On the path toward cervical cancer elimination in Canada: a national survey of factors influencing women's intentions to participate in human papillomavirus test-based primary cervical screening

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Summary

Background HPV test-based primary cervical screening is replacing cytology in Canada. In other countries, women's unpreparedness and concerns hindered the transition and post-implementation screening uptake. We investigated psychosocial correlates of intentions of screening in eligible individuals to participate in HPV-based primary cervical screening.

Methods We conducted a nationwide web-based survey of individuals aged 21–70 years in 2022 and oversampled under-screened individuals. We used five Canadian-validated scales to measure HPV test-based screening knowledge, attitudes, and beliefs. Using the multistage Precaution Adoption Process Model, we assessed women's stage of intentions to participate in HPV testing and self-sampling. We estimated associations of psychosocial factors with intentions' stage using multinomial logistic regression.

Findings In both groups (adequately screened n = 1778; under-screened n = 1570), higher HPV knowledge was associated with intention for HPV testing and more personal barriers to the HPV test were associated with lower intentions to participate in HPV testing or use of self-sampling. In both groups, higher self-sampling concerns were associated

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with lower intentions for self-sampling and higher women's need for autonomy was associated with increased intentions for self-sampling. In the under-screened group, increased age was associated with lower intentions for HPV testing and self-sampling, while living in Canada for <10 years was associated with higher intentions.

Interpretation Our results could be used by policymakers and healthcare professionals to design communication strategies and ensure a smooth transition to HPV-based primary cervical screening, especially for under-screened individuals.

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Keywords: Cervical screening; HPV testing; Self-sampling; Attitudes and beliefs; Screening intentions; Obstetrics and gynecology; Public health; Reproductive health; Women's health; Human papillomavirus; Cancer prevention; Behavioural sciences

Research in context

Evidence before this study

Strong evidence shows that human papillomavirus (HPV) DNA testing has a superior sensitivity for detecting cervical intraepithelial neoplasia compared to cytology and that a negative HPV test denotes a lower risk of developing invasive cervical carcinomas compared to a negative cytology test. Also, HPV testing on self-collected cervicovaginal samples (i.e., self-sampling) has similar sensitivity and specificity for the detection of precancerous lesions compared to clinician-collected samples. This evidence led major health organisations in the Americas, Europe, and Australia to recommend HPV testing in primary cervical cancer screening. Countries that have replaced cytology with the HPV test as part of their nationally organised primary cervical screening programs (e.g., Australia, the UK) encountered significant implementation roadblocks triggered by screening eligible individuals' knowledge gaps related to cervical cancer and negative attitudes related to HPV testing.

In the context of an imminent transition from cytology to HPV test-based primary screening in Canada, we conducted a web survey of screening-eligible individuals and estimated the associations between psychosocial factors and intentions of adequately screened (n = 1778) and under-screened (n = 1570) women to participate in HPV test-based screening and self-sampling.

Added value of this study

This study is the first in Canada that surveyed a national sample of cervical screening eligible individuals and used psychometrically validated scales to measure HPV-related knowledge and attitudes and beliefs. To provide a more precise and nuanced understanding of where women were in their decision-making process, we used the multistage Precaution Adoption Process Model to measure intentions to adopt HPV testing. We conducted multivariable multinomial regression analyses to estimate the associations between psychosocial factors and women's intentions to participate in HPV testing and self-sampling. By oversampling under-screened individuals and separately analyzing individuals with an adequate from those with an inadequate cervical screening history we highlighted particularities in psychosocial barriers of cervical screening in under-screened women.

Implications of all the available evidence

Our results will inform healthcare professionals and public health decision-makers about the multifaceted factors that influence the acceptability of the new screening method, especially HPV and screening knowledge and negative attitudes and beliefs. Considering the crucial role of healthcare providers in cervical cancer prevention, interventions could be delivered face-to-face to address low knowledge, high perceived personal screening barriers, low confidence in the HPV test and empower screening autonomy needs. Our study could inform the design of larger-scale interventions orchestrated by public health to prepare women for this transition and design screening programs to ensure adequate uptake. Digital health interventions, such as web-based intervention, could leverage the high internet access among the Canadian population to improve screening accessibility for vulnerable, underscreened groups and empower them to participate in HPV test-based screening.

The study emphasizes the importance of educating individuals eligible for screening about self-sampling, which provides an alternative to clinician-collected samples for HPV testing. Self-sampling should be considered as a screening option in newly designed HPV test-based primary screening programs because it increases accessibility to screening and meets women's autonomy needs. Addressing key knowledge gaps—such as women's difficulties in interpreting the implications of a positive HPV test result, insufficient understanding of the rationale for starting screening at 25 years or later, and the extension of screening intervals to at least five years—is essential for ensuring optimal uptake of HPV test-based screening during the transition from cytology-based primary cervical screening.

Introduction

In Canada, the age-standardized incidence rate of cervical cancer (estimated at 7.1 per 100,000 women in 2020) exceeds the WHO target of <4 per 100,000 that must be sustained for the elimination of cervical cancer as a public health problem.[1,2] Most Canadian jurisdictions have implemented cytology-based (i.e., Pap test) organized primary cervical screening programs except for Quebec, Yukon, Northwest Territories, and Nunavut, which have long-standing opportunistic activities.[3] Depending on the province or territory, cervical screening begins at 21 or 25 years of age and continues every 2 or 3 years up to the age of 65–70.[3] Importantly, 30% of cervical cancers in Canada are diagnosed in under-screened groups amongst whom only 60% are screened according to guidelines and which include individuals with lower educational attainment, low income, recent immigration status, who speak other languages than English or French in the home, live in rural areas, identify as LGBTQI + or are of Indigenous identity.[4–8] These women may experience screening-related psychosocial or health system barriers differently from adequately screened women; e.g., embarrassment, lack of confidentiality or comfort with the procedure, low accessibility to health care providers, stigma and anxiety associated with testing positive for a sexually transmitted infection.[4,7,9–13]

Over the last decade, the landscape of secondary cervical cancer prevention has significantly evolved. Strong evidence shows that human papillomavirus (HPV) DNA testing has superior sensitivity (>90%) for detecting cervical intraepithelial neoplasia (CIN) grade 2 or worse (CIN2+) compared to cytology (50–70%) and that a negative HPV test denotes lower risk of developing invasive cervical carcinomas compared to a negative cytology test, supporting the extension of screening intervals to 5 years or more.[14–16] Importantly, using polymerase-chain-reaction assays tests for HPV on self-collected cervicovaginal samples (i.e., self-sampling) has similar sensitivity and specificity for the detection of CIN2+ or CIN3+ compared to clinician-collected samples.[15] Mail-in or community/clinic approaches are the most effective self-sampling interventions for increasing screening uptake in under-screened women (defined herein as inclusive of all individuals with a cervix).[17]

Several countries, including Australia, the UK, and the Netherlands have already implemented organized primary HPV test-based cervical screening programs.[18–20] Despite the documented advantages of HPV-based screening, women's insufficient cervical screening knowledge and negative attitudes and beliefs related to replacing the decades-long use of cytology with the HPV test (e.g., reduced screening frequency, higher age of screening initiation) can hinder implementation efforts (as experienced in Australia and Wales) and post-implementation screening uptake.[21–29]

The Canadian Partnership Against Cancer Action Plan for eliminating cervical cancer set as targets for 2030 that 90% of eligible individuals have been screened with an HPV test and are up to date with cervical screening, including at least 80% from historically under-screened groups.[4] To meet these targets, the Action Plan highlights the importance of informing the public about the benefits of HPV test-based screening.[4] As Canadian jurisdictions are expected to speed up the transition toward HPV testing, the objective of the current study was to estimate the associations between psychosocial factors and the intentions of adequately screened and under-screened women to participate in HPV test-based screening and self-sampling. The results will inform public health authorities of potential challenges to implementation, allowing for a targeted adhesion campaign.

