

1  
2  
3 1 **Up to Date Patterns for Colorectal Cancer Screening, Low Uptake in a Population with No**  
4  
5 2 **Regular Primary Care Provider, and Opportunities for Improvement— A Cross-sectional**  
6  
7 3 **Study**

8  
9  
10 4 Kamala Adhikari, PhD<sup>1,2</sup>; Huiming Yang, MD, MSc, FRCPC<sup>1</sup>; Gary Teare, PhD<sup>1</sup>  
11  
12

13 5 **Affiliations:**  
14  
15

16 6 <sup>1</sup>Alberta Health Services, Provincial Population and Public Health  
17  
18

19 7 <sup>2</sup>University of Calgary, Department of Community Health Sciences  
20  
21

22  
23 8  
24  
25

26 9 **Correspondence Author:**  
27  
28

29 10 Kamala Adhikari  
30  
31

32 11 Email: kamala.adhikaridahal@ucalgary.ca  
33  
34

35 12  
36  
37

38 13 **Funding statement:**  
39

40 14 This research was funded by Alberta Health through the Alberta Cancer Prevention Legacy Fund  
41  
42 15 (ACPLF). Provision of funding by Alberta Health does not signify that this project represents the  
43  
44 16 policies or views of Alberta Health. The funders had no role in the design of the study; in the  
45  
46 17 collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision  
47  
48 18 to publish the results.  
49  
50

51 19  
52

53 20 **Competing interests:**  
54

55  
56 21 Authors declare no competing interest.  
57  
58  
59  
60

1  
2  
3 **22 Abstract**  
4

5 **23 Objective:** This study examined patterns of modality use for colorectal cancer screening  
6  
7  
8 **24** (CRCS), and quantified the association between having a regular primary care provider (PCP)  
9  
10 **25** and being up-to-date for CRCS in a community-based representative population in Alberta,  
11  
12 **26** Canada.  
13

14  
15 **27**  
16  
17 **28 Methods:** This was a cross-sectional study using the Canadian Community Health Survey data  
18  
19 **29** (2015-2016) of adults between 50-74 years of age (N=4,600). Being up-to-date for CRCS was  
20  
21 **30** defined as having completed a Fecal Occult Blood Test (FOBT) or fecal immunochemical test  
22  
23 **31** (FIT) within the last 2 years or colonoscopy/sigmoidoscopy in the last 5 years before the survey.  
24  
25 **32** Data were analyzed using multivariable logistic regression models.  
26  
27  
28  
29  
30

31 **34 Results:** 62.6% of surveyed adults were up-to-date for CRCS, using either FIT/FOBT (45.0%)  
32  
33 **35** or colonoscopy/sigmoidoscopy (34.1%) or both (15.7%). The adjusted odds ratio of being up-to-  
34  
35 **36** date for CRCS was 0.24 (95% CI=0.17, 0.35) and the absolute probability of being up-to-date for  
36  
37 **37** CRCS was lower by 34.4% for those who had no regular PCP compared to those who had. This  
38  
39 **38** pattern was observed in male and female sub-groups and the sub-groups with and without a  
40  
41 **39** medical consultation in the last 12 months.  
42  
43  
44  
45  
46

47 **41 Conclusions:** Findings suggest a suboptimal uptake of CRCS overall, with high disparity  
48  
49 **42** between those with and without a regular PCP. The use of customized, multicomponent  
50  
51 **43** intervention strategies that are shown to be effective to increase CRCS participation may address  
52  
53 **44** the issues. Future studies that longitudinally assess the CRCS up-to-date status can further  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

45 improve our understanding of CRCS uptake and adherence to guide future improvement and  
46 interventions.

Confidential

## 52 **Background**

53 Colorectal cancer (CRC) is the 3rd most commonly diagnosed cancer and the 2nd most common  
54 cause of cancer death in Alberta, Canada<sup>1</sup>. CRC screening (CRCS) plays an important role in  
55 reducing the incidence and mortality of CRC through early detection of pre-cancerous polyps or  
56 CRC cases<sup>2</sup>. Many CRC cases can be prevented if pre-cancerous polyps found as a result of  
57 screening are removed<sup>3, 4</sup>. Similarly, if detected early, more than 90% of CRC cases can be  
58 successfully treated, and CRC-associated mortality (RR=0.82, 95% CI=0.73, 0.92) can be  
59 significantly reduced<sup>3, 5, 6</sup>. However, high adherence to CRCS is essential for achieving those  
60 benefits, more rapidly and cost-effectively.

62 The Canadian Task Force on Preventive Health Care and the Alberta CRCS program guidelines  
63 recommend CRCS starting from the age of 50 and continuing until the age of 74 for people at  
64 average risk<sup>7</sup>. Fecal Immunochemical Test (FIT), a type of Fecal Occult Blood Test (FOBT), is  
65 the recommended primary screening modality for people at average-risk for CRC who represent  
66 more than three-quarters of the total population between the ages of 50 to 74<sup>7, 8</sup>. The guideline  
67 recommends repeating the FIT every 1- 2 years if the test result is negative. Colonoscopy every  
68 10 years or sigmoidoscopy every 5 years is recommended for people with increased risk for CRC  
69 (such as family history of CRC). The provincial target for CRCS participation was 70%.

70 According to the Canadian Community Health Survey 2012, the prevalence of being up-to-date  
71 for CRCS (fecal-based test in the last 2 years or colonoscopy in the last 10 years or  
72 sigmoidoscopy in the last 5 years) was 59.5% in the age group of 50-74 years, with 38.1% stool-  
73 based and 36.7% colonoscopy/sigmoidoscopy<sup>9</sup>. Overall, the available published data suggest that  
74 uptake of CRCS and adherence to provincial CRCS guidelines are suboptimal<sup>8-10</sup>. Continuous

1  
2  
3 75 assessment of adherence to CRCS, in accordance with the guidelines, is vital to monitor the  
4  
5 76 progress and opportunities for improvement in the provincial CRCS program.  
6  
7  
8 77

9  
10 78 In Alberta, while the current CRCS practice is population-based, the opportunity for CRCS still  
11  
12 79 depends largely on access to a primary care provider (PCP), primarily family physicians (FP),  
13  
14 80 and the attention or priority the PCP/FP places on initiating CRCS. As such, the PCP plays an  
15  
16 81 informative, facilitating, and prescriptive role for CRCS. They determine patients' eligibility for  
17  
18 82 CRCS (FIT or colonoscopy) and offer FIT or colonoscopy requisition/referrals during the clinic  
19  
20 83 visit. This practice is not optimal for the initiation of CRCS among people who do not have a  
21  
22 84 regular PCP/FP, who comprise about 18% of Alberta's total population<sup>11</sup>. However, formal,  
23  
24 85 detailed quantification of CRCS adherence patterns of those who do not have a regular PCP and  
25  
26 86 characterization of this segment of the population is lacking, such that our understanding of how  
27  
28 87 to address low CRCS in this group is limited. Such quantification and sub-group characterization  
29  
30 88 is an important step towards understanding this service disparity in order to identify  
31  
32 89 opportunities for the development of tailored CRCS intervention approaches to improve CRCS  
33  
34 90 among people who do not have a regular PCP. This study examined patterns of modality use for  
35  
36 91 CRCS, and quantified the association between having a regular PCP and being up-to-date for  
37  
38 92 CRCS in a community-based representative population.  
39  
40  
41  
42  
43  
44  
45  
46

