Are United States and Canadian cancer screening rates consistent with guideline information regarding the age of screening initiation?

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Abstract

Objective. To understand whether US and Canadian breast, colorectal and prostate cancer screening test utilization is consistent with US and Canadian cancer screening guideline information with respect to the age of screening initiation.

Design. Cross-sectional, regression discontinuity.

Setting. Canada and the US.

Participants. Canadian and American women of ages 30–60 and men of ages 40–60.

Interventions. None.

Main Outcomes Measures. Mammography, prostate-specific antigen (PSA) and colorectal cancer test use within the past 2 years.

Methods. We identify US and Canadian compliance with age screening information in a novel manner, by comparing test utilization rates of individuals who are immediately on either side of the guideline recommended initiation ages.

Results. US mammography utilization within the last 2 years increased from 33% at age 39 to 48% at age 40 and 60% at age 41. US colorectal cancer test utilization, within the last 2 years, increased from 15% at age 49 to 18% at age 50 and 28% at age 51. US PSA utilization within the last 2 years increased from 37% at age 49 to 44% at age 50 and 54% at age 51. In Canada, mammography utilization within the last 2 years increased from 47% at age 49 to 57% at age 50 and 66% at age 51.

Conclusion. American and Canadian cancer screening utilization is generally consistent with each country’s guideline recommendations regarding age. US and Canadian differences in screening due to guidelines can potentially explain cross-country differences in breast cancer mortality and affect interpretation of international comparisons of cancer statistics.

Keywords: health policy, guidelines, cancers, prevention (incl. screening)

Introduction

Cancer screening guidelines provide important information to physicians and patients regarding optimal medical treatment. Given the rapid pace at which new medical information is generated, guidelines are also useful tools for disseminating information resulting from advances in medical research. In this study we examine whether US and Canadian physicians and patients follow cancer screening guideline information with respect to the age at which screening is recommended to begin. We analyze US and Canadian screening patterns simultaneously because guideline information varies across the two countries both regarding whether a screening test is recommended as effective (prostate cancer) and the age when screening is recommended to begin (breast cancer).

While many professional organizations publish cancer screening guidelines (e.g. American Urological Association, Canadian Association of Gastroenterology), Federal agencies and national cancer associations in both countries generally
set the standard. The US Preventive Services Task Force (USPSTF) and the Canadian Task Force on Preventive Health Care (CTFPHC) base their guidelines on the quality of evidence from clinical trials and rate their recommendations accordingly [1–7]. The American Cancer Society (ACS) and the Canadian Cancer Society (CCS) also publish guidelines based on evidence from clinical trials, but also base recommendations on evidence from observational studies [6–10]. From each of these guidelines we focus on the screening recommendations for breast, colorectal and prostate cancers because these are the three largest cancers in terms of incidence.

Table 1 summarizes breast, colorectal and prostate cancer screening guidelines from the ACS, CCS, CTFPHC and the USPSTF that were in effect during the time of data used for analyses in this study. For breast cancer, the ACS and USPSTF recommend mammography screening be initiated at age 40 for asymptomatic women, while the CTFPHC and CCS recommend that mammography screening be initiated for women starting at age 50. In 2009, the USPSTF changed its position and now recommends against routine screening mammography in women ages of 40–49 and that physicians and patients make decisions on an individual case-by-case basis regarding screening between ages of 40 and 49 [11]. The CTFPHC and the CCS do not recommend mammography screening for women after age 69. For colorectal cancer, all four guidelines recommend that screening begin at age 50 for asymptomatic men and women. For prostate cancer the ACS recommends that physician offer prostate specific antigen (PSA) screening to men aged 50 and older. The other three organizations recommend either not using the PSA test (CTFPHC), recommend discussion of the test with physicians (CCS) or conclude that there is insufficient evidence regarding whether or not PSA testing is effective (USPSTF).

An extensive literature has evaluated cancer test rates for targeted age groups in the US and Canada. All of these studies interpret high test rates among the targeted age group as guideline compliance. In Canada, Zarychanski et al. [12] report that 17.6% of asymptomatic individuals of ages 50 and older were up to date on their colorectal screening in 2003 and Beaulac et al. [13] report that 24.7% of men of ages 40 and older had a recent PSA screening test within the last year in the years 2000 and 2001. In 2001, approximately half of Canadian women age 50–69 reported mammography screening in the past 2 years [14]. In the US, a recent paper by Smith et al. [15] uses the 2004 Behavioral Risk Factor Surveillance System (BRFSS) data to evaluate screening. They find that 58% of women of ages 50–64 received a mammogram within the previous year, 19% of women and men of ages 50–64 received a home fecal occult blood test (FOBT) within the previous year, and 54% of men of ages 50–64 received a PSA test within the previous year. A number of other studies have evaluated US breast [16–22], colorectal [11–18, 20, 21, 23–27] and prostate [17, 18, 20, 21, 24, 28–30] cancer test use in the 1990s and 2000s. The overarching conclusion from all of these studies in both countries is that cancer test rates are below the ideal for targeted ages.