Methods

Study design and participants

Eligible individuals (i.e., with a cervix and no history of cervical cancer) aged 21–70 years were invited to complete an online survey between August and September 2022.[3] Participants were recruited by Dynata, an international survey research firm that uses advanced methods (e.g., modelling approaches, proprietary software) to constantly update their panels and ensure the closest match to census and social benchmarks. Using their panel of Canadian residents, Dynata applied census-based quotas for age, province, primary language, household income, and rural/urban residence to ensure the representativeness of the sample. The survey was available in English and French, and participants were compensated according to Dynata's rewards and points system (e.g., Amazon and Starbucks). At the beginning of the survey, all participants were presented with an electronic consent form. Consent was implied if they clicked on the icon indicating their agreement to participate, while declining led to the termination of the survey.

Using current Canadian recommendations for cytology screening,[3] we categorized screening eligible participants into adequately screened (reported receiving at least one Pap test in the last 3 years) or under-screened (had a Pap test more than 3 years ago or never). Driven by the importance of elucidating the associations between psychosocial factors and screening intentions in under-screened individuals in whom cervical cancer is most frequently diagnosed, we oversampled this group to ensure adequate power in multivariable analyses. To facilitate understanding of HPV-based screening, we provided all participants with informative statements and pictograms related to HPV testing and self-sampling before the attitude and beliefs sections (Fig. 1 and Appendix A in the Supplementary Material). To ensure adequate readability and

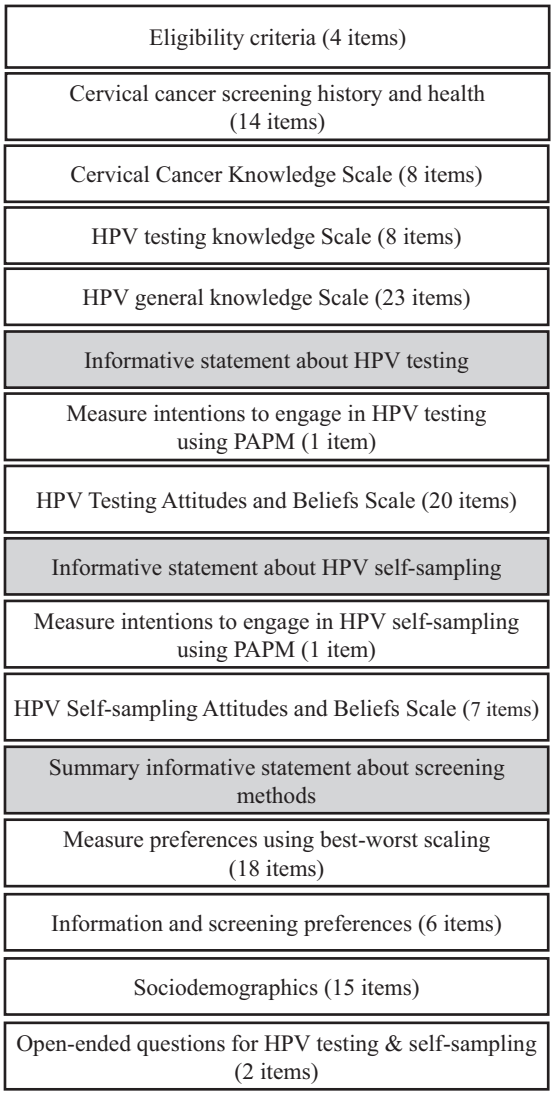

Fig. 1: **Questionnaire structure.** HPV, human papillomavirus; PAPM, Precaution Adoption Process Model.

understanding of the content, we incorporated suggestions received from 7 screening-eligible individuals who participated in cognitive interviews. Further details about the questionnaire development including the CHERRIES[30] and STROBE[31] checklist of recommendations and study procedures are available in the Supplementary Material and elsewhere.[32]

Measures

The two primary outcomes, intentions to receive HPV testing and to use self-sampling, were measured using the Precaution Adoption Process Model (PAPM).[33] Women placed themselves in one of five nominal intention stages separately for HPV testing and self-sampling use. For HPV testing, the intention stages were: 1) unengaged ("At this moment, I have not thought about having the HPV test"); 2) undecided ("At this moment, I am undecided about having the HPV test"; 3) decided NOT ("At this moment, I DO NOT want to have the HPV test"; 4) decided TO ("At this moment, I DO want to have the HPV test"; and 5) already tested ("I already had the HPV test"). For self sampling, the PAPM questions included statements such as "At this moment, I have not thought about doing self-sampling" (unengaged).

We used scales that were validated a priori by our research group using a national sample of screening-eligible Canadians. HPV test knowledge (HTKS) was measured using 8 items (e.g., "If the HPV test shows a woman has HPV, this means she already has cervical cancer"),[34] cervical cancer knowledge (CCKS) was measured using 8 items (e.g., "A woman is at lower risk for developing cervical cancer if she smokes")[34] and the HPV general knowledge (HPVGK) scale included 23 items (e.g., "HPV always has visible signs and symptoms").[35] The attitudes related to HPV testing scale (HTABS) included 4 subscales: *personal barriers* (7 items, e.g., "I would not need to have the HPV test because I do not have symptoms"); *social norms* (4 items, e.g., My friends' opinion about getting the HPV test would be important to me"); *confidence* (6 items, e.g., "Having the HPV test would be a good way to identify problems before they become cancer"); and *worries* (3 items, e.g., "I would be worried about getting tested with the HPV test less often than every 3 years").[36] The attitudes and beliefs about self-sampling scale (HSABS) comprise two subscales: *concerns* (4 items, e.g., "If I did HPV self-sampling, I would worry that I am not doing it right") and *autonomy* (3 items, e.g., "I would be more comfortable doing the swab by myself using HPV self-sampling than having an HPV test done by a healthcare professional")[36] (Scale items are shown in Appendix B in Supplementary Material). Attitudes and beliefs were measured on a 7-point Likert scale from "strongly disagree" to "strongly agree", and for each subscale, an average score was calculated. All knowledge items were answered with "true", "false", or "I don't know". Within each knowledge scale, we summed correct responses ("I don't know" was considered incorrect) to calculate a total score.

In addition to sociodemographic data, the survey measured health behaviours (e.g., smoking history), cervical cancer risk factors (e.g., number of lifetime sexual partners) and structural factors (e.g., access to a family doctor). The use of intelligent programming in the survey mitigated the potential problem of missing data. Because participants could not skip questions, missing data was not an issue for completed surveys.

Statistical analysis

We used multinomial logistic regression to calculate the relative risk ratio (RRr) for each PAPM intention stage

and used *unengaged* as the reference; for categorical independent variables, we estimated the RRr [and 95% confidence interval (CI)] using the reference category (e.g., single versus in a relationship), and for continuous variables (e.g., HTKS) we reported the RRr for one-unit increase in the variable (e.g., scale score). We conducted bivariate analyses to evaluate the association between each variable and PAPM intention stages. In multivariable analyses, we compared the fit of regression models that included all predictors (full models) with parsimonious models (i.e., that included only variables significantly associated with the outcome in bivariate analyses) using the log-likelihood ratio test. In multivariable analyses, the stages *decided to* and *tested* were collapsed due to the low number of participants who had already participated in HPV testing. We used the following fit indices to evaluate the final models: Cragg & Uhler's R2 and McFadden's R2.

We tested final models for independence of irrelevant alternatives (IIA), which posits that the ratio of probabilities for two alternatives (i.e., two PAPM stages) does not depend on what other alternatives are available. To test for significant differences in the coefficients between the full and restricted multinomial models (in which one of the alternatives was sequentially dropped), we used the seemingly unrelated estimation procedure implemented in STATA (*suest* command).

