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How Is Health Literacy Related to Pap Testing Among US Women?

Erika L. Thompson[1] · Christopher W. Wheldon[2] · Cheryl A. Vamos[3,4] · Stacey B. Griner[3] · Ellen M. Daley[3,4]

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Abstract
While Pap testing has significantly reduced the burden of cervical cancer, not all women follow prevention recommendations of cervical cancer screening every 3 years. Health literacy regarding Pap testing may influence the adoption of this behavior. The objective of this study was to assess the health literacy-related factors associated with Pap testing among a nationally representative sample of women in the USA. The Health Information National Trends Survey Cycles 4.4 and 5.1 were restricted to women 21–65 years of age ($N = 2992$). Questions were selected using the Integrated Model of Health Literacy domains: access (i.e., seeking cancer information), understand (i.e., HPV awareness, HPV knowledge), appraise (i.e., prevention not possible, chance of getting cancer), and apply (i.e., received a Pap in last 3 years [outcome]). Survey-weighted, logistic regression models estimated how the health literacy domains were associated with Pap testing, using SAS 9.4. In the sample, 81.1% of women received a Pap test within the last 3 years. The analysis revealed women who knew HPV is an STD (aOR = 1.64, 95% CI 1.20–2.26) were more likely to have received a Pap test in the last 3 years, while controlling for sociodemographic factors. These findings indicate that knowledge about HPV may be associated with Pap testing behavior among US women. Continued research is needed to examine the impact of health literacy on Pap testing given the changes in screening guidelines, with the ultimate goal of decreasing cervical cancer.

Keywords Cervical cancer · Screening · Health literacy · Women

Introduction

Cervical cancer was previously a leading cause of cancer death among women in the USA. These rates have declined substantially due to cervical cancer screening with Pap testing [1]. As of 2014, 12,578 women in the USA were diagnosed with cervical cancer, and 4,115 died of cervical cancer [2]. While these lower rates are a public health achievement, disparities persist. Hispanic women have higher cervical cancer incidence rates and Black women have higher cervical cancer death rates compared to other racial/ethnic groups [3, 4]. Cervical cancer can largely be a preventable disease, and with early detection and intervention among those who develop cervical cancer, the survival rate is favorable [4].

Historically, secondary prevention through Pap test screening was the only cervical cancer prevention mechanism—a way to detect early abnormal cervical cellular changes. However, in 2006, the first three-dose quadrivalent HPV vaccine was approved for females 9–26 years, protecting against two of the most common HPV strains responsible for cervical cancer (HPV types 16 and 18) [5]. Given scientific advancements, there is currently a nonavalent vaccine, providing additional protection against seven oncogenic HPV strains [6]. Nonetheless, the HPV vaccine does not protect against all oncogenic HPV strains that are sexually transmitted, and many women are not vaccinated as they did not receive the vaccine or were not age-eligible. Thus, promoting cervical cancer screening remains essential for women's health.

As of 2012, Pap test screening for cervical cancer is recommended for women ages 21 to 65 years of age, every 3 years, or for women 30 to 65 years, Pap testing and HPV co-testing every 5 years. This was a change in recommendations from screening every year starting at age 18 [7, 8]. As of 2013, 82% of women 21–44 years and 74% of women 45–

✉ Erika L. Thompson
Erika.Thompson@unthsc.edu

[1] Department of Health Behavior and Health Systems, School of Public Health, University of North Texas Health Science Center, 3500 Camp Bowie Blvd, EAD 709M, Fort Worth, TX 76107, USA

[2] Division of Cancer Control and Population Sciences, National Cancer Institute, 9609 Medical Center Drive, Bethesda, MD 20892, USA

[3] Department of Community and Family Health, College of Public Health, University of South Florida, 13201 Bruce B. Downs Blvd, Tampa, FL 33612, USA

[4] The Chiles Center, College of Public Health, University of South Florida, 13201 Bruce B. Downs Blvd, Tampa, FL 33612, USA

