

BMJ Open Reducing income-related inequities in colorectal cancer screening: lessons learned from a retrospective analysis of organised programme and non-programme screening delivery in Winnipeg, Manitoba

Kathleen M Decker,^{1,2} Alain A Demers,¹ Zoann Nugent,^{3,4} Natalie Biswanger,⁵ Harminder Singh^{1,3,4}

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For numbered affiliations see end of article.

Correspondence to

Dr Kathleen M Decker;
kdecker@cancercare.mb.ca

ABSTRACT

Objective: We examined organised colorectal cancer (CRC) screening programme and non-programme faecal occult blood test (FOBT) use from 2008 to 2012 for individuals living in Winnipeg, Manitoba, by area-level income.

Setting: Winnipeg, Manitoba, a region with universal healthcare and an organised CRC screening programme.

Participants: Individuals who had a non-programme FOBT were identified from the Provincial Medical Claims database. Individuals who had a programme FOBT were identified from the provincial screening registry. Census data were used to determine average household income based on area of residence.

Statistical analysis: Trends in age-standardised FOBT rates were examined using Joinpoint Regression. Logistic regression was performed to explore the association between programme and non-programme FOBT use and income quintile.

Results: FOBT use (non-programme and programme) increased from 32.2% in 2008 to 41.6% in 2012. Individuals living in the highest income areas (Q5) were more likely to have a non-programme FOBT compared with those living in other areas. Individuals living in areas with the lowest average income level (Q1) were less likely to have had programme FOBT than those living in areas with the highest average income level (OR 0.80, 95% CI 0.77 to 0.82). There was no difference in programme FOBT use for individuals living in areas with the second lowest income level (Q2) compared with those living in areas with the highest. Individuals living in areas with a moderate-income level (Q3 and Q4) were more likely to have had a programme FOBT compared with those living in an area with the highest income level (OR 1.12, 95% CI 1.09 to 1.15 for Q3 and OR 1.10, 95% CI 1.07 to 1.13 for Q4).

Conclusions: Inequities by income observed for non-programme FOBTs were largely eliminated when

Strengths and limitations of this study

- This study provides information about the impact of a population-based organised screening programme on colorectal cancer screening in people living in areas with different income levels.
- This study used data from several previously validated administrative health databases which eliminates biases inherent when using self-reported survey data.
- The study found that individuals living in areas with lower average income levels were less likely to be screened with a non-programme faecal occult blood test (FOBT) compared with those living in areas with higher average income levels. However, there was no difference in programme FOBT use for individuals living in areas with lower or moderate average income levels compared with those living in areas with the highest income level.
- The analysis was limited to one city since FOBT data from rural and northern areas were not available.
- Area-level income was used.

programme FOBTs were examined. Targeted interventions within organised screening programmes in very low-income areas are needed.

INTRODUCTION

Colorectal cancer (CRC) is the second most common cause of cancer related deaths in Canada and is responsible for a large component of cancer burden.¹ In 2014, an estimated 23 900 Canadians were diagnosed

with CRC and 9200 died from the disease.¹ Most CRCs are believed to develop from adenomatous polyps over a period of at least 10 years.² Therefore, CRC is ideally suited for screening. The most commonly used CRC screening tests include faecal occult blood tests (FOBTs), flexible sigmoidoscopy (FS), and colonoscopy; FOBT and FS use has been found to reduce mortality in randomised clinical trials (RCTs).^{3–8} A Cochrane meta-analysis that included four RCTs found that FOBT followed by colonoscopy for those who tested positive lead to a 15% reduction in the relative risk of CRC mortality.⁹ Based on the results of these studies and the demonstrated feasibility of FOBT use for population-based CRC screening in pilot studies, as of 2010, all Canadian provinces had announced or had started to implement organised screening programmes with the goal of reducing CRC mortality.¹⁰

In August 2007, the province of Manitoba implemented a population-based, organised CRC screening programme (ColonCheck) for average risk individuals 50–74 years of age using the higher sensitive FOBT Hemoccult II SENSEA.¹¹ The FOBT and instructions are mailed to eligible individuals and also distributed by healthcare providers. There is no incentive to healthcare providers to provide the test. Promotional activities (media campaigns, public advertisements, invitation letters to eligible participants and healthcare provider information sessions) are a part of the programme. In addition to programme FOBTs, residents of Manitoba also have the option of completing a non-programme FOBT received when they visit their primary healthcare provider.