Analyses were conducted for each primary outcome and separately for under-screened and adequately screened groups. For all analyses, the significance level was set at $p < 0.05$. We used R v.4.2.2 and STATA v.17BE to conduct analyses.

Using power analyses based on the work of Peduzzi et al.,[37] we calculated a minimum sample size of N = 1500 per group (i.e., adequately, and under-screened). Please refer to the methods paper.[32]

The study was approved by the Research Ethics Board of the Integrated Health and Social Services University Network (CIUSSS) West-Central Montreal (Project ID: 2022–2960).

Role of the funding source

The funders of this study played no role in the study design, data collection, data analysis, data interpretation, or writing of this manuscript.

Results

Out of 4609 participants who provided informed consent and met eligibility criteria, 4082 completed the questionnaire i.e., 88.6% retention rate (Supplementary Material, Appendix C). We used data cleaning methods to identify careless or inattentive respondents (i.e., attention check items and outlying response times),[32] and removed 358 observations from the dataset. We used age-based recommendations for cervical screening initiation for each jurisdiction and retained for analysis only participants who were at least 3 years older than the recommended screening initiation age at the time of participating in the survey i.e., older than 28 years in BC, AB, NS and PEI and older than 24 years in the other jurisdictions (n = 3348; n = 1778 adequately screened; n = 1570 under-screened). Among adequately screened, 43.1% (n = 766) were in the PAPM stage *unengaged*, 11.8% (n = 210) were *undecided*, 3.9% (n = 69) were *decided not*, and 41.2% (n = 733) were *decided to* or *already tested*. Among under-screened, 48.9% (n = 768) were in the PAPM stage *unengaged*, 13.6% (n = 214) were *undecided*, 9.3% (n = 146) were *decided not*, and 28.2% (n = 442) were *decided to or tested*. Sociodemographic characteristics are provided in Table 1.

Bivariate multinomial regression results for intentions to receive the HPV test and use self-sampling are provided in Appendix D and E in the Supplementary Material, respectively. Results of the log-likelihood test were not significant ($p > 0.05$) and we retained parsimonious models. Model fit indices are presented in multivariable analysis tables. The assumption of IIA was not violated as we found no significant differences in coefficients between full and restricted models showing that the final multinomial models were correctly specified.

HPV test intentions

a) Knowledge

In both adequately and under-screened groups, higher HPV knowledge was associated with higher intentions to receive the HPV test (Adequately screened: RRr = 1.05; CI: 1.02; 1.08; Under-screened: RRr = 1.04; CI: 1.01; 1.08). In under-screened women, higher cervical cancer knowledge was associated with a lower probability of deciding **not to** receive the HPV test (RRr = 0.85; CI: 0.77; 0.95) (Table 2).

b) Attitudes and beliefs

In both groups, perceiving HPV testing to have more barriers was associated with lower intentions to receive HPV testing (Adequately screened: RRr = 0.63; CI: 0.54; 0.73; Under-screened: RRr = 0.56; CI: 0.48; 0.65). Participants with higher worries scale scores were more likely to decide in favour of HPV testing (Adequately screened: RRr = 1.16; CI: 1.07; 1.26; Under-screened: RRr = 1.28; CI: 1.15; 1.42). In under-screened women, higher perceived norms were associated with a higher probability of being undecided (RRr = 1.25; CI: 1.09; 1.42), while higher confidence in HPV testing was associated with a lower probability of refusing it (RRr = 0.51; CI: 0.40; 0.65) and a higher probability of deciding to receive the HPV test (RRr = 1.26; CI: 1.03; 1.54) (Table 2).

c) Sociodemographic, structural, health behaviour and risk factors

	Full sample (N = 3348)	Adequately screened (n = 1778)	Under-screened (n = 1570)	p-value (Effect size)[a]
Age (years), M (SD)	47.37 (13.57)	47.60 (13.34)	47.11 (13.82)	p = 0.30 (d = 0.04)
Region, n (%)				p < 0.001
Western and Territories	1005 (30.0)	575 (32.3)[i]	430 (27.4)[i]	h = 0.11
Ontario	1327 (39.6)	722 (40.6)	605 (38.5)	h = 0.04
Quebec	779 (23.3)	343 (19.3)[i]	436 (27.8)[i]	h = 0.20
Atlantic	237 (7.1)	138 (7.8)	99 (6.3)	h = 0.06
Area, n (%)				p = 1
Rural	681 (20.3)	362 (20.0)	319 (19.9)	h = 0.00
Urban	2667 (79.7)	1416 (80.0)	1251 (80.1)	
Ethnicity, n (%)				p < 0.001
North American Indigenous[b]	96 (2.9)	57 (3.2)	39 (2.5)	h = 0.04
North American-Other[c]	1526 (45.6)	805 (45.3)	721 (45.9)	h = 0.01
European[d]	1029 (30.7)	593 (33.3)[i]	436 (27.8)[i]	h = 0.12
Asian[e]	446 (13.3)	193 (10.9)[i]	253 (16.1)[i]	h = 0.15
Other[f]	251 (7.5)	130 (7.3)	121 (7.7)	h = 0.02
Visible minority, n (%)				p < 0.001
Yes	613 (18.3)	275 (15.5)[i]	338 (21.5)[i]	h = 0.16
No	2735 (81.7)	1503 (84.5)[i]	1232 (78.5)[i]	
Primary Language, n (%)				p < 0.001
English	2570 (76.8)	1430 (80.4)[i]	1140 (72.6)[i]	h = 0.18
French	631 (18.8)	286 (16.1)[i]	345 (22.0)[i]	h = 0.15
Other	147 (4.4)	62 (3.5)[i]	85 (5.4)[i]	h = 0.09
Living in Canada > 10 years, n (%)				p = 0.01
Yes	3135 (93.6)	1683 (94.7)[i]	1452 (92.5)[i]	h = 0.09
No	213 (6.4)	95 (5.3)[i]	118 (7.5)[i]	
Completed post-secondary education, n (%)				p = 0.67
Yes	2463 (73.6)	1314 (73.9)	1149 (73.2)	h = 0.02
No	885 (26.4)	464 (26.1)	421 (26.8)	
Gender identity, n (%)				p = 0.03
Female/woman	3315 (99.0)	1767 (99.4)[i]	1548 (98.6)[i]	h = 0.08
Gender diverse	33 (1.0)	11 (0.6)[i]	22 (1.4)[i]	
Sexual Orientation, n (%)				p = 0.01
Heterosexual	3035 (90.7)	1632 (91.8)[i]	1403 (89.4)[i]	h = 0.08
Bisexual	161 (4.8)	83 (4.7)	78 (4.9)	h = 0.01
Other[g]	152 (4.5)	63 (3.5)[i]	89 (5.7)[i]	h = 0.10
Relationship/marital status, n (%)				p < 0.001
In a relationship	2212 (66.1)	1262 (71.0)[i]	950 (60.5)[i]	h = 0.22
Single	1136 (33.9)	516 (29.0)[i]	620 (39.5)[i]	
Household income, n (%)				p < 0.001
≤39,999 CAD[h]	735 (22.0)	322 (18.1)[i]	413 (26.3)[i]	h = 0.20
40,000–79,999 CAD	1119 (33.4)	609 (34.3)	510 (32.5)	h = 0.04
≥80,000 CAD	1393 (41.6)	796 (44.7)[i]	597 (38.0)[i]	h = 0.14
Prefer not to answer	101 (3.0)	51 (2.9)	50 (3.2)	h = 0.02
Employment status, n (%)				p = 0.005
Employed	2106 (62.9)	1158 (65.1)[i]	948 (60.4)[i]	h = 0.10
Not employed	1242 (37.1)	620 (34.9)[i]	622 (39.6)[i]	

[a]Calculated for adequately screened versus underscreened; independent samples t-tests used for continuous data and chi-square tests of independence for categorical data. For significant differences between categories, we provide Cohen's d (for continuous data) and Cohen's h (for proportions); Effect size (Cohen d or h) is interpreted as very small <0.2, small 0.2 to 0.49, medium 0.5–0.79, and large ≥0.8. [b]e.g., Canadian, American, Ontarian, Quebecois, Acadian. [c]i.e., First Nations, Inuit, Metis. [d]e.g., British, French, Western European, Eastern European. [e]e.g., West Central Asian, South Asian, East and Southeast Asian. [f]i.e., Caribbean (e.g., Cuban, Haitian, Jamaican), Latin, Central and South American (e.g., Mexican, Argentinian, Brazilian, Chilean), African (e.g., Central and West African, North African, Southern African), Oceania (e.g., Australian, New Zealander, Pacific Islander), and Other. [g]i.e., gay, lesbian, queer, two spirit and "prefer not to answer". [h]CAD denotes Canadian Dollar. [i]Paired denotes statistically significant (p < 0.05) difference in proportions.