## 47 94 **Methods**

### 48 49 95 ***Data source***

50  
51 96 This cross-sectional study used the Public Use Meta File (PUMF) of the Canadian Community  
52  
53 97 Health Survey (CCHS) 2015-2016. The data file was obtained from the University of Calgary  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 98 webpage (<https://library.ucalgary.ca/sands>). A detailed description of the survey, including data  
4  
5 99 collection methodology, questionnaire, and survey response rate, are available on the website of  
6  
7  
8 100 Statistics Canada<sup>12</sup>. Briefly, the CCHS 2015-2016, conducted by Statistics Canada, was a  
9  
10 101 nationally representative cross-sectional survey of the Canadian household population aged 15  
11  
12 102 years or older living in the ten provinces (n=109,700). This survey excluded people who lived in  
13  
14 103 reserves and any other aboriginal settlements, full time Canadian armed forces, and people who  
15  
16 104 lived in institutions, altogether accounting for around 3% of the total Canadian population.  
17  
18 105 CRCS was an optional content in the CCHS 2015-2016. It was measured on 4,600 respondents  
19  
20 106 from Alberta who were between the age of 50 and 74 during the survey time (n=4,600). The  
21  
22 107 reported sample sizes are rounded according to the reporting guidelines of Statistics Canada.  
23  
24 108 Given that the Public Use Microdata File of the CCHS is de-identified and publicly available,  
25  
26 109 review and approval by our research ethics board, the Conjoint Health Research Ethics Board at  
27  
28 110 the University of Calgary, was not required.  
29  
30  
31  
32

33 111

### 35 112 *Measures*

37 113 In the CCHS, the respondents were asked: if they had a FIT and colonoscopy or sigmoidoscopy  
38  
39 114 in their lifetime, if yes, the last time they had them, and if they had colonoscopy or  
40  
41 115 sigmoidoscopy for follow up of FOBT. We defined being current or up-to-date for CRCS (point  
42  
43 116 prevalence of participation in CRCS)<sup>13</sup> as receiving FOBT within the last 2 years prior to the  
44  
45 117 survey, and/or either colonoscopy or sigmoidoscopy in the last 5 years prior to the survey<sup>14</sup>. A  
46  
47 118 conservative time cut-off was used as CCHS questionnaire does not distinguish the type of  
48  
49 119 endoscopy (colonoscopy or sigmoidoscopy) performed and whether it was performed in the last  
50  
51 120 10 years prior to the survey.  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 121 The CCHS 2015-2016 collected data on whether the respondents have a regular healthcare  
4  
5 122 provider and if yes, the type of regular healthcare providers. We defined having or not having a  
6  
7 123 regular PCP based on responses to the item that asked whether the respondent had a “regular  
8  
9 124 healthcare provider”, because 99% of those who reported having a regular healthcare provider  
10  
11 125 reported having a FP. Other variables included in the study were sociodemographic (age, sex,  
12  
13 126 marital status, education attainment, income status, ethnicity, and immigration status) and health  
14  
15 127 behavior characteristics (smoking, alcohol consumption, illicit drug use, physical activity, body  
16  
17 128 mass index, and FP consultations) (see Table 1 for variable definitions or categories).  
18  
19  
20  
21  
22 129

### 23 24 130 *Analysis*

25  
26 131 The proportion of survey respondents being current or up-to-date for CRCS was calculated. The  
27  
28 132 proportion of those with colonoscopy or sigmoidoscopy in the past 5 years who also had  
29  
30 133 FIT/FOBT in the past 2 years was also calculated. Sociodemographic and health behavior  
31  
32 134 characteristic variables significantly associated with both up-to-date CRCS status and having a  
33  
34 135 regular PCP were identified using bivariate analyses ( $p < 0.05$ ). Then, multivariable logistic  
35  
36 136 regression models were developed to assess the association between having a regular PCP and  
37  
38 137 being up-to-date for CRCS, adjusting for these potential confounding variables (age, marital  
39  
40 138 status, education attainment, smoking, and illicit drug use). In females, being up-to-date for  
41  
42 139 breast cancer screening was also identified as a potential confounder, however we excluded it  
43  
44 140 from the model so that we could compare among males and females in the model.  
45  
46  
47  
48  
49 141

50  
51 142 This model was then stratified to assess further whether the association differs for those who had  
52  
53 143 at least one GP consultation in the last 12 months and those who did not and in male and female  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 144 sub-groups. Odds ratios (OR) and 95% confidence intervals (CI) were estimated from these  
4  
5 145 models. Additionally, adjusted prediction of being up-to-date for CRCS (i.e., predicted  
6  
7 146 probability of being up-to-date for CRCS that was evaluated at the average value of co-variables)  
8  
9  
10 147 was estimated using the multivariable regression model for the overall group and the stratified  
11  
12 148 models for male and female groups. The distribution patterns of respondents' characteristics,  
13  
14 149 except ethnicity, were similar across the FIT/FOBT and colonoscopy/sigmoidoscopy  
15  
16  
17 150 **(Supplementary Table 1)**; hence, the regression models were developed for the overall CRCS  
18  
19 151 group (included FIT/FOBT or/and colonoscopy/sigmoidoscopy).  
20  
21  
22 152

23  
24 153 The CCHS survey used stratified, multistage sample selection techniques that included clustering  
25  
26 154 and unequal selection probabilities. All the estimates were weighted and bootstrapped to ensure  
27  
28 155 the representativeness of the target population and to account for design effect, using survey  
29  
30 156 weights and a set of 1,000 replicate bootstrap sampling weights that were provided by Statistics  
31  
32  
33 157 Canada for use with the datafile. Alpha ( $\alpha$ ) of  $<0.05$  was used to determine statistical  
34  
35 158 significance. All analyses were performed using STATA/IC 14.1.  
36  
37  
38 159

## 39 40 160 **Results**

41  
42 161 Of the total 4,600 survey respondents, 45.0% (95% CI= 43.0, 47.0) had FIT/FOBT in the past 2  
43  
44 162 years, 34.1 (95% CI=32.0, 36.2) had colonoscopy/sigmoidoscopy in the last 5 years, and 62.6%  
45  
46 163 (95% CI=60.3, 65.0) had either or both. Among those who had colonoscopy/sigmoidoscopy in  
47  
48  
49 164 the last 5 years, 47.1% also had FIT/FOBT in the last 2 years, and 26% were done for the follow-  
50  
51 165 up of FIT/FOBT **(Table 1)**. Eleven percent of respondents did not have a regular PCP.  
52  
53  
54 166



1  
2  
3 167 A higher proportion of respondents who were not up-to-date for CRCS were aged 50-59 years,  
4  
5 168 widowed/divorced/separated or unmarried (single), non-white, landed immigrants, current  
6  
7 169 smokers, and illicit drug users, and had less than secondary education, no regular PCP, and no  
8  
9 170 GP/FP consultation in the last 12 months compared to those up-to-date for CRCS ( $p<0.05$ )  
11  
12 171 (**Table 2**). Similarly, respondents' characteristics, including age, marital status, education status,  
13  
14 172 smoking, illicit drug use, and GP/FP consultation were also different among those with and  
15  
16 173 without a regular PCP ( $p<0.05$ ). In the group with a regular PCP, 67.7% were up-to-date for  
17  
18 174 CRCS, whereas in the group without a regular PCP, it was 29.4% (**Table 3**).  
19  
20  
21  
22 175

