

Prostate-specific antigen (PSA) screening rates and factors associated with screening in Eastern Canadian men: Findings from cross-sectional survey data

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Cite as: *Can Urol Assoc J* 2020;14(7):E319-27. <http://dx.doi.org/10.5489/cuaj.6072>

Published online February 4, 2020

Abstract

Introduction: The prostate-specific antigen (PSA) test is used in Canada to detect prostate cancer (PCa) despite mixed recommendations. Complications arising from false-positives are common, posing as a cancer-screening concern. This work estimates some Canadian rates of PSA screening and identifies men at increased odds for PSA screening.

Methods: The Canadian Community Health Survey (CCHS) from 2009/10 (Atlantic Canada; ATL), 2011/2012 (Ontario; ON), and 2013/2014 (Quebec; QC) were used. Lifetime and recent PSA screening with confidence intervals were constructed to estimate PSA screening in ATL, ON, and QC. Two logistic regression models (for men <50 and ≥50 years of age) were used to determine associations between factors and lifetime PSA screening.

Results: PSA screening rates have increased in most age groups for ATL, ON, and QC since 2000/2001. Factors positively associated with lifetime PSA screening in men of all ages were: having a digital rectal exam, having a regular doctor, and having a colorectal exam. Fruit and vegetables consumption and non-smoking status were positively associated with lifetime PSA screening in men <50 years of age. High income and the presence of chronic health conditions were positively associated with lifetime PSA screening in men ≥50 years of age.

Conclusions: PSA screening rates have generally increased since 2000/2001 in Canada. Physician-related factors play a role in men at all ages, while different factors are associated in men <50 years of age and men ≥50 years of age. Limitations include the generalizability to all of Canada and the potential for recall bias.

Introduction

Prostate cancer (PCa) is the most common cancer malignancy and a main cause of cancer death (accounting for 21%) in Canadian men.^{1,2} While prostate-specific antigen

(PSA) blood tests are used to detect PCa, most men with elevated blood PSA levels do not have PCa.³ Other problems with PSA testing include limited benefits for all-cause and cancer-specific mortality, psychological distress from false-positives, and complications from biopsies.⁴⁻⁸ Some evidence suggests only one in 1000 men screened via PSA testing might prevent PCa⁴ and only three in 1000 men screened will be protected from metastatic PCa.^{9,10} Therefore, recommendations for PSA screening in Canada are currently mixed and not recommended for men under 50 or over 70 years of age (except men at increased risk for PCa).^{11,12}

Despite limitations with PSA testing, it remains the default Canadian PCa screening method and rates may be increasing for men under 50 years of age.¹³ Thus, pending definitive evidence of PSA test benefits, it is important to establish the most recent PSA screening rates in Canada and to determine factors associated with men being screened. To the best of our knowledge, literature documenting Canadian PSA screening rates and factors associated with having a PSA test is either over a decade old for national data¹⁴ or limited to Alberta.^{13,15} Given that recent Canadian guidelines recommend men to be screened beginning at 50 years of age,¹² and not under 50 years of age,^{11,12} we aimed to determine screening rates and factors associated with the PSA test in men younger, and older than, 50 years of age.

Our first objective was to compute recent PSA screening rates in Canada and compare them to past Canadian data. Our second objective was to update the current understanding of factors associated with having a PSA test in Canadian men, namely by examining the associations between having a PSA screening test and each of several lifestyle-, physician-, and social-related variables, and whether these associations differed by Canadian region.

Methods

Secondary data analyses were completed using data from the Canadian Community Health Survey (CCHS).¹⁶

Data source

The CCHS is an annual, cross-sectional, validated, population-based survey conducted in-person and via telephone, intended to inform health policy for Canadian communities.¹⁶ Men who answered the optional PSA screening content on the CCHS were included for the analyses. The last CCHS cycle to include PSA-relevant questions was 2015/2016, limited to men from Nova Scotia (NS) and Newfoundland (NL). The next recent cycle from 2013/2014 was limited to men 35 years and older from Quebec (QC). For this reason, we also included the 2009/2010 and 2011/2012 CCHSs, because the 2009/2010 CCHS has PSA-related questions for men 35 years and older from Newfoundland (NL), Prince Edward Island (PEI), and Nova Scotia (NS), hereafter referred to as Atlantic Canada (ATL), and the 2011/2012 CCHS because it has PSA-relevant questions for men 35 years and older from Ontario (ON), to be representative of Eastern Canada. The response rates for PSA-relevant questions were 41.6%, 41.7%, and 43.1% for ATL, ON, and QC, respectively. We dropped the 2015/2016 cycle because many of the variables of interest differed from the 2009–2014 cycles.

