Health Literacy Correlates to HPV Vaccination Among US Adults Ages 27–45

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Abstract

Human papillomavirus (HPV) vaccination is now available for adults aged 27–45 as a shared clinical decision. Health literacy skills (i.e., accessing, understanding, appraising, applying information) may facilitate vaccine decision-making for adults with a provider recommendation. This study assessed associations between health literacy skills and willingness to get a provider-recommended HPV vaccine among newly eligible US adults. In 2020, US participants (51% women), aged 27–45 years, were surveyed online ($n = 691$). The outcome was willingness (willing/not willing) to get the HPV vaccine with provider recommendation. Measures were adapted from Sørensen's multidimensional European Health Literacy Scale, which assesses health literacy among four domains (i.e., access, understanding, appraisal, application). Adjusted odds ratios were calculated for the outcome and each health literacy domain, adjusting for personal health determinants (e.g., age, sex). The sample consisted of primarily non-Hispanic (91.2%), White (74.4%), and married (60.7%) adults. Approximately 65% of participants were willing to get a provider-recommended HPV vaccine. Higher willingness to vaccinate with provider recommendation was significantly associated with increased HPV knowledge (understanding; aOR = 1.13, 95% CI 1.04, 1.24), ability to understand HPV information (understanding; aOR = 1.96, 95% CI 1.09, 3.52), increased perceived vulnerability to HPV-related cancer (appraising; aOR = 3.22, 95% CI 1.83, 5.69), and the need for more information on vaccine safety to seek vaccination (applying; aOR = 3.25, 95% CI 2.05, 5.16). Utilizing a multidimensional health literacy framework to evaluate facilitators to HPV vaccination uptake among adults aged 27–45 can help guide future interventions by targeting accurate, easy-to-understand HPV information that connects vaccination efficacy to reduction in HPV cancer risk.

Keywords Health literacy · HPV vaccination · Provider recommendation · Shared clinical decision

Introduction

Human papillomavirus (HPV), the most common sexually transmitted infection in the USA [1], causes six types of cancer and genital warts [2]. A key prevention strategy for HPV and HPV-related cancers is HPV vaccination. Currently, the Advisory Committee on Immunization Practices recommends routine vaccination for 11- and 12-year-olds in the USA. Unvaccinated persons can receive catch-up vaccination until age 26 [3]. As of 2019, adults ages 27–45 can also receive the HPV vaccine; however, routine vaccination is not recommended, and receipt depends on a shared clinical decision with their healthcare provider [3]. To translate this new HPV vaccine guideline into practice, we need to understand what contributes to HPV vaccination decisions in this age group. Preliminary research has shown that adults ages 27–45 years old are more likely to ask their provider about the vaccine or be likely to receive the HPV vaccine if

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they perceive a benefit to vaccination [4]. Thus, a key factor may be provider recommendation, as provider recommendation has been a key facilitator for HPV vaccination for other age groups [5].

To understand how provider recommendation may influence HPV vaccine uptake for adults ages 27–45, it is important to assess patient information needs related to shared decision making. Within this age group, individuals reported they do not have enough information about the HPV vaccine to make a vaccination decision and specifically needed more information about the efficacy and safety of the vaccine [6]. However, addressing these information needs alone may not lead to vaccine uptake, but considering these needs in context with the preferred sources of information, how the information is processed, appraised, and used may provide a more complete picture [7]. As health care providers begin transitioning toward making these recommendations for their patients and implementing HPV vaccination shared decision making into practice, optimizing shared decision making and information seeking with qualified health care providers is critical. One way to potentially optimize shared decision making is through assessing the health literacy needs and assets for these newly eligible adults.

In the broadest sense, health literacy provides social and systems-level context on an individual's interactions with health information [7]. Health literacy is dynamic and amenable to improvement through active provider engagement [8]. Improved health literacy strengthens the connection between exposure to health information and engaging in health behavior based on said information [9]. After synthesizing several definitions of health literacy, four primary dimensions of health literacy that can serve as targets for intervention were identified: (1) access and obtain, (2) understand, (3) process and appraise, and (4) apply and use relevant health information [7]. Furthermore, this multidimensional model has been utilized in several studies to identify salient health literacy factors specifically for HPV and cervical cancer-related health promotion [8, 10, 11]. For adults aged 27–45 who are newly eligible for HPV vaccination with a shared clinical decision, further exploration of how the various dimensions of health literacy facilitate this information processing is needed.