23  
24 176 **Table 4** shows the significant association between having a regular PCP and being up-to-date for  
25  
26 177 CRCS, adjusting for age, marital status, education attainment, smoking status, and illicit drug  
27  
28 178 use. The odds of being up-to-date for CRCS for those who did not have a regular PCP was  
29  
30 179 significantly lower compared to the odds of being up-to-date for CRCS for those who had a  
31  
32 180 regular PCP (adjusted OR (aOR)=0.24, 95% CI=0.17, 0.35). When the analysis was stratified by  
33  
34 181 sex or whether the respondent had a GP/FP consultation in the past 12 months, the odds of being  
35  
36 182 up-to-date with CRCS remained significantly lower for those without a regular PCP although the  
37  
38 183 odds varied between the stratification groups. Not having had a GP/FP consultation in the past 12  
39  
40 184 months or being male was associated with lower odds of being up-to-date with CRCS. Overall,  
41  
42 185 the absolute probability of being up-to-date for CRCS was significantly lower for those without a  
43  
44 186 regular PCP (33.4%, 95% CI=25.4, 41.5) than those with a regular PCP (67.8%, 95% CI=65.4,  
45  
46 187 70.3). This pattern was observed in both male and female subgroups (**Figure 1**).  
47  
48  
49  
50  
51  
52 188  
53  
54 189

## 190 **Discussion**

### 191 *Main findings*

192 This study examined up-to-date CRCS status and the association between having a regular PCP  
193 and being up-to-date for CRCS in a population-based, representative sample of people in  
194 Alberta. Overall, 63% were up-to-date for CRCS using either of two screening modalities: 45%  
195 used FIT, 34% used colonoscopy/sigmoidoscopy, and 16% (i.e., 25% of those who were up-to-  
196 date) used both. Approximately, half of those who had colonoscopy/sigmoidoscopy in the last 5  
197 years also had FIT/FOBT within the last 2 years. The odds of being up-to-date for CRCS was  
198 significantly lower among those who did not have a regular PCP compare to those who had  
199 (OR=0.24). This was persistent in both male and female subgroups and the subgroups of people  
200 with and without a GP consultation in the last 12 months, with slightly different estimates within  
201 the stratification groups. The absolute probability of being up-to-date for CRCS was lower by  
202 34% in those who did not have a regular PCP than those who did.

### 204 *Interpretation and Practical Implications*

205 Our findings show the sub-optimal prevalence of up-to-date CRCS status for people in Alberta  
206 during the study period. Approximately, 37% of the eligible population was not up-to-date for  
207 CRCS, although this is improved from the prevalence in 2012<sup>8-10</sup>. Uptake of FIT/FOBT, intended  
208 to be the first-line screening modality for the average-risk population, was disproportionately low.  
209 Whereas, the observed proportion of colonoscopy/sigmoidoscopy (34%) may be  
210 disproportionately high because these procedures are recommended as first-line CRCS  
211 modalities only for the population at high risk for CRC, which is estimated to be less than 15%  
212 of the total CRCS population in Alberta<sup>8</sup>. Furthermore, a large proportion of those who were up-

1  
2  
3 213 to-date on CRCS had used both screening modalities. However, detailed data on indications of  
4  
5 214 colonoscopy/sigmoidoscopy, temporal data on use of FIT/FOBT and  
6  
7  
8 215 colonoscopy/sigmoidoscopy, and longitudinal assessment of these screening modalities used will  
9  
10 216 be required to understand the suboptimal use of screening resources.

11  
12 217  
13  
14 218 The CRCS up-to-date status was exceptionally lower in the group with no regular PCP compared  
15  
16  
17 219 to those with a regular PCP, indicating the disparities in CRCS. The wide disparity was  
18  
19 220 independent of their socioeconomic status, and it persisted regardless of their medical  
20  
21 221 consultations. These findings reflect the fact that CRCS in Alberta is opportunistic, with access  
22  
23 222 provided only through PCPs. While studies comparing CRCS between those having and not  
24  
25 223 having a regular PCP are scarce in literature, our findings are in line with strong evidence that  
26  
27 224 indicates a clinician's recommendation is the most important independent predictor of up-to-date  
28  
29 225 CRCS<sup>15</sup>. Disparities in CRCS across sociodemographic, socioeconomic status, and health  
30  
31 226 behaviour characteristics are well-documented in literature<sup>8, 9, 15, 16</sup>. Our study adds the  
32  
33 227 understanding that having a regular PCP is a strong predictor of up-to-date CRCS independent to  
34  
35 228 these characteristics (**Supplementary Table 2**). These findings provide guidance for the  
36  
37 229 improvement of the population-based CRCS programs, aiming to reduce CRC mortality by  
38  
39 230 detecting CRC at an early stage.

40  
41 231  
42  
43  
44  
45 232 In general, the use of CRCS depend on providers' service delivery, individuals' demand, and  
46  
47 233 organizational structure or access to CRCS; hence, multicomponent intervention strategies  
48  
49 234 influencing barriers at different levels are required to enhance screening participation<sup>17, 18</sup>. In  
50  
51 235 Alberta's current CRCS practices, PCPs are required to identify patients eligible for FIT or  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 236 colonoscopy and offer CRCS requisition/referral. After obtaining FIT requisition from a PCP,  
4  
5 237 patients have to go through multiple inconvenient steps to complete screening: patients travel to  
6  
7 238 a laboratory site to pick up the test kit, take the sample at home and then travel again to return  
8  
9 239 the sample to the laboratory. Patients' and/or providers' deviation on these actions can lead to  
10  
11 240 low participation in CRCS. A multicomponent intervention involving improved provider  
12  
13 241 screening routines, patient education and follow-up, and making FIT kit access easier, would  
14  
15 242 seem valuable to address the overall low CRCS participation<sup>17, 18</sup>. However, as such, these  
16  
17 243 strategies will not reach those people who do not have a regular PCP. Tailored intervention  
18  
19 244 approaches targeting this group to address their access to CRCS will be required. This will  
20  
21 245 involve shifting from the current opportunistic screening program to a universal/organized  
22  
23 246 approach, whereby every eligible person receives a screening recommendation or invitation  
24  
25 247 regardless of attachment with PCPs. Particular supports and strategies will be needed for  
26  
27 248 vulnerable populations in the context of healthcare contacts and through use of outreach  
28  
29 249 strategies such as offering FIT kits and arranging its follow-up for people in the non-healthcare  
30  
31 250 community spaces in which they are familiar/comfortable.  
32  
33  
34  
35  
36  
37  
38  
39

#### 40 252 ***Strengths and limitations***

41  
42 253 Our study used CCHS data collected from a population-based representative sample in Alberta;  
43  
44 254 thus, the findings are generalizable to the target population. As CCHS collects a wide range of  
45  
46 255 data on socio-demographics, health behavior, and healthcare use, which allowed us to quantify  
47  
48 256 the association between having a regular PCP and CRCS considering these crucial variables. The  
49  
50 257 CCHS asked the questions on FOBT and colonoscopy/sigmoidoscopy specifically for screening.  
51  
52  
53 258 It is less likely that the exposure to FIT/FOBT, colonoscopy/sigmoidoscopy for other purposes  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 259 are included in our CRCS definition. However, the CCHS data were self-reported; thus, likely to  
4  
5 260 have recall bias. Provincial CRCS guidelines consider as up-to-date for CRCS those who  
6  
7 261 received colonoscopy in the last 10 years: we included colonoscopy that occurred in the past 5  
8  
9 262 years due to the limitations of our data source. While this may have reduced recall bias  
10  
11 263 significantly, this can underestimate the use of CRCS. However, this may not change our  
12  
13 264 estimates significantly as few of our respondents reported having had colonoscopy more than 5  
14  
15 265 years prior to the survey, and a large proportion of these respondents may have also participated  
16  
17 266 in fecal-based screening in the last 2 years and thus might have been included in our FIT/FOBT  
18  
19 267 calculation in that case (combined modality). According to the guidelines, the CRCS should be  
20  
21 268 started at the age of 50, the choice of screening modalities should depend on the risk levels, and  
22  
23 269 longitudinal adherence or retention is required to achieve the full benefits of CRCS. Due to data  
24  
25 270 limitations, we could not examine these issues.  
26  
27  
28  
29  
30  
31  
32

