Predictors of colorectal cancer screening: A comparison of men and women

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SE McGregor, HE Bryant. Predictors of colorectal cancer screening: A comparison of men and women. Can J Gastroenterol 2005;19(6):343-349.

BACKGROUND: New Canadian guidelines recommend screening average-risk adults to reduce mortality from colorectal cancer, the second most common cause of cancer death among Canadians. The present study examined the self-reported prevalence of colorectal cancer testing and sex-specific predictors of having had a fecal occult blood (FOB) test for screening, among a cohort of Alberta residents aged 50 to 69 years.

METHODS: Subjects (n=5009) enrolled in a geographically based cohort study completed a Health and Lifestyle Questionnaire between October 2000 and June 2002 that ascertained their colorectal cancer detection practices, as well as demographic and other health and lifestyle characteristics.

RESULTS: Patterns of FOB testing, and sigmoidoscopy or colonoscopy, were similar for men and women. The majority of subjects (83.3%) reported no first-degree family history of colorectal cancer or bowel conditions, and they were considered to be at average risk. Few average-risk subjects reported having a screening FOB test within the past two years (7.7% [95% CI 6.7% to 8.7%] of subjects aged 50 to 59 years and 12.5% [95% CI 10.9% to 14.3%] of subjects aged 60 to 69 years). In men, the strongest predictors of having a screening FOB test in the past two years were a recent history of prostate-specific antigen testing and educational attainment. Among women, the strongest predictors were a recent history of having had a Pap test, a recent mammogram, employment status and educational attainment.

CONCLUSIONS: Screening for colorectal cancer in average-risk adults was infrequent in this sample and lagged behind screening for other cancers. Screening of average-risk adults occurred primarily in people already accessing the health care system, suggesting that public education programs will be required to increase screening rates.

Key Words: *Alberta; Cohort; Colorectal cancer; Health surveys; Mass screening*

Les variables pour le dépistage de cancer colorectal : Une comparaison entre les hommes et les femmes

HISTORIQUE : De nouvelles lignes directrices canadiennes recommandent le dépistage des adultes à risque moyen afin de réduire le taux de mortalité imputable au cancer colorectal, la deuxième cause de décès par le cancer en importance chez les Canadiens. La présente étude porte sur la prévalence autodéclarée de dépistage du cancer colorectal et sur les variables selon le sexe d'avoir subi une recherche de sang occulte dans les selles (SOS) chez une cohorte de citoyens de l'Alberta de 50 à 69 ans.

MÉTHODOLOGIE : Les sujets (n=5 009) enrôlés dans une étude de cohorte de base géographique ont répondu à un questionnaire sur la santé et le mode de vie entre octobre 2000 et juin 2002 afin de déterminer leurs pratiques de détection du cancer colorectal, ainsi que les caractéristiques démographiques et d'autres caractéristiques reliées à la santé et au mode de vie.

RÉSULTATS : Les modèles de recherche de SOS et la sigmoïdoscopie ou la coloscopie étaient similaires chez les femmes et les hommes. La majorité des sujets (83,3 %) n'ont déclaré aucun antécédent de cancer colorectal ou de pathologie intestinale dans la famille immédiate, et étaient considérés comme à risque moyen. Peu de sujets à risque moyen ont déclaré avoir subi une recherche de SOS au cours des deux années précédentes (7,7 % [95 % IC 6,7 % à 8,7 %] des sujets de 50 à 59 ans et 12,5 % [95 % IC 10,9 % à 14,3 %] des sujets de 60 à 69 ans). Chez les hommes, les principales variables de recherche de SOS au cours des deux années précédentes étaient un récent test de dépistage de l'antigène prostatique spécifique et le niveau de scolarisation. Chez les femmes, les principales variables étaient un récent test Pap, une mammographie récente, le statut d'emploi et le niveau de scolarisation.

CONCLUSIONS : Le dépistage du cancer colorectal chez les adultes à risque moyen était peu fréquent au sein de cet échantillon et accusait un certain retard par rapport au dépistage des autres cancers. Le dépistage des adultes à risque moyen se produisait surtout chez des personnes ayant déjà accès au système de santé, ce qui laisse supposer que des programmes d'éducation publique s'imposeront pour accroître les taux de dépistage.

