

Predictors of Adults' Knowledge and Awareness of HPV, HPV-Associated Cancers, and the HPV Vaccine: Implications for Health Education

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Abstract

High human papillomavirus (HPV) prevalence and low HPV vaccine uptake are significant public health concerns. Disparities in HPV-associated cancers and HPV vaccine uptake rates suggest the need for additional research examining factors associated with vaccine acceptance. This study assessed HPV awareness and knowledge and identified sociodemographic characteristics associated with HPV knowledge at the population level. Data from adult men ($n = 1,197$) and women ($n = 1,906$) who participated in the National Cancer Institute's 2014 Health Information National Trends Survey were analyzed. Multivariable regression was used to identify predictors of four HPV knowledge categories: (1) general knowledge, (2) cervical cancer knowledge, (3) "other" cancer knowledge (i.e., anal, oral, penile), and (4) vaccine knowledge. Significant gender differences in awareness and knowledge of HPV and the HPV vaccine were revealed. Most participants (>70%) knew that HPV could cause cervical cancer, but fewer (14.9% to 31.5%) knew of the association between HPV and "other" cancers. Women were more likely to report that a health care provider recommended vaccination. Significant predictors of general HPV and HPV vaccine knowledge included gender, education, income, race, and other sociodemographic characteristics. Age and income predicted cervical cancer knowledge. Knowledge of "other" HPV-associated cancers was predicted by having a child under 18 years in the household and relationship status. HPV knowledge appears to be socially patterned. Low HPV knowledge among men and some racial minorities suggests a need for further intervention. Health education should emphasize risks of noncervical HPV-associated cancers. Patient-provider communication that includes education, counseling, and clear recommendations favoring vaccination may improve uptake.

Keywords

awareness, cancer, health disparities, HPV, knowledge, vaccine

In the United States, the human papillomavirus (HPV) is ubiquitous, and most sexually active individuals will be infected during their lifetime (Myers, McCrory, Nanda, Bastian, & Matchar, 2000; Satterwhite et al., 2013). While the majority of infections are asymptomatic and transient and will clear within 2 years, persistent oncogenic (high-risk) infections have been linked to genital, anogenital, and oropharyngeal cancers in men and women (Cutts et al., 2007; Jemal et al., 2013; Patel, Wagner, Singhal, & Kothari, 2013). Estimates suggest HPV is associated with 90% of anal and cervical cancers, 70% of vulvar and vaginal cancers, and over 60% of penile cancers (Centers for Disease Control and Prevention, 2014). Head and neck cancers are among the 10 most common forms of cancer worldwide, and rates of oropharyngeal cancers are predicted to exceed cervical cancer by 2020 (Chaturvedi et al., 2011).

Three prophylactic vaccines have been approved for HPV and are licensed by the U.S. Food and Drug Administration (Handler, Handler, Majewski, & Schwartz, 2015). Currently, a two-dose schedule is recommended (Meites, Kempe, & Markowitz, 2016); however, vaccine coverage among all eligible groups remains low, with males representing the most undervaccinated segment of the population despite increased risk for oropharyngeal cancers among all men and anal cancers in men who have sex with men (Daniel-Ulloa, Gilbert,

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& Parker, 2016; Peng-jun et al., 2015; Prue, Lawler, Baker, & Warnakulasuriya, 2016; Wilkinson et al., 2014). In 2014, 39.7% of girls and 21.6% of boys ages 13 to 17 years had received all doses in the series (Reagan-Steiner et al., 2015). In comparison, several countries have documented vaccine coverage rates among girls, ranging from 60.5% to 91.5% (Australian Government Department of Health and Ageing, 2011; Potts et al., 2013; Sheridan & White, 2010).

Public health research suggests that awareness and knowledge of HPV are important to vaccine acceptance and uptake (Beavis & Levinson, 2016; Foley et al., 2015; Galbraith et al., 2016; Kessels et al., 2012). However, systematic investigation has documented highly variable levels of knowledge and awareness (Beshers, Murphy, Fix, & Mahoney, 2015; Blake et al., 2015; Daley et al., 2011; Pierre et al., 2014; Reimer, Schommer, Houlihan, & Gerrard, 2014), and recently published research found that only 68% of respondents from a nationally representative sample of U.S. adults had heard of HPV and the HPV vaccine (Blake et al., 2015).

