Preference for Human Papillomavirus Self-Collection and Papanicolaou: Survey of Underscreened Women in North Carolina

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Objectives: Self-collection of samples for human papillomavirus (HPV) testing (self-collection) has the potential to increase cervical cancer screening among underscreened women. We assessed attitudes toward at-home HPV self-collection compared with clinic-based Pap testing in this higher-risk population.

Materials and Methods: Participants were low-income women in North Carolina overdue for cervical cancer screening. Women self-collected samples at home, returned samples by mail for HPV testing, and completed phone questionnaires about at-home HPV self-collection. Participants were referred to clinic-based Pap testing and invited to complete a second questionnaire about Pap testing. A cross-sectional questionnaire compared attitudes, experiences, and preferences for self-collection versus Pap testing and assessed predictors of preference for HPV self-collection.

Results: Half (51%) of 221 women reported a preference for HPV self-collection, 19% preferred Pap testing, and 27% reported no preference. More women reported difficulty finding time to do the Pap test (31%) than the self-test (13%, $p = .003$) and being afraid of the self-test results (50%) than the Pap test results (36%, $p = .02$). There were relatively fewer reports of physical discomfort and pain from self-collection than Pap testing (discomfort: 18% self; 48% Pap; pain: 8% self; 30% Pap, $p = .001$). No differences were found in positive versus negative thoughts about the tests, trust in the tests' safety and accuracy, or willingness to do tests again.

Conclusions: Overall positive attitudes toward HPV self-collection compared with Pap testing among underscreened women suggest that self-collection is a promising option to increase cervical cancer screening in this high-risk population.

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This study was supported by a grant from the Kate B. Reynolds Charitable Trust. Additional support for staff time came from the National Cancer Institute of the National Institutes of Health (Award Numbers U54 CA156735, U54CA156733, and NIH NCI R01 CA183891). K.A.K. was supported by an institutional NIH training grant (T32 HD040672-15). Hybrid-Capture-2 HPV testing reagents were donated by QIAGEN Corporation. Self-collection brushes were donated by Rovers Medical Devices B.V.

J.S.S. has received research grants and consultancies from Hologic, Becton Dickenson Corporation, and Trovagene for the past 5 years. A.D.M. has had some conference travel expenses covered by Hologic in the last 5 years.

Approved, UNC IRB# 08-2099.

DOI: 10.1097/LGT.0000000000000430

Key Words: cervical cancer screening, human papillomavirus, Pap test, self collection, United States

(*J Low Genit Tract Dis* 2018;22: 302–310)

In 2018, an estimated 13,240 women in the United States (US) will be diagnosed with invasive cervical cancer, and 4,170 women will die from this preventable disease.[1] In the US, more than half of invasive cases occur among women who are underscreened: never screened or overdue for screening by national guidelines.[2] Barriers to screening among US women include cost, poor access to healthcare facilities, and lack of knowledge about screening.[3,4] Psychological factors include distrust of healthcare providers, embarrassment, and fear of physical discomfort or results.[5–7]

Almost all cervical cancers are caused by high-risk human papillomavirus.[8] Human papillomavirus testing alone or in conjunction with Pap testing (cytology) is approved by the US Food and Drug Administration and recommended in some countries as a primary screen for cervical cancer.[9,10] Self-collection of cervicovaginal samples for HPV testing ("self-collection") has been shown to have comparable sensitivity to physician collection of cervical samples for the detection of high-grade cervical intraepithelial neoplasia.[11]

Human papillomavirus self-collection can remove several barriers to cervical cancer screening and improve uptake of primary cervical cancer screening among the 18% of US women who self-report being overdue for cervical cancer screening at recommended intervals.[12] Human papillomavirus self-collection may increase screening coverage if used with these women for primary screening, with the referral of self-test HPV-positive women to secondary screening by cytology or colposcopy. Several international studies have found that offering home-based self-collection to underscreened women increases screening completion compared with invitation for in-clinic screening.[13–15] Several US studies have found self-collection to be acceptable to diverse women,[16] and a recent meta-analysis across 24 countries found greater preference for self-collection over clinician collection among diverse populations, although these studies were not limited to underscreened women.[17]

To our knowledge, few US studies have compared preference for HPV self-collection with that for provider-performed Pap testing,[18–21] and only one has assessed preference among underscreened women, a critical target group for such an intervention.[20] A better understanding of differences between underscreened women's attitudes toward home-based HPV self-collection compared with Pap testing, and of possible predictors of preference for 1 screening method, over the other could help inform the implementation of self-test interventions to increase cervical cancer screening.

Data were collected as part of the My Body My Test-1 study to assess the feasibility and acceptability of using self-collection for HPV testing among underscreened women in North Carolina.[22] Here, we assess attitudes, experiences, and preferences regarding

HPV testing by home-based self-collection compared with Pap testing among a sample of low-income, underscreened women in North Carolina. In addition, we determine predictors of preference for HPV self-collection within this high-risk population.

