the Loma Linda University Whole Child Assessment⁴⁰, and the Yale-Vermont Adversity in Childhood Scale⁴¹ (Table 1). All of these tools include the original 10 ACEs, however they also record other health information and none have been validated⁴².

Table 9.1. Tools for screening for adverse childhood experiences.

Tool	Target population	Who completes it	Types of items assessed	Number of items
CYW ACE-Q Child ³⁷	0-12 years	Parent	ACEs, Other adversity	17
Childhood Trust Events Survey ³⁹	0-18 years	Parent	ACEs, Resilience	26-30
Loma Linda University Whole Child Assessment ⁴⁰	0-17 years	Parent, Self	ACEs, Other adversity, Resilience	41-52
PEARLS Child ⁴³	0-12 years	Parent, Self	ACEs, Other adversity	17
Yale-Vermont Adversity in Childhood Scale ⁴¹	0-20 years	Parent, Self, Clinician	ACEs, Other adversity	20

A further questionnaire was developed in 2018 by the Bay Area Research Consortium (BARC), a team that includes representatives from the CYW, the University of California San Francisco, and UCSF Benioff Children’s Hospital Oakland³⁸. Together, the BARC group reviewed five relevant ACE screening tools to create a 17-item screening tool for use in primary care settings³⁸, called the Paediatric ACEs Screening and Resiliency Screener (PEARLS). An evaluation of the PEARLS tool was found to be acceptable and to have face validity among 28 participants. Although it is currently not in use for screening³⁸, it is being trialled in the first randomised controlled trial (RCT) of ACEs in a paediatric clinic setting⁴³. As the ACE-Q and PEARLS tools are similar, and the ACE-Q has been in use since 2015 and more information about its administration is available we have chosen to focus on the ACE-Q.

The CYW ACE-Q is administered with a paper copy (Appendix III) for children aged 0-5 years³⁷. The parent is asked to indicate the total number of ACEs their child has experienced in each section, but not to identify specific ACEs³⁷. A total ACE score is the combined number of ACEs from the first and second sections³⁷. The parent is then interviewed briefly by the health care provider to identify the presence or absence of their child’s stress related symptoms (Appendix IV)³⁷. Other services may choose different approaches to collecting the ACE score, which is an area requiring further research. For example, the PEARLS study looked at preference for the administration of the screening tool, and found that paper, tablet, and face-to-face interview were all acceptable³⁸. However, as some participants had a clear preference for one of the options³⁸, it was suggested, parents be given the option to choose which they prefer.

In the CYW screening model, the ACE-Q score and the presence of any stress related symptoms identified during the interview determines the need for referral to intervention services. If a child has 1-3 ACEs with no symptoms, they are not referred for specialty intervention, however their parents are asked to monitor symptoms³⁷. If the child has 1-3 ACEs with symptoms, or 4 or more ACEs, they are referred for assessment and intervention³⁷. CYW ACE-Q screening begins at nine months of age, followed up at 24 months, then each year until the child is 19 years old³⁷.

9.2 Summary

Tools

- *The ACE-Q Child (0-12 years) is a 17-item questionnaire with two sections (Appendix III), has been in use since 2015, but is not validated.*
- *Section 1 - 10 included items from the Felitti (1998) ACE Study*
- *Section 2 - 7 included items relevant to the community*
- *The PEARLS is very similar to the ACE-Q and is part of a current randomised controlled trial of ACEs in a paediatric clinic setting.*

Administration

- *Parents list the total number of ACEs for their child in each section, rather than identifying the individual ACEs.*
- *The total ACE score is the combined number from the two sections.*
- *The health care provider interviews the parents to determine if the child has any symptoms (Appendix IV).*

Referral

- *1-3 ACEs with no symptoms – parents monitor child for symptoms*
- *1-3 ACEs with symptoms – referred for interventions*
- *4 or more ACEs – referred for interventions*

Screening

- *CYW ACE-Q screening begins at nine months of age, followed up at 24 months, then each year until the child is 19 years old.*
-

9.3 Are there any other evidence based Adverse Childhood Experiences that should be included in a screen?

As discussed in section 1.2, many ACE screening tools include a section with adversities that were not included in the 10-item ACE Study questionnaire. The second section of the ACE-Q includes experience of foster care, bullying, death of a parent/guardian, separation due to deportation/immigration, serious medical procedure/illness, violence in the neighbourhood, and discrimination³⁷. The second section of the PEARLS is similar except questions on housing insecurity and food insecurity were added, foster care was merged into housing insecurity, and the serious medical procedure/illness was removed⁴³.

A number of longitudinal studies in NZ, such as GUiNZ and The Dunedin Study, as well as studies worldwide, investigate adversity specific to children including exposure to perinatal insults such as low birthweight. One study by Vervoort-Schel et al. (2018) investigated intellectual disability and its association with adversity and therefore the poor outcomes associated with ACEs⁴⁴. Additionally, a review on childhood poverty in NZ by Gibson et al (2017) found that low socioeconomic deprivation is associated with poor child outcomes in NZ⁴⁵. This finding is consistent with other research that shows that socioeconomic status is a key indicator of adversity across childhood. If an ACE tool was to be adopted for the NZ setting, a systematic review of the NZ longitudinal research should be completed, and adversities specific to the NZ population should be considered. However, it is important that

included adversities have been associated with a severe stress response, as it is the hypothesised physiological pathway from ACEs to poor mental and physical health outcomes¹¹.

9.3.1 Prevention of outcomes associated with adversity

Studies have shown that there are children who, despite exposure to significant adversity, manage to meet age salient tasks or milestones. This is known as resilience, a psychological construct that has been studied for over 4 decades. Current research suggests that resilience is not a personal trait such as “hardiness”, but a process that is informed by multiple biological and psychological systems that interact with family, peer relationships, school environments, and the community^{46,47}. Positive experiences during childhood are associated with improved mental and physical health outcomes in adulthood including positive, supportive relationships, lower stress, lower rates of depression, less sleep difficulties, and better cardiovascular health⁴⁸⁻⁵¹. However, at present there is limited research that promoting protective or resilience factors will ameliorate the effects of ACEs.

Counter-ACEs or resilience assets could be included in an ACE screening tool in NZ, if there is support from future research. An evaluation of the screening tools used to measure social, emotional, and behavioural difficulties in children showed that parents favoured a tool that measured prosocial behaviours as well as negative behaviours⁵². Parents may be more accepting of a screening tool that addresses adverse as well as positive childhood experiences. Narayan et al. (2017) created the Benevolent Childhood Experiences Scale (BCEs), a 10-item questionnaire to measure advantageous childhood experiences (counter-ACEs) and their effect on physical and mental health⁴⁹. The 10 BCEs include: having at least one caregiver with whom you feel safe, at least one good friend, beliefs that give you comfort, enjoying school, at least one teacher who cared about you, good neighbours, an adult other than primary caregiver who could provide support or advice, opportunities to have a good time, liking yourself or being comfortable with yourself, and having a predictable home routine e.g. regular mealtimes and bedtimes⁴⁹. Crandall et al. (2019) used the BCEs and the Centre for Disease Control and Prevention’s Behavioural Risk Factor Surveillance System Survey to retrospectively measure counter-ACEs and ACEs among 246 adults and found that when ACE scores are moderate, counter-ACEs can neutralise poor health outcomes⁴⁸. However, the BCEs includes questions that would not be appropriate for children aged 0-5 years e.g. do you like school?⁴⁹ Therefore, if counter-ACEs or other resilience factors, were to be included in a screening tool, the questions would need to be adapted depending on the age of the children being screened, and if it is parent or self-report.

Bellis et al. (2018) retrospectively looked at data that included ACEs, childhood health, school attendance, and childhood community resilience assets⁵³. They developed a 7-item tool for use in adults, based on the Child and Youth Resilience Measure that included: access to a trusted adult, being treated fairly, supportive childhood friends, being given opportunities to use your abilities, cultural engagement, knowing where to get help and having someone to look up to⁵³. Bellis et al. found that these were independently linked to better outcomes⁵³. Different resilience assets influenced different difficulties and also contributed to better outcomes for those with and without ACEs⁵³. For example, 59.8% of the individuals with ≥ 4 ACEs were identified as having poor childhood health. This fell to 21.3% when the resilience assets had been present⁵³.

9.3 Summary

- *The ACE-Q, and similar ACE screening tools, contain a second section of ACEs that were not included in the original 10 ACEs.*
 - *Longitudinal studies in NZ collect data on adversities that are specific to NZ and not collected in the ACE-Q, such as low birthweight.*
 - *Advantageous childhood experiences (counter-ACEs) and other resilience measures, may be able to reduce the effect of ACEs on children.*
-

9.4 Are there any known harms from screening for Adverse Childhood Experiences?

The possible harms of a screening programme need to be carefully considered. Although negative physical and mental health outcomes for an individual, their family, and future generations have been documented (section 9.1), this does not mean that screening will be successful. We need to ensure that the positives of screening outweigh the negatives. To determine if screening for ACEs is appropriate in the NZ population at this time, we have used ideas from the health screening criteria developed by Dobrow et al (2018)^{54,55}. The 12 Dobrow et al. criteria are split into 3 domains: the disease/condition, the test/intervention principles, and the programme/system principles⁵⁵. As we have already argued in previous sections that ACEs are an important health problem, and have identified the target population as early childhood, the disease/condition principles do not require further discussion.

The test/intervention principles state that the test should be appropriate, accurate, and acceptable; the results should be easily interpretable so that those who should or should not receive interventions can be identified; and post-test options should be available e.g. follow-up care that will modify the natural history and improve outcomes. The program/system principles include: the screening infrastructure, coordination and integration, acceptability and ethics, benefits and harms, economic evaluation, and quality and performance management.

9.4.1 Test/interventions

As mentioned in section 9.2, many of the screening tools we discuss have not been thoroughly tested for their psychometric properties. While the PEARLS tool was found to have face validity and acceptability, it was a small study with only 28 participants³⁸. Some parents have a problem with the sexual abuse and violence questions in the ACE-Q, even though parents do not need to state which ACEs their child has experienced, just the total number of ACEs³⁸. The PEARLS asked parents to state the actual ACEs, rather than just the number, and about half of the parents felt uncomfortable but all completed the questionnaire³⁸. However, if parents do not find the questions acceptable, it may prevent some parents from completing the screening, or may lead to an underestimate of ACEs for their children. An underestimate of ACEs could lead to false negatives, which is when the child is at risk for poor outcomes but is not found positive by the screen. Alternatively, some children may have ACEs and may not develop poor health outcomes due to, for example, having a reliable positive relationship with a grandparent. Attention to symptoms is important. If these 'false positive' children are screened as positive it may put undue pressure on the child, the family, and on the health care system.

For children that have a positive screen, there needs to be an agreed upon type of follow-up care that will modify the course of the condition to ensure positive outcomes⁵⁵. While there is evidence for

interventions or programmes that help with symptoms or conditions (e.g. Post-Traumatic Stress Disorder), or for prevention (e.g. perinatal mental health services), there is no evidence for interventions for an ACE score. The World Health Organisation (WHO) do not recommend universal screening for child maltreatment as no research has been completed that shows evidence of positive outcomes⁵⁶. Instead they recommend that health care providers should be alert to the features of child maltreatment⁵⁶.

9.4.2 Programme/system principles.

A screening programme needs an adequate infrastructure to allow for timely access to follow-up care. Currently, access to interventions for children 0-5 years in NZ is restricted due to availability. Infant and Early Childhood Mental Health (IECMH) services are scarce, with only 4 District Health Board (DHB) based IECMH programmes/services currently established⁵⁷. Implementing ACE screening would require services that can provide timely assessment and effective interventions. At present, children identified with ACEs would likely be referred to Home Visiting programmes or a Non-Government Organisation (NGO) programme such as Triple-P or Incredible Years. These programmes have limited capacity. Additionally, these programmes have limited evidence as to their effectiveness and whether they are more or less effective in specific populations throughout NZ, particularly in rural areas. Selvaraj et al (2018) found that in one public health centre referral rates increased from 2% to 13% after screening⁵⁸. Therefore, when planning for increased services in NZ we need to plan for more numbers than are currently referred from screening programmes such as social, emotional, and behavioural difficulties.

A first step in building a more integrated health care system may be expanding the use of the Facilitating Attuned Interaction (FAN) approach developed for Fussy Baby Network practitioners⁵⁹. The purpose of FBN training is to infuse infant mental health principles and practices into programs and systems of care for infants and toddlers through FAN training: a practical model for practitioners to build relationships and develop reflective practice^{60,61}. Providers in NZ, including Plunket, Well Child Tamariki Ora, and home visiting programmes (Pakeha, Māori and Pacific Teams) are positive about the FAN approach being implemented by the Infant Mental Health Association Aotearoa New Zealand. FAN has had good uptake, and is successful in reducing parental stress, increasing parent satisfaction and provider confidence and reducing provider burnout⁶⁰. To address needs of higher risk families the High-Risk FAN has been integrated into Level I Practitioner training⁶⁰. The FAN is now a 'Promising Practice' through the Association of Maternal and Child Health Programs.

Currently, there is not enough evidence that universal screening for ACEs will have positive outcomes. In addition, there are limited interventions available for children aged 0-5 years, a limited workforce skilled in treating infants and young children aged 0-5 years, and limited rigorously evaluated interventions that have identified whether they are effective in all populations at risk. Therefore, at this stage we would not recommend the implementation of a universal screening tool. However, given the importance of identifying significant adversity (Domain 3), we would recommend targeted screening for parental mental health, domestic violence and parental alcohol and substance abuse in NZ. Additionally, we need workforce development in identifying children at risk, and the development and evaluation of interventions for the 0-5 age group.

9.4 Summary

Ideas from health screening criteria were used to help consider the risks to universal screening with a measure such as the ACE-Q.

Test/interventions

- *Few tools for screening ACEs are validated.*
- *If parents are uncomfortable answering the abuse questions it could lead to false negatives.*
- *At present, there is limited evidence for an association between the use of a universal ACE screening tool and positive outcomes.*
- *WHO does not recommend screening for child maltreatment as they cannot identify evidence of positive outcomes.*

Programme/system principles

- *Access to interventions for 0-5 year olds in NZ is restricted due to availability.*
- *IECMH are especially limited, with only 4 DHB based IECMH programmes/services currently established.*
- *Referral rates to follow-up care may increase, so there is a need to plan for increased services.*
- *Interventions are limited depending on location, therefore access for some families will be poor.*

Overall

- *Currently, there is not enough evidence that screening for ACEs will lead to positive outcomes for children.*
 - *Research on ACEs is ongoing and screening may be plausible in the future.*
-

9.5 What interventions or additional supports are effective following early detection for adverse childhood experiences?

There are no comprehensive programmes that screen for ACEs in the early years, have implemented an intervention programme and formally evaluated the results. There are some programmes in the process of evaluation and that includes the CYW model which intervenes with a focus on reducing toxic stress and building resilience. After screening, paediatricians assess children with ACEs, and their families, before referral to integrated paediatric care⁶². Children are provided with a care coordinator who educates the family on ACEs, toxic stress, and the importance of good nutrition, good sleep, physical activity, mental health, mindfulness practices, and supportive parent-child relationships⁶². The care coordinator also refers the child and family to the appropriate medical, mental health, and wellness interventions including: bio-psycho-social assessment, home visiting, child-parent psychotherapy, health education, wellness nursing, psychiatry, biofeedback, and acupuncture⁶².

The antenatal and early years constitute a critical developmental junction where integrating interventions, especially for families with multiple adversities, has the potential to improve infant and young children's outcomes. There is a need for combined approaches rather than disjointed efforts focused on one adversity or that don't take account of emotional and relational wellbeing. Currently in NZ, we do not have an integrated care model for children 0-5 years with accumulating ACEs. Also, as discussed in section 1.4, there is not enough evidence to support universal ACE screening at this stage.

There are programmes that offer supports or interventions, which focus on improving protective factors that have the possibility of reducing toxic stress from ACEs, and/or address specific adversities. Toxic stress is worsened by the lack of supportive adult relationships and infants are especially vulnerable, and for that reason improving these relationships may build resilience and reduce toxic stress^{55,56,63}. Counter-ACEs (section 9.3) highlight the fact that supportive parent relationships are key to reducing the poor outcomes associated with having multiple ACEs. Other studies have also shown that positive experiences and supportive relationships are associated with resilience⁶⁴⁻⁶⁶. Di Lemma et. al. (2019) in their evidence review of interventions to prevent and address adversity across the life course, identified four common approaches; supporting parenting, building relationships and resilience, early identification of adversity and responding to trauma and specific ACEs⁶⁴.

The Purewal Boparai et al. (2018) review of biological outcomes with interventions developed for children exposed to adversity (institutionalised, in foster care and in community settings) found three key elements underpinned interventions that were effective. Improved parenting skills, earlier intervention placement and greater intervention engagement. Supportive and responsive parenting that promotes secure attachment was advocated⁵⁸.

Parents exposure to trauma and ACEs increases caregiving behaviours that are significantly associated with infant disorganisation which is a risk factor for later emotional, social and externalising problems⁶⁷. Attachment informed interventions are available and show positive effects for mothers and infants⁶⁸. Watch, Wait, and Wonder^{69,70}, Circle of Security-20-week group Intervention⁷¹, and Video-feedback Interventions including Video Interaction Guidance and Video-feedback to promote Positive Parenting⁷² directly focus on the parent-child relationship, are effective at reducing disorganisation and are available in some areas of NZ. Domain 2 has more detail about attachment informed approaches which are more likely to be available in specialty IECMH and Perinatal Mental Health services. These services are extremely limited in NZ. Other supports for children and families with adversities include home visiting programmes and parenting programmes. Interventions that directly address parenting capacity and are available in NZ include: Mellow Bumps, Mellow Parenting, Parent Child Interaction Therapy, Incredible Years and Triple P. These programmes are also discussed in detail in Domain 2.

In NZ, we have invested in intensive home visiting with the Family Start programme which has shown reduced infant mortality, increased utilisation of health services and early education, and increased utilisation of addiction services for mothers^{73,74}. The NZ Early Start home visiting service based on NFP has shown reduced behaviour problems at age 3 years⁷⁵. There are plans to invest in a 'prototype Nurse-led Family Partnership model' in NZ. Corbacho et. al. (2017) found the NFP intervention lacked evidence of better outcomes and was not cost effective in the UK setting. They proposed that the differences in universal health care and support services across the different countries may be the factor in different findings⁷⁶. The evidence from these Home Visiting programmes for efficacy in improving the parent-infant relationship is lacking.

