

Methodology Report 2019/20

New Zealand Health Survey

2020



New Zealand Health Survey

Authors

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Introduction

The New Zealand Health Survey (NZHS) is an important data collection tool that is used to monitor population health and provide supporting evidence for health policy and strategy development. The Health and Disability Intelligence group, within the Ministry of Health's Health System Improvement and Innovation business unit, is responsible for designing, analysing and reporting on the NZHS. The NZHS field activities are contracted out to a specialist survey provider, CBG Health Research Ltd (CBG).

The NZHS collects information that cannot be obtained more effectively or efficiently through other means, such as by analyses of hospital administrative records, disease registries or epidemiological research. The NZHS is the best source of information at a population level for most of the topics it covers.

Before 2011, the Ministry conducted New Zealand Health Surveys (in the years 1992/93, 1996/97, 2002/03 and 2006/07) and additional, separate stand-alone surveys on specific subjects (adult and child nutrition; tobacco, alcohol and drug use; mental health; and oral health) once every three or four years. In July 2011, all of these surveys were integrated into a single NZHS, which is now in continuous annual operation.

From 2013 onwards, a number of key outputs from the NZHS became Tier 1 statistics (a portfolio the government maintains of the most important official statistics, essential to understanding how well New Zealand is performing in different aspects of national concern). For the 2019/20 year, the eight Tier 1 statistics from the NZHS are: smoking (current), past-year (alcohol) drinking, hazardous (alcohol) drinking, obesity, unmet need for a general practitioner (GP) due to cost, unfilled prescription due to cost, self-rated health and mental health status (psychological distress).

This NZHS methodology report outlines the procedures and protocols followed to ensure the NZHS produces the high-quality and robust data expected of official statistics (Statistics New Zealand 2007). The information from the continuous NZHS specific to the 2019/20 year (data collected from July 2019 to March 2020) is included in the 'New Zealand Health Survey 2019/20' section of this report. Data collection for the NZHS usually occurs over 12 months, to minimise seasonal variation. However, due to COVID-19 restrictions, data collection for the 2019/20 year ended in late March 2020. See 'Impact of shortened data collection (COVID-19)' in the 'New Zealand Health Survey 2019/20' section for more information about the impact of the shorter data collection period. The corresponding information for years 2011/12 to 2018/19 of the NZHS can be found in previous methodology reports.¹

¹ See www.health.govt.nz/nz-health-statistics/national-collections-and-surveys/surveys/current-recent-surveys/new-zealand-health-survey

Background

As a signatory to the *Protocols for Official Statistics* (Statistics New Zealand 1998), the Ministry employs best-practice survey techniques to produce high-quality information from the NZHS. It uses standard frameworks and classifications, with validated questions where possible, so that NZHS data can be integrated with data from other sources.

Goal

The goal of the NZHS is to support the formulation and evaluation of health policy by providing timely, reliable and relevant health information that cannot be collected more efficiently from other sources. The information covers population health, health risk and protective factors, as well as health service utilisation.

Objectives

To achieve this goal, 13 high-level objectives have been identified for the NZHS. These are to:

1. monitor the physical and mental health of New Zealanders and the prevalence of selected long-term health conditions
2. monitor the prevalence of risk and protective factors associated with these long-term health conditions
3. monitor the use of health services, and patient experience with these services, including access to the services
4. monitor trends in health-related characteristics, including health status, risk and protective factors, and health service utilisation
5. monitor health status and health-related factors that influence social wellbeing outcomes
6. examine differences between population groups, as defined by age, gender, ethnicity, disability and socioeconomic position
7. provide a means for collecting data quickly and efficiently to address emerging issues related to the health of the population
8. enable follow-up surveys of at-risk populations or patient groups identified from the NZHS as necessary to address specific information needs
9. measure key health outcomes before and after a policy change or intervention
10. facilitate links to routine administrative data collections to create new health statistics and address wider information needs
11. provide data for researchers and health statistics for the general public

12. allow New Zealand data to be compared with international health statistics
13. evaluate methods and tools to improve the NZHS's quality, including implementing objective tests to capture information that is not accessible under the self-report process, such as measuring blood pressure.

Features of the survey

The NZHS has been carefully designed to minimise impact on survey respondents. Features for this purpose include:

- selecting only one eligible adult and one eligible child per dwelling
- using well-tested and proven questions
- using professional, trained interviewers to conduct the interviews
- making an appointment to conduct each interview at a time that suits the respondent and their family
- having the option of using a proxy respondent where would-be respondents living in private dwellings have severe ill health or cognitive disability.

The New Zealand Health and Disability Multi-region Ethics Committee (MEC) approved the 2019/20 NZHS (MEC reference: MEC/10/10/103).

Survey content

The NZHS comprises a set of core questions combined with a flexible programme of rotating topic modules. The questionnaire is administered (face to face and computer assisted) to adults aged 15 years and older, as well as to children aged 0–14 years, generally through their primary caregiver, who acts as a proxy respondent.

The current NZHS maintains continuity with the previous surveys by including a set of core questions in both the adult and child questionnaires. The module topics usually change every 12 months.

For details on the rationale of topic inclusion, cognitive testing, and the content of the questionnaires, see the *Content Guide 2019/20* (Ministry of Health 2020c).

Core content

Most of the core questions for both adults and children are drawn from the main topic areas included in the 2006/07 and 2011/12 NZHSs. Topic areas include long-term conditions, health status and development, health behaviours, health service utilisation and patient experience, sociodemographics and anthropometry. Table 1 summarises the topics included in the core content of the 2019/20 NZHS. See the *Content Guide 2019/20* (Ministry of Health 2020c) for the module topics of each survey year between 2011/12 and 2019/20.

Table 1: New Zealand Health Survey 2019/20 core content

Domain	Topics
Children	
Long-term conditions	Asthma, eczema, diabetes, rheumatic heart disease, mental health conditions
Health status and development	General health, functional difficulties
Health behaviours	Breastfeeding, nutrition, physical activity, child's misbehaviour, sleep, tooth brushing
Health service utilisation and patient experience	Primary health care provider use, GPs, nurses, medical specialists, dental health care workers, other health care workers, hospital use, prescriptions
Sociodemographics	Child: <ul style="list-style-type: none"> gender, age, ethnicity, language, country of birth Primary caregiver/proxy respondent: <ul style="list-style-type: none"> relationship to child, age, education, income and income sources, employment status, household characteristics
Anthropometry	Height, weight and waist circumference measurements
Adults	
Long-term conditions (self-reported)	Heart disease, stroke, diabetes, asthma, arthritis, mental health conditions, chronic pain, high blood pressure, high blood cholesterol
Health status	General health (physical and mental health), functional difficulties, psychological distress
Health behaviours	Physical activity, tobacco smoking, electronic cigarette use, vegetable and fruit intake, alcohol use, drug use, sleep, teeth brushing
Health service use and experience	Primary health care provider use, GPs, nurses, medical specialists, dental health care professionals, other health care professionals, hospital use, prescriptions
Sociodemographics	Gender, age, ethnicity, language, country of birth, sexual identity, education, income and income sources, employment status, medical insurance, household characteristics
Anthropometry	Height, weight, and waist circumference measurements, blood pressure

Survey population and sample design

This section describes the target population, the survey population and the sample design for the NZHS.

Target and survey population

The **target population** is the population the survey aims to represent. The **survey population** is the population that was covered in the survey.

Target population

The target population for the NZHS is the New Zealand 'usually resident' population of all ages, including those living in non-private accommodation.

The target population is approximately 4.0 million adults (aged 15 years and over) and 0.9 million children (aged from birth to 14 years), according to the 2013 Statistics New Zealand Census (2013 Census) population figures.

The NZHS previously (in 2006/07 and earlier) included only people living in private accommodation. The target population for the current NZHS includes people living in some types of non-private accommodation, to improve coverage of older people.

Survey population

Approximately 99 percent of the New Zealand 'usually resident' population of all ages is eligible to participate in the NZHS. For practical reasons, a small proportion of the target population is excluded from the survey population. People in this category include:

- those in most types of non-private dwellings (prisons, hospitals, hospices, dementia care units and hospital-level care in aged-care facilities)
- non-New Zealand diplomats, diplomatic staff and their dependants
- people who usually live in a household but are currently away and will not return within the next four weeks (except students based in hostels and boarding schools)
- people in households located on islands other than the North Island, South Island and Waiheke Island.

Included in the survey population are:

- usual residents who live in aged-care facilities (rest homes)
- students who live away for at least four weeks from their household in student accommodation (university hostels and boarding schools)
- usual residents who live in a household, but are away for less than four weeks
- children under shared care arrangements if they spend:
 - at least four days per week in the current household
 - equal time in the current household and somewhere else, and they are present in the household on the day of recruitment
- overseas visitors who intend to stay in New Zealand for more than 12 months.

Sample design

The sample design for the NZHS was developed by the National Institute for Applied Statistics Research Australia, University of Wollongong, Australia.

The sample design used in the current year is the same design used for the years 2015/16 to 2018/19, but it is slightly different from the design used for the years 2011/12 to 2014/15. The main changes made in 2015/16 are as follows:

- The first-stage selection units are now Statistics New Zealand's household survey frame primary sampling units (PSUs) rather than the census meshblocks used in the previous four years. PSUs are groupings of one or more meshblocks. There have also been some associated changes to the selection probabilities and the number of dwellings selected from each PSU.
- PSUs are now selected using the Statistics New Zealand coordinated selection facility to manage overlap across many government surveys and to minimise the NZHS revisiting the same households.
- PSUs selected for the area component (defined below under 'Sample selection') of the sample are now surveyed in two different quarters of the same calendar year, but in different reporting years, such as 2018/19 and 2019/20. Different households are surveyed in these two different quarters.

For more detail on the current sample design, see *Sample Design from 2015/16: New Zealand Health Survey* (Ministry of Health 2016), and for detail on the sample design used prior to 2015/16, see Clark et al (2013) and *The New Zealand Health Survey: Sample design, years 1–3 (2011–2013)* (Ministry of Health 2011).

Sample selection

The NZHS has a multi-stage, stratified, probability-proportional-to-size (PPS) sampling design. The survey is designed to yield an annual sample size of approximately 14,000 adults and 5,000 children.

A dual-frame approach has been used, whereby respondents are selected from an area-based sample and a list-based electoral roll sample. The aim of this approach is to increase the sample sizes for Māori, Pacific and Asian ethnic groups.