Table 1: **Sample characteristics.**

	Adequately screened (N = 1778) reference category unengaged (n = 766)			Under-screened (N = 1570) reference category unengaged (n = 768)		
	Undecided (n = 210)	Decided not (n = 69)	Decided to or tested (n = 733)	Undecided (n = 214)	Decided not (n = 146)	Decided to or tested (n = 442)
Knowledge scales						
HPV knowledge (one-unit increase)	1.01 (0.97; 1.06)	1.03 (0.96; 1.10)	**1.05 (1.02; 1.08)*****	1.04 (1.00; 1.09)	**1.10 (1.04; 1.16)*****	**1.04 (1.01; 1.08)***
Cervical cancer knowledge (one-unit increase)	1.00 (0.92; 1.09)	1.04 (0.91; 1.20)	1.02 (0.96; 1.08)	0.96 (0.88; 1.04)	**0.85 (0.77; 0.95)****	1.01 (0.94; 1.08)
HPV test knowledge (one-unit increase)	1.06 (0.95; 1.19)	1.07 (0.89; 1.29)	1.05 (0.97; 1.13)	0.99 (0.89; 1.10)	1.01 (0.89; 1.16)	1.08 (0.99; 1.19)
HPV test attitudes and beliefs scale						
Barriers (one-unit increase)	1.04 (0.85; 1.26)	**1.59 (1.16; 2.17)****	**0.63 (0.54; 0.73)*****	0.96 (0.79; 1.15)	**1.56 (1.24; 1.97)*****	**0.56 (0.48; 0.65)*****
Norms (one-unit increase)	1.07 (0.94; 1.23)	0.90 (0.71; 1.13)	1.04 (0.95; 1.14)	**1.25 (1.09; 1.42)****	1.10 (0.92; 1.32)	1.01 (0.91; 1.13)
Confidence (one-unit increase)	**0.75 (0.60; 0.94)***	0.72 (0.51; 1.02)	1.14 (0.96; 1.35)	**0.70 (0.57; 0.87)****	**0.51 (0.40; 0.65)*****	**1.26 (1.03; 1.54)***
Worries (one-unit increase)	**1.14 (1.00; 1.30)***	0.97 (0.77; 1.21)	**1.16 (1.07; 1.26)*****	1.07 (0.93; 1.23)	**0.73 (0.61; 0.88)*****	**1.28 (1.15; 1.42)*****
Sociodemographics						
Primary language spoken at home: English	Reference					
French	1.31 (0.62; 2.75)	0.99 (0.32; 3.05)	**1.72 (1.02; 2.90)***	1.33 (0.87; 2.05)	1.23 (0.73; 2.05)	**1.67 (1.17; 2.38)****
Other	1.82 (0.73; 4.55)	2.27 (0.55; 9.43)	**2.14 (1.06; 4.32)***	1.02 (0.50; 2.06)	1.12 (0.41; 3.11)	0.77 (0.40; 1.50)
Age (one-year increase)	**0.98 (0.97; 1.00)***	1.02 (0.99; 1.04)	**0.98 (0.97; 0.99)*****	0.99 (0.97; 1.00)	**1.03 (1.01; 1.05)****	**0.98 (0.96; 0.99)*****
Province: Western and Territories	Reference					
Atlantic	0.50 (0.24; 1.06)	0.16 (0.02; 1.26)	0.87 (0.56; 1.35)	NA		
Ontario	1.06 (0.73; 1.54)	0.89 (0.48; 1.67)	1.08 (0.83; 1.41)			
Quebec	0.83 (0.40; 1.71)	2.33 (0.80; 6.78)	1.00 (0.60; 1.66)			
Ethnicity: North American	Reference					
Indigenous people	1.07 (0.44; 2.56)	0.60 (0.07; 4.99)	1.00 (0.52; 1.95)	0.35 (0.32; 2.18)	0.67 (0.08; 1.58)	1.50 (0.68; 3.35)
European	0.97 (0.66; 1.44)	1.59 (0.84; 2.99)	1.18 (0.90; 1.54)	0.87 (0.57; 1.31)	**0.45 (0.26; 0.76)****	0.99 (0.70; 1.38)
Asian	1.02 (0.50; 2.08)	0.83 (0.22; 3.05)	1.69 (0.98; 2.91)	0.80 (0.46; 1.39)	0.69 (0.34; 1.40)	1.21 (0.74; 1.99)
Other	1.36 (0.61; 3.06)	1.01 (0.24; 4.31)	**2.03 (1.14; 3.60)***	0.92 (0.65; 1.97)	0.89 (0.49; 1.75)	**1.74 (1.02; 2.96)***
Self declared visible minority: No	Reference					
Yes	1.14 (0.63; 2.04)	2.23 (0.80; 6.19)	1.04 (0.67; 1.63)	NA		
Religious influence on health: no	Reference					
Yes	1.40 (0.83; 2.34)	**2.43 (1.15; 5.13)***	1.16 (0.76; 1.77)	1.48 (0.87; 2.52)	**3.51 (2.03; 6.07)*****	**1.91 (1.19; 3.07)****
Living in Canada >10 years: Yes	Reference					
No	0.53 (0.22; 1.31)	1.27 (0.36; 4.49)	1.59 (0.90; 2.82)	1.43 (0.74; 2.76)	1.59 (0.56; 4.55)	1.74 (0.99; 3.04)
Post secondary education: Yes	Reference					
No	NA			0.77 (0.51; 1.14)	1.28 (0.81; 2.02)	1.04 (0.76; 1.42)
Sexual orientation: Heterosexual	Reference					
Other	NA			0.89 (0.52; 1.52)	0.67 (0.30; 1.46)	**1.65 (1.08; 2.52)***
Relationship/marital status: in a relationship	Reference					
Single	NA			0.93 (0.63; 1.37)	0.99 (0.60; 1.64)	0.90 (0.66; 1.24)
Household income: ≥80,000 CAD	Reference					
≤40,000 CAD	**2.56 (1.64; 4.00)*****	0.76 (0.36; 1.61)	**1.55 (1.13; 2.14)****	1.09 (0.70; 1.71)	**1.78 (1.01; 3.14)***	1.35 (0.92; 1.97)
41,000–80,000 CAD	**1.64 (1.12; 2.38)***	0.83 (0.46; 1.51)	1.07 (0.83; 1.38)	0.97 (0.66; 1.43)	1.28 (0.76; 2.17)	1.19 (0.87; 1.64)
Employed: yes	Reference					
No	0.85 (0.58; 1.24)	**2.43 (1.33; 4.43)****	0.91 (0.70; 1.18)	0.83 (0.57; 1.21)	1.15 (0.73; 1.81)	0.81 (0.60; 1.10)
Children given birth: no children	Reference					
1 or 2	NA			0.98 (0.66; 1.43)	0.83 (0.50; 1.38)	1.31 (0.96; 1.80)
3 or more				0.63 (0.36; 1.10)	0.86 (0.46; 1.61)	1.10 (0.72; 1.68)
Structural factors						
Time to clinic <30 min	Reference					
>30 min	**1.62 (1.12; 2.34)***	0.98 (0.50; 1.93)	1.15 (0.87; 1.53)	NA		
Access to family doctor: yes	Reference					
No	**1.70 (1.01; 2.87)***	1.75 (0.79; 3.86)	**1.69 (1.14; 2.50)****	NA		