Colorectal cancer (CRC) is the fourth most commonly diagnosed type of cancer and the second most common cause of cancer death among Canadians. In Canada in 2004, it is estimated that there will be 19,100 newly diagnosed CRC cases and 8300 deaths (1). Most CRC occurs sporadically, although up to 15% may have a genetic basis (2). Risk factors for CRC relevant to screening include age, family history of CRC, familial colon cancer syndromes and ulcerative colitis (3).

CRC typically arises from benign adenomatous polyps (4) which allows for a precancerous interval in which screening may be efficacious. Four randomized controlled trials (5-9) and one meta-analysis (10) provide evidence that screening with fecal occult blood (FOB) tests can reduce CRC mortality, with RR reductions ranging from 15% to 33%. Reduced mortality is due to both the early detection of existing cancers and the prevention of subsequent cancer development by the removal of adenomatous polyps by colonoscopy in people with positive FOB tests (11).

A number of organizations (12-15) now recommend CRC screening for persons at average risk. However, there

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Received for publication October 20, 2004. Accepted January 26, 2005

are differences in the recommended screening tests, frequency of testing and target age group. The Canadian Task Force on Preventive Health Care (16) concluded in 2001 that there is good evidence to include annual or biennial FOB testing and fair evidence to include flexible sigmoidoscopy in the periodic health examination of asymptomatic people over 50 years of age. More recently, the Canadian Association of Gastroenterology (17) has recommended the establishment of CRC screening programs with choices for testing determined by patient preference, current evidence and local resources.

An understanding of the current use of CRC detection tests is required to evaluate the subsequent impact, if any, of new Canadian guidelines recommending screening for average-risk people. The aims of the present study were to identify and compare predictors of CRC screening in average-risk adults participating in a newly initiated, geographically based, Alberta cohort study.

METHODS

Data were obtained from participants recruited from October 2000 to June 2002 into a geographically based cohort of Alberta residents. Written ethical approval for the establishment of the cohort was received from the Alberta Cancer Board Research Ethics Committee and the University of Calgary Health Research Ethics Board.

Adults eligible for cohort enrollment were identified using random digit dial computer-assisted telephone interviews. Inclusion criteria were age 35 to 69 years; no personal history of cancer other than nonmelanotic skin cancer; planning to live in Alberta for at least the next year; able to complete a written survey in English with or without the help of a household member; and agreeable to being approached about the cohort study. Subjects were recruited from all 17 Alberta regional health authorities (RHAs), using 2001 boundaries.

Of the eligible individuals identified by random digit dial calling, 61.1% agreed to receive a mailed package of study material. Of these individuals, 52.4% enrolled in the study by returning a completed baseline Health and Lifestyle Questionnaire and signed consent form. Overall, 32.0% of eligible individuals enrolled in the cohort.

The Health and Lifestyle Questionnaire ascertained information on general health status; chronic conditions; reproductive history; cancer detection practices; smoking status; risk factors for CRC including whether the subject had ever been told by a doctor that he or she had polyps in the colon or rectum; ulcerative colitis or Crohn's disease; first-degree family history of colon cancer or rectal cancer; and demographic factors. Questionnaire items were adapted from existing instruments used in other large surveys and/or cohort studies (18-22).

Questions on FOB testing included whether the subject had ever been tested before (ie, asking the subject, "Have you ever had a Blood Stool Test? [A Blood Stool Test is when your stool is examined to determine if it contains blood]"), the time since the most recent test and the reason for the most recent FOB test. Subjects were asked whether they had ever had a sigmoidoscopy or colonoscopy, and if so, the time elapsed since the most recent examination and the reason for testing. Definitions of sigmoidoscopy and colonoscopy were provided. The authors were unable to determine whether the most recent test was a sigmoidoscopy or colonoscopy; thus, the term 'endoscopy' is used throughout the present study.

The present analysis was restricted to participants aged 50 years and older, the age group typically targeted for CRC screening in Canada. Two geographical regions were defined by combining subjects living in RHAs without a major metropolitan area (a city with a population of 100,000 or more inhabitants during the most recent census) into a single geographical region (nonmetropolitan), and subjects living in a health region with one of the two major metropolitan centres in Alberta (Calgary Health Region and Capital Health Authority, Edmonton, Alberta) into a single group (metropolitan). CRC tests were classified as screening tests if the reason for testing was 'part of a routine checkup or screening', and/or because of 'age'. Risk groups were defined based on the presence of one or more risk factors for CRC. Subjects with no risk factors were considered to be at average risk. Subjects with a family history of CRC in at least one first-degree relative were considered to be at elevated risk and subjects with a personal history of bowel polyps, Crohn's disease and/or ulcerative colitis were considered to be at high risk.