It is worthy to note that most of the existing HPV awareness and knowledge research has assessed only cervical cancer despite the fact that incidence of noncervical infection is high among men and women (Taylor, Bunge, Bakker, & Castellsague, 2016). Studies that have investigated knowledge of noncervical HPV-associated health outcomes suggest that most individuals know little about the association between HPV and noncervical cancers (Davlin, Berenson, & Rahman, 2015; Fenkl, Jones, Schochet, & Johnson, 2016; Giuliani et al., 2016; Nadarzynski, Smith, Richardson, Jones, & Llewellyn, 2014; Wisk, Allchin, & Witt, 2014).

Additional examination of knowledge and awareness of noncervical HPV-related cancers, by itself and in relation to other types of HPV awareness and knowledge, may provide information that has important implications for vaccine uptake. For example, parents are often the vaccine decision makers for their children, and understanding parental knowledge and awareness of noncervical HPV-associated cancers may be critical to improving coverage rates among all children. Men and the parents of boys may benefit from increased awareness of the disproportionate rates of HPV-associated head and neck cancers in males, while men who have sex with men may benefit from information that addresses increased risk for anal cancers. Prevention efforts may use findings to develop tailored educational approaches that include information about noncervical HPV-associated cancer risks that are most salient to the targeted audiences. In addition, findings may be used as evidence to support the need for systems-level interventions that reduce structural barriers to vaccination, screening, and treatment.

The purpose of this study was to examine HPV-related awareness and knowledge among a population-based sample of U.S. adults. Specifically, we sought to assess differences in general awareness and knowledge of HPV, awareness and knowledge of HPV-associated cervical cancer, awareness and knowledge of noncervical or "other" HPV-associated

cancers (anal, penile, and oral cancer), and the HPV vaccine. The contribution of sociodemographic characteristics to awareness and knowledge was explored.

Method

Cross-sectional survey data from U.S. adults ($N = 3,103$) were obtained from the National Cancer Institute's Health Information National Trends Survey (HINTS; 2014) fourth iteration, Cycle 4 (HINTS 4, Cycle 4). Data were collected by questionnaires mailed between August 19 and November 17, 2014. The sample was obtained through a two-stage, stratified process wherein addresses were randomly selected from a U.S. Postal Service file of residential addresses, and respondents were selected from each household sampled. The response rate was 34.44%. HINTS 4 Cycle 4 was approved by the Westat Institutional Review Board in an expedited review in November 2010, and considered exempt from Institutional Review Board's review by the National Institutes of Health Office of Human Subjects Research (No. 5567) in January 2011. Full descriptions of HINTS 4 Cycle 4 methodology have been published elsewhere (HINTS, 2014).

Measures

HPV, HPV-associated cancer, and HPV vaccine awareness and knowledge items from HINTS 4 Cycle 4 were analyzed. We combined items to assess four knowledge categories:

General HPV Knowledge. General HPV knowledge items were the following: (1) Have you ever heard of HPV? (2) Do you think that HPV is a sexually transmitted disease? (3) Do you think HPV (a) requires medical treatment or (b) will go away on its own without treatment? All the item responses were coded as categorical, and sum of the three items were used in the analysis. This scale to measure General HPV knowledge was coded as a continuous variable with scores ranging from 0 to 3 and had internal consistency (Cronbach's α) coefficient of .63.

HPV-Associated Cervical Cancer Knowledge. HPV-associated cervical cancer knowledge was assessed with a single item: (1) Do you think HPV causes cervical cancer? This item response was coded as a categorical variable (yes/no).

HPV-Associated "Other" Cancer Knowledge. Other HPV-associated cancer knowledge was assessed by the following items: (1) Do you think HPV causes anal cancer? (2) Do you think HPV causes penile cancer? (3) Do you think HPV causes oral cancer? Individual item responses were coded on a 3-point scale (1 = *yes*, 2 = *no*, 3 = *not sure*) and were further dichotomized (yes/no). Sum of the three items were used in the analysis, and this scale to measure HPV-associated other cancer knowledge was coded as a continuous variable with scores ranging from 0 to 3 and had internal consistency (Cronbach's α) coefficient of .82.