(Table 2 continues on next page)

	Adequately screened (N = 1778) reference category unengaged (n = 766)			Under-screened (N = 1570) reference category unengaged (n = 768)		
	Undecided (n = 210)	Decided not (n = 69)	Decided to or tested (n = 733)	Undecided (n = 214)	Decided not (n = 146)	Decided to or tested (n = 442)
(Continued from previous page)						
Health behaviors and risk factors						
Oral birth control for 5+ years: no	Reference					
Yes	NA			0.93 (0.65; 1.33)	1.20 (0.77; 1.87)	1.07 (0.81; 1.43)
Smoking history: never	Reference					
In the past	NA			0.71 (0.46; 1.11)	0.67 (0.39; 1.13)	0.83 (0.59; 1.18)
Current				0.85 (0.52; 1.39)	**0.41 (0.21; 0.83)***	0.90 (0.61; 1.33)
HPV vaccination: No	Reference					
Yes	1.02 (0.64; 1.62)	0.97 (0.43; 2.18)	**1.46 (1.06; 2.01)***	1.24 (0.80; 1.92)	0.74 (0.37; 1.49)	1.22 (0.84; 1.76)
Unknown status	0.95 (0.58; 1.56)	0.39 (0.11; 1.31)	1.01 (0.70; 1.45)	1.32 (0.84; 2.08)	1.32 (0.74; 2.36)	1.02 (0.69; 1.53)
STI history: No	Reference					
Yes	0.66 (0.39; 1.13)	0.95 (0.42; 2.16)	1.21 (0.88; 1.66)	**1.68 (1.00; 2.80)***	1.16 (0.56; 2.40)	1.47 (0.99; 2.19)
Abnormal Pap history: No	Reference					
Yes	1.12 (0.75; 1.65)	0.82 (0.42; 1.61)	**1.37 (1.05; 1.78)***	1.38 (0.84; 2.28)[a]	0.83 (0.39; 1.77)[a]	1.25 (0.85; 1.81)[a]
Age at sexual debut: ≤21 years	Reference					
>21 years	1.19 (0.78; 1.82)	1.19 (0.60; 2.37)	**0.71 (0.51; 0.99)***	1.19 (0.76; 1.86)	0.81 (0.45; 1.44)	1.08 (0.73; 1.59)
No sexual life	1.29 (0.82; 2.03)	1.05 (0.46; 2.37)	0.83 (0.53; 1.30)	0.87 (0.65; 1.17)	1.15 (0.82; 1.60)	**0.54 (0.39; 0.75)*****
Nr of lifetime sexual partners: 1–4	Reference					
5–10	0.86 (0.55; 1.34)	1.88 (0.95; 3.70)	1.17 (0.87; 1.58)	0.73 (0.45; 1.20)	**0.29 (0.12; 0.68)****	1.31 (0.91; 1.88)
>10	0.86 (0.53; 1.38)	1.34 (0.58; 3.10)	1.11 (0.81; 1.58)	0.99 (0.58; 1.67)	0.99 (0.50; 1.94)	1.40 (0.94; 2.08)
None	1.29 (0.82; 2.04)	1.05 (0.46; 2.37)	0.83 (0.53; 1.30)	0.87 (0.65; 1.17)	1.15 (0.82; 1.60)	**0.54 (0.39; 0.75)*****
Prefer not to answer	0.66 (0.24; 1.84)	1.50 (0.40; 5.70)	**2.26 (1.22; 4.20)****	0.89 (0.37; 2.13)	1.00 (0.38; 2.61)	1.57 (0.74; 3.30)

Note: Bold indicates significant RRr and 95% CI. Significance levels are *p < 0.05; **p < 0.01; ***p < 0.001. [a]Denotes estimates in screening eligible individuals who reported a history of Pap testing (n = 1186). NA denotes not available; the variable was not significant in bivariate analyses and was not included in the multivariable model. Model fit statistics: adequately screened: Cragg & Uhler's R2 = 0.25, McFadden's R2 = 0.12; under-screened: Cragg & Uhler's R2 = 0.34, McFadden's R2 = 0.15.

Table 2: **Multivariable analyses of HPV test intentions showing relative risk ratios (95% confidence intervals).**

In both groups, for each 1-year increase in age, the probability of being in the intention stages *decided to* or *already tested* decreased (Adequately screened: RRr = 0.98; CI: 0.97; 0.99; Under-screened: RRr = 0.98; CI: 0.96; 0.99). For those who primarily spoke French at home (compared to English) we found higher intentions of receiving the HPV test (Adequately screened: RRr = 1.72; CI: 1.02; 2.90; Under-screened: RRr = 1.67; CI: 1.17; 2.38). Belonging to other than North American ethnic groups (e.g., Caribbean, Latin, Central, and South American) was associated with higher intentions to receive the HPV test (Adequately screened: RRr = 2.03; CI: 1.14; 3.60; Under-screened: RRr = 1.74; CI: 1.02; 2.96). Women who declared influence of religious beliefs on health decisions had a higher probability of deciding against receiving the HPV test (Adequately screened: RRr = 2.43; CI: 1.15; 5.13; Under-screened: RRr = 3.51; CI: 2.03; 6.07) (Table 2).

For adequately screened women, we found that speaking other languages at home (compared to English, RRr = 2.14; CI: 1.06; 4.32) and having an annual income <40,000 CAD (compared to >80,000 CAD, RRr = 1.55; CI: 1.13; 2.14) were associated with intention to receive the HPV test. Being unemployed was associated with a higher probability of refusing the test (RRr = 2.43; CI: 1.33; 4.43). The probability of deciding to receive the HPV test was higher in participants who did not have access to a family doctor (RRr = 1.69; CI: 1.14; 2.50), had received the HPV vaccine (RRr = 1.46; CI: 1.06; 2.01), and had a history of abnormal cytology (RRr = 1.37; CI: 1.05; 1,78). Sexual debut >21 years (compared to ≤21 years) was associated with lower intention to receive the HPV test (RRr = 0.71; CI: 0.51; 0.99) (Table 2).

In the under-screened group, declaring no lifetime sexual partners (RRr = 0.54; CI: 0.39; 0.75) was associated with lower intentions. Participants identifying as non-heterosexual (RRr = 1.65; CI: 1.08; 2.52) had a higher probability of deciding to or have received the HPV test. Current smokers (RRr = 0.41; CI: 0.21; 0.83) and participants with 5–10 lifetime sexual partners (compared to 1–4, RRr = 0.29; CI: 0.12; 0.68) had a lower probability of deciding against receiving the HPV test (Table 2).