Area-based sample

Statistics New Zealand's PSUs form the basis of the area-based sample. The area-based sample is targeted at the ethnic groups of interest by assigning higher probabilities of selection to areas (PSUs) in which these groups are more concentrated.

A three-stage selection process is used to achieve the area-based sample:

- First, a sample of PSUs is selected within each district health board (DHB) area. The PSUs are selected with PPS, where the size measure is based on the counts of occupied dwellings from the 2013 Census. This means that larger PSUs have a higher chance of being selected in the sample. The size measures are modified using a targeting factor to give higher probabilities of selection to PSUs where more Pacific or Asian people live, also based on the 2013 Census.
- Second, a list of households is compiled for each selected PSU. A systematic sample of approximately 21 households is selected from this list by choosing a random start point and selecting every k^{th} household. The skip k is calculated by the 2013 Census occupied-dwellings count divided by 21.
- Third, one adult (aged 15 years or over) and one child (aged from birth to 14 years, if any in the household) are selected at random from each selected household.

Aged-care facilities in the selected PSUs are included in the area-based sample by first dividing them into 'accommodation units', typically consisting of an individual or couple living together in the facility. Accommodation units are then treated as households in the sampling process, although, at most, five accommodation units are selected from a single facility.

Students living away from home in university hostels and boarding schools are eligible to be selected via their family's house if they still consider this to be their home. If selected, arrangements are made to survey them either when they are next at home or at their student accommodation.

Electoral roll sample

The electoral roll provides another sampling frame, used to increase the sample size of the Māori ethnic group. The electoral roll is used to select a sample of addresses where a person has self-identified as having Māori ancestry. A copy of the electoral roll is obtained quarterly for this purpose.

Stratified three-stage sampling is used to select the sample from the electoral roll:

- The first stage involves selecting a sample of PSUs within each stratum (DHB area), with probability proportional to the number of addresses on the electoral roll containing at least one person who has self-identified as having Māori ancestry. The sample of PSUs is selected so that it does not overlap with the sample of PSUs for the area-based sample.
- The second stage involves selecting a systematic sample of 14 addresses (from the list of households where any person has self-identified as having Māori ancestry) from each selected PSU, or all addresses if there are fewer than 14 addresses in a selected PSU.
- In the third stage, one adult (aged 15 years or over) and one child (aged from birth to 14 years, if there are any children in the household) are selected at random from each selected address.

The process of contacting households and selecting an adult and child is exactly the same for the electoral roll sample as for the area-based sample. The adult and child (if there are any children in the household) randomly selected into the sample can be Māori or non-Māori. This approach ensures that probabilities of selection can be correctly calculated for all respondents.

Data collection

CBG collects the data for the NZHS. The CBG interview team comprises approximately 35 professional public policy interviewers.

Interviews are conducted in respondents' homes; the interviewer enters responses directly into a laptop using The Survey System's Computer Assisted Personal Interviewing (CAPI) software.

For the 2019/20 NZHS survey, adult respondents were also invited to complete some sections of the interview by themselves using the laptop. 'Showcards' with predetermined response categories were used to assist respondents where appropriate. In the 2017/18 survey, electronic showcards on a tablet were introduced. The options displayed on the electronic showcards automatically change as the survey progresses. In 2018/19, images relating to the dietary habits questions were included in the showcards to help improve respondent engagement and the accuracy of their responses.

Pilot study

Before the main data collection for the NZHS 2019/20, a pilot study was carried out with 100 respondents from seven PSUs in Auckland, Wellington, Blenheim and Oamaru. A total of 76 adult and 24 child interviews were completed. As a result of the pilot study, some minor changes were made to the survey questions. See the *Content Guide 2019/20* (Ministry of Health 2020c) for more information about the purpose and results of the pilot study.

Enumeration

CBG pre-selects households from PSUs selected for the survey using the New Zealand Post address database, obtained quarterly. Each area PSU is re-enumerated by the interviewer when they first visit, to ensure accuracy of both new dwellings and those removed (since the previous Census). New household details are entered into CBG's Sample Manager software while the interviewer is in the field, making those households eligible for random selection process within its PSU.

Invitation to participate

The NZHS is voluntary, relying on the goodwill of respondents, and interviewers obtain consent for participation without coercion or inducement. CBG posts each selected household an invitation letter from the Ministry, along with an information pamphlet. Interviewers take copies of the information pamphlet in 11 different languages when they subsequently visit households seeking people's agreement to participate in the survey.

Using CBG's Sample Manager software, one adult and one child (if any in the household) are randomly selected from each selected household to take part in the survey. Respondents are asked to sign an electronic consent form and are given a copy to keep. The consent form requires the respondent to confirm they have read and understood the information pamphlet, that they can ask questions at any time and that they can contact CBG or the Ministry for more information.

The consent form also informs respondents:

- of their right to request an interpreter if required (in a range of 10 different languages)
- that they can stop the interview at any time
- that they do not have to answer every question
- that their participation is confidential, and no identifiable information will be used in any reports
- that their answers are protected by the Privacy Act 1993.

Where a selected adult respondent is unable to provide consent themselves, a welfare guardian, or someone who holds enduring power of attorney for the respondent's personal care and welfare, is permitted to consent to and complete the survey on the respondent's behalf.

Child interviews are conducted with a guardian or primary caregiver of the child; that is, a person who has day-to-day responsibility for the care of the child.

All respondents for the NZHS are given a thank you card and a small token of appreciation, such as a pen or fridge magnet, at the conclusion of the interview. A list of health and community organisations is also included should respondents wish to discuss their participation, or if they need advice on a health issue.

Visit pattern

In attempting to make contact, interviewers make up to 10 visits to each selected household, on different days and at different times of the day before recording the household as a 'non-contact'. Visits are recorded as separate events only if they are made at least two hours apart.

Interviewers space their PSU visits over a two- to three-month period. During the first month, the interviewer will make up to six visits to each selected household within the PSU. If contact with the household is not established during that time, the interviewer suspends visiting for three or four weeks, before attempting twice more. If contact is still not established, the interviewer suspends visiting for another three or four weeks before their final two attempts. This process helps the interviewer contact people temporarily away, or those who are otherwise engaged when their household is first approached.

Interview duration

The mean duration of the adult survey in 2019/20 was 43 minutes, comprising 36 minutes for the core questions (including measurements) and seven minutes for the module. The mean duration of the child survey in 2019/20 was 22 minutes, comprising 18 minutes for the core questions (including measurements) and four minutes for the module. Time taken for the interviewer to engage with the household, to complete the consent process and to pack away at the end of the survey (an average of 10 minutes) is not included in these figures.

Respondent feedback

To ensure survey protocols have been followed correctly and to ascertain respondents' satisfaction with the survey process, CBG conducts audit calls with at least 15 percent of all respondents and at least two households per PSU. Interviewers leave postcards with respondents, which they can use to send feedback (anonymously if they choose) directly to CBG. Feedback is also encouraged via the survey helpline and email.

Audio recording

Audio recording of interviews was introduced in the 2017/18 NZHS as a part of quality control. Audio recording helps to ensure that interviews are conducted in a consistent and impartial manner. Upon respondent consent, random or pre-determined questions are recorded.

Interviewer training

Interviewers participate in annual training for new modular content, and receive ongoing training and support during the year, in the form of individualised and group learning. In-field assessments are also conducted by field managers at regular intervals during the survey year. Interviewers are retrained annually and must pass a recertification assessment to ensure they maintain the required skill levels.

Objective measurements

Interviewers request height and weight measurements of all respondents aged two years and over at the end of the interview. They also request waist circumference measurements of those aged five years and over. Respondents may decline to provide any or all of these measurements. Pregnant women are excluded from the measurement component of the survey.

Laser height measurement was introduced with the 2012/13 NZHS. The laser design was trialled and refined before being introduced; it replaced the traditional stadiometers used in the 2011/12 NZHS. The professional measuring device, a Precaster HANS CA770, consists of a laser meter mounted to a rigid headboard held by the interviewer against the corner of a wall or door. The headboard is lowered until it reaches the respondent's head, activating the laser to take a measurement to the nearest 0.1 cm. Measurements are taken without shoes.

Weight is measured using professional electronic weighing scales (Tanita HD-351) to the nearest 0.1 kg, to a maximum of 200 kg. Respondents are asked to empty their pockets, and remove their shoes and any bulky clothing.

Waist circumference is measured to the nearest 0.1 cm using an anthropometric measuring tape, Lufkin W606PM. Measurements are taken over one layer of clothing, at the midpoint between the lowest palpable rib and the top of the hip bone.

Height, weight and waist circumference measurements are taken at least twice in each respondent. If there is a variation of more than 1 percent between the first and second measurements, a third measurement is taken for accuracy. The final height, weight and waist measurements used for analysis are calculated for each respondent by taking the mean of the two closest measurements.

Blood pressure measurement for adults was included from 2012/13. It was removed during the 2017/18 survey year (to allow more time for the questionnaire portion of the survey) and reintroduced in 2018/19. If the respondent consents, interviewers obtain a blood pressure measurement using an OMRON HEM 907, a portable electronic sphygmomanometer with three cuff sizes. A fabric cuff is wrapped around the respondent's upper left arm, just above the elbow. Within the cuff is a plastic bladder connected by a tube to the main device. As the bladder inflates, the device detects the respondent's blood pressure. The device is programmed to take three readings, with a one-minute pause between each. The final systolic and diastolic

measurements used for analysis are calculated for each respondent by taking the mean of the second and third measurements. The first reading is not used, to minimise the impact of any increase in blood pressure caused by taking measurements.

Respondents are given a measurement card, detailing the readings taken on the day of the survey. The card also includes details of where to go for further information or advice.

Several techniques are used to ensure the quality of the objective measurement equipment. If interviewers report faulty equipment, replacements are supplied immediately. In-field checks of equipment by CBG managers are carried out at least twice a year. These checks include:

- a visual check of equipment for damage/cleanliness (to ensure, for example, that blood pressure cuffs are in good condition, blood pressure tubes and connectors are sound and weighing scales have all four feet)
- a check that the laser and blood pressure devices are still programmed with the correct settings.

At the time of the annual module change, the equipment is checked and recalibrated as follows:

- the electronic weighting scales and blood pressure monitors are recalibrated by a manufacturer-approved agent
- the lasers are checked against a known fixed height to ensure they are measuring correctly and are still programmed to the correct settings.