HPV Vaccine Knowledge. HPV vaccine items were as follows: (1) Before today, have you ever heard of the cervical cancer vaccine or HPV shot? (2) How successful is the HPV vaccine at preventing cervical cancer? (3) In the past 12 months, has a doctor ever talked with you or immediate family member about the HPV shot or vaccine? (4) In the past 12 months, has a doctor ever recommended that you or immediate family member about the HPV shot or vaccine? Individual item responses were dichotomized (yes/no), and sum of the three items were used in the analysis. This scale to measure HPV vaccine knowledge was coded as a continuous variable with scores ranging from 0 to 4 and had internal consistency (Cronbach's α) coefficient of .70.

Sociodemographic Characteristics

Sociodemographic variables included in analysis were sex, age, race, Hispanic ethnicity, education, marital status, household income, having a child under age 18 living in the household, self or immediate family member between the ages of 9 and 26, and employment status. Each variable was categorized as follows: sex (female/male), age (18-34, 35-49, 50-65, >65 years), race (White, Black, Asian), ethnicity (Hispanic: Yes/No), education (some high school, high school graduate, some college, college graduate), marital status (married, never married, divorced/widowed/separated), household income (<\$50,000, \$50,001-\$99,999, and \geq \$100,000), child under 18 years living in the household (yes/no), self or immediate family member between ages of 9 and 26 (yes/no), and employment status (employed, unemployed).

Statistical Analysis

Analyses were conducted in 2016 using STATA-SE, Version 13.1, to allow appropriate weighting of the complex survey design of HINTS and to provide representative estimates of the U.S. population. A full-sample weight was used to calculate population estimates, and 50 replicate weights, calculated using jackknife variance estimation method, were used to compute standard errors. Weighted, unadjusted prevalence estimates were calculated for HPV-related items in HINTS 4 Cycle 4, to assess HPV awareness and knowledge. Weighted multivariable regression models were used to test predicted probability that sociodemographic characteristics each independently predict HPV knowledge, HPV-associated cervical cancer knowledge, HPV-associated "other" cancer knowledge, and HPV vaccine knowledge, controlling for the contribution of other sociodemographic factors.

Results

Table 1 summarizes the sociodemographic characteristics of the sample. The majority of respondents were White, under age 50, had some college education or were college graduates, were married, were employed, and had no children

Table 1. Respondent Demographics Characteristics, HINTS 4 Cycle 4, 2014.

Demographics characteristic	Men (total N = 1,424), n (%)	Women (total N = 2,184), n (%)
Age (years)		
18-34	141 (32.01)	323 (29.61)
35-49	265 (27.15)	472 (26.27)
50-65	544 (26.31)	766 (26.71)
>65	419 (14.53)	530 (17.41)
Education		
Some high school	102 (9.73)	202 (13.36)
High school graduate	237 (16.55)	424 (19.86)
Some college	442 (27.07)	632 (32.32)
College graduate	595 (46.65)	852 (34.45)
Marital status		
Married	840 (58.33)	958 (54.60)
Never married	229 (31.96)	356 (25.89)
Divorce/widow/separated	300 (9.71)	783 (19.51)
Household income, \$		
<50,000	595 (40.09)	1,122 (52.79)
50,001-99,999	380 (32.15)	536 (30.06)
\geq 100,000	297 (27.76)	307 (16.61)
Employment status		
Employed	710 (65.56)	1,042 (55.78)
Unemployed	642 (34.44)	1,013 (44.22)
No. of children under 18 years in household		
0	970 (65.42)	1,357 (62.79)
\geq 1	306 (34.58)	609 (37.21)
Hispanic ethnicity		
Yes	198 (15.07)	335 (15.02)
No	1,107 (49.93)	1,630 (84.98)
Race		
White	838 (67.52)	1,109 (65.88)
Black	167 (9.42)	359 (12.97)
Asian	57 (6.17)	66 (3.55)
Others	26 (1.70)	75 (2.53)

Note. HINTS = Health Information National Trends Survey.

under the age of 18 living in the household. Nearly 41% of the sample reported that they or an immediate family member and were between the ages of 9 and 26 years.