Slade et al.'s Minding the Baby⁷⁷, and Guedeney's Compétences parentales et Attachement dans la Petite Enfance (Parental Skills and Attachment in Early Childhood)⁷⁸, are two home visiting programmes that have targeted high to medium risk mothers utilising programmes that integrated Infant Mental Health with a focus on increasing maternal sensitivity, and maternal reflective function and reducing disrupted maternal communication.

We need to identify problems like domestic violence, substance abuse, and mental health difficulties in parents antenatally. Currently, questions on family violence, caregiver mental health (e.g. depression) and substance abuse, are recommended but they should be made part of routine antenatal screening for all parents at the earliest antenatal visit. A response to parents that need follow-up care may be to

refer to services including Perinatal Mental Health Services, drug and alcohol addiction programmes including Pregnancy and Parenting Services, and family violence programmes. However, across a number of these services there is a lack of two-generational approaches and workforce capacity to implement interventions addressing the infants' relationship with the parent in these specific adverse environments. Furthermore, reducing parental difficulties does not ensure the developmental outcomes for infants are better^{68,79}.

Lastly, it is important to note that to prevent ACEs the Centre for Disease Control and Prevention in the US and the WHO INSPIRE framework suggest strengthening economic supports, changing social norms and positive parenting, quality care and education, enhancing parenting skills, and intervening to lessen harms and prevent future risk^{80,81}. To improve these areas, there needs to be political and social changes, alongside improvements to the provision of skilled interventions to infants, young children and their families. For example, factors like racism, colonialism, and poverty are key structural factors of adversity that may not be improved by intervention programmes⁸².

9.5 Summary

- *There are comprehensive follow-up programmes that are currently being evaluated including CYW that provide integrated care that includes education, medical health, mental health, and wellness services.*
- *At present, NZ does not have the resources and workforce for an integrated care system.*
- *Improved awareness of ACES, and the development and testing of interventions targeting children aged 0-5 years should be a priority to prevent the effects or intervene early. These should include: supporting parenting, building relationships and resilience, early identification of adversity and responding to trauma and specific ACEs.*
- *Early and ongoing attention to the parent-child relationship, especially parental sensitivity during infancy, and reducing factors associated with disorganised attachment is advocated.*
- *Effective interventions engage families, improve parent-child relationships and parenting skills, and are culturally appropriate.*
- *Interventions available in NZ include: for attachment – Watch, Wait Wonder, Circle of Security, and Video feedback Interventions; for parenting capacity - Mellow Bumps, Mellow Parenting, Parent Child Interaction Therapy, Incredible Years and Triple P; home visiting – Family Start, Early Start, Nurse-led Family Partnership.*
- *These interventions are discussed in detail in Domains 2 and 3.*
- *Services such as maternal mental health, drug and alcohol addiction programmes, and family violence programmes are accessible across NZ and incorporate 2-generational approaches to care, and are available to parents.*

9.6 Does early intervention lead to significant improvements later in childhood/adolescence?

There is substantial evidence that inequalities in cognitive development, health and social and emotional competence emerge prior to three years of age and can often be traced to a range of adverse circumstances. In addition, research shows that by investing early in development, the benefits are

larger and are enjoyed for longer than for later remediation⁸³. Purewal Boparai et al. (2018) conducted a review of studies that looked at biomarkers for toxic stress before and after intervention programmes for children with adversity; children in institutions, foster care, or a community setting⁸⁴. Overall, Purewal Boparai et al. found that interventions reduced or normalised the levels of biomarkers for toxic stress⁸⁴. Some interventions only showed improvements among children aged 24 months and under^{85,86}. This may be due to the brain development that occurs in the first couple of years, during which the child is susceptible to the effects of chronic and severe stress, especially when there is no supportive adult relationship^{86,87}. Patterns of stress biomarkers normalise around age two⁸⁴, and if untreated early life stress is associated with altered brain development^{88,89}. However, most of the studies reviewed looked at general adversities e.g. living in institutional care, rather than at cumulative ACEs. Further research is needed into the effects of intervention on children with multiple ACEs, and their long term effect. Additionally, these studies looked at intervention on stress biomarkers but not at the effect on disease.

Bellis et. al. (2017) found access to a trusted adult in early childhood substantively contributed to reductions in adult mental health difficulties and health harming behaviours in a retrospective study addressing ACEs and life-course resilience. Fergusson et al. (2019) found that children who were a part of the NZ Early Start home visiting programme had reduced hospital admissions, lower risks of physical punishment, higher parental competence, and positive child behaviour, compared to children not included in the programme⁹⁰. These results were sustained over a 9 year follow up⁹⁰. No significant differences were found on a range of measures including maternal depression, parental substance use, intimate partner violence, adverse economic outcomes, and life stress. The authors recommended closer integration of home-visiting services with health and education especially for families with multiple challenges⁹⁰.

Intervening prior to age 3 when children are in their most receptive stage of development has the potential to permanently alter their developmental trajectories and protect them against risk factors present in their early environment. For instance, a recent follow-up of the Abecedarian Project, a comprehensive early education programme for children at high risk for developmental delay found that at age 35 individuals had lower rates of hypertension than those in the comparison group⁹¹. Additionally, they were at a significantly lower risk of experiencing coronary heart disease within the next 10 years. Finally, prevention as well as early intervention should be considered. There is now substantial evidence that exposure to maternal depression, and substance use and other perinatal events such as being born preterm can have life-long consequences. Therefore, intervening during pregnancy by screening for parental mental health and alcohol and substance use and family violence as well as support systems has the potential to improve outcomes for NZ children (Domains 4 and 5).

9.6 Summary

- *Interventions for children with adversity can reduce the levels of stress biomarkers.*
 - *There is a growing evidence that the presence of a supportive responsive adult ameliorates the impact of early adversity.*
 - *Some interventions have a bigger impact on children under 2 years, possibly due to changes in brain development that occur during this time.*
-

9.7 What do we know from a Māori and Pacific knowledge basis about screening in this domain?

Colonialism, and economic changes of the 80s and 90s, have brought about intergenerational socioeconomic pressures and whānau/family problems in NZ that have had significant consequences for Māori families⁹². Although Pacific peoples living in NZ have a history of acculturation rather than colonialism both Māori and Pacific tend to have lower paying jobs, and are more likely to be living in crowded or substandard housing and their children are more likely to be attending lower decile schools. ACEs are generally more prevalent in low socioeconomic populations than high socioeconomic populations⁹³ and as Māori and Pacific families are disproportionately represented among the low socioeconomic groups⁹⁴, it is likely that Māori and Pacific children may have a higher proportion of ACEs than other ethnic groups. Currently there is no data on the prevalence or number of accumulated ACEs by ethnicity among children in NZ. However, a feature that permeates the statistics on children at risk in NZ are the poorer outcomes experienced by young Māori and Pacific children. Māori and Pacific children are more likely to be abused or neglected than the average NZ child⁹⁵⁻⁹⁸, they are 5 or 6 times more likely to die from child abuse or neglect, respectively^{95,96}; and they have greater exposure to household dysfunction including parental alcohol and drug abuse, parental incarceration, parental mental illness, and loose or unstable family structure including sole parenting or serial changes of adults responsible for performing a care-giving role to children⁹⁴⁻⁹⁶. Māori adults are more likely to be victims of intimate partner violence than the NZ average, while Pacific adults are around the same as the NZ average^{95,96}.

As Māori and Pacific children are likely to have higher exposure to ACEs than non-Māori children, ACE screening and interventions need to be designed, implemented and evaluated in consultation with Māori and Pacific. For Māori, any discussion needs to consider the evidence and applications that are consistent with the Treaty of Waitangi. Therefore, a Māori screening and intervention model needs to use a Kaupapa Māori framework to ensure that cultural approaches are underpinned by evidence⁹². For example, Hoki te Rito Mellow Parenting and Mellow Bumps use a Kaupapa Māori approach to intervention for parenting capacity⁹⁹. Additionally, Look at You - Aroha Atu, Aroha Mai, films addressing the social and emotional communication of babies in the first 3-4 months aiming to improve parental sensitivity, has Te Reo, Samoan, Tongan, Cook Island, and Nuie versions available¹⁰⁰. One approach to reconciling western science and kaupapa Māori perspectives is the Awa whiria (Braided Rivers model)¹⁰¹. Other conceptual frameworks should also be considered, such as Nga Vaka o Kāiga Tapu for addressing family violence in Pacific communities, as it includes education for building and restoring positive family relationships¹⁰².

One example of challenges to screening for child behavioural difficulties has been the utility of using standardized questionnaires such as the Strengths and Difficulties Questionnaire (SDQ). One review showed a portion of the Māori and Pacific parents did not like questionnaires such as the Strengths and Difficulties Questionnaire (SDQ) which requires parents to rate their child's social, emotional, and behavioural problems¹⁰³. The parents commented that they would prefer a discussion about their child. In this respect, some Māori and Pacific parents may prefer a screening tool like the ACE-Q, as the health care provider discusses the child's behaviour with the parents to determine the symptomology³⁷. Nevertheless, whether parents should be given the option of a face-to-face discussion or a paper and pencil screener or how the topic of adversity is discussed in general should be developed in consultation with Māori and Pacific stakeholders.

9.7 Summary

- *ACEs are more prevalent among low socioeconomic populations and as Māori and Pacific families are disproportionately represented in low socioeconomic populations, it is possible that they will have multiple ACEs.*
 - *Māori and Pacific children have higher rates of abuse, neglect, and household dysfunction than non-Māori and non-Pacific children.*
 - *Māori and Pacific parents may like the ACE-Q as the provider discusses the child's symptoms and behaviour with the parents.*
-

9.8 Recommendations for further action

Policy and practice

- Early intervention programmes should consider screening throughout pregnancy and at birth to identify adverse circumstances or perinatal outcomes that have been shown to have life-long consequences.
- Ensuring that the development and implementation of any programmes for infants, toddlers and pre-school children includes a focus on early primary caregiver relationships and awareness of ACEs
- Ensuring that the planning of approaches to prevention and intervention is done in partnership with Māori, Pacific and other ethnic communities.
- In the early years' attention to early relationships, is key for prevention, protection and intervention. Policy and practice in New Zealand needs to focus on infant and early childhood mental health to significantly improve outcomes.
- A national health literacy programme could be developed to raise public awareness about what can be done to support children's healthy development, encourage positive relationships, and support responsive parenting. An example of a promotion intervention includes Look at You – Aroha Atu, Aroha Mai.
- Train workforce to ensure all professionals working with infants, young children and their families are engaging, have an understanding of ACEs and are equipped to identify early warning signs in infants and young children. The FAN approach is a promising practice for building relationships and developing reflective practice
- Prevention services with mental health consultation should be available during pregnancy.
- IECMH services need to be available across NZ. Significant investment is needed in these services.
- Caregiver relationships in the first three years of life are important, we need to work with at least two generations during this time.
- Parents with young children and who have chronic mental illness and addiction problems need priority access to services with 2-generational approaches to ameliorate the effects on the development of the young child.
- Within the Ministry of Health there needs to be better integration of health and mental health in addressing policy and practice for the antenatal and first years. Much of the work including WCTO

is held within Child Health which is typically minus mental health. In this area perinatal and IECMH must be integrated.

- There needs to be a clear pathway from screening to interventions so that all healthcare providers are sure which services are available and effective for children who receive a positive screen for adversity.

Further research

Before universal screening for ACEs:

- When developing interventions or screening in NZ, we need to use Māori and Pacific healthcare frameworks, consult with Māori and Pacific leaders, and consider strengths-based approaches to ensure positive outcomes for Māori and Pacific children.
- There needs to be evaluations of interventions and comprehensive services to ensure they are effective for young children with ACEs and have a positive outcome in the short, medium, and long-term. We need services to be available, but also effective.
- Research is needed that shows screening for ACEs is linked to positive outcomes after intervention.

If we establish universal screening for ACEs:

- ACE screening tools currently in use need to be evaluated, and an evidence-based ACE screening tool that incorporates those adverse experiences unique to NZ adopted and piloted to determine its reliability, validity and its acceptability.
- A systematic review is needed of the longitudinal research in NZ to identify other adversities that could be included in the above screening tool.
- More research is needed into protective factors, which if appropriate, could be included in an ACE screening tool.
- An evaluation of the administration systems used in other screening programmes, including timeline of administration and pathways to interventions. This evaluation will help to determine a screening model for the NZ population.
- Screeners should be available in te reo Māori and Pacific Island languages.

9.9 Graded Evaluations

- While there are many tools available for screening for adverse childhood experiences, only the ACE-Q and PEARLS, were discussed in this review.
- Screening with the ACE-Q and PEARLS tools is promising, but neither have been validated [grade C]. The ACE-Q has been in use in the US since 2015. PEARLS is currently being validated in a Randomised Controlled Trial, also in the US.
- There has been no research completed that shows positive outcomes after screening for ACEs. While there are interventions established in NZ that promote resilience, and improved primary caregiving relationships for children, there is limited availability for these interventions, especially in rural areas.
- In the review we discuss many interventions that children and families could be referred to, but they have not been specifically evaluated for their efficacy for children with ACEs.
- Given the lack of research into interventions for ACEs, we chose to look at interventions that improve the parent-child relationship and parent capacity. The grades given in Table 9.3 are for the effectiveness of the interventions, but not specifically their ability to improve outcomes for children with ACEs.
- Home visiting programmes such as Family Start [grade C], and Early Start [grade B] have shown reduced infant mortality and increased use of health services, and improved behaviour problems, respectively.
- Group-based programmes, such as Incredible Years (3-6 years) [grade A] and Mellow Parenting [grade C] improve SEB difficulties and parent wellbeing and behaviour. Hoki te Rito, the kaupapa Māori Mellow Parenting programme, has been found to be culturally acceptable, although like Incredible Years Toddler [grade C], needs evidence from more high quality studies.
- PCIT for children aged 2-12years [grade A]. PCIT has empirical evidence that it improves behavioural difficulties.
- Programmes that address the attachment relationship focusing on improving parenting sensitivity and/or reducing parenting frightening behaviour, include Watch Wait and Wonder [grade C], VIPP [grade C], and ABC [grade A].
- Integrated health care may be the most effective treatment for children that have experienced ACEs, and their families.
- Attention to parental mental health, addictions, and family violence is an important part of integrated health care, but needs a two generational approach.

Table 9.2. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
ACE-Q	C	Small	Moderate	Has not yet been validated, but captures childhood adversity. Has been in use as a screening tool since 2015 in the US.
PEARLS	C	Small	Moderate	Currently being validated in a Randomised Controlled Trial, but captures childhood adversity. One small study found that the tool has face validity and acceptability.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 9.3. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Home visiting: Family Start	C	Moderate	Low	Could be provided to families of all children who need it.
Home visiting: Early Start	B	Moderate	Moderate	Could be provided to families of all children who need it. Only available in Christchurch.
Group-based: Incredible Years (3-6)	A	Moderate	Moderate	Could be provided for families of all children 3-6 years and above who need it.
Group-based: Incredible Years - Toddler	C	Small	Low-Moderate	Could be provided to families of all children aged 1-3 years who need it. Needs more research for social and emotional problems.
Group-based: Mellow Parenting	C	Moderate	Low-Moderate	Could be provided to families of all children who need it. Hoki te Rito, the kaupapa Māori Mellow Toddler programme, has been found to be culturally acceptable.
Dyadic: Parent Child Interaction Therapy	A	Moderate	Moderate	Could be provided for families of all children 2-3 years and above with behavioural difficulties.
Dyadic: Watch, Wait, Wonder	C	Moderate	Low-Moderate	Could be provided for children aged 0-4 years where presentation indicates parent-child relationship problems Improves social, emotional, and cognitive problems and reduces disorganised attachment. Needs more research.
FAN	C	Moderate	Low	Could be provided to all practitioners involved with families with children under 5 years (health, education, child protection). Home visitors were more attentive to parents' cues, better able to focus on parenting, and better able to explore the concerns of parents after training. Reduced burnout in practitioners. Positive uptake in NZ. Needs more research.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
VIPP (includes VIG within programme)	C	Moderate	Low-Moderate	Could be provided to families of all children who need it. Evidence shows improved maternal sensitivity and a reduction in the rate of disorganised attachment in at-risk populations. The use of video to promote positive parent-child interaction is widely used in infant and early childhood mental health.
ABC	A	Moderate	Moderate	Could be provided to families of all children who need it. Findings have included reduced disorganised attachment and normalised cortisol patterns in children and improved parental sensitivity.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty.](#)

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Appendix I Search strategy

Scopus

ACEs: 486

```
( (TITLE-ABS-KEY ( "adverse childhood experiences" )
AND
( TITLE-ABS-KEY ( "child" OR "children" OR "infant" OR "preschool" OR "pre school" OR "paediatric" ) )
AND
( TITLE-ABS-KEY ( screening OR questionnaires ) )
AND PUBYEAR > 1989 ( LIMIT-TO ( LANGUAGE , "English" ) ) )
```

Cochrane reviews

- 72 Trials matching "adverse childhood experience" in Title Abstract Keyword

NCBI – PubMed

- Adverse Childhood Experiences, child abuse (filters 1990-2019, humans, English, child: birth to 18, infant) - **815**
- Adverse Childhood Experiences, child abuse, health (filters 1990-2019, humans, English, child: birth to 18, infant) – **577**
- Adverse Childhood Experiences, health status child abuse (filters 1990-2019, humans, English) – **172**
- adverse childhood experiences questionnaire (filters 1990-2019, humans, English, child: birth to 18, infant) – **604**

Medline/Ovid

<input type="checkbox"/>	# ▲	Searches	ults	Type	Actions	Annotations
<input type="checkbox"/>	1	Child/	864	Advanced	Display Results More ▼	
<input type="checkbox"/>	2	Infant/	920	Advanced	Display Results More ▼	
<input type="checkbox"/>	3	Child, Preschool/	833	Advanced	Display Results More ▼	
<input type="checkbox"/>	4	1 or 2 or 3	644	Advanced	Display Results More ▼	
<input type="checkbox"/>	5	Adverse Childhood Experiences/	283	Advanced	Display Results More ▼	
<input type="checkbox"/>	6	4 and 5	158	Advanced	Display Results More ▼	
<input type="checkbox"/>	7	limit 6 to (english language and humans and yr="1990 -Current")	155	Advanced	Display Results More ▼	

Grey literature sources

- Centre for Youth and Wellness, website.
- Dr Denise Guy, personal communication and a presentation on infant mental health interventions.
- Early Intervention Foundation, UK, website.
- Early Start Project, NZ, website.