64 years had a Pap test in the last 3 years [9]. These proportions are less than the Healthy People 2020 objective, which aims to increase the proportion of women who received cervical cancer screening to 93%. A corresponding Healthy People 2020 objective is to increase the proportion of women who were counseled by their providers about Pap tests to 66% [10]. Given the changes in Pap screening guidelines in 2012, confusion regarding Pap testing recommendations may persist. Research examining women's perspectives on changing Pap testing guidelines revealed women were "uncomfortable" with longer screening intervals [previously every year] [11]. Additionally, women may also question the credibility of these guidelines changes [12].

A key determinant that may influence Pap testing among women is health literacy [13]. There are numerous definitions of health literacy, with many measuring varying dimensions or conceptual skills [14–16]. Common elements of these definitions are seen in the Integrated Model of Health Literacy, which defines health literacy from a public health perspective as: "people's knowledge, motivation and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course" [16]. Previous studies have examined health literacy and cervical cancer screening [17]. However, these studies often utilized print measures of health literacy, such as the TOFHLA and REALM, or only measured one domain of health literacy [17]. While these studies demonstrate an association between health literacy and Pap testing, they do not incorporate the multidimensional skill set from a public health perspective of health literacy.

Applying a multidimensional approach to health literacy can assist in identifying the specific health literacy skills associated with Pap testing. This framework for health literacy can be applied to the informed decision-making for Pap testing. National data collected from the Health Information National Trends Survey (HINTS) cycle 4.4 and cycle 5.1 include questions regarding cancer prevention that align with these health literacy domains, as well as timing of last Pap testing. Thus, the objective of this study was to assess the health literacy-related factors associated with Pap testing among a nationally representative sample of women in the USA.

Methods

Sample

This study assessed health literacy factors associated with Pap testing among participants in the Health Information National Trends Survey (HINTS) cycle 4.4 and cycle 5.1 ($n = 3677$ and $n = 3191$, respectively). The purpose of the HINTS is to assess US adults on their use of cancer information. These two cycles of HINTS data were pooled due to the common questions used. Data were collected in August–November 2014 for cycle 4.4 and January–May 2017 for cycle 5.1. Details of data collection and procedures are reported elsewhere [18, 19]. Briefly, a stratified sampling design is used, and households are mailed the survey with a pre-paid $2 monetary incentive. The response rates for the survey were 34.44% in 2014 and 32.39% in 2017 [18, 19]. The sample was further restricted to women ages 21 to 65 years due to the recommendations for cervical cancer screening and women with complete responses ($n = 2992$).

Measures

Health literacy-related variables were selected using the domains included in the Integrated Model of Health Literacy's definition of health literacy—*accessing*, *understanding*, *appraising*, and *applying* health information to make an informed health decision [16]. The outcome of Pap testing was considered the *apply* component of the health literacy framework. It was measured from the question, "How long ago did you have your most recent Pap test to check for cervical cancer?" Participants were dichotomized into two categories: Pap test within the last 3 years and Pap test more than 3 years ago or never. The *access* variable included: "Have you ever looked for information about cancer from any source?" (yes/no). *Understand* variables were related to HPV awareness and knowledge. First, participants were asked, "Have you heard of HPV?" (yes/no) as a measure of HPV awareness. If participants had not heard of HPV, then they did not respond to the next HPV knowledge questions. These participants were then coded as incorrect knowledge on the remaining HPV knowledge questions due to this skip pattern. Two additional HPV knowledge measures were included in the *understand* domain: "Do you think HPV can cause cervical cancer?" (correct: yes; incorrect: no, don't know) and "Do you think HPV is a sexually transmitted disease (STD)?" (correct: yes; incorrect: no, don't know). As for *appraise*, participants responded to "There's not much you can do to lower your chances of getting cancer" (disagree and agree) and "How likely are you to get cancer in your lifetime?" (unlikely, neither, likely).

