The Bowel Screening Pilot:

Results of the First 18 Months of Round One

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DISCLAIMER

The data analysed in this report were supplied to the Centre for Public Health Research, Massey University by the Ministry of Health. The data sources are the Bowel Screening Pilot Register and the Waitemata District Health Board.

The Centre for Public Health Research accepts no liability or responsibility for the data or its use.

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Acknowledgements

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[1] Professor Steve Haslett reviewed the Appendix BSP Methodology and Analysis.

Executive Summary

Introduction

A bowel cancer screening pilot (BSP) programme using an immunochemical faecal occult blood test (iFOBT) commenced in January 2012 among 50-74 year olds living in the Waitemata District Health Board area. This report is based on the participation in, and outcomes from, the first 18 months of the first screening round.

The results take into account the effects of all demographic factors other than the one under consideration. For example, when considering participation by age group, the results have been adjusted to take account of the potential effects of sex, ethnicity and deprivation (NZDep2006). Unless otherwise stated, all results are statistically significant.

Participation

The participation rate[2] of eligible people was 53.5% (n=46,409). The Ministry of Health's target is 60% by the end of the four year BSP.

Participation increased with increasing age. Males were slightly less likely to participate than females.

Participation was highest among Europeans (60.3%), followed by Asians (51.3%), 'Other' (43.1%), Māori (42.0%) and Pacific people (23.8%).

Participation declined with increasing deprivation.

Colonoscopy uptake was 86.1%. The uptake rate is an under-estimate because private colonoscopy data were not included.

Colonoscopy uptake was higher among males (87.3%) compared with females (84.4%).

Colonoscopy uptake was less likely among Asians aged 50-59 years (81.1%) than Europeans of the same age (88.3%).

Colonoscopy uptake increased with increasing deprivation.

Outcomes

Seven percent of those who returned an adequate kit had a positive iFOBT result.

Test positivity increased with increasing age. Males were more likely to have a positive iFOBT result than females.

Māori were slightly more likely to have a positive iFOBT result than Europeans.

[2] This is a proportion rather than a rate which is occurrence per unit time. "Rate" has been used synonymously with "proportion" in this report to improve readability.

Positivity was more likely with increasing deprivation.

The overall detection rate for adenoma was 3.4%, advanced adenoma was 1.9%, and cancer was 0.2%.

The detection rate per iFOBT for adenoma, advanced adenoma and cancer increased with increasing age. Males were more likely to have an adenoma, advanced adenoma, or cancer detected than females.

Māori aged 60-69 years were more likely to have an adenoma detected than Europeans of the same age.

Māori were more likely to have an advanced adenoma detected than Europeans.

Asians were less likely to have an advanced adenoma detected than Europeans.

Participants from the most deprived areas were more likely to have an adenoma or advanced adenoma detected than participants from the least deprived area. This was also found when participants with advanced adenoma were combined with those with cancer.

Forty-eight per cent of people who had a positive iFOBT had an adenoma detected, 26.9% had an advanced adenoma, and 2.9% had cancer detected. The positive predictive value of a positive iFOBT for cancer of 2.9% is below the range reported internationally in the first screening round of population-based programmes that use the iFOBT (Moss et al 2010; Major et al 2013).

There were some age, sex and ethnic differences in the effectiveness of a positive iFOBT in detecting adenoma, advanced adenoma and cancer.

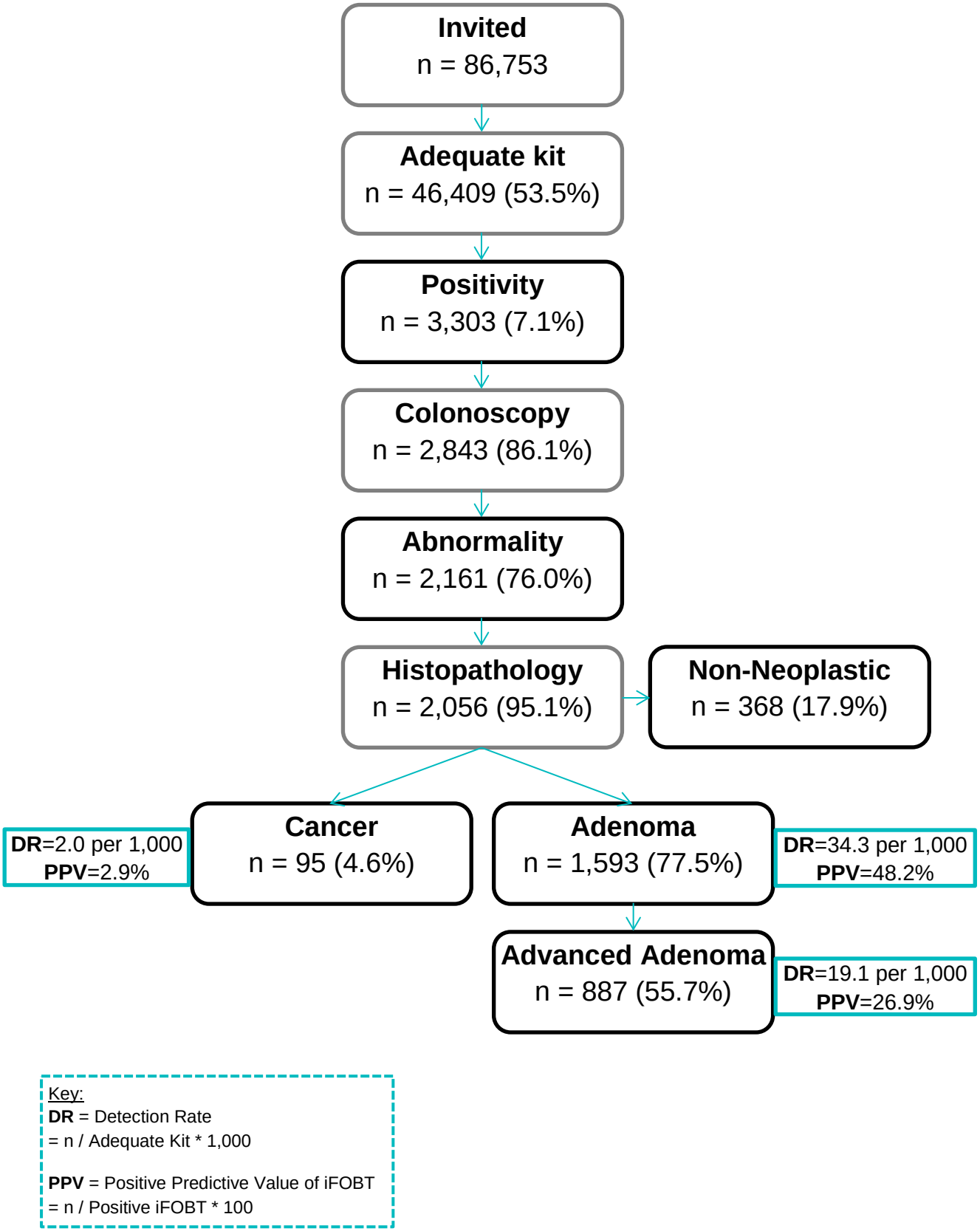
Figure 1 summarises the key findings for those participants who had a positive iFOBT, a completed colonoscopy in the public system, and histopathology results available by the end of October 2013. Some of these participants would have had more than one type of pathology; only the most serious type was recorded.

Ninety-five participants had cancer detected (2.0 per 1,000 screened). Eighty were European, 12 were Asian, 2 were Māori and none was Pacific.

The cancer detection rate increased with increasing age. Males were almost twice as likely to have cancer as females.

Almost 39% (n=37) of those participants with cancer detected had Stage I, the least advanced, and 8.4% (n=8) had Stage IV, the most advanced.

Figure 1: Summary of Bowel Screening Pilot outcomes



The self-selected population (n=1,895) were analysed separately and are not included in Figure 1. This population comprised people in the eligible population who were not on the BSP Register but who requested screening, and people on the BSP Register who requested screening before they were invited. Unlike the non-self-selected population, there was no statistically significant difference in participation between males and females, and participation was higher among people living in the middle deprivation areas rather than the least deprived areas. This may explain the higher positivity (9.3%) and detection rates for all outcomes for the self-selected group. It is also possible that this group included people who were symptomatic, and therefore motivated to self-select. Eleven people from this group, all European, had cancer detected.

Forty-nine participants were readmitted after their colonoscopy[3]. The most common causes for readmission were bleeding (n=31), abdominal pain (n=7) and perforation (n=5).

The perforation rate was 1.2 per 1,000 colonoscopies and the bleeding rate was 7.7 per 1,000 colonoscopies[4]. There were no colonoscopy-related deaths.

Different definitions for adverse events, particularly for bleeding and follow up periods, make direct comparisons with international data difficult. Complications are more likely following polypectomy. The data supplied did not allow reliable calculation of rates for colonoscopies with polypectomy.

Conclusions

We recommend that the Ministry of Health comprehensively review the BSP Register and implement a robust data quality assurance programme. The evaluation has identified data quality issues that must be addressed as a high priority for the final evaluation and a national programme. Data quality issues include data definition, data inconsistencies, errors and data capture.

A further high priority is to address the low participation among people living in the most deprived areas. More disease was found in this population group, irrespective of age, sex and ethnicity.

Further strategies are also needed to promote the BSP among the other low-uptake groups: Māori, males, Pacific people, and younger age groups. Māori were slightly more likely to have a positive iFOBT result than Europeans and there was suggestive evidence they were more likely to have disease[5]. Males of all ages were more likely to have adenomas and advanced adenomas, and at older ages to have cancer, than females. Pacific people's participation was the lowest, although they were less likely than Europeans to have disease, irrespective of their age, sex and deprivation.

[3] The denominator for readmissions is all colonoscopies (n=4,001), not just publicly funded colonoscopies (n=2,843 Figure 1), as this was how the readmissions data was supplied to CPHR.
[4] See Adverse events p30-31 for comparisons with reported data from other programmes.
[5] Disease refers to "neoplasia" (adenomas and colorectal cancer).

Introduction

Colorectal cancer incidence and mortality is high in New Zealand by international standards (National Cancer Institute 2013). In 2010 colorectal cancer was one of the two most common cancers registered and the second most common cause of death from cancer (Ministry of Health 2013). Although the age-standardised registration rate is less for Māori than non-Māori, Robson et al (2006) found differences in stage at diagnosis and survival. Early detection and removal of colorectal cancer or its precursor lesion, adenoma, by population screening can reduce colorectal cancer mortality (Towler et al 1998).

The Ministry of Health (the Ministry) has funded Waitemata District Health Board (WDHB) to run a bowel cancer screening pilot (BSP) programme over four years from 2012–15. The BSP began with a 'soft launch' in late 2011, with full operation starting from 1 January 2012.

The BSP offers eligible people, aged between 50-74 years living in the WDHB area, colorectal cancer screening by a single sample immunochemical faecal occult blood test (iFOBT), with colonoscopy as the diagnostic test. Colonoscopy with polypectomy also provides a therapeutic intervention that can prevent colorectal cancer.

Epidemiological analysis of data from the first screening round was carried out to inform the evaluation of the BSP by Litmus, the results of which will contribute to a decision in 2016 on whether or not to implement a national bowel screening programme.

Methods

The scope of the epidemiological analysis was approved by the Ministry of Health. It was based on the evaluation of the United Kingdom (UK) bowel cancer screening pilot (Weller et al 2007).

The data were extracted by the Ministry of Health from the BSP Register and WDHB.

The results represent the first 18-22 months of the first (or prevalence) screening round. The first screening round commenced on 1 January 2012 and was completed on 31 December 2013. The full screening round could not be analysed due to the timing of data extraction and the need to allow sufficient time to pass for those people who were invited in the latter half of 2013 to complete the full screening pathway. Figure 1 of the Appendix shows the possible pathway process of a participant in the BSP.

For details of the methodology, including definitions, and results, see the Appendix.

This analysis allows four months from the time of invitation for the full screening pathway to be completed.

Logistic regression has been used to investigate associations between demographic variables and screening outcomes. The results are given in the Appendix as odds ratios,

both unadjusted and adjusted for all other demographic variables, with 95% confidence intervals.

Key findings are presented and only counts and percentages together with the adjusted odds ratios are discussed. Adjusted odds ratios allow for the effects of all demographic variables other than the one under consideration. For example, when considering participation by age group, the results have been adjusted to take account of the potential effects of sex, ethnicity and deprivation (NZDep2006).

Unless otherwise stated, the results discussed here are statistically significant[6].

Results for the self-selected population are presented separately.

The results sections for participation and the various outcomes are each followed by a discussion section that focuses on relevant comparisons with population-based screening programmes in other countries.

Participation

Immunochemical faecal occult blood test (iFOBT) uptake

During the first 18 months of the first screening round, 86,753 eligible people aged 50-74 years living in the WDHB area were invited to participate. This is the denominator population used in the analysis. For all demographic information about the eligible population see the Appendix, Table 1. Details of the exclusion criteria applied to determine the eligible population are also in the Appendix[7].

About 55% (n=47,310) of those who received an invitation responded by returning a completed kit. The majority (n=46,409; 98%) returned an adequate kit resulting in a participation rate of 53.5%. About 17% of participants required more than one attempt, and some up to five attempts, to achieve an adequate kit[8].

The *European guidelines for quality assurance in colorectal cancer screening and diagnosis* (European guidelines) regard less than 3% inadequate kits as acceptable and less than 1% as desirable (Moss et al 2010). The BSP meets the acceptable level.

At least 1,456 of those invited did not respond because of an 'invalid/not found' address. This represents 3.3% of non-responders.

For all results see the Appendix, Table 2a.

[6] The result is deemed to be statistically significant if the 95% confidence interval of the odds ratio does not include 1.
[7] There were 7,662 people who were deemed ineligible as they met at least one exclusion criteria.
[8] The inadequate kit return rate is expected to fall as a result of introducing a revised consent form and simpler instructions in 2014.

Participation increased with increasing age

People aged 65-69 and 70-74 years were more than twice as likely to participate as people aged 50-54 years (Figure 6).

Participation differed by sex and ethnicity

Males were slightly less likely to participate than females (Figure 7). This difference decreased with increasing age.

Participation was highest among Europeans (60.3%), followed by Asians (51.3%), 'Other' (43.1%), Māori (42.0%) and Pacific people (23.8%).

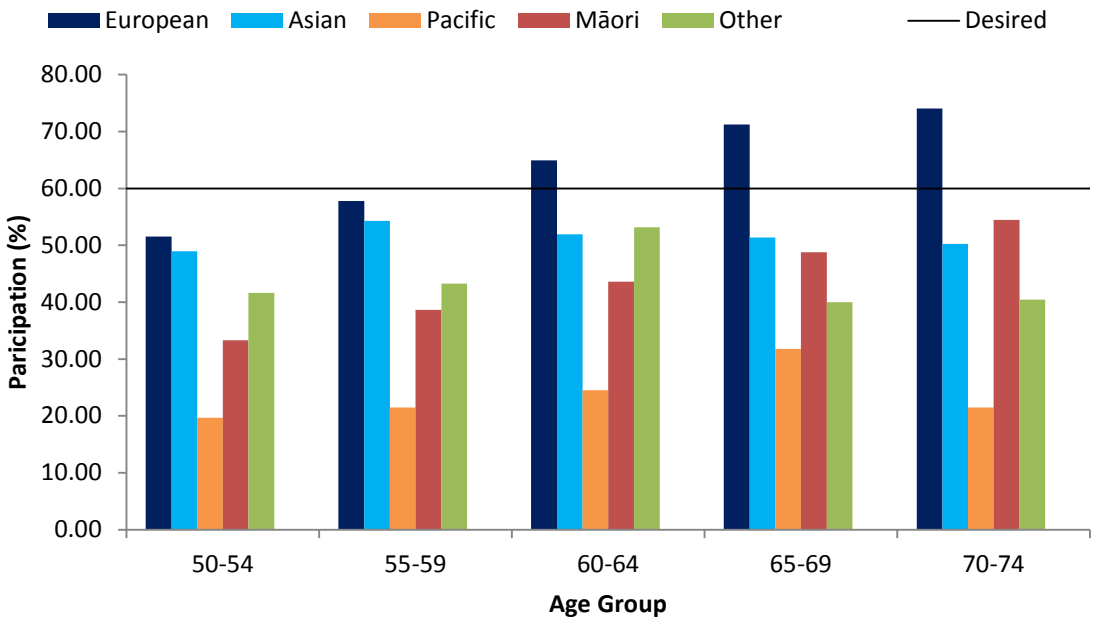
Asians were slightly less likely to participate than Europeans (Figure 4). Participation was close to that of Europeans for those aged 50-59 years but Asians aged 70-74 years were about half as likely to participate as Europeans of the same age.

Pacific people were about four times less likely to participate than Europeans (Figure 4). In the 70-74 year age group, Pacific people were seven times less likely to participate than Europeans of the same age.

Māori were almost half as likely to participate as Europeans (Figure 4). This difference was similar for each age group.

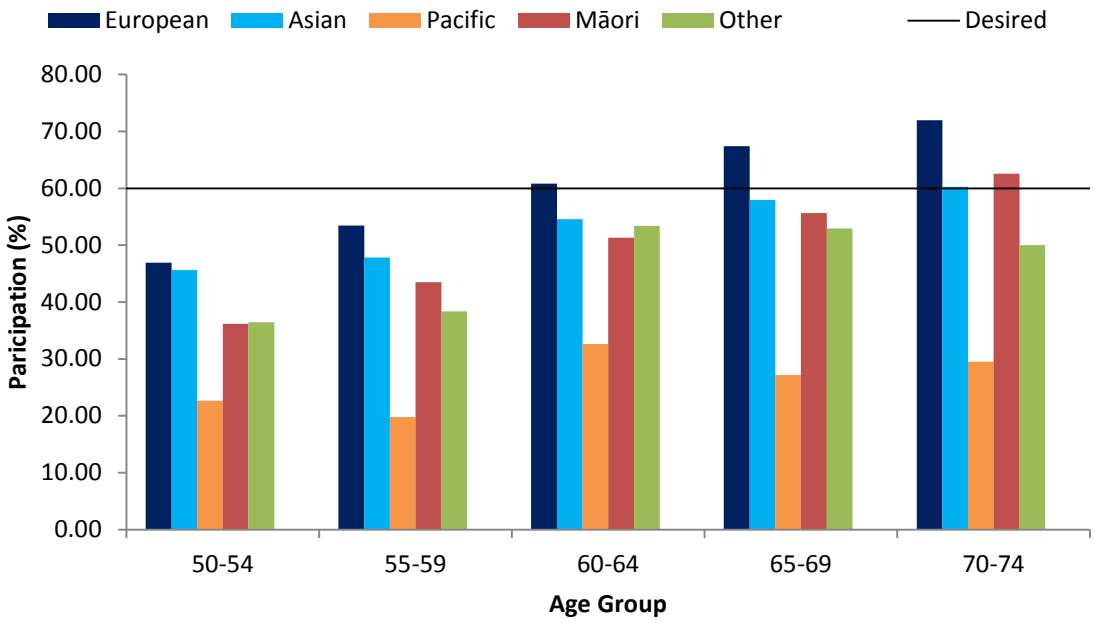
Figures 2 and 3 show the participation of females and males respectively, for each age and ethnic group. European females and males aged 60-74 years, and Asian and Māori males aged 70-74 years met the Ministry's 60% participation target.

Figure 2: Female participation by age and ethnicity



Source: BSP Register

Figure 3: Male participation by age and ethnicity



Source: BSP Register

Participation declined with increasing deprivation

Participation among people from the most deprived quintile area (NZDep Index 9-10) was more than 1.5 times less likely than people from the least deprived quintile area (NZDep Index 1-2) (Figure 5).

Discussion

The success of screening depends on participation. The overall participation rate of 53.5% is below the Ministry's target of 60% by the end of the BSP, but higher than the Australian pilot of 45.4%[9] and the early stages of implementation in Canada (16.1%) (BCSPMESC 2005; Major et al 2013). The Australian pilot did not include 50-54 year olds and no exclusion criteria applied to people living in a pilot site in the relevant age group (BCSPMESC 2005).

The BSP participation rate is similar to the first round of the UK pilot in Scotland (53%), but below that in England of 61%[10] (Steele et al 2010; Weller et al 2007). Participation in the UK pilot may have been higher if the older age group (70-74 years) had been included.

Participation has been found to be higher when the iFOBT is used rather than the guaiac faecal occult blood test (Hol et al 2009). Both Australia and Canada used the iFOBT.

[9] This is the average participation for the two iFOBTs combined that were compared in the Australian pilot. The participation rate was 47.2% for the Magstream and 43.6% for the InSure iFOBT.
[10] Uptake was 58.5% before exclusion criteria were applied.

The European guidelines set a minimum uptake level of 45% as acceptable and recommend at least 65% as desirable (Moss et al 2010). The BSP meets the acceptable level.

Lower participation among males and those from more deprived areas was also found in the Australian pilot. Participation tended to be lower for Aboriginal and Torres Strait Islander people and for people who spoke a language other than English (BCSPMESC 2005).