- Google Scholar, search engine.
- Ministry of Health, New Zealand, website.
- Ministry of Social Development, New Zealand, website.
- New Zealand Family Violence Clearinghouse, NZ, website.
- Oranga Tamariki, NZ, website.
- Public Health Wales, Wales, website.
- The Families Commission, New Zealand, website.
- Well Child Tamariki Ora Programme, New Zealand, website.
- World Health Organisation, UK, website.

Appendix II Estimated costs of health risk factors

Estimated costs of health risk factors attributable to ACEs and costs of illnesses attributable to ACEs per year.

Health risk factor	Total Estimated Cost of Condition, Billion US\$	Total attributable costs by ACE count, Billion US\$			Total attributable costs, %GDP
		1 ACE	≥2 ACEs	All ACEs	
Harmful Alcohol Use					
Europe	577	52	90	143	0.65%
North America	260	19	53	73	0.34%
Illicit Drug Use					
Europe	135	14	31	46	0.21%
North America	410	30	138	168	0.80%
Smoking					
Europe	909	51	115	165	0.76%
North America	673	28	132	160	0.76%
Obesity					
Europe	709	10	30	40	0.18%
North America	728	12	53	65	0.31%
Causes of Ill Health					
Anxiety					
Europe	80	6	17	23	0.10%
North America	115	1	35	36	0.17%
Depression					
Europe	104	10	19	29	0.13%
North America	116	6	41	46	0.22%
Cancer					
Europe	1034	17	100	117	0.54%
North America	945	20	75	95	0.45%
Cardiovascular Disease					
Europe	1583	35	150	185	0.85%
North America	978	29	164	193	0.92%
Diabetes					
Europe	203	1	15	16	0.07%
North America	244	6	12	18	0.09%
Respiratory Disease					
Europe	251	9	38	47	0.21%
North America	359	17	82	99	0.47%

ACE = Adverse Childhood Experience, GDP = Gross Domestic Product

Data from Bellis, M. A. et al. Life course health consequences and associated annual costs of adverse childhood experiences across Europe and North America: a systematic review and meta-analysis. *Lancet Public Health* 2019; 4:e517-528. Published online September 3, 2019. [http://dx.doi.org/10.1016/S2468-2667\(19\)30145-8](http://dx.doi.org/10.1016/S2468-2667(19)30145-8)

Appendix III CYW ACE Questionnaire

Questionnaire downloaded from: <http://centerforyouthwellness.org/cyw-aceq/>

CYW Adverse Childhood Experiences Questionnaire (ACE-Q) Child

To be completed by Parent/ Caregiver

Today's Date: _____

Child's Name: _____ Date of birth: _____

Your Name: _____ Relationship to Child: _____

Many children experience stressful life events that can affect their health and wellbeing. The results from this questionnaire will assist your child's doctor in assessing their health and determining guidance. Please read the statements below. Count the number of statements that apply to your child and write the total number in the box provided.

Please DO NOT mark or indicate which specific statements apply to your child.

1) Of the statements in Section 1, HOW MANY apply to your child? Write the total number in the box.



Section 1. At any point since your child was born...

- Your child's parents or guardians were separated or divorced
- Your child lived with a household member who served time in jail or prison
- Your child lived with a household member who was depressed, mentally ill or attempted suicide
- Your child saw or heard household members hurt or threaten to hurt each other
- A household member swore at, insulted, humiliated, or put down your child in a way that scared your child OR a household member acted in a way that made your child afraid that s/ he might be physically hurt
- Someone touched your child's private parts or asked your child to touch their private parts in a sexual way
- More than once, your child went without food, clothing, a place to live, or had no one to protect her/ him
- Someone pushed, grabbed, slapped or threw something at your child OR your child was hit so hard that your child was injured or had marks
- Your child lived with someone who had a problem with drinking or using drugs
- Your child often felt unsupported, unloved and/ or unprotected

2) Of the statements in Section 2, HOW MANY apply to your child? Write the total number in the box.



Section 2. At any point since your child was born...

- Your child was in foster care
- Your child experienced harassment or bullying at school
- Your child lived with a parent or guardian who died
- Your child was separated from her/ his primary caregiver through deportation or immigration
- Your child had a serious medical procedure or life threatening illness
- Your child often saw or heard violence in the neighborhood or in her/ his school neighborhood
- Your child was often treated badly because of race, sexual orientation, place of birth, disability or religion

Appendix IV Symptomatology Checklist

Symptomatology Checklist reproduced from: Purewal S. K., Bucci M., Gutiérrez Wang L., Koita K., Silvério Marques S., Oh D. and Burke Harris N. [2016] *Screening for Adverse Childhood Experiences [ACEs] in an Integrated Paediatric Care Model* Zero to Three, 10-17, January.

Tick if Present	Symptoms
	Sleep disturbance
	Weight gain or loss
	Failure to Thrive
	Enuresis, encopresis
	Constipation
	Hair loss
	Poor control of chronic disease [e.g. asthma, diabetes]
	Developmental regression
	School failure or absenteeism
	Aggression
	Poor impulse control
	Frequent crying
	Restricted affect or numbing
	Unexplained somatic complaints [e.g. headache or abdominal pain]
	Depression
	Anxiety
	Interpersonal conflict
	Total Score

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10. Hearing screening in childhood (excluding newborns)

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Suggested citation: Sanders M, Welch D. Hearing screening in childhood (excluding newborns). In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019; p. 287-307.

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: The authors have no financial or non-financial conflicts of interest to declare that may be relevant to this work.

Aims

This rapid review attempts to answer the following questions about childhood hearing screening as posed by the Ministry of Health.

Review Approach

A literature review was performed using Scopus and Google Scholar. The search was conducted using combinations of the following terms: hearing screening, preschool, early childhood, otoacoustic emissions, sweep test, Pacific, Māori. Key references from identified articles were also included where appropriate. The search was limited to studies published in English.

10.1 What are the most common hearing impairments in early childhood (0-5 years) in New Zealand, and what is their prevalence?

Despite the availability of universal newborn hearing screening there are a number of children who are lost to follow-up each year, further some children who arrive in the country as immigrants may not have been screened; also there are a number of causes of late / delayed onset hearing loss, including middle ear disease, but also slight or progressive sensorineural hearing losses which are not detected through the newborn programme and acquired hearing loss

New Zealand specific prevalence values are not available, although estimates can be made from data obtained through the NZ Deafness Notification Database (NZDNDB), B4 school check data and census data. These data are incomplete however, with NZDNDB data estimated to reflect only 50-70% of permanent hearing loss diagnosis every year¹, the B4 school check data has incomplete coverage and is conflated with referrals due to otitis media, and census data are dated and based on parental interpretation of “disabling hearing loss”.

NZDNDB data indicates that 88% of reported cases have an unknown cause.

From 2010-2017, 70% of notifications were for bilateral hearing loss, the remaining 30% were for unilateral losses with severe unilateral losses called “Single Sided Deafness” (SSD) accounting for 6% of notifications. 40% of cases were coded as likely present since birth, 14% of cases unlikely to have been present since birth and 46% of cases of unknown duration. There are no data or information regarding the proportion of cases of hearing loss that are progressive in nature. The severity profile of hearing loss reported in the NZDNDB is summarised in Figure 10.1.

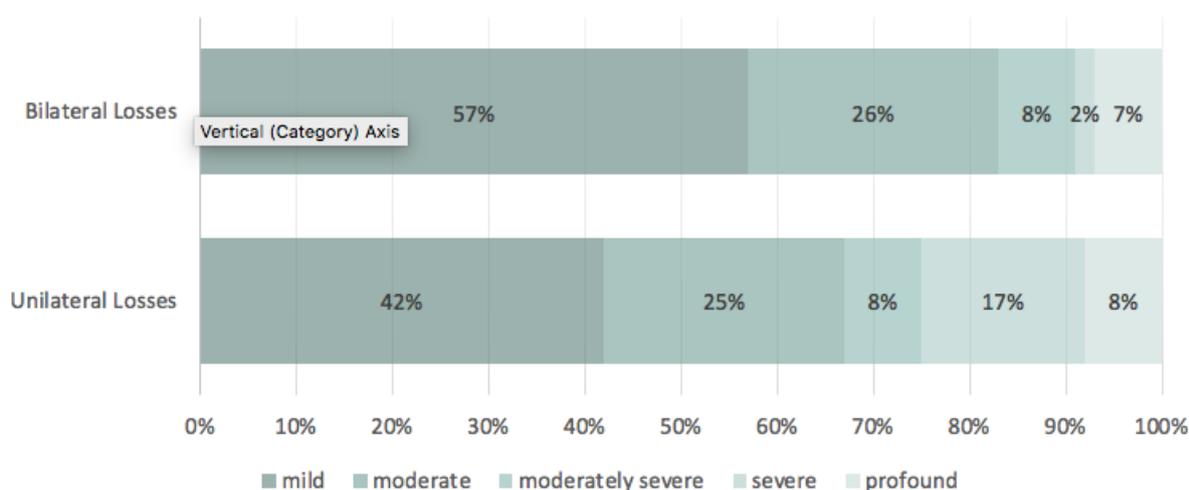


Figure 10.1. Unilateral and bilateral hearing losses by degree reproduced from Deafness Notification Report (2017) Hearing loss (not remediable by grommets) in New Zealanders under the age of 19; Figure 13, page 49¹.

The B4 School Check is a nationwide programme which offers free hearing screening for all 4 year olds and aims to detect mild losses or poorer. Coverage has improved significantly in the last 10 years although it varies significantly by ethnicity (see section 10). The following table has been replicated from the NZDNDB report as it provides insight to the current B4 school screening programme. Referrals do not necessarily indicate a permanent hearing loss and may include referral due to transient middle ear disease or false positive results.

Table 10.1. B4 School Check Hearing Screening Data reproduced from Deafness Notification Report (2017) Hearing loss (not remediable by grommets) in New Zealanders under the age of 19; Table 15, page 40¹.

Outcome	Description	2010/11	2012/13	2014/15	2016/17
Pass Bilaterally	The child was screened and passed	58%	71%	79%	81.2%
Referred	The child was screened and referred to a relevant service	5%	5%	5%	5.2%
Rescreen	The child was unable to complete the screen, so a rescreen was booked, normally in around 6 months.	7%	7%	6%	4.8%
Under care	The child is already under the care of a relevant service	1%	3%	3%	3.5%
Decline	The hearing check was declined by the caregiver	4%	4%	1%	0.7%
Not Checked	The child did not receive a hearing check	24%	11%	6%	4.5%
Population	Derived from PHO enrolled populations	63,585	64,911	63,730	62,581

Census-derived data are old (2001/2), and were collected prior to the advent of the NZ Universal Newborn Hearing Screening and Early Intervention Programme (UNHSEIP). They show prevalence of hearing loss of 1.7%, 2.7% and 2.0% for children aged 0-4y, 5-9y and 10-14y respectively².

Given the lack of NZ specific information, prevalence data from similar countries may provide better information.

British evidence suggests that there is a significant increase in prevalence of hearing loss (>20 dB HL) from birth (2-3 per 1000) to school age (6-10 per 1000), with prevalence continuing to increase between ages 6 to 8³. This trend remains true with more recent data looking at mild or greater hearing losses with prevalence increasing from 1.79 per 1000 at birth to 3.65 per 1000 for children at school entry⁴; and again if only looking only at hearing losses greater than 40 dB HL (1.06 per 1000 at birth rising to between 1.65-2.05 per 1000 among children age 9 years or older)⁵.

This is consistent with NZ UNHSEIP data which reports 1.2 cases of bilateral hearing loss per thousand babies and an additional 1.1 cases of unilateral hearing loss per thousand babies screened. This places the NZ prevalence at birth slightly higher than that of the UK data. Sixty percent of diagnoses in the 2017 NZDNDB are attributable to New Zealand's UNHSEIP. We therefore might infer that 40% of reported losses are either late notifications, UNHSEIP misses, progressive or acquired losses. Note however that NZDNDB reporting for older children is likely less reliable and significantly underrepresents the proportion of children as evidenced by international data.

Note from the UK data this increase in prevalence with age is primarily due to sensorineural hearing loss, and likely a combination of losses that were too mild to be picked up at birth, progressive losses, and adventitious hearing loss (e.g. CMV, measles, mumps, meningitis). UK findings indicate that for every child detected through newborn hearing screening programmes another 50-90% more children will be detected with permanent sensorineural hearing loss by age 9⁵.

Another significant contributor to the increase in hearing loss prevalence during childhood is Otitis Media with Effusion (OME), which can cause transient, chronic and permanent hearing losses. From international data approximately 90% of children have OME at some time before starting school⁶, and 25% of school aged children may have effusion at some time during the year⁷. While OME is highly

prevalent it will spontaneously resolve in most children within 3 months^{8,9}. Therefore, a period of watchful waiting is recommended before any medical intervention is applied. However, 30 – 40% of children will have recurrent OME, and 5-10% of episodes last one year or longer;^{6,8-10} and if middle ear effusion is present for longer than three months there is little chance of recovery without medical treatment^{6,8-10}. The degree of hearing loss associated with OME varies from minimal to moderate (15 – 50 dBHL across 0.5 – 4 kHz); therefore care needs to be taken while screening to detect persistent OME but to avoid over-referring for transient cases, which can create unnecessary burden upon families and health care services.

10.2 What are the long-term consequences of undiagnosed hearing impairments?

There is evidence that children with unrecognized and unmanaged unilateral or minimal bilateral hearing loss have significant speech-language delays, negative educational consequences, and behavioural problems¹¹⁻¹³. The greater the degree of loss the more significant the long-term impact on the child and their future vocational attainment¹⁴. In the case of chronic middle ear disease, long term sequelae include progressive hearing loss, eardrum perforation, sensorineural deafness, balance disorders, mastoiditis, and meningitis.

10.3 Behavioural or objective screening – what is the most appropriate tool to detect hearing impairments in children aged 0-5 years beyond birth?

10.3.1 Overview

Outlined below are methods that have been investigated as screening tools for hearing loss in the preschool population. We have excluded tools that could be used for middle ear disease but are not sensitive or specific for hearing loss (e.g. Immittance Testing). Generally, much of the current literature revolves around the use of pure tone audiometric screening (behavioural testing) and the use of otoacoustic emissions (OAE; objective testing based on physiological activity in the normally-functioning inner ear). Three systematic reviews^{3,15,16} have covered this topic and concluded that with the available (limited) evidence pure-tone screening had higher sensitivity than OAE testing in school age children, however for preschool children aged 4 the difference in sensitivity between the two tests has not been adequately investigated and is a matter of debate;^{17,18} and for 3 year-olds pure-tone screening is not recommended as most children are unable to perform the test reliably at this age¹⁶. This has led to the recommendation of the use of OAEs in children chronologically and developmentally under 3 years of age by the American Academy of Audiology (AAA)¹⁶. More recently a series of papers have encouraged the use of Distortion Product Otoacoustic Emissions (DPOAEs; a subgroup of OAEs that provide a degree of specificity about the frequencies at which hearing losses may be present) to be re-examined as a screening method¹⁷. This work addresses many of the identified limitations of OAE screening (i.e. reduced sensitivity for mild losses, insensitivity to auditory neuropathy dysynchrony disorder, and difficulty to obtain low frequency results) and proposes a screening protocol that may be more efficient than behavioural screening because of its speed, frequency specificity and the need for less cooperation from the child.

Emergent mobile app based technologies (e.g. Hear Screen¹⁹⁻²¹, SoundScouts²² and Digits in Noise Tests^{23,24}) are also discussed, all of which fall within the behavioural testing approach to screening.

Questionnaire based screening approaches were also investigated^{25,26}, however a recent rapid review found insufficient evidence that parent- or teacher-completed questionnaires can reliably be used to screen for hearing loss²⁷.

According to the AAA(2011) guidelines¹⁶, an effective screening tool should correctly identify 90-95% of children who have existing hearing loss (sensitivity), and should fail no more than 5-10% of children with normal hearing (specificity). There is a wide range of sensitivity and specificity values for both behavioural and objective screening approaches (see below).

10.4 Behavioural testing (manual and automated pure-tone screening, digits in noise tests)

10.4.1 Pure tone audiometry screening

Screening using pure-tone audiometry or the Pure-tone Sweep Test is the current method used in New Zealand²⁸. It has traditionally been considered the gold standard in screening for school aged children¹⁶. The current methodology uses a manual approach, although automated and app based methods are now available. App based screening is still in development and not commonly used internationally for preschool children. The advantage of a manual approach is that it allows flexibility when working with this age group¹⁵.

Administration

Manual Pure-Tone Audiometric Screening

Using calibrated headphones with a screening audiometer, children are required to respond to a tone by performing a task (e.g. placing a peg on a pegboard). Responses are checked for a set of frequencies (e.g. 0.5, 1, 2, and 4kHz) at a specified sound level (e.g. 20 dBHL).

Screening times are usually at least 4-5 minutes. However in best case scenarios test times are 45 seconds for instructions and then a further 60 seconds for the actual screen²⁹.

Automated PTA Screening

This can be performed using specialised screening audiometers or using an App on mobile phones or tablets with calibrated headphones^{30,31}. App based methods also monitor background noise levels to enhance test reliability. Screening times tend to be faster (around 12.3%) than manual approaches, and reliability is comparable for older children (7-9 year olds)¹⁹.

Accuracy

Sensitivity and specificity compared to pure-tone audiometry performed in a sound treated room varies significantly across studies from 50% - 93% sensitivity and 70%- 99% specificity (Table 1). A number of papers present data indicating that automated app based testing is comparable in sensitivity and specificity to manual testing¹⁹⁻²¹.

Table 10.2. Reported Sensitivity and Specificity of Behavioural Pure-tone Screening Studies performed in a real world setting.