Significant gender differences in general HPV knowledge were found, with more women reporting that they had heard of HPV when compared to men (see Table 2). The majority of men and women believed that HPV is transmitted through sexual contact and requires medical treatment. Knowledge of the link between HPV and other cancers was universally low. Men were significantly more likely than women to report having heard of the HPV vaccine, but no gender differences were found in beliefs regarding the vaccine's effectiveness at preventing cervical cancer. While there was no gender difference in the percentage of respondents who indicated that a doctor had ever talked to them or an immediate family member about

Table 2. Weighted, Unadjusted Population Estimates for HPV Knowledge, HPV-Associated Cervical Cancer Knowledge, HPV-Associated Other Cancer Knowledge, and HPV Vaccine Knowledge by Gender, HINTS 4 Cycle 4, 2014.

Variable	Men, %	Women, %
HPV knowledge		
Have you ever heard of HPV?	43.8***	59.72***
Do you think you can get HPV through sexual contact?	73.30	67.38
Do you think HPV requires medical treatment?	88.89	89.39
will usually go away on its own without treatment?	11.11	10.61
HPV-associated cervical cancer knowledge		
Do you think HPV can cause cervical cancer?	76.12	79.31
HPV-associated other cancer knowledge		
Do you think HPV causes anal cancer?	29.92	28.92
Do you think HPV causes penile cancer?	27.11	14.97
Do you think HPV causes oral cancer?	31.50	28.75
HPV vaccine knowledge		
Before today, have you ever heard of the cervical cancer vaccine or HPV shot?	47.28***	25.61***
How successful is the HPV vaccine at preventing cervical cancer?	22.68	25.97
Has a doctor ever talked with you or immediate family member about the HPV shot or vaccine?	22.71	38.49
Has a doctor ever recommended that you or immediate family member about the HPV shot or vaccine?	18.13***	32.83***

Note. HPV = human papillomavirus; HINTS = Health Information Trends National Survey.

*** $p < .001$.

the HPV vaccine in the past 12 months, significantly more women reported that a doctor had *recommended* the HPV vaccine for them or an immediate family member when compared to men.

Results of the regression analysis (see Table 3) examining predictors of general HPV knowledge suggest that knowledge is significantly and positively associated with being female ($b = .49$, $SE = .07$, $p = .000$); having some college education ($b = .56$, $SE = .18$, $p = .004$) or a college degree ($b = .62$, $SE = .19$, $p = .002$); being divorced, widowed, or separated ($b = .19$, $SE = .08$, $p = .02$); and having an annual income between \$50,000 and \$99,000 ($b = .22$, $SE = .07$, $p = .006$) or over \$100,000 ($b = .33$, $SE = .10$, $p = .003$). Being over age 65 years ($b = -.75$, $SE = .13$, $p = .000$), Black race ($b = -.39$, $SE = .15$, $p = .011$), or Asian race ($b = -.81$,

$SE = .24$, $p = .002$) was significantly and negatively associated with general HPV knowledge.

The only significant positive predictor cervical cancer knowledge was having an income over \$100,000 per year ($b = .11$, $SE = .04$, $p = .021$; see Table 3). The only significant negative predictor of cervical cancer knowledge was age 50 to 65 years ($b = -.09$, $SE = .04$, $p = .020$). When examining knowledge of other HPV-associated cancers, it was found that being never married ($b = .10$, $SE = .04$, $p = .013$) or having a child under 18 years living in the household ($b = .10$, $SE = .03$, $p = .003$) was significantly and positively associated with knowledge.