χ^2 tests were used to compare the proportions of subjects that reported CRC testing between sexes, age groups and risk groups. Unconditional logistic regression analysis using backward elimination was used to identify predictors in the average-risk group of screening FOB tests in the previous two years. Separate models were developed for men and women. Potential predictor variables included demographic factors, geographical region, health status, smoking habits, number of chronic conditions and weight classification based on body mass index (BMI) (23). Subjects were considered to have a chronic condition if they reported a previous diagnosis of high blood pressure, angina, high cholesterol, heart attack, stroke, emphysema, chronic bronchitis, diabetes, hepatitis or cirrhosis of the liver. Uptake of other cancer screening tests was also included in the model. Men were considered 'active screeners' if they had a prostate-specific antigen (PSA) test within the previous year. Women were considered 'up-to-date' for cervical cancer screening if they reported a Pap test within the previous year or within the previous three years if they had a hysterectomy. Women who reported a mammogram within the previous three years and a clinical breast examination within the previous year were considered 'up-to-date' for breast cancer screening. Reported frequency of breast self-examination (monthly or once every two to three months versus less often or not at all) was considered in the model for women. Only those factors that were significant predictors of screening FOB testing ($P \leq 0.10$) were retained in the model. Pearson χ^2 tests were used to assess the model's goodness of fit.

RESULTS

Results are presented for 5009 of 5252 (95.4%) subjects who provided complete information on cancer detection practices and demographic factors. The most common reasons for exclusion were missing information on income (n=177, 3.4%) and/or cancer detection practices (n=73, 1.4%).

Over two-thirds of the subjects resided outside the two major metropolitan RHAs (Table 1), reflecting the recruitment strategy for the cohort. The distributions for age and place of residence were similar for both sexes. The majority of men (84.5%) and women (74.7%) were married or living with a partner. Self-rated health was reported as very good (41.7%) or good (37.2%) by most subjects; only 8.2% rated their health as fair or poor compared with others of the same age. Among women, rates of screening for cervical and breast cancer were high; almost all women (at least 98%) reported having had at least one Pap test regardless of age group or hysterectomy status, and 94.0% reported having had at least one mammogram (data not shown). Just over one-half (56.8%) reported they regularly

TABLE 1
Proportion of subjects with selected characteristics among men and women aged 50 to 69 years in Alberta from October 2000 through June 2002

	Men (n=2094)		Women (n=2915)	
Characteristic	**n**	**%**	**n**	**%**
Age (years)				
50 to 59	1337	63.9	1828	62.7
60 to 69	757	36.2	1087	37.3
Highest level of education				
High school or less	706	33.7	1171	40.2
Technical school	742	35.4	1000	34.3
University	646	30.9	744	25.5
Employment				
Fulltime employment	1221	58.3	880	30.2
Homemaker or retired	349	16.7	1290	44.3
Other	524	25.0	745	25.6
Regional health authority residence				
Metropolitan	665	31.8	931	31.9
Nonmetropolitan	1429	68.2	1984	68.1
Body mass index category				
Normal	405	19.3	930	31.9
Overweight	1017	48.6	1076	36.9
Obese	667	31.9	877	30.1
Underweight	5	0.2	32	1.1
Current daily smoker				
No	1786	85.3	2447	83.9
Yes	308	14.7	468	16.1
Number of chronic conditions*				
Zero	820	39.2	1276	43.8
One	674	32.2	1036	35.5
Two or more	600	28.7	603	20.8
Active for PSA testing†				
No	1496	71.4		
Yes	598	28.6		
Practicing regular breast self-examination‡				
No			1260	43.2
Yes			1655	56.8
Up-to-date on breast cancer screening§				
No			1776	60.9
Yes			1139	39.1
Up-to-date on Pap screening¶				
No			1272	43.6
Yes			1643	56.4