Source (n) [age]	Test evaluated	Definition of screening fail	Reference standard	Sensitivity	Specificity
Sabo et al., 2000 ³² (583) [5-9y]	Pure tone sweep test	>25 at 0.5 kHz and >20 dB at 1,2, and 4 kHz	PTA	87%	80%
Holtby et al., 1997 ³³ (610) [5-6y]	Puretone sweep test	No response at 20 dB in either ear at any frequency	PTA and Tympanometry	86%	70.2%
Fortnum et al., 2016 ³⁴ (240) [4-6]	Puretone sweep test	No response at 20 dB in either ear at any frequency	PTA	89%	78%
Fortnum et al., 2016 ³⁴ (240) [4-6]	Automated Handheld screener	>20 dB HL at 1 kHz and >35 dB HL at 3 kHz	PTA	83%	83%
FitzZaland and Zink, 1984 ³⁵ (3510) [4.5- 7y]	Puretone sweep test	>25 dB at 0.5 and 4 kHz , and >20 dB at 1 and 2 kHz	PTA and tympanometry	93%	99%
Halloran et al., 2009 ¹⁸ (1061) [3-19y]	Puretone sweep test	>20 dB at 1, 2 or 4 kHz	PTA	50%	78%
Kam et al., 2014 ³⁰ (6231) [3-7y]	Automated test using tablet and noise cancelling phones	>30 dB	PTA (959)	3y: 33% 4y: 54% 5y: 92% 6y: 95%	15% 32% 79% 100%
Mahomed-Asmail et al., 2016 ¹⁹ (1070) [8y±1.1y]	Smartphone hearing screening using the hearScreen™	>25 dBHL at 1, 2, and 4 kHz	PTA	75%	98.5%
Dillon et al., 2018 (116) [4y-14y]	Game based screening using the SmartScreen App	>20 dBHL at 0.5, 1, 2 or 4 kHz	PTA	86%	93%

Note that age had a significant impact on sensitivity and specificity values and where published, age is shown in the first column. All screening tests were conducted in real-world (non-sound-treated) conditions. Sensitivity and Specificity are relative to pure-tone audiometry conducted in a sound-attenuating chamber, but diagnostic criteria for hearing loss were not reported.

Limitations

Traditional PTA screening requires a high level of expertise and training¹⁶, although this is not the case for newer automated procedures³⁶. Screening of children younger than 3 years is unreliable with behavioural techniques, as is screening of developmentally delayed children³⁷ who may not understand or be able to perform the task.

Background noise is a significant issue and guidelines recommend levels no louder than 40-45dBA. Keeping background levels down to this level significantly reduces false positive rates by as much as 60%³⁵. However, levels this low in a real world context are difficult to achieve; automated techniques and approaches that incorporate real time background noise monitoring and noise cancellation may help mitigate this limitation.

10.4.2 Digits in noise test (speech in noise screening)

The digits in noise test developed by Smits et al. (2004)²³ is a behavioural screening tool that relies on the loss of sensitivity to speech stimuli in noise with hearing loss. It is a closed set automated adaptive speech in noise screening test using combinations of 3 digits (triplets) as speech material. The test measures speech reception threshold (SRT) within noise. The SRT is compared to set pass / fail criterion. Sensitivity and specificity in adults are around 80 to 90% to distinguish between normal hearing and hearing impaired listeners when compared to pure-tone audiometry conducted in a sound booth^{24,38}. The Digits in Noise Test has been used in school screening programmes however it is not currently as specific as other screening methods mentioned above for a school population and was assessed only with older children (ages 9 – 16)²⁴. Younger children are able to perform the task (age 5), however we have not found any sensitivity or specificity data or validation for this age group in a screening context³⁹. Advantages of this test are that it does not require calibrated headphones and can be performed on a mobile phone or over the internet because it responds to the relative sound levels of the digits and the noise in which they are presented. It may also detect hearing damage before it becomes evident as reduced hearing thresholds on an audiogram. As such the poorer specificity data may reflect greater sensitivity of this test to hearing loss that is not yet detectable on a pure-tone audiogram. Speech in Noise Tests measure the relative sound level of speech to background noise and so are less sensitive to conductive losses than tests of absolute hearing level⁴⁰. This is useful if the purpose is not to test for transient middle-ear disease, but a limitation if the screening programme is aimed at detecting these.

10.4.3 App / Game-based Screening (Sound Scouts)

Sound Scouts is a game-based hearing test delivered over the internet or via App, it can be downloaded and used without the involvement of a clinician, for children down to age 4.5 years²². Of note, it is currently available online as a screening tool for school age children with support from the Australian Department of Health.

Sound Scouts incorporates 3 separate hearing tests / games; a test of speech in quiet and noise, and a test of tones in noise²². It has been evaluated in a single piece of published research (in 116 children). In the study 8.6% of children were unable to perform the task reliably.

Duration of testing is approximately 15 minutes, including a five minute setup period which involves a supervising adult. Testing needs to take place in a quiet room.

Sensitivity and specificity are comparable to other screening approaches at 0.5, 1, 2, and 4 kHz (**Error! Reference source not found.** and **Error! Reference source not found.**). In the study, the cases of hearing loss missed by the test were all mild hearing losses up to 30 dBHL.

10.5 Objective Testing

10.5.1 Otoacoustic Emissions (OAEs)

Otoacoustic emissions (OAEs), are low amplitude signals generated in a normally-functioning ear by the outer hair cells of the cochlea in response to a sound stimulus. The presence of OAEs indicates that the pre-neural cochlear receptor mechanism and middle ear mechanism can respond to sound in a normal way. OAEs come in two primary forms, Transient Evoked (TEOAE) or Distortion Product (DPOAE). For screening, TEOAEs are produced by the presentation of a relatively high-level (80-86 dB pSPL) click stimulus. With current protocols TEOAEs are expected to be present in ears with normal hearing

sensitivity and absent in cases of mild hearing loss (>35dBHL)⁴¹. They are sensitive to conductive pathologies, however they are less sensitive than tympanometry. Using click stimuli TEOAEs can detect hearing losses between 1-4kHz. There is good evidence that OAE testing is a useful tool for screening within the paediatric population^{15,17,42,43}.

The majority of research on the efficacy of OAEs as a screening tool has used TEOAEs and this therefore dominates the systematic reviews on screening tools discussed above^{3,15,16}, however more recently there has been an emphasis on the utility of DPOAEs for this role⁴⁴⁻⁴⁷. Distortion Product otoacoustic emissions are typically recorded using a series of paired tones between 1 – 6kHz, although it is possible to record up to 10kHz¹⁶. The presentation of paired tones results in the generation of a third (lower frequency) tone by the hair cells within the cochlea. This means that DPOAEs recorded using high frequency stimuli are sensitive to middle ear disease and conductive losses that primarily affect low frequencies⁴⁸. DPOAEs are less sensitive to hearing loss than TEOAEs and can be detected in some cases with 40-60 dBHL of hearing loss depending on the protocol used⁴¹. This statement however does not consider the amplitude of the DPOAE which is also affected by hearing loss. Hall (2016)¹⁷ indicates that OAE sensitivity can be improved to detect hearing losses greater than 20dBHL by looking at both the noise floor (detectability) and amplitude of the DPOAE. This is currently done in diagnostic assessments of hearing loss but has not been implemented within a screening programme.

The advantages of OAEs for paediatric populations are many: results are not affected by age, cognitive level and language. Furthermore, results may be less susceptible to background noise levels than pure-tone audiometric screening (depending on protocol, equipment, and coupling method used). Testing is generally quick (within 30 seconds using an optimised method),¹⁷ although other studies have reported longer test times ranging from 25-330 seconds with TEOAEs;¹⁶ and a median time of 4.8 minutes (range:1 min – 30 minutes) to complete visual inspection and DPOAE screening of both ears on preschool children⁴⁹.

Accuracy

There are many studies that examine the accuracy of OAEs as a screening tool, however none incorporate the latest recommendations from Hall (2016). Few compare OAEs to the gold standard of diagnostic pure tone audiometry (PTA), with most referencing a puretone screen with or without tympanometry.

The following table is an adaptation of the work of Bamford et al. (2006)³, Prieve et al. 2015¹⁵ and Strabrawa & Scott (2019)⁵⁰ it includes only studies in which screening was performed in a real world setting.

Table 10.3. Reported Sensitivity and Specificity Values for OAE studies performed in a real-world setting

Source (n) [age]	Test evaluated	Definition of screening fail	Reference standard	Definition of hearing impairment	Sensitivity	Specificity
Sabo et al., 2000 ³² (583) 5-9y	TEOAE	Response of 3 frequencies \leq 3 db SNR, min 70%	PTA	Not Reported	65%	91%
Nozza et al., 1997 ⁵¹ (66) [5-10y]	TEOAE	Various*	PTA	Not Reported	67-100%*	80-98%*
Taylor and Brooks, 2000 ⁵² (152) [3-8y]	TEOAEs Tympanometry Screening	Response of 3 frequencies \leq 3 db SNR	Pure tone sweep test	PTA >20 dBHL at 1, 2 and 4 kHz	81%	94%
McPherson and Smyth, 1997 ⁵³ (150) [5-13y]	TEOAE	Various*	PTA	PTA >15 dBHL at 0.5, 1, 2, and 4 kHz	84% 70% 78% 57%	53% 88% 81% 93%
Driscoll, Kei and Macpherson, 2001 ⁵⁴ (940) [6y]	TEOAE Tympanometry	Various*	Pure tone sweep test	PTA >20 dBHL at 1,2 and 4 kHz	70-89%*	84-96%*
Yin et al., 2009 ⁵⁵ (744/142*) [2-6y]	TEOAE		Pure tone sweep test (142 participants)	PTA >25 dBHL at 1,2 and 4 kHz	100%	94%
Lyons et al., 2004 ⁵⁶ (1003) [4.1-7.9y]	DPOAE + Tympanometry	Various DPOAE* SNR criteria and normal tympanogram	Pure tone sweep test	PTA >25 dB at 0.5, 1, 2 and 4 kHz	97%* 97% 98% 96%	86%* 83% 74% 95%

* indicates that the pass/refer criteria were varied systematically in order to show how they could be set. In general, settings that increased sensitivity reduced specificity and vice versa.

Administration

OAE testing is performed by the insertion of a small speaker and microphone (probe tip) into the ear. Screening OAE machines are handheld devices and some can perform tympanometry (testing of the mobility of the tympanic membrane and middle ear status) as well. The child will hear an audible click (TEOAEs) or tones (DPOAEs). Results for each ear are generally obtained within 30 seconds during which the child needs to stay still and quiet; restlessness will cause the test to take longer. Results are presented to the screener as a simple pass or refer.

Limitations

Limitations of OAEs as a screening tool are discussed in the AAA (2011)¹⁶ guidelines and subsequently addressed by Hall (2016)¹⁷. They are as follows:

It is difficult to record OAEs in the low frequency range (<1000 Hz) due to contamination from physiological and ambient noise (the same issue applies to Screening PTA) and as discussed above

DPOAEs tested at mid frequencies are still sensitive to low frequency conductive losses. Hall (2016)¹⁷ recommends focussing testing on a frequency region of 2-5kHz to avoid low frequency interference.

OAEs are insensitive to Auditory Neuropathy Spectrum Disorder (ANSD); as OAEs are a pre-neural response any hearing losses that originate at or after the sensory hair cell and auditory nerve synapse will not be detected. However, the chances of a *miss* due to this is remote as almost all children with ANSD should be detected at birth through the newborn hearing screening programme, which uses evoked neural response testing. Additional screening questions can be used to further mitigate the chances of a *miss* by asking if the child was admitted into NICU at birth or has a sibling with a hearing loss¹⁷.

DPOAEs are less sensitive to hearing loss when only signal to noise ratio (SNR) is used as a pass/fail criterion. However, addition of a secondary criterion of amplitude can increase DPOAE sensitivity significantly. Hall (2016)¹⁷ proposes a criterion of ≥ 0 dB SPL amplitude and SNR of ≥ 6 dB. This proposal has not yet been evaluated.

10.5.2 Immittance Testing

Immittance Testing in the form of tympanometry is a measure of ear drum movement and is sensitive to some forms of conductive hearing loss including Otis Media with Effusion. However; it is insensitive to sensorineural hearing losses. Tympanometry and acoustic reflex testing have an important role in determining pathology and as they are very quick to administer have a useful adjunct role in the screening process as they help to determine likely cause of a refer result and therefore appropriate referral pathways⁵⁷.

10.5.3 Auditory Evoked Potentials

AABR testing as performed in the newborn hearing screening programme is not appropriate for this age group as it requires the child to be asleep, other auditory evoked potential methods such as ASSR or cortical testing are not currently viable screening methods due to long test time duration.

10.5 Summary

Both Pure-tone Screening and OAEs are useful tools for hearing screening. Pure-tone screening is only viable for testing at age four and above. OAEs can be used at all ages. Digits in noise testing is a viable screening tool for older school children but is still in development. Based on a single study, game based screening appears to be a useful tool for screening school aged children, though an effective approach to programme delivery is needed. Auditory evoked potentials are not a viable approach for wakeful children.

10.6 What is the optimal time, or times, to conduct a hearing screening test?

There is some evidence suggesting that more frequent testing is beneficial in the preschool population, particularly for high risk, and poorer populations⁵⁸.

Screening of children throughout primary and intermediate school has been advised in a report by the American Academy of Audiology (AAA), based on screening data from over 200,000 children from three schools in the United States¹². They found that 3-6% of children screened were referred. Their results indicated that a single screen at 4 years of age would identify only 25-50 % of the newly detectable hearing losses. (AAA, 2001, pg. 18)¹⁶. The AAA therefore recommend screening at ages 3-4 (preschool), 5, 6, 7, 10 and 12 or 14 at a minimum¹⁶. These guidelines may place too much focus on detection of hearing loss by screening, and there are other concerns regarding the cost of implementing such an extensive programme. However, there is no data available to address these issues.

Other organisational guidelines recommend screening after the neonatal period because of the significant increase in prevalence of hearing loss up to age 9,⁴ including the latest Joint Committee on Infant Hearing Position Statement⁵⁹.

A recent study comparing two districts with and without school screening found no benefit in cost effectiveness for school entry screening (SES)³⁴. With children living in the district without SES being detected slightly earlier and detection rates being comparable to the district with SES. Note however the district without SES made use of a well-established ad-hoc referral system, in which referral was driven by parental, preschool teacher, and GP concern.

Further, the district with an SES programme had a lower referral rate to hearing services. This is an important finding and directly relates to the economic effectiveness of such programmes. The authors of the study concluded that there are two ways in which SES may be cost-effective, either a reduction in the number of referrals associated with SES or an increase in referrals due to a lack of SES. Note for example that the referral rate for the SES programme studied was 10.6%, which is over twice that of the NZ B4 School check¹. The authors commented that caution should be taken in interpreting their results as they are not necessarily generalisable, and if withdrawal of school based screening is to be considered it needs to be carefully managed to ensure that an ad-hoc referral system is working effectively³. This is particularly important in NZ as evidenced by NZDNDB data in which parents were 3rd most likely to suspect hearing loss behind Vision Hearing Technicians (B4 School Check) and Newborn hearing Screeners (UNHSEIP)¹. Age of detection profiles from the NZDNDB do show a peak around 4-5 years of age which is assumed to be due to the B4 School screening check¹. There are also concerns about accessibility of an ad-hoc referral system for deprived families, which may exacerbate social inequalities.

10.7 Are there known harms from screening for hearing impairments in children aged 0-5 years?

Referrals from school entry programmes have minimal to no negative impact on families³⁴. However hearing screening programmes can potentially place burden on services, potentially slowing down diagnosis³⁴. Note that this is not necessarily the case with hearing screening programmes more likely reducing (false positive) referrals³⁴.

Additionally screening programmes that have high false positive rates can undermine parental belief in screening accuracy and compliance in diagnostic appointment attendance¹⁸.

As with any screening programme, hearing screening has the potential to increase societal inequalities if not managed carefully: the middle classes tend to make more use of them and interact more positively with the healthcare system while the higher deprivation people are more likely not to engage as effectively, so not gain benefits and thus societal inequalities are exacerbated. Targeting of the screen on at-risk and/or higher deprivation communities, or making sure that coverage is really universal (i.e. 100% uptake) and that there are properly funded and pro-active follow-up procedures for referrals are key approaches to mitigating this risk, but need adequate funding and a properly aligned screening system.

10.8 What interventions or additional support for hearing are effective following early detection?

Following detection there are multiple pathways to support a child with hearing loss. The approach depends on the type of loss, degree of hearing loss, whether the loss is bilateral or unilateral, and the home and educational environment.

The primary cause of hearing loss for the target age group is Otitis Media with Effusion. Management varies depending on whether the effusion is persistent. In most cases OME spontaneously resolves however for some cases active intervention is required to minimise long term detrimental effects. Interventions may include ventilation tube insertion, antibiotics, and ear drum repair; for chronic and longstanding disease, invasive operations may be required (e.g. mastoidectomy).

For sensorineural hearing losses effective management again depends on the degree of hearing loss but options include: speech language therapy, class room sound field systems or personal FM systems, hearing aids, preferential seating and other environmental and behavioural modifications, sign language, and enrolment in a deaf school, cochlear implantation, and auditory verbal therapy. For Auditory Processing Disorders, there are a range of treatment options including hearing aids and behavioural training and environmental modifications.

10.9 Does early intervention lead to significant improvements later in childhood/ adolescence?

It has been well established that early detection and intervention leads to improved speech and language outcomes for even mild hearing losses⁶⁰. Certainly the benefit of intervention becomes more obvious as the severity of hearing loss increases⁶¹.

There is some debate within the literature regarding the impact of intervention for minimal and more mild losses; as well as unilateral losses. Of note is a cross sectional study which assessed 6581 children in 80 schools in Melbourne⁶². The study found 39 children (0.59%) with a slight sensorineural loss (16 – 25 dB HL) and 16 children (0.24%) with mild sensorineural loss (26 – 40 dB HL) in the better ear; a total of 55 children (0.88% or approximately nine per thousand)⁶². It found no strong evidence that slight/mild bilateral sensorineural hearing loss adversely affect language, reading, behaviour or health-related quality of life⁶². This study is a significant addition to the literature as unlike many other investigations into intervention impact (which have recruited from clinical populations); it has no opportunity for sampling bias. Furthermore given the higher prevalence of mild hearing loss in the Māori population

(see below) research in New Zealand would be of benefit to assess what the rates are here and whether slight to mild losses are associated with negative outcomes.

Conductive losses were excluded from this study. Children with a history of conductive loss (as a result of otitis media with effusion) are more likely to present with spatial processing disorder, a form of auditory processing disorder⁶³. Interventions exist for auditory processing disorder however accessing such interventions may be challenging due to a relatively small number of clinicians specialising in this area.

Regarding chronic otitis media, earlier intervention leads to less complications later in life, however care needs to be taken to ensure that screening services do not needlessly refer cases that will likely spontaneously resolve which can overwhelm diagnostic services. A Cochrane review found no clinically significant benefits to language and behaviour outcomes of screening and early treatment of OME in the first four years of life for the general population⁶⁴. The reviewers did take care to note however that the findings may not be the same for high risk populations where incidence of OME complications is higher and early intervention may reduce complication severity which includes the same as that for hearing loss^{64,65}.

