The effects of cancer beliefs and sociodemographic factors on colorectal cancer screening behavior in Newfoundland and Labrador

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Abstract

Background

This study investigated the beliefs about cancer treatment, outcomes, and screening among older adults ages 50–74 in Newfoundland and Labrador and whether these beliefs or sociodemographic factors were associated with differences in colorectal cancer (CRC) screening behavior.

Methods

This analysis uses data collected online survey of adults on cancer awareness and prevention in NL. Chi-square tests were used to assess whether there were differences in distributions of beliefs based on CRC screening behaviour. Logistic regression was used to identify sociodemographic factors independently associated with CRC screening behavior.

Results

Most people held positive beliefs about cancer outcomes and treatment, though only 57.36% ever had CRC screening. Interestingly, 56.5% of participants believed that cancer treatment is worse than cancer itself. However, no beliefs about cancer treatment and outcomes were associated with CRC screening behavior. People who never had CRC screening were more likely to believe that: their worries about what might be found would prevent them from screening (χ^2 = 9.380, P = .009); screening is only necessary if they have symptoms (χ^2 = 15.680, P < .001); screening has a high risk of leading to unnecessary surgery (χ^2 = 6.824, P = .032). Similarly, people who never had CRC screening were less likely to believe that regular screening would give them a feeling of control over their health (χ^2 = 12.255, P = .002). Logistic regression identified that men had higher odds of having had CRC screening than women in our study (OR(95% CI):1.689(1.135–2.515)), as did all other age groups compared to people ages 50–54. No differences were found in CRC screening behaviour based on ethnicity, BMI classification, geography, education, income, or history of cancer in self, or history of cancer in a first-degree relative.

Conclusion

Although the majority NL residents in our sample held positive beliefs towards cancer screening, treatment and outcomes, only just over half of participants have ever had CRC screening. This discordance should be investigated further. Participants with more negative beliefs about screening were more likely to have never participated in CRC screening. Our findings further suggest that NL's CRC screening program is equitably reaching people from different socioeconomic backgrounds, though we observed a disparity in participation among genders in our sample.

Background

Colorectal cancer (CRC) is one of the most common cancers worldwide, and is a leading cause of cancer death, second only to lung cancer in Canada (Araghi et al., 2019; Arnold et al., 2019; Canadian Cancer Society, 2019). The five-year survival rate of colorectal cancer in Canada has shown slow and steady improvement, recently estimated to be 66.8% (Arnold et al., 2019). In the province of Newfoundland and Labrador, the incidence rate is considerably higher than the rest of Canada, and this is considered to be related, in part, to poor diet and other health behaviors (Sharma et al., 2017). Fortunately, there are robust screening tests available to detect CRC, which provide a lead time that allows premalignant adenomas to be detected and removed, thereby effectively reducing colorectal cancer incidence (Canadian Task Force on Preventive Health Care, 2016). Among adults ages 50–74 years of age, screening with sigmoidoscopy is recommended every ten years, while Fecal Immunochemical Testing (FIT) or Fecal Occult Blood Testing (FOBT) is recommended every two years (Canadian Task Force on Preventive Health Care, 2016). However, the uptake of screening has been far less than desirable in Canada, and is particularly poor in regions of Newfoundland and Labrador (Sewitch, Cournier, Ciampi, & Dyachenko, 2008). Therefore, understanding reasons for this poor uptake and identifying factors associated with adoption of CRC screening will have value in population health promotion.

Studies have found significant associations between intent to screen and factors such as age, knowledge, attitudes, and test worries related to cancer and screening tests (Jimbo et al., 2017). Based on this, the authors recommended that interventions aimed at positively influencing knowledge, attitudes, and worries may help improve uptake of CRC screening (Jimbo et al., 2017). Furthermore, other studies have found that feeling healthy and fearing test outcomes have been associated with CRC screening avoidance, while factors such as knowing someone with cancer can increase uptake (Chapple, Ziebland, Hewitson, & Mcpherson, 2008). No studies to date have attempted to assess awareness and beliefs about cancer treatment, outcomes, and screening among the population of Newfoundland and Labrador. In order to guide policy recommendations in this province, it is important to understand the beliefs of this population about cancer and cancer screening. Moreover, while beliefs have been found to be associated with screening intent elsewhere, it is important to assess whether these beliefs are associated with screening behaviour in this population.