Interviewers undergo retraining on the collection of measurements at the time of each annual module change. They must pass a certification assessment before being permitted to deliver the survey in the field. The assessment is administered by a nurse and includes an assessment of the interviewers' ability to measure children.

Response and coverage rates

The response rate is a measure of how many people who were selected to take part in the survey actually participated. The higher the response rate, the more representative the survey results are of the New Zealand population.

In 2019/20, the final weighted response rate was 75 percent for adults and 74 percent for children.

For more details on the response rates for 2019/20, see the 'New Zealand Health Survey 2019/20' section.

Response rate is an important measure of the quality of a survey. Methods used to maximise response rates in the NZHS include:

- giving interviewers initial and ongoing training and development
- supporting and assessing interviewers in the field
- using well-designed call pattern processes, allowing for up to 10 calls to potential respondents at different times of the week and day
- revisiting 'closed' PSUs at the end of each quarter – non-contact households are revisited (up to 10 times overall) and attempts made to complete interviews with selected respondents who were unable to take part when they were originally selected.

Calculating the response rate

The NZHS calculates a weighted response rate. The weight of each household reflects the probability of the household being selected into the sample; the weighted response rate describes the survey's success in terms of achieving the cooperation of the population being measured.

For adults, the response rate calculation classifies all selected households into the following four groups:

1. ineligible (such as vacant sections, vacant dwellings and non-residential dwellings)
2. eligible responding (interview conducted; respondent confirmed to be eligible for the survey)
3. eligible non-responding (interview not conducted but enough information collected to indicate that the household did contain an eligible adult; almost all refusals were in this category)
4. unknown eligibility (such as non-contacts and refusals who provided insufficient information to determine eligibility).

The response rate is calculated as follows:

$$\text{Response rate} = \frac{\text{number of eligible responding}}{\left[\begin{array}{c} \text{number of eligible} \\ \text{responding} \end{array} \right] + \left[\begin{array}{c} \text{number of eligible} \\ \text{non-responding} \end{array} \right] + \left[\begin{array}{c} \text{estimated number of eligibles} \\ \text{from the unknowns} \end{array} \right]} \times 100$$

The justification for using this calculation method is that a proportion of the unknowns is likely to have been eligible if contact could have been made. This proportion of the unknowns is therefore treated as eligible non-responding.

The estimated number of unknown eligibles is calculated as follows:

$$\left[\begin{array}{c} \text{Estimated number} \\ \text{of eligibles from the} \\ \text{unknowns} \end{array} \right] = \left[\begin{array}{c} \text{number} \\ \text{of} \\ \text{unknowns} \end{array} \right] \times \frac{\left[\begin{array}{c} \text{number of eligible} \\ \text{responding} \end{array} \right] + \left[\begin{array}{c} \text{number of eligible} \\ \text{non-responding} \end{array} \right]}{\left[\begin{array}{c} \text{number of eligible} \\ \text{responding} \end{array} \right] + \left[\begin{array}{c} \text{number of eligible} \\ \text{non-responding} \end{array} \right] + \left[\begin{array}{c} \text{number of} \\ \text{ineligibles} \end{array} \right]}$$

The response rate for children is calculated using the same approach as for adults, but 'eligible' means the household contained at least one child, and the definition of 'responding' is that a child interview was conducted.

Coverage rate

The coverage rate is an alternative measure related to survey response, and shows the extent to which a population has been involved in a survey. It provides information on the discrepancy between the responding sample (weighted by selection weight) and the population. It encompasses the impact of non-response rates and also incorporates other factors, such as being excluded or missed from the sample frame. For example, dwellings that have just been built may not be included in the sample frame, in this way contributing to under-coverage.

The coverage rate is defined as the ratio of the sum of the selection weights for the survey respondents to the known external population size.

Unlike the response rate, the coverage rate can be calculated without making any assumption about how many households with unknown eligibility were in fact eligible. Moreover, the coverage rate can usually be broken down in more detail than the response rate, including by individual characteristics. However, definitional or operational differences between the survey scope and the external population size (such as differing definitions of usual residence) will affect the coverage rate. As a result, the response rate is generally used as the primary measure of the survey's quality. Some information on the coverage rate is included to provide more detail on response, particularly response by ethnicity and age group.

The coverage rate also represents the factor by which the calibrated weighting process adjusts selection weights to force agreement with calibration benchmarks (see the 'Weighting' section for more on calibration).

For details on the coverage rates in 2019/20, see the 'New Zealand Health Survey 2019/20' section.

Data processing

Capturing and coding

Questionnaire responses are entered directly on interviewers' laptops using CAPI software.

Most questions have single-response options or require discrete numerical responses, such as age at the time of a specific event or the number of visits to a specific medical professional. However, a number of questions allow for multiple responses. For these questions, all responses are retained, with each response shown as a separate variable on the data file.

In addition, a number of questions in the questionnaire offer an 'other' category, where respondents can specify non-standard responses. Each 'other' category response is recorded (in free text).

Ethnicity is self-defined, and respondents are able to report their affiliation with more than one ethnic group using the Statistics New Zealand standard ethnicity question. Responses to the ethnicity question are coded to level 4 of the *Ethnicity New Zealand Standard Classification 2005* (Statistics New Zealand 2005a).

Securing information

Any information collected in the survey that could be used to identify individuals is treated as strictly confidential. Data is transferred daily from interviewers' laptops to CBG by a secure internet upload facility. The Ministry accesses the data through the CBG website using a secure username and password login.

The names and addresses of people and households that participate in the survey are not stored with response data. Unit record data are stored in a secure area and are only accessible on a restricted basis.

Checking and editing

CBG and the Ministry routinely check and edit the data throughout the field period of the NZHS. In addition, the final unit record data sets provided to the Ministry are edited for range and logic. Any inconsistencies found are remedied by returning to the interviewer and, if necessary, the respondent for clarification and correction.

In 2018/19, enhanced data cleaning was introduced by CBG. Previously, where a respondent decided to go back in the survey and change their response to an earlier question, any responses that were no longer on a valid logic path were retained in the data set. This resulted in extra cleaning being required at the analysis stage to manually remove these responses. To resolve this issue, CBG worked with the survey software provider to develop on-the-fly automatic cleaning of survey responses that were no longer on a valid logic route.

Missing data due to non-response

The term 'unit non-response' refers to the situation in which no response is obtained from the selected household or person; for example, if the household is unable to be contacted or declines to participate. 'Item non-response' refers to the situation in which a respondent does not provide an answer to some (but not all) questions asked on the questionnaire, usually because they do not know the answer or refuse to answer.

Unit non-response is adjusted for in the calculation of weights, as described in the 'Weighting' section. Weighting is also used to adjust for non-response to the measurement phase of the interview.

Almost all questions have less than 1 percent item non-responses. The questions with the most item non-responses in the 2019/20 NZHS are:

- personal income and household income (9.7 percent and 15.9 percent non-responses respectively)
- sexual identity (3.7 percent non-responses)
- questions that ask for the cost of the respondent's last GP visit and nurse visit (4.8 and 12.2 percent non-responses respectively).

Where a respondent does not provide their date of birth or their age in years, age is imputed as the midpoint of the age group they have provided. No other imputation is used to deal with item non-responses.

Creating derived variables

A number of derived variables are created on the NZHS data set. Many of these, such as body mass index (BMI), Alcohol Use Disorders Identification Test (AUDIT) and level of psychological distress (K10), are based on commonly used or standard definitions to enable comparison with other data sources and countries. Other derived variables are developed specifically for the NZHS, such as a summary indicator of physical activity level that incorporates information on the intensity, duration and frequency of a person's physical activity.

See the *Annual Data Explorer* for more detailed information on all the indicators used in the NZHS (www.health.govt.nz/publication/annual-update-key-results-2019-20-new-zealand-health-survey).

Outliers

Respondents with height and weight measurements that lead to a calculated BMI of less than 10 or greater than 80 are considered outliers and treated as non-respondents to the measurement phase of the interview.

Respondents who report more than 112 hours of physical activity per week (an average of 16 hours per day) are excluded from the derived summary measure of physical activity.

Ethnicity

Ethnic group variables are derived using the concept of **total response ethnicity** (Statistics New Zealand 2005a). This means that respondents can appear in, and contribute to, the published statistics for more than one ethnic group.

NZHS reports generally provide statistics for the following four ethnic groups: Māori, Pacific, Asian and European/Other. The ethnic group Other (comprising mainly Middle-Eastern, Latin-American and African ethnicities) has been combined with European to avoid problems with small sample sizes.

Respondents who do not know or refuse to state their ethnicity are included as European/Other, as are those who answer 'New Zealander'.

The ethnicity data is collected using a standard Statistics New Zealand ethnicity question that provides eight checkboxes for the most common ethnic groups in New Zealand, and up to three text responses for other ethnic group options. The ethnicity coding was improved in 2015/16. The Other ethnicity text response options have been coded to level 4 of the *Ethnicity New Zealand Standard Classification 2005* (Statistics New Zealand 2005a) since 2015/16. This is likely to have had a small effect on the time series; for example, increasing the size of the Asian ethnic group. It is unlikely to have affected responses relating to Māori ethnicity, because Māori is listed as an ethnicity in the eight checkboxes for the most common ethnic groups.

Neighbourhood deprivation

Neighbourhood deprivation refers to the New Zealand Index of Deprivation 2018 (NZDep2018), developed by researchers at the University of Otago (Atkinson et al 2019). NZDep2018 measures the level of socioeconomic deprivation for each neighbourhood (meshblock) according to a combination of the following 2013 Census variables: income, benefit receipt, transport (access to car), household crowding, home ownership, employment status, qualifications, support (sole-parent families) and access to the internet. The older version of NZDep2018 (NZDep2013) was used between NZHS years 2014/15 and 2018/19, and NZDep2006 was used prior to NZHS 2014/15.

NZHS reports generally use NZDep2018 quintiles, where quintile 1 represents the 20 percent of small areas with the lowest levels of deprivation (the least deprived areas) and quintile 5 represents the 20 percent of small areas with the highest level of deprivation (the most deprived areas).

A small number of meshblocks do not have a value for NZDep2018. If any of these meshblocks are selected in the NZHS, the respondents are assigned to quintile 3 (the middle quintile) for weighting and analysis purposes.