Self-sampling intentions

a) Knowledge

Higher HPV test knowledge was associated in both groups with a higher probability of deciding against

	Adequately screened (N = 1778) reference category unengaged (n = 637)			Under-screened (N = 1570) reference category unengaged (n = 557)		
	Undecided (n = 294)	Decided not (n = 196)	Decided to or tested (n = 651)	Undecided (n = 270)	Decided not (n = 174)	Decided to or tested (n = 569)
Knowledge scales						
HPV knowledge (one-unit increase)	1.01 (0.97; 1.05)	1.04 (1.00; 1.09)	1.03 (1.00; 1.06)	1.03 (0.99; 1.07)	1.02 (0.97; 1.07)	**1.03 (1.00; 1.10)***
Cervical cancer knowledge (one-unit increase)	1.06 (0.98; 1.14)	0.96 (0.88; 1.06)	1.03 (0.97; 1.10)	1.00 (0.93; 1.09)	0.95 (0.86; 1.05)	1.00 (0.94; 1.08)
HPV test knowledge (one-unit increase)	1.02 (0.93; 1.13)	**1.15 (1.02; 1.31)***	1.05 (0.96; 1.15)	0.99 (0.89; 1.09)	**1.20 (1.06; 1.36)****	1.05 (0.96; 1.15)
HPV test attitudes and beliefs scale						
Barriers (one-unit increase)	1.12 (0.92; 1.37)	1.13 (0.88; 1.45)	**0.79 (0.67; 0.94)****	0.93 (0.77; 1.13)	**1.30 (1.03; 1.65)***	**0.75 (0.64; 0.88)*****
Norms (one-unit increase)	1.04 (0.92; 1.18)	0.92 (0.79; 1.08)	**1.11 (1.01; 1.22)***	1.11 (0.98; 1.26)	0.99 (0.85; 1.16)	1.09 (0.98; 1.22)
Confidence (one-unit increase)	1.00 (0.80; 1.23)	0.81 (0.63; 1.06)	**1.23 (1.02; 1.49)***	0.83 (0.68; 1.02)	0.87 (0.69; 1.10)	1.13 (0.94; 1.36)
Worries (one-unit increase)	1.07 (0.95; 1.20)	1.02 (0.89; 1.17)	**1.12 (1.02; 1.23)***	**1.20 (1.05; 1.37)****	0.87 (0.74; 1.02)	**1.23 (1.11; 1.38)*****
Concerns (one-unit increase)	1.05 (0.89; 1.23)	**1.44 (1.19; 1.75)*****	**0.70 (0.60; 0.81)*****	1.06 (0.90; 1.26)	1.12 (0.92; 1.37)	**0.69 (0.59; 0.80)*****
Autonomy (one-unit increase)	0.97 (0.86; 1.09)	**0.54 (0.46; 0.63)*****	**1.40 (1.26; 1.55)*****	1.13 (0.98; 1.29)	**0.61 (0.52; 0.71)*****	**1.44 (1.27; 1.63)*****
Sociodemographics						
Primary language spoken at home: English	Reference					
French	1.38 (0.69; 2.74)	0.64 (0.27; 1.51)	1.30 (0.74; 2.29)	1.04 (0.55; 1.98)	0.66 (0.31; 1.39)	0.87 (0.51; 1.49)
Other	0.74 (0.32; 1.72)	1.17 (0.43; 3.19)	0.95 (0.47; 1.91)	1.20 (0.58; 2.47)	1.22 (0.50; 2.97)	1.18 (0.63; 2.24)
Age (one-year increase)	**0.99 (0.97; 1.00)***	1.00 (0.99; 1.02)	**0.98 (0.97; 0.99)*****	**0.98 (0.97; 1.00)***	1.00 (0.98; 1.01)	**0.98 (0.97; 0.99)*****
Province: Western and Territories	Reference					
Atlantic	**0.47 (0.24; 0.93)***	1.10 (0.54; 2.24)	0.76 (0.47; 1.23)	0.60 (0.31; 1.18)	0.58 (0.26; 1.30)	**0.39 (0.21; 0.70)****
Ontario	1.30 (0.92; 1.82)	1.26 (0.83; 1.93)	1.16 (0.87; 1.55)	1.01 0.69; 1.48)	0.73 (0.46; 1.16)	0.93 (0.67; 1.28)
Quebec	0.98 (0.50; 1.92)	1.21 (0.54; 2.71)	1.13 (0.65; 1.94)	0.91 (0.48; 1.74)	1.05 (0.50; 2.21)	1.09 (0.64; 1.85)
Ethnicity: North American	Reference					
Indigenous people	2.25 (0.99; 5.11)	0.48 (0.09; 2.41)	1.58 (0.76; 3.28)	NA		
European	1.17 (0.83; 1.66)	0.97 (0.64; 1.48)	0.97 (0.73; 1.30)			
Asian	1.37 (0.71; 2.64)	0.94 (0.39; 2.28)	1.18 (0.67; 2.11)			
Other	1.06 (0.49; 2.31)	1.78 (0.73; 4.34)	1.38 (0.75; 2.55)			
Self declared visible minority: no	Reference					
Yes	0.84 (0.48; 1.47)	1.10 (0.52; 2.31)	1.16 (0.72; 1.85)	1.07 (0.71; 1.60)	0.79 (0.48; 1.32)	**1.51 (1.06; 2.16)***
Religious influence on health: no	Reference					
Yes	NA			1.46 (0.88; 2.40)	**2.07 (1.18; 3.62)***	1.30 (0.82; 2.08)
Living in Canada > 10 years: Yes	Reference					
No	0.79 (0.37; 1.67)	0.57 (0.20; 1.57)	1.49 (0.82; 2.69)	0.96 (0.48; 1.95)	1.20 (0.50; 2.87)	**1.91 (1.08; 3.38)***
Sexual orientation: heterosexual	Reference					
Other	NA			0.82 (0.47; 1.42)	1.53 (0.84; 2.78)	1.53 (0.99; 2.37)
Relationship/marital status: in a relationship	Reference					
Single	NA			0.70 (0.48; 1.01)	1.25 (0.81; 1.94)	0.81 (0.59; 1.11)
Household income: >80,000 CAD	Reference					
≤40.000 CAD	NA			1.45 (0.96; 2.20)	1.06 (0.63; 1.77)	1.11 (0.77; 1.62)
41,000–80,000 CAD				0.93 (0.64; 1.35)	1.13 (0.72; 1.79)	1.04 (0.76; 1.43)
Employed: yes	Reference					
No	1.07 (0.77; 1.49)	**1.78 (1.17; 2.71)****	0.97 (0.74; 1.29)	0.98 (0.69; 1.39)	**1.53 (1.01; 2.33)***	0.81 (0.60; 1.10)
Structural factors						
Access to family doctor: yes	Reference					
No	NA			**0.61 (0.42; 0.87)****	0.76 (0.49; 1.16)	0.83 (0.61; 1.11)

(Table 3 continues on next page)

