

# Exploring Factors Associated with Preferences for Human Papillomavirus (HPV) Self-Sampling among Racially- and Ethnically-Diverse Women: A Cross-Sectional Study

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## Research Article

**Keywords:** Human papillomavirus (HPV), HPV self-sampling, cervical cancer screening, Anderson's Behavioral Model

**Posted Date:** June 17th, 2022

**DOI:** <https://doi.org/10.21203/rs.3.rs-1762475/v1>

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# Abstract

## BACKGROUND

Cervical cancer rates have declined since the implementation of cervical cancer screening methods such as Pap tests. However, Pap tests are still underutilized by many minority women due to limited awareness about human papillomavirus (HPV) and cervical cancer, difficulties accessing health care services, and cultural or religious beliefs. HPV self-sampling has been proposed as an alternative to overcome some of these barriers. The objective of this study was to assess awareness, self-efficacy, and preferences of HPV self-sampling among racially- and ethnically-diverse women.

## METHODS

From May – November 2021, women, ages 30–65 years old, were recruited in person and virtually to complete an online survey. The survey included 15 sociodemographic questions and five outcome measures related to HPV self-sampling: (1) awareness of test; (2) self-efficacy to conduct test; (3) location preference of test (clinic vs. home); (4) collector preference for screening strategy (self-collected vs. clinician-collected); and (5) preference of cervical cancer screening strategy (HPV self-sampling vs. Pap test). Modified Poisson regression was conducted to assess exploratory associations between sociodemographic variables and each outcome measure; relative risks were adjusted for age.

## RESULTS

A total of 420 women completed the online survey, of which 32.4% identified as Non-Hispanic white, 22.2% as Hispanic, 12.6% as Black/African-American, 28.3% as Asian, 1.9% as American Indian/Alaskan Native, and 1.4% as more than two races. The majority of women had not heard of HPV self-sampling (93.5%), but reported high self-efficacy (75.3%). Women also reported higher preferences for completing an HPV test in the clinic (52.2%) and for performing a self-collected HPV test themselves (58.7%), yet would choose a traditional Pap test over HPV self-sampling (56.0%).

## CONCLUSION

The low level of HPV self-sampling awareness, across all racial and ethnic groups, suggests a strong opportunity to promote widespread educational efforts around this new tool. While many women, including those that are racially- and ethnically-diverse, still prefer the Pap test, the biggest barrier to their potential uptake of HPV self-sampling is a strong reliance on provider expertise. Future research should leverage the provider role in HPV self-sampling interventions as well as explore the feasibility of home-based or clinic-based HPV self-sampling approaches.

## Introduction

Although preventable, cervical cancer continues to affect many women in the United States (US). According to the American Cancer Society (ACS), 0.63% of all women in the US will develop cervical cancer in their lifetime.[1] The burden of this cancer, however, is not shared equally among all races and ethnicities.[2, 3] In 2017, the age-adjusted incidence rate of cervical cancer for all US women was 7.5 cases per 100,000 women per year. In Black/African-

American and Hispanic/Latina women, the incidence of cervical cancer was 8.4 cases per 100,000 women and 8.9 cases per 100,000 women, respectively.[4] Current cancer surveillance studies and analyses continue to point to these stark and persistent disparities in cervical cancer incidence among minority groups.[5, 6]

Multiple barriers contribute to this increased cancer burden in racially and ethnically diverse groups. These barriers commonly include interpersonal factors such as education, socioeconomic status (SES), low cancer knowledge, religious and cultural beliefs (e.g. medical mistrust, fatalistic view of cancer), limited English proficiency, and structural impediments such as lack of health insurance and transportation.[7–10] Of chief importance is the fact that most of the disparity in cancer incidence rates among minority groups are related to education and SES.[11–14] Despite this, many, if not all of these barriers and concerns are modifiable, suggesting that they can be addressed through multilevel evidence-based cancer prevention interventions.[15–17]

Evidence-based cancer prevention interventions, such as Pap tests, have been shown to be effective in curbing cervical cancer incidence and mortality.[18, 19] However, they are still underutilized by many racially- and ethnically-diverse women.[7–10] In Somali women, for example, cervical cancer screening rates are as low as 52% at urban primary care clinics in Minnesota.[20] The continued existence of cervical cancer and the disparities noted in its incidence suggest that evidenced-based interventions, such as Pap tests, have not been wholly successful. Novel interventions that maximize the prevention of cervical cancer, therefore, are critical to eradicate this disease.