Disability status

The question set used to identify disabled people in the NZHS is known as the Washington Group Short Set (WGSS) and has been included in the NZHS since 2018/19. Using the WGSS, disabled people are those who have at least a lot of difficulty seeing or hearing (even with glasses or hearing aids), walking or climbing stairs, remembering or concentrating, self-care, or communicating. The six domains included in the WGSS were chosen because they were found to be the ones that identified a majority of people at risk of being restricted in their independent participation in society.

The WGSS should not be used to produce estimates of disability prevalence or to investigate levels of need for services or environmental change. To meet these and other data needs, a disability-specific survey, with a more extensive question set, would be required. The population identified as disabled using the WGSS is considerably smaller than the population identified by disability-specific surveys. One of the limitations is that no WGSS question fully captures mental health impairments.

For more information, please see <https://www.washingtongroup-disability.com>.

NZHS results by disability status are presented for adults but not for children. The number of children in one survey year of the NZHS who are identified as disabled by the WGSS is too small to allow robust conclusions to be drawn.

Weighting

Weighting of survey data ensures the estimates calculated from this data are representative of the target population.

Most national surveys have complex sample designs whereby different groups have different chances of being selected in the survey. These complex designs are used for a variety of purposes; in particular, to:

- reduce interviewer travel costs by ensuring the sample is geographically clustered
- ensure all regions of interest, including small regions, have a sufficient sample size for adequate estimates to be made
- ensure important sub-populations – in particular, Māori, Pacific and Asian ethnic groups – have a sufficient sample size for adequate estimates to be made.

To ensure no group is under- or over-represented in estimates from a survey, a method of calculating estimates that reflects the sample design must be used. Estimation weights are used to achieve this aim.

A weight is calculated for every respondent, and these weights are used in calculating estimates of population totals (counts), averages and proportions. Typically, members of groups that have a lower chance of selection are assigned a higher weight so that these groups are not under-represented in estimates. Conversely, groups with a higher chance of selection receive lower weights. Also, groups that have a lower response rate (such as young men) are usually assigned a higher weight so that these groups are correctly represented in all estimates from the survey.

The NZHS uses the calibrated weighting method to:

- reflect the probabilities of selecting each respondent
- make use of external population benchmarks (typically based on the population census) to correct any discrepancies between the sample and the population benchmarks; this improves the precision of estimates and reduces bias due to non-response.

Data from each calendar quarter of the NZHS data set are weighted separately to population benchmarks for that quarter. This means that each quarter's data can be used to produce valid population estimates.

Calculating selection weights

The first step in producing calibrated weights is to calculate a selection probability (and hence selection weight) for each respondent. It is crucial to calculate selection weights correctly to avoid bias in the final calibrated estimators.

Selection weights for the area-based sample and the electoral roll sample are calculated in different ways, as follows.

Area-based sample

- The probability of a PSU i being selected in the area-based sample (A) is written as π_{Ai} . The values of π_{Ai} are greater than 0 for all PSUs in the survey population.
- The probability of a dwelling being selected from a selected PSU i in the area sample is $1/k_{Ai}$, where k_{Ai} is a skip assigned to each PSU on the frame.
- The probability of any particular adult being selected from a selected dwelling j in a selected PSU i is then $1/N_{ij(\text{adult})}$, where $N_{ij(\text{adult})}$ is the number of adults in the dwelling. Similarly, the probability of any particular child (if any in the household) being selected is $1/N_{ij(\text{child})}$, where $N_{ij(\text{child})}$ is the number of children in the dwelling.

Electoral roll sample

- The probability of a PSU i being selected in the electoral roll sample (R) is written as π_{Ri} . The values of π_{Ri} are 0 for some PSUs (those with fewer than five households with residents who registered Māori descent on the electoral roll snapshot used in the sample design for that year).
- Dwellings are eligible for selection in the electoral roll sample if they have at least one adult registered as being of Māori descent in the electoral roll snapshot extracted for the enumeration quarter. ($E_{ij} = 1$ if PSU i has $\pi_{Ri} > 0$ and dwelling j in this PSU is eligible; $E_{ij} = 0$ otherwise.)
- A skip k_{Ri} is assigned to each PSU and applied to eligible dwellings. The probability of an eligible dwelling being selected from PSU i in the electoral roll sample is $1/k_{Ri}$, where k_{Ri} is a skip assigned to each PSU on the frame.
- The probability of any particular adult being selected in the electoral roll sample from a selected dwelling j in a selected PSU i is then $1/N_{ij(\text{adult})}$, and the probability of any particular child (if any in the household) being selected is $1/N_{ij(\text{child})}$.

Combined sample

The electoral roll sample and the area-based sample are selected according to the probabilities calculated using the above methods. The two samples of PSUs do not overlap. The complete NZHS sample is defined as the union of the two samples. The probability of selecting any adult in dwelling j in PSU i in the combined sample is therefore:

$$(1) \quad \pi_{ij(\text{adult})} = E_{ij} \pi_{Ri} k_{Ri}^{-1} N_{ij(\text{adult})}^{-1} + \pi_{Ai} k_{Ai}^{-1} N_{ij(\text{adult})}^{-1} = (E_{ij} \pi_{Ri} k_{Ri}^{-1} + \pi_{Ai} k_{Ai}^{-1}) N_{ij(\text{adult})}^{-1}$$

Similarly, the probability of selecting any child in dwelling j in PSU i in the combined sample is:

$$(2) \quad \pi_{ij(\text{child})} = E_{ij} \pi_{Ri} k_{Ri}^{-1} N_{ij(\text{child})}^{-1} + \pi_{Ai} k_{Ai}^{-1} N_{ij(\text{child})}^{-1} = (E_{ij} \pi_{Ri} k_{Ri}^{-1} + \pi_{Ai} k_{Ai}^{-1}) N_{ij(\text{child})}^{-1}$$

The selection weights for adults and children are given by the reciprocal (inverse) of the above:

$$(3) \quad d_{ij(\text{adult})} = \pi_{ij(\text{adult})}^{-1} = (E_{ij} \pi_{Ri} k_{Ri}^{-1} + \pi_{Ai} k_{Ai}^{-1})^{-1} N_{ij(\text{adult})}$$

$$(4) \quad d_{ij(\text{child})} = \pi_{ij(\text{child})}^{-1} = (E_{ij} \pi_{Ri} k_{Ri}^{-1} + \pi_{Ai} k_{Ai}^{-1})^{-1} N_{ij(\text{child})}$$

For the purposes of calculating weights, values of $N_{ij(\text{adult})}$ or $N_{ij(\text{child})}$ greater than five are truncated to five. This affects only a small proportion of households (approximately 1 percent) and is designed to reduce the variability of weights to avoid instability in weighted statistics.

Calibration of selection weights

Calibrated weights are calculated by combining the selection weights and population benchmark information obtained externally from the survey. The NZHS uses counts from Statistics New Zealand's estimated resident population for each calendar quarter, broken down by age, gender, ethnicity and socioeconomic position, as its benchmark population.

Calibrated weights are calculated to achieve two specific requirements:

- A. The weights should be close to the inverse of the probability of selecting each respondent.
- B. The weights are calibrated to the known population counts for a range of sub-populations (such as age-by-gender-by-ethnicity categories). This means that the sum of the weights for respondents in the sub-population must equal exactly the known benchmark for the sub-population size.

Requirement A ensures that estimates have low bias; requirement B improves the precision of estimates and achieves consistency between the survey estimates and external benchmark information. The calibrated weights are calculated in such a way as to minimise a measure of the distance between the calibrated weights and the inverse selection probabilities, provided that requirement B above is satisfied.

A number of distance measures are in common use. A chi-square distance function (case 1 in Deville and Särndal 1992) is used for calibrating the NZHS weights, which corresponds to generalised regression estimation (also known as GREG). This distance function is slightly modified to force weights to lie within certain bounds, with the aim of avoiding extreme weights.

The inverse selection probability is sometimes called the initial weight. The final, calibrated weights are sometimes expressed as: final weight = initial weight * g-weight. The 'g-weight' indicates the factor by which calibration has changed the initial weight.

Population benchmarks

The following population benchmarks are used in the NZHS weighting:

- age group (0–4, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–74, 75+ years) by gender (male, female) for all people
- age group (0–4, 5–9, 10–14, 15–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–64, 65+ years) by gender (male, female) for all Māori
- adult population by Pacific and non-Pacific
- adult population by Asian and non-Asian
- total population by NZDep2018 quintile.

Age, gender, ethnicity (Māori, Pacific, Asian, using self-identified total ethnicity) and socioeconomic position (NZDep2018) are included because these variables are related to many health conditions and to non-response, and they are a key output classification for the survey.

Quarterly calibration means that benchmarks are less detailed than would be possible if annual data sets were weighted. In particular, broader age groups are used for the Māori population benchmarks.

Benchmarks for the Māori population

Quarterly benchmarks for the Māori population are constructed for the NZHS by projecting forward the annual (mid-year) population estimates for Māori released by Statistics New Zealand.

Using the Māori population estimates and total population estimates as at 30 June, the proportion of the total population who are Māori is calculated for each five-year age-by-gender group. Then these proportions are applied to quarterly total population estimates, by age and gender, for the subsequent four quarters. For example, the proportion of each age-by-gender group who are Māori as at 30 June 2018 is used to construct estimates of the Māori population by age and gender in each of the quarters ending 30 September 2018, 31 December 2018, 31 March 2019 and 30 June 2019.

Benchmarks for the Pacific and Asian populations

Quarterly benchmarks for the adult Pacific and Asian populations are derived from Statistics New Zealand's Household Labour Force Survey. This large national survey of 15,000 households per quarter achieves a very high response rate (close to 90 percent).

The Household Labour Force Survey publishes quarterly estimates of the working-age (aged 15 years and over) Pacific and Asian populations. From these estimates, the proportions of the adult population who are Pacific and Asian are obtained for each quarter. Some of the quarter-to-quarter variation in these proportions is smoothed out by applying a moving average over the quarterly figures. The final smoothed proportions are applied to the total adult benchmark for the corresponding quarter to give quarterly benchmarks for Pacific and Asian adults.

Benchmarks for the NZDep2018 quintiles

Benchmarks for the quintiles of NZDep2018 are derived by dividing the latest total population figures (of all age groups) into five groups of equal size.

The calibration for the 2011/12 and 2012/13 surveys used benchmarks for the New Zealand Index of Deprivation 2006 (NZDep2006) based on 2006 Statistics New Zealand Census data. The surveys between 2013/14 and 2018/19 used NZDep2013 based on 2013 Census data, while the current survey has used NZDep2018.