One of the primary aims of organised screening is to reach all individuals eligible for screening thereby reducing the impact of inequities that can occur with non-programme screening.¹² Inequities in cancer screening participation by income level have been shown in several studies in countries both with and without universal healthcare insurance.^{13–18} However, data are limited on the impact of population-based, organised screening CRC programmes compared with non-organised screening and their impact on income-related inequities. The objectives of this research were to examine differences in organised CRC screening programme and non-programme provided FOBT use by area-level average income and to examine trends over time by income quintile.

METHODS

Data sources

Four data sources were used: the Manitoba Health Population Registry, the Medical Claims Database, the ColonCheck Registry, and Statistics Canada 2006 census data. Manitoba Health, the publically funded provincial health insurance agency, provides comprehensive health coverage for all hospitalisations, procedures and physician visits for all provincial residents. There are no

deductibles or co-payments for healthcare visits or investigations in Manitoba.

The Population Registry contains demographic information, vital status, migration information and a personal health identification number which can be used to link provincial databases. The Medical Claims Database is generated by claims filed by physicians and laboratories for payment of services. The Population Registry and the Medical Claims Database have been validated for accuracy and have been used extensively to study many health outcomes.^{19 20}

The ColonCheck Registry is a population-based registry of all individuals in Manitoba 50–74 years of age. The registry includes the date and result of programme FOBTs as well as information about follow-up colonoscopy results and future screening recommendations.

Statistics Canada 2006 census data were used to determine average household income (categorised into quintiles from Q1, the lowest income quintile to Q5, the highest income quintile) based on each individual's dissemination area (DA) of residence. The Canadian census provides information about people and housing units in Canada by their demographic, social and economic characteristics.²¹ The 2006 census counted 31 612 897 Canadians. The median household income and IQR was \$34 820 (\$30 536–\$39 494) for Q1, \$48 470 (\$45 137–\$51 480) for Q2, \$60 951 (\$57 679–\$64 133) for Q3, \$76 702 (\$72 100–\$82 138) for Q4 and \$102 477 (\$93 530–\$118 685) for Q5. The use of quintiles reduces the effect of misattribution of income. Prior reports from Canada and Manitoba have found that area-based income measures are appropriate for measuring health outcomes^{22–24} and have been extensively used as proxy to define the socioeconomic status of study participants.

In this population-based retrospective study, the Population Registry was used to identify individuals 50–74 years of age. The Medical Claims Database was used to identify individuals who had a non-programme FOBT, colonoscopy or FS from 1 January 2008 to 31 December 2012. We included FOBTs provided in a physician's office which were then processed and claimed by the laboratory. Since FOBTs administered through the screening programme are not included in the Medical Claims Database, the ColonCheck Registry was used to identify individuals who completed a programme FOBT.

Study population

The province of Manitoba, located in central Canada, has a population of approximately 1.29 million (as of 2013). Two-thirds of the population lives in the capital city of Winnipeg. This study included all individuals 50–74 years of age who lived in Winnipeg from 2008 to 2012. Individuals who lived outside of Winnipeg were excluded from the analyses because many FOBTs in rural and northern areas of Manitoba are not registered in the Medical Claims database. Individuals with a prior diagnosis of CRC were excluded from the study. Individuals who had a colonoscopy in the previous

5 years are not sent a programme FOBT. In addition, individuals who had an FOBT in the previous 2 years identified through claims data are not sent a programme FOBT. When individuals are sent a programme FOBT, they are asked to complete and return an eligibility form. Individuals who are considered high risk (adenomatous polyps or inflammatory bowel disease with associated colitis, a confirmed hereditary colon cancer syndrome such as hereditary non-polyposis colon cancer or familial adenomatous polyposis) are told to not complete the FOBT and that they should see their doctor for ongoing endoscopic surveillance.