**Calculated as the sum of the 'Yes' responses to the question "Has a doctor ever told you that you had any of the following conditions: high blood pressure, angina, high cholesterol, heart attack, stroke, emphysema, chronic bronchitis, diabetes, hepatitis or cirrhosis of the liver". †Men were considered active for prostate-specific antigen (PSA) testing if they reported having had a PSA test in the previous year; otherwise they were not considered to be active for PSA testing. ‡Women were considered to practice regular breast self-examination if they reported a frequency of breast self-examination at least once every three months; otherwise they were considered not to practice breast self-examination regularly. §Women were considered to be up-to-date on Pap testing if they reported having had a Pap test within the previous year or within the previous three years if they had a hysterectomy; otherwise they were considered not to be up-to-date on Pap testing. ¶Women were considered to be up-to-date on breast cancer screening if they reported having a mammogram within the previous three years and a clinical breast examination within the previous year; otherwise they were considered not to be up-to-date on breast cancer screening*

practiced breast self-examination. Among men, rates of PSA testing were strongly related to age, with 39.8% and 58.6% of men aged 50 to 59 years and 60 to 69 years respectively, reporting having had at least one PSA test. The majority of men had their most recent PSA test as part of a routine checkup (70.2%), suggesting that these were screening PSA tests.

TABLE 2
Percentage reporting having had colorectal cancer testing, by colorectal cancer risk group and by age group, in persons aged 50 to 69 years in Alberta from October 2000 through June 2002

	Fecal occult blood test			Endoscopy	
		Previous 2 years			Previous 5 years, for any reason (%)
Colorectal cancer risk group by age group (years)	**Ever, for any reason (%)**	**For any reason (%)**	**For screening (%)**	**Ever, for any reason (%)**	
Average risk*					
(n=4173)					
50 to 59	31.4	12.0	7.7	17.2	10.0
60 to 69	41.0	16.8	12.5	23.3	12.0
Family history†					
(n=446)					
50 to 59	39.8	13.9	3.2	33.5	29.1
60 to 69	54.9	20.5	7.2	50.3	32.3
High-risk‡					
(n=390)					
50 to 59	57.7	17.9	3.0	81.6	62.2
60 to 69	64.6	20.1	5.3	88.9	63.0
Overall					
(n=5009)					
50 to 59	33.7	12.5	7.0	22.6	14.8
60 to 69	44.8	17.5	11.2	32.9	19.4

**Defined as subjects with no risk factors for colorectal cancer. †Defined as subjects with at least one first-degree relative with a history of colorectal cancer. ‡Defined as subjects with a personal history of bowel polyps, Crohn's disease and/or ulcerative colitis*

Risk factors for CRC and risk groups

First-degree family history in at least one relative was the most common risk factor for CRC (10.4%), followed by a personal history of colorectal polyps (6.6%). Few subjects reported a personal history of Crohn's disease and/or ulcerative colitis (1.7%). The prevalence of risk factors increased with age, with 14.3% and 20.8% of subjects aged 50 to 59 years and 60 to 69 years, respectively, reporting at least one risk factor for CRC. The majority of subjects (83.3%) reported no risk factors for CRC and were considered to be at average risk. Of the remaining subjects, 8.9% were at elevated risk because of family history and 7.8% were considered high risk because of bowel conditions (this includes 77 [1.5%] subjects who reported both a family history of CRC and a bowel condition). CRC testing was related to the presence of risk factors for CRC. Rates of CRC testing were similar between men and women in each age group and, thus, data in Table 2 are presented for both sexes combined. The percentage of subjects who had an FOB test or endoscopy was higher in those at elevated or high risk compared with those at average risk (Table 2). Subjects at elevated or high risk were more likely to have had a recent endoscopy than a recent FOB test and over 80% of high-risk subjects had been tested within the previous five years. Recent endoscopy testing, particularly for screening, was infrequent in those at average risk, with only 1.9% (95% CI 1.6% to 2.4%) of subjects reporting an endoscopy for routine reasons within the previous five years. Investigation of a problem or symptoms (76.1% men;

TABLE 3
Predictors of a fecal occult blood (FOB) test for screening in the previous two years in average-risk men aged 50 to 69 years in Alberta from October 2000 through June 2002