The aim of the study was to assess attitudes towards cancer treatment and outcomes and towards cancer screening in NL adults ages 50 to 74, and to determine factors affecting CRC screening behavior. To achieve these aims, three specific objectives were proposed: (1) Describe and analyze associations between participants' beliefs about cancer (treatment and outcomes) and CRC screening behaviour (having ever had versus having never had CRC screening); (2) Describe and analyze associations between participants' beliefs about cancer screening and CRC screening behaviour; (3) Analyze independent associations between sociodemographic factors and CRC screening behaviour. This study was conducted as part of a larger study on the awareness and prevention of cancer among adults ages 35–74 in Newfoundland and Labrador. Given that CRC screening is indicated for adults ages 50 to 74, we limited this analysis to survey respondents ages 50 to 74.

Methods

Design

The web-based cross-sectional health survey was conducted during April and May 2018, recruiting a partially representative sample of NL adults aged 35 to 74 years. A Facebook page was created for the study and was used as a medium for posting recruitment advertisements with a focus on cancer awareness and prevention. Purposive quota sampling was employed using targeted advertising to improve representativeness of the sample. The details of study design and an assessment of sample representativeness have been published elsewhere (Shaver et al., 2019). Item randomization and adaptive questioning were not conducted. Participation was anonymous, and informed consent was required before participants could start the survey.

Participants

NL residents aged 35 to 74 years were recruited through Facebook Advertising for the online survey about cancer awareness and prevention. During the recruitment process, we regularly evaluated the distribution of respondent demographics to find underrepresented samples; targeted advertisements based on geography, age, gender, and education were then employed to improve representation. Not all quotas were met by the time the survey period ended, so some populations (men; people with no post-secondary education) were still underrepresented (Shaver et al., 2019). We restricted our analyses in this paper to the 724 participants who were between the ages of 50 and 74, as these are the current ages included in provincial CRC screening programs.

Data Collection

Participant Information

This form had 10 questions measuring sociodemographic characteristics such as gender, age group, education, geography, income, and whether they were living with a partner (the sections of the instrument relevant to this analysis can be found in Supplementary File 1).

Assessing Health and Health Care

These forms were developed to assess participants' self-rated health, number of chronic illnesses, self-rated life stress, cancer history of among self and others. To assess CRC screening behavior, participants were asked whether they had ever had a (1) FIT or FOBT test, or a (2) sigmoidoscopy as a screening test for colorectal cancer, and how long ago these were. Scores were recorded as 0 = Never had screening, and 1 = Ever had screening, for each test. If an individual had any one of the two screening tests, or both, they were classified as having had CRC screening. Individuals who responded "Never had one" to both of the questions, or who responded "Never had one" to one of the questions and left the other blank, were

classified as “never had any CRC screening.” Those who did not respond to either screening question were coded as “system missing.” Because colonoscopies are not recommended as a screening modality by the Canadian Task Force on Preventive Health Care, we did not consider having had a colonoscopy as CRC screening.

Assessing Beliefs About Cancer Treatment, Outcomes, and Screening

Participants’ beliefs about cancer treatment and outcomes, as well as beliefs about cancer screening, were assessed. Questions were adapted from a variety of sources, including the Awareness and Beliefs about Cancer (ABC) instrument (Beydoun et al., 2014; Marmarà, Marmarà, & Hubbard, 2017; Simon et al., 2012). Six questions from the ABC instrument assessed beliefs about cancer treatment and outcomes, three of which were positive beliefs and three of which were negative beliefs, on a four-point Likert-type scale. Positive beliefs scored from 1 to 2 (1 = disagree or strongly disagree; 2 = agree or strongly agree); negative beliefs were reverse-scored (2 = disagree or strongly disagree; 1 = agree or strongly agree). To measure attitudes towards cancer screening (four questions in the positive domain and four in the negative domain), participants were asked to answer items on a five-point Likert-type scale, ranging from 1 to 3 (for the positive domain: 1 = strongly disagree or disagree, 2 = neither agree nor disagree, 3 = agree or strongly agree; for the negative domain: 1 = strongly agree or agree, 2 = neither agree nor disagree, 3 = disagree or strongly disagree).

Data analysis

A descriptive analysis was conducted to report demographic, social, and health characteristics of participants. Chi-square tests were performed to evaluate differences among categorical variables for beliefs about cancer and cancer screening beliefs, and how these beliefs varied with CRC screening behaviour. A logistic regression model was used to identify independent factors that influenced CRC screening behavior. Significance level was set at 0.05. The data analyses were performed with SPSS statistical software (version 21.0, IBM company, Armonk, NY, USA, 2014).