Outcome and study variables

The outcome variables for the study were the prevalences for lifetime and recent (within one year) PSA screening in Eastern Canada. Factors associated with lifetime PSA screening were identified from the literature. Lifestyle-related variables included in the analyses are alcohol consumption¹⁷ in the last 12 months, body mass index (BMI),^{18,19} daily consumption of fruits and vegetables,²⁰ type of smoker,¹⁴ self-perceived health,²¹ and physical activity.¹⁷ Having a regular doctor,¹⁴ ever having a digital rectal exam (DRE),²² and receiving a colorectal exam (CRE)^{15,17} were physician-related factors included in the analyses. Other social- and health-related independent variables considered were needing help with daily activities,¹⁷ marital status,¹⁴ urinary incontinence (a potential urinary tract problem),²³ the number of chronic health conditions,¹⁵ country of birth,¹⁴ and spoken language.¹⁴ Control variables used were age, ethnicity, household income, and education.^{14,15} Refer to Table 1 or Table 2 for the list of the variables used in our analyses.

Statistical methods

The three datasets were combined and weights were standardized for the combined dataset. Descriptive statistics and regression modelling were performed on the weighted data with SAS v9.4. Prevalence estimates of lifetime and recent (within one year) PSA screening with 95% confidence intervals (CIs) were calculated for each survey. We constructed 95% CIs for the weighted prevalences of men 40–49, 50–59,

60–69, ≥ 70 , ≥ 50 , and ≥ 40 years of age. We formed one logistic model for men aged <50 years of age and another model for men ≥ 50 years of age. To determine which variables were associated with the outcome variable, bivariate logistic regression analyses of each independent variable with the outcome variable were completed first. Those pairs with $p < 0.20$ were to be included in the logistic regression model. All variance inflation factor (VIF) scores were below 2.5, indicating a negligible influence of multicollinearity. Interaction terms for these variables and the region of respondent (ATL, ON, QC) were included if $p < 0.05$, given that the region of the respondent might differentially influence the independent variables on the outcome variable. Influential points were removed as described by Ryan et al.²⁴ Binary logistic regression was used to build our final models for the combined 2009/2010, 2011/2012, 2013/2014 CCHS data with a 0.05 significance level. Individuals with missing data were deleted case-wise; variables with greater than 5% missing data were excluded. Daily consumption of fruits and vegetables in the ≥ 50 years old model was excluded because of too many missing observations ($>5\%$). The need for ethics approval was unnecessary because of the secondary analyses of publicly available, de-identified data.

Results

The total sample size of the combined dataset was 22 048. The demographic information of men <50 years of age and ≥ 50 years of age can be respectively found in Tables 1 and 2. Note that a higher proportion of men ≥ 50 years of age have been screened with the PSA test, DRE, and CRE compared to men <50 years of age (59.72%, 74.83%, 63.23% compared to 16.57%, 30.23%, and 19.78%, respectively). The proportion of men having multiple chronic conditions was greater in the ≥ 50 years of age group compared to the <50 years of age group ($p < 0.0001$).

Prevalence rates with 95% CIs of lifetime and recent PSA screening (i.e., last year), respectively, by region and age can be found in Tables 3 and 4. From these tables, men in ATL and ON have higher lifetime screening rates than men in QC. No such statistical differences existed in recent (last year) screening rates across the three regions. Over half of men aged ≥ 40 from ATL and QC have had a PSA screening test. Approximately a quarter of men aged ≥ 40 from ATL, ON, and QC have had a PSA screening test in the last year and over one-third of men aged ≥ 70 from ATL, ON, and QC have had a PSA screening test in the last year. Estimates, odds ratios (ORs), and 95% CIs of independent variables in the final logistic regression models for the <50 year old men and of ≥ 50 year old men can be found in Tables 5 and 6, respectively.

For the <50 years of age model (Table 5): Men who have had a DRE ($p < 0.0001$), are non-smokers ($p < 0.0001$), and who

Table 1. Descriptive statistics of Canadian men <50 years of age having a PSA screening test, 2009–2014 (n=6167)