Primary human papillomavirus (HPV) testing is a newer method recommended by the US Preventive Services Task Force as an alternative to Pap test screening. Currently, the United States Preventive Services Task Force (USPSTF) recommends three cervical cancer screening options for women ages 30–65: 1) a Pap test every 3 years or 2) a high-risk human papillomavirus (hrHPV) test every 5 years or 3) a hrHPV testing in combination with Pap test (co-testing) every 5 years.[21] Importantly, the recommendation for hrHPV testing (primary HPV testing) was only approved in 2018. As with the introduction of any new innovation or tool[22], the diffusion of primary HPV testing has been slow within health systems.[23] To increase its uptake, HPV self-sampling has emerged as a promising tool for facilitating patient-initiated primary HPV testing.

HPV self-sampling, the process of collecting a vaginal sample by oneself for HPV testing, has been proposed as an appropriate and effective alternative to traditional Pap test screening.[24–27] Furthermore, it is being considered by the USPSTF as a potentially evidence-based modality for facilitating primary HPV testing under the 2021 draft research plan for cervical cancer screening.[28] When compared to Pap tests, HPV testing with self-collected vaginal samples has shown to have higher sensitivity in detecting high grade cervical disease.[27, 29] Additionally, data for self-collected HPV specimens have shown good concordance with clinician-sampling methods.[30–32] Multiple large randomized controlled trials (RCTs) have also demonstrated that HPV self-sampling can improve cervical cancer screening rates among women who may delay or opt out of cervical cancer screening.[33–36] In countries with organized cervical cancer screening programs (e.g., Chile, Denmark, Netherlands), HPV self-sampling has already been adopted as an adjunct strategy for increasing primary cervical cancer screening.[37–39] In studies examining acceptability and preference, many women report a high acceptability of self-collected HPV tests, and in some cases, women indicated a higher preference for self-collected HPV tests than provider-collected procedures.[40–42] Cost-effectiveness analyses have also found that self-collected HPV testing had a lower lifetime cost and a higher quality-adjusted life expectancy than Pap test screening. [43–45] Taken together, these findings suggest that HPV self-sampling is an effective and cost-saving strategy to increase cervical cancer screening among women who may not readily access Pap test-based screening? in health care systems.

Most research in this area, however, has focused on the home-based, mail-in self-sampling approach[45–47], and there is an untapped opportunity to utilize HPV self-sampling in health care systems within primary care settings. Clinic-based HPV self-sampling, wherein women can conduct the self-collection in real-time within a primary care exam room, can mitigate some of the mail-based challenges (e.g., missing samples, lack of follow-up) and offer opportunities for patient to develop self-efficacy to conduct the self-collection (e.g., visual tutorials provided by clinic staff).[48] Only one pilot study (i.e., ROSE 1.0 pilot project) has implemented clinic-based HPV self-sampling and found that this approach significantly increased follow-up in HPV positive-tested women.[49] These optimistic findings warrant additional research on clinic-based HPV self-sampling.

Currently, few US-based studies have explored the various adaptations of an HPV self-sampling intervention; it remains to be explored whether clinic-based HPV self-sampling is preferable for underscreened women to initiate cervical cancer screening than home-based HPV self-sampling alone. To begin building an evidence base for clinic-based approaches, this cross-sectional study aimed to gather perspectives from racially- and ethnically-diverse women regarding their delivery preferences (clinic-based vs. home-based) for HPV self-sampling. This study also assessed women’s awareness, self-efficacy, and additional preferences of HPV self-sampling (clinician-collected vs. self-collected, Pap test vs. HPV self-sampling) and potential factors associated with these outcomes.

## **Methods**

### **Study sample and recruitment**

From May to November 2021, women representing diverse groups were recruited to complete an online survey through community-based organizations via online newsletters, e-mail listservs, social media postings, and in-person events. Community-based organizational partners ranged from cultural non-profits to faith-based organizations. Interested women had to complete an online eligibility screener prior to enrolling in the study. To be eligible for study enrollment, all women had to meet the following eligibility criteria: (1) no prior hysterectomy; 2) no prior history of invasive cervical cancer; and 3) be within the USPSTF cervical cancer screening age range for high-risk HPV testing (30–65 years old). Only study participants, who were recruited through in-person community events (e.g., health fairs, church masses), were compensated with a \$5 gift card. All study protocols and materials were approved by the University of Minnesota’s IRB (STUDY00011906).

### **Data collection and procedures**

The online survey was administered through Qualtrics, a largely self-service, secure, web-based application for building and managing data collection forms.[50] The survey was available in English, Hmong, Spanish, and Somali languages, and was pilot tested with seven bicultural female community members (two Hmong, two Spanish, two Somali, and one American-Indian) prior to data collection.