Lower participation among younger age groups, males, those from more deprived areas and from the Indian sub-continent were also found in the UK pilot, and among younger age groups and males in Canada (Weller et al 2003; Major et al 2013).

Colonoscopy uptake

Of the participants who returned an adequate kit in the first 22 months of the first screening round, 6.1% (n=2,843) had a publicly funded colonoscopy. The outcomes in this report are only for this group (n=2,843) due to uncertainty about data quality, including data completeness, for those participants who opted for a privately funded colonoscopy. Information on private colonoscopy was not included in the UK pilot evaluation (Weller et al 2003).

Almost 11% (n=356) of those with a positive iFOBT were subsequently recorded as being outside the public system. At least 184 of these participants had a privately funded colonoscopy. The data are uncertain for the other 171 participants. It is not clear whether they indicated intent to have privately funded colonoscopy but had not yet done so, had private colonoscopy locally but the results were not available or had not been entered into the BSP, or were going overseas eg, Asia, or outside the WDHB area for colonoscopy.

The number of participants with a positive iFOBT who declined colonoscopy is uncertain due to data quality issues. For example, two participants who 'declined' were also entered as having had a publicly funded colonoscopy with histopathology results. Reasons for declining that were entered in the free text indicated a few people were ineligible to be part of the BSP based on residence and previous colonoscopy.

Of those participants who had a positive iFOBT in the first 22 months of the first screening round (n=3,303), 86.1 % had a colonoscopy in the public system. The colonoscopy was not completed in 0.6% of cases. Seventy-six percent (n=2,161) of colonoscopies had abnormal results.

Thirty-nine (1.2%) participants with a positive iFOBT had CT colonography[11].

For all results see the Appendix, Table 2b.

[11] CT colonography, sometimes called virtual colonoscopy, is a radiological procedure that uses a CT scanner to visualise the bowel.

Colonoscopy uptake differed by sex and Asian ethnicity

Males were slightly more likely to have a colonoscopy than females. Males aged 70-74 years were more than twice as likely to have a colonoscopy as females of the same age.

Asians aged 50-59 years were half as likely to have a colonoscopy as Europeans of the same age.

Colonoscopy uptake increased with increasing deprivation

Colonoscopy uptake among people from the most deprived quintile areas (NZDep Index 7-8 and 9-10) was twice as likely as people from the least deprived quintile area (NZDep Index 1-2).

Discussion

The colonoscopy uptake rate of 86.1% is consistent with the 87% achieved in Scotland (Steele et al 2010). The BSP colonoscopy uptake rate is an under-estimate because of the exclusion of private colonoscopy data. The BSP rate is higher than uptake in England and Canada, both of which report 80.5%, although private colonoscopy data were not available to Weller *et al* so uptake in England may have been higher (Weller et al 2007; Major et al 2013). The high rate of missing data on the Australian register meant the reported colonoscopy uptake was only 55% in the pilot (BCSPMESC 2005). Uptake in the Australian National Bowel Cancer Screening Program is now 76.3% but this is an under-estimate because of missing data (AIHW 2010).

The European guidelines set the acceptable colonoscopy compliance rate at 85% (Moss et al 2010). Uptake in the BSP meets this standard.

Given the participation of younger Asians in the BSP was only slightly less, and their iFOBT positive rate was slightly higher, than younger Europeans, their lower colonoscopy uptake may reflect that they are returning to Asia or are more likely to go to the private system for their colonoscopy. This requires further investigation.

Outcomes

For a summary of the outcomes of the BSP, see Figure 1.

Immunochemical faecal occult blood test (iFOBT) positivity

Of the participants who returned an adequate kit in the first 22 months of the first screening round (n=46,409), 7.1% had a positive iFOBT result.

For all results see the Appendix, Table 3a.

Positivity increased with increasing age

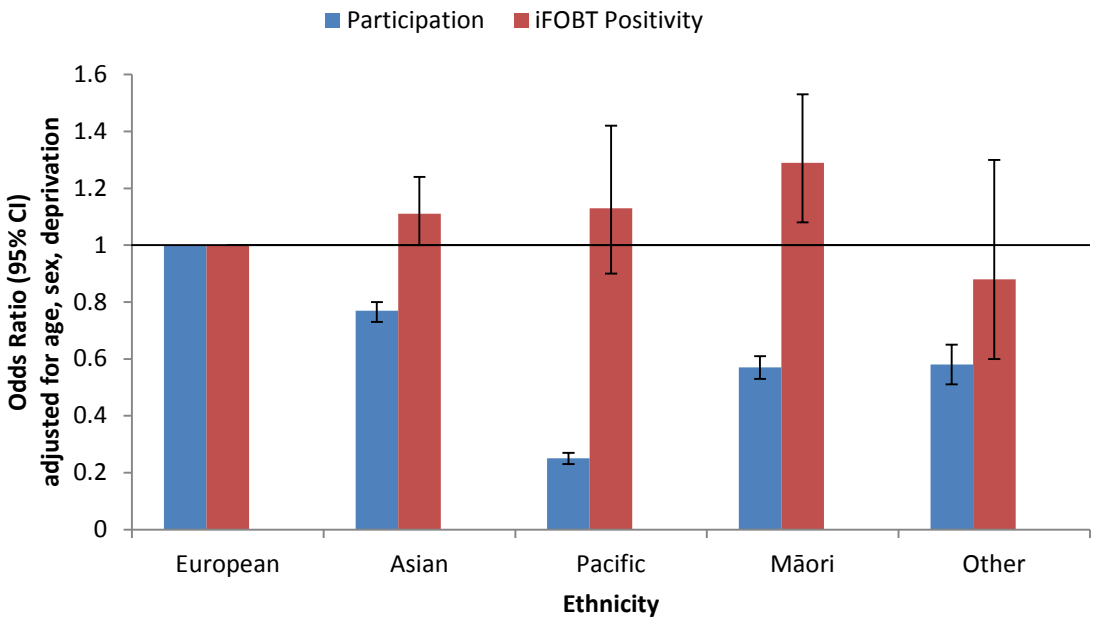
Participants aged 70-74 years were more than twice as likely to have a positive iFOBT result as participants aged 50-54 years (Figure 6).

Positivity differed by sex and Māori ethnicity

Males were over 1.5 times more likely to have a positive iFOBT result than females (Figure 7). This difference was found for each age group.

Māori were slightly more likely to have a positive iFOBT result than Europeans (Figure 4).

Figure 4: Participation and iFOBT positivity by ethnicity

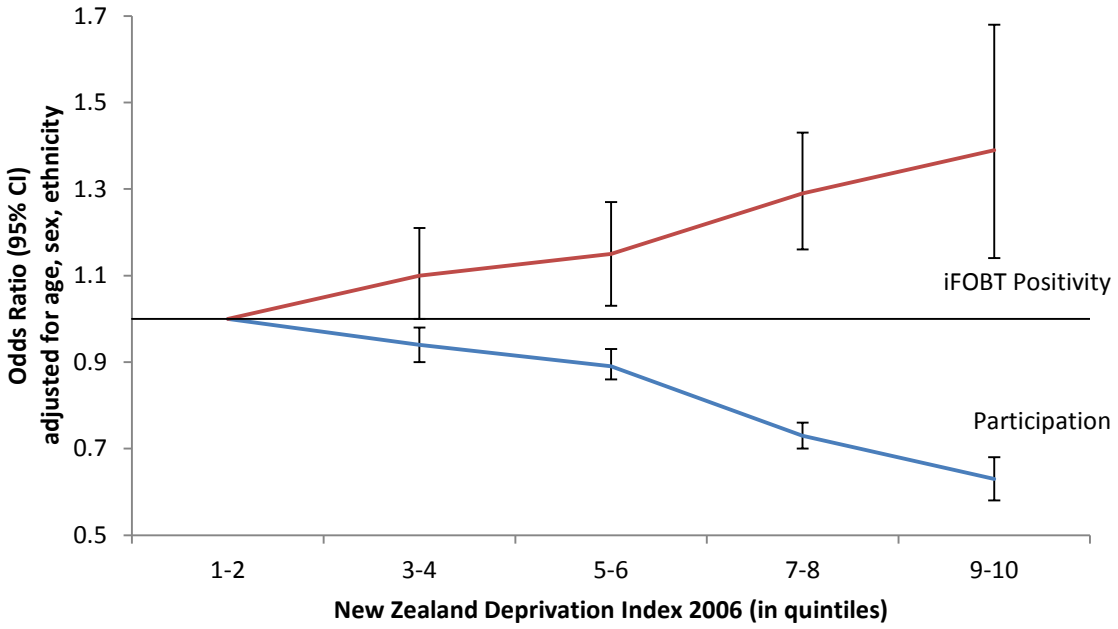


Source: BSP Register

Positivity increased with increasing deprivation

Positivity among people from the most deprived quintile area (NZDep Index 9-10) was about 1.5 times more likely than people from the least deprived quintile area (NZDep Index 1-2) (Figure 5).

Figure 5: Participation and iFOBT positivity by deprivation quintiles



Source: BSP Register

Discussion

Comparison of the positivity rate with other population-based screening programmes is limited by the use elsewhere of a guaiac rather than iFOBT and varying iFOBT cut-off levels. The iFOBT is more sensitive for advanced adenomas and cancer than the guaiac faecal occult blood test (Lansdorp-Vogelaar and von Karsa 2010). Guittet et al (2009) found the increase in sensitivity of the iFOBT for colorectal cancer was confined to rectal cancer, which was attributed to the lower amount of bleeding of rectal cancer.

The positivity rates for the iFOBTs used in the Australian bowel cancer screening pilot of 55-74 year olds were 8.2% for Magstream and 9.9% for InSure (BCSPMESC 2005). The BSP positivity rate is similar to the rate (6.6%) seen when 50 year olds were included in the Australian National Bowel Cancer Screening Programme (NBCSP) in 2008 (AIHW 2010).

If the positivity rate is too low, the screening programme will fail to adequately identify adenomas and cancer, whereas if it is too high there will be pressure on colonoscopy capacity.

The BSP positivity rate was within the range (4.4-11.1%) of positive iFOBT rates reported in the first round of population-based screening programmes (Moss et al 2010; Major et al 2013). The positivity rate from the first screening round in the Netherlands using an iFOBT with the same cut-off level and a population of the same age range as the BSP was lower – 5.7% (Hol et al 2009).

A higher positivity rate with increasing age, and in males compared with females, has also been reported in Australia, the UK and Canada (BCSPMESC 2005; Weller et al 2007; Major et al 2013). This reflects the natural history of the disease.

A higher positivity rate in more deprived areas was also found in England (Weller et al 2007).

Detection rates of adenoma, advanced adenoma and colorectal cancer

Following colonoscopy, there were 1,593 participants who had at least one adenoma and no cancer detected. There were 887 participants who had at least one advanced adenoma and no cancer detected. Ninety-five participants had cancer detected. Some of these participants would have had more than one type of pathology; only the most serious type was recorded.

The overall detection rate of adenoma was 3.4%, advanced adenoma was 1.9%, and cancer was 0.2%.

For all results see the Appendix, Table 3a.

Detection rates increased with increasing age

This trend reflects the natural history of adenomas and colorectal cancer.

The 70-74 year old participants were almost three times more likely to have an adenoma or advanced adenoma detected than 50-54 year old participants.

The 70-74 year old participants were almost four times more likely to have cancer detected than 50-54 year old participants.

Figure 6 shows increasing participation, iFOBT positivity, and combined advanced adenoma[12] and colorectal cancer with age.

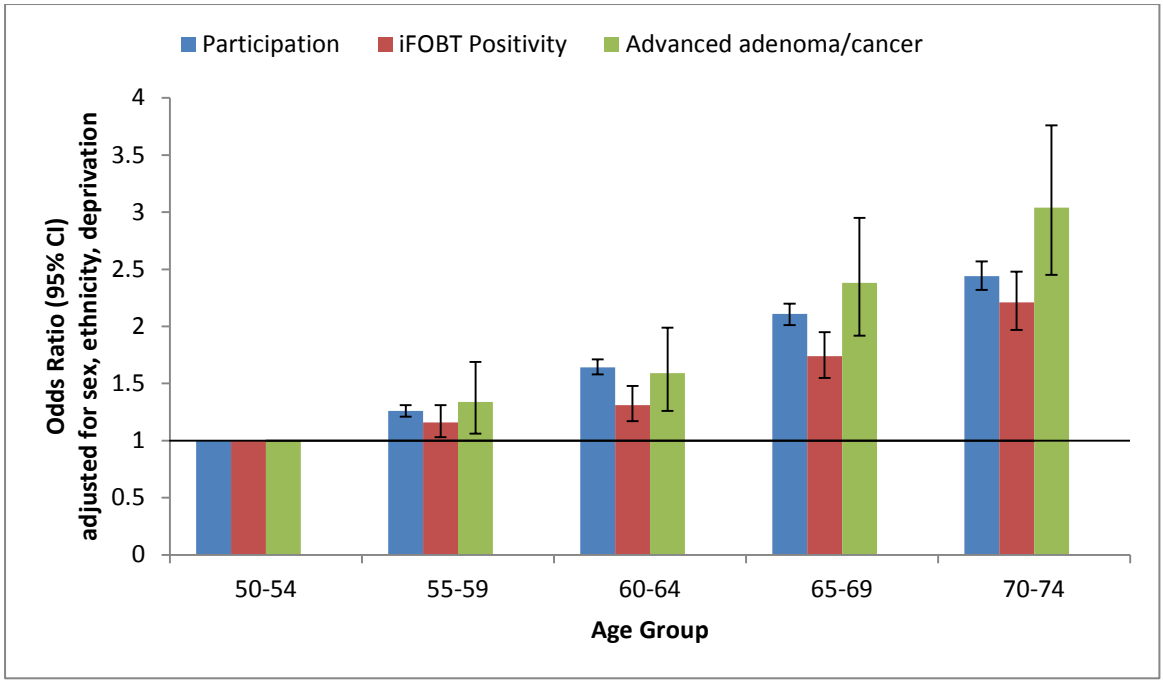
Detection rates differed by sex, and Māori and Asian ethnicity

Males were about twice as likely to have an adenoma, advanced adenoma, or cancer detected than females (Figure 7). The difference between males and females existed at every age group for adenoma and advanced adenoma, and in the 65-69 and 70-74 year age groups for cancer.

The difference between males and females for adenoma and advanced adenoma decreased with increasing age.

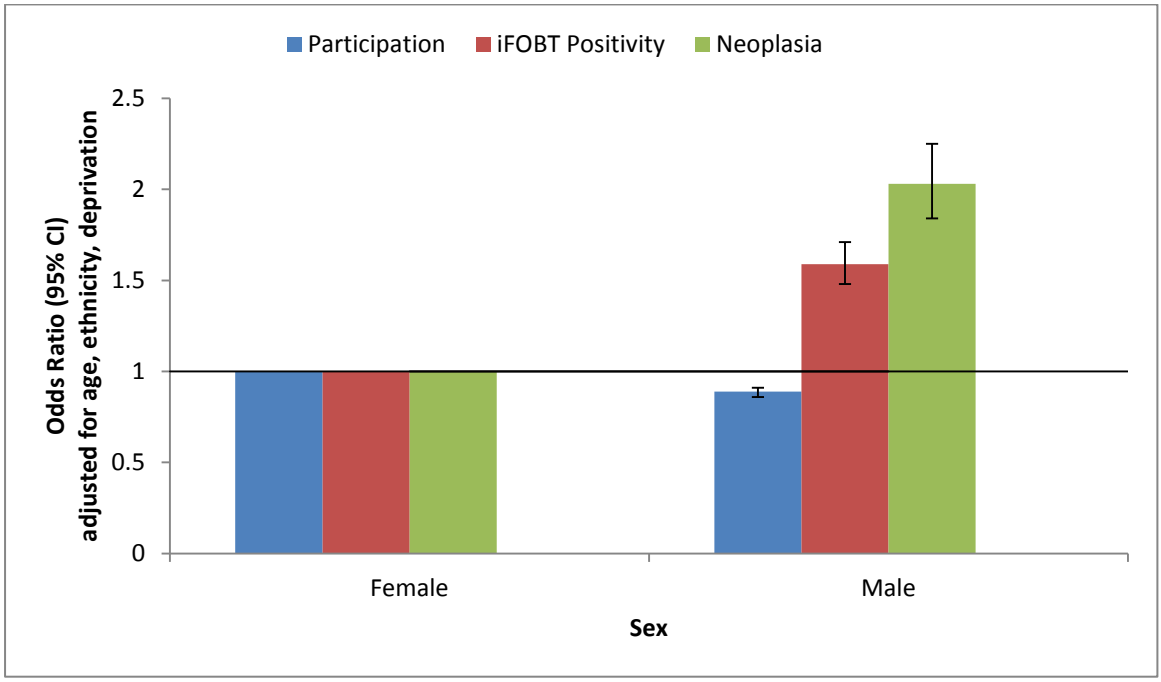
[12] Advanced adenomas are the highest-risk precursors of colorectal cancer.

Figure 6: Participation, iFOBT positivity, and combined advanced adenoma and colorectal cancer by age



Source: BSP Register

Figure 7: Participation, iFOBT positivity, and neoplasia[13] by sex



Source: BSP Register

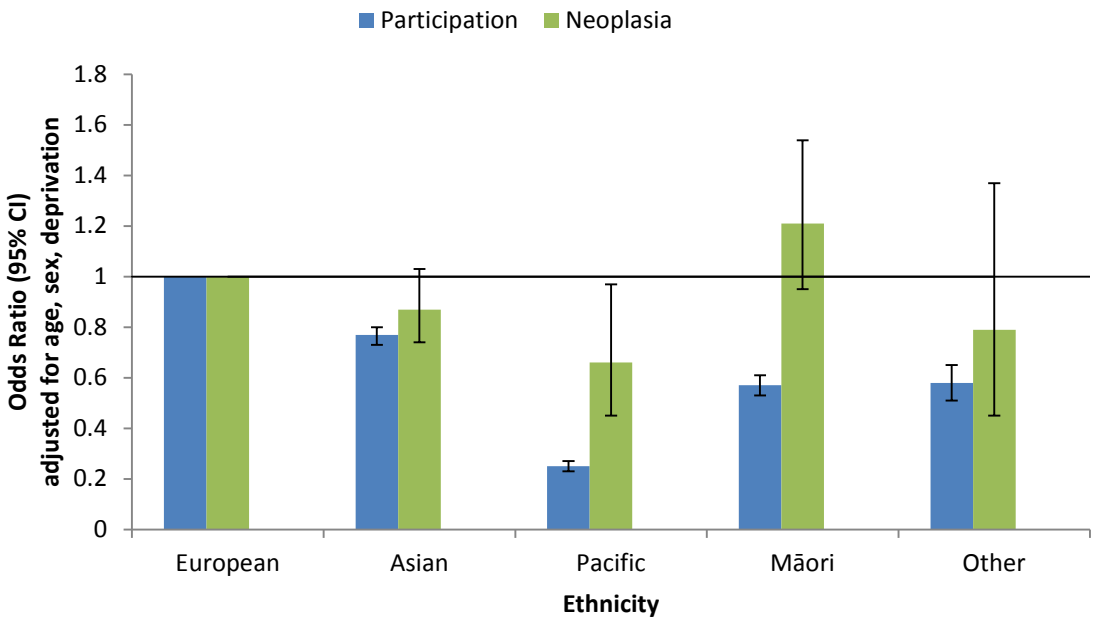
Māori aged 60-69 years were 1.5 times more likely to have an adenoma detected than Europeans of the same age.

Māori were almost 1.5 times more likely to have an advanced adenoma detected than Europeans.

Asians were over 1.5 times less likely to have an advanced adenoma detected than Europeans.

[13] Neoplasia refers to adenomas (including advanced adenoma) and colorectal cancer.

Figure 8: Participation and neoplasia by ethnicity

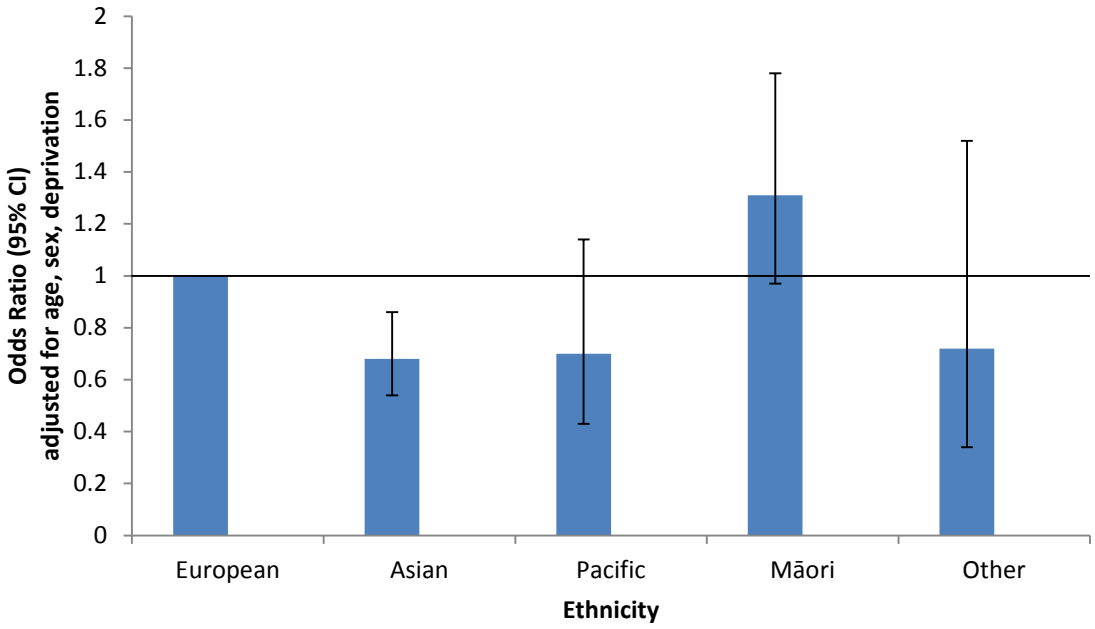


Source: BSP Register

Figure 8 shows Pacific people were less likely than Europeans to have neoplasia detected. There was a suggestion that Asians were less likely and Māori were more likely than Europeans to have neoplasia detected, but this was not statistically significant.