Respondent characteristics	CCHS data n (weighted %)
Lifetime PSA screening [†]	
Yes (screened for family history, regular checkup, or for age)	929 (16.57)
No	5238 (83.43)
Age*	
35–39	2094 (31.65)
40–44	2147 (33.58)
45–49	1926 (34.77)
Missing	0
Household income*	
<20 000 CAD	395 (5.21)
20 000–39 999 CAD	835 (11.61)
40 000–59 999 CAD	984 (15.13)
60 000–79 999 CAD	970 (16.21)
≥80 000 CAD	2916 (51.37)
Missing	67 (0.48)
Educational attainment [†]	
Low (some post-secondary or less)	1807 (27.59)
High (post-secondary certificate)	4195 (69.64)
Missing	165 (2.77)
Ethnicity*	
White	4957 (70.37)
Visible minority	952 (25.68)
Missing	258 (3.94)
Has a regular doctor*	
Yes	4921 (80.39)
No	1243 (19.59)
Missing	3 (0.02)
Had a digital rectal exam*	
Yes	1879 (30.23)
No	4264 (69.50)
Missing	24 (0.27)
Had a colorectal exam [†]	
Yes (had a fecal occult blood test, sigmoidoscopy, or colonoscopy)	1220 (19.78)
No	4922 (79.87)
Missing	25 (0.36)
Needs help with daily activities [†]	
Yes (with preparing meals, making appointments, doing housework, personal care, moving within the house, or personal finances)	294 (3.41)
No	5872 (96.57)
Missing	1 (0.02)
Has urinary incontinence*	
Yes	43 (0.54)
No	6119 (99.39)
Missing	5 (0.07)

*Taken directly from the CCHS. [†]Derived from the CCHS. [‡]Derived from chronic health conditions on the CCHS which include asthma, fibromyalgia, high blood pressure, migraines, chronic obstructive pulmonary disorders, diabetes, heart disease, cancer, intestinal/stomach ulcers, ailments from stroke, bowel disorder, bowel disease, mood disorders, and anxiety disorders.

Table 1 (cont'd). Descriptive statistics of Canadian men <50 years of age having a PSA screening test, 2009–2014 (n=6167)

Respondent characteristics	CCHS data n (weighted %)
Body mass index (BMI) [†]	
Normal/underweight (<25)	1981 (33.49)
Overweight (25–29.9)	2634 (42.90)
Obese (≥30)	1481 (22.25)
Missing	71 (1.36)
Perceived health [†]	
Poor	123 (1.39)
Fair	412 (5.96)
Good	1814 (30.73)
Very good/excellent	3816 (61.91)
Missing	2 (0.02)
Physical activity*	
Active	1662 (24.46)
Moderately active	1633 (24.59)
Inactive	2865 (50.83)
Missing	7 (0.13)
Type of smoker [†]	
Current smoker	1807 (27.08)
Former/never smoker	4310 (72.26)
Missing	50 (0.66)
Daily consumption of fruits and vegetables*	
<5 times per day	4097 (66.56)
5–10 times per day	1704 (27.34)
>10 times per day	176 (3.68)
Missing	190 (2.42)
Marital status [†]	
Married/equivalent	4023 (76.04)
Single	2137 (23.66)
Missing	7 (0.30)
Country of birth*	
Canada	4848 (66.09)
Other	1070 (30.25)
Missing	249 (3.66)
Number of chronic health conditions [‡]	
0	3834 (65.74)
1	1450 (22.25)
≥2	878 (11.97)
Missing	5 (0.04)
Alcohol usage in the last 12 months*	
Yes	5254 (83.36)
No	782 (14.54)
Missing	131 (2.10)

*Taken directly from the CCHS. [†]Derived from the CCHS. [‡]Derived from chronic health conditions on the CCHS which include asthma, fibromyalgia, high blood pressure, migraines, chronic obstructive pulmonary disorders, diabetes, heart disease, cancer, intestinal/stomach ulcers, ailments from stroke, bowel disorder, bowel disease, mood disorders, and anxiety disorders. CCHS: Canadian Community Health Survey; PSA: prostate-specific antigen.

Table 1 (cont'd). Descriptive statistics of Canadian men <50 years of age having a PSA screening test, 2009–2014 (n=6167)

Respondent characteristics	CCHS data n (weighted %)
Spoken language [†]	
Native (English at home in ATL and ON; French at home in QC)	5456 (82.73)
Non-native (English at home in QC; French at home in ATL and ON)	185 (4.13)
Other (foreign language at home)	305 (9.69)
Missing	221 (3.45)
Region (CCHS year) [†]	
ATL (2009/10)	883 (7.05)
ON (2011/12)	3528 (59.16)
QC (2013/14)	1756 (33.79)
Missing	0

*Taken directly from the CCHS. [†]Derived from the CCHS. [‡]Derived from chronic health conditions on the CCHS which include asthma, fibromyalgia, high blood pressure, migraines, chronic obstructive pulmonary disorders, diabetes, heart disease, cancer, intestinal/stomach ulcers, ailments from stroke, bowel disorder, bowel disease, mood disorders, and anxiety disorders. CCHS: Canadian Community Health Survey; PSA: prostate-specific antigen.

consume fruits and vegetables more than 10 times per day ($p=0.0005$) had higher odds of being screened with the PSA test. It was found that men in ON and QC with regular doctors had higher odds of being screened than men in ON and QC without regular doctors ($p=0.0001$, $p<0.0001$, respectively).

