Published in final edited form as:

Am J Prev Med. 2015 April ; 48(4): 402–410. doi:10.1016/j.amepre.2014.10.024.

Predictors of Human Papillomavirus Awareness and Knowledge in 2013:

Gaps and Opportunities for Targeted Communication Strategies

Kelly D. Blake, ScD, Allison J. Ottenbacher, PhD, Lila J. Finney Rutten, PhD, MPH, Meredith A. Grady, MPH, Sarah C. Kobrin, PhD, MPH, Robert M. Jacobson, MD, and Bradford W. Hesse, PhD

Branches of Health Communication and Informatics Research (Blake, Grady, Hesse), Science of Research and Technology (Ottenbacher), and Process of Care Research (Kobrin), Behavioral Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, Maryland; and the Department of Health Sciences Research (Rutten, Jacobson), Division of Epidemiology, Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery, Mayo Clinic, Rochester, Minnesota

Abstract

Background—Nearly 80 million people in the U.S. are currently infected with at least one of two strains of human papillomavirus (HPV), which is associated with 70% of cervical cancers. Greater cervical cancer mortality has been observed among women of lower SES and those living in rural, versus urban, areas. African American and Hispanic women are significantly more likely to die from cervical cancer than non-Hispanic white women.

Purpose—To assess current population awareness of and knowledge about HPV and the HPV vaccine, as well as the contribution of sociodemographic characteristics to disparities in HPV awareness and knowledge.

Methods—Cross-sectional data were obtained from the National Cancer Institute's 2013 Health Information National Trends Survey (HINTS; N=3,185). Multivariable logistic regression was employed to identify gaps in awareness and knowledge by sex, education, income, race/ethnicity, geographic area, and other important sociodemographic characteristics. Analyses were conducted in 2014.

Results—Sixty-eight percent of Americans had heard of HPV and the HPV vaccine. Consistent with the Knowledge Gap Hypothesis, awareness and knowledge were patterned by sex, age, education, and other important sociodemographic factors. Those in rural areas were less likely than those in urban areas to know that HPV causes cervical cancer. Less than 5% of Americans were aware that HPV often clears on its own without treatment.

Address correspondence to: Kelly D. Blake, 9609 Medical Center Drive, Room 3E626, MSC 9671, Bethesda MD 20892-9671. kelly.blake@nih.gov.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

No financial disclosures were reported by the authors of this paper.

Conclusions—Although awareness and knowledge of HPV is increasing, there are opportunities to target communication with populations for whom knowledge gaps currently exist, in order to promote dialogue about the vaccine among patients and their providers.

Introduction

Nearly 80 million Americans are infected with at least one strain of human papillomavirus (HPV).¹ By age 50 years, approximately 80% of sexually active U.S. women have been infected with HPV.² Not all types of HPV cause cancer. At least 12 high-risk virus types have been identified as cancer-causing, of which just two types (HPV 16 and 18) account for 70% of cervical cancer cases.³ These two types also contribute to cancers of the vulva, vagina, anus, and penis.³ HPV infection causes other anogenital and oropharyngeal cancers, with significant increases observed over the last two decades.^{4,5}

Most high-risk HPV infections occur without symptoms and go away on their own within 1–2 years.³ These high-risk HPV infections may persist and progress to cancer. Each year in the U.S., 33,000 new cases of HPV-caused cancers occur.⁶ Cervical cancer affects females at a rate of >12,000 new cases annually, with 4,000 deaths per year.^{6,7} Greater cervical cancer mortality has been observed among women of lower SES and those living in rural areas. African American and Hispanic women are more likely to die from cervical cancer than non-Hispanic white women.^{8,9}

The U.S. Food and Drug Administration (FDA) has approved two HPV vaccines: Gardasil® for the prevention of cervical, anal, vulvar, and vaginal cancer, as well as precancerous lesions and genital warts also caused by HPV; and Cervarix® for the prevention of cervical cancer and precancerous cervical lesions. Both vaccines are highly effective in preventing infections with HPV types 16 and 18.^{5,10} Gardasil also prevents infection with HPV types 6 and 11, which cause genital warts and recurrent respiratory papillomatosis. The vaccines have not been approved for prevention of penile or oropharyngeal cancer. Although the HPV vaccine targets the two most virulent types of HPV, it does not protect against all types, and must be used in conjunction with proven screening strategies that incorporate Pap and HPV testing at recommended intervals to prevent cervical cancer.