	FOB test for screening in the previous two years (n=168)		No FOB test for screening in the previous two years (n=1581)		FOB test for screening in the previous two years (n=1749)		
Characteristic	n	%	n	%	Crude OR*†	Adjusted OR†	Adjusted 95% CI
Age (years)							
50 to 59	90	53.6	1049	66.4	1.0	1.0	Referent
60 to 69	78	46.4	532	33.7	1.7	1.6	1.2 to 2.3
Highest level of education							
High school or less	39	23.2	547	34.6	1.0	1.0	Referent
More than high school	129	76.8	1034	65.4	1.7	2.0	1.3 to 2.9
Regional health authority residence‡							
Metropolitan	73	43.5	490	31.0	1.0	1.0	Referent
Nonmetropolitan	95	56.6	1091	69.0	0.6	0.7	0.5 to 1.0
Body mass index (BMI) category§							
Obese	38	22.6	504	31.9	1.0	1.0	Referent
Overweight	98	58.3	760	48.1	1.5	1.7	1.2 to 2.6
Normal	32	19.1	317	20.1	0.9	1.3	0.8 to 2.2
Number of chronic conditions¶							
Zero	50	29.8	646	40.9	1.0	1.0	Referent
One	66	39.3	495	31.3	1.4	1.6	1.1 to 2.4
Two or more	52	31.0	440	27.8	1.2	1.4	0.9 to 2.2
Active for PSA testing**							
No	73	43.5	1184	74.9	1.0	1.0	Referent
Yes	95	56.6	397	25.1	3.9	3.5	2.5 to 4.9

**OR for having an FOB screen in the previous two years. †OR adjusted for all variables in Table 3. ‡Metropolitan regional health authorities were regional health authorities that included a city with a population of 100,000 or more inhabitants during the most recent census; all other regional health authorities were considered to be nonmetropolitan regional health authorities. §Men (n=5) in the 'underweight' BMI category (BMI<18.5) were excluded from the logistic regression analysis. ¶A chronic condition was defined as ever having been diagnosed with high blood pressure, angina, high cholesterol, heart attack, stroke, emphysema, chronic bronchitis, diabetes, hepatitis or cirrhosis of the liver. **Men were considered to be active for prostate-specific antigen (PSA) testing if they reported having had a PSA test in the previous one year, otherwise they were not considered to be active for PSA testing*

86.4% women) was the most commonly reported reason for a recent endoscopy in average-risk subjects.

Among those at average risk, the percentage of subjects who reported an FOB test in the previous two years (both for any reason and screening) did not differ between men and women in either age group. Older average-risk subjects were more likely than younger average-risk subjects to report recent FOB testing for any reason (P<0.0001) and for screening (P<0.0001). Few average-risk subjects reported a screening FOB test within the previous two years (7.7% [95% CI 6.7% to 8.7%] of subjects aged 50 to 59 years, and 12.5% [95% CI 10.9% to 14.3%] of subjects aged 60 to 69 years). Men were 3.1 times more likely to have had a recent PSA test compared with a screening FOB test. Women were 4.8 times more likely to be up-to-date on breast and cervical cancer screening compared with a screening FOB test.

Predictors of screening FOB testing in subjects at average risk for CRC

To focus on subjects with no specific triggers for colorectal testing, the present analysis was restricted to the 4173 subjects who reported no risk factors for CRC. The analysis was further restricted to an examination of FOB testing practices because of the low frequency of endoscopy for routine screening.

In men, the strongest predictors of having a screening FOB test within the previous two years were having had a PSA test within the previous year and educational attainment (Table 3). Men who had at least one chronic condition were more likely than those with no chronic conditions to report having an FOB test for screening in the previous two years. The adjusted OR for having an FOB test for screening in subjects with one chronic condition, and in subjects with two or more chronic conditions, compared with having no chronic conditions, were OR 1.6 (95% CI 1.1 to 2.4) and OR 1.4 (95% CI 0.9 to 2.2), respectively. Obesity and living in a health region outside of a major metropolitan area were associated with less frequent screening.

Women who were active screeners for breast and cervical cancer were more likely to have had an FOB test for screening in the previous two years compared with women who were not up-to-date on these screening tests (Table 4). Education, age and employment status were also predictors in women but geographical region was not. Income was not a predictor of recent FOB test screening for either men or women.

DISCUSSION

Screening in people at average-risk for CRC was infrequent in cohort members and lagged behind screening for other types of cancers. The high rate of use of other available cancer detection tests in cohort members, especially women, suggests that low uptake of CRC screening was not due to avoidance of cancer testing in general. Endoscopic screening was very infrequent in both men and women. Rates of screening FOB testing increased with age and were similar between men and women. The majority of average-risk persons, aged 50 years and older, had not had an FOB test in the previous two years.