We contribute to this area of research by focusing on whether breast, colorectal and prostate cancer screening test rates are consistent with guideline age information. By specifying an age at which screening should begin, the guidelines implicitly recommend that screening does not occur for asymptomatic individuals below that age, often due to low specificity of the test and the health consequences of unnecessary intervention and treatment [31]. We approach this question of age-appropriate screening in both countries by comparing cancer test utilization rates for individuals close to and on either side of the guideline recommended initiation ages. Cross-country differences in the levels and timing of screening utilization have the potential to generate differences in population health and affect comparisons of cancer survival statistics across countries.

Methods

Study sample

We calculate US cancer test rates using the 2006 BRFSS and the 2003 National Health Interview Survey (NHIS) [32, 33]. For Canada, we calculate test rates from the 2003 and 2005 Canadian Community Health Surveys (CCHS) [34, 35]. All three are nationally representative surveys that measure health-care utilization in their respective countries. Sample sizes from the BRFSS are significantly larger than the NHIS, but only the NHIS questions individuals below the age of 50 about colorectal cancer test use. We use 2 years of the CCHS survey because the colorectal and prostate cancer test questions were asked in different provinces in different years. Survey response rates for the cancer test questions are extremely high in all of these surveys—approximately 95%. Finally, the BRFSS, NHIS and the CCHS all use complex survey designs to collect information. All of the following analyses take the surveys’ complex sampling frames into account via weighting and adjusted standard errors.

Outcome measures

For breast, colorectal and prostate cancers we examine cancer test use within the past 2 years, using this timeframe due to the biennial periodicity recommended in the Canadian guidelines. For breast cancer we calculated the proportion of women who received a mammogram in the past 2 years. For colorectal cancer, none of the guidelines takes a stance on which colorectal screening test to perform. Consequently, we calculated the proportion of individuals who received a home FOBT, sigmoidoscopy or colonoscopy in the past 2 years. For prostate cancer the proportion of men who received a PSA test in the previous 2 years was the primary measure examined. The CCHS and NHIS surveys also ask individuals about the reasons for using cancer tests. Cancer tests can be used for both screening reasons, i.e. cancer detection in asymptomatic individuals and for non-screening reasons if individuals have symptoms that must be evaluated. We also use information detailing the reason for testing


<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>US</th>
<th>Canada</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Test: mammography, every 1–2 years</td>
<td>Test: mammography, every 1–2 years</td>
</tr>
<tr>
<td></td>
<td>Population: asymptomatic women age 40+</td>
<td>Population: asymptomatic women ages 50–69</td>
</tr>
<tr>
<td></td>
<td>Test: mammography, annually</td>
<td>Test: mammography, every 2 years</td>
</tr>
<tr>
<td></td>
<td>Population: asymptomatic women age 40+</td>
<td>Population: asymptomatic women of ages 50–69</td>
</tr>
<tr>
<td><strong>Colorectal cancer</strong></td>
<td>USPSTF (2002)</td>
<td>CTFPHC (2001)</td>
</tr>
<tr>
<td></td>
<td>Test(s): FOBT (good evidence) annually and or sigmoidoscopy (fair evidence) every 5 years; no direct evidence for colonoscopy</td>
<td>Test(s): FOBT (good evidence) every 1–2 years, sigmoidoscopy (fair evidence) periodicity unspecified, insufficient evidence to include or exclude colonoscopy</td>
</tr>
<tr>
<td></td>
<td>Population: asymptomatic individuals age 50+</td>
<td>Population: asymptomatic individuals age 50+</td>
</tr>
<tr>
<td></td>
<td>Tests and frequency: FOBT annually, flexible sigmoidoscopy every 5 years, colonoscopy every 10 years, double contrast barium enema every 5 years,</td>
<td>Test and frequency: FOBT at least every 2 years</td>
</tr>
<tr>
<td></td>
<td>Population: asymptomatic individuals age 50+</td>
<td>Population: asymptomatic individuals age 50+</td>
</tr>
<tr>
<td></td>
<td>Insufficient evidence to recommend or not recommend the test</td>
<td>PSA testing not to be used due to low positive predictive value and risk of adverse affects associated with treatment</td>
</tr>
<tr>
<td></td>
<td>Test: offer PSA, annually</td>
<td>Test: PSA</td>
</tr>
<tr>
<td></td>
<td>Population: 50+ men who have at least a 10-year life expectancy</td>
<td>Population: men age 50+ should discuss with physician the benefits and risks of PSA</td>
</tr>
</tbody>
</table>