Outcomes

Rates of non-programme and programme FOBT use among the eligible population were determined and stratified by sex, age group and income quintile. The eligible population refers to individuals aged 50–74 years who had not had a colonoscopy in the previous 10 years or a FS in the previous 5 years. Non-programme FOBT use was defined as any FOBT identified using the Medical Claims Database in the 2 years prior to any date in the calendar year examined. Similarly, programme FOBT coverage was defined as any FOBT identified using the ColonCheck Registry in the preceding 2 years. Since population-based data sources were used, information was available for all individuals.

Statistical analysis

Trends over time, the annual percentage change (APC) and 95% CI were calculated using the Joinpoint Regression program V.4.1.1.1 developed by SEER (Surveillance Epidemiology and End Results, National Cancer Institute, Bethesda, Maryland, USA). Joinpoint Regression is a statistical method that describes changing trends over successive segments of time and the amount of increase or decrease within each segment. Rates were age standardised to the 2001 Canadian population. The rate (y axis) was per 100 individuals, the x axis was calendar year and the model used was $\ln(y)=xb$.

Multivariate logistic regression was performed to assess differences in FOBT use (programme and non-programme) by income quintile. Calendar year and age were included as covariate linear predictors in the model, while sex was included as a dichotomous covariate. Previous research has found that CRC screening increases with age and is higher for women than men.^{17–25} An increase in screening with calendar year was expected based on ongoing programme evaluation. The results are expressed as ORs and associated 95% CIs. SAS V.9.2 (SAS Institute, Cary, North Carolina, USA) was used for data management and statistical analyses.

RESULTS

There were 171 627 individuals 50–74 years of age resident in Winnipeg in 2008 and 192 285 in 2012. A total of 134 364 individuals in 2008 and 141 882 individuals in

Table 1 Characteristics of the population eligible to complete a faecal occult blood test in 2008 and 2012, Winnipeg, Manitoba

Characteristics	2008	2012
Total	134 364	141 882
Gender		
Men	65 893	69 878
Women	68 471	72 004
Age group		
50–54	42 537	44 304
55–59	34 236	35 750
60–64	25 833	28 201
65–69	17 594	19 864
70–74	14 164	13 763
Income quintile		
Q1 (lowest)	24 479	26 163
Q2	25 025	26 404
Q3	24 827	25 546
Q4	29 014	30 706
Q5 (highest)	30 717	33 266

Eligible individuals include those who have not had a colonoscopy in the previous 10 years or a flexible sigmoidoscopy in the previous 5 years.

2012 had not had a colonoscopy in the previous 10 years or a FS in the previous 5 years and were therefore considered eligible to complete an FOBT (table 1).

Overall, 32.2% of eligible individuals in 2008 and 41.6% of eligible individuals in 2012 had a non-programme or programme FOBT in the previous 2 years (table 2).

FOBT use was higher for women and increased with age and income quintile. By 2012, 58.4% of eligible 70–74-year olds had had an FOBT in the previous 2 years. Figure 1 shows the increase in non-programme and

Table 2 Eligible individuals who had a faecal occult blood test by gender, age group and income quintile, Winnipeg, Manitoba, 2008 and 2012

Characteristics	2008 n (%)	2012 n (%)
Total	43 338 (32.2)	59 085 (41.6)
Gender		
Men	20 081 (30.5)	27 547 (39.4)
Women	23 307 (34.0)	31 538 (43.8)
Age group		
50–54	9882 (23.2)	13 738 (31.0)
55–59	10 435 (30.5)	13 731 (38.4)
60–64	9652 (37.4)	12 811 (45.4)
65–69	7444 (42.3)	10 764 (54.2)
70–74	5975 (42.2)	8041 (58.4)
Income quintile		
Q1 (lowest)	5590 (22.8)	8321 (31.8)
Q2	6992 (27.9)	9936 (37.6)
Q3	8072 (32.5)	10 653 (41.7)
Q4	10 571 (36.4)	13 789 (44.9)
Q5 (highest)	11 528 (37.5)	15 177 (45.6)