## **Measures**

### **Theory and factors examined**

Key issues and barriers experienced by minority women’s participation in cervical cancer screening informed the factors that were included in the survey.[7–10] Drawing from Andersen’s Behavioral Model of Health Services Use, these potential determinants of HPV self-sampling outcomes were categorized into three distinct categories – predisposing, enabling, and need. Andersen’s Behavioral Model of Health Services Use is a theoretical framework that has been widely used by health researchers to explain why individuals take up certain health care services.[50,

51] According to Andersen, predisposing factors refer to the sociocultural characteristics of an individual that exist prior to their illness, for example, an individual's age and gender. Enabling factors are defined as conditions that facilitate an individual to use health services, for example, having health insurance. Finally, need factors refer to the conditions that elicit an individual's need to use a health service, for example, a recently

Five predisposing factors were included in the survey: age (in years), race/ethnicity (Non-Hispanic white, Hispanic, Black/African-American, Asian, American Indian/Alaskan Native, Multirace), sexual orientation (straight, queer), marital status (single, married/partnered), and nativity (foreign-born, US-born). Meanwhile, annual household income (<\$34,999, \$35,000 – \$89,999, ≥ \$90,000), health insurance (no, yes), educational level (less than a high school degree, high school degree or equivalent, Bachelor's degree or higher), English language capability (limited, advanced), HPV awareness (no, yes), and knowledge of cervical cancer were included as enabling factors. Knowledge of cervical cancer was assessed with a seven-item HPV literacy index adapted from the Knowledge and Perceptions Survey (KAPS)[52] and validated with several racially- and ethnically-diverse female populations.[53–55] A total knowledge score was calculated for each respondent by summing up all of their correct responses (one point each per correct answer, with a maximum total score of seven points). For the analysis, the knowledge score was further dichotomized by the mean into low and high. Need factors included routine exam and Pap test in past year (no, yes), previous Pap test experiences (pleasant, neutral, unpleasant), and perceived health status (fair/good, very good/excellent). Most measures were adapted from the 2019 Health Information National Trends Survey 5 Cycle 3 (HINTS 5, Cycle 3)[56] and the 2019 Behavioral Risk Factor Surveillance Survey (BRFSS).[57]

## Outcome measures

Five outcomes were collected in the survey: (1) awareness of HPV self-sampling; (2) self-efficacy to complete an HPV self-sampling test; (3) location preference for HPV self-sampling collection; (4) collector preference for HPV testing; and (5) preference of cervical cancer screening strategy. Awareness was assessed with the following question, "Have you ever heard of self-collected HPV testing?" with three response options (yes, no, and unsure). Self-efficacy was measured with the following question, "How confident are you that you could successfully collect a vaginal sample for an HPV test on your own?" with four response options ranging from "Very confident" to "Not at all confident." Both location and collector preferences were assessed with the following item, "If your clinic offered you a self-collected HPV test, which option below would you choose?" with the following response options: (1) Receive the test by mail and complete the test by myself at home. (2) Pick up the test at the clinic and complete the test by myself at home. (3) Receive and complete the test by myself at my clinic. (4) Have my doctor or nurse complete the test on me when I am at the clinic. Preference of cervical cancer screening strategy was measured with the following question, "Now that you know more about self-collected HPV testing, what would be your preference for cervical cancer screening?" with two response options: (1) A Pap test; or (2) Do self-collected HPV testing on your own. Respondents were also asked to rank-choice their reasons for selecting or not selecting HPV self-sampling as their preferred cervical cancer screening strategy. Reasons included privacy, convenience, transportation/healthcare access, embarrassment, pain, spousal influence, and free-write options.

## Data analysis

Descriptive frequencies were calculated for all variables including outcomes. All outcome measures were operationalized as binary variables. Bivariate and adjusted analyses using modified Poisson regression were conducted to assess exploratory associations between all potential factors associated with each outcome. Based on previous HPV self-sampling studies that have determined age as a confounder[58, 59] and due to the exploratory nature of the study, all associations between potential factors related to each outcome were adjusted only for age in

the multivariable models. Relative risks (RR) and 95% CIs were reported for all analyses, and a significance level of 0.05 was set *a priori* for all statistical tests. Subgroup analyses were also conducted to test if significant correlations differed by three racial/ethnic groups (Non-Hispanic white, Hispanic, Asian). These interactions were tested using the Likelihood Ratio chi-square test. All analyses were conducted in Stata version 17.[60]