### 33 272 *Future directions*

34  
35 273 Future studies examining longitudinal CRCS status across screening modalities and high- and  
36  
37 274 low-risk groups may improve our understanding of individuals' adherence patterns to CRCS  
38  
39 275 (underuse, overuse, disproportionate use of screening modalities, retention,) and physicians'  
40  
41 276 CRCS practices or guideline adherence. This understanding guides the optimization of CRCS  
42  
43 277 practices, which is essential as there are risks and costs of over- and under-screening. The use of  
44  
45 278 existing surveillance/administrative data, including lab data for FIT and prescription databases  
46  
47 279 for colonoscopy/sigmoidoscopy and their data linkage, can be valuable to analyze these issues.  
48  
49 280 From a research perspective, the use of these data helps answer our research questions with a  
50  
51 281 breadth and in-depth for the improved understanding of CRCS practices and uses. From a  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 282 programmatic perspective, the use of these data also allows us to monitor the performance of the  
4  
5 283 CRCS program and identify the progress or gaps. However, note that the use of administrative  
6  
7  
8 284 data on colonoscopy/sigmoidoscopy can be complicated as it is done for several indications:  
9  
10 285 unclarity may exist in the current data records to identify their use for CRCS. Hence, efforts  
11  
12 286 aiming to explore and optimize these data's performance in identifying the CRCS will be  
13  
14  
15 287 required before their use for research and programmatic monitoring purposes.  
16  
17 288

## 19 289 **Conclusions**

21 290 Overall, we found that being up-to-date for CRCS was sub-optimal in the general population.  
22  
23 291 People who did not have a regular PCP were particularly unlikely to be up-to-date on CRCS.  
24  
25  
26 292 Intervention strategies to improve the practice of CRCS need to be multi-faceted in order to  
27  
28 293 reduce the structural barriers to access CRCS, enhance providers' CRCS service delivery  
29  
30  
31 294 practices and encourage individuals' demand for CRCS. Tailored strategies to improve access to  
32  
33 295 CRCS for those who do not have a regular PCP are needed to address the large disparity in  
34  
35 296 CRCS participation seen for this group. Future studies should perform a longitudinal assessment  
36  
37  
38 297 of CRCS status across screening modalities and high- and low-risk groups. This assessment can  
39  
40 298 offer an improved understanding of CRCS status and guidance on future improvement and  
41  
42 299 interventions.  
43  
44  
45 300  
46  
47 301  
48 302  
49 303  
50 304  
51 305  
52 306  
53 307  
54  
55  
56  
57  
58  
59  
60

**References**

1. Cancer Measurement Outcomes Research and Evaluation (CMORE\_ Cancer Statistics update, 2019.
2. Heitman SJ, Hilsden RJ, Au F, Dowden S, Manns BJ. Colorectal cancer screening for average-risk North Americans: an economic evaluation. *PLoS Med.* 2010;7(11):e1000370.
3. IARC (2019). Colorectal cancer screening. *IARC Handb Cancer Prev.* 17:1–300. Retrieved on May 15, 2020 from: <http://publications.iarc.fr/573>.
4. Shaukat A, Lehenbauer KP. Screening for colorectal neoplasia. *New England Journal of Medicine.* 2017;376(16):1598-9.
5. Fitzpatrick-Lewis D, Ali MU, Warren R, Kenny M, Sherifali D, Raina P. Screening for Colorectal Cancer: A Systematic Review and Meta-Analysis. *Clinical Colorectal Cancer.* 2016;15(4):298-313.
6. Health Quality Council of Alberta. Patient completion of screening tests, 2019. Retrieved on June 11, 2020 from: <https://focus.hqca.ca/primaryhealthcare/screening/>.
7. Alberta Health Services (AHS). (2014). Alberta Colorectal Cancer Screening Program: Standards and Guidelines for Screening Colonoscopy Services, version 2.0. Retrieved on June 15, 2020 from: <https://screeningforlife.ca/wp-content/uploads/2019/12/ACRCSP-Standards-and-Guidelines-for-Screening-Colonoscopy-Services-Feb-2014.pdf>.
8. Solbak NM, Xu JY, Vena JE, Al Rajabi A, Vaseghi S, Whelan HK, et al. Patterns and predictors of adherence to colorectal cancer screening recommendations in Alberta's Tomorrow Project participants stratified by risk. *BMC public health.* 2018;18(1):177.
9. Singh H, Bernstein CN, Samadder JN, Ahmed R. Screening rates for colorectal cancer in Canada: a cross-sectional study. *CMAJ open.* 2015;3(2):E149-57.

- 1  
2  
3 331 10. Canadian Partnership Against Cancer. The 2014 cancer system performance report.  
4  
5 332 Toronto: Canadian Partnership Against Cancer. accessed at: systemperformanceca. 2014:48-50.  
6  
7 333 11. Statistic Canada. Health fact sheet: primary health care provider, 2016.. Retrieved on  
8  
9 334 November 07, 2020 from: Primary health care Providers, 2016 (statcan.gc.ca).  
10  
11  
12 335 12. Statistics Canada. Canadian community health survey—2015-2016. Retrieved on June  
13  
14 336 11, 2020 from:  
15  
16 337 [http://dli-idd-nesstarstatcangcca/webview/indexjsp?object=http://dli-idd-  
19  
20 nesstarstatcangcca:80/obj/fCatalog/Catalog85](http://dli-idd-nesstarstatcangcca/webview/indexjsp?object=http://dli-idd-<br/>17<br/>18 nesstarstatcangcca:80/obj/fCatalog/Catalog85).  
21  
22 339 13. Chubak J, Hubbard R. Defining and measuring adherence to cancer screening. *J Med*  
23  
24 340 *Screen*. 2016;23(4):179-85.  
25  
26 341 14. Blair A, Gauvin L, Ouedraogo S, Datta GD. Area-level income disparities in colorectal  
27  
28 342 screening in Canada: Evidence to inform future surveillance. *Current Oncology*.  
29  
30 343 2019;26(2):e128-e37.  
31  
32 344 15. Gimeno García AZ. Factors influencing colorectal cancer screening participation.  
33  
34 345 *Gastroenterol Res Pract*. 2012;2012:483417.  
35  
36 346 16. Crouse A, Sadrzadeh SM, de Koning L, Naugler C. Sociodemographic correlates of fecal  
37  
38 347 immunotesting for colorectal cancer screening. *Clinical biochemistry*. 2015;48(3):105-9.  
39  
40 348 17. Community Preventive Task Force. Increasing Colorectal Cancer Screening:  
41  
42 349 Multicomponent Interventions. Finding and Rationale Statement, 2016. Retrieved on January 11,  
43  
44 350 2020 from: [https://www.thecommunityguide.org/findings/cancer-screening-multicomponent-  
47  
48 352 interventions-colorectal-cancer](https://www.thecommunityguide.org/findings/cancer-screening-multicomponent-<br/>45<br/>46 351 interventions-colorectal-cancer).  
49  
50 353 18. Sabatino SA, Lawrence B, Elder R, Mercer SL, Wilson KM, DeVinney B, et al.  
51  
52 Effectiveness of interventions to increase screening for breast, cervical, and colorectal cancers:  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

354 nine updated systematic reviews for the guide to community preventive services. American  
355 journal of preventive medicine. 2012;43(1):97-118.