The most recent survey of vaccination uptake and completion in the U.S. revealed that, in 2012, among female patients aged 13–17 years, 53.8% had received the first dose in the three-dose series, and 33.4% completed the series.¹¹ This completion rate is lower than that of the previous year, and rates of initiation for HPV vaccination are increasing at a slower rate than other recently licensed vaccines for adolescents.¹¹ In December 2011, the U.S. Advisory Committee on Immunization Practices recommended routine use of HPV vaccination for male patients.¹² In 2012, 20.8% of male 13–17-year-olds had received the first dose and 6.8% completed the series.¹¹ The President's Cancer Panel released a 2014 report urging increased uptake of the HPV vaccine among adolescent girls and boys.¹³ Current vaccination rates for girls fall short of the *Healthy People 2020* goal of having 80% of girls aged 13–15 fully vaccinated.

Potential reasons for why vaccine uptake is slower than desired are complex. Although awareness and knowledge are not sufficient to spur preventive behavior, they are critical components of any health promotion strategy. The “Knowledge Gap Hypothesis”¹⁴ observes that absent some conditions, the flow of information on a given topic can lead to differential learning among members of certain groups, delineated by SES, race and ethnicity, or geographic area.¹⁵ Examining the role of inequalities in HPV awareness and knowledge can contribute to the knowledge base in communication inequality research and to practice strategies that aim to ameliorate modifiable constraints on behavior, as awareness and knowledge across groups can and should be increased to achieve equal levels of vaccine uptake.

Previous research has sought to identify factors associated with HPV awareness and knowledge. An analysis of data from the National Cancer Institute’s (NCI) Health Information National Trends Survey (HINTS) collected in 2005 revealed low awareness among women, with 40% of women having ever heard of HPV.¹⁶ These same data showed that among women who had heard of HPV, less than half were aware of its causal link to cervical cancer.¹⁶ Although more recent analyses of HINTS data show that overall population knowledge has improved, with 65% of the population having heard of HPV in 2008,^{17–22} disparities in awareness of and knowledge about HPV have been identified among immigrant and minority populations, and among non-Internet users.^{17,22,23}

The objective of this study is to assess current population awareness and knowledge of HPV and the HPV vaccine and the contribution of sociodemographic characteristics to disparities in HPV awareness and knowledge by sex, age, education, race/ethnicity, family size, income, geography, insurance status, and Internet use.

Methods

Data

Data were obtained from NCI’s HINTS fourth iteration, Cycle 3 (HINTS 4, Cycle 3), a cross-sectional survey of the U.S. adult, civilian, non-institutionalized population. Data were collected by questionnaires mailed from September through December 2013. The sample design was a two-stage, stratified sample wherein addresses were randomly selected from a U.S. Postal Service file of residential addresses, and individual respondents were selected from each sampled household (response rate=35.19%; N=3,185). HINTS 4 methodology details have been published elsewhere.²⁴ HINTS 4 was approved by the Westat IRB in an expedited review in November 2010, and was deemed exempt from IRB review by the NIH Office of Human Subjects Research (No. 5567) in January 2011.

Measures

In HINTS 4, Cycle 3, five HPV awareness and knowledge questions were asked of the full sample, with embedded skip patterns, described below. Items included: *Have you ever heard of HPV? HPV stands for Human Papillomavirus. It is not HIV, HSV, or herpes (yes/no).* These follow up questions were asked only of those who answered *yes* to ever hearing of HPV: *Do you think HPV can cause cervical cancer? (yes/no/not sure); Do you think that*

HPV is a sexually transmitted disease (STD)? (yes/no/not sure); and Do you think that HPV will often go away on its own without treatment? (yes/no/not sure). For logistic regression, responses to the three follow-up questions were dichotomized to be yes versus no and not sure. This vaccine awareness question was asked of the full sample with no skip pattern: *A vaccine to prevent HPV infection is available and is called the cervical cancer vaccine or HPV shot. Before today, have you ever heard of the cervical cancer vaccine or HPV shot? (yes/no).*

Sociodemographic variables included in the analysis were sex, age, education, race, Hispanic ethnicity, number of children in household, income, geographic area, health insurance status, and Internet use. Each variable was categorized as follows: sex (male, female); age (18–34, 35–49, 50–65, 65 years); education (less than high school; high school degree; technical, vocational, or some college; college graduate or postgraduate); race (white; black; multiple races; and “other race,” which combines low-frequency responses for American Indian/Alaska Native, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, other Asian, Native Hawaiian, Guamanian or Chamorro, Samoan, and other Pacific Islander), Hispanic ethnicity (Hispanic, non-Hispanic), number of children in household (zero, one or more), income (<\$19,999, \$20,000–\$49,999, \$50,000–\$74,999, \$>75,000); geographic area (rural/urban, based on continuum codes outlined by the U.S. Department of Agriculture’s Economic Research Service), health insurance status (yes, no), and Internet use (*Do you ever go online to access the Internet or World Wide Web, or to send and receive e-mail? [yes/no]*). The HINTS 4, Cycle 3 instrument can be found here: hints.cancer.gov/instrument.aspx.