## Results

### Description of sample

Four hundred twenty women (n = 420) completed the online survey (Table 1). Approximately 32.4% identified as Non-Hispanic white, 22.2% as Hispanic, 12.6% as Black/African-American, 28.3% as Asian, 1.9% as American Indian/Alaskan Native, and 1.4% as more than two races (multirace). Respondents had a mean age of 41.6 years (SD:  $\pm 10$ ) and were predominantly straight (81.4%), married/partnered (69.3%), US-born (63.5%), had an annual household income of  $\geq$  \$90,000 (41.2%), were insured (88.8%), had a Bachelor's degree or higher (69.3%), had advanced English language capability (90.5%), were aware of HPV (85.3%), had high knowledge of cervical cancer (59.8%), had a routine exam in the past year (60.7%), had not completed a Pap test within the past year (63.3%), reported neutral previous Pap test experiences (50.7%), and had very good/excellent perceived health status (71.9%).

Table 1  
Study participant characteristics and outcomes of data in a multi-ethnic  
sample in Minnesota (n = 420), 2021

<i>n</i> (%)		
Predisposing Factors (5)		
Age (years): mean $\pm$ SD	41.6 $\pm$ 10.0	
Age (years): group		
30–39	190	(45.2)
40–49	102	(24.3)
50–59	53	(12.6)
60+	29	(6.9)
Missing	46	(11.0)
Race/ethnicity		
Non-Hispanic White	136	(32.4)
Hispanic	93	(22.2)
Black/African-American	53	(12.6)
Asian	119	(28.3)
American Indian/Alaskan Native	8	(1.9)
Multirace	6	(1.4)
Missing	5	(1.2)
Sexual orientation		
Straight	342	(81.4)
Queer	70	(16.7)
Missing	8	(1.9)
Marital status		
Single	124	(29.5)
Married/partnered	291	(69.3)
Missing	5	(1.2)
Nativity		
Foreign-born	149	(35.5)
US-born	267	(63.5)
Missing	4	(1.0)
Enabling Factors (6)		

<i>n</i> (%)		
Annual household income		
< \$34,999	79	(18.8)
\$35,000 - \$89,999	156	(37.1)
≥ \$90,000	173	(41.2)
Missing	12	(2.9)
Health insurance		
No	35	(8.3)
Yes	373	(88.8)
Missing	12	(2.9)
Educational level		
Less than a high school degree	33	(7.9)
High school degree or equivalent	90	(21.4)
Bachelor's degree or higher	291	(69.3)
Missing	6	(1.4)
English language capability		
Limited	37	(8.8)
Advanced	380	(90.5)
Missing	3	(0.7)
HPV awareness		
No	56	(13.3)
Yes	358	(85.3)
Missing	6	(1.4)
Knowledge of cervical cancer (0–7): mean ± SD		
	3.67 ± 1.91	
Knowledge of cervical cancer (dichotomized at the mean)		
Low	158	(37.6)
High	251	(59.8)
Missing	11	(2.6)
Need Factors (4)		
Routine exam in past year		
Yes	255	(60.7)
No	162	(38.6)

<i>n</i> (%)		
Missing	3	(0.7)
Pap test in past year		
Yes	151	(36.0)
No	266	(63.3)
Missing	3	(0.7)
Previous Pap test experience		
Pleasant	54	(12.9)
Neutral	213	(50.7)
Unpleasant	139	(33.1)
Missing	14	(3.3)
Perceived health status		
Fair/good	113	(26.9)
Very good/excellent	302	(71.9)
Missing	5	(1.2)
Outcomes (5)		
HPV self-sampling awareness		
No	386	(91.9)
Yes	27	(6.4)
Missing	7	(1.7)
Self-efficacy		
Low	102	(24.3)
High	311	(74.0)
Missing	7	(1.7)
Location preference		
Clinic	215	(51.2)
Home	197	(46.9)
Missing	8	(1.9)
Collector preference		
Clinician-collected	170	(40.5)
Self-collected	242	(57.6)
Missing	8	(1.9)

<i>n</i> (%)		
Preferred cervical cancer screening strategy		
Pap test	192	(45.7)
HPV self-sampling	151	(36.0)
Missing	77	(18.3)

## Outcomes and exploratory associations

The majority of women had not heard of HPV self-sampling ( $n = 386, 91.9\%$ ). Only one factor was statistically significantly associated with HPV self-sampling awareness after adjusting for age – with increasing annual household income, women were less likely to report awareness of HPV self-sampling (Table 2). In contrast to awareness, the majority of women reported high self-efficacy to complete an HPV self-sampling test ( $n = 311, 74.0\%$ ). Many of the predisposing, enabling, and need factors were statistically significantly associated with high self-efficacy in crude analyses. After adjusting for age, however, most of these associations were attenuated and no longer statistically significant, with two exceptions: high self-efficacy was less likely to be reported only among women who identified as Asian and women reporting previous neutral and/or negative experiences with Pap tests.