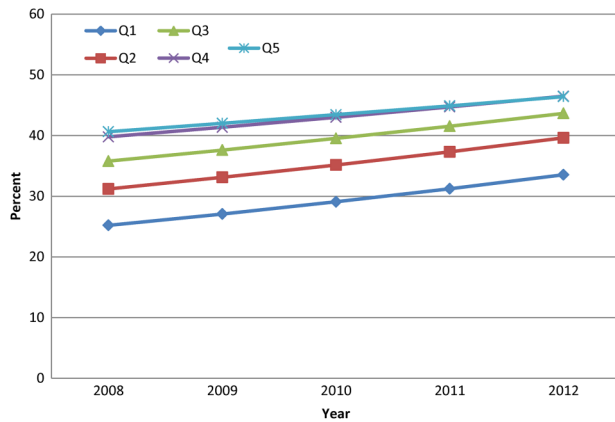


Figure 1 Age standardised rates of non-programme and programme faecal occult blood test coverage for individuals who lived in Winnipeg, 2008–2012 by income quintile.

programme FOBT use by income quintile. Although overall FOBT use remained lower for individuals living in areas with lower average income levels (Q1, Q2 and Q3) throughout the study time period, there was a more rapid increase for individuals living in areas with the lowest average income level (Q1; APC: 7.4%, table 3).

From 2008 to 2012, non-programme FOBT use remained stable or decreased slightly for all income quintiles with lower rates for individuals living in areas with lower average income levels (Q1, Q2 and Q3) (figure 2). The decrease was higher for individuals living in areas with the highest average income level (Q5). Shortly after the introduction of the organised, province-wide screening programme in 2007, programme FOBT use increased significantly for individuals regardless of average area income (figure 3). Although programme FOBT use was lower for individuals living in Q1 (the lowest average income level), there was little

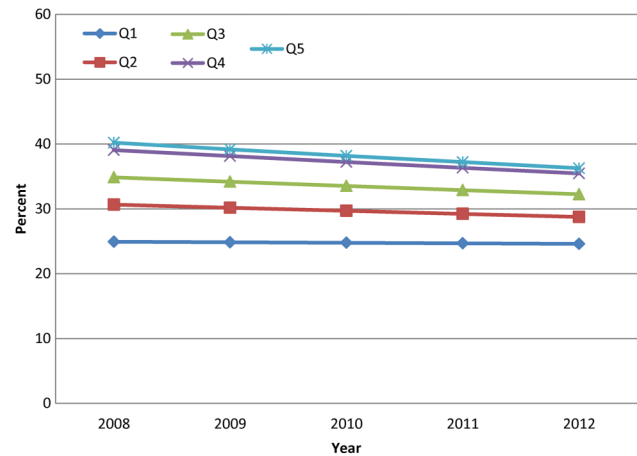


Figure 2 Age standardised rates of non-programme faecal occult blood test coverage for individuals who lived in Winnipeg, 2008–2012 by income quintile.

difference in the rates for individuals living in areas with moderate or high average income levels (Q2, Q3, Q4 and Q5). In addition, the increase over time in programme FOBT use was highest for individuals living in areas with the lowest average income level (Q1; APC: 80.4% for men and 63.9% for women, data not shown).

Table 4 shows the results of the multivariate logistic regression modelling to evaluate the association between FOBT use and income quintile by FOBT type with model covariates of age, sex and calendar year.