Statistical Analysis

All analyses were conducted using SAS-callable SUDAAN, version 9.2 (RTI International, Research Triangle Park NC) to allow for appropriate weighting for 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 the jackknife variance estimation method, were used to compute SEs. These two weighting approaches ensured valid inferences from the sample to the U.S. population, correcting for non-response and non-coverage bias.

Weighted, unadjusted prevalence estimates (n , %) were calculated for the HPV-related items in HINTS 4, Cycle 3 (Table 2) in order to assess overall population awareness and knowledge of HPV in late 2013. Weighted, multivariable logistic regression models were used to test the predicted probability that sociodemographic characteristics each independently predict HPV awareness and knowledge, fully controlling for the contribution of other sociodemographic factors (Tables 3 and 4). A weighted, multivariable logistic regression model was also employed on women in the sample to assess potential sociodemographic differences in awareness and knowledge among women, to compare findings with that of Tiro et al. (2007)¹⁶ and identify opportunities for intervention. Tests for statistical significance were calculated at $p < 0.05$. Complete case analysis with listwise deletion was utilized for regression models. Statistical analysis was conducted in 2014.

Results

Among women only (data not shown in Tables), 77% had heard of HPV, but women with children aged <18 years were significantly less likely than those without children aged <18 years to have heard of HPV (OR=0.54, 95% CI=0.30, 0.96) or the HPV vaccine (OR=0.58, 95% CI= 0.35, 0.97) in fully adjusted models.

Across all outcomes under study in the analyses of the full sample (men and women), age and sex were primary drivers of awareness and knowledge, with men being significantly less likely than women and those in younger age categories being significantly more likely than those aged ≥ 65 years to have heard of the vaccine, heard of HPV, and know that HPV can cause cervical cancer.

Approximately 68% of Americans had heard of HPV (Table 2). Those with a high school degree were less likely than those with a college education to have heard of HPV (OR=0.58, 95% CI=0.34, 0.98), and those without Internet access and health insurance were significantly less likely than those with them to have heard of HPV (OR=0.49, 95% CI=0.31, 0.78 and OR=0.57, 95% CI=0.36, 0.92, respectively). Men were significantly less likely than women to have heard of the virus (OR=0.27, 95% CI=0.20, 0.36), as were those in the “other race” race category compared to whites (OR=0.19, 95% CI=0.08, 0.46). There were gradations of effect by age, wherein those in the younger age categories were significantly more likely than those aged >65 years to have heard of HPV (Table 3).

Sixty-eight percent of Americans had heard of the HPV vaccine (Table 2). Those with a high school degree were less likely than those with a college education to have heard of the vaccine (OR=0.55, 95% CI=0.30, 0.98), and those without Internet access were significantly less likely than those with Internet access to have heard of the vaccine (OR=0.68, 95% CI=0.48, 0.98). Hispanics (OR=0.50, 95% CI=0.30, 0.82) and those in the “other race” race category (OR=0.36, 95% CI=0.17, 0.75) were significantly less likely to have heard of the vaccine compared to whites, as were those with a high school degree compared to those with a college education (OR=0.55, 95% CI=0.30, 0.98). Men were significantly less likely than women to have heard of the vaccine (OR=0.25, 95% CI=0.17, 0.38), and age gradations were also present, with those in the younger age categories being significantly more aware of the vaccine than those aged >65 years (Table 3).

Sixty-two percent of Americans knew that HPV causes cervical cancer, 34% were unsure, and 4% inaccurately thought that HPV does not cause cervical cancer (Table 2). People in rural areas were significantly less likely than those in urban areas to know that HPV causes cervical cancer (OR=0.54, 95% CI=0.30, 0.98). There were also fine gradations of effect by education, wherein people with less than high school education, high school graduates, and people with some college were significantly less likely than college graduates to know that HPV causes cervical cancer (Table 4). Men were less likely than women to know about the link (OR=0.66, 95% CI=0.45, 0.97), and those aged 18–34 years were more than twice as likely as those aged >65 years to know about the link (OR=2.12, 95% CI=1.12, 4.00) (Table 4).