Figure 9 shows Asians were less likely than Europeans to have either advanced adenoma or colorectal cancer detected.

Figure 9: Combined advanced adenoma and colorectal cancer by ethnicity



Source: BSP Register

Detection rates increased with increasing deprivation

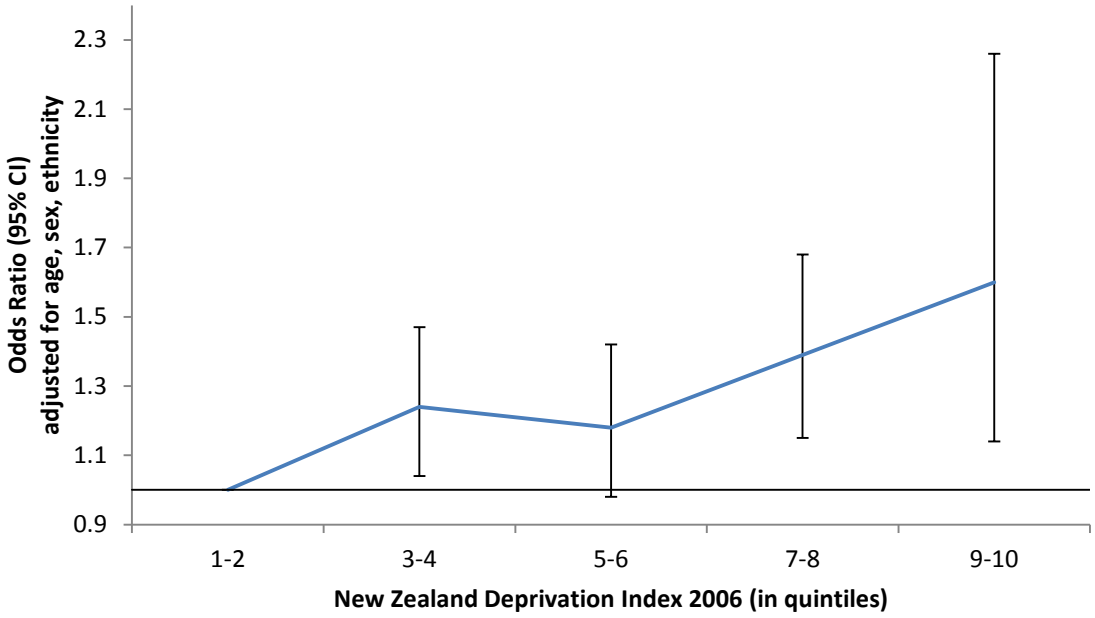
Participants from the two most deprived quintile areas (NZDep 7-8 and 9-10) were about 1.5 times more likely to have an adenoma or advanced adenoma detected than participants from the least deprived quintile area (NZDep Index 1-2).

The results, adjusted for age, sex and ethnicity, also suggest cancer was more likely to be detected among participants living in the most deprived quintile area compared with the least deprived quintile area. However, the results were not statistically significant. When cancer and advanced adenoma were combined, there was a trend of more disease with increasing deprivation (Figure 10). The trend was similar for neoplasia (Figure 11).

The detection rates may be an under-estimate since the dataset only allows four months for completion of the pathway. However, on average, completion occurred within three months. The UK bowel screening pilot evaluation allowed a three month lag period.

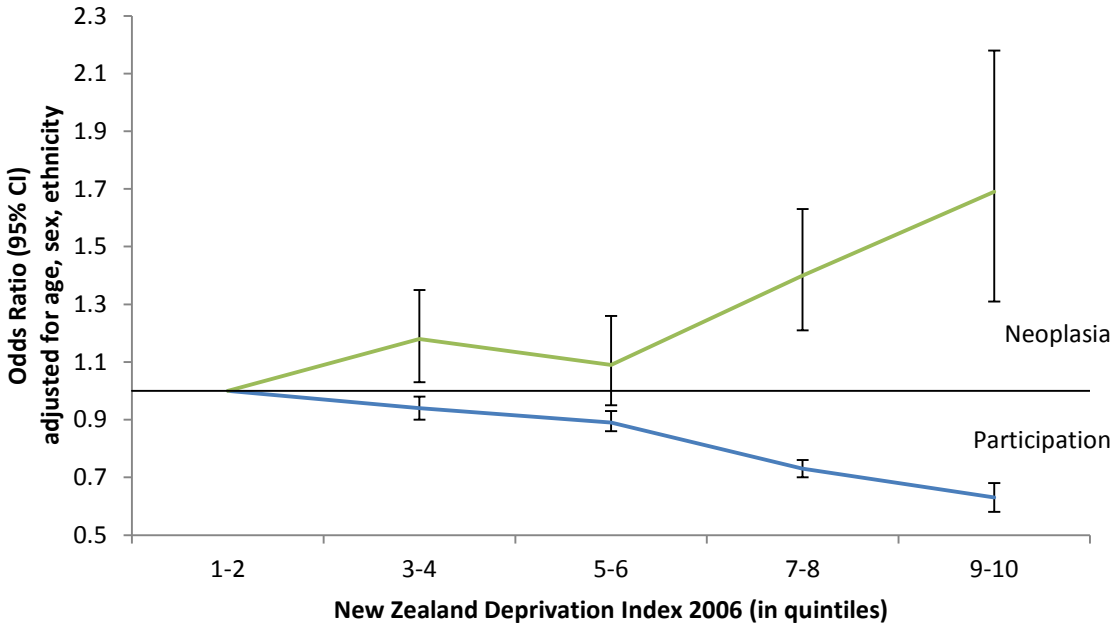
Absence of private colonoscopy data also means that detection rates for the various outcomes are under-estimates.

Figure 10: Combined advanced adenoma and colorectal cancer by deprivation quintiles



Source: BSP Register

Figure 11: Participation and neoplasia by deprivation quintiles



Source: BSP Register

Discussion

The BSP detection rate for adenoma (3.4%) is above the range (1.33-2.23%), and for cancer (0.2%) is at the lower end of the range (0.18-0.95%) reported in the first screening round of population-based programmes that use the iFOBT (Moss et al 2010).

Reliable detection rates are not available for Australia as a whole due to missing histopathology outcome data in the register[14] (AIHW 2010).

The UK *Quality assurance standards for colonoscopy* give a standard of adenoma detected in at least 35% of colonoscopies and cancer detected in at least 2 per 1,000 screened (Chilton and Rutter 2011). The BSP almost meets the detection standard for adenoma and just meets that for cancer.

In a Dutch randomised population-based trial of 50-74 year olds, Hol et al (2009) found the detection rate for advanced adenoma and cancer at an iFOBT cut-off level of 75ng haemoglobin/ml was twice as high as the guaiac faecal occult blood test. This is the cut-off level of the iFOBT used in the BSP (Hol et al 2009).

Positive Predictive Values

The positive predictive value (PPV) of a positive iFOBT for adenoma was 48.2%, advanced adenoma was 26.9%, and cancer was 2.9%. That is, 51.1% of people who had a positive iFOBT had an adenoma or cancer detected, and 29.7% had an advanced adenoma or cancer detected.

For all results see the Appendix, Table 3b.

There were some age, sex and ethnic differences in the effectiveness of a positive iFOBT in detecting neoplasia

The PPV was higher for adenoma (1.8 times) and advanced adenoma (1.5 times) among 70-74 year old participants than 50-54 year old participants.

The PPV for adenoma and advanced adenoma was higher for males than females. The difference in effectiveness between males and females was for the younger age groups (50-54, 55-59 and 60-64 years for adenoma, and 50-54 and 55-59 years for advanced adenoma).

The PPV was about twice as high for both adenoma and advanced adenoma among 65-69 and 70-74 year old females as 50-54 year old females.

The PPV for adenoma was about 1.5 times less for Asians than that for Europeans.

[14] 35.5% of people invited in 2008 who had a positive faecal occult blood test had no outcome data recorded in the National Bowel Cancer Screening Register by the end of January 2010.

The PPV for adenoma for Pacific people was about half that for Europeans.

The PPV for advanced adenoma for Asians was about half that for Europeans.

The PPV for cancer was more than three times as high for 65-69 and 70-74 year old males as 50-54 year old males.

Discussion

The PPV for adenoma was found to be higher for programmes using the iFOBT compared with the guaiac faecal occult blood test in Canada (Major et al 2013). The PPV for cancer did not differ between the test types (Hol et al 2009; Major et al 2013).

Differences in the international prevalence of colorectal cancer will lead to differences in the PPVs.

The PPV of a positive iFOBT was higher in the BSP than the Australian pilot for advanced adenoma (26.9% vs 13.9%) but lower for cancer (2.9% vs 5.3%). However the Australian register had a high rate of missing colonoscopy data (BCSPMESC 2005).

The BSP PPV of a positive iFOBT for cancer of 2.9%[15] is below the range (4.5-8.6%) reported in the first screening round of population-based programmes, whereas the PPV for adenoma of 48.2% is above the reported range (19.6-40.3%) (Moss et al 2010). However, the more recently reported PPV for adenoma and cancer (50.6% and 4.3% respectively) from the three Canadian provincial programmes that use the iFOBT is outside of these ranges, and higher than in the BSP (Major et al 2013).

Colorectal cancer

Ninety-five participants had cancer detected (2 per 1,000 screened). Eighty were European, 12 were Asian, 2 were Māori and none was Pacific.

The cancer detection rate increased with increasing age. Participants aged 65-69 and 70-74 years were between three and four times more likely to have cancer than participants aged 50-54 years.

Males were almost twice as likely to have cancer as females.

Males aged 65-69 and 70-74 years were more than 2.5 times more likely to have cancer than females of the same age.

Males aged 65-69 and 70-74 years were about six times more likely to have cancer than 50-54 year old males.

[15] The PPV of a positive iFOBT for cancer increases to 3.1% if the cancers detected among the self-selected population are included.

The extent of spread of a cancer is known as its stage. There are various staging systems; the BSP has adopted Tumour Node Metastasis (TMN) staging. The staging ranges from Stage 1, the least advanced, to Stage 4, the most advanced.

Most cancers were Stage I (42.6 per 100,000 participants), followed by Stage II (18.4 per 100,000 participants), Stage III (12.7 per 100,000 participants) and Stage IV (8.1 per 100,000 participants) (Appendix, Table 4).

Almost 39% (n=37) of those participants with cancer detected had Stage I (ie, confined to the bowel inner lining or muscle wall) and 8.4% (n=8) had Stage IV (ie, spread to a distant part of the body).

Discussion

The cancer detection rate and the proportion of early-stage cancers was found to be higher for programmes using the iFOBT compared with the guaiac faecal occult blood test in Canada (Major et al 2013).

The BSP cancer detection rate (2.0 per 1,000)[16] is at the lower end of the range (1.8-9.5 per 1,000) reported in the first screening round of population-based programmes that use the iFOBT (Moss et al 2010).

The detection rate for cancer from the three Canadian provincial programmes that use the iFOBT was also higher (2.8 per 1,000), as was the proportion of Stage I or II cancers (76.1% compared with 62.1% in the BSP) (Major et al 2013).

A review of colorectal cancer cases diagnosed in the first two years that the Australian NBCSP was operating found 40% of NBCSP-detected cancers were Stage I and 3% were Stage IV (Ananda et al 2009).

The UK pilot used the guaiac faecal occult blood test so the results are not directly comparable. The cancer detection rate was 1.26 per 1,000 screened in England and 1.99 per 1,000 screened in Scotland (Weller et al 2006). Staging results for the UK pilot after the first invitation round were 48% at Dukes' A and 1% at Dukes' D (UK Colorectal Cancer Screening Pilot Group 2004). After three rounds of invitation for prevalence screening in Scotland, the proportion of cancers detected at Stage I (Dukes' A) was 46.5% and 6% were Stage IV (Dukes' D) (Steele et al 2010). Reports of screening programmes that refer to staging have mostly used the Dukes' staging system (Colorectal Cancer Screening Advisory Group 2006).

The self-selected population

The self-selected population comprised people in the eligible population who were not on the BSP Register (eg, no National Health Index, moved into the area) but who requested

[16] The cancer detection rate increases slightly to 2.2 per 1,000 if the cancers detected among the self-selected population are included. This may reflect a higher likelihood of self-selection because of symptoms among this group.

screening, and people on the Register who requested screening before they received an invitation. The latter group included Māori and Pacific people who may have attended a community education session or hui and expressed an interest to take part in the BSP. Health promoters then notified the Coordination Centre and an invitation letter and iFOBT kit was sent out.

There were 1,895 eligible[17] people in this group – 1,555 Europeans, 183 Asians, 43 Pacific and 71 Māori. Ethnicity data were missing for 31 people. The Register records some people as being both self-registered and self-referred (see Appendix – Data Quality). There were 1,580 self-referred people of whom 41 were Pacific and 60 Māori.

Eighty-eight percent (n=1,676) returned an adequate kit compared with 98% of the non-self-selected population.

For all results see the Appendix, Table 5.

Participation was highest among people aged 65-69 and 70-74 years. People aged 70-74 years were five times more likely to participate than those aged 50-54 years. Unlike the non-self-selected population, there was no statistically significant difference in participation by sex.

Almost 85% of the self-selected group who returned an adequate kit were European.

Asians were almost half as likely to participate than Europeans and Pacific people were almost three times less likely to participate than Europeans. Whilst Māori were also less likely to participate than Europeans, this difference was not statistically significant. The differences between Māori and European, and Pacific and European participation were less than with the non-self-selected population. This may reflect the fact that Māori and Pacific were able to self-refer.

People living in the NZDep 5-6 quintile area were almost twice as likely to participate as those living in the least deprived quintile area.

Of those who returned an adequate kit, 9.3% had a positive iFOBT result. The positivity rate was higher than in the non-self-selected eligible population.

Almost 90% (n=140) had a publicly funded colonoscopy.

There were 79 people who had at least one adenoma and no cancer detected. There were 47 people who had at least one advanced adenoma and no cancer detected. One Pacific person and three Māori people had an adenoma, one of whom had an advanced adenoma. Eleven people from this group, all European, had cancer detected.

The overall detection rate of adenoma was 4.7%, advanced adenoma was 2.8%, and cancer was 0.7%. These detection rates are higher than those found in the non-self-selected eligible population.

Outcomes did not significantly differ by ethnicity.

[17] Eligibility is defined in the Appendix.

A positive iFOBT result and detection of adenoma were more likely among males compared with females, and the 70-74 year age group than the 50-54 year age group.

Positivity was 3.5 times more likely in the most deprived quintile area (NZDep 9-10) compared with the least deprived quintile area (NZDep1-2). Advanced adenoma was between three and seven times more likely in the two most deprived quintile areas (NZDep 7-8 and 9-10) compared with the least deprived quintile area.

Discussion

The lack of difference in participation between males and females, and higher participation among people living in the middle deprivation areas rather than the least deprived areas, may explain the higher positivity and detection rates for all outcomes for the self-selected group. It is also possible that this group included people who were symptomatic, and therefore motivated to self-register or self-refer.

Adverse events

Data for readmissions for adverse events within 14 to 30[18] days of colonoscopy were supplied as a spreadsheet from the WDHB separately from data provided by the BSP Register. Due to lack of matching with the Register data, these data may include some self-selected people, whose results for other analyses have been presented separately. The rates are based on all colonoscopies recorded in the BSP Register so include privately funded colonoscopies[19]. The data for both the denominator (all colonoscopies) and the numerator (readmissions) may be incomplete.

The post-colonoscopy complications of particular concern in colorectal cancer screening are perforation and bleeding. They are more common following colonoscopy with polypectomy (Chilton and Rutter 2011).

Forty-nine participants were readmitted (Appendix, Table 6). The most common causes for readmission were bleeding (n=31), abdominal pain (n=7) and perforation (n=5). All readmissions for bleeding were associated with polypectomy.

The perforation rate was 1.2 per 1,000 colonoscopies and the bleeding rate was 7.7 per 1,000 colonoscopies. The rate for all other complications was 3.0 per 1,000 colonoscopies. There were no colonoscopy-related deaths.

[18] The readmissions time period was 14 days until December 2012 and thereafter 30 days.
[19] The data used by the BSP as monitoring indicators for adverse events excludes privately funded colonoscopies.

Discussion

Different definitions for adverse events, particularly for bleeding and follow up periods, make direct comparisons with other reported data difficult.

During the first screening round of the UK pilot, the admission rate for bleeding[20] or abdominal pain was 2.4 per 1,000 colonoscopies. The perforation rate was 0.5 per 1,000 colonoscopies. The follow up period for adverse events post-colonoscopy was not reported (UK Colorectal Cancer Screening Pilot Group 2004).

Adverse event data from the first three years of the National Health Service Bowel Cancer Screening Programme in England found the perforation rate was 0.9 per 1,000 colonoscopies and the bleeding rate was 4.1 per 1,000. There were no colonoscopy-related deaths. The period of follow up was 30 days and included events that did not result in admission (Lee et al 2012). The bleeding rate, although it appears to include an unpublished number of bleeding events that did not result in admission, was lower than that reported in the BSP. This will be affected by the number of polypectomies, but BSP data were not available to explore this.

The UK *Quality assurance standards for colonoscopy* give a standard for perforation of less than 1 in 1,000 colonoscopies and less than 1 in 500 colonoscopies where polypectomy is carried out. The standard for bleeding is less than 1 in 100 colonoscopies where polypectomy is carried out (Chilton and Rutter 2011). The data supplied did not allow reliable calculation of rates for colonoscopies with polypectomy. The BSP monitoring indicator for perforation or bleeding is less than 10 in 1,000 colonoscopies (excluding privately funded colonoscopies). This has not been exceeded (personal communication, Ministry of Health).

[20] The bleeding rate for the UK pilot was not reported separately.

Conclusions

The findings are largely similar to those found in other population-based colorectal screening programmes. Where there are differences (eg, lower PPV of a positive iFOBT for cancer) or the findings cannot be directly compared (eg, adverse events), these have been noted in the discussion above.

We recommend that the Ministry of Health comprehensively review the BSP Register and implement a robust data quality assurance programme. The evaluation has identified data quality issues that must be addressed as a high priority for the final evaluation and a national programme. Data quality issues include data definition, data inconsistencies, errors and data capture. Examples are given in the Appendix.

A further high priority is to address the low participation among people living in the most deprived areas. More disease was found in this population group, irrespective of age, sex and ethnicity.

Further strategies are also needed to promote the BSP among the other low-uptake groups: Māori, males, Pacific people, and younger age groups. Māori were slightly more likely to have a positive iFOBT result than Europeans and there was suggestive evidence they were more likely to have disease. Males of all ages were more likely to have adenomas and advanced adenomas, and at older ages to have cancer, than females. Pacific people's participation was the lowest, although they were less likely than Europeans to have disease, irrespective of their age, sex and deprivation.

Data on ethnicity are obtained from the National Health Index and the screening consent form. Data were missing for 9.9% of non-responders. Although the number of participants with missing ethnicity data was small (n=159)[21], given the BSP's aim of equity, we recommend checks for missing ethnicity data in the BSP Register for participants who progress in the pathway beyond the iFOBT, with subsequent data collection at pre-assessment and entry into the Register.

[21] This increases to 190 if the 31 with missing ethnicity from the self-selected population are included.

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Appendix: BSP Methodology and Analysis

Mathu Shanthakumar

Barry Borman

The Ministry of Health (the Ministry) supplied the Centre for Public Health Research (CPHR) with the data and approved terms, definitions and analytical methodology used in the evaluation of the bowel cancer screening pilot (BSP). The analysis was based on the Ministry's pilot draft indicator methodology (Ministry of Health 2012); the European guidelines for quality assurance in colorectal cancer screening and diagnosis (Segnan et al 2010); the Ministry's pilot interim quality standards (Ministry of Health 2012); and the quality assurance guidelines for bowel cancer screening compiled in the United Kingdom (National Health Service 2011).

Data Sources

Three data sources were used for the analysis: the BSP Register was the primary data source, a Colorectal Cancer Staging spreadsheet and a Readmissions spreadsheet from Waitemata District Health Board (WDHB).