MATERIALS AND METHODS

Recruitment

Participants were recruited from 10 North Carolina counties between January 2010 and September 2011 through methods including distribution of flyers and postcards, referral from the United Way 211 social assistance hotline, and word of mouth. Women were eligible to participate if they had not received a Pap test in the previous 4 years, lived in North Carolina, were not pregnant, had not undergone a hysterectomy, were 30 to 65 years old, and met one of the following income criteria: (*a*) had children that qualified for the federal school lunch program, (*b*) had Medicaid or Medicare Part B insurance, or (c) were uninsured and living at or less than 200% of the federal poverty level (determined by household income and size). Women who learned of the study through recruitment efforts called a 24-hour hotline staffed by trained personnel from the American Sexual Health Association (ASHA) to be screened for eligibility and enroll in the study.

Procedures

Eligible women were mailed a self-test kit, which included informed consent and Health Insurance Portability and Accountability Act authorization forms, illustrated instructions for completing self-collection of a cervicovaginal sample, and a prepaid mailer to return their self-collected sample for HPV testing using the Aptima high-risk HPV RNA test (Hologic Corporation, Marlborough, MA). The package also contained a listing of local clinics that perform low-cost or free Pap tests and their contact information. Women who did not promptly return a self-collected sample received a reminder letter at 2 weeks, a reminder phone call at 3 weeks, and a second reminder letter at 1 month.

The ASHA called participants when their HPV self-test results were ready. During this call, participants completed a questionnaire about the self-test experience ("acceptability questionnaire"), received their self-test results, were encouraged to complete clinic-based screening, and were given information on where to obtain a free or low-cost Pap in their area. Given that HPV testing on self-collected samples is not yet approved for clinical use, all participants were referred to in-clinic screening regardless of result.

After study staff received notification of Pap test completion, or after 2 months without notification, participants were contacted to complete a "follow-up questionnaire" to elicit attitudes toward and feedback on Pap testing. Study participants received $30 for returning the self-test and completing the acceptability questionnaire, US $10 for reporting completion of Pap testing (by postcard or verbally), and US $5 for completing the follow-up questionnaire. The study protocol was reviewed and approved by the University of North Carolina at Chapel Hill Institutional Review Board.

Measures

Acceptability Questionnaire. Standardized questionnaire items assessed participants' attitudes, concerns, and experiences regarding HPV self-collection, as well as basic demographics and health history. Attitudes toward the self-collection experience were assessed by items such as, "I am confident that I used the self-test correctly," and "I was afraid of what the self-test would say about my health," with response options of "strongly agree," "somewhat agree," "somewhat disagree," or "strongly disagree." Physical discomfort experienced during the HPV self-test was assessed by the question, "How much physical discomfort, if any, did you have when you used the self-test?" The questionnaire also assessed participants' knowledge about HPV, medical and reproductive history, and sociodemographic factors. Human papillomavirus knowledge was categorized into "low" (correctly answering <3 of 5 items) and "high" (correctly answering ≥3 of 5): HPV causes cervical cancer (categorized as true), causes genital warts (true), causes herpes (false), is rare (false), and is curable (false).

Preference for HPV self-collection compared with Pap testing was assessed by the acceptability questionnaire item, "If HPV self-tests and Pap tests protected women's health equally well, which one would you want the next time you were screened: an HPV self-test, a Pap smear, or it doesn't matter?" For logistic regression, preference for Pap testing was combined with "it doesn't matter." Trust in the tests was assessed by the item, "Which test do you think protects a woman's health better: an HPV self-test, a Pap smear, or they are about the same?"

Follow-Up Questionnaire. The follow-up questionnaire assessed in more detail women's attitudes toward and experiences with Pap testing (either before or after enrollment in the study). For comparison, several questions matching the wording of those asked about the self-test were asked about Pap testing.

Data Analysis

Overall, 892 women were screened for study eligibility, and 429 (48%) were study eligible and mailed an HPV self-collection kit (see Figure 1). Of these, 275 women (64%) returned a self-collected sample (of which HPV self-positivity was 14.6%),[22] and 227 (83%) of these 275 women completed the acceptability questionnaire. Of these women, 145 (64%) started the follow-up questionnaire. Given that not all participants who started the follow-up questionnaire completed it, our final sample for analysis of follow-up questionnaire data included 100 women.

Estimates for difference in sociodemographic characteristics and health history between the 127 women who completed only the acceptability questionnaire and the 100 women who completed both the acceptability and follow-up questionnaires were conducted using *t* tests, Wilcoxon rank sum tests, and χ^2 tests for continuous, ordered categorical, and categorical variables, respectively (Table 1).

We compared attitudes, feelings, and experiences of HPV self-collection versus Pap testing among the 100 women who completed both questionnaires using Cochran–Mantel–Haenszel tests using rank scores and clustering at the participant level to control for paired results (Table 2). Age-adjusted odds ratios (ORs) were calculated to assess predictors of preference for HPV self-collection compared with preference for Pap test/no preference, including demographic characteristics, barriers to screening, and health history (Table 3). A multivariable logistic regression model was conducted to assess predictors of preference controlling for age, race (white vs black/other race), and lifetime number of sexual partners (<5 vs ≥5). We used McNemar test to assess whether reported preference for self-test and for Pap test changed between the acceptability and follow-up questionnaires. Missing values were excluded from all analyses.