Since adults aged 27–45 potentially require increased health literacy to engage with providers to make the shared clinical decision for HPV vaccination, this study aims to evaluate associations between four domains of health literacy and willingness to get HPV vaccine if a provider recommends vaccination. It is hypothesized a priori that assessing various domains of health literacy will be more strongly associated with willingness to get HPV vaccine from a provider recommendation than personal determinants alone. Moreover, it is hypothesized a priori that there will be significant factors across multiple domains of health literacy

(i.e., finding, understanding, accessing, applying) associated with getting an HPV vaccine with provider recommendation.

Methods

Participants and Procedures

Data for this study were drawn from a cross-sectional survey where participants aged 27–45 years with no history of HPV vaccination were recruited online ($n = 691$). Participant recruitment was conducted using the Qualtrics online panel, and Qualtrics provided compensation to the participants. Due to higher HPV-related disparities among non-Hispanic Black and Hispanic populations [12], oversampling was performed for those groups. Recruitment was conducted between April and May 2020, and the study was approved by the North Texas Regional Institutional Review Board. Informed consent was obtained after the nature and possible consequences of the studies were fully detailed, prior to start of the survey.

Measures

The outcome of interest was willingness to receive the HPV vaccine with provider recommendation with the question asking, “How willing are you to get the HPV vaccine in the next six months if the doctor recommended it to you?” The response options were based on a 5-item Likert scale and ranged from “very willing” to “very unwilling.” Based on the distribution of data, the variable was dichotomized into “willing” (“very willing,” “willing”) and “not willing” (“neither willing nor unwilling,” “unwilling,” “very unwilling”).

Predictor variables were selected based on the Sørensen's multidimensional European Health Literacy Scale [13], which assesses health literacy among four domains (i.e., access, understanding, appraisal, application). For the *access* domain, to assess the ease of finding HPV vaccination information, participants were asked, “Please rate how easy it is for you to find information on HPV vaccination” with four response options ranging from “very easy” to “not easy,” dichotomized into “easy” (“very easy,” “easy”) and “not easy” (“somewhat easy,” “not easy”). The *understand* domain was assessed using two variables—ease of understanding HPV vaccination information and HPV knowledge score, based on a scale adapted from 2019 ACIP-recommended items to consider with shared decision-making: details on risk based on relationship status, sexual partnerships, and age, testing for HPV, efficacy of the vaccine, effectiveness of the vaccine, and prevention of HPV. Ease of understanding HPV vaccination information was assessed by asking, “Please rate how easy it is for you to understand information on HPV vaccination” with the four response

options dichotomized to “easy” (“very easy,” “easy”) and “not easy” (“somewhat easy,” “not easy”). HPV knowledge was assessed through a thirteen-item scale developed based on the recently modified HPV vaccine guidelines. The response options included “true,” “false,” and “don’t know.” Incorrect response and “don’t know” options were coded as incorrect. Participants received 1-point for each correct response, and responses were summed to derive the total score for each participant. A higher score indicated higher knowledge, with potential scores ranging from 0 to 13. The *appraisal* domain was assessed by asking participants about their perceived vulnerability to genital warts and cancer without the HPV vaccine. The question asked, “Without the HPV vaccine, what do you think your chances are that you will get... (i) genital warts; (ii) cancer at some point in your life?” with five response options dichotomized as “likely” (“very likely,” “likely”) and “not likely” (“neither,” “unlikely,” “very unlikely”). The *apply* domain was assessed by asking, “How much do you agree... I need more information about how well the HPV vaccine would work for me before I decide whether to get it or not.” The five response options were dichotomized to “agree” (“strongly agree,” “agree”) and “not agree” (“neither,” “disagree,” “strongly disagree”).