Results

Participant Characteristics

A total of 1104 unique surveys were submitted, of which 1048 met inclusion criteria; after excluding seven surveys with considerable missing data, the final sample included 1041 participants aged 35–74. Sociodemographic and personal variables of all study participants ages 35–74 (N = 1041) and the subgroup of participants ages 50–74 (N = 724) are presented in Table 1. The characteristics of participants aged 50–74 (referred to hereinafter as “participants” as this group is the focus of our study and analyses), did not vary unexpectedly from our initial sample of participants aged 35–74. In this study, 77.46% [550/710] people were overweight or obese. About half of the participants rated their health as very good or excellent (48.62[352/724]) and only one fifth reported that their life was quite a bit or

extremely stressful (20.30% [147/724]). Half were from rural areas (51.24% [371/724]), just under one-third had ‘low’ education (high school or less; 27.92% [201/720]), and half had a household income of $60,000 or more (48.48% [318/656]).

Table 1
Characteristics of all study participants and participants ages 50–74

Characteristics	All Participants (n = 1041)		Subgroup, Ages 50–74 (n = 724)	
	N	%	*N*[a]	%
Gender				
Female	799	76.75	535	73.90
Male	242	23.25	189	26.10
Age				
35–49	317	30.45	-	-
50–54	157	15.08	157	21.69
55–59	169	16.23	169	23.34
60–64	179	17.20	179	24.72
65–74	219	21.04	219	30.24
Ethnicity				
Caucasian/White	975	95.49	677	96.16
Other	46	4.51	27	3.84
Geography				
Urban	574	55.14	353	48.76
Rural	467	44.86	371	51.24
Living with a partner				
No	253	24.37	167	23.16
Yes	785	75.63	554	76.84
Education				
High	799	77.12	519	72.08
Low	237	22.88	201	27.92
Household Income				
$60,000+	524	55.33	318	48.48
$30,000 - $59,999	283	29.88	225	34.30

Characteristics	All Participants (n = 1041)		Subgroup, Ages 50–74 (n = 724)	
	N	%	*N*[a]	%
<$29,999	140	14.78	113	17.23
Health				
Poor or Fair	161	15.47	120	16.57
Good	370	35.54	252	34.81
Very Good or Excellent	510	48.09	352	48.62
Stress				
Extremely stressful	25	2.40	16	2.21
Quite a bit stressful	211	20.29	131	18.09
A bit stressful	473	45.48	307	42.40
Not very stressful	274	26.35	219	30.25
Not at all stressful	57	5.48	51	7.04
BMI Classification				
Underweight or Normal Weight	243	23.80	160	22.54
Overweight	352	34.48	257	36.20
Obese	426	41.72	293	41.27
Number of Chronic Conditions				
0	463	44.48	321	44.34
1–2	434	41.69	293	40.47
3+	144	13.83	110	15.19
Has a Regular Health Care Provider				
No	94	9.04	59	8.16
Yes	946	90.96	664	91.84
History of Cancer Diagnosis				
No	871	83.83	579	80.19
Yes	168	16.17	143	19.81
History of Cancer Diagnosis in First Degree Relative				

Characteristics	All Participants (n = 1041)		Subgroup, Ages 50–74 (n = 724)	
	N	*%*	*N*[a]	*%*
No or Not Sure	301	29.54	153	21.70
Yes	718	70.46	552	78.30

[a] Totals may not equal 1041 or 724 in each group due to missing variables.

Associations between CRC Screening and Beliefs About Cancer Treatment and Outco99mes

Most of the participants held positive, non-fatalistic, attitudes towards cancer treatment and outcomes. There were no statistically significant differences between people who have ever had CRC screening and those who have never had CRC screening, for any of the six beliefs about cancer treatment and outcomes studied (Table 2). While we did not control for sociodemographic variables, in additional analyses (not shown) we found only two beliefs had correlations with age or gender: older age was correlated with 'believing that cancer can often be cured' (r_s=0.106, P = 0.005) and men were more likely than women to disagree with the belief that 'that cancer treatments are worse than the cancer itself' (r_s=0.097, P = 0.009). Interestingly, 61.3% (433/712) of people ages 50–74 agreed or strongly agreed that cancer treatment is worse than cancer itself, and 28.9% (209/720) agreed or strongly agreed that cancer is a death sentence. Almost all the participants (96.0% [692/721]) believed that going to see a doctor as quickly as possible after noticing a symptom of cancer could increase chances of surviving.