10.10 What do we know from a Māori and Pacific knowledge basis about screening in this domain?

A study on 485 South Auckland children aged 2-3yrs that attended a screening recall due to a problem with their newborn hearing screen found Māori and Pacific ethnicity was significantly associated with hearing loss⁶⁶. They concluded that “there is a high proportion of children in South Auckland with unsuspected hearing loss” and that “a different approach to screening is warranted for this population with high rates or middle ear disease at age 3”⁶⁶. Pacific children have a higher incidence of ear disease even at 2 years of age⁶⁷, and this increased incidence of disease may account for more disabling losses and higher fail rates for the B4 school check.

More Māori and Pasifika children fail the B4 School check than any other ethnic groups⁶⁶. Young Māori have a higher incidence of hearing loss than NZ Europeans and their hearing losses are more likely to be mild-moderate and bilateral^{1,68}. This is an important finding as generally speaking mild losses are less likely to be detected^{66,69} and their impacts on learning are less likely to be understood. This influences how families treat the condition and consequently support interventions such as hearing aids. Therefore it has been recommended that screening programmes must be supported by good community education programmes and appropriate habilitation options for families⁶⁸. This is particularly relevant because Māori and Pacific Island children appear to be under-represented for otitis media hospitalisations and have higher rates of non-attendance at ENT out-patient clinics⁷⁰.

Coverage rates for the B4 School check are poorest for Pasifika children with 10.4% not checked compared to 4.8% of New Zealand Europeans and 0.2% of Māori children, (note this is a significant improvement in coverage for Māori from a high of 28% not checked in 2010/11)¹.

10.11 Summary of Findings and Graded Evaluations

- No reliable NZ specific prevalence data or data regarding current efficacy of the B4 school check as it stands could be found. If looking to make changes to current screening programmes improving reporting and obtaining efficacy data would be useful.
- Targeted screening of at-risk populations for OME should be investigated further (at-risk being higher deprivation regions, and Pacific and Māori populations), with implementation most likely done at 3 years of age.
- Regarding level of screening (pass rates) it may be acceptable to exclude minimal and smaller losses for school aged children. However, consideration must be given to at risk populations including Māori and Pacific peoples. Notably Māori who tend to have a higher prevalence of mild sensorineural hearing loss which already tends to be detected or occur later in childhood. Such a shift in approach therefore needs to be considered carefully and research conducted to determine the prevalence and impacts in New Zealand.
- Recommendations around school entry and current B4 school programme are difficult to make without the prevalence and current efficacy data. From international data there is good evidence to shift to DPOAE screening with tympanometry and puretone sweep testing as backup for a DPOAE refer result to reduce the rate of false positive referrals.
- For other populations (developmentally delayed) DPOAE screening is clearly the best option and should be implemented.
- School age screening using Sound Scouts may be an appropriate tool, perhaps at school entry* and at year 3 and 5 (as recommended on the SoundSkills website) this could be tied into the academic health studies in later years, and likely has minimal cost and can be implemented easily. However caution is recommended at this stage as all data currently available is from a single study. Furthermore, the test is currently self-administered, and a protocol and support system would have to be set up to ensure equitability of outcomes across the community.

Table 10.4. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening Tool	Grade	Estimated net benefit	Level of certainty	Recommendation
Manual Pure-Tone Screen	B	Substantial	Moderate	This tool is widely internationally. There are concerns however regarding its reliability in younger populations and in background noise.
Automatic (Phone App) Pure-Tone Screen	C	Moderate	Moderate	This approach may be useful for school children age 6+; the main advantage is that as opposed to manual testing screeners require less training.
Digits in Noise Test	I	Insufficient evidence	Low	May be applicable for screening older children 9 years and above, currently not enough evidence to recommend for younger children. Primary benefit is that this type of test can be performed as an online test. Possible limitation is that it has poor sensitivity for conductive losses.
TEOAES	C	Moderate	Moderate	TEOAES are quick and sensitive to moderate hearing losses but are not sensitive to minimal hearing losses and perform poorly in noisy environments.
DPOAEs	B	Substantial	Moderate	DPOAEs are widely used for screening hearing in children 3 years or younger. They are fast and require minimal patient cooperation. It is a sensitive screening tool, however false positive rates may be higher than pure-tone screening. DPOAE testing may be a good first line screen for all ages, with a second screen of manual pure-tone and tympanometry for those who get a refer result.
Game Based Screening (Sound Scouts)	B	Substantial	Moderate-Low	This tool has been made available online in Australia, and is suitable for ages 4.5 and above in developmentally normal children. Sensitivity and specificity is equivalent to published data for both DPOAEs and the Pure-Tone Screen if the goal is to detect slight and mild losses, and even better for larger losses. It requires a longer time to conduct the testing, and does not requires an adult to supervise but not specialist training to administer. All data for this approach comes from a single study.
Questionnaires	D	Nil	High	Not useful for this population
Auditory Evoked Potentials	D	Nil	High	Not useful for this population

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 10.5. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Treatments for persistent middle ear disease	A	Substantial	High	This intervention should be provided for every child who needs it, dependent upon history and extent of disease, this may involve surgery and be dependent upon surgical waiting lists.
Hearing Aids / Cochlear Implants	A	Substantial	High	This intervention should be provided for every child who needs it. Specific intervention depends upon several factors (degree of loss, speech recognition performance, performance in school), and is decided upon by professionals and parents
FM Systems / Soundfield Systems	A	Substantial	High	This intervention should be provided for every child who needs it. Application is dependent upon a child's hearing performance in the classroom environment, and also the teacher's and student's willingness to use the devices.
Sign language / Deaf School	A	Substantial	High	This intervention should be provided for every child who needs it. For some children tradition amplification of cochlear implants are not an option, or parents may choose this mode of communication.
Auditory Verbal Therapy / Speech language therapy	A	Substantial	High	This intervention should be provided for every child who needs it. In cases where children have a significant hearing loss, or a late diagnosis, speech language therapy is usually required to help them make the most of language and the habilitation devices they are using.
Behavioural and Environmental Modifications	A	Moderate	High	This intervention should be provided for every child who needs it. Simple environmental and behavioural modifications (e.g. acoustic tiling, sitting closer to the target talker) help all children with hearing loss. They are low cost and generally easy to implement.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty.](#)

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A BETTER
START

E Tipu e Rea

11. Family violence screening and intervention

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Suggested citation: Maessen SE, Wilson D. Family violence screening and intervention. In: Cutfield WS, Derraik JGB, Waetford C, Gillon GT, Taylor BJ [editors]. *Brief Evidence Reviews for the Well Child Tamariki Ora Programme*. A Better Start National Science Challenge. Auckland, New Zealand; 2019; p. 308-340.

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Abbreviations

AAS	Abuse Assessment Screen
CAN	Child abuse and neglect include: physical, emotional or sexual abuse, physical or emotional neglect
CAS	Composite Abuse Scale
CBT	Cognitive Behavioural Therapy
CTS2	Revised Conflict Tactics Scale
HARK	Humiliated, Afraid, Rape, Kick: IPV screening tool
HITS	Hurts, Insults, Threatens, Screams
IPV	Intimate partner violence can include physical, emotional, sexual or economic abuse
ISA	Index of Spouse Abuse
SUDI	Sudden Unexplained Deaths in Infancy
WCTO	Well Child/Tamariki Ora

Summary

- Family violence is common in New Zealand, though the exact prevalence is difficult to estimate due to heterogeneous and limited data particularly within the context of Well Child Tamariki Ora.
- 23.5% of New Zealand children are likely to be reported to Oranga Tamariki before 18 years of age due to concerns about their safety or wellbeing but is almost one in two for Māori children
- 33% of New Zealand women experience physical or sexual violence from an intimate partner in their lives. More than half of children may be exposed to emotional violence between their caregivers, and 15-20% witness physical violence at home.
- Māori and Pacific whānau are disproportionately burdened with family violence, associated homicide, and involvement with child protective services.
- Despite poor evidence that screening results in reductions in family violence, it provides an opportunity for education and intervention and may have benefits even for women who do not disclose abuse.
- The Ministry of Health recommends regular, routine enquiry for family violence accessing healthcare for women and well-child checks, but it is unclear what screening occurs in practice.
- As far as we are aware, no universal screening tools for IPV or CAN have been validated in New Zealand populations.
- Screening for family violence should include management of associated issues (e.g. mental health problems, substance use disorders).
- Programmes such as The Incredible Years Parenting programme, which has been offered to at-risk families as part of Family Start, has positive effects on parenting and on family relationships.
- A Whānau Ora approach to addressing family violence appears to be an effective and empowering option for whānau who are ready to address violence in their homes.

- There is a lack of research about screening and interventions and what works for Māori and Pacific, aside from the Ngā Tau Mīraho o Aotearoa research recently published that focuses on the cost benefits of a cultural adaptation of the Incredible Years Parenting Programme.
- Testing of validated screening tools within NZ and ethnic settings is recommended, given the lack of tools within the NZ health context.

Method

We used the following strategy to identify and retrieve relevant evidence relevant to the questions guiding this rapid review. These questions are:

1. What is the prevalence of family violence in New Zealand during pregnancy and childhood?
2. What suitable tests are available and when is the optimal time to screen for family violence?
3. What interventions or additional support for family violence is effective following detection? Is it currently well implemented in NZ? Does early intervention lead to significant improvements later in childhood/ adolescence?
4. Are there any known harms from screening for family violence?
5. What do we know from a Māori and Pacific knowledge basis about screening in this domain?

The strategy used for this rapid literature review included searching the PubMed and EBSCO databases for peer-reviewed articles published between 2000 and 2019. The Cochrane libraries were also accessed for systematic reviews on family violence. The following keywords were used to access the publications:

- ‘domestic violence’, ‘child abuse’, ‘prevalence’, ‘mass screening’, ‘questionnaire’, ‘intervention’, ‘New Zealand’, ‘indigenous’, ‘systematic review’, ‘meta-analysis’.

The inclusion criteria were:

- publications available in the English language;
- published between 2000-2019;
- focused specifically on screening, prevalence, and intervention for intimate partner violence (IPV) and/or child abuse and neglect (CAN); and
- included, where possible, Māori or Pacific populations.

We took initially searched evidence of screening and interventions demonstrating success in New Zealand; then indigenous populations in other countries; then meta-analyses or systematic reviews with strong evidence for interventions not used in either NZ or indigenous populations.

Following the review of databases, relevant websites and databases focused on New Zealand research and policy were searched: These included the Family Violence Clearinghouse, the Centre for Interdisciplinary Trauma Research, the Dunedin Multidisciplinary Health and Development Study, and the Ministry of Health.

11.1 Introduction to concepts

11.1.1 Family Violence

Family violence describes violence between members of the same family, whānau, or household. Family violence encompasses physical violence and emotional, psychological, financial, and sexual abuse; and the physical and emotional neglect of dependent family members. Family violence affects the safety and development of an exposed child. This review focuses on intimate partner violence (IPV) and child abuse and neglect (CAN) due to the direct or indirect influence of exposure to violence on young children's wellbeing. Fairhall¹, commenting on the Treasury's review of the family violence legislation stated: "There is a lack of clear and convincing evidence for what works in responding to family violence. This is impacted by a range of factors including inconsistent understandings of what constitutes family violence, and low reporting of family violence to Police"¹ (p.1). It is within this context this rapid review was undertaken.

Child maltreatment and IPV are significant financial and social burdens in New Zealand that include the loss of productivity, pain, suffering, and premature mortality experienced by victims. Kahui and Snively² estimated family violence costs NZD 4.1-7.0 billion in 2014. Recently the New Zealand Family Violence Death Review Committee (FVDRC) reported 194 family violence deaths between 2009 and 2015 comprising 92 IPV and 56 CAN deaths³. The FVDRC highlights the deaths of women and children are a consequence of family violence, making up three-quarters of four family violence homicides.¹

11.1.2 Child abuse and neglect

The FVDRC's definition of CAN refers broadly to "...all forms of physical and emotional ill-treatment, sexual abuse, neglect and exploitation that actually or potentially harms a child's health and development or dignity"³ (p. 62). The World Health Organization's definition of child maltreatment is consistent and includes physical, sexual or psychological violence against persons under the age of 18 years, and neglect of infants, children, and adolescents by a caregiver⁴. Psychological abuse in this context refers to harmful patterns of behaviour that include hostile treatment such as threats, intimidation, rejection, ridicule, or restricting a child's movements⁴. For the purposes of this review CAN refers to maltreatment by an authority figure in the home setting, although CAN also take place in diverse settings such as schools or in state care facilities. Furthermore, CAN and IPV are intertwined forms of family violence whereby mothers and children together are likely to be exposed to the harm⁵.

CAN and family violence are significant causes of long-term health issues – the physical, psychological, emotional, spiritual and social morbidity and mortality that affects children into their adulthood in diverse ways⁶⁻⁸. In addition to immediate effects on mood, behaviour, confidence, and perceptions of safety⁹, CAN strongly impacts psychological functioning and antisocial behavior later in life¹⁰. One meta-analysis suggests CAN contributes to half of the depression and anxiety globally¹¹. During adolescence and adulthood, physical, sexual, or emotional abuse and neglect are all associated with an increased risk for mental health problems including depressive and anxiety disorders, suicidal behaviours, eating disorders; and post-traumatic stress disorder and panic disorders are linked to physical or sexual abuse¹¹⁻¹³. Sexual abuse is also associated with sleep disorders¹² and somatic disorders such as pelvic or non-specific chronic pain, functional gastrointestinal disorders, and psychogenic seizures¹⁴.

¹ The Family Violence Death Review Committee excludes deaths related to family violence due to suicide, assisted suicide, or chronic illness, or the death of non-family members who were bystanders or intervened in family violence episodes.

Exposure to CAN increases a child’s risk of developing several health disorders throughout their life as a result of both physiological and behavioural mechanisms (Figure 11.1). Table 11.1 itemises examples of the impacts CAN has on a person’s health. More detail about the impact of adverse childhood experiences is described in domain three of this Well Child Tamariki Ora review series.

Table 11.1. Lifetime health disorders associated with CAN

Non-Communicable Diseases (NCD)	Risky Behaviours
<ul style="list-style-type: none"> • Stroke • Heart Disease • Diabetes • Cancer⁴ • Overweight/obesity¹⁵ • Arthritis • Ulcers • Headaches/Migraines • [less convincing evidence]¹³ 	<ul style="list-style-type: none"> • Sexual activities leading to: <ul style="list-style-type: none"> ▪ STIs and HIV • Alcohol and substance use • Smoking • Increased likelihood of being a victim or a perpetrator of violence in adulthood¹³

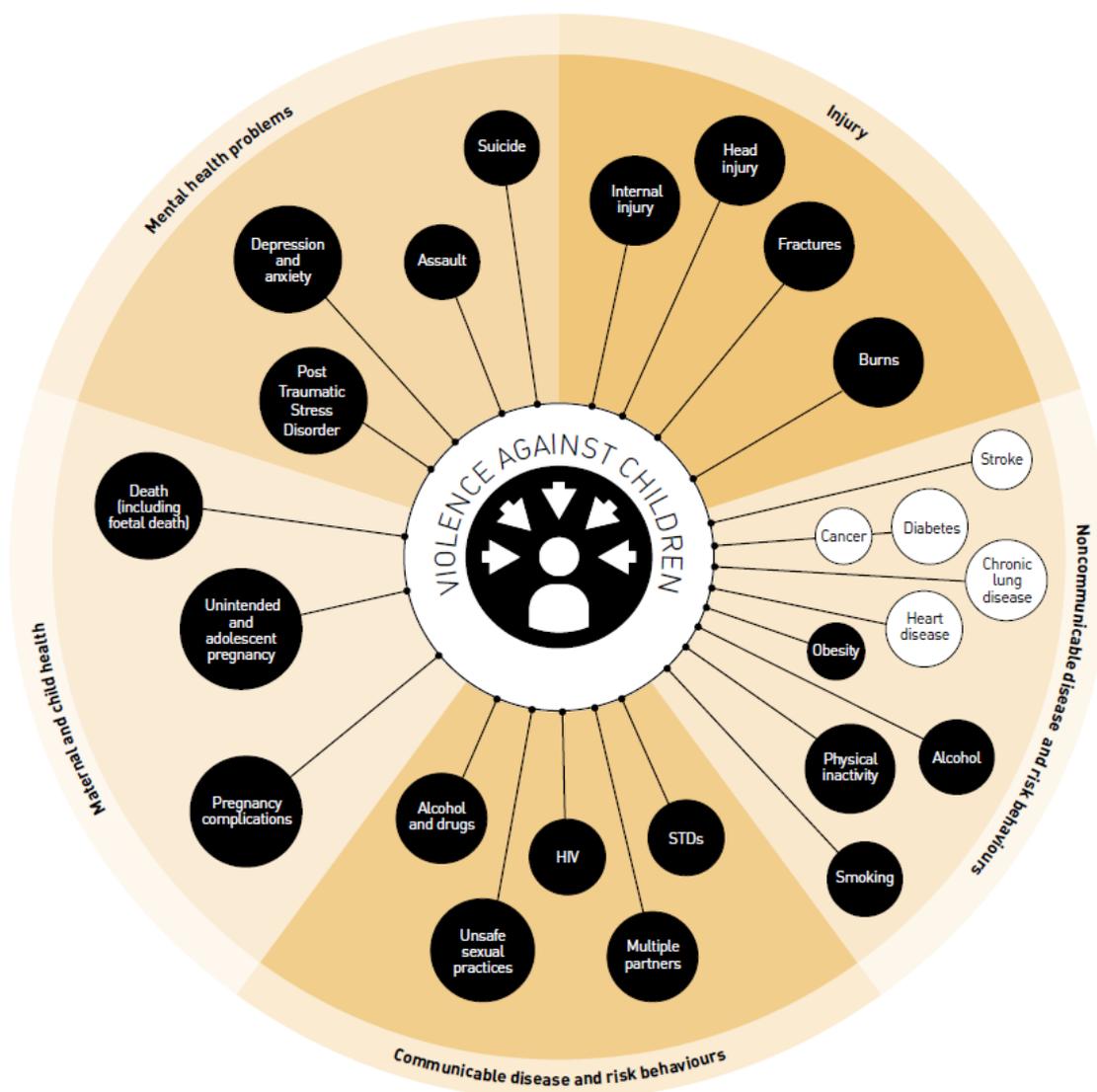


Figure 11.1. Health effects in adulthood of exposure to child abuse and neglect.
 Source: World Health Organization INSPIRE report⁴

11.1.3 Intimate partner violence

IPV results in physical, psychological, or sexual harm within an intimate relationship^{4,16} characterised by women's fear of their partner and a partner's control of a woman¹⁷. IPV, sometimes called intimate terrorism, is less common than and differentiated from situational or mutual couple conflict which is perpetrated by both men (55%) and women (44%)¹⁷. Though IPV can affect any person in an intimate relationship including same-sex relationships, it is commonly gendered – that is, a male offender abusing a female partner⁴, with women bearing the greatest burden of harm from assault requiring hospitalization and causing death^{3,18}. IPV often combines several abusive and controlling behaviour patterns such as manipulation, coercion, harassment, intimidation, surveillance and talking, and gaslighting^{ii,3,19}. Such behaviours deprive victims of control over their finances, reproductive choices, time spent with family and friends, and increases their risk of precarity^{2,19-22}.