Significant positive predictors of HPV vaccine knowledge were being female ($b = .50$, $SE = .05$, $p = .000$), a college graduate ($b = .27$, $SE = .12$, $p = .039$), never married ($b = .25$, $SE = .10$, $p = .013$), having a child under 18 years living in the household ($b = .43$, $SE = .09$, $p = .000$), an annual income between \$50,000 and \$99,999 ($b = .26$, $SE = .09$, $p = .006$), or an annual income over \$100,000 ($b = .43$, $SE = .10$, $p = .000$). Asian race ($b = -.49$, $SE = .17$, $p = .006$) was the only significant negative predictor of vaccine knowledge.

Discussion

Results suggest that general HPV knowledge and awareness are highly variable and influenced by sociodemographic characteristics. Only 60% of women and 44% of men reported having ever heard of HPV, which is well below rates reported in other published research (Blake et al., 2015; Sherman et al., 2016). The examination of sociodemographic predictors suggests that gender, age, education, relationship status, income, and race are associated with general HPV knowledge. These findings reinforce that disparities in general HPV awareness and knowledge warrant attention, particularly given ongoing disparities in vaccine uptake, general undervaccination of eligible groups in the United States, and higher observed rates of certain HPV-associated cancers among men and racial/ethnic minorities (Centers for Disease Control and Prevention, 2014).

Knowledge and awareness of the association between HPV and cervical cancers were high, but knowledge of the link between HPV and noncervical cancers was universally low. To date, awareness and knowledge of the association between HPV and noncervical cancers have not been a focus of systematic investigation or reporting in the scientific literature. The few studies that have provided documentation report similar findings (Davlin et al., 2015; Fenkl et al., 2016; Giuliani et al., 2016; Nadarzynski et al., 2014; Wisk et al., 2014).

The results specific to vaccine awareness and knowledge and gender are somewhat inconsistent with past research that has shown that women consistently demonstrate higher levels of knowledge and awareness (Beshers et al., 2015; Blake et al., 2015; Reimer et al., 2014). In the current study, the percentage of men indicating that they had ever heard of the vaccine (awareness) was significantly higher when compared to women;

Table 3. Weighted, Fully Adjusted Multivariable Regression Models Predicting HPV Knowledge, HPV-Associated Cervical Cancer Knowledge, HPV-Associated Other Cancer Knowledge, and HPV Vaccine Knowledge, by Sociodemographic Variables, HINTS 4 Cycle 4, 2014.

Variable	HPV knowledge, coefficient (SE)	HPV cervical cancer knowledge, coefficient (SE)	HPV other cancer knowledge, coefficient (SE)	HPV vaccine knowledge, coefficient (SE)
Age (years)				
18-34	Ref.	Ref.	Ref.	Ref.
35-49	-.14 (.11)	-.03 (.03)	.00 (.04)	.00 (.12)
50-65	-.19 (.10)	-.09 (.04)*	-.00 (.04)	-.11 (.10)
>65	-.75 (.13)***	-.01 (.06)	-.06 (.05)	-.37 (.12)
Sex				
Female	.49 (.07)***	.05 (.13)	.05 (.02)	.50 (.05)***
Male	Ref.	Ref.	Ref.	Ref.
Education				
Some high school	Ref.	Ref.	Ref.	Ref.
High school graduate	.20 (.18)	.02 (.10)	.04 (.05)	-.03 (.13)
Some college	.56 (.18)***	.10 (.09)	.10 (.05)	.22 (.11)
College graduate	.62 (.19)***	.13 (.09)	.10 (.06)	.27 (.12)*
Marital status				
Married	Ref.	Ref.	Ref.	Ref.
Never married	.15 (.11)	.05 (.04)	.10 (.04)*	.25 (.10)*
Divorce/widow/separated	.19 (.07)*	.01 (.03)	.05 (.03)	.02 (.07)
Child under 18 years in household				
Yes	.17 (.10)	-.00 (.04)	.10 (.03)**	.43 (.09)***
No	Ref.	Ref.	Ref.	Ref.
Income, \$				
<50,000	Ref.	Ref.	Ref.	Ref.
50,001-99,999	.22 (.07)**	.05 (.04)	-.01 (.04)	.26 (.09)**
≥100,000	.33 (.10)**	.11 (.04)*	.03 (.05)	.43 (.10)***
Employment status				
Employed	Ref.	Ref.	Ref.	Ref.
Unemployed	-.02 (.09)	-.03 (.22)	-.03 (.03)	-.06 (.09)
Hispanic ethnicity				
Hispanic	-.15 (.13)	.00 (.05)	-.04 (.04)	-.06 (.09)
Not Hispanic	Ref.	Ref.	Ref.	Ref.
Race				
White	Ref.	Ref.	Ref.	Ref.
Black	-.40 (.15)**	-.09 (.05)	-.05 (.05)	-.20 (.16)
Asian	-.81 (.24)**	.02 (.06)	-.12 (.06)	-.49 (.17)**
Others	-.36 (.26)	.00 (.06)	-.01 (.09)	-.10 (.24)