Role of Funding Source

This research was supported by a grant from the Kate B. Reynolds Charitable Trust. Additional support for staff time came from the National Cancer Institute of the National Institutes of Health (Award Numbers U54 CA156735, U54CA156733, and

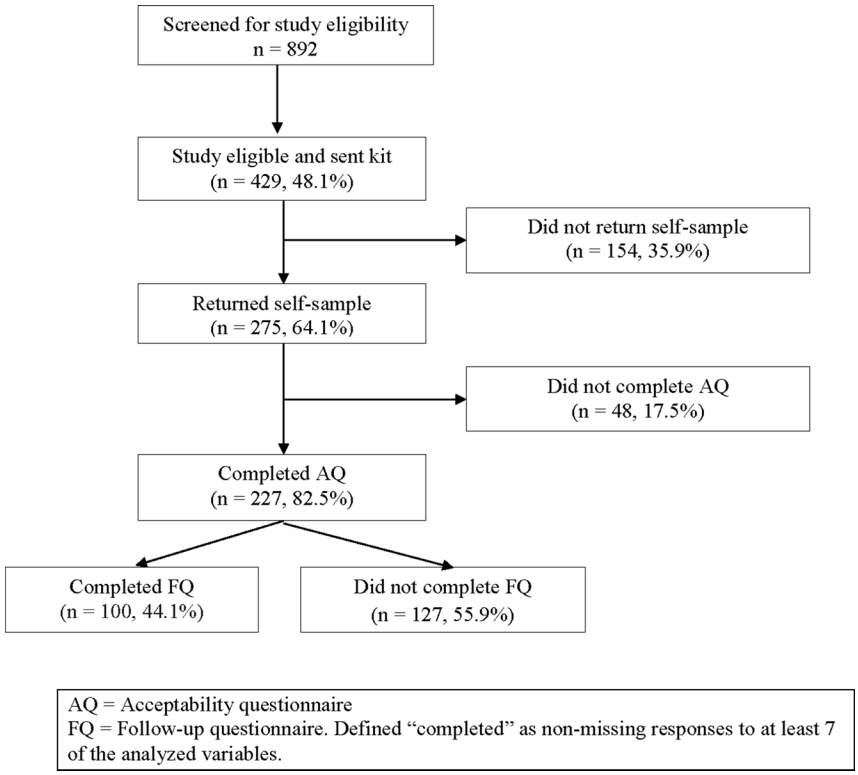

FIGURE 1. Participant flow diagram.

NIH NCI R01 CA183891). K.A.K. was supported by an institutional NIH training grant (T32 HD040672-15). Hybrid-Capture-2 HPV testing reagents were donated by QIAGEN Corporation. Self-collection brushes were donated by Rovers Medical Devices B.V.

RESULTS

Demographic and Other Characteristics

The median age of our total sample of 227 women was 44 years (range = 30–64 years) (Table 1). Most women (65%) reported black or "other" race, whereas 35% reported white race. Sixty-two percent had a high school education or less, 79% lived in an urban setting, and 46% reported an annual household income of less than US $10,000 per year. Most participants (68%) did not have health insurance, and 24% were covered by Medicaid. All women reported 4 or more years since their last Pap test. Of 161 women who provided a specific number of years from previous Pap, median time since prior Pap was 5 years, and 4 women (1.8%) reported never having had a Pap test. No significant differences in demographics or health history were observed between the 100 women who completed both questionnaires compared with the 127 who completed only the acceptability questionnaire.

Attitudes, Feelings, and Physical Discomfort Related to HPV Self-Test and Pap Test

Most respondents had overall positive thoughts about both the HPV self-test (81%) and the Pap test (75%) (Table 2). Nearly all participants were willing to do the self-test (98%) and the Pap test (98%) again and thought that the HPV self-test (99%) and the Pap test (97%) were safe. Twenty-two percent of participants reported feeling positive emotions when they used the self-test, compared with 8% for Pap testing, although this difference was not significant ($p = .16$). Three women reported being discouraged by friends or family to do the self-test, and 1 woman reported being discouraged from doing the Pap test. Most participants (63%) believed that the HPV self-test and the Pap test protected a woman's health equally well, 20% believed that the Pap test protected a woman's health more than the self-test, and 7% believed that the self-test protected a woman's health more than a Pap ($p < .001$). There was no difference between the 2 screening tests in reported trust to give accurate information about one's risk for cervical cancer (self-test: 93%, Pap 95%, $p = .17$).

Women reported less difficulty finding time to do a HPV self-test (13%) than difficulty finding time to do a Pap test (31%, $p = .003$). Comparing the Pap test with the HPV self-test, more women reported experiencing "a little physical discomfort" (Pap 41% vs self 18%, $p < .001$), "a lot of physical discomfort" (5% vs 0%, $p < .001$), or "a little pain" (30% vs 10%) ($p = .001$) from the Pap test. There was no difference in the reporting of minor bleeding from either of the tests (self-test: 9%, Pap test: 16%, $p = .25$). More women reported being afraid of what the HPV self-test results would say about their health (50%) than of the Pap test results (36%, $p = .02$).