Personal health determinants included age, sex (female, male), race (White, Black, multiracial, other), ethnicity (Hispanic, non-Hispanic), education (high school or less, some college/trade school/2-year degree, Bachelor’s/4-year degree, graduate degree), insurance status (private, public, uninsured or don’t know), and marital status (married, single, other).

Data Analysis

Univariate descriptive statistics were conducted for all variables. Bivariate cross-tabulation was assessed with health literacy variables and the outcome (willingness to get HPV vaccine with provider recommendation). Model fit statistics were assessed for separate nested models with the outcome. Models included personal health determinant covariates, health literacy domains, controlling for other variables in the model. This was completed to determine whether all domains of health literacy combined is more strongly associated with willingness to get HPV vaccine from a provider recommendation versus personal health determinants alone.

The base model analyzed the outcome variable with the demographic and socioeconomic covariates. *Access* variables were then added to the model, then *understand* variables, followed by *appraisal* variables, and finally *application* variables. Each time variables were added to the model, the new model was compared to the previous model using a likelihood ratio chi-squared test to examine whether the added covariates significantly improved model fit. For additional

model fit analysis, Akaike information criterion (AIC) was also compared. AIC accounts for both, model goodness of fit and the simplicity of the model, mitigating overfitting and underfitting risks [14]. Lower AICs indicate better model fit. After establishing the final model, adjusted logistic regression analyzed the associations with willingness to get HPV vaccine with provider recommendation and all health literacy predictors, controlling for personal health determinants. All analyses were conducted using SAS 9.4 software.

Results

Sample—Descriptive and Bivariate Statistics

Table 1 presents personal health characteristics of the sample by willingness to vaccinate with provider recommendation. Overall, 65.3% of the 636 participants were willing to

Table 1 Sample personal health determinants by willingness to vaccinate for HPV with provider recommendation among participating US adults aged 27–45 ($n=691$), 2020

	Willingness to vaccinate with provider recommendation	
	Willing N (%)	Unwilling N (%)
Age ^a	36.4 (5.0)	36.8 (5.4)
Sex assigned at birth		
Male	245 (72.1)	95 (27.9)
Female	190 (54.1)	161 (45.9)
Race		
White	328 (64.2)	183 (35.8)
Black	28 (46.7)	32 (53.3)
Other	43 (63.2)	25 (36.8)
Mixed race	36 (69.2)	16 (30.8)
Hispanic ethnicity		
Yes	39 (67.2)	19 (32.8)
No	396 (62.6)	237 (37.4)
Education level		
High school degree or less	65 (46.4)	75 (53.6)
Some college/trade school/2-year degree	93 (47.2)	83 (47.2)
4-year degree	131 (65.8)	68 (34.2)
Graduate school	146 (83.0)	30 (17.1)
Insurance status		
Private insurance	270 (70.9)	111 (29.1)
Public insurance	124 (59.1)	86 (41.0)
None/don’t know	41 (41.0)	59 (59.0)
Marital status		
Single	124 (55.1)	101 (44.9)
Married	280 (68.8)	127 (31.2)
Other	31 (52.5)	28 (47.5)

^aMean, SD

vaccinate with a provider recommendation. Approximately half of the sample were assigned male at birth (49.2%), with an average age of 36.6 years ($SD=5.1$). Most participants identified as non-Hispanic (91.6%), White (74.5%), married (58.9%), with private insurance (55.1%). Education level was evenly distributed across the four categories, with most participants reporting Bachelor's/4-year degrees (28.8%). Regarding personal health characteristics, significant ($p<0.05$) bivariate associations with willing to vaccinate with a provider recommendation included age, sex assigned at birth, education level, marital status, and insurance status.

Health Literacy—Descriptive Statistics

Table 2 depicts the descriptive frequencies for willingness to vaccinate for the health literacy covariates. Many participants reported ease with finding (67.9%) and understanding (65.6%) HPV vaccination information versus participants who did not report ease in finding and understanding, respectively. Out of the possible 13 points, the average HPV knowledge score was 6.0 ($SD=2.8$). Most participants reported a likelihood of getting cancer (67.9%) and genital warts (65.6%) without the HPV vaccine compared to those who found these diagnoses unlikely. Lastly, most participants found it unlikely to get cancer (68.5%) and genital warts (72.1%) without the HPV vaccine versus a higher likelihood, indicating lower perceived vulnerability. For the unadjusted bivariate chi-square analysis (including t -tests for continuous HPV knowledge scores), willingness to vaccinate

with provider recommendation was significantly associated with all health literacy covariates ($p<0.05$).