356

Confidential

**Table 1: Patterns of use of colorectal cancer screening modalities in the age group 50-74 in Alberta**

<b>Colorectal cancer screening</b>	<b>%</b>	<b>95% CI</b>
Had FIT/FOBT:		
Within last 2 years	45.06	42.73, 47.39
Earlier than the last 2 years	19.64	17.78, 21.50
Had colonoscopy or sigmoidoscopy:		
Within last 5 years	34.10	31.99, 36.21
Earlier than the last 5 years	11.78	10.18, 13.38
Had FIT/FOBT within last 2 years and/or colonoscopy or sigmoidoscopy within 5 years	62.61	60.34, 64.89
Had both FIT/FOBT within last 2 years and colonoscopy or sigmoidoscopy within 5 years	15.75	14.28, 17.21
Had FIT/FOBT within last 2 years, of those who had colonoscopy or sigmoidoscopy within last 5 years	47.11	43.30, 50.91
Colonoscopy or sigmoidoscopy for the follow up of FIT/FOBT, among those having colonoscopy or sigmoidoscopy within last 5 years	25.98	22.31, 39.65

Note: CI: confidence interval; FIT: fecal immunochemical test; FOBT: Fecal occult blood test

**Table 2: Characteristics of respondents by up-to-date status for colorectal cancer screening**

Characteristics	FIT/FOBT in last 2 years and/or colonoscopy/ sigmoidoscopy in last 5 years (overall CRC screening)		
	No: % (95% CI)	Yes: % (95% CI)	Chi-square P value
Age:			<0.0001
50-59 years	65.16 (61.53, 68.80)	47.34 (44.82, 49.87)	
60-74 years	34.83 (31.20, 38.46)	52.66 (50.13, 55.18)	
Sex:			0.489
Female	50.39 (47.17, 53.61)	48.64 (46.65, 50.62)	
Male	49.61 (46.38, 52.83)	51.36 (49.37, 53.34)	
Marital status:			0.0001
Widowed/divorced/separated or single	29.89 (26.24, 33.54)	21.82 (19.80, 23.84)	
Married/common-law	70.11 (66.46, 73.76)	78.17 (76.15, 80.19)	
Highest education attainment:			0.067
Less than secondary graduation	14.01 (11.25, 16.77)	10.42 (8.68, 12.17)	
Secondary school education	26.13 (22.09, 30.17)	25.16 (22.88, 27.43)	
Post-secondary certificate, or degree	59.86 (55.62, 64.09)	64.41 (61.84, 66.99)	
Total household income:			0.389
No income or < \$20,000	4.29 (3.24, 5.34)	3.14 (2.45, 3.82)	
\$20,000 to \$39,999	10.93 (8.39, 13.46)	10.08 (8.54, 11.63)	
\$40,000 to \$79,999	23.75 (20.38, 27.12)	25.62 (23.39, 27.74)	
\$80,000 or more	61.03 (57.16, 64.91)	61.16 (57.69, 63.62)	
Ethnicity:			0.017
White	83.02 (78.66, 87.37)	88.47 (86.44, 90.51)	
Non-white (aboriginal or other visible)	16.98 (12.63, 21.33)	11.52 (9.49, 13.56)	
Immigration status:			0.041
Non-immigrants (Canadian-born)	73.21 (68.83, 77.59)	78.28 (75.86, 80.70)	
Landed immigrants/non-permanents	26.78 (22.40, 31.16)	21.72 (19.30, 24.14)	
Body mass index <sup>b</sup> :			0.180
Normal (18.5-24.9 kg/m <sup>2</sup> )	28.97 (24.98, 32.96)	26.22 (23.91, 28.52)	
Overweight (25.0- 29.9 kg/m <sup>2</sup> )	41.95 (37.52, 46.39)	40.46 (37.67, 43.24)	
Obese- class I II, III ( $\geq 30.0$ kg/m <sup>2</sup> )	29.07 (25.33, 32.81)	33.32 (30.71, 35.92)	
Moderate/vigorous physical activity <sup>a</sup> :			0.002
<150 min/week (inadequate)	49.58 (45.17, 54.00)	41.66 (38.94, 44.38)	
$\geq 150$ min/week (adequate)	50.41 (45.99, 54.83)	58.34 (55.62, 61.060)	
Smoking status:			<0.0001
Never smokers	41.74 (37.65, 45.82)	47.82 (45.12, 50.52)	
Current smokers- daily/occasional)	26.78 (23.14, 30.43)	16.04 (14.06, 18.02)	
Past smoker- daily/occasional	31.47 (27.56, 35.38)	36.14 (33.47, 38.80)	
Alcohol intake in past 12 month:			0.030
Regular drinker	58.70 (54.44, 62.96)	65.19 (62.67, 67.71)	
Occasional drinker	16.60 (13.79, 19.41)	14.44 (12.59, 16.29)	
Did not drink	24.70 (20.59, 28.81)	20.37 (18.14, 22.59)	

**Table 2: Characteristics of respondents by up-to-date status for colorectal cancer screening (continue)**

Characteristics	FIT/FOBT and/or colonoscopy or sigmoidoscopy (overall CRC screening)		
	No: % (95% CI)	Yes: % (95% CI)	Chi-square P value
General health:			0.3947
Poor or fair	14.45 (11.60, 17.29)	13.31 (11.61, 15.01)	
Good	27.91 (24.61, 31.21)	26.21 (23.84, 28.58)	
Very good	34.62 (30.85, 38.40)	38.74 (36.10, 41.38)	
Excellent	23.01 (19.36, 26.67)	21.73 (19.22, 24.24)	
Mental health:			0.1823
Poor or fair	9.07 (6.45, 11.68)	6.39 (5.22, 7.56)	
Good	17.81 (15.03, 20.60)	17.51 (15.54, 19.48)	
Very good	37.42 (33.42, 41.42)	40.53 (37.83, 43.23)	
Excellent	35.69 (31.56, 39.82)	35.56 (32.85, 38.27)	
Illicit drug used in past 12 month	9.44 (6.97, 11.90)	5.30 (4.17, 6.42)	0.0006
Had FP/GP consultation in past 12 months	78.58 (75.11, 82.05)	94.85 (93.47, 96.24)	<0.0001
Had a regular primary care provider	67.18 (63.23, 71.13)	87.23 (85.41, 89.05)	<0.0001
Had mammogram in past 2 years(female)	52.35 (46.58, 58.13)	82.22 (79.56, 84.87)	<0.0001

Note: CI: confidence interval; FIT: fecal immunochemical test; FOBT: Fecal occult blood test; <sup>a</sup> physical activity was defined based on Canadian physical activity guidelines; <sup>b</sup> body mass index was calculated based on international standard; GP: general physician; FP: family doctor