Bowel Screening Pilot Register
A colorectal cancer screening service was available to the target population in the WDHB area. There has been a dedicated population register to identify eligible participants, and a Programme Register to store the eligible participant's screening history.

A population-based programme was used for the BSP, aimed at inviting people who are at an average risk from developing colorectal cancer.

The population register data used to identify and invite the target population for the BSP were sourced from the National Health Index (NHI), containing unique identifiers assigned to every person that uses health and disability support services in New Zealand. The NHI includes demographic details about a person such as name, address, sex, ethnicities, date of birth and date of death. It does not include any clinical information about a person.

Screening Test

The screening test used in the BSP is a single sample immunochemical faecal occult blood test (iFOBT). The screening timeframe for the BSP is 2 years, meaning that eligible people will be recalled for a screening test every 2 years.

Population Base

The NHI captures every person that uses health and disability services in New Zealand. This includes people who are not New Zealand residents, such as overseas visitors and non-residents that live in New Zealand, but are not entitled to publicly funded healthcare.

To avoid over-inflating the identified population with people that were not eligible for publicly funded healthcare, work was undertaken by the Ministry to ensure that only the target population was identified and loaded into the BSP Register.

Target Population

The target population for the BSP Register were men and women aged between 50-74 years at the time of invitation, who were both resident in the WDHB, and eligible for publicly funded healthcare.

Eligible Population

The eligible population for the BSP included men and women aged between 50-74 years at the time of invitation, who were resident in the WDHB, eligible for publicly funded healthcare, and did not meet the exclusion criteria during their life in the pilot.

Exclusions from the Analysis

Step 1. Those without an Invitation Date
The data were extracted from the BSP Register by the Ministry in mid-November 2013. The extract contained data from 175,903 people on the BSP Register from 23 November 2011 – 11 November 2013. Of these, 53,565 people did not have an invitation date[22] and were excluded from the analysis.

Step 2. The 22-month Cut-off Period for the Dataset
The official start date of the BSP was 1 January 2012. For the analysis of the dataset a 22-month cut-off date range from 1 January 2012 – 31 October 2013 was used[23]. This led to 2,864 people being excluded from the analysis as they were outside this date range. Of these exclusions, 445 people were from 23 November 2011 – 1 January 2012 (as part of the 'soft launch'), and 2,419 people were from 31 October 2013 – 11 November 2013.

[22] They also did not have dates recorded for response of iFOBT kit, colonoscopy, or histopathology.
[23] The exclusion cut-off was made to the dates of invitation, response of iFOBT kit, colonoscopy, and histopathology.

Step 3. The 18-month Cut-off Period for Invitation Date

An 18-month cut-off period from 1 January 2012 – 30 June 2013 was used to allow for participants invited in the last week of June to have four months to progress through the pilot pathway. The time lag period was consistent with the United Kingdom colorectal cancer screening programme pilot evaluation (Weller et al 2007). This led to a further 25,059 people being excluded from the analysis, as they were invited between 1 July 2013 – 31 October 2013.

The complete pathway of a participant (ie, *invitation –> iFOBT completion –> pre-assessment –> colonoscopy –> histopathology*) took about six months for 88% of the participants.

Ninety-four percent of participants who returned an iFOBT kit did so within two months of being sent their invitation.

Ninety-six percent of participants who had a colonoscopy did so within three months of returning a positive iFOBT kit result.

Ninety-eight percent of participants had a histopathology result within 20 days of a specimen being taken from the colonoscopy.

On average, participants completed the pathway from invitation to histopathology results within three months.

Step 4: The Exclusion Criteria

The remaining people who met at least one[24] of the following exclusion criteria were not eligible for the analysis, resulting in a further 7,662 people being excluded. These comprised those with:

Exclusion Criterion	Number	Comment
EnrolmentStatusCode		
Ineligible	1040	
Withdrawn	4360	
Address not valid or not found	1460	
Moved out of eligible area	394	
Not suitable for screening	634	
Person declines further invitations	517	
Private care	1	
Requested by person	493	
Unable to contact person	153	
Other	691	
missing	17	
Ineligibility		
IneligiblePreviousCancer	50	
IneligibleDeceased	168	
IneligibleDomicile	788	
IneligibleManual	6	
Self-referred (reported separately)	1590	People who requested screening

[24] There were people who were captured in multiple exclusion criteria.

		before they received an invitation
Self-registered (reported separately)	792	Eligible people who were not identified by the BSP Register but requested screening
Previous Colonoscopy	343	Colonoscopy within five years before invitation
Age<50, Age>74	15	Age at time of invitation

There were 356 participants who had a positive iFOBT kit result and were not coded with a public healthcare facility (ie, endoscopy unit or North Shore Hospital). They were excluded from all colonoscopy and histopathology analysis.

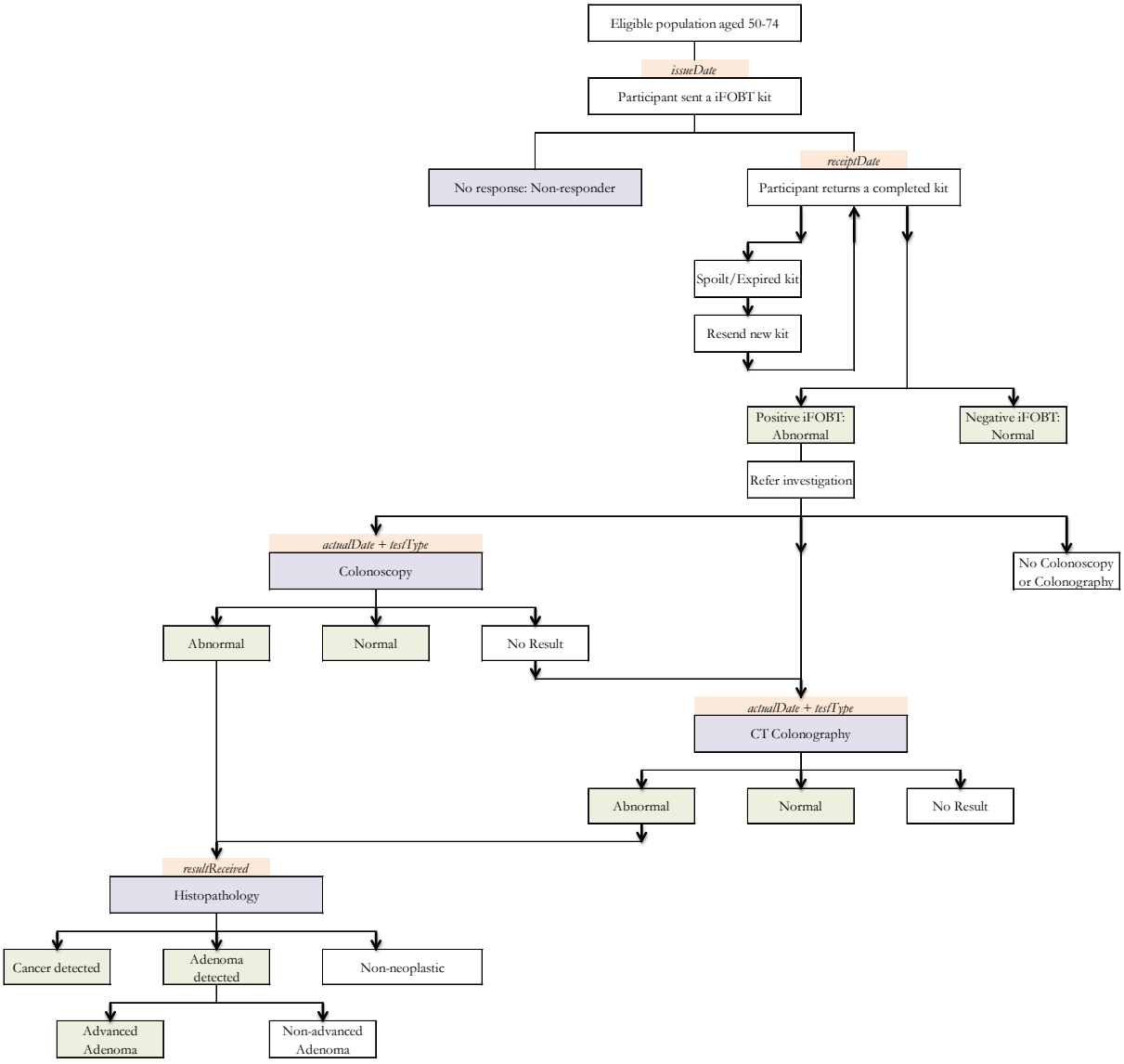
Invited Population

The invited population were those members of the eligible population who received an invitation for screening by mail. This can include people who opted not to respond as well as those that may not have received the invitation.

Out of the exclusion criteria, the BSP Register is only able to identify people who have had a colorectal cancer registration in New Zealand and these people were not sent an invitation. People who fit the remaining criteria were therefore required to opt-out after they were sent the notification letter or invitation with the kit. Some people contacted the Coordination Centre and withdrew from the programme because they fit the exclusion criteria, or did not wish to participate.

Figure 1 below depicts the possible pathway process of an eligible participant that went through the BSP.

Figure A1: Bowel Screening Pilot – Pathway Process



iFOBT Kits

All returned iFOBT kits were tested at a laboratory and classified as positive (abnormal), negative (normal), or inadequate (spoilt or expired).

Each participant was counted once, regardless of the number of iFOBT kits that they returned. The iFOBT kit result was recorded for a participant on the basis of the following priority: Abnormal, Normal, Spoilt, and Expired.

Colonoscopy and Colonography

Each participant was counted once, regardless of the number of follow-up colonoscopies that were performed. Where more than one colonoscopy was performed, the colonoscopy result for a participant was recorded on the basis of the following priority: Abnormal, Normal, No Result.

The analysis of colonoscopy did not include participants who had a CT colonography. If a participant had an unsuccessful colonoscopy that later required a colonography they were categorised as a colonography participant.

Histopathology

Results from the histopathology recorded participants as having a cancer (cancer or malignant polyp) or adenoma detected, or it was non-neoplastic.

Each participant was counted once, regardless of the number of follow-up histopathology examinations that were performed. Where histopathology examinations were performed more than once, the histopathology result for a participant was recorded on the basis of the following priority: Cancer, Malignant polyp, Adenoma, Non-neoplastic.

An adenoma was classified as an advanced adenoma if either its size was 10mm or greater, or it contained high-grade dysplasia or a villous component (ie, villous or tubulovillous).

Staging of Colorectal Cancers

In discussion with the Ministry, colorectal cancers were staged according to the TNM staging criteria for colorectal cancers.

The stages were:
Stage 1,
Stage 2, Stage 2A, Stage 2B, Stage 2C,
Stage 3, Stage 3A, Stage 3B, Stage 3C,
Stage 4, Stage 4A, Stage 4B.

Severity Categorisation of Adverse Events

As per the Quality Assurance Guidelines (National Health Service 2011), the reasons for readmission were categorised on the basis of the following priority: Perforation, Bleeding, and Other. For example, if a person had perforation and bleeding, they would be categorised as perforation.

Epidemiological Analysis

The analysis of the BSP was based on the evaluation work conducted in the United Kingdom on a similar screening pilot (Weller et al 2007), with appropriate modifications made for local context (ie, ethnicity and New Zealand deprivation index). The analysis plan was approved by the Ministry.

The analysis was carried out on demographic variables: age (five- year age groups), sex (female, male), ethnicity (European, Asian, Pacific, Māori, 'Other'), and NZ Deprivation Index 2006 (decile and quintile groups).

Logistic regression was used to investigate associations between the various demographic variables and measures of uptake and detection. Counts and percentages, together with the associated unadjusted odds ratios and 95% confidence intervals, were calculated for each category of the demographic variables. Adjusted odds ratios and 95% confidence intervals, controlling for the effects of other demographic variables (ie, age group, sex, ethnic group, and deprivation quintiles), were also calculated.

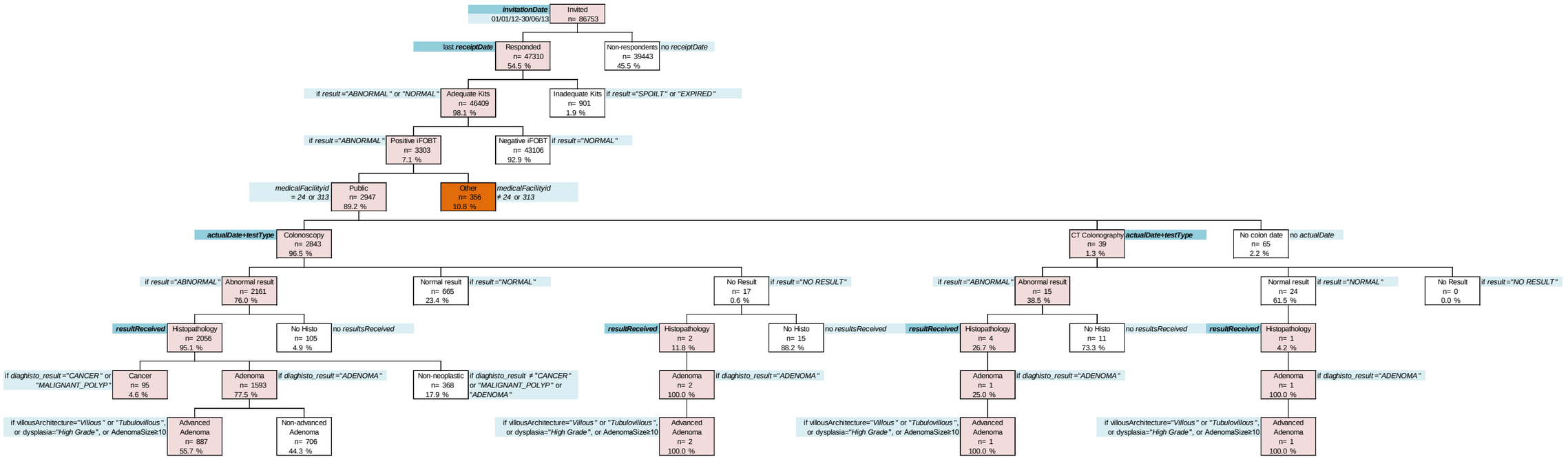
Data Processing

The analysis contained data from 1 January 2012 – 31 October 2013, for eligible participants invited from 1 January 2012 – 30 June 2013. The dynamic[25] BSP Register database was extracted into an Access database file on 13 November 2013 and provided to CPHR. The various Access tables were linked to produce a flat file dataset of one record per person for analysis using the SAS 9.4 program.

Creating a dataset consisting of one record per person was essential in order to produce results on participation, and screening performance. The dataset followed each eligible participant with information recorded about their demography, date of invitation, response date of iFOBT kits, iFOBT kit results, public healthcare service codes for colon examination, whether the examination was a colonoscopy or colonography, colonoscopy and/or colonography results, histopathology examination date and results, including details about size and type. Figure 2 below shows a summary of these eligible participants' progression through the pilot.

[25] From an analysis perspective, the date of extraction from a dynamic database is critical. The same analysis for an extract from a different date may yield different results.

Figure A2. Flow diagram of eligible participants in the Pilot between 1 January 2012 – 31 October 2013.



Indicator Variables

The analysis was based on the eligible participants being categorised by the following indicators:

Indicator	Defined by
Invited	Issue date of invitation
Self-Selected	Self-registered or Self-referred
Responded	Receipt date of iFOBT kit
Adequate kit	Abnormal or Normal iFOBT kit result
Positive iFOBT	Abnormal iFOBT kit result
Colonoscopy	Actual date of colonoscopy and type of test
Colonography	Actual date of colonography and type of test
Histopathology	Date histopathology result was received
Adenoma	Histopathology result of Adenoma
Advanced Adenoma	Histopathology result of Adenoma and either of: size≥10mm, high grade dysplasia, or a villous component
Cancer	Histopathology result of Cancer or Malignant polyp

Demographic Factors Affecting Indicator Variables

Demographic factor	Comment
Age	Defined by issue date of invitation and date of birth Grouped into five-year age bands ranging from 50-54 years to 70-74 years
Sex	"Unknown" was recoded as a missing value
Ethnicity	Prioritised by: Māori, Pacific, Asian, European, 'Other' and Unknown "Unknown" was recoded as a missing value
Deprivation	Deciles ranging from 1 (least deprived) to 10 (most deprived) Grouped by quintiles ranging from 1 (NZDep of 1 and 2 combined) to 5 (NZDep of 9 and 10 combined) "Not known" was recoded as a missing value

Definitions in the Analysis

- Uptake / Overall Participation – This is the percentage of participants with an adequate iFOBT kit result out of all those who received an invitation with an iFOBT kit.
- Positivity Rate – This is the percentage of participants with a positive iFOBT kit result out of all those who returned an adequate iFOBT kit.

- Adenoma Detection Rate – This is the number of participants diagnosed with any adenoma per 1,000 screened with an iFOBT kit result available.
- Advanced Adenoma Detection Rate – This is the number of participants diagnosed with any advanced adenoma (villous or tubulovillous, or high grade dysplasia, or greater than or equal to 10 mm in size) per 1,000 screened with an iFOBT kit result available.
- Colorectal Cancer Detection Rate – This is the number of participants diagnosed with any colorectal cancer per 1,000 screened with an iFOBT kit result available.
- Positive Predictive Value of Positive iFOBT:
    - → for Adenoma – This is the percentage of participants with any adenoma in those having a positive iFOBT kit result.
    - → for Advanced Adenoma – This is the percentage of participants with any advanced adenoma in those having a positive iFOBT kit result.
    - → for Cancer – This is the percentage of participants with a malignant outcome (cancer or malignant polyp) in those having a positive iFOBT kit result.
- Colorectal Cancer Stage at Diagnosis (including polyp cancers) – This is the TNM staging for detected colorectal cancer. In cases where more than one staging was given for an individual only the most serious staging result was included.
- Screening Round – The first round of the screening was run for a two-year period, from 1 January 2012 – 31 December 2013. As the extracted dataset lies within this timeframe, the analysis was conducted solely within Round 1 of the BSP.
- Reference Group – When comparing demographic variables that did not have any natural ordering (eg, sex and ethnicity) and how they affect the indicator outcomes, the reference was based on the group with the most participants. Where a variable had a natural order (eg, age and NZDep2006) the reference chosen was the lowest in the category. This also helped avoid making comparisons within a variable against a relatively small group.

Data Quality

During the analysis of the data from the BSP Register, a number of issues were encountered which effected the quality of the data. Some examples are listed below under three broad headings: Lack of sufficient clarity in the Ministry's data dictionary; lack of logic checks in the database; and lack of quality assurance in the database. This is followed by some general recommendations.

Lack of sufficient clarity in the Ministry's data dictionary

Number of people	Issue
75	Flagged "hasPreviousCancer" and not flagged "ineligiblePreviousCancer" (56 had a histopathology result of cancer or malignant polyp, and 3 had an advanced adenoma)
5	Withdrawal reason "Private care" (includes invited and self-selected, or public and non-public healthcare)
2	Colonoscopy with no result but progressed to have a histopathology result

Lack of logic checks in the database

Number of people	Issue
418	EnrolmentStatusCode "Eligible" or "Participant", but Withdrawal reason "Address not valid or not found" (includes invited, self-selected, public and non-public healthcare)
344	Self-registered and self-referred
125	Flagged ineligibleOld but were all aged 74 years at date of invitation
15	Histopathology result before having a colonoscopy
11	EnrolmentStatusCode "Eligible", but Withdrawal reason "Unable to contact person" (includes invited, self-selected, public and non-public healthcare)
8	Returned an iFOBT kit before they were sent an invitation
5	EnrolmentStatusCode "Eligible", but Withdrawal reason "Requested by person" (includes invited, self-selected, public and non-public healthcare)
4	Colonoscopy before their iFOBT kit was received
4	EnrolmentStatusCode "Eligible", but Withdrawal reason "Person declines further invitations" (includes invited, self-selected, public and non-public healthcare)
3	EnrolmentStatusCode "Eligible", but Withdrawal reason "Not suitable for screening" (includes invited, self-selected, public and non-public healthcare)
2	Withdrawal reason "Address not valid or not found" but responded with a completed iFOBT kit

1	CT colonography with a normal result but progressed to have a histopathology examination
1	Withdrawal reason "Unable to contact person" but responded with a completed iFOBT kit

Lack of quality assurance in the database

Number of people	Issue
5	“Unknown” recorded for sex
4	Invited at age < 50
2	No date recorded for colonoscopy but progressed to have a histopathology result
1	Histopathology date of 11 January 2011

Recommendations

The data dictionary should explain all the field names in the data.

If a field is set up, it needs to have complete data.

Logic checks need to be put in place and addressed if there is a missing value in critical fields.

Some fields, and categories within a field, need to be mutually exclusive. Extra fields or categories can be added to resolve this if it requires another classification.

Logic checks need to be put in place and addressed if either the time sequence or logical sequence is not met.