For the ≥ 50 model (Table 6): Men in households earning \$20 000–39 999 CAD and <\$20 000 CAD had decreased odds of having been screened with the PSA test compared to men with household incomes exceeding \$80 000 CAD ($p=0.0104$, $p=0.0153$, respectively). Men with a regular doctor ($p<0.0001$), who have had a DRE ($p<0.0001$) and who have had a CRE ($p<0.0001$) had higher odds of being screened with the PSA test. Obese men had higher odds of having been screened with a PSA test than normal/underweight men ($p=0.0030$). Men who perceived their health to be good, fair, or poor had decreased odds of having been screened compared to men who perceived their health to be very good or excellent ($p=0.0298$, $p<0.0001$, $p=0.0052$, respectively). Men with one and two or more chronic health conditions had higher odds of being screened with a PSA test than men without chronic health conditions ($p=0.0026$, $p=0.0302$, respectively).

Discussion

This study examined lifetime and recent PSA screening rates, and factors associated with lifetime PSA screening in Eastern Canadian men aged 35 and older. We were interested in estimating rates of ever having and having a recent (within the last year) PSA screening test in Eastern Canada. We identified factors associated with PSA screening among men younger than 50 or at least 50 years of age.

Table 2. Descriptive statistics of Canadian men ≥ 50 years of age having a PSA screening test, 2009–2014 (n=15 881)

Respondent characteristics	CCHS data n (weighted %)
Lifetime PSA screening [†]	
Yes (screened for family history, regular checkup, or for age)	9727 (59.72)
No	6154 (40.28)
Age*	
35–39	5366 (44.58)
40–44	5672 (32.32)
45–49	4843 (23.10)
Missing	0
Household income*	
<20 000 CAD	1603 (7.30)
20 000–39 999 CAD	4120 (19.93)
40 000–59 999 CAD	3469 (20.26)
60 000–79 999 CAD	2414 (15.63)
$\geq 80 000$ CAD	4048 (35.95)
Missing	227 (0.93)
Educational attainment [†]	
Low (some post-secondary or less)	6848 (39.19)
High (post-secondary certificate)	8514 (57.31)
Missing	519 (3.50)
Ethnicity*	
White	14054 (82.82)
Visible minority	1084 (12.13)
Missing	743 (5.06)
Has a regular doctor*	
Yes	14391 (89.42)
No	1484 (10.56)
Missing	6 (0.03)
Had a digital rectal exam*	
Yes	12325 (74.83)
No	3477 (24.72)
Missing	79 (0.45)
Had a colorectal exam [†]	
Yes (had a fecal occult blood test, sigmoidoscopy, or colonoscopy)	10455 (63.23)
No	5331 (36.17)
Missing	95 (0.59)
Needs help with daily activities [†]	
Yes (with preparing meals, making appointments, doing housework, personal care, moving within the house, or personal finances)	1658 (8.69)
No	14217 (91.28)
Missing	6 (0.02)
Has urinary incontinence*	
Yes	809 (3.87)
No	15037 (96.00)
Missing	35 (0.14)

*Taken directly from the CCHS. [†]Derived from the CCHS. [‡]Derived from chronic health conditions on the CCHS which include asthma, fibromyalgia, high blood pressure, migraines, chronic obstructive pulmonary disorders, diabetes, heart disease, cancer, intestinal/stomach ulcers, ailments from stroke, bowel disorder, bowel disease, mood disorders, and anxiety disorders. CCHS: Canadian Community Health Survey; PSA: prostate-specific antigen.

Table 2 (cont'd). Descriptive statistics of Canadian men ≥50 years of age having a PSA screening test, 2009–2014 (n=15 881)