Calibrating software and bounding of weights

The GREGWT SAS macro, developed by the Australian Bureau of Statistics, is used to calculate the calibrated weights. The input weights are the selection weights, first rescaled to sum to the overall population benchmark. Final weights are constrained to be less than or equal to the smaller of 2.5 times the input weight and 1625.

Jackknife replicate weights

The NZHS uses the delete-a-group jackknife method (Kott 2001) to calculate standard errors for survey estimates.

One hundred jackknife replicate weights are produced for every respondent in the survey, in addition to the final calibrated weight. Each replicate weight corresponds to removing a group of PSUs from the sample and reweighting the remaining sample. This is achieved using exactly the same approach that was used to construct the weights for the full sample, including calibration to the same population benchmarks.

For any weighted estimate calculated from the survey, 100 jackknife replicate estimates can also be calculated using the 100 jackknife weights. The standard error of the full sample estimate is based on the variation in the replicate estimates.

Prior to 2015/16, the assignment of meshblocks to jackknife replicate groups was done independently in separate survey years. With the introduction of PSUs in 2015/16 survey design, some PSUs in the area sample of one survey year were reused in the following survey year as well (see also 'Sample design' in the 'Survey population and sample design' section). Therefore, a given PSU is assigned to the same jackknife replicate group in each of the two consecutive years with repeat PSUs. This ensures that the resulting jackknife weights appropriately take into account the clustering of the sample when calculating jackknife variances for:

- differences of estimates between consecutive years (with repeat PSUs)
- estimates from pooled data across years.

A number of statistical analysis packages, including SAS, Stata and R, can calculate standard errors using jackknife weights.

Weights for measurement data

An additional set of estimation weights (and corresponding jackknife replicate weights) has been created specifically for analysing the measurements collected from respondents as part of the core NZHS interview. Height and weight measurements are obtained from around 94 percent of eligible adult and 90 percent of eligible child respondents. Because variables derived from height and weight are key outputs from the survey, it is useful to have this additional set of estimation weights to compensate for the non-response to these items.

The extra set of weights is calculated for the subset of respondents who have their height and weight measured. Creating these estimation weights follows exactly the same process as for the full sample. This consistent approach ensures that any bias due to lower participation in the measurement phase of the survey for particular demographic subgroups (such as age groups or ethnic groups) is accounted for in the final estimates for the survey.

These estimation weights are also used for analysis involving waist and blood pressure measurements. Waist and blood pressure measurements are obtained from almost all respondents who have had their height and weight measured.

Analysis methods

Estimating proportions, totals and means

Most statistics published in NZHS reports are proportions, totals or means; that is, survey estimates of:

- the proportion (or percentage) of people with a particular characteristic, such as a specific health condition, behaviour or outcome
- the total number of people with a particular characteristic
- the mean per person of some numeric quantity.

A description of the calculation method for each of these types of statistics follows. References to weights mean the final calibrated weights discussed in the 'Weighting' section.

Adjusting for item non-response

Before calculating proportions, totals or means for a particular variable, an adjustment is made to the final weights to account for respondents who answered with 'don't know' or 'refused' to the relevant question or questions.

The adjustment increases the final weights of the respondents who answered the question, to represent the final weights of the respondents who answered 'don't know' or 'refused'. This is carried out within cells defined by gender and age group (10-year age groups for adults and five-year age groups for children), therefore making use of some information on what type of respondents are more likely to be item non-respondents to the variable. Then the item non-respondents can be safely left out of the calculation of proportions, totals or means for the variable.

The adjustment is most important for totals to ensure that item non-response does not lead to underestimating the number of people who have a particular condition or behaviour. The effect will usually be very small for proportions and means; that is, proportions and means using the adjusted weights will be very similar to those using the final calibrated weights.

The adjustment is done 'on the fly' in the sense that the item-specific weights are created and used for estimating but are not kept on the survey data set.

Calculating proportions

The proportion of the population who belong to a particular group (such as the proportion of the population who have diabetes) is estimated by calculating the sum of the weights of the respondents in the group divided by the sum of the weights of all respondents.

The proportion of people in a population group who belong to a subgroup (such as the proportion of Māori who have diabetes) is estimated by calculating the sum of the weights of the respondents in the subgroup (Māori who have diabetes) divided by the sum of the weights of the respondents in the population group (Māori).

Calculating totals

Estimates of totals are given by calculating the sum, over all the respondents, of the weight multiplied by the variable of interest. For example, the estimate of the total number of people with diabetes in the whole population would be given by the sum, over all respondents, of the weight multiplied by a binary variable indicating which respondents have diabetes. This is equivalent to the sum of the weights of the respondents who have diabetes in the population.

Calculating means

Estimates of population averages, such as the average number of visits to a GP, are determined by calculating the sum, over all respondents, of the weight multiplied by the variable of interest divided by the sum of the weights.

Sometimes the average within a group is of interest; for example, the average number of visits to a GP by males. The estimate is given by calculating the sum over respondents in the group, of the weight multiplied by the variable of interest, divided by the sum of the weights of the respondents in the group.

Suppression of small sample sizes

Small samples can affect both the reliability and the confidentiality of results. Problems with reliability arise when the sample becomes too small to adequately represent the population from which it has been drawn. Problems with confidentiality can arise when it becomes possible to identify an individual; usually someone in a subgroup of the population within a small geographical area.

To ensure the survey data presented is reliable and the respondents' confidentiality is protected, data have only been presented when there are at least 30 people in the denominator (the population group being analysed). Care has been taken to ensure that no respondent can be identified in the results.

Comparing population groups

Age standardisation

NZHS reports mainly focus on presenting crude (unadjusted) estimates of the proportion or mean in the total population by age group (age-specific rates or means). However, age is an important determinant of health, so population groups with different age structures (such as men and women, whose age structures differ due to women's longer life expectancy) may have different rates or means due to these age differences. This means that comparisons of crude rates or means over time and between groups may be misleading if the age structure differs between the groups being compared.

One approach to making more meaningful comparisons between groups is to compare age-specific rates or means. Alternatively, it can be useful to summarise a set of age-specific rates or means for a group into a single age-independent measure. This is achieved by a process called **age standardisation**.

Age standardisation in NZHS reports is performed by **direct standardisation** using the World Health Organization (WHO) world population age distribution:

Age-standardization of Rates: A new WHO standard (Ahmad et al 2000). The direct method calculates an age-standardised rate (ASR), which is a weighted average of the age-specific rates, for each of the population groups to be compared. The weights applied represent the relative age distribution of the WHO population. This provides a single summary rate for each of the population groups being compared that reflects the rate that would have been expected if the group had had an age distribution identical to the WHO population.

The ASR is given by:

$$ASR = \sum r_i (n_i / \sum n_i),$$

where n_i is the population in the i^{th} age group of the standard population and r_i is the rate in the i^{th} age group from the survey.

Age-standardised rates are provided in some tables to help make comparisons by gender, ethnic group and neighbourhood deprivation and between survey years.

Results for children are age-standardised to the population younger than 15 years, and results for adults are age-standardised to the population aged 15 years and over.

The same approach is used to age-standardised estimates of means.

Adjusted rate ratios

NZHS reports also present comparisons between population groups as **rate ratios**; that is, as the ratio of the estimated proportions having the characteristic of interest in the two groups.

Rate ratios are used for comparing:

- men and women
- Māori and non-Māori (for the total population, men and women)
- Pacific and non-Pacific (for the total population, men and women)
- Asian and non-Asian (for the total population, men and women)
- people living in the most and least socioeconomically deprived areas
- disabled and non-disabled (for the total population).

In keeping with the use of total response ethnicity to present statistics by ethnic group, ethnic comparisons are presented such that Māori are compared with non-Māori, Pacific with non-Pacific and Asian with non-Asian. For this purpose, all respondents who identified as Māori are included in the Māori group; all other respondents are included in the non-Māori group. Similar groups are formed for Pacific and Asian ethnic groups.

Rate ratios can be interpreted in the following way:

- A value of 1 shows that there is no difference between the group of interest (for example, women) and the reference group (for example, men).
- A value higher than 1 shows that the proportion is higher for the group of interest than for the reference group.
- A value lower than 1 shows that the proportion is lower for the group of interest than for the reference group.

The rate ratios presented in NZHS reports are adjusted for differences in demographic factors between the groups being compared that may be influencing (confounding) the comparison. The adjustments are as follows:

- The gender comparison is adjusted for age.
- The ethnic comparisons are adjusted for age and gender.
- The deprivation comparison is adjusted for age, gender and ethnic group.

Adjusting for potential confounding factors makes comparisons more accurate and meaningful because the adjustment removes the effect of these confounding factors.

In the above comparisons, the comparison across neighbourhood deprivation is adjusted for ethnicity as well as age and gender. However, ethnic comparisons are adjusted for age and gender only; not for neighbourhood deprivation. This approach is used because ethnicity confounds the association between deprivation and health outcomes. By contrast, deprivation is only a mediator, not a confounder, of the association between ethnicity and health outcomes; that is, deprivation is on the path that links ethnicity to health outcomes. So, if ethnic comparisons were adjusted for deprivation, the analyses would not reflect the full independent effect of ethnicity but only that portion of the ethnic effect that is not mediated by the socioeconomic position of deprivation.

Adjusted rate ratios are calculated using the **predictive margins** approach of Korn and Graubard (1999), which Bieler et al (2010) call **model-adjusted risk ratios**. In this method:

- a logistic regression model is fitted to the data. The variable defining the groups to be compared, and the adjustment variables, are explanatory variables in the model
- the parameters of the fitted model are used to estimate the proportion with the characteristic of interest as if all the respondents belong to the group of interest (such as all male), but otherwise each respondent keeps their own values for the adjustment variables in the model (such as age). That is, the proportion being estimated is for a hypothetical population of men who have the same age distribution as the full sample
- in the same way, the parameters of the fitted model are used to estimate the proportion with the characteristic of interest as if all the respondents belong to the comparison group of interest (such as all female), but otherwise each respondent keeps their own values for the adjustment variables in the model (such as age). That is, the proportion being estimated is for a hypothetical population of women who have the same age distribution as the full sample
- once the model-adjusted proportions for the group of interest (men) and the comparison group (women) have been estimated in this way, their ratio can be calculated.