TABLE 4
Predictors of a fetal occult blood (FOB) test for screening in the previous two years in average-risk women aged 50 to 69 years in Alberta from October 2000 through June 2002

	FOB test for screening in the previous two years (n=222)		No FOB test for screening in the previous two years (n=2197)		FOB test for screening in the previous two years (n=2419)		
Characteristic	**n**	**%**	**n**	**%**	**Crude OR***	**Adjusted OR†**	**Adjusted 95% CI**
Age (years)							
50 to 59	118	53.2	1453	66.1	1.0	1.0	Referent
60 to 69	104	46.9	744	33.9	1.7	1.6	1.1 to 2.2
Highest level of education							
High school or less	74	33.3	886	40.3	1.0	1.0	Referent
Technical school	80	36.0	757	34.5	1.1	1.3	0.9 to 1.8
University	68	30.6	554	25.2	1.3	1.6	1.1 to 2.2
Employment							
Fulltime employment	47	21.2	702	32.0	1.0	1.0	Referent
Homemaker or retired	123	55.4	918	41.8	1.7	1.7	1.2 to 2.6
Other	52	23.4	577	26.3	0.9	1.3	0.8 to 1.9
Practicing regular breast self-examination‡							
No	75	33.8	969	44.1	1.0	1.0	Referent
Yes	147	66.2	1228	55.9	1.5	1.4	1.0 to 1.9
Up-to-date on Pap testing§							
No	50	22.5	988	45.0	1.0	1.0	Referent
Yes	172	77.5	1209	55.0	2.8	2.1	1.4 to 3.0
Up-to-date on breast cancer screening¶							
No	65	29.3	1180	53.7	1.0	1.0	Referent
Yes	157	70.7	1017	46.3	2.8	1.9	1.4 to 2.7

**OR for having an FOB screen in the previous two years. †OR adjusted for all variables in Table 4. ‡Women were considered to practice regular breast self-examination if they reported a frequency of breast self-examination equal to, or more than, once every three months, otherwise they were considered not to practice breast self-examination regularly. §Women were considered to be up-to-date on Pap testing if they reported having had a Pap test within the previous one year or within the previous three years if they had a hysterectomy, otherwise they were considered not to be up-to-date on Pap testing. ¶Women were considered to be up-to-date on breast cancer screening if they reported having a mammogram within the previous three years and a clinical breast examination within the previous one year, otherwise they were considered not to be up-to-date on breast cancer screening*

Rates of CRC screening in the present study are lower than those reported in the United States (24,25) but similar to rates reported in Ontario (26), where only 9.3% of adults aged 50 to 59 years in an inception cohort had at least one FOB test over six years of follow-up ending in 2000. Higher rates in the United States may reflect the earlier publication of recommendations for screening, differences in clinical recommendations and accompanying American public education programs (27). In American studies, men tend to report higher rates of sigmoidoscopy (28) compared with women (24,28,29). The lack of differences in CRC screening practices between men and women in the present study may simply reflect the very low use of these tests in cohort members.

Use of other cancer screening tests, age and education were predictors of FOB test screening in the present study, and were found to predict recent FOB testing in other studies (24,30-33). Although income was found to predict FOB testing in other studies (24,32-34), it was not important for either men or women in the present study, perhaps reflecting increased access to preventive care in a publicly funded health care system. Total household income in the sample ranged from less than $20,000 (10.2% of the sample) to over $100,000 (15.1%), suggesting that variability in income level in cohort members was sufficient to assess its role in predicting FOB test screening.

A recent Ontario study (35) reported a positive association between socioeconomic status (SES) and receipt from 1997 to 2001 of any colorectal investigation (FOB test, endoscopy, barium enema) and colonoscopy in a cohort of over 1.6 million adults aged 50 to 70 years identified from administrative databases. There are a number of differences in methodology in the Ontario study that make it difficult to compare these findings directly with those of the present study. Income was not measured directly in the Ontario study (mean household income of residential enumeration area was used as a surrogate for personal income); no information on educational attainment was available; and the outcomes were assessed differently. It is possible that educational attainment, another measure of SES, is more useful in explaining CRC screening behaviour; however, the findings from the Ontario study (35) support the fact that SES may be an important predictor of CRC screening uptake, which needs to be considered in future studies.