Model Fit Statistics

For model fit statistics, 5 different models were compared: (1) personal determinant covariates only ($-2 \text{ Log } L=822$, $DF=13$, $AIC=850$); (2) personal and access covariates ($-2 \text{ Log } L=800$, $DF=14$, $AIC=830$); (3) personal, access, and understand covariates ($-2 \text{ Log } L=544$, $DF=16$, $AIC=578$); (4) personal, access, understand, and appraise covariates ($-2 \text{ Log } L=514$, $DF=18$, $AIC=552$); and (5) the full model—personal, access, understand, appraise, and apply covariates ($-2 \text{ Log } L=489$, $DF=19$, $AIC=528$). Each model had progressively lower $-2 \text{ Log } L$ values (with statistically significant [$p<0.05$] chi-square likelihood tests indicating that the larger model was better than the reduced model) and progressively lower AICs. Furthermore, the final model had the lowest AIC. Therefore, the adjusted logistic regression model for all health literacy and personal covariates were analyzed and interpreted (Table 3).

Willingness to Receive HPV Vaccination with Provider Recommendation

Table 3 displays the results from the final adjusted model for the associations between health literacy domains and willingness to receive the HPV vaccine after provider recommendation. Understand, appraise, and apply domains were significantly associated with willingness to receive HPV

Table 2 Descriptive frequencies and unadjusted p -values for health literacy covariates among US adults aged 27–45 ($n=691$), 2020

Health literacy covariates	Willingness to vaccinate with provider recommendation		p -value
	Willing N (%)	Unwilling N (%)	
Access: Easy to find information			<0.0001
Easy	329 (70.2)	140 (29.9)	
Not easy	106 (47.8)	116 (52.3)	
Understand: Easy to understand information			<0.0001
Easy	327 (72.2)	126 (27.8)	
Not easy	108 (45.4)	130 (54.6)	
Understand: HPV knowledge ^a	6.41 (2.40)	5.14 (3.24)	<0.0001
Appraise: Perceived vulnerability to cancer			<0.0001
Likely	183 (83.9)	35 (16.1)	
Unlikely	252 (53.3)	221 (46.7)	
Appraise: Perceived vulnerability to genital warts			<0.0001
Likely	158 (81.9)	35 (18.1)	
Unlikely	277 (55.6)	221 (44.4)	
Apply: Needs more safety info before making decision			<0.0001
Agree	85 (35.9)	152 (64.1)	
Disagree	350 (77.1)	104 (22.9)	

^aMean, SD ; higher scores = more knowledge, range = 0–13

Table 3 Adjusted odds ratio associations between four health literacy domains and willingness to get an HPV vaccination after a provider recommendation for US adults aged 27–45 ($n = 691$), 2020

<i>Health literacy covariates</i>	Willingness to vaccinate with provider recommendation
Access: Easy to find information	
Easy	0.92 (0.51, 1.66)
Not easy	Reference
Understand: Easy to understand information	
Easy	1.96 (1.09, 3.52)*
Not easy	Reference
Understand: HPV knowledge	1.13 (1.04, 1.24)*
Appraise: Perceived vulnerability to cancer	
Likely	3.22 (1.83, 5.69)*
Unlikely	Reference
Appraise: Perceived vulnerability to genital warts	
Likely	1.31 (0.70, 2.46)
Unlikely	Reference
Apply: Needs more safety info before making decision	
Agree	3.25 (2.05, 5.16)*
Disagree	Reference
Personal health determinants covariates	
Age	0.98 (0.94, 1.03)
Sex assigned at birth	
Female	Reference
Male	2.66 (1.63, 4.35)*
Race	
White	Reference
Black	0.83 (0.36, 1.94)
Other	1.18 (0.49, 2.83)
Multiracial	1.09 (0.46, 2.57)
Hispanic ethnicity	
Non-Hispanic	0.92 (0.41, 2.06)
Hispanic	Reference
Education level	
HS or less	1.20 (0.63, 2.30)
Some college/trade school/2-year degree	Reference
Bachelor's degree	1.33 (0.74, 2.37)
Graduate school	2.13 (1.07, 4.24)*
Insurance status	
Private insurance	Reference
Public insurance	1.12 (0.66, 1.90)
None/don't know	0.67 (0.33, 1.37)
Marital status	
Single	Reference
Married	1.21 (0.71, 2.04)
Other	1.12 (0.50, 2.50)