*Source:* U.S. Screening Guidelines: ACS Breast, Colorectal, Prostate Cancer (8). USPSTF Breast Cancer, Colorectal, Prostate Cancer (1,2,3). Canadian Screening Guidelines: CTFPHC Breast Cancer (4), CTFPHC Colorectal Cancer (5), CTFPHC Prostate Cancer (6), CCS Breast Cancer (9), CCS Colorectal Cancer (10), CCS Prostate Cancer (6).
when available to understand U.S and Canadian cancer test use at the guideline recommended ages.

Analytic strategy

The guidelines’ specification of a screening initiation age implies that, if the guideline information is being followed by physicians and patients, cancer screening rates should increase sharply at, or near, the recommended ages. Not finding such discontinuities would suggest that patients and physicians are not using guideline age information in their cancer screening decisions. While a high screening rate among the target group would suggest compliance with respect to those who should be screened, a similarly high rate among the non-targeted group would suggest lack of compliance with respect to the initiation age. If the age thresholds are important for physician and patient decision-making for mammography utilization, one should observe a sharp increase in utilization for women near age 40 in the US and near age 50 in Canada. Similarly in the case of colorectal cancer we look for a discrete change in the colorectal cancer screening rate near age 50 in both the US and Canadian data. For the PSA test, consistent with the ACS guideline information, we look for a change in screening near age 50 for men in the US. While the CTFPHC does not recommend PSA testing, high PSA screening rates indicate that many men are indeed using the test in Canada, so we test to see whether screening behavior in Canada is consistent with the ACS guideline.

In our analyses we first plot cancer test rates within the past 2 years by age for each of the cancer types. We then formally test for a break at the specified ages using logistic regression models with test use in the last 2 years as the dependent variable. Our key independent variable is an indicator variable that assumes a value of 1 if the individual is above the recommended initiation age and zero otherwise. Our regression samples include individuals within 10 years of age on either side of the initiation age, so the non-targeted group is similar to the targeted group in terms of their age cohort and in demographic, socio-economic and health characteristics that may also impact cancer screening rates. To control for any remaining differences between the two groups, we control for age trends (age, age-squared, age-cubed), sex (for colorectal cancer test use), race, education, family income, health insurance and marital status. Linear and non-linear age trends are included to control for the linear relationship between age and screening rates over shorter age ranges and the potential for non-linear relationships over longer age spans. In the regression specification, race is an indicator variable that assumes a value of 1 if the individual is non-white and zero otherwise. Education is defined by four variables: less than high school, high school graduate, some college and college graduate or higher. We adjust for marital status by using the following categories: married, divorced or separated, widowed, never married and a member of an unmarried couple. In the US, we adjust for whether or not an individual has private or public health insurance. For family income we group individuals into income quartiles.

Results

Breast cancer

Figure 1 plots mammography test rates in the past 2 years by age for women in Canada and the US, revealing several interesting patterns. At every age, the probability of a woman receiving a mammogram is higher in the US than in Canada. Between ages 40 and 50, where the countries’ guidelines differ, test use varies by as much as 42 percentage points at age 45. Consistent with the USPSTF and ACS guidelines, there is a large discrete increase in mammography rates in the US near age 40, rising from 33% at age 39 to 48% (P < 0.001) at age 40 and 60% (P < 0.001) at age 41. In Canada, mammography rates rise significantly at age 50,
from 47% at age 49 to 57% (P = 0.008) at 50 and 66% by age 51 (P < 0.001). The graph also indicates that mammography rates in Canada begin to decrease starting at age 70, a finding that is consistent with the CTFPHC and CCS guidelines. The US data do not show a similar decrease in mammography rates until a woman reaches her late 70s.