In the neighbourhood deprivation comparisons, the rate ratio refers to the **relative index of inequality** (Hayes and Barry 2002). This measure is used instead of simply comparing the most deprived quintile with the least deprived quintile. It is calculated by first using data from all quintiles to calculate a line of best fit (linear regression line), adjusted for age group, gender and ethnic group. The points on the regression line corresponding to the most and least deprived areas are used to calculate the rate ratio that is presented in the reports. This method has the advantage of using data from all the NZDep2018 quintiles to give an overall test for trend (gradient) by neighbourhood deprivation rather than only using the data from quintiles 1 and 5.

While total response ethnicity is used to report ethnic group statistics in the NZHS reports, a prioritised ethnicity variable is used when adjusting for ethnicity in the regression model underlying the relative index of inequality. Using prioritised ethnicity in the model simplifies the modelling process and gives results similar to including total response ethnicity variables in the model. The priority ordering of ethnic groups used is: Māori, Pacific, Asian, European/Other.

Confidence intervals and statistical tests

Ninety-five percent confidence intervals are used in NZHS reports to represent the sampling error associated with the statistics; that is, the uncertainty due to selecting a sample to estimate values for the entire population. A 95 percent confidence interval for a statistic is constructed in such a way that, under a hypothetical scenario where selecting the sample could be repeated many times, 95 percent of the confidence intervals constructed in this way would contain the true population value.

Calculating confidence intervals

In most cases, confidence intervals presented in NZHS reports are calculated using the usual normal approximation. The upper and lower limits of the 95 percent confidence interval are found by:

$$\text{estimate} \pm 1.96 \times \text{standard error of the estimate}$$

However, confidence intervals based on the normal approximation sometimes do not work well when estimating small proportions. In these cases, the symmetrical behaviour of these normal confidence intervals can be unrealistic and can even lead to confidence intervals containing negative values.

The Korn and Graubard (1998) method is used to calculate more appropriate confidence intervals where:

- the prevalence estimate is less than 5 percent or greater than 95 percent
- the lower confidence interval limit from the normal approximation results in a value less than 0 percent
- the upper confidence interval limit from the normal approximation results in a value greater than 100 percent.

In any of these circumstances, the Korn and Graubard confidence intervals can and should be asymmetrical.

Confidence intervals for percentiles such as medians are calculated using the Woodruff (1952) method.

Tests for statistically significant differences

Some analysts assess whether two estimates differ significantly by seeing whether their confidence intervals overlap or not. This procedure is known to be overly conservative, resulting in a substantial degrading of statistical power, with some significant differences incorrectly assessed as insignificant.

When confidence intervals do not overlap, it can be concluded that the estimates differ significantly. However, when they do overlap, it is still possible that there is a significant difference. In this case, a *t*-test is used to correctly test the statistical significance of differences between NZHS estimates.

Time trends

Where possible, the results of indicators presented in the current report are compared with the corresponding results from the previous years of the continuous NZHS (from 2011/12 onwards) and from the 2006/07 NZHS, to examine whether an indicator shows an increase or a decrease. This is referred to as 'time trends' in the annual report.

Testing the statistical significance of changes over time is based on age-standardised statistics.

New Zealand Health Survey 2019/20

This section provides some field-related information specific to the data collection and analysis of the NZHS 2019/20. The appendix contains some relevant information on the survey carried out in 2006/07.

2019/20 module topics

Table 2 outlines the NZHS 2019/20 module topics.

Table 2: New Zealand Health Survey 2019/20 module topics

Adult module topics	Child module topics
Food security	Food security
Dietary habits	Dietary habits
Alcohol use	

For details about the questionnaires used in the 2019/20 NZHS, see the Ministry webpage: www.health.govt.nz/publication/content-guide-2019-20-new-zealand-health-survey.

Data collection

The 2019/20 NZHS refers to the sample selected from 1 July 2019 to end of March 2020; interviews were completed between mid-July 2019 and 19 March 2020. The data collection was suspended after 19 March 2020 due to COVID-19 restrictions.

A total of 9,699 adults and 3,290 children took part in the 2019/20 NZHS. Table 3 shows the number of respondents selected in each quarter.

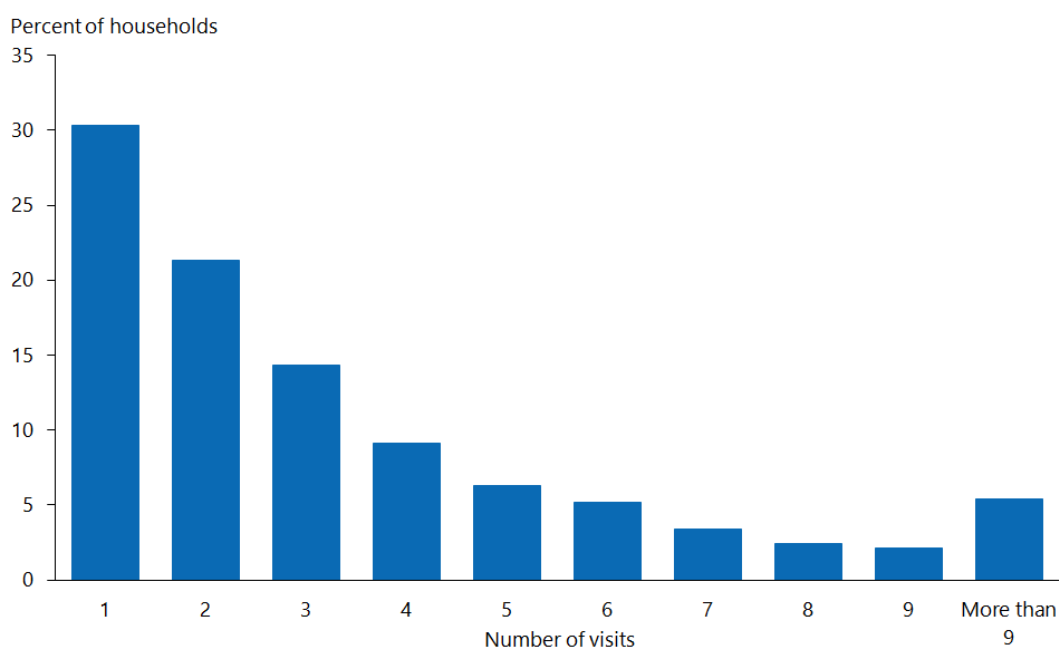
Table 3: Number of survey respondents by quarter, 2019/20

	Adults		Children	
	Number	Percentage of total respondents	Number	Percentage of total respondents
Quarter 1 (July–September 2019)	3,358	35	1,123	34
Quarter 2 (October–December 2019)	3,353	34	1,148	35
Quarter 3 (January–March 2020)	2,988	31	1,019	31
Quarter 4 (April–June 2020) (Suspended due to COVID-19)	-	-	-	-
Total (July 2019–March 2020)	9,699	100	3,290	100

Visit pattern

The visit pattern (as described in the ‘Data collection’ section above) used in the NZHS is an important part of achieving a high response rate. Interviewers followed a proven visit approach also used in 2018/19, visiting PSUs at different times and on different days depending on the area. For about 95 percent of households, the first (or only) interview took place within nine visits (Figure 1).

Figure 1: Proportion of households agreeing to first interview, by number of visits, 2019/20



Impact of shortened data collection (COVID-19)

Due to COVID-19 restrictions, data collection was suspended at the end of quarter 3; the published figures for 2019/20 are based on the data collected in the first three quarters only.

One impact of the shortened data-collection period is that the 2019/20 statistics are based on a smaller sample size than previous years. This means that most 2019/20 statistics will have wider confidence intervals than in previous years, and movements in the statistics between previous years and 2019/20 will be less likely to be detected as statistically significant changes. As the 2019/20 sample size is around 25 percent smaller, users can expect the confidence intervals on the statistics to be around 15 percent wider. The smaller sample size may also mean that more subgroup statistics will be suppressed this year, where subgroups of the population have fewer than 30 respondents (see 'Suppression of small sample sizes' in the 'Analysis methods' section above).

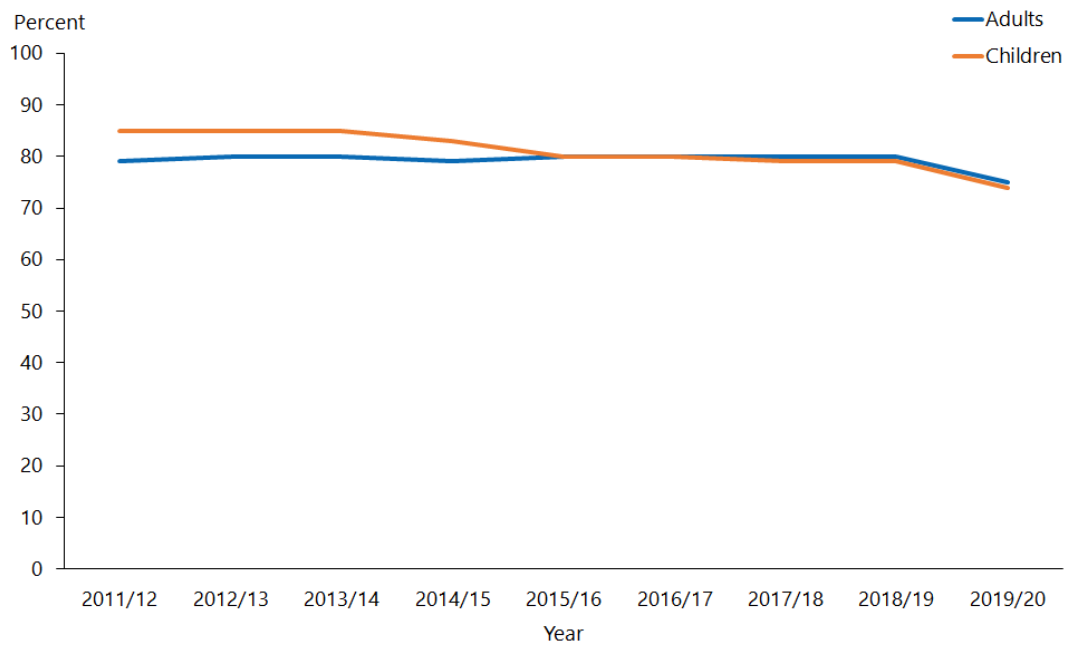
A second impact is that, unlike in previous years, the 2019/20 data does not cover the whole July to June year. This means that statistics for some indicators that tend to show strong seasonal patterns may be less comparable with previous years. An investigation of the 2011/12 to 2017/18 data by quarter showed that most indicators have little or no seasonal variation. The indicators that show significant seasonal variation are listed under the 'Methodology' section of the annual data explorer 2019/20 (https://minhealthnz.shinyapps.io/nz-health-survey-2019-20-annual-data-explorer/_w_868967f4/#!/methodology). For those indicators, users should be more cautious about interpreting movements between previous years and 2019/20.