As for demographic characteristics, factors included age (21–29, 30–39, 40–49, and 50+ years), health insurance (insured, uninsured), educational attainment (less than high school, high school/some college, and college graduate), Hispanic ethnicity (yes, no), race (White, Black, Other, including Asian, Native American/Alaskan Native/Pacific Islander, Multi-Race), and marital status (divorced, never married, and married). Participants also reported if they have ever had cancer (yes, no).

Data Analysis

This study was a secondary analysis of HINTS cycles 4.4 and 5.1. The two HINTS cycles with the same items were pooled and used in the analysis. Hot-deck imputation was used to replace missing responses with imputed data for items used in the raking procedure of the weighting process. Data were analyzed using SAS 9.4. Population estimates were obtained by using the full sample weights, and the standard errors for statistical modeling were generated using the delete-one jackknife method based on 50 replicate weights separately for each cycle.

Logistic regression models were used to assess the independent associations of each sociodemographic and health literacy factor with Pap testing. Those factors that were significantly associated with Pap testing were then included in adjusted models: sociodemographic factors only (model 1), health literacy factors only (model 2), and a combined model (model 3). To understand if the association of HPV awareness and knowledge with Pap testing was due in part to education, stratified analyses were conducted by educational attainment. Additionally, a sensitivity analysis was conducted removing participants who were not aware of HPV (*understand domain*) since these participants did not respond to the remaining knowledge questions. Effect estimates were not significantly different (data not shown). Odds ratios and 95% confidence intervals are presented.

Results

Out of 2992 women between the ages of 21 and 65, 81.1% met the recommendation for pap screening (Table 1). The prevalence of Pap screening was higher among women 30 to 39 years of age (89.5%), married women (84.3%), those with health insurance (82.5%), and women with a college degree (86.3%). The relative odds of these sociodemographic associations are reported in Table 1. In the adjusted model (model 1), there were significant independent associations between Pap testing and education, health insurance, age, and marital status. Differences by race (White vs. Black), ethnicity (Hispanic vs. non-Hispanic), or previous cancer diagnosis were not statistically significant.

The prevalence of Pap screening was higher among women who had heard of HPV (83.9%), knew that HPV can cause cervical cancer (84.7%), or knew that HPV is an STD (86.1%). The relative odds of these associations are reported in Table 1. In the adjusted model (model 2), knowing that HPV is an STD was the only independent factor associated with pap testing. The other health literacy variables were not independently associated with Pap testing and not included in adjusted models. We also restricted the health literacy model to only women who were aware of HPV, since women who were not aware did not respond to knowledge questions. In this restricted model, knowledge that HPV is an STD was still the only independent factors associated with Pap testing (aOR = 1.56, 95% CI 1.10, 2.22).

In the combined multivariable model (model 3), lower educational attainment was negatively associated with Pap testing, as was being outside the 30 to 39 age group, whereas having health insurance and being divorced or married were positively associated with Pap testing. Women who knew that HPV is an STD had 64% higher odds of having received a Pap test than women who did not know HPV is an STD (aOR = 1.64; 95% CI: 1.20–, 2.26) after adjusting for education, health insurance, age, and marital status (see model 3 in Table 1 for adjusted odds ratios).

To determine if educational attainment moderated the association between knowledge of HPV as an STD and Pap screening, we modeled the association of HPV awareness and knowledge stratified by educational attainment (Table 2). We found that knowledge of HPV as an STD was associated with Pap test among those with less than high school education (aOR = 2.89; 95% CI: 1.07–7.82) and for women with a high school education/some college (aOR = 1.82; 95% CI: 1.14–, 2.88), but not women with college degrees. Conversely, general awareness of HPV was positively associated with Pap testing among women with college degrees (aOR = 1.98; 95% CI: 1.18–, 3.32), but not among women with lower educational attainment. Knowledge that HPV can cause cervical cancer was not associated with pap testing regardless of educational attainment.