References

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Tables

Table 1. Demographic information (after exclusion criteria)

	Invited[1]		Responders[2]		Non-responders[3]	
	n	%	n	%	n	%
Total	86753	-	47310	-	39443	-
Age (years)						
50-54	24803	28.59	11138	23.54	13665	34.64
55-59	20085	23.15	10174	21.50	9911	25.13
60-64	17239	19.87	9874	20.87	7365	18.67
65-69	13870	15.99	8874	18.76	4996	12.67
70-74	10756	12.40	7250	15.32	3506	8.89
Sex						
Female	45013	51.89	25587	54.08	19426	49.25
Male	41735	48.11	21722	45.91	20013	50.74
Unknown[£]	5	0.01	1	0.00	4	0.01
Sex - Age (years)						
Female: 50-54	13014	15.00	6260	13.23	6754	17.12
Female: 55-59	10507	12.11	5648	11.94	4859	12.32
Female: 60-64	8847	10.20	5267	11.13	3580	9.08
Female: 65-69	7135	8.22	4702	9.94	2433	6.17
Female: 70-74	5510	6.35	3710	7.84	1800	4.56
Male: 50-54	11788	13.59	4878	10.31	6910	17.52
Male: 55-59	9576	11.04	4525	9.56	5051	12.81
Male: 60-64	8391	9.67	4607	9.74	3784	9.59
Male: 65-69	6734	7.76	4172	8.82	2562	6.50
Male: 70-74	5246	6.05	3540	7.48	1706	4.33
Unknown[£]: 50-54	1	0.00	0	0.00	1	0.00
Unknown[£]: 55-59	2	0.00	1	0.00	1	0.00
Unknown[£]: 60-64	1	0.00	0	0.00	1	0.00
Unknown[£]: 65-69	1	0.00	0	0.00	1	0.00
Unknown[£]: 70-74	0	0.00	0	0.00	0	0.00
Age (years) - Sex						
50-54						
Female	13014	15.00	6260	13.23	6754	17.12
Male	11788	13.59	4878	10.31	6910	17.52
Unknown[£]	1	0.00	0	0.00	1	0.00
55-59						
Female	10507	12.11	5648	11.94	4859	12.32
Male	9576	11.04	4525	9.56	5051	12.81
Unknown[£]	2	0.00	1	0.00	1	0.00
60-64						
Female	8847	10.20	5267	11.13	3580	9.08
Male	8391	9.67	4607	9.74	3784	9.59
Unknown[£]	1	0.00	0	0.00	1	0.00
65-69						
Female	7135	8.22	4702	9.94	2433	6.17

Male	6734	7.76	4172	8.82	2562	6.50
Unknown[£]	1	0.00	0	0.00	1	0.00
70-74						
Female	5510	6.35	3710	7.84	1800	4.56
Male	5246	6.05	3540	7.48	1706	4.33
Unknown[£]	0	0.00	0	0.00	0	0.00
Ethnicity						
European	61747	71.18	37837	79.98	23910	60.62
Asian	11335	13.07	5937	12.55	5398	13.69
Pacific	4407	5.08	1112	2.35	3295	8.35
Māori	4084	4.71	1765	3.73	2319	5.88
Other	1111	1.28	500	1.06	611	1.55
Unknown[£]	4069	4.69	159	0.34	3910	9.91
Age (years) - Ethnicity						
50-59						
European	30063	34.65	16056	33.94	14007	35.51
Asian	6593	7.60	3335	7.05	3258	8.26
Pacific	2518	2.90	557	1.18	1961	4.97
Māori	2602	3.00	995	2.10	1607	4.07
Other	722	0.83	301	0.64	421	1.07
Unknown[£]	2390	2.75	68	0.14	2322	5.89
60-69						
European	23246	26.80	15551	32.87	7695	19.51
Asian	3598	4.15	1964	4.15	1634	4.14
Pacific	1453	1.67	439	0.93	1014	2.57
Māori	1152	1.33	575	1.22	577	1.46
Other	300	0.35	157	0.33	143	0.36
Unknown[£]	1360	1.57	62	0.13	1298	3.29
70-74						
European	8438	9.73	6230	13.17	2208	5.60
Asian	1144	1.32	638	1.35	506	1.28
Pacific	436	0.50	116	0.25	320	0.81
Māori	330	0.38	195	0.41	135	0.34
Other	89	0.10	42	0.09	47	0.12
Unknown[£]	319	0.37	29	0.06	290	0.74
Deprivation Index (NZDep)						
1 (least)	8778	10.12	5166	10.92	3612	9.16
2	15865	18.29	9208	19.46	6657	16.88
3	13971	16.10	8049	17.01	5922	15.01
4	8315	9.58	4777	10.10	3538	8.97
5	9066	10.45	5083	10.74	3983	10.10
6	8851	10.20	4965	10.49	3886	9.85
7	9716	11.20	4639	9.81	5077	12.87
8	8111	9.35	3774	7.98	4337	11.00
9	3543	4.08	1455	3.08	2088	5.29
10 (most)	451	0.52	158	0.33	293	0.74
Unknown[£]	86	0.10	36	0.08	50	0.13

Deprivation Index (NZDep) in quintiles						
1 (least)	24643	28.41	14374	30.38	10269	26.04
2	22286	25.69	12826	27.11	9460	23.98
3	17917	20.65	10048	21.24	7869	19.95
4	17827	20.55	8413	17.78	9414	23.87
5 (most)	3994	4.60	1613	3.41	2381	6.04
Unknown£	86	0.10	36	0.08	50	0.13
Enrolment Status Code						
Eligible	83529	96.28	44086	93.19	39443	100.00
Participant	3224	3.72	3224	6.81	0	0.00

£ Unknown responses were coded as missing values

[1] People who received an invitation and iFOBT kit between 1 Jan 2012 and 30 Jun 2013, and did not meet the exclusion criteria

[2] People who responded to the invitation with a completed iFOBT kit between 1 Jan 2012 and 31 Oct 2013, and did not meet the exclusion criteria

[3] People who did not respond to the invitation with a completed iFOBT kit between 1 Jan 2012 and 31 Oct 2013, and did not meet the exclusion criteria

Table 2a. Uptake of screening by demographic factors

		Screening Uptake					
		Responders[2]		Responders with adequate kits[3]			
	Number invited[1]	n	%	n	%	Unadjusted OR (95% CI)	Adjusted[†] OR (95% CI)
Total	86753	47310	54.53	46409	53.50	-	-
Age (years)							
50-54	24803	11138	44.91	10870	43.83	Reference	Reference
55-59	20085	10174	50.65	9940	49.49	1.26 (1.21 , 1.30)	1.26 (1.21 , 1.31)
60-64	17239	9874	57.28	9708	56.31	1.65 (1.59 , 1.72)	1.64 (1.58 , 1.71)
65-69	13870	8874	63.98	8734	62.97	2.18 (2.09 , 2.27)	2.11 (2.01 , 2.20)
70-74	10756	7250	67.40	7157	66.54	2.55 (2.43 , 2.67)	2.44 (2.32 , 2.57)
Sex							
Female	45013	25587	56.84	25126	55.82	Reference	Reference
Male	41735	21722	52.05	21282	50.99	0.82 (0.80 , 0.85)	0.89 (0.86 , 0.91)
Unknown[£]	5	1	20.00	1	20.00	-	-
Sex - Age (years)							
Female: 50-54	13014	6260	48.10	6125	47.06	Reference	Reference
Female: 55-59	10507	5648	53.75	5532	52.65	1.25 (1.19 , 1.32)	1.27 (1.21 , 1.34)
Female: 60-64	8847	5267	59.53	5179	58.54	1.59 (1.50 , 1.68)	1.60 (1.51 , 1.69)
Female: 65-69	7135	4702	65.90	4628	64.86	2.08 (1.96 , 2.20)	2.04 (1.92 , 2.17)
Female: 70-74	5510	3710	67.33	3662	66.46	2.23 (2.09 , 2.38)	2.25 (2.10 , 2.41)
Male: 50-54	11788	4878	41.38	4745	40.25	Reference	Reference
Male: 55-59	9576	4525	47.25	4407	46.02	1.27 (1.20 , 1.34)	1.25 (1.18 , 1.32)
Male: 60-64	8391	4607	54.90	4529	53.97	1.74 (1.64 , 1.84)	1.70 (1.60 , 1.81)
Male: 65-69	6734	4172	61.95	4106	60.97	2.32 (2.18 , 2.47)	2.18 (2.05 , 2.33)
Male: 70-74	5246	3540	67.48	3495	66.62	2.96 (2.77 , 3.17)	2.68 (2.49 , 2.88)
Unknown[£]	5	1	20.00	1	20.00	-	-
Age (years) - Sex							
50-54, Female	13014	6260	48.10	6125	47.06	Reference	Reference
50-54, Male	11788	4878	41.38	4745	40.25	0.76 (0.72 , 0.80)	0.87 (0.83 , 0.92)
55-59, Female	10507	5648	53.75	5532	52.65	Reference	Reference
55-59, Male	9576	4525	47.25	4407	46.02	0.77 (0.73 , 0.81)	0.84 (0.80 , 0.90)
60-64, Female	8847	5267	59.53	5179	58.54	Reference	Reference
60-64, Male	8391	4607	54.90	4529	53.97	0.83 (0.78 , 0.88)	0.91 (0.86 , 0.97)
65-69, Female	7135	4702	65.90	4628	64.86	Reference	Reference
65-69, Male	6734	4172	61.95	4106	60.97	0.85 (0.79 , 0.91)	0.90 (0.84 , 0.97)
70-74, Female	5510	3710	67.33	3662	66.46	Reference	Reference
70-74, Male	5246	3540	67.48	3495	66.62	1.01 (0.93 , 1.09)	1.00 (0.92 , 1.09)
Unknown[£]	5	1	20.00	1	20.00	-	-
Ethnicity							
European	61747	37837	61.28	37201	60.25	Reference	Reference
Asian	11335	5937	52.38	5817	51.32	0.70 (0.67 , 0.72)	0.77 (0.73 , 0.80)
Pacific	4407	1112	25.23	1050	23.83	0.21 (0.19 , 0.22)	0.25 (0.23 , 0.27)
Māori	4084	1765	43.22	1716	42.02	0.48 (0.45 , 0.51)	0.57 (0.53 , 0.61)
Other	1111	500	45.00	479	43.11	0.50 (0.44 , 0.56)	0.58 (0.51 , 0.65)
Unknown[£]	4069	159	3.91	146	3.59	-	-
Age (years) - Ethnicity							
50-59, European	30063	16056	53.41	15712	52.26	Reference	Reference
50-59, Asian	6593	3335	50.58	3258	49.42	0.89 (0.85 , 0.94)	0.93 (0.88 , 0.98)
50-59, Pacific	2518	557	22.12	525	20.85	0.24 (0.22 , 0.27)	0.28 (0.26 , 0.32)
50-59, Māori	2602	995	38.24	964	37.05	0.54 (0.49 , 0.58)	0.59 (0.54 , 0.65)
50-59, Other	722	301	41.69	288	39.89	0.61 (0.52 , 0.70)	0.64 (0.55 , 0.75)
60-69, European	23246	15551	66.90	15326	65.93	Reference	Reference
60-69, Asian	3598	1964	54.59	1929	53.61	0.60 (0.56 , 0.64)	0.62 (0.58 , 0.67)
60-69, Pacific	1453	439	30.21	418	28.77	0.21 (0.19 , 0.23)	0.25 (0.22 , 0.28)
60-69, Māori	1152	575	49.91	561	48.70	0.49 (0.44 , 0.55)	0.53 (0.47 , 0.60)
60-69, Other	300	157	52.33	151	50.33	0.52 (0.42 , 0.66)	0.54 (0.43 , 0.68)
70-74, European	8438	6230	73.83	6163	73.04	Reference	Reference
70-74, Asian	1144	638	55.77	630	55.07	0.45 (0.40 , 0.51)	0.48 (0.42 , 0.54)
70-74, Pacific	436	116	26.61	107	24.54	0.12 (0.10 , 0.15)	0.14 (0.11 , 0.18)

70-74, Māori	330	195	59.09	191	57.88	0.51	(	0.41	,	0.63	)	0.55	(0.44 , 0.69)
70-74, Other	89	42	47.19	40	44.94	0.30	(	0.20	,	0.46	)	0.32	(0.21 , 0.48)
Unknown£	4069	159	3.91	146	3.59			-					-
Deprivation Index (NZDep)													
1 (least)	8778	5166	58.85	5079	57.86	Reference						Reference	
2	15865	9208	58.04	9050	57.04	0.97	(	0.92	,	1.02	)	0.97	(0.91 , 1.02)
3	13971	8049	57.61	7918	56.67	0.95	(	0.90	,	1.01	)	0.92	(0.87 , 0.98)
4	8315	4777	57.45	4698	56.50	0.95	(	0.89	,	1.01	)	0.91	(0.85 , 0.97)
5	9066	5083	56.07	4986	55.00	0.89	(	0.84	,	0.94	)	0.87	(0.82 , 0.93)
6	8851	4965	56.10	4873	55.06	0.89	(	0.84	,	0.95	)	0.87	(0.82 , 0.93)
7	9716	4639	47.75	4533	46.66	0.64	(	0.60	,	0.68	)	0.72	(0.68 , 0.77)
8	8111	3774	46.53	3669	45.23	0.60	(	0.57	,	0.64	)	0.70	(0.65 , 0.75)
9	3543	1455	41.07	1418	40.02	0.49	(	0.45	,	0.53	)	0.63	(0.58 , 0.69)
10 (most)	451	158	35.03	152	33.70	0.37	(	0.30	,	0.45	)	0.49	(0.39 , 0.60)
Unknown£	86	36	41.86	33	38.37			-					-
Deprivation Index (NZDep) quintiles													
1 (least)	24643	14374	58.33	14129	57.33	Reference						Reference	
2	22286	12826	57.55	12616	56.61	0.97	(	0.94	,	1.01	)	0.94	(0.90 , 0.98)
3	17917	10048	56.08	9859	55.03	0.91	(	0.88	,	0.95	)	0.89	(0.86 , 0.93)
4	17827	8413	47.19	8202	46.01	0.63	(	0.61	,	0.66	)	0.73	(0.70 , 0.76)
5 (most)	3994	1613	40.39	1570	39.31	0.48	(	0.45	,	0.52	)	0.63	(0.58 , 0.68)
Unknown£	86	36	41.86	33	38.37			-					-

£ "Unknown" responses were coded as missing values

[1] People who received an invitation and iFOBT kit between 1 Jan 2012 and 30 Jun 2013, and did not meet the exclusion criteria

[2] People who responded to the invitation with a completed iFOBT kit between 1 Jan 2012 and 31 Oct 2013, and did not meet the exclusion criteria

[3] People who responded to the invitation with an adequately completed iFOBT kit between 1 Jan 2012 and 31 Oct 2013, and did not meet the exclusion criteria

† Adjusted for all other demographic variables (ie, Age, Sex, Ethnicity and NZDep2006 quintiles)

OR=odds ratio; CI=confidence interval

Statistically higher than reference group

Statistically lower than reference group

Table 2b. Uptake of colonoscopy by demographic factors

		Colonoscopy Uptake			
		Colonoscopy[≈]		Unadjusted OR (95% CI)	Adjusted[†] OR (95% CI)
	Positive iFOBT*	n	%		
Total	3303	2843	86.07	-	-
Age (years)					
50-54	554	474	85.56	Reference	Reference
55-59	582	515	88.49	1.30 (0.92 , 1.84)	1.30 (0.91 , 1.84)
60-64	647	542	83.77	0.87 (0.64 , 1.19)	0.85 (0.62 , 1.18)
65-69	746	642	86.06	1.04 (0.76 , 1.43)	0.98 (0.71 , 1.35)
70-74	774	670	86.56	1.09 (0.79 , 1.49)	1.04 (0.75 , 1.44)
Sex					
Female	1426	1204	84.43	Reference	Reference
Male	1877	1639	87.32	1.27 (1.04 , 1.55)	1.28 (1.04 , 1.56)
Unknown[£]	0	0	0.00	-	-
Sex - Age (years)					
Female: 50-54	248	209	84.27	Reference	Reference
Female: 55-59	270	234	86.67	1.21 (0.74 , 1.98)	1.19 (0.73 , 1.96)
Female: 60-64	276	228	82.61	0.89 (0.56 , 1.41)	0.88 (0.55 , 1.41)
Female: 65-69	305	267	87.54	1.31 (0.81 , 2.12)	1.25 (0.77 , 2.04)
Female: 70-74	327	266	81.35	0.81 (0.52 , 1.26)	0.80 (0.51 , 1.26)
Male: 50-54	306	265	86.60	Reference	Reference
Male: 55-59	312	281	90.06	1.40 (0.85 , 2.30)	1.48 (0.89 , 2.45)
Male: 60-64	371	314	84.64	0.85 (0.55 , 1.31)	0.84 (0.54 , 1.31)
Male: 65-69	441	375	85.03	0.88 (0.58 , 1.34)	0.84 (0.55 , 1.29)
Male: 70-74	447	404	90.38	1.45 (0.92 , 2.29)	1.42 (0.89 , 2.26)
Unknown[£]	0	0	0.00	-	-
Age (years) - Sex					
50-54, Female	248	209	84.27	Reference	Reference
50-54, Male	306	265	86.60	1.21 (0.75 , 1.94)	1.17 (0.72 , 1.92)
55-59, Female	270	234	86.67	Reference	Reference
55-59, Male	312	281	90.06	1.39 (0.84 , 2.32)	1.45 (0.86 , 2.46)
60-64, Female	276	228	82.61	Reference	Reference
60-64, Male	371	314	84.64	1.16 (0.76 , 1.77)	1.15 (0.75 , 1.77)
65-69, Female	305	267	87.54	Reference	Reference
65-69, Male	441	375	85.03	0.81 (0.53 , 1.24)	0.82 (0.53 , 1.27)
70-74, Female	327	266	81.35	Reference	Reference
70-74, Male	447	404	90.38	2.15 (1.42 , 3.28)	2.19 (1.42 , 3.37)
Unknown[£]	0	0	0.00	-	-
Ethnicity					
European	2605	2246	86.22	Reference	Reference
Asian	426	359	84.27	0.86 (0.64 , 1.14)	0.77 (0.58 , 1.04)
Pacific	85	73	85.88	0.97 (0.52 , 1.81)	0.78 (0.41 , 1.47)
Māori	146	129	88.36	1.21 (0.72 , 2.04)	1.11 (0.65 , 1.87)
Other	28	28	100.00	####### (0.00 , #####)	####### (0.00 , #####)
Unknown[£]	13	8	61.54	-	-
Age (years) - Ethnicity					
50-59, European	823	727	88.34	Reference	Reference
50-59, Asian	201	163	81.09	0.57 (0.38 , 0.86)	0.49 (0.32 , 0.75)
50-59, Pacific	34	29	85.29	0.77 (0.29 , 2.03)	0.57 (0.21 , 1.55)
50-59, Māori	63	55	87.30	0.91 (0.42 , 1.96)	0.79 (0.36 , 1.74)
50-59, Other	14	14	100.00	####### (0.00 , 0.00)	####### (0.00 , 0.00)
60-69, European	1123	949	84.51	Reference	Reference
60-69, Asian	155	134	86.45	1.17 (0.72 , 1.91)	1.10 (0.67 , 1.80)
60-69, Pacific	37	33	89.19	1.51 (0.53 , 4.32)	1.27 (0.43 , 3.73)
60-69, Māori	59	52	88.14	1.36 (0.61 , 3.05)	1.29 (0.57 , 2.91)
60-69, Other	13	13	100.00	####### (0.00 , 0.00)	####### (0.00 , 0.00)

70-74, European	659	570	86.49	Reference	Reference
70-74, Asian	70	62	88.57	1.21 (0.56 , 2.61)	1.07 (0.49 , 2.35)
70-74, Pacific	14	11	78.57	0.57 (0.16 , 2.09)	0.46 (0.12 , 1.79)
70-74, Māori	24	22	91.67	1.72 (0.40 , 7.43)	1.34 (0.30 , 6.03)
70-74, Other	1	1	100.00	76682.06 (0.00 , 0.00)	67173.24 (0.00 , 0.00)
Unknown£	13	8	61.54	-	-
Deprivation Index (NZDep)					
1 (least)	295	243	82.37	Reference	Reference
2	585	476	81.37	0.93 (0.65 , 1.35)	0.94 (0.65 , 1.36)
3	541	470	86.88	1.42 (0.96 , 2.09)	1.46 (0.98 , 2.17)
4	339	293	86.43	1.36 (0.89 , 2.10)	1.37 (0.88 , 2.11)
5	363	317	87.33	1.47 (0.96 , 2.27)	1.49 (0.96 , 2.30)
6	368	319	86.68	1.39 (0.91 , 2.13)	1.37 (0.89 , 2.10)
7	379	341	89.97	1.92 (1.23 , 3.01)	1.97 (1.25 , 3.12)
8	288	257	89.24	1.77 (1.10 , 2.86)	1.89 (1.16 , 3.08)
9	121	108	89.26	1.78 (0.93 , 3.40)	1.81 (0.93 , 3.51)
10 (most)	17	16	94.12	3.42 (0.44 , 26.37)	3.65 (0.47 , 28.41)
Unknown£	7	3	42.86	-	-
Deprivation Index (NZDep) quintiles					
1 (least)	880	719	81.70	Reference	Reference
2	880	763	86.70	1.46 (1.13 , 1.89)	1.49 (1.14 , 1.93)
3	731	636	87.00	1.50 (1.14 , 1.97)	1.49 (1.13 , 1.97)
4	667	598	89.66	1.94 (1.43 , 2.63)	2.02 (1.48 , 2.75)
5 (most)	138	124	89.86	1.98 (1.11 , 3.54)	2.02 (1.12 , 3.65)
Unknown£	7	3	42.86	-	-