Table 2

Unadjusted and adjusted modified Poisson regressions to examine factors associated with Awareness vs. No Awareness of HPV Self-Sampling in a multi-ethnic sample (n = 420) in Minnesota, 2021

	No. with Outcome / Total (%)		HPV Self-Sampling Awareness			
			RR <sub>un</sub> <sup>a</sup>	(95% CI)	RR <sub>adj</sub> <sup>b</sup>	(95% CI)
Predisposing Factors						
Age (years)						
30–39	11/190	(5.8)	1.00	ref		
40–49	9/100	(9.0)	1.62	(0.66, 3.96)		
50–59	1/53	(1.9)	0.87	(0.01, 2.52)		
60+	2/29	(6.9)	1.42	(0.60, 1.04)		
Race/ethnicity						
Non-Hispanic White	8/136	(5.9)	1.00	ref	1.00	ref
Hispanic	7/90	(7.8)	1.36	(0.49, 3.76)	0.65	(0.10, 4.09)
Black/African-American	4/52	(7.7)	1.40	(0.43, 4.61)	1.09	(0.19, 6.14)
Asian	6/119	(5.0)	0.87	(0.30, 2.48)	1.17	(0.22, 5.25)
American Indian/Alaska Native	1/8	(12.5)	3.02	(0.46, 19.92)	5.67	(0.26, 148.10)
Multirace	1/6	(16.6)	1.16	(0.06, 22.42)	1.65	(0.06, 41.88)
Sexual orientation						
Straight	21/338	(6.2)	1.00	ref	1.00	ref
Queer	5/70	(7.1)	1.16	(0.42, 3.20)	1.13	(0.30, 4.19)
Marital status						
Single	10/123	(8.1)	1.00	ref	1.00	ref
Married/partnered	17/288	(5.9)	0.71	(0.31, 1.60)	1.06	(0.33, 3.41)
Nativity						
Foreign-born	12/146	(8.2)	1.00	ref	1.00	ref
US-born	15/266	(5.6)	0.67	(0.30, 1.47)	0.71	(0.19, 2.63)
Enabling Factors						

	No. with Outcome / Total (%)		HPV Self-Sampling Awareness			
			RR <sub>un</sub> <sup>a</sup>	(95% CI)	RR <sub>adj</sub> <sup>b</sup>	(95% CI)
Annual household income						
< \$34,999	10/79	(12.7)	1.00	ref	1.00	ref
\$35,000 - \$89,999	10/156	(6.4)	0.47	(0.19, 1.19)	0.24	(0.06, 0.93)
≥ \$90,000	7/170	(4.1)	0.30	(0.11, 0.81)	0.16	(0.03, 0.87)
Health Insurance						
No	2/35	(5.7)	1.00	ref	1.00	ref
Yes	24/369	(6.5)	1.15	(0.26, 5.08)	6.10	(0.40, 92.17)
Educational level						
Less than a high school degree	4/33	(12.1)	1.00	ref	1.00	ref
High school degree or equivalent	7/90	(7.8)	0.61	(0.17, 2.25)	1.08	(0.17, 6.84)
Bachelor's degree or higher	16/287	(5.6)	0.43	(0.13, 1.37)	0.50	(0.07, 3.73)
English language capability						
Limited	5/37	(13.5)	1.00	ref	1.00	ref
Advanced	22/376	(5.9)	0.40	(0.14, 1.12)	0.48	(0.04, 5.25)
HPV awareness						
No	1/56	(1.8)	1.00	ref	1.00	ref
Yes	26/357	(7.3)	4.32	(0.57, 32.57)	9.38	(0.45, 194.84)
Knowledge of cervical cancer						
Low	7/158	(4.4)	1.00	ref	1.00	ref
High	19/250	(7.6)	1.77	(0.73, 4.33)	2.72	(0.71, 10.48)
Need Factors						
Routine exam in past year						
Yes	14/253	(5.5)	1.00	ref	1.00	ref
No	13/160	(8.1)	1.51	(0.69, 3.30)	1.03	(0.35, 3.02)