	Adequately screened (N = 1778) reference category unengaged (n = 637)			Under-screened (N = 1570) reference category unengaged (n = 557)		
	Undecided (n = 294)	Decided not (n = 196)	Decided to or tested (n = 651)	Undecided (n = 270)	Decided not (n = 174)	Decided to or tested (n = 569)
(Continued from previous page)						
Health behaviors and risk factors						
Self-perceived health status: very good or excellent	Reference					
Good	1.24 (0.90; 1.70)	1.48 (1.00; 2.21)	1.09 (0.84; 1.43)	NA		
Fair or very poor	1.16 (0.72; 1.87)	1.50 (0.84; 2.69)	0.98 (0.65; 1.48)			
Oral birth control for 5+ years: no	Reference					
Yes	1.12 (0.83; 1.51)	1.21 (0.84; 1.76)	1.23 (0.96; 1.58)	NA		
Smoking history: never	Reference					
In the past	1.08 (0.77; 1.52)	0.96 (0.64; 1.44)	1.03 (0.78; 1.37)	NA		
Current	0.80 (0.50; 1.28)	**0.48 (0.25; 0.91)***	1.03 (0.71; 1.49)			
HPV vaccination: No	Reference					
Yes	1.26 (0.84; 1.89)	**1.77 (1.08; 2.91)***	1.19 (0.83; 1.69)	NA		
Unknown status	0.99 (0.62; 1.58)	0.85 (0.45; 1.59)	**1.50 (1.02; 2.20)***			
STI history: no	Reference					
Yes	1.28 (0.82; 2.01)	1.10 (0.64; 1.90)	**1.63 (1.14; 2.31)****	1.56 (0.95; 2.56)	1.29 (0.70; 2.38)	**1.61 (1.06; 2.46)***
Abnormal pap history: No	Reference					
Yes	NA			1.04 (0.64; 1.69)[a]	1.16 (0.65; 2.06)[a]	1.47 (0.99; 2.18)[a]
Age at sexual debut: ≤21 years	Reference					
>21 years	NA			0.85 (0.55; 1.30)	1.12 (0.67; 1.86)	0.82 (0.57; 1.18)
No sexual life				0.93 (0.70; 1.23)	0.94 (0.68; 1.29)	**0.67 (0.51; 0.88)****
Nr of lifetime sexual partners: 1–4	Reference					
5–10	1.03 (0.71; 1.50)	1.08 (0.67; 1.74)	1.08 (0.78; 1.49)	0.95 (0.61; 1.50)	1.17 (0.67; 2.04)	1.10 (0.75; 1.59)
>10	**0.59 (0.38; 0.92)***	1.23 (0.75; 2.03)	1.04 (0.74; 1.47)	0.79 (0.49; 1.29)	0.86 (0.47; 1.58)	0.93 (0.62; 1.38)
None	0.48 (0.15; 1.53)	0.31 (0.06; 1.67)	1.30 (0.57; 2.97)	0.93 (0.70; 1.23)	0.94 (0.68; 1.29)	**0.67 (0.51; 0.88)****
Prefer not to answer	0.93 (0.43; 2.03)	0.96 (0.39; 2.40)	1.00 (0.50; 2.01)	0.52 (0.21; 1.28)	1.36 (0.58; 3.18)	1.03 (0.50; 2.12)
BMI categorical: normal	Reference					
Underweight	2.13 (0.92; 4.94)	0.21 (0.03; 1.79)	1.00 (0.41; 2.42)	NA		
Overweight	**0.64 (0.44; 0.95)***	0.76 (0.48; 1.21)	1.00 (0.74; 1.34)			
Mild or moderate obesity	1.07 (0.74; 1.55)	0.95 (0.59; 1.51)	0.84 (0.60; 1.16)			
Severe obesity	1.02 (0.55; 1.87)	1.21 (0.61; 2.40)	1.19 (0.70; 2.01)			

Note: In bold are provided significant RRr and 95% CI. Significance levels *p < 0.05; **p < 0.01; ***p < 0.001. [a]Denotes estimates in women who reported a history of Pap testing (n = 1186). NA denotes not available; the variable was not significant in bivariate analyses and was not included in the multivariable model. Model fit statistics: adequately screened: Cragg & Uhler's R2 = 0.34 and McFadden's R2 = 0.15; under-screened: Cragg & Uhler's R2 = 0.31 and McFadden's R2 = 0.13.

Table 3: **Multivariable analyses of self-sampling intentions showing relative risk ratios (95% confidence intervals).**

using self-sampling (Adequately screened: RRr = 1.15; CI: 1.02; 1.31; Under-screened: RRr = 1.20; CI: 1.06; 1.36). In under-screened women, higher HPV knowledge was associated with higher intentions of using self-sampling (RRr = 1.03; CI: 1.00; 1.10) (Table 3).

b) Attitudes and beliefs

In both groups, higher perceived barriers to the HPV test were associated with lower intentions to use (or have used) self-sampling (Adequately screened: RRr = 0.79; CI: 0.67; 0.94; Under-screened: RRr = 0.75; CI: 0.64; 0.88). Similarly, higher concerns about self-sampling were associated with lower intentions for self-sampling (Adequately screened: RRr = 0.70; CI: 0.60; 0.81; Under-screened: RRr = 0.69; CI: 0.59; 0.80). Conversely, higher autonomy needs (Adequately screened: RRr = 1.40; CI: 1.26; 1.55; Under-screened: RRr = 1.44; CI: 1.27; 1.63) and higher worries related to HPV testing (Adequately screened: RRr = 1.12; CI: 1.02; 1.23; Under-screened: RRr = 1.23; CI: 1.11; 1.38) were associated with higher intentions for self-sampling.

In the adequately screened group, higher confidence in the HPV test (RRr = 1.23; CI: 1.02; 1.49) and higher social norms (RRr = 1.11; CI: 1.01; 1.22) were associated with a higher probability of intending to use self-sampling (Table 3).

c) Sociodemographic, structural, health behaviour and risk factors

In both groups, for each 1-year increase in age, the probability of using self-sampling decreased (RRr = 0.98; CI: 0.97; 0.99). Reporting a history of STI was associated with increased intentions to self-collect samples (Adequately screened: RRr = 1.63; CI: 1.14; 2.31; Under-screened: RRr = 1.61; CI: 1.06; 2.46). Unemployment was associated with a higher probability of deciding against self-sampling (Adequately screened: RRr = 1.78; CI: 1.17; 2.71; Under-screened: RRr = 1.53; CI: 1.01; 2.33) (Table 3).

In the adequately screened, having received the HPV vaccine (RRr = 1.77; CI: 1.08; 2.91) was associated with a higher probability of deciding against using self-sampling. Current smoker status (RRr = 0.48; CI: 0.25; 0.91) was associated with higher self-sampling intentions, reflected by the lower probability of deciding against using self-sampling.

In the under-screened group, living in Canada for less than 10 years was associated with higher intentions for self-sampling (RRr = 1.91; CI: 1.08; 3.38), and declaring influence on health decisions by religious beliefs was associated with a higher probability of deciding against using self-sampling (RRr = 2.07; CI: 1.18; 3.62). Participants who never had sexual partners were less likely to intend to use self-sampling (RRr = 0.67; CI: 0.51; 0.88) (Table 3).

Discussion

Given the upcoming transition from cytology to HPV test-based primary cervical screening in Canada, we conducted a national survey and assessed the relationship between psychosocial factors and the intentions of screening-eligible individuals—both those with adequate and inadequate screening histories—to use the new cervical screening test.

We found that higher HPV testing knowledge was associated with a higher probability of refusing to participate in self-sampling in participants with adequate or inadequate screening history. This unexpected result could be explained by item-level analyses of the HPV testing knowledge scale which revealed that independent of their screening status, only about 25% of participants correctly distinguished the implications of testing positive for HPV from receiving an abnormal cytology result and that only approximately 20% knew that HPV testing can be performed on self-collected samples.[38] Moreover, item-level analyses of the *Concerns* subscale of the Self-sampling attitudes and beliefs scale revealed that among 4 items, the agreement was highest with the statement "If I did self-sampling, I would worry that I am not doing it right.[38] Consequently, women need information about the health implications of testing positive in the HPV test,[13,38] and clear instructions on how to use self-sampling devices to improve their confidence in self-collecting a cervicovaginal sample because, as shown here and in previous studies,[10,11,39–41] higher concerns (e.g., of not doing it right, risk of harm or infection) were associated with lower self-sampling intentions.