Reproductive control is a form of coercive control by abusive partners that often goes unrecognized. Such forms of control can result in increased sexually transmitted infections, HIV and unintended pregnancies. Partners use various forms of coercion that include contraceptive sabotage, threats of physical harm, verbal abuse, forced sex that result in women being afraid to ask their partner to wear a condom or refusing sex^{23,24}.

Intimate partner violence affects a child's development before and after their birth - women with lifetime experiences of IPV are at increased risk for pregnancy complications including miscarriage and premature birth²⁵. Pregnant or post-partum women are also at increased risk of IPV by their partners. Despite these events increasing contact with health professionals, they are unlikely to have been screened for IPV²⁶.

IPV and CAN commonly co-occur and have overlapping risk factors. Two US surveys suggested that between a third and half of the children lived in homes where they witnessed IPV and were also subjected to maltreatment^{27,28}. There are several explanations for this co-occurrence: (a) an abusive parent may also abuse other family members, and (b) threatened or actual violence towards children is used to intimidate or control their partner^{3,20}. Further, mothers who are victims of IPV are more likely to use physically or psychologically hypervigilant approaches to parenting^{28,29}. Corporal punishment is a strong risk factor for physical abuse and other poor outcomes for children, although is not always considered to be abuse³⁰. Children exposed to IPV in their homes are more likely to engage in disruptive behaviours, which contributes to a higher likelihood of receiving physical punishment or other harsh discipline²⁹.

The disruption of mother-child relationships as a result of dysfunctional family dynamics and poor maternal mental health are indirect effects of IPV on child outcomes (see Domains Two and Four of this Well Child Tamariki Ora review). Children who are living in households with IPV are at increased risk for health, behavioural, and mental health problems, which are likely to persist into adulthood^{29,31}. They also have an increased chance of becoming either a perpetrator or victim of IPV, contributing to an intergenerational cycle of violence^{32,33}.

11.1.4 Context of family violence

Family violence occurs across all social and ethnic groups in New Zealand, but often in environments with multiple risks to child development and family functioning^{25,34-37}. Low income is associated with increased odds of both CAN and IPV^{25,37}, while increasing vulnerable families' incomes through welfare

ⁱⁱ Gaslighting refers to the psychological abuse that leads the victim to question their own mental wellbeing.

benefits reduces their likelihood of involvement with child welfare services^{37,38}. In New Zealand, Māori whānau are disproportionately affected by family violence^{3,35,39,40}. Rouland et al.⁴⁰ found income did not protect Māori children notified to and placed in out of home care for child maltreatment. Other risk factors include alcohol and illicit drug use, younger maternal age, fewer years of education, history of criminal offending, and more changes in the child's primary caregiver^{35,39}. Māori whānau exposed to family violence often have all these risk factors, and while adjusting for these factors in analyses significantly reduces the relationship between ethnicity and family violence it is not eliminated³⁹. The social and cultural influences on violence in Māori whānau are discussed further in section 6 of this review.

11.2 What is the prevalence of family violence in New Zealand during pregnancy and childhood?

The exact prevalence of family violence is difficult to estimate, as family violence definitions and information sources vary substantially. Under-reporting and non-disclosure further impede establishing family violence prevalence. We do know 55% of women (ever partnered) reported IPV in their lifetime, with 33% experiencing more than one type of IPV⁴¹. In 2016, there were 118,910 family violence investigations by NZ Police, and 41% of frontline Police time is spent responding to family violence incidents⁴². Between the introduction of legislation criminalizing strangulation in December 2018, as of November 2019, over 1600 charges have been filed and Police charge on average 33 people a week for strangling or suffocating their partners (Inspector F. de Bes, National Prevention Centre, Personal communication, November 25, 2019).

Even when directly asked, many women choose not to disclose violence for a variety of reasons,⁴³⁻⁴⁷ such as:

- fear their children will be taken by child protective services;
- fear the consequences of disclosure from either the perpetrator or their community;
- their abuse is normalized;
- feel they are to blame;
- protecting their partner from potential arrest;
- Or they will not get the help needed or it is unavailable.

Further language, cultural, and social barriers to disclosure also exist for women who want to seek help^{43,44}. Similarly, only a third of adults reported they disclosed abuse as children at the time it occurred⁴⁸.

11.2.1 Prevalence of CAN

Hospital admissions and deaths

Fifty-six children in New Zealand died in family violence events between 2009 and 2015³. Of these children, 80% were younger than five years of age, and two-thirds of these deaths resulted from fatal physical abuse and/or grossly negligent treatment. Notably, 74% of offenders were male and the majority were known to the police for abusing the mother of the deceased child or another female partner³. Children (n=114) lived in households where another child died as a result of family violence³.

In 2015, 63 children aged <16 years were hospitalised with injuries inflicted by a family member⁴². Between the 1990s and 2000s, referrals for children with abuse-related traumatic head injury increased almost threefold, from 88 cases to 257⁴⁹. While the total number of traumatic head injuries from any cause (abusive and non-abusive) remained stable, non-accidental injuries accounted for 23% of fatal head injuries⁵⁰. Most hospitalisations were for children under two years of age, but mortality was higher for those who were three years or older^{49,50}. Most children aged under two years hospitalised with abusive head trauma had no known history of abuse⁴⁹, meaning that first instances are very severe or that oftentimes abuse goes undetected until it is severe.

Notifications to child protective services (Oranga Tamariki)

Based on the number of notifications to the police or Oranga Tamariki, one in four (23.5%) New Zealand children born between 1998 and 2015 were a notification of concern within the first full 17 years of their life³⁸, while 9.7% of children were substantiated as victims of abuse or neglect³⁸. Though these data indicate CAN is common in New Zealand, they describe a specific subset of children whose abuse is detected and substantiated through a child and family assessment or investigation by Oranga Tamariki and New Zealand Police. When abuse is not suspected to be severe, families may not undergo this assessment¹⁹. Report volumes are also subject to changes in awareness and policy and to systemic biases^{36,40}. Therefore, the underestimation of the number of children subject to CAN is likely.

Data from longitudinal studies

Longitudinal studies provide prospective data about family violence. It is important to separate prospective from retrospective measures of childhood maltreatment as there is disagreement between the two approaches⁵¹. The measures used differ considerably, as retrospective measures tend to be self-reported, whereas prospective measures are often based on observation or parental report⁵¹. Prospective measures are typically considered more accurate as they have the potential to identify behaviours that an infant or child may not understand or remember to be abuse or neglect. However, prospective studies can still be subject to desirability biases and have less specificity than retrospective measures⁵¹.

Participants in the Dunedin Multidisciplinary Health and Development Study (14%) retrospectively reported they experienced sexual abuse as children, although the perpetrator was not necessarily a family member³⁹. Women reported sexual abuse in childhood three times more than men⁵². More than three-quarters of participants regularly received physical punishment, but only 4.5% experienced harsh or abusive punishment³⁹. Harsh and abusive punishment was less commonly reported by participants in the Christchurch Health and Development study, affecting only 2%. However, over a third of participants who reported 'regular physical punishment' had an injury⁵³.

11.3 Prevalence of IPV

Between 2009 and 2015, for most of the 92 IPV deaths, men were the predominate abuser of their female partner³.

Population prevalence

The Violence Against Women Survey randomly sampled 2855 ever-partnered women living in Auckland and North Waikato households using a questionnaire based on a similar World Health Organization Multi-Country Study survey conducted internationally⁵⁴. IPV is common in these regions, with 33% of

Auckland and 39% of North Waikato participants reporting lifetime physical or sexual IPV. Nearly a fifth of Auckland and a quarter of North Waikato respondents experienced severe physical IPV, and 5% of participants overall had experienced IPV in the previous 12 months with 55% experiencing at least one form of violence^{41,54}.

Prevalence of IPV in pregnancy

The Violence Against Women Survey indicated 6% of Auckland and 9% of rural women experienced physical violence while they were pregnant, and almost half had been kicked or punched in the abdomen during a violent episode⁵⁵. This is considerably higher than the approximately 2% of women in Australia and Denmark who reported being victims of physical IPV during pregnancy⁵⁶. For the majority of women, the perpetrator was the father of the unborn child, and 25% of women experienced IPV for the first time during pregnancy⁵⁵. For most of those who had previously experienced physical violence, the violence was similar to or worse than previous violence. Although, 26% of women reported their partner was less violent during pregnancy⁵⁵.

Prevalence of children exposed to IPV

In addition to an increased risk for abuse, children whose caregivers are in abusive relationships live in a fearful environment and may have complex and dysfunctional relationships with other household members⁵⁷. Of the adults involved in IPV death events between 2009 and 2015, 92% had children. A total of 254 children lost a parent to an IPV death, while 65 children witnessed the death of a family member³. Almost all women who screened positive for IPV in a Māori health provider clinic had one or more children living with them⁵⁸.

The Dunedin Multidisciplinary Health and Development Study reported 24% of adults witnessed violence or threats between their parents while growing up⁵⁹. Of these, 9% of participants witnessed infrequent assaults between parents and 10% reported witnessing physical violence between their parents on at least five occasions. Fathers were most likely to be the offenders, although 28% of participants reported that both parents were violent towards each other, and 16% reported their mother perpetrated the violence⁵⁹.

In the Growing Up in New Zealand study (n=>6000), mothers reported 62% of children witnessed some form of conflict (including arguments) between their parents at four years of age, but exposure to regular or severe conflict was rare⁶⁰. Four percent of children were reported to ever witness physical conflict between parents, and 2% were usually present when their mother was insulted or threatened by her partner⁶⁰.

The Youth 2000 series surveyed secondary school students in 2001, 2007 and 2012, found almost 60% of students witnessed emotional violence, and in 2012 16% witnessed physical violence, a significant reduction from the 19% reported in the 2007 survey³⁶. These higher numbers potentially reflect the capacity of the older age of the young people to report violence, and because they may witness more violence than their parents report.

Inequities in the prevalence of family violence

Stark disparities exist in family violence in New Zealand, with Māori, Pacific families, and those living in neighbourhoods with high levels of deprivation bearing the burden of family violence. Historical, political, and social forces contribute to multiple social, economic and health inequities for Māori and

Pacific families in New Zealand. While disparities shine a light on two population groups, what is less obvious is complex and intersecting relationships between:

- ongoing effects of colonisation and historical trauma for Māori and subsequent social, political and economic disenfranchisement⁶¹.
- long histories of immigration, generational immigration differences, and settlement of Pacific peoples within New Zealand, and during the 1990s economic reforms loss of employment leading to high levels of unemployment and social disadvantage; and
- higher experiences of adversity and poverty.

Moreover, social frameworks rooted in a racist, Western neo-liberal or exclusionary ideology⁶² further contribute to disparities in family violence.

While Māori made up 15% of the total population between 2009 and 2015 and 25% were aged under 19 years, they comprised 50% of CAN deaths and 44% of CAN offenders. Between 2009 and 2015, compared to non-Māori children, Māori children aged 0-4 years were four times more likely to die from CAN. Intentional injury comprises 28.7% of deaths and is the second-highest cause of death in Māori children and adolescents, although not all are family violence deaths⁶³. One study suggests higher rates of preventable blindness in Māori children can be explained by higher rates of severe non-accidental injury⁶⁴.

Māori ethnicity and deprivation combined predicts victims and offenders of family violence deaths (rather than ethnicity alone)³, Less than half of non-Māori women who died in an IPV event lived in neighbourhoods in the highest deprivation quintile, compared to 77% of Māori women³.

Of the Māori participants in the Dunedin Multidisciplinary Health and Development Study, 14% were exposed to harsh or abusive punishment, almost three times more than non-Māori participants³⁹. A cohort study of children born in 1998 found 42.2% of Māori children were notified to child protective services, compared to 27.2% of Pacific children and only 17.4% of New Zealand European children⁴⁰. Compared to New Zealand European children, Māori children were more than three times likely to have abuse substantiated (6.3% vs 20.4%, respectively), and placed in care (2.0% vs 7.1%). Although other data sources confirm that Māori children are at greater risk for family violence, this research suggests increased surveillance of Māori families⁴⁰.

The Violence Against Women survey demonstrated ethnic differences in lifetime prevalence of physical and/or sexual violence: 57.6% of Māori, 32.4% of Pacific, 34.3% of European/other, and 11.5% of Asian⁶⁵. Māori women were more likely to have been recently affected by violence, three times as likely to be physically assaulted while pregnant, and six times more likely to be hospitalised as a result of assault or attempted homicide compared to non-Māori New Zealanders, indicating the likelihood of severe violence¹⁸.

The repeal of section 59 of the Crimes Act enacted in 2007 (removed the legal defence for “use of reasonable force” parents charged with assault of a child), was associated with changes in public attitudes toward physical punishment of children⁶⁶. In 2007, more than 75% of four-year-old Pacific children were smacked regularly by either parent and around a quarter regularly hit with an object by their mother, although 17.3% were smacked and 2.4% were hit with an object. Fathers tended to use harsher punishment on children aged 1 to 2 years than mothers, with 13.2% of fathers of two-year-olds regularly punishing their child by hitting them with an object⁶⁷. In 2011, the Pacific Island Families Study

reported physical punishment was a common element of parenting in Pacific families, with 81.7% of two-year-olds receiving a smack at least sometimes as part of regular discipline⁶⁸.

Pacific cultural norms around raising children and the role of biblical teachings shed light on discipline and violence. For instance, from a Samoan perspective, responsible parenting is about raising 'good citizens' who are respectful and dutiful. Therefore, educating children on appropriate behaviour may involve physical discipline, something that is influenced by biblical teachings. Poorly behaved children are a reflection on their parents and their quality of parenting⁶⁹.

The Pacific Island Families Study found 77% of Pacific mothers experienced verbal aggression from their partner, and 23.2% experienced physical violence, and almost half had experienced severe violence (48%)⁷⁰. Pacific mothers self-reported severe IPV that increased over time: 10.1% of mothers when their child was six weeks old, and 14.2% when the child was two years of age⁶⁸. The Youth 2000 survey series of secondary school students reported Pacific Island students were less likely than Māori or European students to report emotional abuse between their parents, but almost twice as likely as Māori students to report physical IPV³⁶. Poor food security was also associated with witnessing physical IPV and with Pacific ethnicity, suggesting adversity may play a role in strained relationships that lead to aggression³⁶.

11.3 Summary

- *Family violence is common in New Zealand, although the prevalence is difficult to accurately estimate due to heterogeneous and limited data and underreporting.*
- *One in four New Zealand children are likely to be reported to Oranga Tamariki before 18 years of age due to concerns about their safety or wellbeing, but this is almost one in two for Māori children.*
- *A third of New Zealand women experience physical or sexual violence from an intimate partner in their lives.*
- *More than half of children may witness emotional violence between their caregivers, and 15-20% witness physical violence at home.*
- *Māori and Pacific whānau are disproportionately burdened with family violence, associated homicide, and involvement with child protection services.*

11.4 What suitable tests are available and when is the optimal time to screen for family violence?

There are several terms used for screening family violence: screening, routine screening and routine enquiry. Screening describes to the universal assessment of whole population groups, while routine enquiry is similar to screening it refers to the routinely asking women about IPV in the healthcare setting without applying public health criteria for screening programmes⁷¹. In New Zealand, the latest guidelines for family violence assessment intervention has shifted terminology from screening to routine enquiry⁵.

While several experts and medical associations recommend screening for family violence⁷²⁻⁷⁴, it is not universally believed to be of value. The World Health Organization⁷¹ recommends against screening unless conditions such as mental health, substance use, unexplained health conditions and traumatic caused or complicated by IPV are present because insufficient evidence to suggest screening results in a reduction of family violence for those screened, and lack of availability of appropriate interventions.

Although, the WHO does recommend antenatal care as an opportunity for screening to take place. Limited evidence is available, and randomised controlled trials have failed to demonstrate screening and provision of a brief family violence resource has a benefit on quality of life, IPV exposure, or hospitalisation and emergency department visits after a three month to three year follow-up⁷⁵⁻⁷⁷. Such research cannot provide any information about the efficacy of screening for women who experience abuse but do not disclose it, nor consider women's subjective reports that screening is of value and provided relief and comfort⁷⁸.

Screening and providing information for Australian women improved their knowledge and attitudes around IPV, with 34% reporting positive benefits of screening that helped them to evaluate their situation and feel less isolated⁷⁹. The value of screening depends on follow-up with effective intervention. Screening presents an opportunity to create a safe space for a person to discuss IPV and to receive information, whether they disclose abuse or not. This may have immediate positive effects or be of value in the future if they experience abuse, can draw on information provided, or ask for help⁷⁸.

11.4.1 Timing of screening

We are not aware of any empirical evidence about the optimal timing for screening, but in general, interventions provide the greatest benefits when they are applied early⁸⁰. Healthcare engagement provides an opportunity for screening for family violence, especially in antenatal settings⁸¹. In general, women who have experienced moderate or severe IPV are more likely to have recently visited their GP or pharmacist, providing further opportunities to screen⁵⁴.

The antenatal period may be an important time to enquire about family violence, because it is a time of increased contact with healthcare services and increased risk for IPV²⁶. This time provides an opportunity for intervention before a child is brought into an environment of family violence. Suicide is the leading cause of death for New Zealand women during pregnancy or during the six weeks following pregnancy⁸². Family violence was known to be experienced by 73% of Māori maternal suicides between 2006 and 2015⁸³. A Cochrane review suggests that universal screening in healthcare settings using validated screening tools improves identification of women experiencing IPV but still does not identify as many women that experience IPV based on prevalence estimates¹⁶.