£ "Unknown" responses were coded as missing values

* iFOBT: immunochemical faecal occult blood test

⦸ Only includes participants who had a colonoscopy through the public system

† Adjusted for all other demographic variables (ie, Age, Sex, Ethnicity and NZDep2006 quintiles)

OR=odds ratio; CI=confidence interval

Statistically higher than reference group

Statistically lower than reference group

Table 3a. Screening outcomes (Positivity and Detection) by demographic factors

		Positive iFOBT*				Detection											
						Adenoma@				Advanced Adenoma@				Cancer@			
	Adequate return¥	n	%	Unadjusted OR (95% CI)	Adjusted† OR (95% CI)	n	%	Unadjusted OR (95% CI)	Adjusted† OR (95% CI)	n	%	Unadjusted OR (95% CI)	Adjusted† OR (95% CI)	n	%	Unadjusted OR (95% CI)	Adjusted† OR (95% CI)
Total	46409	3303	7.12	-	-	1593	3.43	-	-	887	1.91	-	-	95	0.20	-	-
Age (years)																	
50-54	10870	554	5.10	Reference	Reference	220	2.02	Reference	Reference	119	1.09	Reference	Reference	10	0.09	Reference	Reference
55-59	9940	582	5.86	1.16 (1.03 , 1.31)	1.16 (1.03 , 1.31)	270	2.72	1.35 (1.13 , 1.62)	1.34 (1.12 , 1.61)	147	1.48	1.36 (1.06 , 1.73)	1.35 (1.05 , 1.72)	11	0.11	1.20 (0.51 , 2.83)	1.18 (0.50 , 2.79)
60-64	9708	647	6.66	1.33 (1.18 , 1.49)	1.31 (1.17 , 1.48)	304	3.13	1.56 (1.31 , 1.87)	1.53 (1.28 , 1.82)	168	1.73	1.59 (1.26 , 2.02)	1.54 (1.21 , 1.95)	17	0.18	1.91 (0.87 , 4.16)	1.85 (0.85 , 4.05)
65-69	8734	746	8.54	1.74 (1.55 , 1.95)	1.74 (1.55 , 1.95)	376	4.31	2.18 (1.84 , 2.58)	2.13 (1.79 , 2.52)	219	2.51	2.32 (1.86 , 2.91)	2.23 (1.78 , 2.80)	29	0.33	3.62 (1.76 , 7.43)	3.42 (1.66 , 7.05)
70-74	7157	774	10.81	2.26 (2.02 , 2.53)	2.21 (1.97 , 2.48)	423	5.91	3.04 (2.58 , 3.59)	2.91 (2.46 , 3.43)	234	3.27	3.05 (2.44 , 3.82)	2.86 (2.29 , 3.58)	28	0.39	4.27 (2.07 , 8.79)	3.90 (1.89 , 8.07)
Sex																	
Female	25126	1426	5.68	Reference	Reference	587	2.34	Reference	Reference	329	1.31	Reference	Reference	36	0.14	Reference	Reference
Male	21282	1877	8.82	1.61 (1.50 , 1.73)	1.59 (1.48 , 1.71)	1006	4.73	2.07 (1.87 , 2.30)	2.04 (1.84 , 2.27)	558	2.62	2.03 (1.77 , 2.33)	1.99 (1.74 , 2.29)	59	0.28	1.94 (1.28 , 2.93)	1.89 (1.25 , 2.87)
Unknown£	1	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Sex - Age (years)																	
Female: 50-54	6125	248	4.05	Reference	Reference	73	1.19	Reference	Reference	39	0.64	Reference	Reference	6	0.10	Reference	Reference
Female: 55-59	5532	270	4.88	1.22 (1.02 , 1.45)	1.21 (1.01 , 1.44)	98	1.77	1.50 (1.10 , 2.03)	1.49 (1.10 , 2.03)	49	0.89	1.39 (0.91 , 2.13)	1.39 (0.91 , 2.12)	6	0.11	1.11 (0.36 , 3.44)	1.08 (0.35 , 3.36)
Female: 60-64	5179	276	5.33	1.33 (1.12 , 1.59)	1.33 (1.11 , 1.59)	108	2.09	1.77 (1.31 , 2.38)	1.78 (1.32 , 2.40)	61	1.18	1.86 (1.24 , 2.78)	1.82 (1.21 , 2.72)	7	0.14	1.38 (0.46 , 4.11)	1.37 (0.46 , 4.11)
Female: 65-69	4628	305	6.59	1.67 (1.41 , 1.99)	1.69 (1.42 , 2.01)	142	3.07	2.62 (1.97 , 3.49)	2.65 (1.99 , 3.53)	88	1.90	3.02 (2.07 , 4.42)	2.92 (2.00 , 4.28)	9	0.19	1.99 (0.71 , 5.59)	1.91 (0.67 , 5.43)
Female: 70-74	3662	327	8.93	2.32 (1.96 , 2.76)	2.30 (1.94 , 2.74)	166	4.53	3.94 (2.98 , 5.20)	3.95 (2.98 , 5.23)	92	2.51	4.02 (2.76 , 5.86)	3.81 (2.61 , 5.57)	8	0.22	2.23 (0.77 , 6.44)	2.11 (0.72 , 6.14)
Male: 50-54	4745	306	6.45	Reference	Reference	147	3.10	Reference	Reference	80	1.69	Reference	Reference	4	0.08	Reference	Reference
Male: 55-59	4407	312	7.08	1.11 (0.94 , 1.30)	1.11 (0.94 , 1.31)	172	3.90	1.27 (1.02 , 1.59)	1.27 (1.01 , 1.59)	98	2.22	1.33 (0.98 , 1.79)	1.33 (0.98 , 1.79)	5	0.11	1.35 (0.36 , 5.02)	1.32 (0.35 , 4.93)
Male: 60-64	4529	371	8.19	1.29 (1.11 , 1.51)	1.30 (1.11 , 1.53)	196	4.33	1.41 (1.14 , 1.76)	1.41 (1.13 , 1.75)	107	2.36	1.41 (1.05 , 1.89)	1.40 (1.04 , 1.88)	10	0.22	2.62 (0.82 , 8.37)	2.57 (0.81 , 8.21)
Male: 65-69	4106	441	10.74	1.75 (1.50 , 2.03)	1.78 (1.52 , 2.07)	234	5.70	1.89 (1.53 , 2.33)	1.88 (1.52 , 2.32)	131	3.19	1.92 (1.45 , 2.55)	1.91 (1.44 , 2.53)	20	0.49	5.80 (1.98 , 16.99)	5.59 (1.90 , 16.40)
Male: 70-74	3495	447	12.79	2.13 (1.83 , 2.48)	2.15 (1.84 , 2.51)	257	7.35	2.48 (2.02 , 3.06)	2.44 (1.98 , 3.01)	142	4.06	2.47 (1.87 , 3.26)	2.42 (1.83 , 3.20)	20	0.57	6.82 (2.33 , 19.97)	6.46 (2.20 , 18.99)
Unknown£	1	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Age (years) - Sex																	
50-54, Female	6125	248	4.05	Reference	Reference	73	1.19	Reference	Reference	39	0.64	Reference	Reference	6	0.10	Reference	Reference
50-54, Male	4745	306	6.45	1.63 (1.38 , 1.94)	1.64 (1.38 , 1.94)	147	3.10	2.65 (2.00 , 3.52)	2.64 (1.99 , 3.50)	80	1.69	2.68 (1.82 , 3.93)	2.63 (1.79 , 3.86)	4	0.08	0.86 (0.24 , 3.05)	0.89 (0.25 , 3.17)
55-59, Female	5532	270	4.88	Reference	Reference	98	1.77	Reference	Reference	49	0.89	Reference	Reference	6	0.11	Reference	Reference
55-59, Male	4407	312	7.08	1.48 (1.26 , 1.76)	1.51 (1.27 , 1.79)	172	3.90	2.25 (1.75 , 2.90)	2.28 (1.77 , 2.93)	98	2.22	2.54 (1.80 , 3.59)	2.54 (1.80 , 3.59)	5	0.11	1.05 (0.32 , 3.43)	1.07 (0.33 , 3.52)
60-64, Female	5179	276	5.33	Reference	Reference	108	2.09	Reference	Reference	61	1.18	Reference	Reference	7	0.14	Reference	Reference
60-64, Male	4529	371	8.19	1.59 (1.35 , 1.86)	1.59 (1.35 , 1.87)	196	4.33	2.12 (1.67 , 2.70)	2.13 (1.68 , 2.71)	107	2.36	2.03 (1.48 , 2.79)	2.05 (1.49 , 2.81)	10	0.22	1.64 (0.62 , 4.30)	1.68 (0.64 , 4.43)
65-69, Female	4628	305	6.59	Reference	Reference	142	3.07	Reference	Reference	88	1.90	Reference	Reference	9	0.19	Reference	Reference
65-69, Male	4106	441	10.74	1.71 (1.46 , 1.99)	1.72 (1.48 , 2.01)	234	5.70	1.91 (1.54 , 2.36)	1.93 (1.56 , 2.38)	131	3.19	1.70 (1.29 , 2.23)	1.72 (1.31 , 2.26)	20	0.49	2.51 (1.14 , 5.52)	2.54 (1.15 , 5.59)
70-74, Female	3662	327	8.93	Reference	Reference	166	4.53	Reference	Reference	92	2.51	Reference	Reference	8	0.22	Reference	Reference
70-74, Male	3495	447	12.79	1.50 (1.29 , 1.74)	1.53 (1.31 , 1.78)	257	7.35	1.67 (1.37 , 2.04)	1.70 (1.39 , 2.08)	142	4.06	1.64 (1.26 , 2.15)	1.69 (1.29 , 2.20)	20	0.57	2.63 (1.16 , 5.98)	2.66 (1.17 , 6.06)
Unknown£	1	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Ethnicity																	
European	37201	2605	7.00	Reference	Reference	1312	3.53	Reference	Reference	747	2.01	Reference	Reference	80	0.22	Reference	Reference
Asian	5817	426	7.32	1.05 (0.94 , 1.17)	1.11 (1.00 , 1.24)	167	2.87	0.81 (0.69 , 0.95)	0.86 (0.73 , 1.02)	70	1.20	0.59 (0.46 , 0.76)	0.64 (0.50 , 0.82)	12	0.21	0.96 (0.52 , 1.76)	1.07 (0.58 , 1.98)
Pacific	1050	85	8.10	1.17 (0.93 , 1.47)	1.13 (0.90 , 1.42)	28	2.67	0.75 (0.51 , 1.10)	0.70 (0.48 , 1.03)	17	1.62	0.80 (0.49 , 1.30)	0.77 (0.47 , 1.27)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Māori	1716	146	8.51	1.24 (1.04 , 1.47)	1.29 (1.08 , 1.53)	72	4.20	1.20 (0.94 , 1.53)	1.24 (0.97 , 1.59)	45	2.62	1.31 (0.97 , 1.78)	1.39 (1.02 , 1.89)	2	0.12	0.54 (0.13 , 2.20)	0.61 (0.15 , 2.49)
Other	479	28	5.85	0.82 (0.56 , 1.21)	0.88 (0.60 , 1.30)	12	2.51	0.70 (0.40 , 1.25)	0.77 (0.43 , 1.37)	6	1.25	0.62 (0.28 , 1.39)	0.68 (0.30 , 1.53)	1	0.21	0.97 (0.13 , 6.99)	1.10 (0.15 , 7.93)
Unknown£	146	13	8.90	-	-	2	1.37	-	-	2	1.37	-	-	0	0.00	-	-
Age (years) - Ethnicity																	
50-59, European	15712	823	5.24	Reference	Reference	381	2.42	Reference	Reference	214	1.36	Reference	Reference	17	0.11	Reference	Reference
50-59, Asian	3258	201	6.17	1.19 (1.01 , 1.39)	1.19 (1.01 , 1.40)	68	2.09	0.86 (0.66 , 1.11)	0.87 (0.67 , 1.14)	26	0.80	0.58 (0.39 , 0.88)	0.59 (0.39 , 0.89)	4	0.12	1.13 (0.38 , 3.37)	1.07 (0.35 , 3.22)
50-59, Pacific	525	34	6.48	1.25 (0.88 , 1.79)	1.14 (0.79 , 1.64)	11	2.10	0.86 (0.47 , 1.58)	0.74 (0.40 , 1.37)	8	1.52	1.12 (0.55 , 2.28)	0.95 (0.46 , 1.97)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
50-59, Māori	964	63	6.54	1.27 (0.97 , 1.65)	1.21 (0.93 , 1.59)	25	2.59	1.07 (0.71 , 1.61)	1.00 (0.66 , 1.52)	15	1.56	1.14 (0.68 , 1.94)	1.06 (0.62 , 1.81)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
50-59, Other	288	14	4.86	0.92 (0.54 , 1.59)	0.91 (0.53 , 1.56)	5	1.74	0.71 (0.29 , 1.73)	0.69 (0.28 , 1.69)	3	1.04	0.76 (0.24 , 2.40)	0.74 (0.23 , 2.33)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
60-69, European	15326	1123	7.33	Reference	Reference	564	3.68	Reference	Reference	328	2.14	Reference	Reference	38	0.25	Reference	Reference
60-69, Asian	1929	155	8.04	1.11 (0.93 , 1.32)	1.05 (0.88 , 1.25)	64	3.32	0.90 (0.69 , 1.17)	0.85 (0.65 , 1.11)	28	1.45	0.67 (0.46 , 0.99)	0.65 (0.44 , 0.96)	6	0.31	1.26 (0.53 , 2.97)	1.15 (0.48 , 2.75)
60-69, Pacific	418	37	8.85	1.23 (0.87 , 1.73)	1.05 (0.74 , 1.50)	12	2.87	0.77 (0.43 , 1.38)	0.66 (0.37 , 1.19)	7	1.67	0.78 (0.37 , 1.66)	0.69 (0.32 , 1.50)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
60-69, Māori	561	59	10.52	1.49 (1.13 , 1.96)	1.40 (1.05 , 1.85)	33	5.88	1.64 (1.14 , 2.35)	1.53 (1.06 , 2.21)	20	3.57	1.69 (1.07 , 2.68)	1.61 (1.01 , 2.56)	1	0.18	0.72 (0.10 , 5.24)	0.64 (0.09 , 4.71)
60-69, Other	151	13	8.61	1.19 (0.67 , 2.11)	1.11 (0.62 , 1.96)	6	3.97	1.08 (0.48 , 2.46)	0.99 (0.43 , 2.26)	3	1.99	0.93 (0.29 , 2.92)	0.85 (0.27 , 2.68)	1	0.66	2.68 (0.37 , 19.66)	2.31 (0.31 , 16.99)
70-74, European	6163	659	10.69	Reference	Reference	367	5.95	Reference	Reference	205	3.33	Reference	Reference	25	0.41	Reference	Reference
70-74, Asian	630	70	11.11	1.04 (0.80 , 1.36)	1.00 (0.77 , 1.31)	35	5.56	0.93 (0.65 , 1.33)	0.84 (0.59 , 1.21)	16	2.54	0.76 (0.45 , 1.27)	0.70 (0.42 , 1.18)	2	0.32	0.78 (0.18 , 3.31)	0.72 (0.17 , 3.09)
70-74, Pacific	107	14	13.08	1.26 (0.71 , 2.22)	1.20 (0.67 , 2.14)	5	4.67	0.77 (0.31 , 1.91)	0.65 (0.26 , 1.61)	2	1.87	0.55 (0.14 , 2.26)	0.49 (0.12 , 2.03)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
70-74, Māori	191	24	12.57	1.20 (0.78 , 1.86)	1.18 (0.76 , 1.84)	14	7.33	1.25 (0.72 , 2.17)	1.15 (0.66 , 2.01)	10	5.24	1.61 (0.84 , 3.08)	1.53 (0.79 , 2.96)	1	0.52	1.29 (0.17 , 9.59)	1.29 (0.17 , 9.70)
70-74, Other	40	1	2.50	0.21 (0.03 , 1.56)	0.20 (0.03 , 1.48)	1	2.50	0.41 (0.06 , 2.96)	0.37 (0.05 , 2.74)	0	0.00	0.00 (0.00 , ####)	0.00 (0.00 , ####)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Unknown£	146	13	8.90	-	-	2	1.37	-	-	2	1.37	-	-	0	0.00	-	-
Deprivation Index (NZDep)																	
1 (least)	5079	295	5.81	Reference	Reference	149	2.93	Reference	Reference	83	1.63	Reference	Reference	4	0.08	Reference	Reference
2	9050	585	6.46	1.12 (0.97 , 1.29)	1.09 (0.95 , 1.27)	271	2.99	1.02 (0.83 , 1.25)	1.00 (0.82 , 1.23)	148	1.64	1.00 (0.76 , 1.31)	0.99 (0.75 , 1.30)	15	0.17	2.11 (0.70 , 6.35)	2.05 (0.68 , 6.19)
3	7918	541	6.83	1.19 (1.03 , 1.38)	1.14 (0.99 , 1.33)	265	3.35	1.15 (0.93 , 1.40)	1.10 (0.90 , 1.35)	154	1.94	1.19 (0.91 , 1.56)	1.16 (0.89 , 1.52)	21	0.27	3.37 (1.16 , 9.83)	3.17 (1.09 , 9.25)
4	4698	339	7.22	1.26 (1.07 , 1.48)	1.21 (1.03 , 1.42)	178	3.79	1.30 (1.04 , 1.63)	1.25 (1.00 , 1.56)	98	2.09	1.28 (0.95 , 1.72)	1.24 (0.92 , 1.67)	9	0.19	2.44 (0.75 , 7.91)	2.28 (0.70 , 7.41)
5	4986	363	7.28	1.27 (1.09 , 1.49)	1.20 (1.02 , 1.41)	168	3.37	1.15 (0.92 , 1.44)	1.09 (0.87 , 1.37)	102	2.05	1.26 (0.94 , 1.68)	1.21 (0.90 , 1.63)	9	0.18	2.29 (0.71 , 7.45)	2.11 (0.65 , 6.88)
6	4873	368	7.55	1.32 (1.13 , 1.55)	1.23 (1.05 , 1.45)	156	3.20	1.09 (0.87 , 1.37)	1.03 (0.82 , 1.29)	86	1.76	1.08 (0.80 , 1.47)	1.03 (0.76 , 1.40)	16	0.33	4.18 (1.40 , 12.51)	3.77 (1.26 , 11.33)
7	4533	379	8.36	1.48 (1.26 , 1.73)	1.41 (1.20 , 1.65)	198	4.37	1.51 (1.22 , 1.88)	1.50 (1.21 , 1.87)	112	2.47	1.52 (1.14 , 2.03)	1.53 (1.15 , 2.05)	7	0.15	1.96 (0.57 , 6.71)	2.02 (0.59 , 6.95)
8	3669	288	7.85	1.38 (1.17 , 1.63)	1.31 (1.10 , 1.55)	135	3.68	1.26 (1.00 , 1.60)	1.26 (0.99 , 1.60)	67	1.83	1.12 (0.81 , 1.55)	1.14 (0.82 , 1.58)	10	0.27	3.47 (1.09 , 11.06)	3.54 (1.10 , 11.35)
9	1418	121	8.53	1.51 (1.21 , 1.89)	1.42 (1.14 , 1.78)	64	4.51	1.56 (1.16 , 2.11)	1.62 (1.19 , 2.19)	32	2.26	1.39 (0.92 , 2.10)	1.48 (0.97 , 2.25)	4	0.28	3.59 (0.90 , 14.37)	3.93 (0.97 , 15.94)
10 (most)	152	17	11.18	2.04 (1.22 , 3.43)	1.93 (1.14 , 3.26)	9	5.92	2.08 (1.04 , 4.16)	2.12 (1.05 , 4.27)	5	3.29	2.05 (0.82 , 5.12)	2.12 (0.84 , 5.34)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Unknown£	33	7	21.21	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-