For non-programme and programme FOBT use, individuals living in areas with average income quintiles of Q2, Q3 and Q4 were significantly less likely to have had an FOBT compared with individuals living in areas with the highest average income level (Q5). The results were similar when only non-programme FOBT use was assessed. When programme FOBTs were examined,

Table 3 Annual percentage change (APC) in faecal occult blood test (FOBT) use in Winnipeg, Manitoba, by income quintile, 2008–2012

FOBT source	Income quintile	APC	95% CI	p Value
Non-programme and programme	Q1	7.4	5.3 to 9.6	0.0014
	Q2	6.2	1.8 to 10.7	0.0205
	Q3	5.1	0.8 to 9.5	0.0313
	Q4	4.0	0.9 to 7.1	0.0251
	Q5	3.4	0.6 to 6.2	0.0308
Non-programme	Q1	−0.3	−3.7 to 3.2	0.7755
	Q2	−1.6	−5.8 to 2.8	0.3239
	Q3	−1.9	−5.3 to 1.5	0.1681
	Q4	−2.4	−5.4 to 0.7	0.0918
	Q5	−2.5	−5.5 to 0.5	0.0770
Programme	Q1	70.0	37.5 to 110.2	0.0041
	Q2	62.1	14.9 to 128.8	0.0209
	Q3	55.4	10.1 to 119.4	0.0268
	Q4	58.2	21.0 to 106.9	0.0122
	Q5	63.0	31.5 to 102.0	0.0054

Bold typeface indicates significance at $p < 0.05$.

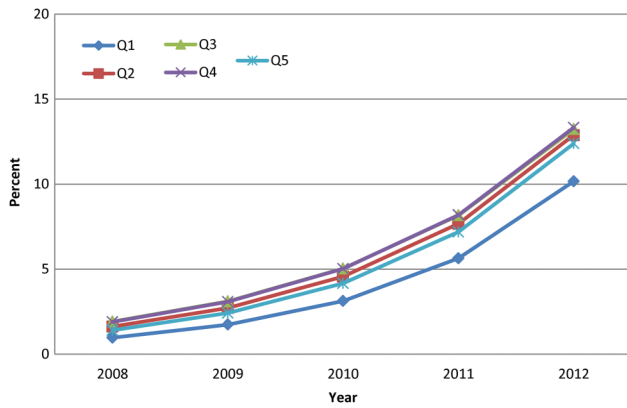


Figure 3 Age standardised rates of programme faecal occult blood test coverage for individuals who lived in Winnipeg, 2008–2012 by income quintile.

individuals living in areas with the lowest average income level (Q1) were still less likely than those living in areas with the highest average income level (Q5) to have had an FOBT (OR 0.80, 95% CI 0.77 to 0.82) although the difference in participation between low and high income was less than for non-programme FOBTs (OR 0.53, 95% CI 0.52 to 0.53). There was no difference in programme FOBT use for individuals living in areas with an income quintile of Q2 as compared with those living in Q5. Importantly, individuals living in areas with moderate average income levels (Q3 and Q4) were more likely to have had a programme FOBT compared with those living in area with the highest average income level (Q5; OR 1.12, 95% CI 1.09 to 1.15 for Q3 and OR 1.10, 95% CI 1.07 to 1.13 for Q4).

DISCUSSION

This study found that FOBT use increased over time; by 2012, 58.4% of eligible 70–74-year olds had had an FOBT in the previous 2 years which is close to the Canadian target of 60%.²⁶ Individuals living in areas with the lowest average income level showed the greatest increase in FOBT use. Importantly, the income-related inequities in FOBT use observed for non-programme FOBTs were largely eliminated when organised programme FOBTs were examined. A key goal of organised screening is to reduce inequities in screening; it appears

that the ColonCheck programme is achieving this goal in Manitoba.

The sustained promotional campaign by the screening programme in the province is likely contributing to the steady increase in overall (programme and non-programme) FOBT use among all groups—one of the primary objectives of the screening programme.

Previous studies have found inequalities in cancer screening participation by income level in countries both with and without universal healthcare insurance.^{14–16} Information from the 2008 Canadian Community Health Survey showed that CRC screening rates were lower for individuals from lower income households (25.2%) than in those from higher income households (37.7%).¹⁷ The ability of the organised colon cancer screening programme in Manitoba to address income-related inequities seen with non-programme FOBT coverage may be due to the mailing of FOBT kits directly to individuals and ongoing health promotion campaigns.²⁷ Direct mailing of the kits and postage-paid, preaddressed return envelopes eliminates the economic barriers of travel to healthcare providers and laboratories associated with non-programme FOBT use.²⁷

A Canadian survey from 2012 found that only 32% of Canadians reported that their physician initiated a conversation about CRC screening and such conversations were associated with higher CRC screening rates.¹⁰ The effect of providers' recommendation on inequity in participation is not known. Organised screening reduces the need for healthcare providers to address CRC screening during their visits and allows them to focus on other pressing issues. Thus, organised programmes have the potential to increase FOBT use for all income groups, as seen in this study.