In the present study, use of other cancer detection tests was less strongly predictive of screening FOB testing in women than men, perhaps because breast and cervical cancer screening is habitually included in the periodical health examination and newly available screening tests are not routinely considered. It may also be an indication that screening for CRC will need to compete with other long-standing screening tests for time during health maintenance visits. Living in a metropolitan RHA compared with a nonmetropolitan area was associated with higher screening rates in men; a finding which has also been observed in prostate cancer screening (36) and perhaps reflects the higher profile of screening in specialists who tend to be concentrated in urban areas. The high correlation between PSA testing and CRC screening may be partly due to digital rectal examination, which is recommended for men who choose to have prostate cancer screening and which may also be used by some physicians to screen for rectal cancer.

Obese men were less likely to have been tested recently compared with less heavy men, but BMI was not predictive of screening in women in the present study. An American study reported that the prevalence of FOB testing in morbidly obese women (BMI at least 35) was lower compared with normal weight (BMI 18.5 to 24.9) women; however, no difference was found in men (37). Other studies (31,38) which have looked at predictors for both sexes combined, have found no relationship between BMI and FOB testing or endoscopy. Further investigations of BMI on screening behaviour, using sex-specific models, are warranted particularly because obesity is a risk factor for CRC.

Men who had at least one chronic condition were more likely to be recently screened. Examination of the data found that there was not any specific condition associated with being screened. The most common conditions reported by average-risk men were high cholesterol (38%) and high blood pressure (33%). We speculate that in the absence of long-standing and available screening for other types of cancers, other triggers such as regular monitoring for high blood pressure are required for men to initiate a physician visit, increasing the likelihood of the discussion of CRC screening and testing.

Unfortunately, no information was available on primary care practices of subjects or about CRC screening recommendations made by the subject's physician. Attending for a health maintenance visit has been found to be strongly associated with FOB testing in other studies (30,31,39,40). Physician recommendation is a strong predictor of acceptance of screening, (41-43) including CRC screening (40,44). The low rates of CRC screening observed in the present study likely reflect low physician recommendation but could also indicate low patient acceptance of available CRC screening tests.

The importance of factors which may trigger a physician visit (eg, screening for other cancers, having a chronic condition) in predicting screening for CRC in the cohort suggests that screening, at least in cohort members, is restricted to those already regularly accessing care. Public education programs and interventions to specifically invite average-risk adults for screening, in addition to strategies involving family physicians, are required to increase CRC screening rates.

There are both strengths and limitations to the data presented here. Although cohort members were recruited from a wide geographical area, the sample and estimates presented here are not representative and cannot be generalized to the Alberta population. Participants in the cohort are likely to be more health conscious compared with the general population and, thus, CRC screening rates are likely overestimated. Strengths of the cohort include a large sample size which permits separate models of predictors for men and women, and the ability to investigate predictors of screening in average-risk subjects.

Low rates of CRC screening are not surprising in light of Canadian clinical practice guidelines (45), which were in place during the period of observation (October 2000 through June 2002) and stated there was insufficient evidence to recommend screening for CRC in persons at average risk. However, publication of evidence supporting CRC screening for average-risk adults over 50 years of age (46) and the release of guidelines (16,17) recommending screening may neither result in a significant change in physicians' practices, nor in the screening behaviours of the public (47,48). American guidelines recommending CRC screening were introduced in the middle 1990s (49). However, since then, self-reported screening rates for CRC have changed very little and lag behind other recommended cancer screening tests (50). The much higher rates of PSA testing in men in the cohort, despite Canadian clinical practice guidelines recommending against prostate cancer screening (51), suggest that factors other than clinical practice guidelines affect uptake of cancer screening.

A major challenge for health care decision-makers is to translate findings from clinical trials of CRC screening into general practice and to the population at large (52). Research is needed to facilitate planning and implementation of population-based CRC screening (53) and to increase CRC screening rates, particularly in those not already accessing screening for other cancers. Population-based studies are needed to assess variations in screening uptake by age, sex and geographical region.

ACKNOWLEDGEMENTS: The data used in the present study were provided by the Alberta Cohort Study (The Tomorrow Project) at the Division of Population Health and Information, Alberta Cancer Board, Calgary, Alberta, with funding from the Alberta Cancer Board New Initiatives Program. Dr SE McGregor was funded by a Population Health Investigator Award from the Alberta Heritage Foundation for Medical Research.

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