The mammography rates suggest that physicians and women in both countries are following the guidelines for breast cancer screening. However, the graphs also show a clear upward trend in mammography rates as women age, as well as possible discrete shifts at ages other than those specified in the guidelines. For example, Canadian rates rise from 13% at age 39 to 24% (P < 0.001) at age 41, potentially indicating a second trend break. Regression analysis allows us to test whether the breaks that are apparent in the graph persist after controlling for age trends and other covariates.

Table 2 shows that, even after adjusting for all the other covariates, being above the age threshold in Canada increases the probability of being tested within the last 2 years by 9.9 percentage points (OR = 1.49; P = 0.002). Similarly, in the US data being above the recommended initiation age increases the probability of being tested by 10.7 percentage points (OR = 1.55; P < 0.001). Since the results in Fig. 1 show a non-trivial increase in mammography rates at age 40 in Canada, we also estimated a regression model that tests for a break at age 40. After controlling for trends in age, we did not find a statistically significant break (results not shown) at age 40 in Canada. Similarly, the apparent decrease at age 70 is not significant after controlling for a linear age trend. Overall, these results indicate that significant breaks in mammography rates occur at the initiation ages indicated by each country’s guideline information.

**Colorectal cancer**

Figure 2 plots colorectal cancer test use in the past 2 years by age for men and women in Canada and the US. Unlike mammography, Canadian and US colorectal test rates are similar across the entire age distribution. Even though the test rates are similar, the changes in test rates near the age 50 threshold are larger in the US than in Canada. The US data show that colorectal cancer test rates rise from 15% at age 49 to 18% (P = 0.199) at age 50 and 28% at age 51 (P < 0.001). In Canada the shift in test use is less striking, rising from 15% at age 49 to 17% at age 50 (P = 0.367) and 21% at age 51 (P = 0.02).

Table 2 presents regression results for the Canadian and US data with colorectal test use as the dependent variable of interest. In addition to age trends and other covariates from the mammography regressions, we include a dummy variable for females. Holding all other covariates constant, being above the age threshold only increases the probability of being tested by 1.3 percentage points in Canada, but this difference is not statistically significant (OR = 1.11; P = 0.53). In the US, all else equal, being above the recommended initiation age increases the probability of colorectal test use in the past 2 years by 4.7 percentage points (OR = 1.39; P = 0.049).

**Prostate cancer**

Figure 3 shows that age-specific PSA test rates are generally high in both countries, but higher in the US. PSA test rates increase substantially near the guideline recommended age in the US, from 37% at age 49 to 44% (P = 0.007) at age 50 and 54% (P < 0.001) at age 51. In Canada, there does not appear to be a discrete increase at the particular age of 50 that is separate from the increasing trend with age. Thirty-five percent of men are tested at age 49 and at age 51 (P = 0.921).

Table 2 presents regression results for the Canadian and US data with prostate cancer test use as the dependent variable. Consistent with Fig. 3, the US regression results indicate that holding all other covariates constant, being above the age threshold increases the probability of being tested in the last 2 years by 9.4 percentage points (OR = 1.48; P < 0.001). There is no similar effect above the ACS recommended age for Canadian men (OR = 1.043; P = 0.843).

**Discussion**

We draw three conclusions from the results presented in the previous section. First, except in the case of colorectal cancer in Canada, each country’s screening practices are consistent with its own guideline age of initiation information. Second, in the US, relative to test rates below the initiation age, compliance with guideline age information is strongest for mammography and colorectal cancer test use. This is consistent with the randomized control trial evidence showing that these tests are effective in increasing survival. Third, for each of the cancer types, there are differences in the timing of test initiation between the US and Canada. The starkest difference is seen in the case of mammography, where test rates increase dramatically for women at age 40 in the US and at age 50 in Canada. Cancer test use differences are also noticeable across the two countries for colorectal and prostate cancer test use, due in part to higher US compliance with US guideline age information.