Although we found that differences in programme FOBT use were smaller between the income quintiles, there was still lower use of FOBT among individuals living in areas with the lowest average income level. This is likely due to barriers other than direct economic costs and may include a lack of knowledge about the importance of CRC screening, cultural barriers and new immigration.^{25 28–32} Additionally, individuals with very low incomes may experience a higher frequency of stressful events, have fewer social resources available to help cope with stress, or have less time available to practice

Table 4 Association between income quintile and faecal occult blood test (FOBT) use, Winnipeg, Manitoba, 2008–2012

Income quintile	Non-programme and/or programme FOBT		Non-programme FOBT		Programme FOBT	
	OR	95% CI	OR	95% CI	OR	95% CI
Q1 vs Q5	0.52	0.52 to 0.53	0.52	0.51 to 0.53	0.80	0.77 to 0.82
Q2 vs Q5	0.70	0.69 to 0.71	0.67	0.66 to 0.68	1.00	0.98 to 1.03
Q3 vs Q5	0.84	0.83 to 0.86	0.81	0.80 to 0.82	1.12	1.09 to 1.15
Q4 vs Q5	0.98	0.97 to 0.99	0.96	0.94 to 0.97	1.10	1.07 to 1.13

Adjusted for sex, age and year.

Q1, lowest income quintile level 1; Q5, highest income quintile 5.

preventive health behaviours such as screening.^{28 29} It is likely that targeted efforts within organised screening programmes are required to improve CRC screening for individuals living in areas with the lowest average income level.

The results of this study should be interpreted in the context of its strengths and limitations. This study used data from several previously validated administrative health databases which eliminates biases inherent when using self-reported survey data on screening utilisation.^{19 20 33 34} This study expands on our previous research that examined differences in up-to-date CRC screening by income quintile by comparing FOBT uptake for population-based, organised FOBTs to the uptake observed for non-programme FOBTs.¹⁸ However, this was an observational study and therefore may be prone to bias from unrecognised or unmeasured factors. Since some FOBTs performed in rural and northern Manitoba are not captured by Medical Claims, the analysis was limited to Winnipeg which may limit the generalisability of the results. Finally, we used DA-level income instead of individual-level income. However, DAs are the smallest unit for which census data are collected (2100 DAs in Manitoba with approximately 700 persons per DA), and are more homogeneous than other units particularly in an urban area. Prior studies in Canada and Manitoba have concluded that area-level indicators of income are appropriate measures for monitoring social inequities in health.^{22–24} Area-level measures characterise the entire population and therefore reflect the impact of place or neighbourhood on health; produce estimates that are reliable and consistent with individual-level indicators; detect sizeable inequalities between groups; are practical, feasible and not costly; and provide important information for healthcare providers and planners.^{24 35 36}

Our study suggests that organised, population-based CRC screening is a key part of reducing income-related inequities in screening participation. A universal healthcare system by itself is not adequate to reduce CRC screening income-related barriers. It is essential that further targeted interventions within organised screening programmes are implemented to improve CRC screening in areas with very low-income levels.

Author affiliations

¹Department of Community Health Sciences, University of Manitoba, Winnipeg, Manitoba, Canada

²Epidemiology and Cancer Registry, CancerCare Manitoba, Winnipeg, Manitoba, Canada

³Department of Internal Medicine, University of Manitoba, Health Sciences Centre, Winnipeg, Manitoba, Canada

⁴Medical Oncology and Haematology, CancerCare Manitoba, Winnipeg, Manitoba, Canada

⁵Screening Programs, CancerCare Manitoba, Winnipeg, Manitoba, Canada

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