	No. with Outcome / Total (%)		HPV Self-Sampling Awareness			
			RR <sub>un</sub> . <sup>a</sup>	(95% CI)	RR <sub>adj</sub> . <sup>b</sup>	(95% CI)
Pap test in past year						
Yes	8/150	(5.3)	1.00	ref	1.00	ref
No	19/263	(7.2)	1.38	(0.59, 3.24)	1.36	(0.42, 4.41)
Previous Pap test experience						
Pleasant	5/54	(9.3)	1.00	ref	1.00	ref
Neutral	14/210	(6.7)	0.70	(0.24, 2.04)	0.58	(0.16, 2.13)
Unpleasant	7/138	(5.1)	0.52	(0.16, 1.73)	0.77	(0.19, 3.22)
Perceived health status						
Fair/Good	8/112	(7.1)	1.00	ref	1.00	ref
Very Good/Excellent	19/299	(6.4)	0.88	(0.37, 2.08)	0.74	(0.24 2.30)
Note: RR = Relative Risk, CI = confidence interval						
<sup>a</sup> crude RR from bivariate analyses						
<sup>b</sup> RR adjusted for age						

In location preference for completing an HPV test, less than half of survey respondents preferred a home-based approach compared to a clinic-based approach (n = 197, 47.8%). As was found for self-efficacy, age confounded most of the crude associations. The two associations that remained statistically significant after adjusting for age were among women who identified as Black/African-American, who were less likely to prefer the home-based approach, and among women reporting previous negative experiences with Pap tests, who were more likely to prefer the home-based location.

Regarding collector preference, more than half of the respondents preferred a self-collected approach compared to a clinician-collected approach (n = 242, 57.6%). Although several factors were associated with this outcome in the crude analyses, no correlations remained statistically significantly after adjusting for age. In terms of the preferred cervical cancer screening strategy, more than one-third of survey respondents preferred HPV self-sampling over a traditional Pap test (n = 151, 36.0%). Similar to the collector preference, however, no statistically significant associations remained after adjusting for age. No meaningful differences were identified between all factors and outcomes when stratified by three racial/ethnic groups, Non-Hispanic whites, Hispanics, and Asians.

In addition to age being examined as a confounder, it was also examined for its relationship to each outcome. Age was not strongly associated with awareness of HPV self-sampling, high self-efficacy, or preference for testing at home versus the clinic. However, compared to younger women, older women were less likely to prefer the self-

collected approach over the clinician-collected approach and less likely to prefer HPV self-sampling over Pap tests. Further, in the preferred cervical cancer screening strategy, the age trend was statistically significant ( $p < 0.05$ ) – with increasing age, older women were less likely to prefer HPV self-sampling. Nevertheless, as previously noted, in all adjusted analyses the associations between age and each outcome moved closer to the null and in many instances, were no longer statistically significant.

Among women who selected HPV self-sampling as their preferred cervical cancer screening strategy, the top three reasons for their decision were due to privacy, convenience, and perceived less pain (Table 3). Other reasons included less embarrassment, not needing transportation/health care access, and ease of use. In contrast, the top three reasons for women not choosing HPV self-sampling included strong reliance on provider expertise, lack of self-efficacy, and perceived lack of concordance between self-collected samples and clinician-collected samples. Additional reasons included spousal influence, less convenience, and less perceived accuracy of HPV self-sampling tests. Reasons for selecting HPV self-sampling slightly differed for Non-Hispanic white women, with less pain being their top choice rather than privacy. Meanwhile, reasons for not selecting HPV self-sampling did not differ between racial/ethnic groups.

Table 3

Comparison of top three reasons for selecting and not selecting HPV self-sampling by percent reporting within a multi-ethnic sample (n = 355) in Minnesota, 2021

	<b>Overall (n = 186)</b>	<b>Non-Hispanic White (n = 76)</b>	<b>Hispanic (n = 35)</b>	<b>Asian (n = 54)</b>
<b>Reasons for Selecting</b>				
Privacy	First (38.2%)	Second (25.0%)	First (45.7%)	First (53.7%)
Convenience	Second (18.8%)	Third (19.7)	Third (17.1)	Second (16.7%)
Transportation/health care access		Second (25.0%)		Third (11.1%)
Embarrassment				Third (11.1%)
Pain	Third (17.7%)	First (26.3%)	Second (20.0%)	
	<b>Overall (n = 169)</b>	<b>Non-Hispanic White (n = 45)</b>	<b>Hispanic (n = 47)</b>	<b>Asian (n = 51)</b>
<b>Reasons for Not Selecting</b>				
Provider expertise	First (46.8%)	First (35.6%)	First (44.7%)	First (51.0%)
Lack of self-efficacy	Second (27.2%)	Second (28.9%)	Second (27.7%)	Second (27.4%)
Concordance	Third (17.8%)	Second (28.9%)	Third (17.0%)	Third (11.7%)
Other (e.g., less convenient, less accurate)		Third (6.7%)		

## Discussion

HPV-based screening is important for curbing and preventing cervical cancer. The recent evidence-based guideline adoptions for primary HPV testing in 2018 by the USPSTF[21] and 2020 by the ACS[61] signal an important change in cervical cancer screening efforts. HPV self-sampling, in particular, may help to facilitate the uptake of primary HPV testing and cervical cancer screening adherence.[28] However, knowledge about cervical cancer and other sociodemographic factors (e.g., age, educational level) remain well-documented important drivers of screening uptake and adherence in minority women.[7, 62] This is the first cross-sectional study to explore a sample of racially and ethnically-diverse women's awareness, self-efficacy, and preferences of HPV self-sampling and potential correlates of those outcomes.