What are the implications of the differences in cross-country test rates identified in this paper? First, the significant difference in breast cancer screening rates among women of ages 40–50 may contribute to differences in health outcomes. Meta-analyses of randomized control trials indicate that mammography screening in the under-age-50 population reduces 10-year mortality by 15–20% [36], although we note that there is disagreement in the literature on this important question [37]. If the 15–20% figures are applicable to the general population, the 34 percentage point difference in mammography rates for women of ages 40–50 between the US and Canada may explain a part of the 6.9% (2000–2004) breast cancer mortality gap between Canada and the US for the 50–54 age group [38–43]. We also identified cross-country differences in the timing of colorectal cancer test use, although the smaller gap of 6 percentage points within the 10 years after age 50 indicates less potential for resulting differences in health outcomes than for mammography. Cross-country differences in prostate cancer test
# Table 2: Impact of guideline initiation age on cancer test use

<table>
<thead>
<tr>
<th></th>
<th>Mammogram&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Colorectal cancer test use&lt;sup&gt;a&lt;/sup&gt;</th>
<th>PSA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Canada Adjusted odds ratios (95% CIs)</td>
<td>US Adjusted odds ratios (95% CIs)</td>
<td>Canada Adjusted odds ratios (95% CIs)</td>
</tr>
<tr>
<td><strong>Age cutoff</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.489*** (1.151, 1.927)</td>
<td>1.55*** (1.311, 1.837)</td>
<td>1.107 (0.860, 1.521)</td>
<td>1.390* (1.002, 1.930)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>0.609 (0.036, 10.268)</td>
<td>0.031*** (0.008, 0.119)</td>
<td>0.017** (0.001, 0.375)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>1.016 (0.960, 1.076)</td>
<td>1.088** (1.022, 1.160)</td>
<td>1.04 (0.969, 1.119)</td>
</tr>
<tr>
<td><strong>Race non-white</strong></td>
<td>1.000 (0.999, 1.000)</td>
<td>0.999** (0.999, 1.000)</td>
<td>1.000 (0.999, 1.000)</td>
</tr>
<tr>
<td><strong>Hold income quartile 2</strong></td>
<td>1.077 (0.898, 1.291)</td>
<td>1.356*** (1.242, 1.481)</td>
<td>0.945 (0.775, 1.152)</td>
</tr>
<tr>
<td><strong>Hold income quartile 3</strong></td>
<td>1.150 (0.958, 1.380)</td>
<td>1.048 (0.925, 1.187)</td>
<td>1.021 (0.813, 1.281)</td>
</tr>
<tr>
<td><strong>Hold income quartile 4</strong></td>
<td>1.284** (1.088, 1.516)</td>
<td>1.153* (1.007, 1.320)</td>
<td>0.986 (0.810, 1.199)</td>
</tr>
<tr>
<td><strong>Unmarried couple</strong></td>
<td>1.412*** (1.180, 1.688)</td>
<td>1.303*** (1.138, 1.491)</td>
<td>1.240* (1.018, 1.510)</td>
</tr>
<tr>
<td><strong>Widowed</strong></td>
<td>0.777*** (0.663, 0.911)</td>
<td>0.921 (0.716, 1.183)</td>
<td>1.070 (0.858, 1.334)</td>
</tr>
<tr>
<td><strong>Never married</strong></td>
<td>0.603*** (0.465, 0.780)</td>
<td>0.853 (0.670, 1.086)</td>
<td>0.903 (0.651, 1.253)</td>
</tr>
<tr>
<td><strong>Divorced/separated</strong></td>
<td>0.817* (0.699, 0.955)</td>
<td>1.055 (0.926, 1.202)</td>
<td>0.931 (0.776, 1.115)</td>
</tr>
<tr>
<td><strong>Secondary education</strong></td>
<td>0.877 (0.753, 1.020)</td>
<td>1.017 (0.916, 1.128)</td>
<td>1.059 (0.873, 1.284)</td>
</tr>
<tr>
<td><strong>Secondary + and higher</strong></td>
<td>1.303** (1.089, 1.558)</td>
<td>1.031 (0.845, 1.258)</td>
<td>1.047 (0.850, 1.290)</td>
</tr>
<tr>
<td><strong>Health insurance</strong></td>
<td>Not applicable</td>
<td>2.286*** (2.016, 2.593)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>N</td>
<td>20 554</td>
<td>69 547</td>
<td>23 802</td>
</tr>
</tbody>
</table>


***P ≤ 0.001, **P ≤ 0.01, *P ≤ 0.05.
use may also affect health outcomes, although this is extremely uncertain. While observational studies indicate that medical treatment conditional on identifying cancer does increase survival [44], two recent randomized control trials regarding the effects of PSA screening test on survival have arrived at conflicting results regarding the effectiveness of the test in increasing survival [45, 46].

A second implication of these results is that differences across countries in the timing of screening initiation may affect the interpretation of cross-country cancer survival statistics. Just as lead-time bias is an important problem in comparing statistics within a country over time [47], differences across countries in the timing of screening initiation imply that US and Canadian cancer survival statistics conditional on detection could differ spuriously, simply because breast, colorectal and prostate cancers are detected at an earlier age in the US than in Canada. This is potentially an important issue in both breast and prostate cancers as these test rates are higher in the US relative to Canada across the entire age distribution.