Respondent characteristics	CCHS data n (weighted %)
Body mass index (BMI) [†]	
Normal/underweight (<25)	5162 (32.70)
Overweight (25–29.9)	6919 (44.68)
Obese (≥30)	3677 (21.85)
Missing	123 (0.78)
Perceived health [†]	
Poor	765 (4.03)
Fair	2128 (11.20)
Good	5287 (32.26)
Very good/excellent	7665 (52.07)
Missing	36 (0.43)
Physical activity [*]	
Active	4145 (24.81)
Moderately active	3978 (24.88)
Inactive	7742 (50.26)
Missing	16 (0.05)
Type of smoker [†]	
Current smoker	3020 (19.25)
Former/never smoker	12714 (79.92)
Missing	147 (0.83)
Daily consumption of fruits and vegetables [*]	
<5 times per day	10314 (65.85)
5–10 times per day	4298 (27.38)
>10 times per day	307 (2.07)
Missing	962 (4.70)
Marital status [†]	
Married/equivalent	10493 (77.00)
Single	5353 (22.87)
Missing	35 (0.13)
Country of birth [*]	
Canada	12813 (70.75)
Other	2387 (24.10)
Missing	681 (5.14)
Number of chronic health conditions [‡]	
0	4816 (35.67)
1	4782 (30.49)
≥2	6273 (33.80)
Missing	10 (0.04)
Alcohol usage in the last 12 months [*]	
Yes	12581 (80.41)
No	2954 (17.25)
Missing	346 (2.34)

*Taken directly from the CCHS. [†]Derived from the CCHS. [‡]Derived from chronic health conditions on the CCHS which include asthma, fibromyalgia, high blood pressure, migraines, chronic obstructive pulmonary disorders, diabetes, heart disease, cancer, intestinal/stomach ulcers, ailments from stroke, bowel disorder, bowel disease, mood disorders, and anxiety disorders. CCHS: Canadian Community Health Survey; PSA: prostate-specific antigen.

Table 2 (cont'd). Descriptive statistics of Canadian men ≥50 years of age having a PSA screening test, 2009–2014 (n=15 881)

Respondent characteristics	CCHS data n (weighted %)
Spoken language [†]	
Native (English at home in ATL and ON; French at home in QC)	14269 (83.98)
Non-native (English at home in QC; French at home in ATL and ON)	500 (3.62)
Other (foreign language at home)	475 (7.81)
Missing	637 (4.59)
Region (CCHS year) [†]	
ATL (2009/10)	2119 (7.11)
ON (2011/12)	8702 (56.10)
QC (2013/14)	5060 (36.79)
Missing	0

*Taken directly from the CCHS. [†]Derived from the CCHS. [‡]Derived from chronic health conditions on the CCHS which include asthma, fibromyalgia, high blood pressure, migraines, chronic obstructive pulmonary disorders, diabetes, heart disease, cancer, intestinal/stomach ulcers, ailments from stroke, bowel disorder, bowel disease, mood disorders, and anxiety disorders. CCHS: Canadian Community Health Survey; PSA: prostate-specific antigen.

We hypothesized there would be no substantial increase in PSA screening rates, given that no overwhelming evidence has suggested that the test is beneficial. We computed lifetime and recent PSA screening rates in Eastern Canada. In Table 3, we present the lifetime PSA screening rates for ATL (2009/2010), ON (2011/2012), and QC (2013/2014) for different age groups. Recent (within the last year) screening rates from the U.S. are similar to ours during the same time frame. Vetterlein et al report that 38.9% of men in 2012 and 35.8% of men in 2014 were recently screened.²⁵ When we compare the corresponding 2000/2001¹⁴ rates for NL, PEI, and NS to our Atlantic Canada rates (Table 3), the 2000/2001 rates are generally lower than our Atlantic Canada rates except for men aged 40–49 from NS.¹⁴ The 2000/2001 ON rates, regardless of age category, are lower than ours (Table 3). For the 2000/2001 QC rates, only the rates for men aged 60–69 years are lower than our rates (Table 3). Despite the PSA screening controversy, our results suggest that since 2000/2001, the rates of lifetime PSA screening have generally increased in ATL, ON, and QC for men ≥40 years of age (with the exceptions of those noted). The fact that screening continues for men <50 or ≥70 years of age is concerning, especially because screening these age groups is not recommended in Canada (except men at increased risk).

Based on the factors associated with PSA screening, we hypothesized that having a regular doctor, a DRE, a CRE, independence in activities, urinary incontinence, obesity status, good perceived health, physical activity, fruits and vegetable consumption (as a proxy for healthy lifestyle), alcohol use, chronic health conditions, married/equivalent status, non-smoking status, been born in Canada, and a English/French spoken language at home would be posi-

Table 3. Weighted prevalence % estimates of lifetime PSA screening by age groups 35–39, 40–49, 50–59, 60–69, ≥70, ≥50, and ≥40 by region (95% CIs)