Note. HPV = human papillomavirus; HINTS = Health Information National Trends Survey; Ref. = reference category. *** $p < .001$. ** $p < .01$. * $p < .05$: statistical significance.

however, being a woman was found to be a significant, positive predictor of actual vaccine knowledge. We hypothesize that these discrepancies may be attributable to the analytic approach and, more specifically, the creation of knowledge categories. While more men in the sample may have heard of the HPV vaccine (awareness), the effect of male gender on actual knowledge disappears in the regression analysis when other sociodemographic characteristics are added to the model.

Given the significant emphasis placed on vaccine efficacy, it was notable to find that the majority of respondents did *not* believe that the vaccine is effective at preventing cervical cancer. While there were no significant differences noted in

the percentage of men versus women who reported having talked to a doctor about the HPV vaccine, women were significantly more likely to have received a doctor's recommendation to vaccinate. Past research suggests a gender bias in patient-provider communication that favors women and parents of girls receiving vaccination recommendations over men and parents of boys (Gerend, Shepherd, Lustria, & Shepherd, 2016; Gilkey et al., 2016; Gilkey & McRee, 2016; Lindley et al., 2016; Luque, Tarasenko, Dixon, Vogel, & Tedders, 2014). Gender bias, combined with the fact that the vaccine has only been recommended for males since 2011, may help explain the current findings.

Implications for Practice

Collectively, the study findings provide critical information for health education research and practice. First, knowledge and awareness of most aspects of HPV were low despite ongoing efforts to improve both. Intervention studies have reported that information has positive effects on intent to vaccinate and vaccine uptake (Obulaney, Gilliland, & Cassells, 2016; Paskett et al., 2016; Weinstein et al., 2016). However, a recent systematic review of the literature that examined intervention efficacy concluded that informational interventions alone are likely insufficient to create lasting changes in vaccine uptake rates (Walling et al., 2016). Our results suggest that there is a continued need for HPV educational interventions. Testing the effectiveness of educational interventions alone, and in combination with other strategies, should be a priority.

Second, there was a general lack of awareness and knowledge of the link between HPV and noncervical HPV-associated cancers. This finding is particularly important given evidence that suggests personal relevance (e.g., perceptions of personal risk, direct personal benefits of vaccination) can influence vaccine decision making. Higher perceived risk for HPV and higher perceived benefits of vaccination have been associated with acceptability and intentions to vaccinate among individuals (Donadiki et al., 2014; Fontenot, Fantasia, Charyk, & Sutherland, 2014; Newman, Logie, Doukas, & Asakura, 2013; Zimet, Weiss, Rosenthal, Good, & Vichnin, 2010) and parents (Holman et al., 2014; Krawczyk et al., 2015; Reiter, Gilkey, & Brewer, 2013). Research has found that men are more willing to endorse vaccine acceptance when male-specific HPV-related health outcomes (e.g., disproportionate rates of oropharyngeal cancer, penile cancer) are emphasized (Bonafide & Venable, 2015). Based on these findings, educational interventions that emphasize the risk for noncervical HPV-associated cancers may be particularly effective at increasing vaccine uptake among men and the parents of boys.