Furthermore, the methodology applied in this study can also be used to inform comparisons of cancer statistics between the US and other OECD countries. In the case of breast cancer, countries including England, Scotland and France either recommend screening near, or have national breast cancer screening programs centered on, women aged 50 and older. Similarly in the case of prostate cancer national guidelines in other OECD countries do not recommend screening for men aged 50 and older. These differences can yet again potentially aid in understanding comparisons of cancer survival statistics between the US and other OECD countries.
These results also raise several questions regarding the effectiveness of recommendations to stop screening after a certain age. The CTFPHC and CCS guidelines do not recommend mammography screening after age 69 and the USPSTF also notes that at the older ages the benefits of screening older women decrease relative to the costs. The rationale behind this recommendation is that older women are more likely to die of other causes than from breast cancer [48]. Our findings indicate that in the US mammography test use stays at a very high level until a woman reaches her late 70s. In contrast, mammography test use in Canada begins a slow decline starting at the CTPFH recommended stopping age. While there is no sharp decline at age 70 that is directly attributable to guideline age information, these results suggest that physicians or patients in Canada have mechanisms for moderating the use of mammography at the older ages.

Finally, Canadian physicians and patients are less likely to comply with the colorectal cancer screening age information than US physicians and patients. Specifically colorectal cancer test use in Canada does not increase in a discrete manner at the guideline recommended age of 50. This difference could be due to country-level differences such as supply of gastroenterologists [49, 50], physician payment incentives (including under managed care), malpractice systems or reductions in the price of screening at the guideline recommended ages due to insurance coverage in the US [51]. Another potential explanation is that variation in Canadian province-specific screening programs, professional recommendations, payment rates may result in no single guideline being followed country-wide [52]. What the US and Canada share in the colorectal context, however, are age-specific screening rates that are far below those for either breast or prostate cancer. Opportunities to increase colorectal cancer screening rates, and compliance with clinical guidelines, should be considered in both countries.

**Limitations**

In this study, we used several nationally representative surveys to calculate age-specific cancer test rates. Test rates are self-reported, and therefore may suffer from recall bias. However, unless problems with recall arose or increased in severity precisely at the recommended screening initiation ages, this issue is unlikely to bias our results. Furthermore, analysis based on US insurance claims data, which would not be subject to recall bias, finds very similar results to the ones presented here [53]. A second potential limitation in this study is that guideline recommendations apply to asymptomatic individuals and our results include test use for non-asymptomatic reasons. We are able to separate out screening done for routine, preventive purposes versus test use for symptomatic reasons in the CCS and the NHIS surveys but not the BRFSS. In the CCHS surveys, only examining routine screening as the dependent variable and adjusting for the other covariates as defined above, the sharp increase at the age of recommended screening initiation persists (OR = 1.516; \( P = 0.003 \)). Conversely, among women receiving a mammography for diagnostic reasons, test rates increase slowly and smoothly with age and do not change in a discrete manner at the guideline recommended ages (OR = .998; \( P = 0.990 \)). We find similar results for colorectal cancer test use in the US. Routine screening increases in a discrete manner at age 50 (OR = 1.58; \( P = 0.012 \)) and diagnostic test use does not (OR = .757; \( P = 0.366 \)). These results indicate that changes in test use identified at the guideline recommended initiation ages are primarily due to changes in the screening of asymptomatic individuals.

**Conclusion**

This study compares US and Canadian compliance with guideline information with respect to the age of cancer screening initiation. We showed that compliance is strongest for breast and colorectal cancer screening in the US and for breast cancer screening in Canada. Compliance with colorectal screening guideline age information is mixed across countries as colorectal screening in the US rises at the expected age but Canadian colorectal cancer screening does not. In the case of breast cancer, existing knowledge regarding the effect of mammography screening on mortality suggests that the large test use differences identified between the two countries have the potential to generate population health differences. For colorectal and prostate cancers, the identified differences in test use are potentially less likely to lead to differences in population health due to the smaller identified differences in magnitudes and the uncertainty in the effectiveness of the PSA test. Finally, due to lead-time bias, differences in the timing of screening utilization across countries have the potential to affect the interpretation of cross-country comparisons of cancer survival statistics.

**Funding**

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