Age group	Region		
	ATL (2009/10)	ON (2011/12)	QC (2013/14)
35–39	–	5.72 (3.29–8.15)	–
40–49	24.57 (19.51–29.62) [12.9, 17.5, 20.0] ¹⁴	27.14 (23.53–30.75) [18.1] ¹⁴	11.70 (8.51–14.89) [14.2] ¹⁴
50–59	58.50 (52.79–64.20) [45.0, 41.5, 43.1] ¹⁴	55.46 (51.62–59.30) [46.3] ¹⁴	47.04 (42.84–51.25) [44.0] ¹⁴
60–69	71.82 (67.15–76.48) [42.0, 59.4, 58.4] ¹⁴	73.22 (69.95–76.50) [57.4] ¹⁴	62.96 (59.16–66.76) [51.0] ¹⁴
≥70	56.64 (51.31–61.97) [43.1, 44.6, 44.5] ¹⁴	62.89 (59.51–66.28) [51.4] ¹⁴	55.78 (52.14–59.43) [48.9] ¹⁴
≥50	62.77 (59.49–66.05)	62.74 (60.53–64.96)	54.40 (51.99–56.81)
≥40	50.40 (47.27–53.53)	51.38 (49.52–53.25)	42.16 (39.95–44.37)

Values in [] are estimates reported in Beaulac et al.¹⁴ For Atlantic Canada, the estimates in [] are respectively for Newfoundland, Prince Edward Island, and Nova Scotia. – Not reported because of unreliable estimates. CI: confidence interval; PSA: prostate-specific antigen.

tively associated with having a PSA test, while controlling for age, income, education, ethnicity, and regional differences. In Tables 5 and 6, respectively, we present the models for ever having had a PSA screening test for men <50 and men ≥50 years of age. Physician-related factors (having a regular doctor, a CRE, and a DRE) were significantly positively associated in both models. Their presence in both models speaks to the role physicians play in PSA screening among men of all ages.^{22,23,26–30} This could suggest regular physicians are prompting men of all ages to be screened. In fact, the literature supports this because the decision to have a PSA test is heavily influenced by physicians' recommendation.^{22,27,28}

In men ≥50 years of age only, we found positive associations with increased income, obesity, very good or better perceived health, and the presence of chronic health conditions and having a lifetime PSA screening test. Higher income in older men predicted PSA screening. Other Canadian studies have found a positive association between income and PSA screening.^{13–15} Obesity was associated with PSA screening, consistent with prior literature.^{18,19,31,32} This might be because physicians are more likely to offer PSA tests to overweight male patients.¹⁸ Physicians complete more technical tasks (i.e., prescribing a diagnostic plan, discussing lab work, etc.)

than other tasks with obese patients,³³ which likely would include PSA screening. Men with lower self-perceived health had decreased odds of being screened, which has been found in prior literature documenting PSA screening.^{15,34} Chronic health conditions predicted PSA screening, as has been documented previously in Canada.¹⁵

In men <50 years of age only, we found associations with smoking (–) and consumption of fruits and vegetables (+) with having a lifetime PSA screening test. These findings are consistent with the literature for PSA screening among non-smokers¹⁴ and fruit and vegetable consumption in colorectal screening²⁰ and could suggest that men who are concerned about their health might seek a PSA screening test. Paradoxically, for men in ON and QC under 50 years of age, there is an increased odd of having a PSA screening test and having a regular doctor. Further research is warranted here, given that no Canadian guidelines advocate for screening under 50 years of age (except for those at increased risk).

When comparing both the <50 years of age and the ≥50 years of age models, some themes emerge. Physician-related factors were important for both models, indicating the role physicians have in the PSA screening process. Among men

Table 4. Weighted prevalence % estimates of recent (last year) PSA screening by age groups 35–39, 40–49, 50–59, 60–69, ≥70, ≥50, and ≥40 by region (95% CIs)

Age group	Region		
	ATL (2009/10)	ON (2011/12)	QC (2013/14)
40–49	13.64 (9.50–17.79)	12.64 (10.24–15.05)	5.39 (3.44–7.34)
50–59	32.02 (26.77–37.28)	28.04 (24.92–31.16)	28.27 (24.69–31.85)
60–69	46.59 (40.93–52.25)	43.04 (39.92–46.16)	43.65 (39.84–47.46)
≥70	38.75 (33.48–44.01)	35.65 (32.37–38.93)	36.27 (32.80–39.74)
≥50	38.54 (35.33–41.74)	34.50 (32.58–36.42)	35.27 (33.06–37.48)
≥40	27.66 (25.26–30.07)	24.32 (22.95–25.69)	23.58 (21.97–25.20)

ATL: Atlantic; CI: confidence interval; ON: Ontario; PSA: prostate-specific antigen; QC: Quebec.