**Table 3: Characteristics of respondents across those with and without a regular primary care provider**

Characteristics	Had a regular primary care provider		Chi-square P value
	No: (11.03%) % (95% CI)	Yes: (88.97%) % (95% CI)	
Age: 50-59 years 60-74 years	73.35 (67.49, 79.21) 26.65 (20.79, 32.510)	50.69 (48.56, 52.81) 49.31 (47.19, 51.43)	<0.0001
Sex: Male Female	33.47 (26.86, 40.07) 66.53 (59.92, 73.14)	51.40 (50.25, 53.55) 48.60 (47.44, 49.75)	<0.0001
Marital status: Widowed/divorced/separated or single Married/common-law	39.92 (32.15, 47.69) 60.08 (52.30, 67.85)	22.95 (21.13, 24.78) 77.04 (75.22, 78.86)	<0.0001
Education: Less than secondary graduation Secondary school education Post-secondary certificate or degree	19.33 (13.13, 25.52) 20.69 (15.37, 26.02) 59.97 (52.72, 67.22)	10.90 (9.47, 12.34) 25.79 (23.65, 27.92) 63.30 (61.03, 65.58)	0.0025
Total household income: No income or < \$20,000 \$20,000 to \$39,999 \$40,000 to \$79,999 \$80,000 or more	4.32 (2.57, 6.08) 14.27 (8.84, 19.69) 25.80 (19.55, 32.05) 55.60 (47.89, 63.31)	3.52 (2.94, 4.11) 10.21 (8.88, 11.54) 25.47 (23.49, 27.45) 60.79 (58.63, 62.95)	0.2282
Ethnicity: White Non-white	86.91 (79.13, 94.68) 13.0 (5.32, 20.86)	86.40 (83.37, 88.42) 13.60 (11.58, 15.63)	0.901
Immigration status: Non-immigrants (Canadian-born) Landed immigrants/non-permanents	74.41 (66.17, 82.64) 25.59 (17.35, 33.83)	76.50 (74.29, 78.72) 23.49 (21.28, 25.71)	0.618
Body mass index <sup>b</sup> : Normal (18.5-24.9 kg/m <sup>2</sup> ) Overweight (25.0- 29.9 kg/m <sup>2</sup> ) Obese- class I II, III ( $\geq 30.0$ kg/m <sup>2</sup> )	33.70 (25.43, 41.97) 40.70 (32.01, 48.49) 25.60 (19.34, 31.87)	26.55 (24.48, 28.63) 40.66 (38.19, 43.13) 32.78 (30.44, 35.12)	0.086
Moderate to vigorous physical activity <sup>a</sup> : <150 min/week (inadequate) $\geq 150$ min/week (adequate)	45.67 (37.58, 53.77) 54.32 (46.23, 62.42)	44.71 (42.21, 47.20) 55.29 (52.79, 57.79)	0.820
Smoking status: Never smokers Current smokers- daily/occasional) Past smoker- daily/occasional	38.41 (30.40, 46.41) 30.59 (23.79, 37.38) 31.01 (24.06, 37.94)	46.56 (44.27, 48.85) 18.51 (16.64, 20.38) 34.93 (32.65, 37.21)	0.001
Alcohol consumption in past 12 months: Regular drinker Occasional drinker Did not drink	62.87 (54.69, 71.04) 13.79 (8.94, 18.65) 23.34 (14.79, 31.88)	62.38 (60.11, 64.64) 15.22 (13.62, 16.81) 22.41 (20.28, 24.53)	0.872
Illicit drug used in past 12 months:	13.55 (8.46, 18.65)	6.04 (4.89, 7.19)	0.0002

**Table 3: Characteristics of respondents across those with and without a regular primary care provider (continue)**

Characteristics	Had a regular primary care provider		
	No: (11.03%)	Yes: (88.97%)	Chi-square P value
	% (95% CI)	% (95% CI)	
General health:			
Poor or fair	12.95 (6.49, 19.41)	13.99 (12.63, 15.36)	
Good	23.36 (17.92, 28.80)	27.38 (25.40, 29.36)	
Very good	38.49 (31.32, 45.65)	37.03 (34.75, 39.31)	
Excellent	25.19 (17.21, 33.17)	21.59 (19.48, 23.69)	
Mental health:			0.965
Poor or fair	6.13 (1.89, 10.38)	7.07 (6.08, 8.14)	
Good	18.61 (13.66, 23.56)	17.85 (16.11, 19.59)	
Very good	39.69 (32.32, 47.06)	39.43 (37.18, 41.68)	
Excellent	35.56 (27.17, 43.95)	35.64 (33.36, 37.92)	
Had FP/GP consultation in last 12 months	41.60 (34.04, 49.16)	84.61 (82.85, 86.38)	<0.0001
Had mammogram in last 2 years (female)	33.04 (23.09, 42.97)	74.34 (71.47, 77.20)	<0.0001
Had FIT/FOBT in the past 2 years	18.00 (13.00, 23.00)	48.53 (46.05, 51.01)	<0.0001
Had Colonoscopy/sigmoidoscopy in past 5 years	17.13 (10.78, 23.47)	36.44 (34.21, 38.68)	0.0001
Had FIT/FOBT and/or colonoscopy or sigmoidoscopy	29.39 (22.57, 36.21)	67.66 (65.34, 69.98)	<0.0001

Note: CI: confidence interval; FIT: fecal immunochemical test; FOBT: Fecal occult blood test; <sup>a</sup> physical activity was defined based on Canadian physical activity guidelines; <sup>b</sup> body mass index was calculated based on international standard; GP: general physician; FP: family doctor

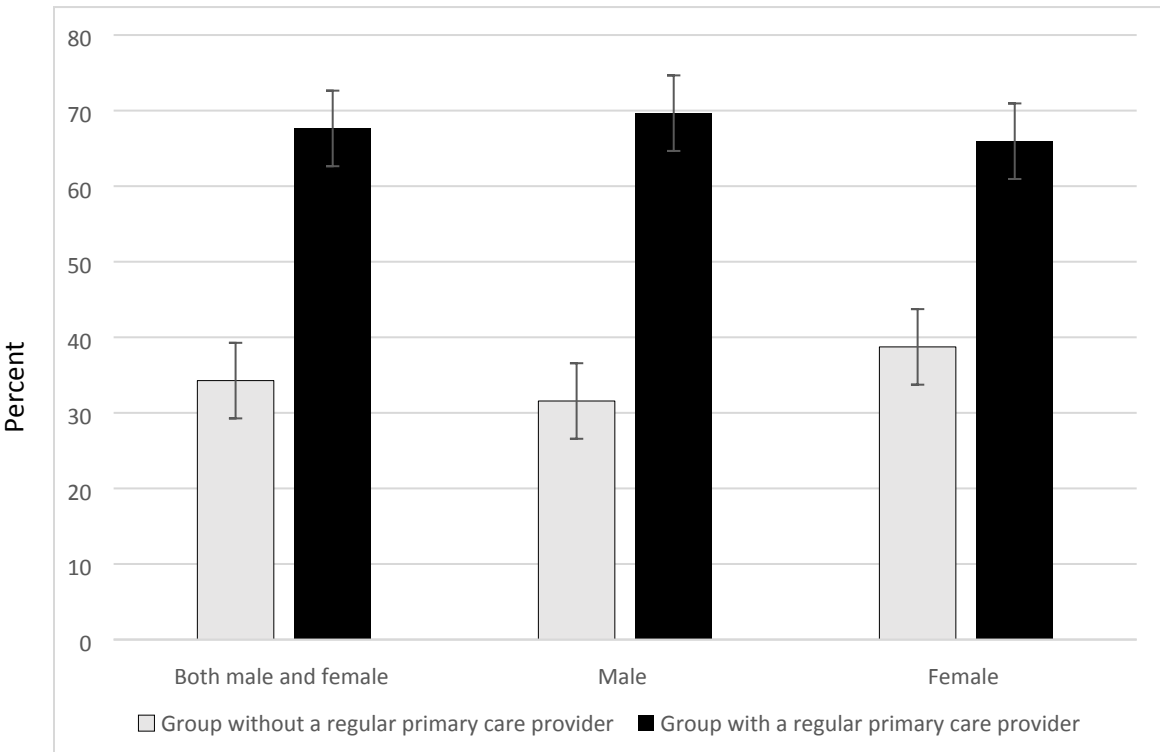
**Table 4: Association between having a regular primary care provider and being up-to-date for colorectal cancer screening (FIT/FOBT in last 2 years or colonoscopy/sigmoidoscopy in last 5 years)**