Associations Between Crc Screening And Beliefs About Cancer Screening

Table 3 displays comparisons in beliefs about cancer screening in individuals ages 50 to 74 to explore whether beliefs differed between people who engaged in CRC screening behaviours and those who did not. While Table 3 does not control for gender and age, there were no significant correlations with age among any of the cancer screening beliefs (analysis not shown), and there was only one screening belief (that they would participate in screening if their doctor told them how important it was) that was significantly correlated with gender (r_s=0.082, P = 0.027), though the correlation was so small that it was considered negligible.

Table 2

Associations Between CRC Screening[a] and Beliefs About Cancer Screening Among Adults Ages 50–74 in Newfoundland and Labrador

Beliefs of cancer	Never had CRC screening (n(%)) (n = 192)		Has had CRC screening(n(%)) (n = 526)		$\chi^2(1)$	P [c]
	D or SD	A or SA	D or SD	A or SA		
1.These days, many people with cancer can expect to live normal lives.	101 (33.2)	203 (66.8)	131 (32.0)	278 (68.0)	0.113	0.747
2.Cancer can often be cured.	44 (14.5)	260 (85.5)	59 (14.5)	348 (85.5)	< 0.001	1.000
3.Going to the doctor as quickly as possible after noticing a symptom of cancer could increase chances of surviving.	12 (3.9)	292 (96.1)	17 (4.2)	390 (95.8)	0.023	1.000
4.Most cancer treatment is worse than the cancer itself.	111 (36.5)	193 (63.5)	168 (41.2)	240 (58.8)	1.590	0.215
5.I would not want to know if I have cancer.	267 (88.4)	35 (11.6)	375 (92.4)	31 (7.6)	3.203	0.089
6. A diagnosis of cancer is a death sentence.	223 (73.6)	80 (26.4)	283 (69.5)	124 (30.5)	1.401	0.242

[a] A person was considered to have ever had CRC screening if they have ever had either FIT/FOBT or a Flexible Sigmoidoscopy screening test.

Abbreviation: SA = Strongly agree; A = Agree; D = Disagree; SD = Strongly disagree. Bold type of P value indicates statistical significance under the significance criteria of 0.05.

The vast majority of participants (84.5% [612/724]) agreed or strongly agreed that screening could reduce their chances of dying from cancer. Interestingly, differences in this attitude were not associated with differences in CRC screening behavior ($\chi^2(2) = 1.410$, P = 0.501), but with the high proportion of participants in agreement there may have been a ceiling effect. Most participants (83.29% [598/718]) correctly disagreed or strongly disagreed with the statement that cancer screening was only necessary if they had symptoms. As shown in Table 3, those who never had CRC screening were twice more likely to agree/strongly agree that they "would be so worried about what might be found during screening, that I would prefer not to do it" than those who have never had CRC screening. The corresponding proportions are 9.2% and 4.9% ($\chi^2(2) = 9.38$, P = 0.009), respectively. The results suggest that fearing an undesirable screening outcome is a factor deterring people from receiving this screening service.

Furthermore, compared to those who have not had CRC screening, those who had CRC screening differed significantly in their agreement with the statement that screening was only necessary if one had

symptoms ($\chi^2(2) = 15.680$, $P < 0.001$). Those who never had screening were twice as likely to strongly agree or strongly agree (12.5% vs 5.4% for those who have had CRC screening) that screening was only necessary if they had symptoms ($\chi^2(2) = 15.680$, $P < 0.001$). While 88.0% of people who have had screening disagreed or strongly disagreed with this statement, this was true for only 77.3% of those who have never had CRC screening.

Beliefs about whether screening has a high risk of leading to unnecessary surgery differed between people have had and those who have not had CRC cancer screening ($\chi^2(1) = 6.824$, $P = 0.032$). Specifically, of people who have not had CRC screening, 11.9% agreed or strongly agreed that there were high risks of unnecessary surgery, whereas only 7.1% of those who had screening agreed or strongly agreed.