Table 5. Logistic regression model for lifetime PSA screening in Canadian men <50 years of age, 2009–2014 (n=5518)

Variable	OR	95% CI	p
Age [§]			
35–39 [†]			
40–44	2.829	(1.948–4.110)	<0.0001
45–49	5.995	(4.153–8.655)	<0.0001
Household income [†]			
<20 000 CAD	0.940	(0.531–1.662)	0.8303
20 000–39 999 CAD	0.967	(0.611–1.529)	0.8850
40 000–59 999 CAD	1.033	(0.716–1.492)	0.8606
60 000–79 999 CAD	0.791	(0.547–1.144)	0.2133
≥80 000 CAD [†]			
Educational attainment			
Low [†]			
High	1.081	(0.805–1.450)	0.6053
Ethnicity			
White [†]			
Visible minority	1.374	(0.969–1.948)	0.0746
Had a digital rectal exam [§]			
Yes	3.742	(2.857–4.901)	<0.0001
No [†]			
Body mass index (BMI)			
Normal/underweight (<25) [†]			
Overweight (25–29.9)	1.198	(0.894–1.604)	0.2263
Obese (≥30)	1.006	(0.710–1.425)	0.9740
Physical activity index			
Active	1.083	(0.790–1.486)	0.6206
Moderately active	0.949	(0.695–1.294)	0.7398
Inactive [†]			
Type of smoker [§]			
Current smoker	0.554	(0.413–0.743)	<0.0001
Former/never smoker [†]			
Daily consumption of fruits and vegetables [§]			
<5 times per day [†]			
5–10 times per day	0.890	(0.682–1.231)	0.4258
>10 times per day	2.980	(1.614–5.503)	0.0005
Number of chronic health conditions			
0 [†]			
1	0.916	(0.682–1.231)	0.5613
≥2	0.883	(0.607–1.284)	0.5137
Spoken language [†]			
Native [†]			
Non-native	0.372	(0.170–0.811)	0.0129
Other	0.821	(0.454–1.483)	0.5124

[†]Reference category. *Interaction terms with region. [†]p<0.05, [§]p<0.01 for testing whether all parameters associated with that effect are zero. ATL: Atlantic; CI: confidence interval; ON: Ontario; OR: odds ratio; PSA: prostate-specific antigen; QC: Quebec.

Table 5 (cont'd). Logistic regression model for lifetime PSA screening in Canadian men <50 years of age, 2009–2014 (n=5518)

Variable	OR	95% CI	p
Has a regular doctor*			
At ATL			
Yes	0.831	(0.309–2.237)	0.7145
No [†]			
At ON			
Yes	3.280	(1.670–6.425)	0.0001
No [†]			
At QC			
Yes	4.739	(2.375–9.456)	<0.0001
No [†]			
Had a colorectal exam*			
At ATL			
Yes	1.022	(0.514–2.032)	0.9540
No [†]			
At ON			
Yes	2.405	(1.708–3.385)	<0.0001
No [†]			
At QC			
Yes	1.243	(0.656–2.356)	0.5400
No [†]			

[†]Reference category. *Interaction terms with region. [†]p<0.05, [§]p<0.01 for testing whether all parameters associated with that effect are zero. ATL: Atlantic; CI: confidence interval; ON: Ontario; OR: odds ratio; PSA: prostate-specific antigen; QC: Quebec.

to play a role in PSA screening. This might indicate that these healthy individuals initiate physician contact and subsequent PSA screening. Conversely, among men ≥50 years of age, non-behavioral-related factors that predict physician interaction (i.e., having chronic health conditions³⁵ or high income³⁶) were found to be significant, suggesting non-behavioral factors are initiating physician contact and subsequent PSA screening in older men. These factors are also related to those described by Andersen.^{37,38} Access to health services (i.e., the PSA test) is likely facilitated or impeded by enabling factors (i.e., income) and/or health beliefs (i.e., valuing a healthy lifestyle).

Given the risks associated with PSA screening and its lack of efficacy in identifying PCa, along with our work showing that a large proportion of males are being screened in non-recommended age groups while possibly being prompted by their physicians, it is evident that PSA screening is a growing public health concern.

Limitations

Responses were self-reported via the CCHS (i.e., ever having taken a PSA test). Therefore, recall bias might have been a factor. Two factors that were not assessed in this work but were assessed in 2000/2001¹⁴ were urban/rural status and employment status. Employment status was not considered

aged <50 years, factors related to leading a healthy lifestyle (non-smoking, high fruit and vegetable consumption) seem

Table 6. Logistic regression model for lifetime PSA screening in Canadian men ≥50 years of age, 2009–2014 (n=14 362)