Across all outcomes, this study found no factors that were consistently correlated with awareness, self-efficacy, and preferences for HPV self-sampling. One key finding is that few women, including those that are racially- and ethnically-diverse, had heard of HPV self-sampling. These results indicate that the dissemination of HPV self-sampling within US contexts is still in its infancy, and further, may not be reaching all women, regardless of race/ethnicity. However, the low level of awareness is consistent with previous US-based research where HPV self-sampling interventions are only beginning to be introduced.[63, 64] Additionally, the majority of research development and assessments of HPV self-sampling interventions have occurred in international contexts (e.g., Mexico, Netherlands) and the implementation traction of this modality has been slow in the US, with only one large pragmatic trial conducted in Seattle, Washington (Kaiser Permanente).[65] The low level of HPV self-sampling awareness in this study, across all racial and ethnic groups, suggests a strong opportunity to promote widespread educational efforts around this new tool within US contexts.

Despite not having heard of HPV self-sampling, many women reported a high self-efficacy to complete an HPV self-sampling test. The strongest negative correlates of high self-efficacy were neutral and unpleasant experiences with previous Pap tests. These findings may suggest that women, who have had neutral or unfavorable pelvic exams in the past for Pap test screening, may be less likely to feel confident in conducting their own tests. Several studies examining self-efficacy in HPV self-sampling interventions have found that women with previous negative screening experiences were more likely to report pain and be averse to initiating self-sampling.[66, 67] In the present study, Asian women were also found to be less likely to report high self-efficacy. This finding is consistent with many studies that have examined the feasibility of HPV self-sampling within Asian women.[68–70] Compared to Non-Hispanic white women, Asian women have been found to be less experienced with tampon use and less confident with inserting a foreign object like a brush into the vagina, such as in the case of HPV self-sampling test kits. Additional theory-based HPV self-sampling interventions are needed to further elucidate predictors of high self-efficacy and further explore whether these predictors differ across racial/ethnic groups.

With regard to the location of where women would like to have their HPV tests conducted, this study found that many may potentially prefer the clinic-based approach. Within the clinic-based approach, women can either conduct their own self-collection or have a clinician perform the collection onsite at the clinic (i.e., point of care). Only one pilot study has implemented clinic-based HPV self-sampling and conferred positive results supporting an increase uptake in cervical cancer screening and adherence to follow-up of abnormal results.[49] Support for the clinic-based approach has also been documented in several pre-implementation studies and protocols of HPV self-sampling interventions.[71, 72] Advantages to the clinic location include having providers be present in the exam rooms to address questions from patients in real-time, allowing patients to examine the brush and testing kit first-hand, providing a sanitary and private location for self-collection, and mitigating challenges around the return of missing

or lost samples with the mail-based approach. Future research efforts should explore the feasibility, efficacy and effectiveness of various delivery approaches, including point-of-care, for HPV self-sampling.

This study also found that many women prefer to self-collect for HPV testing. While no significant correlates were identified, the biggest barriers to all women taking up HPV self-testing was the strong reliance on provider expertise and the perceived concordance and reliability of the test. These two barriers have been extensively researched and written about in prior studies, and will continue to act as a potential barrier to HPV self-sampling uptake for all women.[24, 34] However, many HPV self-sampling interventions with laboratory validation studies have shown and demonstrated that self-collected samples are equally concordant with clinician-collected samples.[31, 73] Future implementation studies on HPV self-sampling should focus on strategies to mitigate these concerns around collection concordance and promote women's self-efficacy to collect their own cervicovaginal samples.

This study, moreover, found that women were less likely to prefer HPV self-sampling over traditional Pap tests. Older women, in particular, were less likely to choose the self-sampling approach as their preferred cervical cancer screening strategy. This finding corroborates many existing studies that have found that self-driven healthcare technologies are generally harder and/or perceived to be less acceptable for older women than younger women.[74, 75] Although no significant correlates were identified across all women and racial/ethnic groups, the primary reason why the Pap test was the preferred cervical cancer strategy was because of the strong reliance on providers. The strong trust that exists between women and their healthcare providers have consistently been reported in many cancer screening interventions, including HPV self-sampling, as an important facilitator for cervical cancer screening uptake.[40, 76–78] Future HPV self-sampling research efforts should examine educational interventions targeted at healthcare providers to educate and encourage patients on the importance of self-collection options.