Deprivation Index (NZDep) quintiles																								
1 (least)	14129	880	6.23	Reference			Reference			420	2.97	Reference			Reference			231	1.63	Reference			Reference			19	0.13	Reference			Reference		
2	12616	880	6.98	1.13	(1.02 ,	1.24)	1.10	(1.00 ,	1.21)	443	3.51	1.19	(1.04 ,	1.36)	1.16	(1.01 ,	1.32)	252	2.00	1.23	(1.02 ,	1.47)	1.20	(1.00 ,	1.44)	30	0.24	1.77	(1.00 ,	3.15)	1.69	(0.95 ,	3.00)
3	9859	731	7.41	1.21	(1.09 ,	1.33)	1.15	(1.03 ,	1.27)	324	3.29	1.11	(0.96 ,	1.29)	1.06	(0.91 ,	1.23)	188	1.91	1.17	(0.96 ,	1.42)	1.13	(0.93 ,	1.37)	25	0.25	1.89	(1.04 ,	3.43)	1.75	(0.96 ,	3.18)
4	8202	667	8.13	1.33	(1.20 ,	1.48)	1.29	(1.16 ,	1.43)	333	4.06	1.38	(1.19 ,	1.60)	1.39	(1.20 ,	1.62)	179	2.18	1.34	(1.10 ,	1.63)	1.37	(1.12 ,	1.67)	17	0.21	1.54	(0.80 ,	2.97)	1.61	(0.83 ,	3.11)
5 (most)	1570	138	8.79	1.45	(1.20 ,	1.75)	1.39	(1.14 ,	1.68)	73	4.65	1.59	(1.23 ,	2.05)	1.66	(1.28 ,	2.16)	37	2.36	1.45	(1.02 ,	2.06)	1.56	(1.09 ,	2.23)	4	0.25	1.90	(0.64 ,	5.58)	2.10	(0.70 ,	6.24)
Unknown£	33	7	21.21	-			-			0	0.00	-			-			0	0.00	-			-			0	0.00	-			-		

£ "Unknown" responses were coded as missing values

⁑ Participants who responded with an adequate iFOBT kit and did not meet the exclusion criteria

* iFOBT: immunochemical faecal occult blood test

ϖ Only includes participants who had a colonoscopy through the public system

† Adjusted for all other demographic variables (ie, Age, Sex, Ethnicity and NZDep2006 quintiles)

OR=odds ratio; CI=confidence interval

Statistically higher than reference group

Statistically lower than reference group

Table 3b. Positive Predictive Value of Positive iFOBT* by demographic factors

	Positive iFOBT*	Positive Predictive Value‡ of positive iFOBT*											
		Adenoma≎				Advanced Adenoma≎				Cancer≎			
				Unadjusted OR (95% CI)	Adjusted† OR (95% CI)			Unadjusted OR (95% CI)	Adjusted† OR (95% CI)			Unadjusted OR (95% CI)	Adjusted† OR (95% CI)
	n	n	%			n	%			n	%		
Total	3303	1593	48.23	-	-	887	26.85	-	-	95	2.88	-	-
Age (years)													
50-54	554	220	39.71	Reference	Reference	119	21.48	Reference	Reference	10	1.81	Reference	Reference
55-59	582	270	46.39	1.31 (1.04 , 1.66)	1.33 (1.05 , 1.69)	147	25.26	1.24 (0.94 , 1.63)	1.25 (0.94 , 1.65)	11	1.89	1.05 (0.44 , 2.49)	1.03 (0.44 , 2.46)
60-64	647	304	46.99	1.35 (1.07 , 1.69)	1.31 (1.04 , 1.65)	168	25.97	1.28 (0.98 , 1.68)	1.23 (0.94 , 1.61)	17	2.63	1.47 (0.67 , 3.23)	1.45 (0.66 , 3.19)
65-69	746	376	50.40	1.54 (1.23 , 1.93)	1.48 (1.18 , 1.86)	219	29.36	1.52 (1.17 , 1.96)	1.44 (1.11 , 1.87)	29	3.89	2.20 (1.06 , 4.55)	2.07 (1.00 , 4.31)
70-74	774	423	54.65	1.83 (1.47 , 2.28)	1.77 (1.41 , 2.22)	234	30.23	1.58 (1.23 , 2.04)	1.49 (1.15 , 1.93)	28	3.62	2.04 (0.98 , 4.24)	1.90 (0.91 , 3.98)
				-	-								
Sex													
Female	1426	587	41.16	Reference	Reference	329	23.07	Reference	Reference	36	2.52	Reference	Reference
Male	1877	1006	53.60	1.65 (1.44 , 1.90)	1.63 (1.42 , 1.88)	558	29.73	1.41 (1.20 , 1.65)	1.39 (1.18 , 1.63)	59	3.14	1.25 (0.82 , 1.91)	1.23 (0.80 , 1.87)
Unknown£	0	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Sex - Age (years)													
Female: 50-54	248	73	29.44	Reference	Reference	39	15.73	Reference	Reference	6	2.42	Reference	Reference
Female: 55-59	270	98	36.30	1.37 (0.94 , 1.97)	1.43 (0.98 , 2.07)	49	18.15	1.19 (0.75 , 1.88)	1.20 (0.75 , 1.91)	6	2.22	0.92 (0.29 , 2.88)	0.83 (0.26 , 2.65)
Female: 60-64	276	108	39.13	1.54 (1.07 , 2.22)	1.56 (1.08 , 2.26)	61	22.10	1.52 (0.97 , 2.37)	1.45 (0.92 , 2.27)	7	2.54	1.05 (0.35 , 3.17)	1.03 (0.34 , 3.15)
Female: 65-69	305	142	46.56	2.09 (1.47 , 2.97)	2.18 (1.52 , 3.13)	88	28.85	2.17 (1.42 , 3.31)	2.13 (1.38 , 3.27)	9	2.95	1.23 (0.43 , 3.49)	1.07 (0.37 , 3.12)
Female: 70-74	327	166	50.76	2.47 (1.74 , 3.50)	2.59 (1.81 , 3.70)	92	28.13	2.10 (1.38 , 3.19)	1.98 (1.29 , 3.03)	8	2.45	1.01 (0.35 , 2.95)	0.99 (0.33 , 2.96)
Male: 50-54	306	147	48.04	Reference	Reference	80	26.14	Reference	Reference	4	1.31	Reference	Reference
Male: 55-59	312	172	55.13	1.33 (0.97 , 1.82)	1.34 (0.97 , 1.84)	98	31.41	1.29 (0.91 , 1.83)	1.31 (0.92 , 1.86)	5	1.60	1.23 (0.33 , 4.62)	1.25 (0.33 , 4.71)
Male: 60-64	371	196	52.83	1.21 (0.89 , 1.64)	1.18 (0.87 , 1.60)	107	28.84	1.14 (0.82 , 1.61)	1.12 (0.79 , 1.57)	10	2.70	2.09 (0.65 , 6.73)	2.03 (0.63 , 6.54)
Male: 65-69	441	234	53.06	1.22 (0.91 , 1.64)	1.15 (0.86 , 1.55)	131	29.71	1.19 (0.86 , 1.66)	1.15 (0.83 , 1.60)	20	4.54	3.58 (1.21 , 10.59)	3.38 (1.14 , 10.01)
Male: 70-74	447	257	57.49	1.46 (1.09 , 1.96)	1.39 (1.03 , 1.88)	142	31.77	1.32 (0.95 , 1.82)	1.26 (0.90 , 1.75)	20	4.47	3.53 (1.20 , 10.44)	3.35 (1.12 , 9.97)
Unknown£	0	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Age (years) - Sex													
50-54, Female	248	73	29.44	Reference	Reference	39	15.73	Reference	Reference	6	2.42	Reference	Reference
50-54, Male	306	147	48.04	2.22 (1.56 , 3.16)	2.18 (1.52 , 3.13)	80	26.14	1.90 (1.24 , 2.91)	1.78 (1.15 , 2.75)	4	1.31	0.53 (0.15 , 1.91)	0.58 (0.16 , 2.12)
55-59, Female	270	98	36.30	Reference	Reference	49	18.15	Reference	Reference	6	2.22	Reference	Reference
55-59, Male	312	172	55.13	2.16 (1.54 , 3.01)	2.20 (1.56 , 3.09)	98	31.41	2.07 (1.40 , 3.05)	2.05 (1.38 , 3.06)	5	1.60	0.72 (0.22 , 2.37)	0.72 (0.22 , 2.44)
60-64, Female	276	108	39.13	Reference	Reference	61	22.10	Reference	Reference	7	2.54	Reference	Reference
60-64, Male	371	196	52.83	1.74 (1.27 , 2.39)	1.75 (1.27 , 2.42)	107	28.84	1.43 (0.99 , 2.05)	1.42 (0.98 , 2.06)	10	2.70	1.06 (0.40 , 2.83)	1.14 (0.43 , 3.08)
65-69, Female	305	142	46.56	Reference	Reference	88	28.85	Reference	Reference	9	2.95	Reference	Reference
65-69, Male	441	234	53.06	1.30 (0.97 , 1.74)	1.26 (0.94 , 1.70)	131	29.71	1.04 (0.76 , 1.44)	1.03 (0.74 , 1.42)	20	4.54	1.56 (0.70 , 3.48)	1.42 (0.63 , 3.20)
70-74, Female	327	166	50.76	Reference	Reference	92	28.13	Reference	Reference	8	2.45	Reference	Reference
70-74, Male	447	257	57.49	1.31 (0.98 , 1.75)	1.34 (1.00 , 1.80)	142	31.77	1.19 (0.87 , 1.63)	1.19 (0.87 , 1.64)	20	4.47	1.87 (0.81 , 4.29)	1.84 (0.79 , 4.27)
Unknown£	0	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Ethnicity													
European	2605	1312	50.36	Reference	Reference	747	28.68	Reference	Reference	80	3.07	Reference	Reference
Asian	426	167	39.20	0.64 (0.52 , 0.78)	0.65 (0.53 , 0.81)	70	16.43	0.49 (0.37 , 0.64)	0.51 (0.38 , 0.67)	12	2.82	0.91 (0.49 , 1.69)	1.00 (0.53 , 1.87)
Pacific	85	28	32.94	0.48 (0.31 , 0.77)	0.46 (0.29 , 0.74)	17	20.00	0.62 (0.36 , 1.07)	0.63 (0.36 , 1.09)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Māori	146	72	49.32	0.96 (0.69 , 1.34)	0.95 (0.68 , 1.34)	45	30.82	1.11 (0.77 , 1.59)	1.13 (0.79 , 1.64)	2	1.37	0.44 (0.11 , 1.80)	0.47 (0.11 , 1.96)
Other	28	12	42.86	0.74 (0.35 , 1.57)	0.74 (0.35 , 1.60)	6	21.43	0.68 (0.27 , 1.68)	0.68 (0.27 , 1.70)	1	3.57	1.17 (0.16 , 8.71)	1.21 (0.16 , 9.17)
Unknown£	13	2	15.38	-	-	2	15.38	-	-	0	0.00	-	-
Age (years) - Ethnicity													
50-59, European	823	381	46.29	Reference	Reference	214	26.00	Reference	Reference	17	2.07	Reference	Reference
50-59, Asian	201	68	33.83	0.59 (0.43 , 0.82)	0.59 (0.42 , 0.82)	26	12.94	0.42 (0.27 , 0.66)	0.42 (0.27 , 0.65)	4	1.99	0.96 (0.32 , 2.89)	0.89 (0.29 , 2.71)
50-59, Pacific	34	11	32.35	0.55 (0.27 , 1.15)	0.47 (0.22 , 1.00)	8	23.53	0.88 (0.39 , 1.96)	0.77 (0.34 , 1.76)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
50-59, Māori	63	25	39.68	0.76 (0.45 , 1.29)	0.70 (0.41 , 1.21)	15	23.81	0.89 (0.49 , 1.62)	0.84 (0.46 , 1.56)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , ####)
50-59, Other	14	5	35.71	0.64 (0.21 , 1.94)	0.58 (0.19 , 1.81)	3	21.43	0.78 (0.21 , 2.81)	0.70 (0.19 , 2.60)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
60-69, European	1123	564	50.22	Reference	Reference	328	29.21	Reference	Reference	38	3.38	Reference	Reference
60-69, Asian	155	64	41.29	0.70 (0.50 , 0.98)	0.71 (0.50 , 1.00)	28	18.06	0.53 (0.35 , 0.82)	0.55 (0.36 , 0.85)	6	3.87	1.15 (0.48 , 2.77)	1.13 (0.46 , 2.78)
60-69, Pacific	37	12	32.43	0.48 (0.24 , 0.96)	0.48 (0.23 , 0.99)	7	18.92	0.57 (0.25 , 1.30)	0.61 (0.26 , 1.42)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
60-69, Māori	59	33	55.93	1.26 (0.74 , 2.13)	1.28 (0.75 , 2.18)	20	33.90	1.24 (0.71 , 2.16)	1.29 (0.74 , 2.26)	1	1.69	0.49 (0.07 , 3.65)	0.49 (0.06 , 3.64)
60-69, Other	13	6	46.15	0.85 (0.28 , 2.54)	0.74 (0.25 , 2.24)	3	23.08	0.73 (0.20 , 2.66)	0.68 (0.18 , 2.49)	1	7.69	2.38 (0.30 , 18.77)	2.00 (0.25 , 16.03)
70-74, European	659	367	55.69	Reference	Reference	205	31.11	Reference	Reference	25	3.79	Reference	Reference

70-74, Asian	70	35	50.00	0.80 (0.49 , 1.30)	0.72 (0.43 , 1.19)	16	22.86	0.66 (0.37 , 1.17)	0.63 (0.35 , 1.14)	2	2.86	0.75 (0.17 , 3.22)	0.72 (0.16 , 3.14)
70-74, Pacific	14	5	35.71	0.44 (0.15 , 1.33)	0.35 (0.11 , 1.08)	2	14.29	0.37 (0.08 , 1.66)	0.34 (0.08 , 1.57)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
70-74, Māori	24	14	58.33	1.11 (0.49 , 2.54)	0.90 (0.38 , 2.14)	10	41.67	1.58 (0.69 , 3.62)	1.45 (0.61 , 3.43)	1	4.17	1.10 (0.14 , 8.49)	0.99 (0.12 , 8.28)
70-74, Other	1	1	100.00	161009.78 (0.00 , 0.00)	125255.34 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Unknown£	13	2	15.38	-	-	2	15.38	-	-	0	0.00	-	-
Deprivation Index (NZDep)													
1 (least)	295	149	50.51	Reference	Reference	83	28.14	Reference	Reference	4	1.36	Reference	Reference
2	585	271	46.32	0.85 (0.64 , 1.12)	0.84 (0.63 , 1.12)	148	25.30	0.87 (0.63 , 1.19)	0.88 (0.64 , 1.21)	15	2.56	1.91 (0.63 , 5.82)	1.88 (0.62 , 5.72)
3	541	265	48.98	0.94 (0.71 , 1.25)	0.92 (0.69 , 1.23)	154	28.47	1.02 (0.74 , 1.39)	1.03 (0.75 , 1.41)	21	3.88	2.94 (1.00 , 8.64)	2.69 (0.91 , 7.93)
4	339	178	52.51	1.08 (0.79 , 1.48)	1.07 (0.78 , 1.48)	98	28.91	1.04 (0.74 , 1.47)	1.06 (0.75 , 1.50)	9	2.65	1.98 (0.60 , 6.51)	1.88 (0.57 , 6.20)
5	363	168	46.28	0.84 (0.62 , 1.15)	0.84 (0.61 , 1.15)	102	28.10	1.00 (0.71 , 1.40)	1.02 (0.72 , 1.44)	9	2.48	1.85 (0.56 , 6.07)	1.75 (0.53 , 5.76)
6	368	156	42.39	0.72 (0.53 , 0.98)	0.71 (0.52 , 0.97)	86	23.37	0.78 (0.55 , 1.11)	0.78 (0.55 , 1.11)	16	4.35	3.31 (1.09 , 10.00)	3.12 (1.03 , 9.47)
7	379	198	52.24	1.07 (0.79 , 1.45)	1.17 (0.86 , 1.60)	112	29.55	1.07 (0.77 , 1.50)	1.16 (0.83 , 1.64)	7	1.85	1.37 (0.40 , 4.72)	1.44 (0.41 , 4.97)
8	288	135	46.88	0.86 (0.62 , 1.20)	0.91 (0.65 , 1.27)	67	23.26	0.77 (0.53 , 1.12)	0.84 (0.58 , 1.23)	10	3.47	2.62 (0.81 , 8.44)	2.57 (0.79 , 8.34)
9	121	64	52.89	1.10 (0.72 , 1.68)	1.17 (0.76 , 1.82)	32	26.45	0.92 (0.57 , 1.48)	0.99 (0.61 , 1.62)	4	3.31	2.49 (0.61 , 10.11)	2.79 (0.67 , 11.60)
10 (most)	17	9	52.94	1.10 (0.41 , 2.94)	1.36 (0.49 , 3.73)	5	29.41	1.06 (0.36 , 3.11)	1.29 (0.43 , 3.86)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Unknown£	7	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Deprivation Index (NZDep) quintiles													
1 (least)	880	420	47.73	Reference	Reference	231	26.25	Reference	Reference	19	2.16	Reference	Reference
2	880	443	50.34	1.11 (0.92 , 1.34)	1.09 (0.90 , 1.32)	252	28.64	1.13 (0.91 , 1.39)	1.13 (0.91 , 1.40)	30	3.41	1.60 (0.89 , 2.86)	1.50 (0.83 , 2.69)
3	731	324	44.32	0.87 (0.72 , 1.06)	0.86 (0.70 , 1.06)	188	25.72	0.97 (0.78 , 1.22)	0.97 (0.77 , 1.22)	25	3.42	1.60 (0.88 , 2.94)	1.53 (0.83 , 2.81)
4	667	333	49.93	1.09 (0.89 , 1.34)	1.18 (0.96 , 1.45)	179	26.84	1.03 (0.82 , 1.29)	1.11 (0.88 , 1.40)	17	2.55	1.19 (0.61 , 2.30)	1.22 (0.62 , 2.38)
5 (most)	138	73	52.90	1.23 (0.86 , 1.76)	1.34 (0.92 , 1.94)	37	26.81	1.03 (0.69 , 1.54)	1.11 (0.73 , 1.69)	4	2.90	1.35 (0.45 , 4.04)	1.55 (0.51 , 4.71)
Unknown£	7	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-

* iFOBT: immunochemical faecal occult blood test

£ "Unknown" responses were coded as missing values

‡ Positive Predictive Value: percent of people with adenoma/advanced adenoma/cancer in those who had a positive iFOBT

ৎ Only includes participants who had a colonoscopy through the public system

† Adjusted for all other demographic variables (ie, Age, Sex, Ethnicity and NZDep2006 quintiles)

OR=odds ratio; CI=confidence interval

Statistically higher than reference group

Statistically lower than reference group

Table 4. The TNM stages of detected colorectal cancers

	n	Rate per 100,000
Population	86753	-
Total	95	109.5
Stages		
1	37	42.6
2	16	18.4
2a	3	3.5
2b	2	2.3
2c	1	1.2
3	11	12.7
3a	4	4.6
3b	6	6.9
3c	1	1.2
4	7	8.1
4a	0	0.0
4b	1	1.2
Uncertain	3	3.5
Not applicable	3	3.5

N.B. Only includes participants with a histopathology result through the public healthcare system between 1 Jan 2012-31 Oct 2013, who were invited between 1 Jan 2012-30 Jun 2013

Table 5. Self-Selected people (Uptake, Positivity and Detection) by demographic factors