Predictors of Preference for HPV Self-Collection Compared With Pap Testing

When asked on the acceptability questionnaire, "If HPV self-tests and Pap smears protected women's health equally well, which one would you want the next time you were screened?" approximately half (51%) of women stated that they would prefer an HPV self-test, 19% stated they would prefer the Pap test, and 27% had no preference ($p < .001$ Pap vs self) (see Figure 2). In age-adjusted analyses, black women and other women of color were less likely than white women to prefer the HPV self-test over the Pap (age-adjusted OR = 0.52, CI = 0.30–0.92) (Table 3). Women

TABLE 1. Characteristics of Women With Infrequent Cervical Cancer Screening in North Carolina, Stratified by Questionnaire Completion

	Returned self-test and completed acceptability questionnaire (n = 227)[a]		Completed acceptability questionnaire only (n = 127)		Completed both acceptability and follow-up questionnaires (n = 100)		
	n	%	n	%	n	%	p[b]
Age, y							
Median (range)	44 (30–64)		43 (30–63)		45.5 (30–64)		.132
Race							
White	78	35%	44	35%	34	34%	.893
Black/other[c]	146	65%	81	65%	65	66%	
Education							
Less than high school diploma	48	23%	28	24%	20	21%	.874
High school diploma or GED	84	39%	44	37%	40	43%	
Some college or more	81	38%	47	39%	34	36%	
Marital status							
Married or living with partner	59	28%	33	28%	26	28%	.874
Divorced/separated/widowed	66	31%	36	30%	30	33%	
Single, never married	87	41%	51	43%	36	39%	
Residence							
Rural	47	21%	26	20%	21	21%	.922
Urban	180	79%	101	80%	79	79%	
Annual household income, US							
<$10,000	95	46%	53	46%	42	46%	.947
≥$10,000	112	54%	63	54%	49	54%	
Insurance							
None	147	68%	81	68%	66	68%	.948
Medicaid	51	24%	29	24%	22	23%	
Private/military/other	19	9%	10	8%	9	9%	
Age at first intercourse, y[d]							
Median (range)	16 (6–34)		16 (6–34)		16 (10–28)		.978
Lifetime number of sexual partners							
<5[d]	71	49%	42	55%	29	43%	.179
≥5	73	51%	35	45%	38	57%	
Years since last Pap test[e]							
Median (range)	5 (4-never)		5 (4-never)		5 (4-never)		.902
≥4 not specified	n = 66		n = 37		n = 29		
Self-reported history of abnormal Pap test							
No	78	57%	48	64%	30	48%	.054
Yes	60	43%	27	36%	33	52%	
Smoking status							
Smoker	111	51%	59	49%	52	53%	.533
Nonsmoker	108	49%	62	51%	46	47%	

[a]Percentages may not sum to 100% because of rounding. Numbers may not sum to total because of missing values: race = 3, education = 14, marital status = 15, annual household income = 20, insurance = 10, age at first intercourse = 51, lifetime number of sexual partners = 83, self-reported history of abnormal Pap test = 85, and smoking status = 8.

[b]P values calculated by t tests, Wilcoxon rank sum tests and χ^2 tests for continuous, ordered categorical, and categorical variables, respectively.

[c]Other includes: Hispanic (n = 12), Asian (n = 2), American Indian/Alaskan Native (n = 6), and multiple race (n = 2).

[d]One participant reported never having had sex. Categorized from continuous variable.

[e]Four women reported no previous Pap test.

GED indicates general equivalency diploma.

reporting 5 or more lifetime sexual partners were more likely to prefer the HPV self-test (age-adjusted OR = 2.36, CI = 1.20–4.63 vs <5 lifetime sexual partners). Preference for HPV self-collection seemed somewhat more likely among women with a reported history of a previous abnormal Pap test (OR = 1.43, CI = 0.91–3.59), women with lower HPV knowledge (OR = 1.80, CI = 0.93–3.51), and women who reported at least 1 barrier to previous Pap testing (OR = 1.56, CI = 0.89–2.75), although these estimates were imprecise. In multivariable analyses controlling for age, race, and lifetime number of sexual partners, only number of lifetime sexual partners remained a significant predictor of preference for self-collection over Pap (OR = 2.03, CI = 1.01–4.10).