The distributions of HPV awareness and knowledge variables by educational attainment among *women who have received a Pap test in the previous 3 years* are displayed in Fig. 1. This figure shows that awareness and knowledge of HPV is higher among women with more educational attainment among all women who have received a Pap test. For example, 82% of college-educated women knew HPV infection could cause cervical cancer compared to just 35% of women with less than a high school education. Similarly, 67% of college-educated women knew that HPV was an STD compared to just 34% of women with less than a high school education.

Discussion

This study aimed to assess health literacy factors associated with Pap testing among US women, using a public health approach to health literacy. Knowledge about HPV was the strongest health literacy factors under the *understand* domain for health literacy. Moreover, knowledge of HPV varied by educational attainment of women in the sample. Specifically, women among lower educational attainment, knowledge HPV is an STD was more strongly associated with Pap testing.

Table 1 Health literacy and sociodemographic factors by pap testing in the last 3 years among women 21–65 years in HINTS cycles 4.4 and 5.1

				Adjusted models aOR (95% CI)		
	No Pap test last 3 years, *N* (%) 574 (18.9%)	Pap test in last 3 years, *N* (%) 2418 (81.1%)	Crude models, OR (95% CI)	Model 1: demographics model	Model 2: health literacy model	Model 3: demographics and health literacy model
Sociodemographic factors						
Education*						
Less than HS	56 (14.7)	131 (6.8)	**0.31 (0.19, 0.52)**	**0.36 (0.21, 0.62)**		**0.39 (0.22, 0.69)**
HS/Some College	302 (55.0)	1091 (48.6)	**0.60 (0.44, 0.82)**	**0.66 (0.48, 0.93)**		**0.71 (0.50, 0.99)**
College Graduate	216 (30.2)	1196 (44.6)	Referent	Referent		Referent
Health insurance*						
Uninsured	104 (18.8)	248 (10.7)	Referent	Referent		Referent
Insured	470 (81.2)	2170 (89.3)	**1.93 (1.31, 2.85)**	**1.75 (1.19, 2.56)**		**1.78 (1.18, 2.67)**
Age*						
21–29	59 (22.8)	239 (17.4)	**0.39 (0.22, 0.69)**	**0.47 (0.26, 0.85)**		**0.46 (0.25, 0.86)**
30–39	62 (12.0)	475 (23.8)	Referent	Referent		Referent
40–49	107 (22.5)	536 (24.0)	**0.54 (0.34, 0.85)**	**0.52 (0.32, 0.83)**		**0.52 (0.31, 0.85)**
50+	346 (42.8)	1168 (34.8)	**0.41 (0.28, 0.61)**	**0.39 (0.26, 0.60)**		**0.40 (0.25, 0.62)**
Hispanic						
No	484 (84.6)	2025 (84.0)	Referent			
Yes	90 (15.4)	393 (16.0)	1.05 (0.69, 1.60)			
Race						
White	378 (71.1)	1640 (75.5)	Referent			
Black	120 (15.7)	520 (14.8)	0.89 (0.59, 1.35)			
Other	76 (13.2)	258 (9.7)	0.69 (0.43, 1.12)			
Marital status*						
Divorced	183 (15.3)	632 (13.2)	1.20 (0.83, 1.74)	**1.57 (1.03, 2.38)**		**1.58 (1.04, 2.42)**
Never married	142 (36.5)	447 (26.3)	Referent	Referent		Referent
Married	249 (48.3)	1339 (60.5)	**1.74 (1.23, 2.47)**	**1.87 (1.36, 2.57)**		**1.90 (1.37, 2.64)**
Cancer history						
No	481 (91.1)	2156 (92.6)	Referent			
Yes	93 (8.9)	262 (7.4)	0.82 (0.55, 1.21)			
Health literacy factors						
Access: seek cancer information						
No	260 (45.6)	1014 (43.4)	Referent			
Yes	288 (54.4)	1348 (56.6)	1.09 (0.82, 1.45)			
Understand: heard of HPV*						
No	166 (30.9)	481 (18.3)	Referent		Referent	
Yes	388 (69.1)	1933 (81.7)	**2.00 (1.40, 2.84)**		1.33 (0.79, 2.24)	
Understand: HPV causes cervical cancer*						
Incorrect	227 (42.7)	728 (28.4)	Referent		Referent	
Correct	294 (57.3)	1572 (71.6)	**1.88 (1.34, 2.65)**		1.25 (0.81, 1.92)	
Understand: HPV is an STD*						
Correct	283 (57.5)	1003 (40.9)	Referent		Referent	Referent
Incorrect	235 (42.5)	1281 (59.1)	**1.95 (1.43, 2.68)**		**1.56 (1.10, 2.22)**	**1.64 (1.20, 2.26)**
Appraise: likelihood of getting cancer in your life						
Unlikely	108 (20.0)	458 (18.4)	0.86 (0.56, 1.32)			
Neither	233 (41.6)	1033 (44.5)	Referent			
Likely	188 (38.4)	847 (37.0)	0.90 (0.63, 1.29)			
Appraise: there is not much to do to lower chances of getting cancer						
Disagree	388 (74.0)	1748 (74.4)	Referent			
Agree	144 (26.0)	610 (25.6)	0.98 (0.71, 1.36)			