	<b>Adjusted OR (95% CI)<sup>a</sup></b>
Had a regular primary care provider	
Yes (reference)	1
No	0.24 (0.17, 0.35)
Stratified by:	
GP/FP consultation, at least one in the last 12 months	0.44 (0.25, 0.77)
No GP/FP consultation in the last 12 months	0.21 (0.12, 0.39)
Stratified by:	
Male	0.20 (0.12, 0.33)
Female	0.32 (0.19, 0.53)

Note: OR: odds ratio; CI: confidence interval; FIT: fecal immunochemical test; FOBT: Fecal occult blood test; GP: general physician; FP: family doctor; <sup>a</sup>adjusted for age, marital status, education status, smoking, and illicit drug use.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Figure 1: Absolute probability of being up-to-date for colorectal cancer screening among those who had a regular primary care provider and those who did not have<sup>a</sup>**



<sup>a</sup> adjusted for age, marital status, education status, smoking, and illicit drug use



**Supplementary Table 1: Characteristics of respondents by up-to-date status for colorectal cancer screening**

Characteristics	FIT/FOBT within past 2 years		Colonoscopy/sigmoidoscopy within past 5 years	
	No: % (95% CI)	Yes: % (95% CI)	No: % (95% CI)	Yes: % (95% CI)
Age:				
50-59 years	61.45 (58.29, 64.00)	45.42 (42.31, 48.53)	57.17 (54.73, 59.61)	45.16 (41.19, 49.12)
60-74 years	38.85 (35.99, 41.70)	54.58 (51.47, 57.69)	41.82 (40.38, 45.26)	54.83 (50.87, 58.80)
Sex:				
Female	50.77 (48.62, 52.92)	47.28 (44.74, 49.82)	48.24 (46.76, 49.71)	52.27 (48.60, 55.94)
Male	49.23 (47.08, 51.38)	52.71 (50.18, 55.25)	51.76 (50.28, 53.24)	47.72 (44.05, 51.39)
Marital status:				
Widowed/divorced/separated or single	27.99 (25.15, 30.83)	20.73 (18.68, 22.79)	25.82 (23.58, 28.06)	22.71 (19.93, 25.48)
Married/common-law	72.01 (69.67, 74.84)	79.26 (77.21, 81.32)	74.07 (71.67, 76.47)	77.29 (74.51, 80.00)
Highest education attainment:				
Less than secondary graduation	12.83 (10.62, 15.03)	10.46 (8.49, 12.44)	12.27 (10.37, 14.18)	10.71 (8.36, 13.07)
Secondary school education	25.17 (22.11, 28.23)	25.99 (23.21, 28.78)	25.90 (23.18, 28.62)	23.37 (21.30, 27.43)
Post-secondary certificate, or degree	61.99 (58.67, 65.32)	63.53 (60.45, 66.61)	61.82 (58.89, 64.75)	65.92 (61.41, 68.42)
Total household income:				
No income or < \$20,000	3.58 (2.81, 4.36)	3.52 (2.64, 4.41)	3.59 (2.91, 4.28)	3.46 (2.45, 4.47)
\$20,000 to \$39,999	10.93 (8.79, 13.07)	9.79 (8.27, 11.31)	10.31 (8.69, 11.92)	10.36 (8.08, 12.63)
\$40,000 to \$79,999	23.93 (21.34, 26.51)	26.26 (23.64, 28.88)	24.16 (21.72, 26.60)	25.60 (24.07, 30.07)
\$80,000 or more	61.55 (58.52, 64.58)	60.42 (57.48, 63.36)	60.93 (59.22, 64.64)	61.10 (55.66, 62.54)
Ethnicity:				
White	86.27 (83.17, 89.38)	86.67 (84.00, 89.34)	84.34 (81.49, 87.19)	91.41 (88.21, 93.09)
Non-white (aboriginal or other visible)	13.73 (10.62, 16.83)	13.32 (10.65, 15.99)	15.65 (12.80, 19.50)	8.34 (6.90, 11.78)
Immigration status:				
Non-immigrants (Canadian-born)	75.86 (72.56, 79.17)	77.09 (74.18, 80.00)	74.34 (71.42, 77.27)	80.18 (77.07, 83.28)
Landed immigrants/non-permanents	24.13 (20.83, 27.44)	22.91 (19.99, 25.82)	25.66 (22.73, 28.58)	19.82 (16.71, 22.93)
Body mass index <sup>b</sup> :				
Normal (18.5-24.9 kg/m <sup>2</sup> )	29.33 (26.22, 32.44)	24.62 (21.98, 27.26)	26.01 (24.32, 29.70)	28.53 (24.20, 30.85)
Overweight (25.0- 29.9 kg/m <sup>2</sup> )	41.23 (37.77, 44.68)	40.63 (37.43, 43.83)	41.22 (38.11, 44.32)	40.46 (36.76, 44.16)
Obese- class I II, III (≥30.0 kg/m <sup>2</sup> )	29.43 (26.47, 32.39)	34.75 (32.61, 37.88)	32.76 (28.89, 34.63)	30.01 (28.67, 35.34)
Moderate/vigorous physical activity <sup>a</sup> :				
≥150 min/week (inadequate)	45.50 (42.01, 48.99)	43.44 (40.13, 48.99)	46.21 (43.10, 49.26)	41.37 (37.77, 44.97)
≥150 min/week (adequate)	54.49 (51.01, 57.98)	56.56 (53.24, 59.86)	54.78 (50.67, 56.90)	58.62 (55.03, 62.22)
Smoking status:				
Never smokers	43.19 (40.01, 46.37)	48.39 (45.19, 51.58)	45.70 (42.81, 48.58)	45.75 (42.12, 49.39)
Current smokers- daily/occasional	23.50 (20.74, 26.27)	15.93 (13.61, 18.26)	21.91 (19.47, 24.35)	14.28 (13.68, 18.87)
Past smoker- daily/occasional	33.30 (30.13, 36.47)	35.68 (32.59, 38.77)	32.38 (29.59, 35.17)	39.96 (34.37, 41.54)
Alcohol intake in past 12 month:				
Regular drinker	62.10 (58.74, 65.46)	63.65 (60.74, 66.56)	61.98 (59.24, 64.81)	64.52 (61.00, 68.04)
Occasional drinker	14.96 (12.79, 17.13)	15.53 (13.31, 17.76)	16.89 (13.97, 17.82)	11.09 (10.66, 15.54)
Did not drink	22.94 (19.78, 26.09)	20.81 (18.26, 23.35)	21.13 (19.40, 24.86)	23.38 (19.30, 25.46)