Logistic Regression of Associations Between CRC Screening Behaviour and Sociodemographic Factors

Overall, 73.3% (526/718) of respondents ages 50 to 74 reported having ever had CRC screening. In the logistic regression model, we adjusted for gender, age, rural/urban geography, ethnicity, BMI class, whether they were living with a partner, their level of education, their income level, having had a history of cancer themselves, and having a first-degree relative with a history of cancer. Expectedly, there were differences in CRC screening by age group. Compared to individuals ages 50–54, those ages 55–59, 60–64, 65–69, and 70–74 all had significantly higher odds of having ever had CRC screening (Table 4). We also found that the odds of having had CRC screening were higher in males than females (OR_{adj}=1.689. 95% CI = 1.135–2.515). There were no statistically significant differences in CRC screening behaviour based on ethnicity, BMI class, geography, whether someone was living with a partner, education, income, or having a regular healthcare provider (Table 4). Furthermore, there were no differences based on whether the individual themselves was ever diagnosed with cancer, or whether they had a first-degree relative who had ever been diagnosed with cancer.

Table 3
Associations Between CRC Screeninga and Beliefs About Cancer Screening Among Adults Ages 50-74 in Newfoundland and Labrador

Beliefs of cancer screening	Never had CRC Screening n (%)			Ever had CRC Screening n (%)			$\chi^2(2)$	*P*
	SD or D	N	SA or A	SD or D	N	SA or A		
1.I would be so worried about what might be found during screening, that I would prefer not to do it.	238 (78.3)	38 (12.5)	28 (9.2)	355 (86.8)	34 (8.3)	20 (4.9)	**9.380**	**0.009**
2.Cancer screening is only necessary if I have symptoms.	235 (77.3)	31 (10.2)	38 (12.5)	360 (88.0)	27 (6.6)	22 (5.4)	**15.680**	**< 0.001**
3.Cancer screening could reduce my chances of dying from cancer.	29 (9.5)	19 (6.3)	256 (84.2)	44 (10.8)	18 (4.4)	347 (84.8)	1.410	0.501
4.If I have a healthy lifestyle, I don't need to worry about having regular cancer screening.	257 (84.5)	29 (9.5)	18 (5.9)	348 (85.3)	34 (8.3)	26 (6.4)	0.356	0.842
5.Cancer screenings are now very routines tests.	62 (20.5)	77 (25.4)	164 (54.1)	94 (23.0)	73 (17.9)	241 (59.1)	5.933	0.051
6.Cancer screening tests have a high risk of leading to unnecessary surgery.	189 (62.4)	78 (25.7)	36 (11.9)	288 (70.4)	92 (22.5)	29 (7.1)	**6.824**	**0.032**
7.Regular cancer screening would give me a feeling of control over my health.	27 (8.9)	57 (18.9)	218 (72.2)	21 (5.1)	48 (11.8)	339 (83.1)	**12.255**	**0.002**
8.I would be more likely to do screening if my doctor told me how important it was	35 (11.6)	57 (18.9)	209 (69.4)	42 (10.3)	57 (13.9)	310 (75.8)	3.955	0.140

[a] A person was considered to have ever had CRC screening if they have ever had either FIT/FOBT or a Flexible Sigmoidoscopy screening test.

Abbreviation: SA = Strongly agree; A = Agree; N = Neither Agree Nor Disagree; D = Disagree; SD = Strongly disagree.

Bold type of P value indicates statistical significance under the significance criteria of 0.05.

Table 4
Logistic Regression of Associations Between CRC Screening Behaviour a and Sociodemographic Factors Among Adults Ages 50–74 in Newfoundland and Labrador(n = 596)b

Characteristics	OR_{unadj} (95% CI)	OR_{adj}(95% CI)[c]
Gender		
Female	1.00	1.00
Male	**1.828 (1.283–2.603)**	**1.689 (1.135–2.515)**
Age		
50–54	1.00	1.00
55–59	**2.328 (1.490–3.639)**	**2.288 (1.405–3.726)**
60–64	**2.432 (1.562–3.789)**	**2.399 (1.440–3.996)**
65–69	**3.268 (2.032–5.256)**	**2.735 (1.591–4.699)**
70–74	**2.913 (1.624-5/227)**	**3.087 (1.582–6.025)**
Ethnicity		
Caucasian	1.00	1.00
Other	1.418 (0.623–3.227)	1.230 (0.503–3.008)
BMI Classification		
< 25.0 (Under or normal weight)	1.00	1.00
25.0 to < 30.0 (Overweight)	1.243 (0.834–1.853)	1.062 (0.673–1.678)
30.0 + (Obese)	**1.528 (1.033–2.260)**	1.465 (0.940–2.285)
Geography		
Urban	1.00	1.00
Rural	1.127 (0.837–1.516)	1.158 (0.815–1.647)
Living With Partner		
No	1.00	1.00
Yes	1.262 (0.888–1.794)	1.013 (0.655–1.569)
Education		
High (Post-secondary degree)	1.00	1.00
Low (No Post-secondary degree)	1.002 (0.718–1.398)	0.955 (0.639–1.428)
Income		