Percentages are weighted and confidence intervals are adjusted for the complex survey design

*P value < 0.05 for bi-variate analyses

Bold values represent statistical significance

Understanding HPV as a cause for cervical cancer and as an STD were the health literacy factors most associated with Pap testing in the last 3 years. With cross-sectional data, we were unable to disentangle if the knowledge about HPV is due to any potential health education received before or during a Pap test, or if women's knowledge about HPV is motivating Pap testing behavior. In an attempt to tease apart this issue, we conducted stratified analyses that revealed associations between HPV awareness/knowledge and Pap testing were not equivalent across women with high and low levels of educational attainment. Evidence for differences in knowledge of HPV was observed by educational

Table 2 HPV awareness and knowledge predictors of Pap testing stratified by educational attainment among women 21–65 years in HINTS cycle 4.4 and 5.1

	Less than high school	High school or some college	College graduate
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Model 1: heard of HPV	1.05 (0.45, 2.43)	1.62 (0.94, 2.79)	**1.98 (1.18, 3.32)**
Model 2: HPV causes cervical cancer	1.53 (0.60, 3.92)	1.51 (0.89, 2.56)	1.52 (0.96, 2.41)
Model 3: HPV is an STD	**2.89 (1.07, 7.82)**	**1.82 (1.14, 2.88)**	1.28 (0.83, 1.96)

Adjusted for age, insurance, and marital status

Bold values represent statistical significance

attainment level among women who had received a Pap test. Recently, a survey-based study found knowledge of the purpose of a Pap test was not associated with screening status; rather, receipt of the HPV vaccine was a stronger predictor of regular Pap testing [20]. The advent of the HPV vaccine as a prevention tool for cervical cancer may be one of the driving factors for knowledge of HPV as an STD, and women who are aware of this vaccine and connection may be more compliant with the continuum of cancer prevention guidelines. Additionally, a recent systematic review found that cervical cancer education interventions doubled cervical cancer screening rates and could be a useful intervention for women and communities with low literacy levels [21]. Based on the findings from this study, incorporating information on HPV may be needed in educational interventions for cervical cancer screening.

In addition to the health literacy factors associated with Pap testing, sociodemographic characteristics were associated with following cervical cancer screening guidelines. Specifically, women with lower educational attainment were less likely to follow guidelines, as well as women outside of the 30–39-year age range. Additionally, women who were divorced or married were more likely to have a recent Pap test compared to never married women. An analysis of the National Health Interview Survey 2013 revealed that age and educational status operated similar to our study [22]. Women between the ages of 30–39 and those who are divorced or married may have interacted more with the health care system for other reproductive health care and thus may have more opportunities to be exposed to provider recommendations regarding Pap testing. Thus, while health literacy is a social determinant of health, other social determinants may be contributing to Pap testing behavior.