The documentation of low levels of awareness and knowledge of noncervical HPV-associated cancers also has methodological relevance. To date, much of the existing literature has assessed knowledge and awareness of cervical cancer, with less attention being given to the assessment of knowledge and awareness of the association between HPV and noncervical HPV-associated cancers. The existing body of knowledge will be enhanced by increased specificity in measurement. The inclusion of items that measure awareness and knowledge of noncervical cancers will provide the data that are needed to improve intervention strategies.

Finally, low levels of vaccine knowledge and the belief that the vaccine is not effective at preventing cervical cancer indicate the need for ongoing education at the population level. Patient-provider interactions present opportunities to address misconceptions about risk, efficacy, and other salient factors that influence decision making, but few participants

reported having discussed the vaccine with a health care provider, and even fewer reported receiving a recommendation to vaccinate. Scientific evidence indicates that clear patient-provider communication, which includes strong recommendations to vaccinate, positively influences vaccine uptake (Bratic, Seyferth, & Bocchini, 2016; Dempsey et al., 2016; Gerend et al., 2016; Moss, Reiter, Rimer, & Brewer, 2016; Smith, Stokley, Bednarczyk, Orenstein, & Omer, 2016; Valentino & Poronsky, 2016). Data from the 2013 National Immunization Survey-Teen found that provider recommendation was among the top five reasons that parents vaccinated daughters and the number one reason that parents vaccinated sons (Stokley et al., 2014). Health care providers should make concerted efforts to systematically integrate strong, unambiguous vaccine recommendations during encounters with all patients and parents. Gender bias should be addressed as part of the routine education and training of health care providers. The implementation of systems-level strategies, including policy, that routinize recommendations to vaccinate has the potential to improve uptake.

Limitations

HINTS data are self-reported and collected at one point in time. Causal inferences, temporal associations, and associations between awareness, knowledge, and actual behavior (i.e., vaccination) cannot be made. HINTS measures Americans' needs for, access to, and use of a variety of cancer-related health information and does not exclusively focus on HPV-associated cancers or HPV awareness and knowledge. Low response rates and incomplete questionnaires, particularly among racial/ethnic minorities, may have led to bias in the data. However, significant efforts were made to limit any biases through sampling and other procedures (HINTS, 2014).

A fairly large percentage of the sample was over the age of 50 years and/or reported no children under the age of 18 living in the household; however, just over 40% said that they or an immediate family member were age-eligible (i.e., 9-26 years) for vaccination. The documentation of older adults' awareness and knowledge does have relevance. First, emphasis is being placed on catch-up vaccination through the age of 26 years, and older adults may have a child living outside the household who would benefit from receiving catch-up vaccination. Second, because older women are still affected by HPV and may transmit the infection to others (Dunne et al., 2007), some researchers are suggesting that older women be offered the option of off-label vaccination given the likelihood of benefit (Dempsey, Brewer, Pyrzanowski, Sevic, & o'leary, 2015). There are data that suggest vaccine efficacy in older women (Schiller, Castellsague, & Garland, 2012; Schwartz et al., 2011), and some countries have licensed the vaccine for women up to age 45 years (Mazza, Petrovic, Grech, & Harris, 2014). Dempsey et al. (2015) found that 50% of their sample of

women ages 26 to 77 years who had not been previously vaccinated reported that they would want the vaccine within the following 12 months if it were recommended and available. Currently, providers are able to vaccinate women and men off-label at their discretion; thus, older adults' knowledge and awareness of HPV may have relevance in this context.

Conclusions

General HPV knowledge, HPV-related cancer knowledge, and HPV vaccine knowledge are influenced by sociodemographic characteristics. HPV vaccine uptake is still well below articulated targets, particularly among the groups identified in this study as having low general HPV knowledge. The HPV vaccine is an important cancer prevention tool, and improving HPV knowledge may be critical to improving vaccine uptake. Research further exploring the link between sociodemographic characteristics, HPV awareness and knowledge, and vaccine uptake is needed. Research that examines knowledge of noncervical HPV-associated cancers should be a priority given the importance of personal relevance in vaccine decision making. Continued investigation of intervention strategies and the documentation of their performance will improve health educators' abilities to effectively influence uptake. The patient-provider relationship is also critical to vaccine acceptance and deserves continued attention in public health research and practice.

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