		Adequate return[ɤ]		Screening Uptake		Positive iFOBT*				Detection									
										Adenoma[ø]				Advanced Adenoma[ø]				Cancer[ø]	
	Self-Selected people	n	%	Unadjusted OR (95% CI)	Adjusted[†] OR (95% CI)	n	%	Unadjusted OR (95% CI)	Adjusted[†] OR (95% CI)	n	%	Unadjusted OR (95% CI)	Adjusted[†] OR (95% CI)	n	%	Unadjusted OR (95% CI)	Adjusted[†] OR (95% CI)	n	%	Unadjusted OR (95% CI)	Adjusted[†] OR (95% CI)
Total	1895	1676	88.44	-	-	156	9.31	-	-	79	4.71	-	-	47	2.80	-	-	11	0.66	-	-
Age (years)																					
50-54	275	209	76.00	Reference	Reference	9	4.31	Reference	Reference	3	1.44	Reference	Reference	1	0.48	Reference	Reference	1	0.48	Reference	Reference
55-59	311	268	86.17	1.97 (1.29 , 3.01)	2.28 (1.43 , 3.63)	13	4.85	1.13 (0.47 , 2.70)	1.11 (0.46 , 2.66) 0.8181	8	2.99	2.11 (0.55 , 8.06)	2.14 (0.56 , 8.23)	4	1.49	3.15 (0.35 , 28.35)	2.89 (0.32 , 26.22)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
60-64	333	287	86.19	1.97 (1.30 , 2.99)	1.91 (1.23 , 2.98)	19	6.62	1.58 (0.70 , 3.55)	1.60 (0.70 , 3.62) 0.2627	12	4.18	3.00 (0.83 , 10.75)	3.14 (0.87 , 11.33)	9	3.14	6.73 (0.85 , 53.46)	6.41 (0.80 , 51.23)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
65-69	338	305	90.24	2.92 (1.85 , 4.59)	3.03 (1.85 , 4.97)	30	9.84	2.42 (1.13 , 5.22)	2.41 (1.11 , 5.22) 0.0256 *	15	4.92	3.55 (1.02 , 12.43)	3.65 (1.04 , 12.85)	13	4.26	9.25 (1.20 , 71.19)	8.91 (1.15 , 68.92)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
70-74	638	607	95.14	6.18 (3.92 , 9.74)	5.19 (3.21 , 8.38)	85	14.00	3.62 (1.79 , 7.33)	3.62 (1.77 , 7.40) 0.0004 **	41	6.75	4.97 (1.52 , 16.24)	5.10 (1.55 , 16.78)	20	3.29	7.08 (0.95 , 53.02)	6.69 (0.89 , 50.48)	10	1.65	3.48 (0.44 , 27.38)	3.41 (0.42 , 27.50)
Sex																					
Female	955	851	89.11	Reference	Reference	63	7.40	Reference	Reference	31	3.64	Reference	Reference	19	2.23	Reference	Reference	4	0.47	Reference	Reference
Male	940	825	87.77	0.88 (0.66 , 1.16)	1.08 (0.79 , 1.47)	93	11.27	1.59 (1.14 , 2.22)	1.65 (1.17 , 2.33) 0.0039 **	48	5.82	1.63 (1.03 , 2.59)	1.69 (1.06 , 2.70)	28	3.39	1.54 (0.85 , 2.78)	1.62 (0.89 , 2.95)	7	0.85	1.81 (0.53 , 6.21)	2.05 (0.57 , 7.39)
Sex - Age (years)																					
Female: 50-54	133	104	78.20	Reference	Reference	3	2.88	Reference	Reference	1	0.96	Reference	Reference	0	0.00	Reference	Reference	0	0.00	Reference	Reference
Female: 55-59	152	132	86.84	1.84 (0.99 , 3.44)	1.87 (0.98 , 3.58)	5	3.79	1.33 (0.31 , 5.68)	1.33 (0.31 , 5.76) 0.7041	5	3.79	4.05 (0.47 , 35.25)	4.60 (0.52 , 40.98)	3	2.27	63194.62 (0.00 , #####)	13854.93 (0.00 , #####)	0	0.00	1.00 (0.00 , #####)	1.30 (0.00 , #####)
Female: 60-64	165	145	87.88	2.02 (1.08 , 3.77)	1.98 (1.04 , 3.77)	6	4.14	1.45 (0.36 , 5.95)	1.47 (0.36 , 6.07) 0.5957	5	3.45	3.68 (0.42 , 31.96)	3.83 (0.43 , 33.99)	4	2.76	77088.47 (0.00 , #####)	15026.03 (0.00 , #####)	0	0.00	1.00 (0.00 , #####)	0.90 (0.00 , #####)
Female: 65-69	179	160	89.39	2.35 (1.25 , 4.40)	2.23 (1.17 , 4.27)	14	8.75	3.23 (0.90 , 11.52)	2.75 (0.76 , 10.00) 0.1245	5	3.13	3.32 (0.38 , 28.85)	2.70 (0.30 , 24.23)	4	2.50	69676.12 (0.00 , #####)	10093.00 (0.00 , #####)	0	0.00	1.00 (0.00 , #####)	0.81 (0.00 , #####)
Female: 70-74	326	310	95.09	5.40 (2.82 , 10.34)	5.10 (2.58 , 10.10)	35	11.29	4.28 (1.29 , 14.24)	3.82 (1.13 , 12.96) 0.0314 *	15	4.84	5.24 (0.68 , 40.14)	4.62 (0.59 , 36.48)	8	2.58	71983.28 (0.00 , #####)	10638.30 (0.00 , #####)	4	1.29	61424.94 (0.00 , #####)	8723.03 (0.00 , #####)
Male: 50-54	142	105	73.94	Reference	Reference	6	5.71	Reference	Reference	2	1.90	Reference	Reference	1	0.95	Reference	Reference	1	0.95	Reference	Reference
Male: 55-59	159	136	85.53	2.08 (1.17 , 3.72)	2.87 (1.46 , 5.66)	8	5.88	1.03 (0.35 , 3.07)	0.99 (0.33 , 2.96) 0.9819	3	2.21	1.16 (0.19 , 7.08)	1.08 (0.18 , 6.67)	1	0.74	0.77 (0.05 , 12.46)	0.67 (0.04 , 11.02)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
Male: 60-64	168	142	84.52	1.92 (1.10 , 3.37)	2.06 (1.10 , 3.83)	13	9.15	1.66 (0.61 , 4.53)	1.61 (0.58 , 4.41) 0.3584	7	4.93	2.67 (0.54 , 13.12)	2.51 (0.50 , 12.45)	5	3.52	3.80 (0.44 , 32.98)	3.46 (0.39 , 30.54)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
Male: 65-69	159	145	91.19	3.65 (1.88 , 7.09)	5.64 (2.43 , 13.06)	16	11.03	2.05 (0.77 , 5.42)	1.95 (0.73 , 5.19) 0.1841	10	6.90	3.81 (0.82 , 17.79)	3.55 (0.76 , 16.70)	9	6.21	6.88 (0.86 , 55.18)	6.44 (0.79 , 52.32)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
Male: 70-74	312	297	95.19	6.98 (3.68 , 13.23)	6.14 (3.06 , 12.29)	50	16.84	3.34 (1.39 , 8.04)	3.11 (1.28 , 7.56) 0.0120 *	26	8.75	4.94 (1.15 , 21.19)	4.44 (1.03 , 19.17)	12	4.04	4.38 (0.56 , 34.09)	3.90 (0.50 , 30.63)	6	2.02	2.14 (0.26 , 18.02)	2.00 (0.23 , 17.15)
Age (years) - Sex																					
50-54, Female	133	104	78.20	Reference	Reference	3	2.88	Reference	Reference	1	0.96	Reference	Reference	0	0.00	Reference	Reference	0	0.00	Reference	Reference
50-54, Male	142	105	73.94	0.79 (0.45 , 1.38)	0.99 (0.55 , 1.81)	6	5.71	2.04 (0.50 , 8.39)	1.89 (0.45 , 7.97) 0.3867	2	1.90	2.00 (0.18 , 22.40)	1.96 (0.17 , 22.70)	1	0.95	44388.56 (0.00 , #####)	1500.13 (0.00 , #####)	1	0.95	44388.56 (0.00 , #####)	1255.49 (0.00 , #####)
55-59, Female	152	132	86.84	Reference	Reference	5	3.79	Reference	Reference	5	3.79	Reference	Reference	3	2.27	Reference	Reference	0	0.00	Reference	Reference
55-59, Male	159	136	85.53	0.90 (0.47 , 1.71)	1.24 (0.60 , 2.53)	8	5.88	1.59 (0.51 , 4.98)	1.60 (0.50 , 5.12) 0.4295	3	2.21	0.57 (0.13 , 2.45)	0.54 (0.12 , 2.37)	1	0.74	0.32 (0.03 , 3.10)	0.31 (0.03 , 3.07)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
60-64, Female	165	145	87.88	Reference	Reference	6	4.14	Reference	Reference	5	3.45	Reference	Reference	4	2.76	Reference	Reference	0	0.00	Reference	Reference
60-64, Male	168	142	84.52	0.75 (0.40 , 1.41)	0.81 (0.40 , 1.61)	13	9.15	2.33 (0.86 , 6.32)	2.36 (0.86 , 6.47) 0.0943	7	4.93	1.45 (0.45 , 4.69)	1.48 (0.45 , 4.82)	5	3.52	1.29 (0.34 , 4.89)	1.39 (0.36 , 5.36)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
65-69, Female	179	160	89.39	Reference	Reference	14	8.75	Reference	Reference	5	3.13	Reference	Reference	4	2.50	Reference	Reference	0	0.00	Reference	Reference
65-69, Male	159	145	91.19	1.23 (0.60 , 2.54)	2.27 (0.89 , 5.75)	16	11.03	1.29 (0.61 , 2.75)	1.35 (0.61 , 2.98) 0.4525	10	6.90	2.30 (0.77 , 6.88)	2.35 (0.75 , 7.34)	9	6.21	2.58 (0.78 , 8.57)	2.69 (0.78 , 9.36)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
70-74, Female	326	310	95.09	Reference	Reference	35	11.29	Reference	Reference	15	4.84	Reference	Reference	8	2.58	Reference	Reference	4	1.29	Reference	Reference
70-74, Male	312	297	95.19	1.02 (0.50 , 2.10)	1.06 (0.49 , 2.30)	50	16.84	1.59 (1.00 , 2.53)	1.72 (1.07 , 2.78) 0.0261 *	26	8.75	1.89 (0.98 , 3.64)	2.19 (1.10 , 4.34)	12	4.04	1.59 (0.64 , 3.95)	1.87 (0.72 , 4.81)	6	2.02	1.58 (0.44 , 5.65)	1.81 (0.48 , 6.86)
Ethnicity																					
European	1555	1420	91.32	Reference	Reference	139	9.79	Reference	Reference	69	4.86	Reference	Reference	42	2.96	Reference	Reference	11	0.77	Reference	Reference
Asian	183	151	82.51	0.45 (0.29 , 0.68)	0.55 (0.35 , 0.85)	10	6.62	0.65 (0.34 , 1.27)	0.76 (0.38 , 1.52) 0.4321	5	3.31	0.67 (0.27 , 1.69)	0.72 (0.28 , 1.86)	4	2.65	0.89 (0.32 , 2.52)	0.85 (0.29 , 2.51)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
Pacific	43	30	69.77	0.22 (0.11 , 0.43)	0.34 (0.16 , 0.74)	1	3.33	0.32 (0.04 , 2.35)	0.29 (0.04 , 2.27) 0.2393	1	3.33	0.68 (0.09 , 5.03)	0.62 (0.08 , 4.90)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Māori	71	61	85.92	0.58 (0.29 , 1.16)	0.72 (0.35 , 1.48)	5	8.20	0.82 (0.32 , 2.09)	0.65 (0.24 , 1.73) 0.3903	3	4.92	1.01 (0.31 , 3.31)	0.78 (0.23 , 2.68)	1	1.64	0.55 (0.07 , 4.04)	0.36 (0.05 , 2.81)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
Other	12	10	83.33	0.48 (0.10 , 2.19)	0.52 (0.11 , 2.55)	1	10.00	1.02 (0.13 , 8.14)	0.79 (0.09 , 6.68) 0.8287	1	10.00	2.18 (0.27 , 17.42)	1.67 (0.19 , 14.51)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Unknown[£]	31	4	12.90	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Age (years) - Ethnicity																					
50-59, European	433	366	84.53	Reference	Reference	20	5.46	Reference	Reference	10	2.73	Reference	Reference	5	1.37	Reference	Reference	1	0.27	Reference	Reference
50-59, Asian	87	71	81.61	0.81 (0.45 , 1.48)	0.87 (0.46 , 1.63)	1	1.41	0.25 (0.03 , 1.87)	0.25 (0.03 , 1.97) 0.1897	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
50-59, Pacific	21	15	71.43	0.46 (0.17 , 1.22)	0.56 (0.19 , 1.70)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , #####) 0.9676	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , #####)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)	0	0.00	0.00 (0.00 , 0.00)	0.67 (0.00 , #####)
50-59, Māori	25	19	76.00	0.58 (0.22 , 1.51)	0.65 (0.24 , 1.76)	1	5.26	0.96 (0.12 , 7.57)	0.86 (0.10 , 7.31) 0.8935	1	5.26	1.98 (0.24 , 16.30)	2.35 (0.26 , 20.94)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)	0	0.00	0.00 (0.00 , 0.00)	0.37 (0.00 , #####)
50-59, Other	4	4	100.00	######## (0.00 , 0.00)	######## (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00) 0.9837	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.46 (0.00 , 0.00)
60-69, European	545	499	91.56	Reference	Reference	42	8.42	Reference	Reference	23	4.61	Reference	Reference	19	3.81	Reference	Reference	0	0.00	Reference	Reference
60-69, Asian	70	57	81.43	0.40 (0.21 , 0.79)	0.37 (0.19 , 0.75)	6	10.53	1.28 (0.52 , 3.16)	1.18 (0.47 , 2.97) 0.7301	4	7.02	1.56 (0.52 , 4.69)	1.52 (0.49 , 4.67)	3	5.26	1.40 (0.40 , 4.90)	1.24 (0.35 , 4.47)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
60-69, Pacific	15	9	60.00	0.14 (0.05 , 0.41)	0.14 (0.04 , 0.47)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00) 0.9840	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
60-69, Māori	27	24	88.89	0.74 (0.21 , 2.54)	0.80 (0.23 , 2.86)	1	4.17	0.47 (0.06 , 3.59)	0.46 (0.06 , 3.58) 0.4572	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
60-69, Other	2	2	100.00	######## (0.00 , 0.00)	######## (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00) 0.9929	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
70-74, European	577	555	96.19	Reference	Reference	77	13.87	Reference	Reference	36	6.49	Reference	Reference	18	3.24	Reference	Reference	10	1.80	Reference	Reference
70-74, Asian	26	23	88.46	0.30 (0.08 , 1.09)	0.30 (0.08 , 1.11)	3	13.04	0.93 (0.27 , 3.21)	0.85 (0.25 , 2.98) 0.8047	1	4.35	0.66 (0.09 , 5.00)	0.53 (0.07 , 4.15)	1	4.35	1.36 (0.17 , 10.62)	1.13 (0.14 , 9.05)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
70-74, Pacific	7	6	85.71	0.24 (0.03 , 2.06)	0.29 (0.03 , 2.74)	1	16.67	1.24 (0.14 , 10.77)	1.24 (0.14 , 11.26) 0.8509	1	16.67	2.88 (0.33 , 25.34)	2.32 (0.24 , 22.49)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
70-74, Māori	19	18	94.74	0.71 (0.09 , 5.59)	1.48 (0.15 , 14.74)	3	16.67	1.24 (0.35 , 4.39)	0.58 (0.12 , 2.70) 0.4852	2	11.11	1.80 (0.40 , 8.14)	0.81 (0.13 , 4.94)	1	5.56	1.75 (0.22 , 13.92)	0.60 (0.05 , 6.91)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
70-74, Other	6	4	66.67	0.08 (0.01 , 0.46)	0.09 (0.01 , 0.58)	1	25.00	2.07 (0.21 , 20.15)	1.68 (0.16 , 17.45) 0.6627	1	25.00	4.81 (0.49 , 47.37)	2.96 (0.26 , 34.06)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Unknown[£]	31	4	12.90	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Deprivation Index (NZDep)																					
1 (least)	150	123	82.00	Reference	Reference	7	5.69	Reference	Reference	4	3.25	Reference	Reference	0	0.00	Reference	Reference	1	0.81	Reference	Reference
2	327	291	88.99	1.77 (1.03 , 3.05)	1.80 (1.00 , 3.26)	29	9.97	1.83 (0.78 , 4.31)	1.90 (0.80 , 4.49) 0.1464	13	4.47	1.39 (0.44 , 4.35)	1.43 (0.45 , 4.51)	7	2.41	######## (0.00 , #####)	47739.13 (0.00 , #####)	3	1.03	1.27 (0.13 , 12.34)	1.24 (0.13 , 12.32)
3	382	339	88.74	1.73 (1.03 , 2.92)	1.58 (0.89 , 2.80)	32	9.44	1.73 (0.74 , 4.02)	1.62 (0.69 , 3.80) 0.2700	15	4.42	1.38 (0.45 , 4.23)	1.30 (0.42 , 4.03)	11	3.24	######## (0.00 , #####)	61552.45 (0.00 , #####)	4	1.18	1.46 (0.16 , 13.16)	1.15 (0.12 , 10.66)
4	202	176	87.13	1.49 (0.83 , 2.67)	1.58 (0.83 , 3.01)	10	5.68	1.00 (0.37 , 2.70)	1.10 (0.40 , 3.01) 0.8523	4	2.27	0.69 (0.17 , 2.82)	0.74 (0.18 , 3.05)	3	1.70	######## (0.00 , #####)	33943.04 (0.00 , #####)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
5	242	224	92.56	2.73 (1.45 , 5.16)	2.35 (1.19 , 4.64)	17	7.59	1.36 (0.55 , 3.38)	1.29 (0.52 , 3.24) 0.5839	5	2.23	0.68 (0.18 , 2.58)	0.65 (0.17 , 2.50)	2	0.89	53101.72 (0.00 , #####)	16507.69 (0.00 , #####)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
6	238	225	94.54	3.80 (1.89 , 7.63)	3.53 (1.65 , 7.56)	25	11.11	2.07 (0.87 , 4.94)	1.91 (0.79 , 4.59) 0.1500	16	7.11	2.28 (0.74 , 6.97)	2.13 (0.69 , 6.59)	10	4.44	######## (0.00 , #####)	83262.96 (0.00 , #####)	2	0.89	1.09 (0.10 , 12.19)	0.81 (0.07 , 9.21)
7	157	131	83.44	1.11 (0.61 , 2.00)	1.08 (0.57 , 2.05)	13	9.92	1.83 (0.70 , 4.74)	2.02 (0.77 , 5.33) 0.1539	8	6.11	1.93 (0.57 , 6.60)	2.01 (0.58 , 6.97)	3	2.29	######## (0.00 , #####)	50557.04 (0.00 , #####)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
8	137	120	87.59	1.55 (0.80 , 2.99)	1.89 (0.90 , 3.97)	15	12.50	2.37 (0.93 , 6.03)	2.55 (0.99 , 6.61) 0.0532	10	8.33	2.70 (0.82 , 8.87)	2.84 (0.85 , 9.47)	8	6.67	######## (0.00 , #####)	######## (0.00 , #####)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
9	55	43	78.18	0.79 (0.37 , 1.69)	1.28 (0.53 , 3.09)	7	16.28	3.22 (1.06 , 9.80)	5.08 (1.59 , 16.24) 0.0062 **	4	9.30	3.05 (0.73 , 12.78)	4.13 (0.93 , 18.30)	3	6.98	######## (0.00 , #####)	######## (0.00 , #####)	1	2.33	2.90 (0.18 , 47.48)	11.01 (0.57 , #####)
10 (most)	3	2	66.67	0.44 (0.04 , 5.02)	0.37 (0.03 , 5.52)	1	50.00	16.57 (0.94 , #####)	16.65 (0.87 , #####) 0.0615	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)	0	0.00	1.00 (0.00 , 0.00)	1.45 (0.00 , 0.00)	0	0.00	0.00 (0.00 , 0.00)	0.00 (0.00 , 0.00)
Unknown[£]	2	2	100.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-
Deprivation Index (NZDep) quintiles																					
1 (least)	477	414	86.79	Reference	Reference	36	8.70	Reference	Reference	17	4.11	Reference	Reference	7	1.69	Reference	Reference	4	0.97	Reference	Reference
2	584	515	88.18	1.14 (0.79 , 1.64)	1.09 (0.73 , 1.63)	42	8.16	0.93 (0.59 , 1.48)	0.90 (0.56 , 1.44) 0.6593	19	3.69	0.89 (0.46 , 1.74)	0.87 (0.44 , 1.70)	14	2.72	1.62 (0.65 , 4.06)	1.59 (0.63 , 3.99)	4	0.78	0.80 (0.20 , 3.23)	0.73 (0.18 , 3.01)
3	480	449	93.54	2.20 (1.40 , 3.46)	1.94 (1.19 , 3.16)	42	9.35	1.08 (0.68 , 1.73)	0.99 (0.61 , 1.59) 0.9593	21	4.68	1.15 (0.60 , 2.20)	1.07 (0.55 , 2.06)	12	2.67	1.60 (0.62 , 4.09)	1.50 (0.58 , 3.87)	2	0.45	0.46 (0.08 , 2.52)	0.36 (0.07 , 2.03)
4	294	251	85.37	0.89 (0.58 , 1.35)	0.94 (0.59 , 1.50)	28	11.16	1.32 (0.78 , 2.22)	1.41 (0.83 , 2.41) 0.2069	18	7.17	1.80 (0.91 , 3.57)	1.86 (0.93 , 3.75)	11	4.38	2.66 (1.02 , 6.97)	3.02 (1.14 , 7.98)	0	0.00	0.00 (0.00 , #####)	0.00 (0.00 , #####)
5 (most)	58	45	77.59	0.53 (0.27 , 1.03)	0.81 (0.37 , 1.79)	8	17.78	2.27 (0.98 , 5.24)	3.46 (1.41 , 8.49) 0.0068 **	4	8.89	2.28 (0.73 , 7.09)	3.04 (0.92 , 10.08)	3	6.67	4.15 (1.04 , 16.66)	6.69 (1.57 , 28.51)	1	2.22	2.33 (0.25 , 21.30)	8.07 (0.73 , 89.46)
Unknown[£]	2	2	100.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-	0	0.00	-	-

£ "Unknown" responses were coded as missing values

ɤ Participants who responded with an adequate iFOBT kit and did not meet the exclusion criteria

* iFOBT: immunochemical faecal occult blood test

ø Only includes participants who had a colonoscopy through the public system

† Adjusted for all other demographic variables (ie, Age, Sex, Ethnicity and NZDep2006 quintiles)

OR=odds ratio; CI=confidence interval

Statistically higher than reference group

Statistically lower than reference group

Table 6. Adverse events (Readmissions within 14 to 30 days of BSP colonoscopy)

	n	Rate per 1,000
Total colonoscopies in BSP Register	4001	-
Complications†		
Perforation	5	1.2
Bleeding	31	7.7
Other	12	3.0
Missing (TBA)	1	0.2

† Complications were prioritised by Perforation, Bleeding, and Other

N.B. Includes patients with colonoscopy and readmission dates between 10 Jan 2012-31 Oct 2013. They were not restricted to colonoscopies performed through the public healthcare system.