According to the U.S. Community Preventive Services Task Force, one-on-one education for clients is a recommended strategy for promoting cervical cancer screening [23]. While this strategy is recommended, the components of this one-on-one education are not specified. These discussions should include HPV and its connection to cervical cancer. Previous research indicates that many women are unaware that a Pap test screens for cervical cancer, instead confusing Pap testing with screening for other STDs, infections, or pregnancy [24]. Addressing one-on-one education with HPV as a focus area is especially timely as transitions to primary HPV testing as a cervical cancer screening strategy option may change the modality and frequency in which women are screened [25]. Future studies will be needed to examine how sociodemographic and psychosocial factors, including knowledge, influence the choice between primary HPV testing and Pap testing among women.

These findings should be considered in the context of the limitations. First, these data were from a cross-sectional study

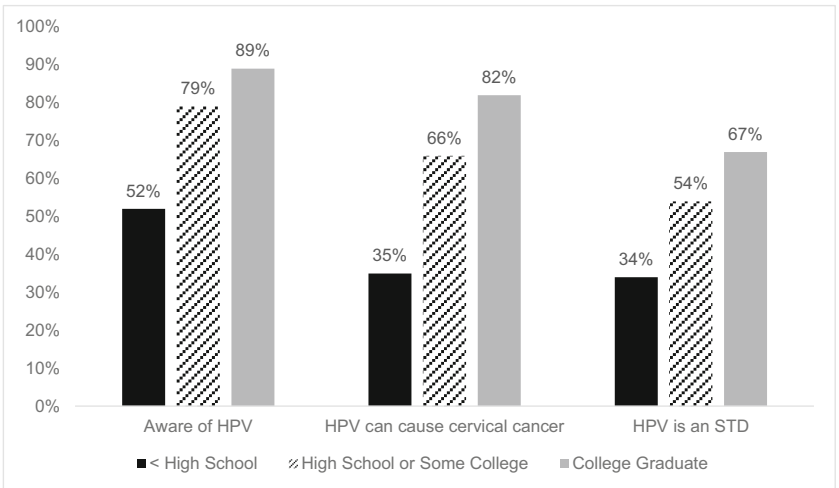

Fig. 1 HPV awareness and knowledge by educational attainment among women who have received a Pap test in past 3 years—HINTS cycles 4.4 and 5.1

where inferences about timing cannot be made. Additionally, the outcome measure of Pap testing was self-reported by women, and women may vary in recommended timeline based on previous abnormal Pap tests or co-testing with HPV. Women may confuse Pap testing with other recommended reproductive health services (e.g., STD screening or pelvic exams), which may overestimate the number of women up-to-date on Pap testing. Given that this is a secondary data analysis of an existing survey, we were limited with what types of measures were available to align with the health literacy framework. Small cell sizes in one eligible health literacy measure—knowledge of HPV requiring treatment—prevented the inclusion of this factor in our analysis. Also, the items available in this dataset used to measure the appraisal domain are not necessarily mutually exclusive from the understand domain, as they address perceived prevention and susceptibility. Despite these limitations, this study is strengthened by using a behavioral epidemiology approach to understanding determinants of health behavior at a population level.

While Pap testing has significantly reduced the burden of cervical cancer, not all women follow with prevention recommendations of cervical cancer screening every 3 years. The findings from this study indicate that knowledge about HPV may be associated with Pap testing behavior among US women. Thus, focusing on the *understand* domain through educational interventions with women may be needed. Continued research is warranted to examine the impact of health literacy on Pap testing given the changes in screening guidelines, with the ultimate goal of decreasing cervical cancer.

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