TABLE 2. Attitudes, Emotions, and Physical Experiences Reported Regarding the HPV Self-Test Compared With the In-Clinic Pap Test Among 100 Underscreened Women in North Carolina[a]

	HPV self-test		Pap test		
	n	%	*n*	%	*p*[b]
Overall thoughts about the test[c]					
Mostly positive	68	81%	63	75%	.353
Mostly negative or neutral	16	19%	21	25%	
Refused/Do not know/Missing	16		16		
Willing to do the test again[c]					
Yes	58	98%	58	98%	1.00
No	1	2%	1	2%	
I do not know/missing	13		13		
Emotions or feelings experienced when doing the test[c]					
Positive emotions[d]	10	22%	4	8%	.160
Negative emotions[e]	11	23%	14	30%	
I did not feel anything at all	26	55%	29	62%	
Missing	25		25		
Thinks the test is safe					
Strongly agree/somewhat agree	91	99%	89	97%	.317
Somewhat disagree/strongly disagree	1	1%	3	3%	
Refused/do not know/missing	8		8		
Trusts the test to give accurate information about her risk for cervical cancer					
None/a little trust	6	7%	4	5%	.165
A moderate amount of trust	43	50%	33	38%	
Complete trust	37	43%	49	57%	
Refused/do not know/missing	14		14		
Afraid of what the test results might say about her health					
Strongly agree/somewhat agree	47	50%	34	36%	.024
Somewhat disagree/strongly disagree	47	50%	60	64%	
Refused/do not know/missing	6		6		
Found it hard to find time to do the test					
Strongly agree/somewhat agree	12	13%	29	31%	.003
Somewhat disagree/strongly disagree	83	87%	66	69%	
Refused/do not know/missing	5		5		
Physical discomfort, if any, felt with the test[c]					
No physical discomfort	49	82%	31	52%	<.001
A little physical discomfort	11	18%	26	43%	
A lot of physical discomfort	0	0%	3	5%	
Refused/do not know/missing	12		12		
Pain, if any, felt with the test[c]					
No pain[f]	49	92%	37	70%	.001
A little pain	4	8%	16	30%	
A lot of pain	0	0%	0	0%	
Do not know/missing	19		19		
Bleeding, if any, from the test[c]					
No bleeding	51	91%	47	84%	.248
A little bleeding	5	9%	9	16%	
A lot of bleeding	0	0%	0	0%	
Missing	16		16		

[a]Limited to participants with nonmissing data on both questionnaires for at least 7 of the analyzed variables. Of 145 women who started the FQ, only 100 completed enough questions to be included in this table.

[b]Cochran–Mantel–Haenszel tests using rank scores and clustering at the participant level to control for paired results.

[c]Participants who at the time of follow-up questionnaire reported not having completed a Pap test since study enrollment ($n = 28$) were not asked the corresponding question about Pap testing and are excluded from analyses for these questions.

[d]Positive emotions: relieved, empowered, confident, surprised, interested, curious, glad to do it, comfortable, good, or great.

[e]Negative emotions: anxious, worried, intimidated, afraid, fearful, embarrassed, shame, overwhelmed, awkward, or concerned about the results.

[f]Question was not asked of women reporting no physical discomfort—these women were included in analysis as "no pain."

HPV indicates human papillomavirus.

TABLE 3. Predictors of Preference for HPV Self-Test as Compared With Preference for a Pap Test or No Preference Among Underscreened Women in North Carolina

	n	% preferring self-test	Age-adjusted OR (95% CI)	Multivariate OR (95% CI)[c]
Total sample[a]	221	51%		
Age, y[b]				
30–44	121	47%	Reference	Reference
45–64	100	55%	1.37 (0.81–2.34)	1.31 (0.66–2.61)
Race				
White	77	61%	Reference	Reference
Black/other[d]	142	45%	0.52 (0.30–0.92)	0.51 (0.25–1.06)
Insurance				
None	147	49%	Reference	___
Any	73	55%	1.27 (0.72–2.24)	
Education				
Less than college	130	48%	Reference	___
Some college or more	81	56%	1.33 (0.76–2.33)	
Annual household income, US				
<$10,000	94	49%	Reference	___
≥$10,000	111	53%	1.17 (0.67–2.03)	
Residence				
Rural	45	49%	Reference	___
Urban	176	51%	1.10 (0.57–2.12)	
Marital status				
Married/living with partner	59	58%	Reference	___
Divorced/separated/widowed	66	55%	0.85 (0.42–1.74)	
Single, never married	85	44%	0.56 (0.29–1.10)	
Lifetime no. sexual partners[b]				
<5[e]	71	45%	Reference	Reference
≥5	73	66%	2.36 (1.20–4.63)	2.03 (1.01–4.10)
Age at first intercourse, y[b]				
<16	64	53%	Reference	___
≥16	112	54%	1.01 (0.54–1.88)	
History of abnormal Pap test result				
Never[f]	78	47%	Reference	___
≥1	60	62%	1.81 (0.91–3.59)	
Years since previous Pap test				
4–5	101	51%	Reference	___
>5[f]	60	60%	1.43 (0.74–2.73)	
High HPV knowledge[g]				
Yes	47	38%	Reference	___
No	173	54%	1.80 (0.93–3.51)	
Barriers to previous Pap tests[h]				
No barriers	78	44%	Reference	___
≥1 barrier	134	55%	1.56 (0.89–2.75)	
Miles needed to travel to obtain Pap test[b]				
<5	71	48%	Reference	___
5–10	87	49%	1.05 (0.56–1.98)	
>10	56	57%	1.46 (0.72–2.97)	