**Supplementary Table 1: Characteristics of respondents by up-to-date status for CRC screening (continue)**

Characteristics	FIT within past 2 years		Colonoscopy/sigmoidoscopy within past 5 years	
	No: % (95% CI)	Yes: % (95% CI)	No: % (95% CI)	Yes: % (95% CI)
General health:				0.383
Poor or fair	13.78 (11.52, 16.04)	13.59 (11.62, 15.51)	13.23 (11.37, 15.09)	13.27 (11.79, 16.74)
Good	25.98 (23.42, 28.53)	27.89 (25.00, 30.78)	27.46 (25.08, 29.84)	24.07 (22.91, 29.24)
Very good	37.44 (34.35, 40.53)	36.82 (33.82, 39.83)	36.48 (33.69, 39.27)	40.01 (35.41, 42.60)
Excellent	22.80 (19.99, 25.61)	21.69 (18.57, 24.80)	22.82 (20.01, 25.62)	21.64 (17.56, 23.72)
Mental health:				0.497
Poor or fair	7.91 (6.00, 9.82)	6.58 (5.21, 7.96)	7.58 (5.99, 9.17)	7.82 (5.03, 8.61)
Good	17.28 (15.12, 19.45)	18.04 (15.66, 20.43)	18.79 (15.80, 19.77)	15.74 (15.09, 20.39)
Very good	38.88 (35.74, 42.01)	40.06 (36.82, 43.30)	38.42 (35.64, 41.19)	40.47 (36.94, 43.99)
Excellent	35.92 (32.73, 39.10)	35.31 (32.13, 38.48)	35.21 (33.31, 39.10)	35.96 (31.40, 38.53)
Illicit drug used in past 12 month	8.47 (3.80, 6.12)	4.96 (3.78, 6.12)	7.23 (5.72, 8.73)	5.04 (4.27, 7.81)
Had FP/GP consultation in past 12 months	83.28 (40.52, 86.04)	95.53 (94.33, 96.74)	86.92 (83.82, 88.02)	94.42 (92.19, 96.66)
Had a regular primary care provider	72.22 (69.20, 75.24)	89.18 (87.25, 91.09)	77.96 (73.37, 78.55)	85.75 (84.31, 89.18)
Had mammogram in past 2 years(female)	60.90 (56.32, 65.49)	84.00 (81.11, 86.54)	66.16 (61.23, 69.08)	79.94 (77.03, 84.86)

Note: CI: confidence interval; FIT: fecal immunochemical test; FOBT: Fecal occult blood test; <sup>a</sup> physical activity was defined based on Canadian physical activity guidelines; <sup>b</sup> body mass index was calculated based on international standard; GP: general physician; FP: family doctor

**Supplementary Table 2: Factors associated with up-to-date colorectal cancer screening**

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI) <sup>a</sup>	Stratified by:	
			Male: Adjusted OR (95% CI) <sup>a</sup>	Female: Adjusted OR (95% CI) <sup>a</sup>
Had a regular primary care provider				
Yes (reference)	1	1	1	1
No	0.23 (0.16, 0.33)	0.24 (0.16, 0.36)	0.21 (0.12, 0.37)	0.30 (0.17, 0.51)
Age:				
30-59 yrs (reference)	1	1	1	1
60-74 yrs	2.08 (1.71, 2.54)	1.88 (1.48, 2.40)	1.64 (1.15, 2.35)	2.14 (1.56, 2.94)
Marital status:				
Previously married or single (reference)	1	1	1	1
Married/common-law	1.52 (1.24, 1.88)	1.40 (1.09, 1.81)	1.58 (1.03, 2.40)	1.25 (0.92, 1.71)
Education attainment:				
Less than secondary graduation (reference)	1	1	1	1
Secondary school education	1.29 (0.91, 1.83)	1.03 (0.64, 1.64)	0.73 (0.36, 1.50)	1.60 (0.89, 2.87)
Post-secondary certificate	1.45 (1.06, 1.97)	1.12 (0.71, 1.76)	0.80 (0.42, 1.52)	1.66 (0.96, 2.88)
Ethnicity:				
White (reference)	1	1	1	1
Non-white	0.64 (0.43, 0.93)	0.78 (0.45, 1.35)	0.84 (0.35, 2.01)	0.71 (0.38, 1.33)
Immigration status:				
Non-immigrants (Canadian-born) (reference)	1	1	1	1
Landed immigrants/non-permanents	0.76 (0.58, 0.99)	0.92 (0.63, 1.34)	0.74 (0.40, 1.35)	1.18 (0.74, 1.87)
Smoking status:				
Never smokers (reference)	1	1	1	1
Current smokers- daily/occasional	0.52 (0.40, 0.67)	0.61 (0.43, 0.86)	0.67 (0.39, 1.15)	0.53 (0.34, 0.83)
Past smoker- daily/occasional	1.00 (0.79, 1.27)	0.92 (0.70, 1.22)	1.05 (0.70, 1.60)	0.82 (0.56, 1.19)
Illicit drug use:				
No (reference)	1	1	1	1
Yes	0.54 (0.37, 0.77)	0.68 (0.43, 1.08)	0.70 (0.40, 1.21)	0.54 (0.19, 1.50)
Alcohol consumption in past 12 months:				
Regular drinker (reference)	1	1	1	1
Occasional drinker	0.78 (0.60, 1.02)	0.80 (0.58, 1.10)	0.69 (0.39, 1.25)	0.53 (0.34, 0.83)
Did not drink	0.74 (0.57, 0.97)	0.83 (0.60, 1.12)	0.76 (0.46, 1.24)	0.82 (0.56, 1.19)
Body mass index <sup>b</sup> :				
Normal (18.5-24.9 kg/m <sup>2</sup> ) (reference)	1	1	1	1
Overweight (25.0- 29.9 kg/m <sup>2</sup> )	1.06 (0.82, 1.37)	0.99 (0.60, 1.13)	0.92 (0.58, 1.48)	0.99 (0.69, 1.42)
Obese- class I II, III (≥30.0 kg/m <sup>2</sup> )	1.27 (0.98, 1.63)	1.13 (0.85, 1.50)	1.01 (0.64, 1.58)	1.15 (0.79, 1.67)
Moderate to vigorous physical activity <sup>a</sup> :				
<150 min/week (inadequate)	1	1	1	1
≥150 min/week (adequate)	1.38 (1.12, 1.69)	1.32 (1.03, 1.69)	1.28 (0.87, 1.89)	1.41 (1.02, 1.95)
General health:				
Poor or fair (reference)	1	1	1	1
Good	1.39 (0.92, 2.11)	1.01 (0.66, 1.55)	1.73 (0.89, 3.35)	0.55 (0.31, 0.98)
Very good	1.54 (1.03, 2.29)	0.94 (0.62, 1.42)	1.33 (0.71, 2.48)	0.64 (0.35, 1.14)
Excellent	1.41 (0.94, 2.12)	0.85 (0.55, 1.29)	1.13 (0.59, 2.18)	0.61 (0.35, 1.08)

Note: OR: odds ratio; CI: confidence interval; <sup>a</sup> adjusted for every other variable in the model (simultaneous adjustment); mammogram was not included for the consistency of variable adjustment to enable the comparison across males and females. Previously married include widowed or divorced or separated