Experiencing autonomy in cervical screening (e.g., being more comfortable, being in control of one's body), was associated with higher intentions to use self-sampling in both adequately and under-screened women. To meet their higher autonomy needs, new HPV test-based screening programs in Canada for under-screened women could include an opt-out strategy (i.e., mailing self-sampling kits to all without an invitation),[11,38,39] or offer self-sampling as an alternative to clinician sampling to all women with an adequate screening history.[17–20,42] Two Canadian provinces, Manitoba and British Columbia, have piloted HPV self-sampling programs. As part of Manitoba's pilot study, mailing self-sampling kits to all previously unscreened women resulted in significantly higher screening participation compared to invitation letters only.[43] British Columbia tested several distribution methods, including direct mail and online ordering.[44] In early 2024, the BC government announced that women would have the choice to order self-sampling kits or opt for HPV test-based clinician-collected samples.[45] Considering the results presented here, future pilot programs that evaluate self-sampling strategies (i.e., opt-in or opt-out) in Canada should incorporate educational campaigns to address women's limited knowledge about self-sampling and their concerns about the self-collecting procedure.[38]

Our study shows that personal barriers (e.g., pain and embarrassment related to clinician-collected cervical samples) can deter adequately or under-screened women from participating in HPV test-based primary cervical screening. This result aligns with the broader literature, highlighting the importance of offering self-sampling to under-screened individuals to overcome these barriers and increase their participation.[38,41] In all women, the prospect of testing positive for a sexually transmitted infection could deter them from participating in HPV-based screening, especially if they feel unequipped to communicate the result to their partner, are worried about the impact on the relationship, or have insufficient HPV-related knowledge.[13,46,47]

Confidence in HPV-based screening was associated with higher intentions to receive it. A recent report found higher preferences of Canadian women for co-testing compared to cytology alone suggesting that women may wish to 'hedge their bets', which suggests that women need to be more clearly informed about the important specific benefits of transitioning from cytology to HPV testing in primary cervical screening.[48] Moreover, improving women's confidence in healthcare professionals and public health agencies' cervical

screening recommendations[38,46]–which also addresses their clear need for autonomy in making these decisions–could also alleviate worries related to postponing screening initiation to 25 years of age or more and increasing screening intervals to 5 years or more, while also preventing over-screening.[48–50]

Consistent with Lesack et al. (2022), who surveyed women adequately screened at the conclusion of the HPV FOCAL cervical screening trial in British Columbia,[51] our study's multivariable analyses found no association between income and intentions for self-sampling. However, our results contradict their findings, in that age was negatively associated and education was not associated with intentions to use self-sampling.[51] These incongruencies might be explained by a broader set of attitudes and knowledge items (and the use of validated scales) that we were able to control for in our multivariable analyses.

In the under-screened group, recent immigration history (<10 years) was associated with higher intentions for self-sampling while individuals reporting being influenced by religious or spiritual beliefs in their health decisions were more likely to refuse the HPV test or participate in self-sampling. These complex sociocultural factors suggest that culturally sensitive and tailored messaging regarding self-sampling strategies could increase cervical screening uptake in these historically under-screened groups.

Overall, our results suggest that attitudinal factors are more consistent correlates across groups (e.g., beliefs, barriers) than socio-demographics or knowledge. While marginalized individuals are less likely to screen, our results suggest that whilst general population-based, public health messaging will likely inform most Canadian women positively, emphasizing key targeted attitudinal messages regarding confidence and autonomy to under-screened women (using the influence of community and spiritual leaders, for example) would likely offer the greatest impact.

Limitations

Several limitations should be taken into consideration when interpreting our study. At the time of data collection, HPV testing was not implemented in primary cervical screening in Canada,[3] therefore, participants indicating they had received HPV testing, had received it as part of the triage/reflex testing after an abnormal cytology result, not as a primary screening test. Collapsing intenders with those who were tested was necessary to ensure the accuracy of multivariable analyses and could have biased our interpretations, but the effect is likely minimal because few participants were tested.

Individuals without internet access were excluded from participating but the digital divide is unlikely to have introduced significant biases as in 2022, 95% of adult Canadians had access to internet and more than 70% owned a smartphone.[52] In addition, we acknowledge that recruiting participants from Dynata's opt-in panel could have introduced a selection bias because of differences in interests or motivations in participating in surveys compared to non-panelists. Participants' self-reporting of the time from last Pap test could have introduced recall and misclassification biases. However, to date, not all Canadian jurisdictions have cervical screening registries and conducting a national survey using registry data linkage would not have been feasible. The study aimed to evaluate the psychosocial correlates of screening intentions in preparation for the rollout of the new HPV test-based screening programs. Behavioural models widely used in healthcare research such as the Theory of Planned Behaviour postulate that intention is the precursor of behaviours.[53] Post-implementation studies will be needed to elucidate what factors continue to influence HPV test-based screening uptake.

Conclusions

Transitioning from cytology to HPV-based primary cervical screening in Canada could encounter significant uptake barriers if communications with screening-eligible individuals fail to address low knowledge levels and negative attitudes and beliefs related to the new test. Studies from the UK and Australia conducted since the implementation of HPV test-based primary cervical screening programmes showed significant HPV and primary cervical screening knowledge gaps in women's understanding of the rationale behind starting screening at an increased age, longer screening intervals compared to cytology, and challenges in interpreting screening results.[25,26,54] Therefore, implementing widespread educational campaigns (print, media, etc; culturally and age-tailored) should be a priority.

Considering the crucial role of healthcare providers in cervical cancer prevention, training in simple direct messaging that could be delivered face-to-face would improve women's knowledge, reduce high perceived personal screening barriers, improve confidence in the HPV test and target individuals' screening autonomy needs.

Our study results support the use of self-sampling interventions to increase screening uptake in both adequately and under-screened individuals. We must draw from other countries experiences as each province or territory transitions from the familiar and decades-old cytology to the new HPV testing. Updated HPV test-based screening policies should be informed by the experience of 17 countries that have already introduced self-sampling, including and especially from Sweden and Australia, where screening eligible individuals have a choice between self-sampling or clinician sampling.[17]

Finally, to ensure a successful shift to HPV testing as the primary method for cervical cancer screening, the design and implementation of programs require a

collaborative approach between public health, healthcare professionals and screening-eligible individuals. Our study supports an inclusive approach and could facilitate the design of large-scale interventions to prepare all individuals with a cervix for this transition and ensure adequate uptake.

Contributors

All authors made substantial contributions to the study conception and design. OT completed formal analysis and wrote the original draft of the manuscript. BH and ZR accessed and verified the underlying data reported in this manuscript. All authors contributed to data interpretation and the critical review of the manuscript for important intellectual content. ZR supervised all stages of the project and was responsible for funding acquisition. All authors read and approved the final manuscript version.

Data sharing statement

The data sets used for this study will not be published in a publicly available repository in accordance with the ethics proposal approved by the overseeing research ethics board. They will be available from the senior author (ZR) upon reasonable request and upon agreement of confidentiality and data use policies provisioned by the primary institution.

Declaration of interests

OT received support from the Canadian Institutes of Health Research (CIHR) through the Frederick Banting and Charles Best Doctoral award (Award No. FBD-170837) outside the scope of the submitted work. OT also serves as a part-time Research Associate Research Associate at the Lady Davis Institute for Medical Research (Montreal, Canada). GKS is supported by the Edith Kirchmann Postdoctoral Fellowship at Princess Margaret Cancer Centre and holds a CIHR 2019 fellowship award (CIHR MFE 171271) unrelated to the submitted study. GZ has received grants, contracts and consulting fees from Merck, has participated on the Data Safety Monitoring Board or Advisory Board for Merck and Moderna, and is a member of the Board of Directors of Unity Consortium, a non-profit organization. JW reports consultancy payments from Hologic to her institution for attending a cervical cancer patient advocacy workshop and participating in a discussion panel. She also received support from Hologic for travel expenses to attend patient advocacy meetings. MS has received grants and lecture honoraria from Abbott, Roche Diagnostics, Laboratories Biron and Attila Diagnostic. MS is the President of the International Society for STD Research, Co-President of the STI&HIV 2025 World Congress, and a board member of the International Papillomavirus Society. MS also reports receiving equipment from the National Cancer Institute. ZR reports unpaid leadership involvement as Vice-President of HPV Global Action, in a non-governmental organization, outside of the submitted work. LS reports consulting fees from the Canadian Partnership Against Cancer (Non-profit organization) EM, JB, KD, PZ, AL, BH, GO, SP, and MHM declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lana.2024.100901.

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