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TABLE 3. *(Continued)*

	n	% preferring self-test	Age-adjusted OR (95% CI)	Multivariate OR (95% CI)[c]
No. medical appointment(s) in the past year[b]				
None	60	360%	Reference	___
≥1 visit	150	49%	0.64 (0.35–1.18)	

[a]Participants who provided a response to the preference question on the acceptability questionnaire. Totals may not add to 221 because of missing data; race = 2, insurance = 1, education = 10, annual household income = 16, marital status = 11, lifetime number of sexual partners = 77, age at first intercourse = 45, history of abnormal Pap test result = 83, years since previous Pap test = 60, high HPV knowledge = 1, barriers to previous Pap tests = 9, miles needed to travel to obtain Pap test = 7, and number of medical appointment(s) in the past year = 11.

[b]Age, lifetime number of sexual partners, age at first intercourse, years since previous Pap test, miles needed to travel to obtain Pap test, and number of medical appointment(s) in the past year were categorized from continuous variables.

[c]Adjusted for age, race, and lifetime number of sexual partners.

[d]Other race includes Asian, Native Hawaiian or Pacific Islander, American Indian or Alaska Native, and Hispanic.

[e]Includes 1 woman who reported never having had sex.

[f]Four women reported no previous Pap test.

[g]"High" HPV knowledge was defined as correctly answering ≥3 of 5 questions about HPV.

[h]Cost too much ($n = 63$), no health insurance ($n = 21$), did not have time ($n = 17$), afraid or nervous about emotional or physical discomfort ($n = 12$), did not perceive need ($n = 7$), trouble with transportation ($n = 4$), have not been to a doctor ($n = 4$), low priority ($n = 4$), dealing with other health issues ($n = 4$), no primary health care provider ($n = 2$), and other not specified ($n = 3$).

HPV indicates human papillomavirus; OR, odds ratio.

Among the 94 women who responded to both questionnaires regarding preference for HPV self-collection versus Pap testing, more women reported preference for the self-test at the time of the acceptability questionnaire (55%) than at the follow-up questionnaire (39%) ($p = .01$). At follow-up, more participants reported preference for the self-test (39%) than for the Pap test (26%), although this difference was no longer significant ($p = .09$). At follow-up, self-test preference was not associated with any variables in either bivariate or multivariable analyses, although power was limited and 95% confidence estimates were relatively imprecise.

DISCUSSION

Approximately half of our sample of 227 underscreened North Carolina women expressed a preference for HPV self-collection over Pap testing, and another third expressed no preference between the screening methods, indicating a high

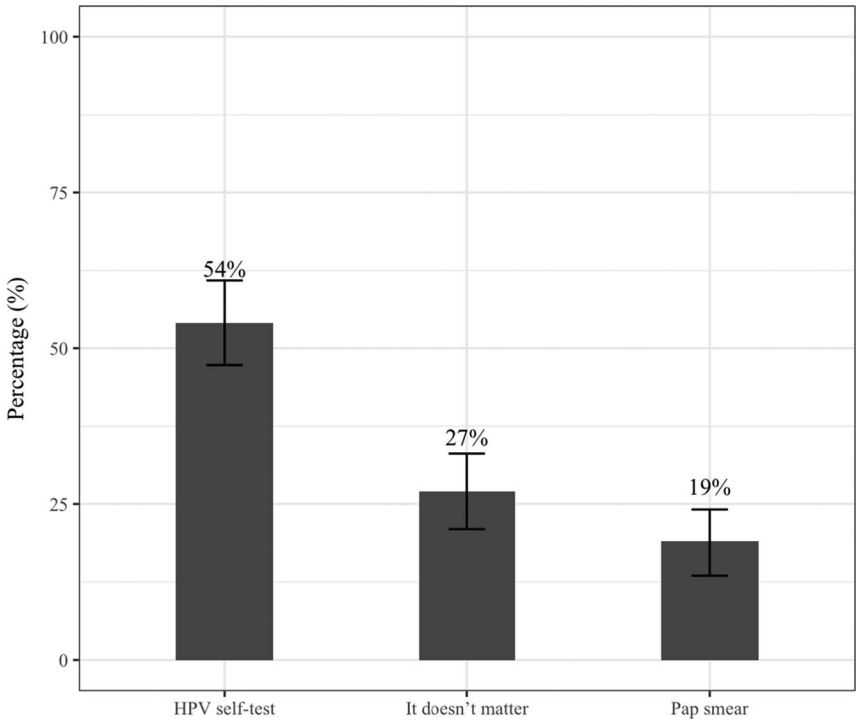

FIGURE 2. If HPV self-tests and Pap smears protected women's health equally well, which one would you want the next time you were screened? ($n = 221$).

level of acceptability of screening by HPV self-collection. We identified no difference in trust in accuracy or safety of the self-test compared with a Pap test and found that most respondents believed that 2 tests protected their health equally well. Participants reported that HPV self-collection was easier to find time to do and resulted in less physical discomfort and pain than provider-performed Pap testing, although they reported that greater fear of what self-test results would say about their health.