Characteristics	OR_{unadj} (95% CI)	OR_{adj}(95% CI)[c]
$60,000+	1.00	1.00
$30,000 - $59,999	1.106(0.782–1.563)	0.915 (0.607–1.379)
<$29,999	1.329(0.847–2.087)	0.932 (0.532–1.634)
History of cancer diagnosis in first-degree relative		
No or not sure	1.00	1.00
Yes	**1.537(1.070–2.208)**	1.433 (0.947–2.169)
History of cancer diagnosis in self		
No	1.00	1.00
Yes	**1.630(1.107–2.401)**	1.219 (0.782–1.898)

[a] A person was considered to have ever had CRC screening if they have ever had either FIT/FOBT or a Flexible Sigmoidoscopy screening test. † Bold text indicates statistical significance at the level of 0.05.

[b] The number of individuals included in the regression is smaller than the number of individuals ages 50–74 in our sample because some individuals had missing data and were thus not included in this analysis.

[c]Adjusted for Gender, Age, Geography, Ethnicity, BMI Class, Living With Partner, Education Category, Income Category, History of Cancer in Self, and History of Cancer Diagnosis in First Degree Relative.

Discussion

Most participants held positive attitudes towards cancer treatment and outcomes. Positive attitudes towards, and awareness of, cancer and cancer screening play a role in adopting proactive strategies to prevent cancer, and so it is important for public awareness campaigns to emphasize the benefits of screening, while at the same time not catastrophizing the disease or instilling fatalistic beliefs. Interestingly, none of the beliefs about cancer treatment or outcomes were associated with differences in CRC screening behaviour. This is encouraging because this suggests that even those who hold more fatalistic beliefs may still participate in screening. It is possible that the observed associations between beliefs and screening behaviour may be influenced by socioeconomic or other confounding factors for which we didn't control.

Most participants also held positive beliefs about cancer screening, with few concerned about risks of false positives leading to unnecessary surgery, and even fewer who stated their fears about what might be found would prevent them from participating in screening. Interestingly, three of the four beliefs about cancer screening in the 'negative domain', but only one of the four beliefs in the 'positive domain', were associated with differences in behaviour. This suggests that awareness campaigns may benefit more

from addressing fears or negative beliefs participants have about screening, rather than just promoting the benefits. As those who never had CRC screening were more likely to believe screening was only necessary if they had symptoms, there may be some role for improving public awareness on the purpose of screening. There were no associations between CRC screening behaviour and believing that cancer screening is not necessary if someone has a healthy lifestyle, and more surprisingly, nor were there associations with believing that cancer screening is now very routine, or believing that it can reduce their chances of dying from cancer.

In our sample, only 55.9% of participants ages 50–74 agreed or strongly agreed with the statement that cancer screening is now very routine. However, since there was no association with having had CRC screening, this suggests that trying to change public perception on the routine nature of cancer screening may not improve screening participation. This is counterintuitive, but perhaps this finding is because other factors beyond beliefs are at play. Alternatively, it could be because we looked at having ever had CRC screening, and not at having regular or recent CRC screening. Believing that regular screening would give them a feeling of control over their health was associated with having had CRC screening. A large majority of participants agreed that they would participate in screening if their doctor told them how important it was, and but this was not associated with a difference in CRC screening behaviour.

To find only a few small differences between screening beliefs and screening behaviors, and no differences in screening behaviours across the beliefs about cancer treatment and outcomes, should be considered a favorable finding. This is because it suggests that even those who have fatalistic beliefs about cancer are barely, if at all, less likely to have participated in CRC screening. We interpret this as an encouraging sign that, despite their beliefs, people are still engaging in cancer screening. That said, Newfoundland and Labrador still has the second lowest rate, behind Quebec, of being up-to-date for CRC screening among all provinces in Canada (H. Singh, Bernstein, Samadder, & Ahmed, 2015). Just over half of participants ages 50–74 have ever had FIT (or FOBT) or flexible sigmoidoscopy CRC screening (57.36% [409/713]). Due to the limitations of our non-random sampling design, this number should not be generalized as a population estimate. This also does not mean that these individuals are up-to-date with screening. That said, these findings further support our assertion that there are gaps between attitudes and action. The lack of large associations between beliefs and CRC screening rates further suggests that interventions beyond health awareness and education may be necessary if public health campaigns wish to improve screening rates.