* p -value < 0.05

vaccine. Participants who found vaccine information easy to understand had almost twice the odds of being willing to vaccinate compared to participants who did not find the information easy to understand (aOR = 1.96; 95% CI 1.09, 3.52). With a one-unit increase in HPV knowledge score, the

odds of being willing to vaccinate increased (aOR = 1.13; 95% CI 1.04, 1.24). Additionally, participants who were more likely to have perceived vulnerability to cancer (aOR = 3.22; 95% CI 1.83, 5.69) and agreed that they needed more safety information before deciding (aOR = 3.25; 95%

CI 2.05, 5.16) had higher odds of being willing to vaccinate with a provider recommendation compared to participants with less perceived vulnerability to cancer and participants who did not need more safety information before deciding to vaccinate, respectively. Among the personal health determinants, males (aOR = 2.66; 95% CI 1.63, 4.35) compared to females and participants with graduate school education (aOR = 2.13; 95% CI 1.07, 4.24) compared to high school graduates had higher odds of being willing to vaccinate with provider recommendation.

Discussion

Due to the recent guideline change recommending the administration of the HPV vaccine to adults ages 27–45 years based on provider recommendation, we sought to assess associations between health literacy and willingness to receive the HPV vaccine with a provider recommendation among these recently eligible US adults. In this study, sex assigned at birth and education level were associated with the willingness to receive the HPV vaccine based on a provider recommendation. Furthermore, while access to HPV vaccination information was no longer significant when adjusting for all four domains of health literacy, a patient's willingness to receive the HPV vaccine based on a provider recommendation was associated with covariates that measured understanding, appraisal, and application of health information.

Since education level and ability to interpret and have a dialogue with a provider are critical, it is important to note that participants with graduate education had significantly higher odds of being willing to get the HPV vaccine with provider recommendation. One study that assessed HPV vaccination attitudes across high school, college, and graduate level students found no association between education level and HPV vaccine series completion [15]. Differences in findings could be attributed to the different age groups since the former study excluded adults over 26 years [15]. Moreover, participants assigned male at birth had a much higher odds of willingness to receive an HPV vaccine with provider recommendation, compared to those assigned female at birth. Similarly, in a study consisting of national sample of adolescent males, receiving a provider recommendation had over eight times the odds of initiating the HPV vaccination series than no recommendation [16]. Previous evidence highlights the disproportionately higher rates of HPV vaccine provider communication [17] and HPV vaccination completion [18] for women populations. In support of the higher odds of willingness to vaccinate among male participants, further research is needed to identify whether provider recommendation can serve as a potential avenue in

increasing HPV vaccination rates in males generally as well as males who fall within the newer guideline ages of 27–45.

Within the understand domain, knowledge and perceived ease of understanding HPV vaccine information was statistically associated with willingness to vaccinate with a provider recommendation, yet the participant's ability to find information about HPV vaccination (e.g., the access domain) was not. The findings for this study may be a result of improved accessibility to health information based on increased health information exposure on the internet and social media [19], as well as the survey collection via online sampling. Similarly, among a US sample of women aged 30–65, accessibility of cervical cancer information was not statistically significant yet cervical cancer knowledge and ability to understand cervical cancer information was significant [11]. A recent study assessing university students' HPV knowledge, vaccination status, and health literacy found significant associations between health literacy and HPV knowledge as well as health literacy and HPV vaccination status [20]. The current study supports on these findings, with a more robust health literacy assessment and newly eligible adults aged 27–45. The potential for augmenting or hindering a newly eligible adult's capacity to understand HPV knowledge and engage in a conversation with their provider about the HPV vaccine is critical. Future studies should account for significant health literacy skills regarding how easily people can understand HPV vaccination information accessed before provider conversations about HPV vaccination.