Our finding of greater preference for self-collection over Pap testing is consistent with other studies, including a recent international review that calculated a pooled estimate of 59% of women preferring screening by self-collection over clinician collection, although the review identified wide variation in preference by geography and population (range = 22%–95%) and studies were not limited to underscreened women.[17] The 1 other US study, to our knowledge, that has assessed preference among women overdue for screening found that 86% of these women preferred self-collection.[20] Common reasons reported for preferring self-collection were ease of use, doing collection oneself, greater convenience and privacy, and lower embarrassment and discomfort of HPV self-collection[17]; these results are consistent with our findings that women reported greater ease finding time to complete the self-test and relatively less pain and discomfort from the self-test compared with Pap testing.

In our study, preference for HPV self-collection decreased between the acceptability questionnaire and the follow-up questionnaire. One potential explanation for this change in preference is that the acceptability questionnaire item was asked before self-test HPV results were delivered, after which all participants were encouraged to complete an in-clinic Pap test. Because referral to Pap test was made regardless of HPV self-test result, some women may have felt that the self-test did not save them any time or effort. In practice, self-test HPV negative women would be considered to have completed screening until the next recommended screening interval, which would address this issue.

A predictor of preference for HPV self-collection in our population was a higher reported number of lifetime sexual partners, which is an established risk factor for HPV infection.[23] Potential explanations for this relationship are that participants with a relatively higher number of sexual partners may have greater comfort with their bodies or more concerns about stigma or embarrassment reporting their sexual history to a health care provider. Alternatively, this finding may be attributable to an unmeasured covariate. We observed that fewer women of color reporting preferring the self-test as compared with whites in univariate analyses. Although differences did not hold in multivariate analyses, likely due to relatively small sample size, the underlying reasons for this may be meaningful, for example, relatively lower trust among black women in research more generally.[24]

Although most women in our study believed that the self-test and Pap test protected women's health equally well, approximately one fifth believed that the Pap test was more protective. A recent meta-analysis of studies that assessed specific reasons for liking or disliking self-collection, uncertainty about self-collecting the sample correctly was the most commonly reported reason for not liking self-collection.[17] Women in our study were slightly more likely to report fear of what their self-test results would say about their health than to report fear of their Pap results. It is not clear whether these concerns were due to the self-test itself or to the fact that the self-test looks for HPV infection.

A strength of our study is the use of matched questionnaire items assessing attitudes toward the self-test and Pap test, allowing us to directly compare attitudes. Our sample was composed of women who had low income and were overdue for cervical cancer screening and a large proportion of minority women and women without health insurance: characteristics associated with a higher risk of being underscreened, and of developing cervical cancer.[2,25,26] Focus on this high-risk population provides valuable knowledge about the use of HPV self-collection among women who might most benefit from an intervention to improve access to screening.

In terms of potential study limitations, there was considerable loss to follow-up between HPV self-test completion and the follow-up questionnaire, and limited data were available from women who did not complete the self-test. Study participants received up to US $45 study monetary payments, which may have had an unidentified effect on the motivation and attitudes of the participating subjects. It is also uncertain whether the fixed sequence of referring to the self-test before the Pap test in our preference question may have had an effect on participants' reported attitudes. Furthermore, women self-selected into the study with the knowledge that self-collection would be part of the study, so there may have been some bias toward acceptability of the self-test. However, participants were all overdue for screening, making them the main target audience for an HPV self-collection program.

Future research and programs could include testing-specific messaging around the purpose and accuracy of the self-test and explanation of the meaning of home-based self-test results to maximize patient comprehension and reduce potential anxiety.

CONCLUSIONS

As self-collection for HPV testing is increasingly considered for implementation in national screening programs globally, assessment of self-test acceptability relative to Pap testing in the US underscreened population is essential. Our findings contribute to promising evidence that HPV self-collection conducted by mail with illustrated instructions could be a valuable tool to improve screening and ultimately decrease deaths from this preventable cancer.

ACKNOWLEDGMENTS

The authors thank Allen Rinas for his contributions to study design; Meredith Kamradt, Rachel Larsen, Kristen Ricchetti, Kelly Murphy, Stephanie Zentz, and Sara B. Smith for their work on study logistics, database, and recruitment; Florence Paillard for her assistance editing the manuscript; and Michael Lawson for cleaning and formatting the database. The authors also thank Meindert Zwartz at Rovers Medical Devices for contributing the Viba self-collection brushes and Belinda Yen-Lieberman and Jerome Belinson at The Cleveland Clinic for conducting the HPV testing.