11.5 What screening takes place in practice?

11.5.1 Routine screening for IPV

The Ministry of Health recommends routine enquiry about IPV should occur for all females aged 16 years and over at any hospital admission or discharge, emergency department visit, mental or sexual health appointments, during prenatal and postpartum care, and at least annually in primary care settings. Males should be questioned about IPV if they have signs or symptoms of abuse⁵. There are limited published data to ascertain who is screened for family violence and the frequency of screening.

Data from the Perinatal and Maternal Mortality Review Committee indicates an increase occurred in antenatal screening for IPV between 2014-2015 for the first time. IPV status was known for 51.0% of women whose babies died as neonates in 2014 and for 64.2% of women in 2015. Overall, 2.4% of women were known to be experiencing IPV in 2014 (4.7% of those screened), and 4.3% in 2015 (6.7% of those screened)⁸³.

11.5.2 Screening for family violence at well-child checks

The Well Child/Tamariki Ora (WCTO) programme provides health assessments, referrals, and support services to children and their families from birth to 5 years⁸⁴. The schedule indicates that a family violence assessment should be carried out at 11 visits, beginning within 48 hours of the child’s birth (Table 11.2).

Table 11.2. Schedule of Well Child/Tamariki Ora visits that include a family violence assessment

Child age	The usual person undertaking the assessment
Within 48 hours of the child’s birth	Lead maternity carer
Up to one week from the child’s birth	Lead maternity carer
2-6 weeks	Lead maternity carer
4-6 weeks	Any well-child provider
8-10 weeks	Any well-child provider
3-4 months	Any well-child provider
5-7 months	Any well-child provider
9-12 months	Any well-child provider
15-18 months	Any well-child provider
2-3 years	Any well-child provider
4 years (B4 School Check)	

From the Ministry of Health’s Well Child/Tamariki Ora National Schedule 2013⁸⁴.

The WCTO practitioner handbook recommends against routine enquiry about child abuse and neglect. Instead, practitioners are instructed to be attentive to interactions between the caregiver and child to detect signs of possible abuse. However, many of the signs listed in the handbook are not relevant for pre-verbal children, so may be limited to detect early abuse⁸⁵. Furthermore, the assessment of CAN is largely subjective and prone to error or unsubstantiated judgment.

Though the Ministry of Health does not recommend a specific screening tool⁵, instructions for enquiring about IPV at well-child checks include examples of specific, direct, and clear questions about different types of IPV and a women’s feelings of safety and fear (Figure 11.2)⁸⁵. However, it is unclear what screening takes place in practice. Our search did not reveal recently published data about how many families are screened at each visit, although screening at well-child checks is historically low, particularly beyond the first core visit at 2-5 weeks⁸⁶. Data from Plunket visits in 2005 indicated that 64% of women were screened in the first visit (2-5 weeks), 18% at 6-9 weeks and fewer than 5% of women were screened at any further visits, with no women screened more than once⁸⁶. Repeat screening may be important for detecting abuse. The likelihood of disclosure may increase as a woman’s relationship with the well-child provider develops, and because the dynamic nature of abuse, risk can change quickly over time⁸⁶. Equally importantly, the manner in which the assessment is undertaken greatly influences the likelihood of disclosure of abuse⁸⁷.

Questions about physical violence

- Within the past year have you been hit, pushed/shoved, slapped, kicked, choked or otherwise physically hurt? (If so, who did this to you?)

Questions about sexual violence

- Within the past year have you been forced to have sexual activities against your will? (If so, who did this to you?)
- Have you been made to do anything sexual at a time or place, or in a way that you did not want to?

Questions about psychological/emotional violence

- Within the past year, did anyone insult or swear at you? (If so, who did this to you?)

Questions about stalking/other feelings of not being safe

- Is there a current or past partner who is making you feel unsafe?
- Are you afraid of what your current (or ex-) partner might do to you or someone else?

Figure 11.2. Recommended questions for enquiring about intimate partner violence at Well Child/Tamariki Ora visits. Reproduced from the Ministry of Health's *Well Child/Tamariki Ora Programme Practitioner Handbook: supporting families and whānau to promote their child's health and development*⁸⁵.

11.5.3 Barriers to screening and disclosure

Aside from the myriad factors outside of a screening setting influencing a woman's decision to disclose abuse, many barriers exist to screening being undertaken or being an acceptable opportunity for disclosure.

A systematic review cited common barriers to screening for healthcare providers were personal discomfort asking the questions, time constraints, and lack of knowledge or training about IPV⁸⁸. Newly trained nurses were influenced by senior staff who documented they had completed an IPV screen but had not undertaken the screen⁸⁹. It was commonly believed that universal screening was not necessary because women who needed to be screened could be identified, despite no evidence supporting such practice⁸⁹.

Plunket well child providers cited privacy, time constraints and personal fears of overstepping their perceived role as a visitor in their clients' homes as key barriers to screening during well-child checks. Some Plunket providers intentionally screened in a way that fulfilled their obligation to enquire about family violence while reducing the likelihood of needing to deal with a positive response, because they felt underprepared to respond⁸⁶. Two of four women who shared their experiences of IPV screening by Plunket providers were unaware screening had taken place, reinforcing the importance of enquiring directly and clearly about abuse⁸⁶. Asking the single question "Are you safe at home?" was reported to have very low sensitivity for identifying women experiencing IPV (8.8%)⁸⁷. Unless asked directly, most women agreed they would not disclose abuse⁴⁵. Further, the use of standardised questions (rather than relying on the practitioners' questioning styles and preferences) improved the practitioner's perceived readiness to ask about IPV and reduced fear of offending the patient⁹⁰.

Although healthcare workers report reluctance to screen for IPV due to the invasiveness of asking about relationship violence and their own discomfort^{86,88,89}, the majority of women are happy to be asked about IPV, including Māori and other New Zealand women^{78,91}. In one study only 3% of women found

the questions to be unacceptable, whether women had or had not experienced IPV themselves⁹¹. However, women who support screening may still choose not to disclose abuse⁴⁵.

Whether women have or have not experienced IPV, they prefer that healthcare providers to explain to women why they are asking about partner violence, and to create an atmosphere of safety, support and privacy^{86,92}. Women also indicated practitioners should show they actually care about the women and her safety, and take their time asking such sensitive questions^{45,92}. These factors improve the likelihood of disclosure⁴⁵. Some women suggested that posters, information cards and pamphlets about IPV could also provide an anonymous way for them to access help when they are unable or unwilling to disclose their abuse⁹². Many women who had experienced IPV thought that providing information to all women, regardless of whether she disclosed abuse, was a good idea⁹². Other factors likely to influence a woman’s decision to disclose IPV is her perception of safety from institutional control, the abuser, and shame perspectives⁴⁵. Women who disclose abuse grapple with real, complex, and sometimes systemic barriers and issues⁹³.

11.5.4 Screening tools that have been evaluated/validated

Calculating predictive validity for family violence screening tools is difficult because a person’s real-life exposure to family violence is often unknown. Screening tools are therefore often validated in comparison to other screening tools or questionnaires intended for research settings. Therefore, the exact sensitivity and specificity for identifying cases of those experiencing family violence are unknown.

Screening for IPV

Our search did not identify any IPV screening tools intended for general populations validated with New Zealand populations. Table 3 provides examples of common screening tools intended for use with a general (or healthcare) population to identify women experiencing IPV with available specificity and sensitivity data. Most screening tools either favour specificity at the expense of sensitivity or vice versa⁸⁷. The HITS demonstrated high sensitivity and specificity for identifying women who had already disclosed they were victims of IPV but did not report sensitivity and specificity for identifying IPV victims in a general population⁹⁴. The HARK screening tool, while showing promising specificity and sensitivity, is plagued by a reduced external validity because of a 54% response rate, and concerns about the inability to confirm false positives for those women who screened positive on the HARK but negative on the CAS⁹⁵. The vast difference in reported specificity and sensitivity between two studies evaluating the Abuse Assessment Screen (AAS)^{96,97} demonstrates the importance of assessing a tool in a specific population as well as the manner of its intended use. A Cochrane review suggested that women may be more likely to disclose family violence if screening was on paper or a computer, rather than a face-to-face interview¹⁶.

Table 11.3. Sensitivity and specificity of selected screening tools for IPV

Screen name	Screen description	Validation study	Sensitivity and specificity	Comparison measure
HARK	Four-item screen (face-to-face interview)	Sohal 2007 ⁹⁵ UK n= 232 women in GP office	Sensitivity = 81%, specificity = 95% with cut-off score of 1	Compared to CAS
AAS	Five-item screen – ‘ever’ or ‘within the last year’ (pen-and-paper questionnaire)	Weiss 2003 ⁹⁶ USA n=856 men and women in emergency department	Sensitivity = 93%, specificity = 55% with cut-off score of 1	Compared to ISA

Screen name	Screen description	Validation study	Sensitivity and specificity	Comparison measure
	Three-item screen (face-to-face interview)	Reichenheim 2004 ⁹⁷ Brazil n=748 women post-delivery in maternity wards	Sensitivity 31.9% (95% CI 24.9 to 40.3) for minor and 61.4% (95% CI 47.6 to 74.0) for severe physical violence, Specificity ≥97% Using only the pregnancy question	Compared to CTS2
OAS	Five-item screen (one pregnancy-specific) – ‘presently experiencing (pen-and-paper questionnaire)	⁹⁶ USA n=856 men and women in emergency department	Sensitivity = 60%, specificity = 90% with cut-off score of 1	Compared to ISA
HITS	Four-item screen with 5-point scale for frequency (pen-and-paper questionnaire)	⁹⁴ USA n= 160 female family practice patients, 99 women from domestic violence crisis shelters or who self-identified as victim of domestic violence at emergency department presentation	Sensitivity = 96% Specificity = 91.2% With cut-off score of 10.5	Self-identification

HARK: Humiliated, Afraid, Rape, Kick. CAS: Composite Abuse Scale. AAS: Abuse Assessment Screen. ISA: Index of Spouse Abuse. CTS2 – Revised Conflict Tactics Scale. HITS: Hurts, Insults, Threatens, Screams.

Screening for CAN

The Ministry of Health’s recommendation against routine enquiry about child abuse and neglect⁸⁵ is based on evidence that screening results in a high number of false positives, and therefore, is likely to do more harm than good⁹⁸. Nevertheless, given the prevalence and seriousness of CAN and false disclosures attention should be paid to the signs of non-accidental injury, abuse and neglect. The review upon which this recommendation is based does not include any research published in the last 20 years. Our literature search did not find any many recently developed screening tools intended for universal screening in a well-child setting.

The majority of screening tools that have been developed to identify CAN are intended to identify non-accidental injury in children presenting to healthcare settings with traumatic injury or other injury or illness⁹⁹⁻¹⁰¹. One screening tool based on the Child Abuse Potential Inventory (CAPI), the Brief CAPI (BCAPI)¹⁰², was validated in Finland^{103,104} and Germany¹⁰⁵. The BCAPI was considered to have the potential for screening in these populations, with the caveat that cut-off points were likely to be different. However, this screen is not intended to identify children subjected to maltreatment, but to identify families with high risk for CAN, based on known risk factors. The inventory did not consistently relate to the likelihood of notifications to child protective services¹⁰². Further, while intended to be brief, the BCAPI includes 33 questions and a complex scoring system¹⁰². Published data do not seem to clarify whether the BCAPI is likely to have a high false-positive rate.

11.5.5 Other important considerations for screening

Though this section has focussed primarily on screening for victims of family violence, known risk factors for being a perpetrator of abuse could be identified and potentially managed in a primary care setting. Mental health problems, particularly when untreated, problem drinking, and substance use are factors identified as leading to violence for perpetrators of family violence in New Zealand^{33,106}. Family violence

prevention should include the screening and provision of support for those with mental health and substance use problems and the caregivers of children. New Zealand parents recently discharged for treatment of serious mental illness or substance use disorders were less likely to have committed violence against their children than a comparison group from the general community, according to both self- and informant-report¹⁰⁷. However, the authors of this research were unable to compare these parents to parents with untreated disorders.

Most interventions are ones implemented in other countries, and their suitability in terms of the New Zealand population and context, particularly with regards to culture and language has not been well established. This is particularly important to note for Māori and Pacific populations whose contexts have added layers of complexity that include their unique historical contexts and the roles of colonisation and immigration. Therefore, consideration should be given to implementing screening tools and interventions with care and the notion of developing specific interventions that are culturally relevant and meaningful to these population groups.

11.5 Summary

- *Despite poor evidence that screening results in reductions in family violence, it provides valuable opportunities for education and intervention, and may benefit women who choose not to disclose abuse.*
- *Screening allows for early support provision or intervention.*
- *The Ministry of Health recommends regular, routine enquiry for family violence during healthcare interactions with women and well-child checks, but it is unclear what screening takes place in practice.*
- ¶ *There are many barriers that may prevent screening from taking place at recommended time points.*
- *Direct questioning and feeling safe are important factors that encourage a woman to disclose IPV.*
- *As far as we are aware, no universal screening tools for IPV or CAN have been validated in New Zealand populations; testing of validated screening tools within NZ and ethnic settings is required.*
- *Screening for family violence should include management of associated issues (e.g. mental health problems, substance use disorders)*

11.6 What interventions or additional support for family violence is effective following detection? Is it currently well implemented in NZ? Does early intervention lead to significant improvements later in childhood/adolescence?

This section focuses on interventions that may be offered to families following the detection of family violence. Therefore, primary preventive approaches are beyond the scope of this review. In New Zealand, if child abuse or neglect is suspected, Oranga Tamariki or Police should be notified, who will carry out their own risk assessment. Interventions for family violence are not easily evaluated using traditional RCT studies and are often evaluated in comparison to a control group already receiving some support services. Few studies measure long-term outcomes of interventions – these are reported where available. Most interventions are multi-faceted due to the complexity of family violence and its wide-reaching consequences, which means that it is difficult to identify exactly what parts of an intervention

approach may be contributing to positive outcomes. However, a recent systematic review identified that the interventions most likely to be successful tended to include (a) ongoing support services in the form of counselling, home visits, and parenting support; and (b) addressing multiple risk factors rather than family violence in isolation⁷⁴.

11.6.1 Interventions during pregnancy

Early intervention is optimal for reducing suffering and preventing risk to a child's development⁸⁰. However, a Cochrane review found insufficient evidence that interventions aiming to prevent or reduce episodes of family violence during pregnancy are effective¹⁰⁸. Only one trial included in the review reported a significant reduction in episodes of IPV¹⁰⁸. This intervention targeted English-speaking women living in Washington, D.C. who self-identified as being of minority ethnicity. Women randomised to the intervention received an individualised series of psycho-behavioural counselling sessions at antenatal care visits, which included information about types of abuse, safety behaviours and safety plans, as well as a list of community resources¹⁰⁹. Women receiving the intervention were about half as likely to experience minor, severe, or any physical IPV postpartum, although there was no difference in the likelihood of sexual violence between groups¹⁰⁹. Other interventions with counselling components, though not necessarily effective in reducing domestic violence, exert positive effects by improving women's coping strategies, stress levels, safety, and health^{108,110}.

Advocacy interventions aim to empower women to set their own goals for managing IPV by improving their understanding of their situation and possible solutions may be successful in antenatal settings according to a second Cochrane¹¹¹. The DOVE intervention was incorporated into existing home visiting programmes for women who had experienced IPV during or in the year leading up to pregnancy¹¹². The brochure-based, structured empowerment intervention comprised three antenatal and three postpartum sessions, delivered by nurses and nurse-supervised community health workers. The brochure contained information addressing the cycle of violence, the Danger Assessment (which assesses risk for homicide), choices available, safety planning information tailored to the context and level of danger, and IPV resources specific to the community along with national hotline information¹¹². A control group received home visits without the DOVE intervention component and was screened and given basic referral information for IPV. Although there was no significant difference in IPV experience between the DOVE and control groups at the 24-month follow up, both groups had a significant decrease in IPV experience, which was greater for the DOVE group¹¹².

11.6.2 Other home visiting interventions

Home visiting interventions vary in method and content, and are flexible to respond to the needs of those receiving them. They typically target vulnerable families and provide support for relationships, substance use problems, mental health problems, employment, and education^{112,113}. A 'screen and refer' approach to addressing maternal depression, substance use, and IPV in home visiting was found to increase the likelihood of discussion about these issues, but not the likelihood of identification of IPV or referral of women experiencing them¹¹⁴. A recent systematic review reported home visiting programmes could not be recommended to reduce the occurrence of child maltreatment limited because of contradictory evidence¹¹³. However, because these interventions are typically designed to be culturally appropriate to the community they intend to serve there was significant heterogeneity between programmes examined¹¹³. Importantly, the New Zealand-based Early Start programme reported improved outcomes for children, though it did not appear to reduce the occurrence of IPV in enrolled families¹¹⁵.

Early Start was based in Christchurch for families with a new infant and facing stress and difficulty. Families received weekly-to-monthly visits depending on their needs until their child was five years old¹¹⁶. Of the children enrolled in Early Start, 43% were identified to be at high risk for maltreatment according to a population-based prediction model, reflecting the high support needs of the population the programme targeted¹¹⁷. The 443 families randomised to Early Start or a control condition had high levels of inter-partner conflict and violence that did not improve with programme participation¹¹⁶. However, at 36 months, children in Early Start had lower rates of severe or very severe physical assault by parents, reduced exposure to punitive parenting in favour of positive parenting styles, and lower rates of internalising and externalising behavioural problems. They were also less likely to have visited a hospital for accident, injury or poisoning and were more likely to attend well-child and GP check-ups. The effects of fewer injuries requiring hospital visits, less physical or harsh punishment, and improved parenting competence persisted at the nine-year follow-up¹¹⁵. Importantly, there was a trend towards stronger effects of the intervention for Māori families and those facing multiple disadvantages, although the trend did not reach statistical significance^{116,118}. Notably, just over a quarter of eligible families declined to participate, so while home visiting may offer an alternative intervention pathway for families with children at risk for CAN, it may not be suitable for all families¹¹⁵.

Family Start is another intensive home visiting programme, originally based on Early Start, that serves the Manukau and Franklin areas¹¹⁹. It is delivered by Māori, Pacific, faith-based, and other service providers to families before or shortly after the birth of a child in a manner that is culturally responsive to the communities they serve. Unlike Early Start, it has not been systematically evaluated using an RCT study design, but families receiving the intervention appear to have higher vaccination rates, higher engagement with early childhood education, and a small reduction in risk of post-neonatal deaths, including injury deaths and SUDI¹¹⁹. The programme continues to evolve but it is unclear whether it reduces family violence.