A third impact is the lower response rates for 2019/20 compared to previous years (See the 'Response rates' section below) due to data collection being suspended abruptly.

Response rates

The NZHS is well received by the public. The 2019/20 weighted response rate was 75 percent for adults and 74 percent for children. These figures are lower compared to the previous years due to data collection being suspended abruptly. Figure 2 shows the time trend of response rates of adults and children from 2011/12 to the current survey year, 2019/20.

Figure 2: Response rates for adults and children, 2011/12 to 2019/20



Coverage rates

In 2019/20, the coverage rates were 62 percent for adults and 72 percent for children. Figure 3 shows the time trend of coverage rates of adults and children from 2011/12 to the current survey year, 2019/20.

Figure 3: Coverage rates for adults and children, 2011/12 to 2019/20

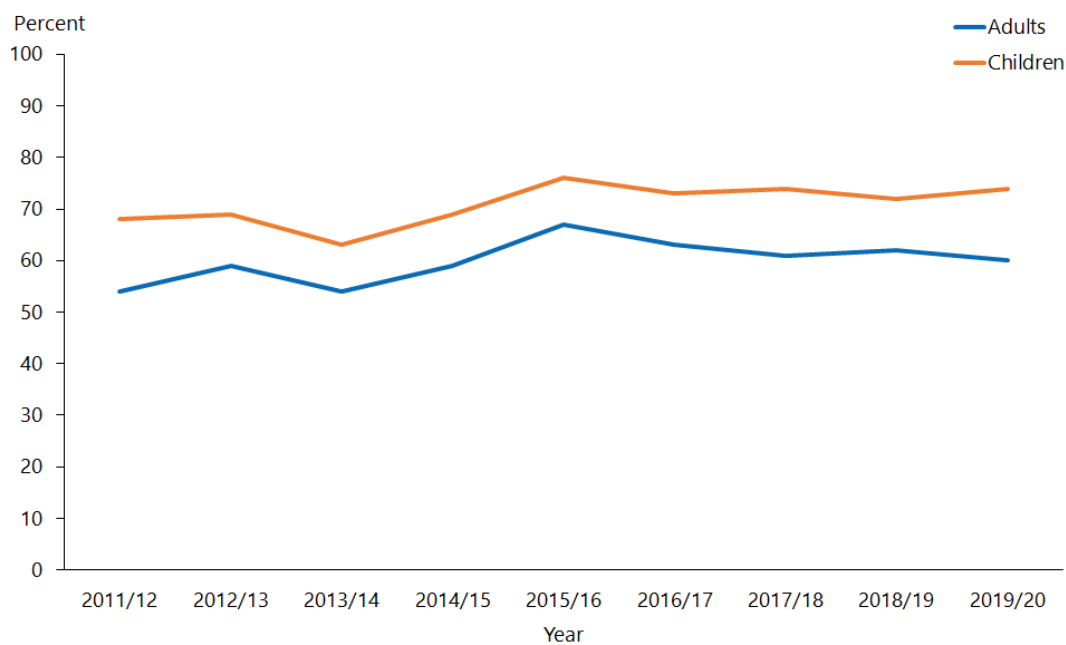
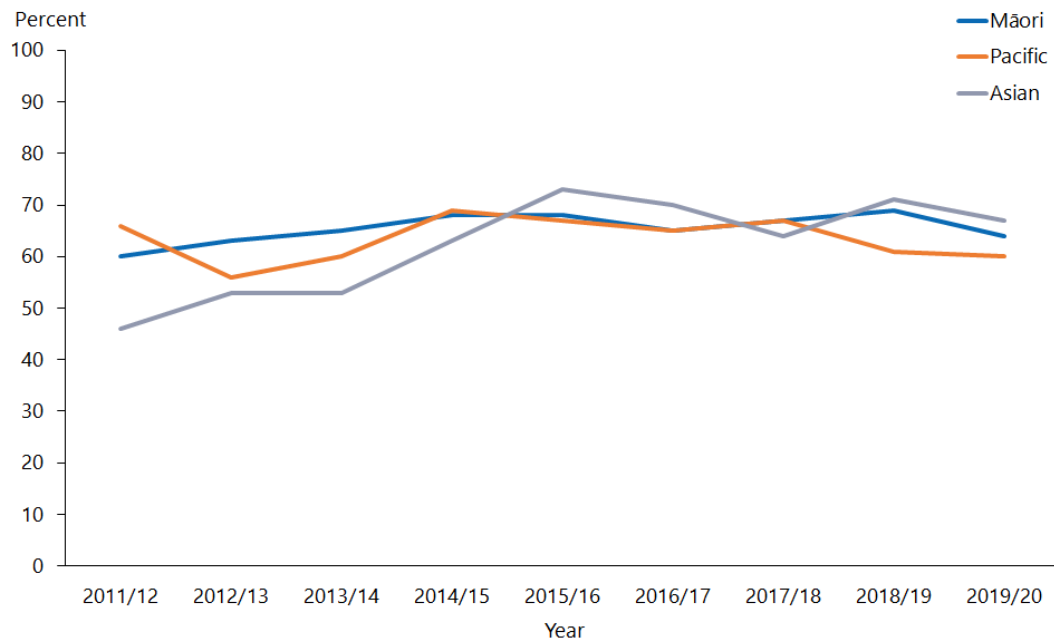


Figure 3 clearly shows that coverage rates for children have been high across all years since 2011/12.

In 2019/20, the coverage rates were 69 percent for Māori, 61 percent for Pacific people and 71 percent for Asian people. Figure 4 shows the time trend of coverage rates for the Māori, Pacific and Asian ethnic groups from 2011/12 to the current survey year, 2019/20.

Figure 4: Coverage rates for Māori, Pacific and Asian groups, 2011/12 to 2019/20



In 2019/20, the coverage rates for neighbourhood deprivation quintiles were 71 percent (NZDep Quintile 1), 65 percent (NZDep Quintile 2), 63 percent (NZDep Quintile 3) and 60 percent (for both NZDep Quintile 4 and NZDep Quintile 5). Figure 5 shows the time trend figures for NZDep Quintile 1 to NZDep Quintile 5 from 2011/12 to the current survey year, 2019/20.

Figure 5: Coverage rates by New Zealand Index of Deprivation quintiles, 2011/12 to 2019/20

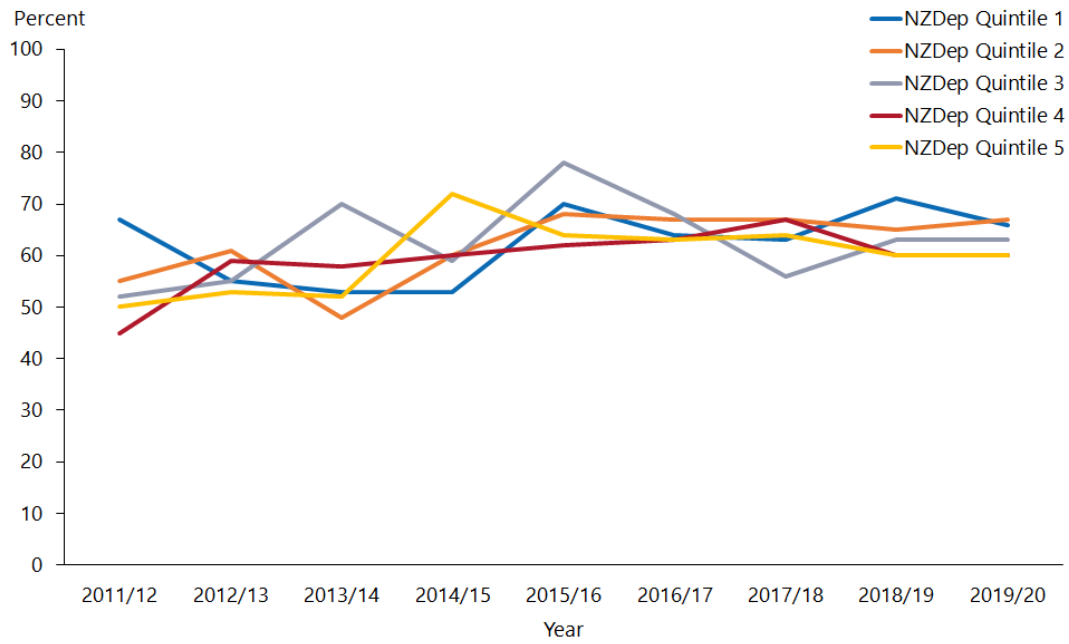


Figure 6 and Figure 7 show the coverage rates by age and gender for 2019/20 for the total population and Māori respectively.