There were no independent associations with CRC screening behaviour observed based on ethnicity, BMI class, geography, whether someone was living with a partner, education, income, or whether the participants, or their first-degree, had a history of cancer. This was unexpected as previous research has identified that income and BMI class were associated with rates of being up-to-date on CRC screening (H. Singh et al., 2015; S. M. Singh et al., 2004). In contrast, another study found little difference in ever-screening rates based on rural/urban geography or income (Sewitch et al., 2008). Also unexpectedly, among our participants, men had higher odds of ever having had CRC screening compared to women, whereas Singh et al. (2015) found absolute rates of screening were slightly higher among women in NL,

and that country-wide, the odds were no different. It is possible that the difference between our findings and that of the literature is due to the different outcome variables assessed, such that these factors may not play a role in having *ever* had CRC screening, but that they do play a role in *being up-to-date* with CRC screening. As expected, we found screening was lowest among individuals ages 50–54 and that, compared to this group, odds were more than double among people 55–59, and the odds increased with increasing age, with approximately triple odds among ages 70–74.

There are a number of important limitations to note. We used Facebook advertising to recruit our sample, which is a non-random method and may thus lead to sampling bias. While this prevents generalizing findings about the prevalence of beliefs, we see no reason why it would lead to bias in associations. Another limitation is that we compared people who had ever had, versus never had, CRC screening, rather than comparing people who were up to date and people who were not up to date with screening. It is possible that the effect of beliefs and sociodemographic factors on being up-to-date with screening may be more or less significant than the effects on ever vs never having had screening. One additional consideration is that we assessed beliefs about cancer in general, but this paper explored CRC screening behaviour in particular. It is possible that beliefs and behaviours vary differently based on cancer type and that general beliefs about may differentially affect specific screening behaviours. We did survey screening behaviours related to other cancers but, for this paper, we chose to look at CRC screening because it is a prevalent problem in NL, and we feel that it receives considerably less attention in awareness and screening campaigns.

Conclusion

The majority of residents in NL held positive beliefs towards cancer screening and non-fatalistic beliefs towards cancer treatment and outcomes. Given the particularly high burden of CRC among the NL population, efforts to promote uptake of CRC programs should prove beneficial to population health. Further research into the relationship between beliefs and behaviour should attempt to confirm these findings and further elucidate this connection in an effort to optimize how public campaigns can promote cancer screening. Our findings suggest, however, that improving awareness and beliefs about cancer and cancer screening may be necessary but not sufficient to improve health behavior. Previous research has suggested that behavioral health promotion often fails in reducing health inequities (Baum & Fisher, 2014) and, as such, upstream action targeted at system-level changes may be more effective. Furthermore, given the considerable discordance between largely positive attitudes towards cancer screening and the poor uptake of cancer screening among participants in our study, we stress that interventions targeted at beliefs and behaviors are necessary but not sufficient. Without system-level changes to reduce barriers to screening, we believe that behavioral interventions will likely yield less-than-favorable results.

Abbreviations

CRC Colorectal cancer

CCHS Canadian Community Health Survey

NL Newfoundland and Labrador

BMI Body mass index

FIT Fecal immunochemical testing

FOBT Fecal Occult Blood Test

FDRs First-degree relatives

Declarations

Competing interests

The corresponding author Peizhong Peter Wang is an associate editor of BMC Journal. All the authors declare that they have no conflicts of interest.

Availability of data and materials

The data generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by Health Research Ethics Authority at Memorial University. All participants signed consent to participate statement included in the questionnaire via the internet.

Consent for Publication

All authors consent for Publication.

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Authors' Contributions

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Acquisition of data: GS, KAB, SA

Analysis and interpretation of data: YK, LGS

Writing, review and/or revision of the manuscript: YK, LGS

Administrative, technical, or material support: PPW, YY

Study supervision: PPW, YY, HE

Other: KAB, SA

All authors read and approved the manuscript.

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