11.6.3 Parenting programmes

A review of treatment interventions found child-parent interventions are effective where mothers with IPV and their children undergo interventions both separately and jointly have positive psychosocial recovery and improved wellbeing¹²⁰.

The Incredible Years Parenting programme is an evidence-based intervention for addressing conduct problems in children aged three to eight years that have demonstrated improvements in child behaviour, parenting, and family relationships in New Zealand¹²¹. The programme is available to all families receiving Family Start home visits. Parents who completed the 14 group sessions reported significant improvements in child behaviour, and that programme participation resulted in a reduction in corporal punishment, hostile or over-reactive discipline, verbal aggression and physical assault towards children that persisted in the 30-month follow-up¹²¹. In addition to improvements to the parent-child relationship, there were modest improvements in the parental relationship, including a reduction in inter-parental violence¹²¹.

Ngā Tau Mīraho o Aotearoa is intended for Māori whānau and is an adaptation of the Incredible Years programme that incorporates Māori tikanga and cultural elements¹²². The programme demonstrated cost-effectiveness, with conservative estimates forecasting a return on investment ratio of 3.75:1. Most parents who completed the programme reported improved parenting skills, family relationships, and mental wellbeing; and that their children had improved emotional, cognitive and social functioning¹²². Further benefits came from feeling supported by other parents in the programme and by the kaiārahi (facilitators), who provided information about and assistance with accessing further support for their

individual needs. Kaiārahi themselves also experienced positive effects on their personal and professional development and their own parenting skills¹²².

The Triple P parenting programme has also demonstrated efficacy for reducing problem behaviours in children, though its effects on family relationships are less well-studied¹²³. Though course length and content vary, in general, they are of lower intensity than the Incredible Years intervention. The Primary Care Triple P-Discussion Groups, which involves two two-hour group sessions, has been adapted to be culturally consistent with Māori values¹²⁴. This adaptation was effective in improving child behaviour and reducing interparental conflict about child-rearing and was considered both culturally acceptable and valuable by participating parents¹²⁴.

Both the Incredible Years and Triple P have parenting programmes targeting children from birth, but their efficacy and effect on family violence have not been evaluated on a large scale in New Zealand for children younger than three years.

11.6.4 Interventions for perpetrators of abuse

The most widely used interventions for perpetrators of family violence are the Duluth model and cognitive behavioural therapy (CBT). The Duluth model focusses on changing patriarchal views that support violence towards women while providing education about alternative methods of conflict management and problem-solving to avoid the use of violence. CBT helps individuals to change harmful behaviours by identifying and addressing the disordered and biased ways of thinking that lead to the behaviours. A Cochrane meta-analysis demonstrated no clear effect of CBT on reducing reoccurrence of violent behaviour¹²⁵.

A systematic review of reviews also suggests there is no clear impact of either approach on recidivism, particularly when looking at victim reports compared to administrative data¹²⁶. Reoffending may be lower when the abuser is self-referred and higher if the program is not completed, suggesting that motivation for change may be an important moderator of the programmes' effects¹²⁶. Another systematic review of perpetrator programmes within the healthcare setting demonstrated weak evidence, although when combined with alcohol treatment authors indicated they could be promising¹²⁷. These findings must be considered within the complexity of interrelated factors that surrounds IPV contributing to perpetrators' behaviours – motivation to change, for instance, may only be one of several factors affecting an individual.

A review of IPV interventions for perpetrators (in addition to those for victims and children) found a lack of evidence for the effectiveness of interventions including the Duluth model and CBT. They noted significant attrition from these programmes, although noted the promise of motivational enhancement therapy (MET) used in substance abuse studies, by focusing on the parenting role, perpetrators attachment to their children and developing an awareness of the effect the violence has on their children¹²⁸. Another study found the use of motivational interviewing techniques in combination with CBT or other family violence reduction interventions improved the effectiveness of the interventions, particularly for offenders who were less motivated to change their behaviour. There was no clear effect on the likelihood of completing an intervention programme¹²⁹.

11.6.5 Whānau Ora and whānau-centred interventions for indigenous early childhood wellbeing

Whānau-centred (or family-centred) approaches to improving outcomes for children at risk provide support and care for the whole family and intend to be consistent with the viewpoints of indigenous cultures¹³⁰. Whānau Ora, a whānau-centred approach, empowers and supports whānau. Shaped by Māori values and culture it delivers support within Māori and other communities^{35,131}. Interventions operating within this framework improve attitudes towards, and actual, home safety, and reduce childhood injury and illness for indigenous children¹³⁰. A whānau-centred approach may be particularly important to address family violence, for those Māori whānau who are at risk for violence, and for those affected by family violence who want to keep their whānau together and safe, rather than separating the abuser(s) from the victim(s)¹³².

Te Manu Tu Tuia is a recently-developed Hawke's Bay-based initiative to address domestic violence informed by a whānau-centred approach and community voices¹³². It offers two-weekend wānanga (forum) for couples at high-risk who are both willing and motivated to make behavioural changes. In the first wānanga, couples attended group workshops, therapy sessions, and activity-based learning. The wānanga included couples' children, who participated in separate workshops on the first day and came together with their caregivers on the final day for whānau activities. For the 37 participating couples, the program significantly reduced reoffending behaviour and police callouts (estimated a 69% decrease in violence). Further, participants were almost six times more likely to be in employment a year after the programme than at the start of the programme. All couples had positive feedback and for some couples, the intervention was life-changing. All felt that it had reduced violence in their homes, and gave the tools to prevent, reduce, or de-escalate violence, and access further support¹³².

11.6.6 Implementation of family violence interventions in New Zealand

Protective interventions for victims of family violence are available in New Zealand through the justice and legal systems. However, the National Collective of Independent Women's Refuge estimates at least 80% of family violence incidents go unreported to the police. A lack of understanding of the dynamics of IPV by the general community and those interacting with women in or leaving an abusive relationship (e.g. WINZ, family court, social services) undermine policies and formal sanctions (e.g. protection orders)⁴³. Many women find legal sanctions to be ineffective, and child access by abusive fathers burdensome, particularly when it involves unwanted contact with her abuser, and having to leave children with fathers who lack the skills to safely care for them^{43,133}.

Applying for a protection order has been described as one of the most frightening experiences in an abused woman's life, and they are not often sought until being re-victimised multiple times¹³³. Still, around two out of five applications do not result in a protection order being granted¹³⁴. Many women do not know about or understand that they may benefit from a protection order until told by a lawyer or by police – who do not always have correct knowledge about who may access them¹³³. Many women describe a lack of faith in police to enforce protection orders due to previous negative experiences in family violence situations¹³³. Women can end up paying thousands of dollars in legal fees to access legal protections from their abuser¹³³.

11.6 Summary

- *Home visiting programmes have demonstrated long-lasting improvements in child safety in New Zealand. The inclusion of an advocacy/empowerment element may improve outcomes for women experiencing IPV.*
 - *The Incredible Years Parenting programme, which has been offered to at-risk families as part of Family Start, has positive effects on parenting and on family relationships.*
 - *Existing interventions targeting perpetrators of family violence depend on the perpetrator's motivation to change.*
 - *A Whānau Ora approach to addressing family violence appears to be an effective and empowering option for whānau who are ready to address violence in their homes.*
 - *Many women have negative experiences of accessing legal protections from perpetrators of family violence.*
-

11.7 Are there any known harms from screening for family violence?

A Cochrane review found no reports of adverse events as a result of screening for family violence. Instead, inquiring about family violence in healthcare settings was associated with increased patient satisfaction¹⁶. However, it should be acknowledged that for some women who have previously experienced IPV, screening can bring up painful memories, feelings of shame, and may make an already stressful healthcare visit worse⁷⁸. Six percent of women who screened positive for IPV in Australia reported feelings of sadness or depression after being prompted to think about their situation⁷⁹. These feelings are not universal, and women who experience them are not necessarily opposed to screening⁷⁸. The women's risk of emotional harm needs to be balanced the opportunity to talk about their IPV⁷⁸, and the potential screening offers for providing support and addressing family violence.

11.8 What do we know from a Māori and Pacific knowledge basis about screening in this domain?

11.8.1 Context of Māori family violence

Māori families are disproportionately affected by violence between family members. Despite normalisation of violence in some Māori families and suggestions that Māori is inherently violent, family violence is antithetical to Māori cultural values and tikanga (practices and protocols), and would not be tolerated in Māori society prior to colonisation⁶¹. Pre-colonisation, Māori culture valued children as active participants in all aspects of community life¹³⁵. Early European accounts documented an absence of violence and physical discipline in Māori domestic life and provide evidence of affection between adults and children^{135,136}. Raising and nurturing tamariki was a collective responsibility, shared between men and women of the wider family group, and did not depend on rigid Western nuclear family structures^{61,135}. Instead of coming from within Māori culture, the causes of violence are rooted in the intergenerational trauma experienced by Māori due to the historical subjugation and ongoing oppression as a result of colonisation¹³⁷.

The destabilisation of gender and power relationships Māori experienced with the loss of land, language and cultural expression resulting from colonisation was driven by Western ideologies of patriarchy and Christianity^{20,47}. The loss of the protections embedded in cultural values and practices left Māori susceptible to disparities, and to being both perpetrators and victims of violence. As with any family, growing up with violence increases the odds of a child growing up and becoming either a perpetrator or victim (or both) of family violence³². Intergenerational patterns of violence and harm increase the likelihood that children have limited opportunities to learn other ways of interacting. However, while a ‘cycle of abuse’ model is commonly used to explain violence in Māori whānau, not all Māori women, children and men affected by IPV and CAN (respectively) come from whānau with intergenerational family violence¹³⁵. Therefore, it is important to note that contemporary Māori are diverse in cultural and whānau backgrounds.

Though physical punishment of children is usually intended to teach a child right from wrong, it is often associated with frustration, anger, and alleviation of the stress of parenting¹³⁵. Physical punishment is seen to deter misbehaviour outside of the home, informed by the belief that if the parent is hard on the child it will make the child better able to deal with people that might pick on them¹³⁵. Some Māori caregivers described using physical punishment in order to make children conform to Pākehā ideals so that their children would not be the targets of racist stereotyping¹³⁵. They also seem to internalise Pākehā ideas that Māori are naturally violent, despite historical evidence suggesting the opposite^{47,135}.

In one study, the desire to protect children from the negative effects of IPV was the main motivation for Māori women leaving past abusive relationships⁴⁷. However, the fear that children will be removed from their care is a barrier for women to seek help. Women’s fears are compounded by frustrated people working within the system who are judgemental and racist and do not practically solve the problems they present with⁴⁷.

11.8.2 Context of Pacific family violence

Pacific peoples are diverse, coming from different island nations within the Pacific, meaning they have different cultural backgrounds. Samoan people value cultural traditions and norms that privilege individual’s responsibilities and obligations to their family contrasting with Western concepts of individuality and independence. This can lead to pressure on women to remain with abusive partners, which is both internal and external in origin – that is, from “churches, from the extended family ... or just from the community”⁴³. Thus, ideas of ‘good wife’ who obey their husbands mean women may be more likely to be met with resistance within the community in terms of leaving them⁶⁵.

Pacific Islanders living in Aotearoa are diverse within and between the various island nations, and do not have access to the same traditional supports that exist in the village structure that is common to their home islands¹³⁸. A collective social identity is common in Pacific cultures, which means that individual models of family and sexual violence have limited applicability to Pacific people¹³⁸. The possibility of social exclusion or family estrangement for disclosing is a particularly strong incentive to keep family violence secret for people with collective social identities⁴³.

11.8.3 Implications for screening

Common to many families, disclosure of abuse will be less likely for Māori whānau who believe it may lead to loss of their children to State care or disruption to their family structure. Some Māori women would prefer to be screened by a Māori woman using Māori processes and practices⁷⁸. In contrast, a Pacific woman preferred a Caucasian person interviewed her because it felt easier than discussing

physical violence with a Pacific person⁷⁸. The normalisation of physical violence is common in Pacific communities, as are perspectives that a woman who has been hit must have done something to deserve it^{43,65}. Pacific women are more likely to endorse ideas that it is “important for a man to show his wife who is the boss” and that family problems should be discussed only within the family⁶⁵, which may mean that they could benefit from provision of information about IPV even if they do not disclose abuse on screening.

11.8 Summary

- *We need to avoid putting Māori and Pacific together as their backgrounds and needs vary significantly, and similarly recognise the different Pacific nations that are sometimes seen as a homogenous group.*
 - *There is a lack of research about screening and interventions and what works for Māori and Pacific.*
 - *Aside from the Ngā Tau Mīraho o Aotearoa research recently published that focuses on the cost benefits of an adaption of the Incredible Years Programme.*
 - *Māori whānau are over-represented in the IPV and CAN statistics.*
 - *Pacific families are over-represented but the IPV and CAN status are less clear.*
-

11.9 Recommendations for future action

Policy and practice

- Explore ways to improve the routine enquiry about IPV with women during the antenatal and postnatal periods. Routine enquiry protocols exist, however, given the higher risks associated with pregnancy and following the birth of a baby for IPV these need to be better implemented.
- Significantly improve the collection of data (and make it available) by antenatal, primary health care and WCTO providers screening for IPV and follow-up referral and intervention.
- Include family violence as part of assessments for mental health and substance use disorders.
- Establish structured evaluation protocols and measures that aim to capture the efficacy of programmes, such as home visiting, the Incredible Years Parenting, Family Start, which are all promising interventions that appear to have positive effects on parenting and family relationships.
 - Design and implement a systematic evaluation programme examining interventions such as Whānau Ora and others adapted for use with Māori whānau and Pacific families.

Future research

- Undertake a programme of research that focuses on Well Child Tamariki Ora screening and interventions. Such a programme should include the following:
 - Exploration of the efficacy of face to face versus electronic versus paper-based methods of screening/routine enquiry and identify potential barriers to screening and routine enquiry.
 - Validation of routine enquiry/screening questions within the context of Aotearoa, and with targeted population groups such as Māori, Pacific, and other relevant population sub-groups.
- Undertake research with Māori and Pacific population groups that captures relevant and meaningful evidence to better inform screening and interventions. Note, these population groups should have separate programmes of research.
 - For Pacific populations, parenting interventions that are culturally appropriate should be a research priority.

11.10 Graded Evaluations

Table 11.4. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
HARK	I	Insufficient	Low	May be applicable in some populations but needs further validation.
AAS	I	Insufficient	Low	May be applicable in some populations but reported validity varies considerably between studies.
OAS	C	Small	Low	May be applicable for evaluating ongoing IPV in some populations but reported sensitivity is low.
HITS	C	Small-moderate	Moderate	It could be offered to both women and men but has not been validated in NZ. Validation should also include ethnic populations.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 11.5. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Psycho-behavioural counselling	C	Moderate	Moderate	This intervention could be offered as part of a comprehensive intervention for IPV.
Advocacy/empowerment interventions	C	Small-moderate	Moderate	This intervention could be provided to everybody who needs it.
Home visiting programmes	B	Moderate-substantial	Moderate	This intervention should be provided for every family who needs it. Content should be tailored to the family's needs.
Parenting programmes	B	Substantial	Moderate-high	This intervention should be provided for every family who needs it. Needs to be evaluated for children younger than three years. Content should be tailored to the family's needs, particularly Māori, Pacific, and other minority groups.
CBT/Duluth model therapy for perpetrators	C	Small	Moderate	This intervention could be provided for every person who is motivated to change their behaviour, or in combination with motivational interviewing.
Whānau Ora approaches	C	Substantial	Low-moderate	This intervention approach shows great potential, particularly for Māori whānau. Research is needed to systematically evaluate Whānau Ora interventions

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

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Supplementary Information: Grade definitions and levels of certainty

Table S1. Grade definitions for screening tools and interventions

Adapted with permission from the U.S. Preventive Services Task Force 2012.ⁱ

Grade	Definition	Recommendation for policy and practice
A	<ul style="list-style-type: none"> The authors recommend this screening tool/intervention. There is high certainty that the net benefit is substantial. 	<ul style="list-style-type: none"> This screening tool/intervention should be offered or provided.
B	<ul style="list-style-type: none"> The authors recommend the screening tool/intervention. There is high certainty that the net benefit is moderate, or there is moderate certainty that the net benefit is moderate to substantial. 	<ul style="list-style-type: none"> This screening tool/intervention should be offered or provided.
C	<ul style="list-style-type: none"> The authors recommend selectively offering or providing this screening tool/intervention to patients based on professional judgment and patient preferences. There is at least moderate certainty that the net benefit is small. 	<ul style="list-style-type: none"> This screening tool/intervention should be provided for selected patients depending on individual circumstances.
D	<ul style="list-style-type: none"> The authors recommend against this screening tool/intervention. There is moderate or high certainty that the screening tool/intervention has no net benefit or that the harms outweigh the benefits. 	<ul style="list-style-type: none"> The authors discourage the use of this screening tool/intervention.
I	<ul style="list-style-type: none"> The authors conclude that the current evidence is insufficient to assess the balance of benefits and harms of the screening tool/intervention. Evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined. 	<ul style="list-style-type: none"> If the screening tool/intervention is offered, patients should understand the uncertainty about the balance of benefits and harms.

Table S2. Levels of certainty regarding net benefit

Adapted with permission from the U.S. Preventive Services Task Force 2012 ¹.

Level Of Certainty	Description
High	<ul style="list-style-type: none"> The available evidence usually includes consistent results from well-designed, well-conducted studies in representative populations. These studies assess the effects of the preventive service on health outcomes. This conclusion is therefore unlikely to be strongly affected by the results of future studies.
Moderate	<ul style="list-style-type: none"> The available evidence is sufficient to determine the effects of the preventive service on health outcomes, but confidence in the estimate is constrained by such factors as: <ul style="list-style-type: none"> the number, size, or quality of individual studies; inconsistency of findings across studies; limited generalizability of findings to routine practice; lack of coherence in the chain of evidence. As more information becomes available, the magnitude or direction of the observed effect could change, and this change may be large enough to alter the conclusion(s).
Low	<ul style="list-style-type: none"> The available evidence is insufficient to assess effects on health outcomes, because of: <ul style="list-style-type: none"> the limited number and/or size of studies; important flaws in study design and/or methods; inconsistency of findings across individual studies; gaps in the chain of evidence; findings not generalizable to routine practice; lack of information on important health outcomes. More information may allow estimation of effects on health outcomes.

ⁱ <https://www.uspreventiveservicestaskforce.org/Page/Name/grade-definitions>

***Ehara taku toa i te toa takitahi,
engari he toa takitini***

*My success is not my own,
but from many others*