Within the appraisal domain of health literacy, perceived vulnerability to cancer was a significant correlate to HPV vaccination with a provider recommendation. A previous study found that adults 27–45 who perceived a benefit from HPV vaccination would be more likely to ask their health-care provider about the vaccine [4]. As such, these two findings may highlight an underlying phenomenon that persons who perceived they are vulnerable to cancer may characterize this risk as a potential benefit if vaccinated. Early work examining young adults' beliefs about HPV and cancer also found a connection between perceived vulnerability and HPV vaccination [21]. While the present study found perceived vulnerability for cancer to be associated with vaccination intention, perceived vulnerability for genital warts was not present. Thus, adults may be considering the more severe health outcome in their appraisal assessment.

In the application domain, people who needed more safety information had higher odds of being willing to vaccinate with provider recommendation, compared to people who disagreed with needing more safety information before making an HPV vaccination decision. This finding suggests that among those with limited information on vaccine safety, provider recommendation may play a stronger role than those who are less knowledgeable. A National Immunization

Survey-Teen study of parents with no intention to provide HPV vaccination to their adolescent daughters found that 18% of these parents reported safety and efficacy concerns [22]. Among 27- to 45-year-olds, most prefer to make vaccine decisions alone or in collaboration with their healthcare provider, and the results from this study align with previous data indicating a large proportion of individuals (ages 27–45) reported a need for more information about vaccine safety and efficacy prior to deciding to vaccinate [6]. Provider recommendation has been noted as a key predictor of HPV vaccination [23], and providers are encouraged to reframe not getting a vaccination as a decision, comparing safety risks with not getting the HPV vaccine to the minimal risks with obtaining the vaccine [24]. As message content from providers often includes information about vaccine efficacy and safety, a more in-depth examination of this complex relationship may be needed, especially in light of recent COVID-19 vaccination discussions about how safety and efficacy are determined [25].

Limitations

The current study has a few limitations to consider. Due to the cross-sectional design of the data collection, temporal sequence and causal inference could not be determined. Additionally, since the survey was collected online and was only written in the English language, those lacking adequate computer/Internet access and non-English speaking individuals were not included in the sample, which may introduce some selection bias. There is also a lack of language and acculturation information in the data collected, limiting our understanding of how these factors may have affected the results of the study. Although strongly associated, “willingness to get the HPV vaccine” does not definitively mean that the participants will get the HPV vaccine. Further research measuring actual vaccination behavior would be necessary to determine if these health literacy constructs provide a valid model for vaccination behavior. Furthermore, because the data collected were self-report, there may be misclassification due to social desirability bias or misunderstanding of survey questions.

Conclusion

Despite these limitations, this study evaluates health literacy and willingness to get an HPV vaccination with provider recommendation among a sample of US adults aged 27–45 who are eligible for HPV vaccination with shared clinical decision. Utilizing a multidimensional health literacy framework to evaluate barriers to and facilitators of HPV vaccination uptake among adults aged 27–45 barriers can help guide future interventions by targeting accurate,

easy-to-understand HPV information that connects vaccination efficacy to reduction in HPV cancer risk.

Author Contribution Annalynn M. Galvin: Conceptualization, methodology, formal analysis, writing—original draft, writing—review and editing, visualization; Ashvita Garg: Writing—original draft, writing—review and editing; Stacey B. Griner: Writing—original draft, writing—review and editing; Jonathan D. Moore: Writing—original draft, writing—review and editing; Erika L. Thompson: Conceptualization, methodology, writing—original draft, writing—review and editing.

Data Availability Not available.

Code Availability Not available.

Declarations

Ethics Approval The authors and project followed all ethical guidelines observed by the North Texas Regional Institutional Review Board.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Consent for Publication N/A.

Conflict of Interest Author Erika Thompson is a consultant to Merck. The other authors declare no competing interests.

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