Figure 6: Coverage rates for total population, by age group and gender, 2019/20

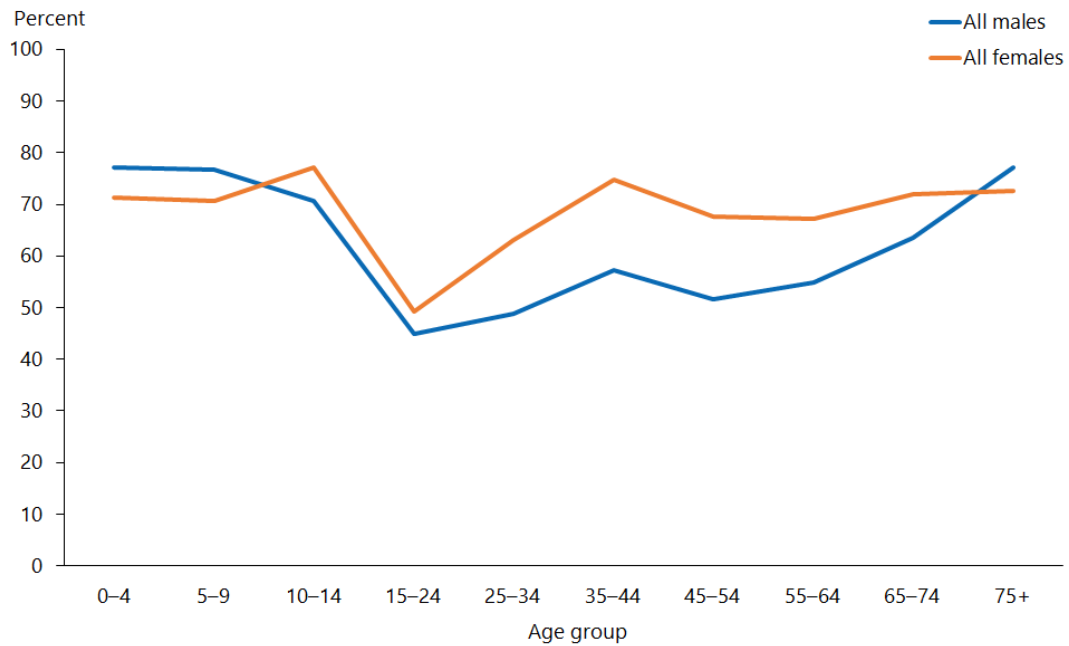
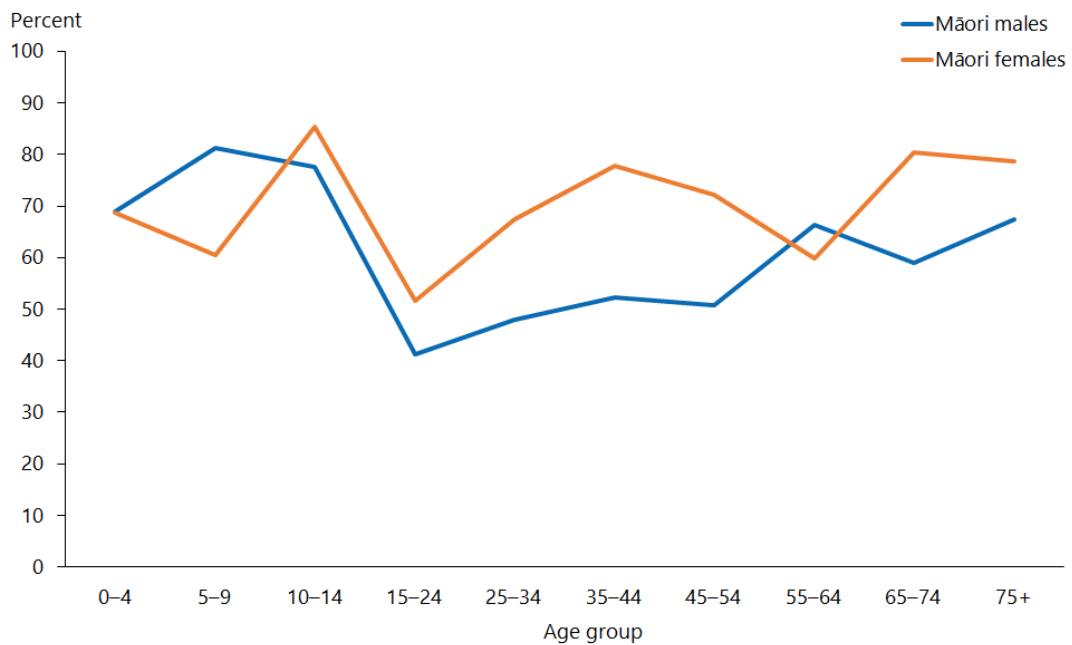


Figure 7: Coverage rates for Māori, by age group and gender, 2019/20



Final weights

The section on weighting has explained how the calibrated weights were calculated. Table 4 gives basic descriptive information on the final weights calculated for the 2019/20 survey.

The g-weights are the ratios of the final weights to the initial selection weights. The mean g-weight is approximately 1.8, which can be considered as reasonable. This means the calibrated weights, which were calculated using population benchmark information, have changed the initial selection weight by an average factor of 1.8.

Table 4: Final weights 2019/20

	Final weight
Minimum	27
Median	301
90th percentile	856
95th percentile	1,133
99th percentile	1,907
Maximum	2,167
Coefficient of variation (CV%)	86.9
Approximate design effect due to weighting (1 + CV ²)	1.8

Sample sizes

Table 5 to Table 9 show the 2019/20 NZHS sample sizes and the total 'usually resident' population counts, by gender, ethnicity, age, NZDep2018 quintile and disability status.

Table 5: Sample sizes and population counts for children and adults, by gender, 2019/20

Population group	Gender	Interviews	Measurements* (2+ years)	Population count
Children (0–14 years)	Boys	1,693	1,244	495,190
	Girls	1,597	1,181	469,640
	Total	3,290	2,425	964,830
Adults (15 years and over)	Men	4,060	3,838	1,951,610
	Women	5,639	5,050	2,053,637
	Total	9,699	8,888	4,005,247

* These numbers are based on the number of respondents with valid height and weight measurements, and they exclude 135 pregnant women not eligible to be measured.

Table 6: Sample sizes and population counts for children and adults, by ethnic group, 2019/20

Ethnic group (total response)	Population group	Interviews	Measurements* (2+ years)	Population count
European/Other	Children	2,243	1,677	686,111
	Adults	7,406	6,800	3,034,573
Māori	Children	1,155	833	242,533
	Adults	1,906	1,710	505,773
Pacific	Children	491	364	130,896
	Adults	613	567	264,667
Asian	Children	537	374	170,604
	Adults	1,018	953	582,667

* These numbers are based on the number of respondents with valid height and weight measurements, and they exclude 135 pregnant women not eligible to be measured.

Table 7: Sample sizes and population counts, by age group, 2019/20

Age group (years)	Interviews	Measurements* (2+ years)	Population count
0–4	1,124	495	306,553
5–9	1,116	949	328,697
10–14	1,050	981	329,580
15–24	893	821	653,983
25–34	1,555	1,391	710,380
35–44	1,552	1,419	616,087
45–54	1,483	1,377	640,470
55–64	1,542	1,413	601,120
65–74	1,459	1,360	453,593
75 and over	1,215	1,107	329,613

* These numbers are based on the number of respondents with valid height and weight measurements, and they exclude 135 pregnant women not eligible to be measured.

Table 8: Sample sizes and population counts, by NZDep2018 quintile, 2019/20

NZDep2018 quintile	Population group	Interviews	Measurements* (2+ years)	Population count
Quintile 1 (least deprived neighbourhoods)	Children	435	338	186,101
	Adults	1,370	1,268	807,915
Quintile 2	Children	535	415	177,719
	Adults	1,583	1,481	816,296
Quintile 3	Children	599	455	184,400
	Adults	1,857	1,712	809,615
Quintile 4	Children	731	523	190,841
	Adults	2,231	2,032	803,175
Quintile 5 (most deprived neighbourhoods)	Children	990	694	225,769
	Adults	2,658	2,395	768,246

* These numbers are based on the number of respondents with valid height and weight measurements, and they exclude 135 pregnant women not eligible to be measured.

Table 9: Sample sizes and population counts, by disability status and gender, 2019/20

Disability status	Gender	Interviews	Population count
Disabled	Men	427	139,456
	Women	648	178,250
Non-disabled	Men	3,626	1,809,516
	Women	4,981	1,870,344

Errors in previously published statistics

This section notifies NZHS users about errors in the statistics published in previous annual reports or in the *Annual Data Explorers*. These errors occurred as a result of independent events at different stages of the survey process, which are explained below. Removal of the data or revisions to the data and statistics have been made in the current publication.

Years 5 to 7 child body size indicators

The statistics for all child body size indicators were revised for survey years 5 to 7 (2015/16 to 2017/18). Child body size indicators are: mean weight (kg), mean height (cm), mean BMI (kg/m²), thin, healthy weight, overweight (but not obese), obese, obese class 1, obese class 2 or 3, overweight or obese, mean waist (cm), and waist to height ratio ≥ 0.5 .

Statistics were revised because one interviewer was found not to be following the correct measurement protocol in children. Although the interviewer had completed a small proportion of all surveys, the error led to the national prevalence of obesity in children being overstated by one percentage point for years 6 and 7 (2016/17 and 2017/18) and half a percentage point for year 5 (2015/16).

Several options for correcting the data were explored, including bias correction, imputation (donor and statistical modelling) and removing the surveyor's child body size data and reweighting the remaining sample. The last option was recommended because it would give robust results at a national level and could be implemented quickly (Clark 2019).

The revised national estimates of child body size for 2015/16, 2016/17 and 2017/18 were included in *Annual Update of Key Results 2019/20: New Zealand Health Survey* (Ministry of Health 2019b).

Years 1 to 6 child indicator – television watching

The definition of the child television watching indicator reported in years 1–6 of the NZHS was inaccurate. Television watching is defined for children (aged 2–14 years) as watching two or more hours of television per day (averaged over a week). However, it was discovered that the code of the software programme mistakenly recorded 1½ hours or more of television watching per day, rather than two or more hours per day.

The television watching indicator has been removed from the *Annual Data Explorer* from year 7 (2017/18) onwards. This is because there has been more focus on the child screen-watching indicators, which capture not only television watching but also other screen-time activities (not including time spent looking at screens at school or for homework), making them more relevant than an indicator for television watching alone.

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Appendix:

2006/07 New Zealand Health Survey

The *Annual Data Explorer*, published on the Ministry's website www.health.govt.nz, compares results from the current NZHS with those from the 2011/12 NZHS, as this marked the beginning of the continuous survey design and the commencement of fieldwork by the current survey provider. However, the *Annual Data Explorer* also publishes results from the survey preceding the continuous survey, conducted in 2006/07. This appendix gives a brief description of the 2006/07 survey.

The target population for the 2006/07 NZHS was the usually resident civilian population of all ages living in permanent private dwellings in New Zealand. An area-based frame of Statistics New Zealand meshblocks was used as the sample frame. Māori, Pacific and Asian peoples were oversampled.

Data was collected from October 2006 to the end of November 2007 using computer-assisted, face-to-face interviewing. The total response rate for the survey was 68 percent for adults and 71 percent for children. A total of 12,488 adults and 4,921 children took part in the survey. The survey included 11,632 European/Other people, 5,143 Māori, 1,831 Pacific people and 2,255 Asian people of all ages.

For full details on the methodology of the 2006/07 NZHS, see *A Portrait of Health: Key results of the 2006/07 New Zealand Health Survey* (Ministry of Health 2008).