REFERENCES

1. Jemal A, Siegel R, Xu J, et al. Cancer statistics, 2010. *CA Cancer J Clin* 2010;60:277–300.
2. Spence AR, Goggin P, Franco EL. Process of care failures in invasive cervical cancer: systematic review and meta-analysis. *Prev Med* 2007;45: 93–106.
3. Plourde N, Brown HK, Vigod S, et al. Contextual factors associated with uptake of breast and cervical cancer screening: a systematic review of the literature. *Women Health* 2016;56:906–25.
4. Akinlotan M, Bolin JN, Helduser J, et al. Cervical cancer screening barriers and risk factor knowledge among uninsured women. *J Community Health* 2017;42:770–8.
5. Montealegre JR, Mullen PD, Jibaja-Weiss M, et al. Feasibility of cervical cancer screening utilizing self-sample human papillomavirus testing among Mexican immigrant women in Harris County, Texas: a pilot study. *J Immigr Minor Health* 2015;17:704–12.

6. Litton AG, Castle PE, Partridge EE, et al. Cervical cancer screening preferences among African American women in the Mississippi Delta. *J Health Care Poor Underserved* 2013;24:46–55.
7. Vanderpool RC, Jones MG, Stradtman LR, et al. Self-collecting a cervico-vaginal specimen for cervical cancer screening: an exploratory study of acceptability among medically underserved women in rural Appalachia. *Gynecol Oncol* 2014;132:S21–5.
8. Parkin DM, Bray F. The burden of HPV-related cancers. *Vaccine* 2006;24: S11–25.
9. American Sexual Health Association (ASHA). FDA Approves HPV Test for Primary Screening. Available at: http://www.ashasexualhealth.org/fda-approves-hpv-test-for-primary-screening/. Accessed April 27, 2018.
10. World Health Organization. WHO guidelines for screening and treatment of precancerous lesions for cervical cancer prevention: supplemental material: GRADE evidence-to-recommendation tables and evidence profiles for each recommendation. 2013. Available at: http://www.who.int/reproductivehealth/publications/cancers/screening_and_treatment_of_precancerous_lesions/en/. Accessed August 28, 2018.
11. Arbyn M, Verdoodt F, Snijders PJF, et al. Accuracy of human papillomavirus testing on self-collected versus clinician-collected samples: a meta-analysis. *Lancet Oncol* 2014;15:172–83.
12. Xu F, Mawokomatanda T, Flegel D, et al. Surveillance for certain health behaviors among states and selected local areas—Behavioral Risk Factor Surveillance System, United States, 2011. *Morb Mortal Wkly Rep Surveill Summ* 2014;63:1–149.
13. Racey CS, Withrow DR, Gesink D. Self-collected HPV testing improves participation in cervical cancer screening: a systematic review and meta-analysis. *Can J Public Heal* 2013;104:159–66.
14. Sultana F, English DR, Simpson JA, et al. Home-based HPV self-sampling improves participation by never-screened and under-screened women: Results from a large randomized trial (iPap) in Australia. *Int J Cancer* 2016; 139:281–90.
15. Racey CS, Gesink DC, Burchell AN, et al. Randomized intervention of self-collected sampling for human papillomavirus testing in under-screened rural women: uptake of screening and acceptability. *J Womens Health (Larchmt)* 2016;25:489–97.
16. Madzima TR, Vahabi M, Lofters A. Emerging role of HPV self-sampling in cervical cancer screening for hard-to-reach women: focused literature review. *Can Fam Physician* 2017;63:597–601.
17. Nelson EJ, Maynard BR, Loux T, et al. The acceptability of self-sampled screening for HPV DNA: a systematic review and meta-analysis. *Sex Transm Infect* 2017;93:56–61.
18. Anhang R, Goodman A, Goldie SJ. HPV communication: review of existing research and recommendations for patient education. *CA Cancer J Clin* 2004;54:248–59.
19. Kahn JA, Bernstein DI, Rosenthal SL, et al. Acceptability of human papillomavirus self testing in female adolescents. *Sex Transm Infect* 2005; 81:408–14.
20. Barbee L, Kobetz E, Menard J, et al. Assessing the acceptability of self-sampling for HPV among haitian immigrant women: CBPR in action. *Cancer Causes Control* 2010;21:421–31.
21. Nelson EJ, Hughes J, Oakes JM, et al. Human papillomavirus infection in women who submit self-collected vaginal swabs after internet recruitment. *J Community Health* 2015;40:379–86.
22. Smith JS, Des Marais AC, Deal AM, et al. Mailed human papillomavirus self-collection with papanicolaou test referral for infrequently screened women in the United States. *Sex Transm Dis* 2018;45:42–8.
23. Munoz N, Kato I, Bosch XF, et al. Risk factors for HPV DNA detection in middle-aged women. *Sex Transm Dis* 1996;23:504–10.
24. Rivers D, August EM, Sehovic I, et al. A systematic review of the factors influencing African Americans' participation in cancer clinical trials. *Contemp Clin Trials* 2013;35:13–32.
25. McDougall JA, Madeleine MM, Daling JR, et al. Racial and ethnic disparities in cervical cancer incidence rates in the United States, 1992-2003. *Cancer Causes Control* 2007;18:1175–86.
26. Ackerson K, Gretebeck K. Factors influencing cancer screening practices of underserved women. *J Am Assoc Nurse Pract* 2007;19:591–601.