Given the pre-implementation context of this study – the limited awareness of HPV self-sampling and the perceptions of potentially conducting an HPV self-sampling test across various settings – it is unclear if the link between these women's perceived self-efficacy and preferences to perform an HPV test will be consistent with their actual experiences. Pragmatic HPV self-sampling interventions need to be more widely implemented and tested so that all women not only become aware of this new modality but also experience the self-collection and its respective location options, before further scale-out and adaptations of an HPV self-sampling practice can be instituted in US contexts. Until greater population uptake of HPV self-sampling has occurred in the United States, it remains unknown the extent to which this method may be preferable to Pap tests for reducing cervical cancer disparities among minority women.

## **Strengths and limitations**

The strengths of the study included a racially- and ethnically-diverse sample and research that was grounded in Anderson's Behavioral Model of Health Services Use. Some limitations, however, should be noted. First, the non-random and convenience sampling of survey respondents may have introduced selection bias in the recruitment process. Participants who took part in the survey may have been more willing to explore alternative cervical cancer screening modalities than those who chose not to participate; as a result, these findings may not generalize to the larger female population. Secondly, this study did not have sufficient sample sizes to determine if any meaningful differences exist across racial/ethnic groups. In addition, the large amount of missing data for the preferred cervical cancer strategy outcome may be a result of a survey design flaw. This particular survey item asked participants to select one of two images related to HPV self-sampling or Pap test as response options; the pictorial responses may have confused participants who are frequently used to seeing response options in text

form. The prevalence of preferred cervical cancer strategies, therefore, may be underreported. Finally, the online survey was fielded during the coronavirus of 2019 (COVID-19) pandemic, when home-based self-testing interventions were proliferating. This effect might have influenced potential interest and uptake of self-testing interventions, including HPV self-sampling, which may have introduced another form of selection bias.

## **Conclusion**

The limited awareness of HPV self-sampling across all racial and ethnic groups suggest a strong opportunity to promote widespread educational efforts around this new tool. Until more women have experience with this procedure, the factors associated with their uptake of HPV self-sampling remain to be identified. While many women in this study, including those that are racially- and ethnically-diverse, still preferred the Pap test, the biggest barrier to their potential uptake of HPV self-sampling was a strong reliance on provider expertise. Future research should leverage the provider role in HPV self-sampling interventions as well as explore the feasibility of home-based or clinic-based HPV self-sampling approaches.

## **Abbreviations**

ACS: American Cancer Society; BRFSS: Behavioral Risk Factor Surveillance Survey; COVID-19: Coronavirus Disease 2019; HINTS: Health Information National Trends Survey; hrHPV: High-risk Human Papillomavirus; HPV: Human Papillomavirus; IRB: Institutional Review Board; KAPS: Knowledge and Perceptions Survey; USPSTF: United States Preventive Services Task Force

## **Declarations**

### **Ethics approval and consent to participate**

All procedures performed in the study were in accordance with the ethical standards of the University of Minnesota Institutional Review Board on Social and Behavioral Research. Informed consents were obtained from all participants included in the study.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

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

### **Competing interests**

All authors have indicated they have no potential conflicts of interest to disclose.

### **Funding**

Effort for the first author (SX) was supported by the National Institutes of Health's National Center for Advancing Translational Sciences grant TL1R002493. The content is solely the responsibility of the author and does not

necessarily represent the official views of the National Institutes of Health's National Center for Advancing Translational Sciences.

## Authors' contributions

SX conceived of the idea for the study and oversaw the research. SX, RG, SK, DL, SM, and RP constructed and refined the study protocol. SX conducted, acquired, and managed the data. SX, DL, and RP were involved in the data collection and analysis. SX drafted, refined, and revised the manuscript, and is the guarantor of this paper. All authors, edited, read, and approved the final manuscript.

## Acknowledgements

The authors would like to thank Christopher Campbell, Pilar de la Parra, Faiza Hassan, Amna Hussein, Janis Johnson, Melissa Melgar, Sakhaudiin Mohamud, Vayong Moua, Christina Nelson, Juan Pablo Higuera, GayLynn Richards, Benita Robinson, Nongnut Thao, Kong Mieng Vang, Clemen Wilcox, and Mary Xiong for their contribution to this research project.

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