Variable	OR	95% CI	p
Age [§]			
50–59 [†]			
60–69	1.708	(1.462–1.995)	<0.0001
≥70	1.097	(0.923–1.306)	0.2937
Household income [‡]			
<20 000 CAD	0.715	(0.545–0.938)	0.0153
20 000–39 999 CAD	0.771	(0.632–0.941)	0.0104
40 000–59 999 CAD	0.829	(0.685–1.004)	0.0549
60 000–79 999 CAD	1.002	(0.817–1.228)	0.9885
≥80 000 CAD [†]			
Educational attainment			
Low [†]			
High	1.028	(0.896–1.180)	0.6935
Ethnicity			
White [†]			
Visible minority	0.883	(0.685–1.137)	0.3348
Has a regular doctor [§]			
Yes	3.123	(2.462–3.962)	<0.0001
No [†]			
Had a digital rectal exam [§]			
Yes	2.407	(2.048–2.830)	<0.0001
No [†]			
Had a colorectal exam [§]			
Yes	1.823	(1.578–2.105)	<0.0001
No [†]			
Needs help with daily activities			
Yes	0.857	(0.677–1.085)	0.1995
No [†]			
Has urinary incontinence [§]			
Yes	0.498	(0.363–0.681)	<0.0001
No [†]			
Body mass index (BMI) [‡]			
Normal/underweight (<25) [†]			
Overweight (25–29.9)	1.161	(0.996–1.352)	0.0562
Obese (≥30)	1.330	(1.102–1.605)	0.0030
Perceived health status [§]			
Poor	0.626	(0.450–0.869)	0.0052
Fair	0.614	(0.490–0.770)	<0.0001
Good	0.837	(0.713–0.983)	0.0298
Very good/excellent [†]			
Physical activity index			
Active	1.007	(0.857–1.182)	0.9331
Moderately active	1.020	(0.867–1.201)	0.8074
Inactive [†]			
Type of smoker			
Current smoker	0.865	(0.735–1.017)	0.0798
Former/never smoker			

[†]Reference category. [‡]Interaction terms with region. [§]p < 0.05, [¶]p < 0.01 for testing whether all parameters associated with that effect are zero. ATL: Atlantic; CI: confidence interval; ON: Ontario; OR: odds ratio; PSA: prostate-specific antigen; QC: Quebec.

Table 6 (cont'd). Logistic regression model for lifetime PSA screening in Canadian men ≥50 years of age, 2009–2014 (n=14 362)

Variable	OR	95% CI	p
Marital status			
Married/equivalent	1.113	(0.956–1.297)	0.1676
Single [†]			
Number of chronic health conditions [§]			
0 [†]			
1	1.303	(1.097–1.547)	0.0026
≥2	1.226	(1.020–1.474)	0.0302
Alcohol usage in the last 12 months			
Yes	1.090	(0.922–1.290)	0.3122
No [†]			
Spoken language			
Native [†]			
Non-native	1.026	(0.746–1.411)	0.8738
Other	1.264	(0.898–1.780)	0.1789
Region (CCHS year) [§]			
ATL (2009/10)	1.204	(1.008–1.438)	0.0404
ON (2011/12) [†]			
QC (2013/14)	0.743	(0.643–0.859)	<0.0001

[†]Reference category. [‡]Interaction terms with region. [§]p < 0.05, [¶]p < 0.01 for testing whether all parameters associated with that effect are zero. ATL: Atlantic; CI: confidence interval; ON: Ontario; OR: odds ratio; PSA: prostate-specific antigen; QC: Quebec.

for this work given the very low response rate on the CCHS. Because lifetime screening was used as the outcome variable, some responses might have changed since the PSA test was taken.¹⁴ For example, a man might have been screened with the PSA test and many years afterwards developed multiple chronic conditions. Lastly, this work was confined to ATL, ON, and QC and, thus, may not be generalizable to all of Canada.

Conclusions

This study investigated screening rates for the PSA test in Canadian men and factors associated with whether Canadian men have ever been screened with the PSA test. We found that rates of PSA screening have generally increased since 2000/2001 in the regions defined for this work (ATL, ON, and QC). We report that physician-related factors are important for the PSA screening of men of all ages. There might also be important differences among men aged <50 years of age and men ≥50 years of age. These results, coupled with the finding that screening rates have generally increased since 2000/2001, demonstrates that physicians continue to play an important role in PSA screening and that despite mixed recommendations for PSA screening, rates continue to rise. The fact that a large portion of men <50 years of age and ≥70 years of age continue to be screened deserves a closer inspection from policy-makers.

Competing interests: Mr. Tchir was a paid intern at fitbase GmbH. The remaining authors report no competing personal or financial interests related to this work.

Acknowledgements/Funding: This work was supported by the TELUS Ride for Dad and the Prostate Cancer Fight Foundation. The views and opinions expressed in this article are strictly the views of the authors and do not necessarily reflect the views of the funders or of Statistics Canada.

This paper has been peer-reviewed

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