A little over half of Americans (55.7%) knew that HPV is an STD, 31% were unsure, and 20% inaccurately believed that it is not an STD (Table 2). African Americans and those of multiple races were significantly less likely than whites to know that HPV is an STD (OR=0.43, 95% CI=0.22, 0.84 and OR=0.40, 95% CI=0.17, 0.96, respectively) (Table 4). Education was associated with STD awareness; those with a high school degree and those with a technical degree or some college were less likely than college graduates to know that HPV is an STD (OR=0.49, 95% CI=0.25, 0.96 and OR=0.58, 95% CI=0.38, 0.89, respectively) (Table 4).

Less than 5% of Americans were aware that HPV often clears on its own without treatment, and 64% answered incorrectly that HPV would not go away on its own, while 31% were unsure (Table 2). Across the sociodemographic variables under study, there were no significant differences (e.g., by income, education, race/ethnicity) between those who knew and those who did not know that HPV will go away on its own without treatment; all analyzed population subgroups were equally likely or unlikely to know this fact (Table 4).

Discussion

Estimates from HINTS 4, Cycle 3 (2013) indicate that HPV awareness and knowledge are increasing compared to past national surveys of HPV knowledge, with 68% of the adult population (both men and women) reporting ever hearing of both HPV and the HPV vaccine, and 77% of women saying they have heard of HPV. By contrast, estimates from other national surveys in 2005 and 2006 showed lower levels of awareness, with 40% of women responding to HINTS 2005 reporting ever hearing of HPV,¹⁶ compared to 49% of women who responded to a national telephone survey of women in 2005,²⁵ and 58% of respondents to an online survey of men and women in 2006.²⁶

Despite increased levels of HPV awareness and knowledge at the population level, results of this study suggest that diffusion is socially patterned, and varies according to sociodemographic and contextual factors. Awareness and knowledge are most highly associated with sex and age, likely given previous health education and social marketing efforts focused initially on young women. The finding that men remain relatively uninformed about HPV and the HPV vaccine poses a problem, according to the recent President's Cancer Panel report.¹³ It may be important to target men with better communication and educational initiatives to ensure recommended levels of vaccine uptake.

The present analysis revealed that among women (only), those with children aged <18 years are significantly **less** likely than those without children aged <18 years to have heard of HPV or the HPV vaccine. One possible explanation may be that in the absence of regularly scheduled healthcare visits, adolescents and their parents may fail to learn about and adhere to new vaccine recommendations. For example, parents of school-aged children and adolescents engage in routine health maintenance visits significantly less often than parents of infants.^{27–30} HINTS does not assess the age of children in the household, so it is impossible to compare those with infants to those with adolescents to determine whether this is a legitimate explanation for the paradoxical finding. In a recent systematic review of the literature summarizing barriers to HPV vaccination, healthcare professionals often identified

parental attitudes and financial concerns as barriers to offering the HPV vaccine.³¹ Most notably, lack of physician recommendation was cited as a prominent barrier to vaccination.³¹ This lack of provider communication with women with children may also contribute to low awareness. Efforts are necessary to increase provider–patient communication about HPV and the HPV vaccine among women with children aged <18 years.

Rural populations shoulder a disproportionate burden of cervical cancer incidence and mortality compared to their urban counterparts.³² It is problematic that these analyses show that people in rural areas are less likely to know that HPV causes cervical cancer than those in urban locales. Increasing knowledge of the HPV–cervical cancer link in rural areas using appropriate communication channels and strategies is an intervention opportunity.

The finding that most Americans do not know that HPV will go away on its own without treatment (see also Anhang and colleagues [2004]³³) should be useful information for physicians who talk with their patients about HPV and about informed decision making regarding vaccination. However, a 2009 study by Koshiol et al.³⁴ suggests that it is possible that gaps in knowledge about HPV may reflect limited knowledge among healthcare providers themselves. They summarize that two surveys of U.S. clinicians found that only 33%–40% knew that HPV could clear without medical intervention,^{35,36} although OB/GYNs were much more likely to know that HPV clears spontaneously than family or internal medicine physicians (67% versus 35% and 29%, respectively³⁵). Those studies found that nearly all physicians knew that persistent HPV infection increases the risk of cervical dysplasia and cancer,^{35,36} but another survey—a needs assessment of 2,748 members of the American Academy of Family Physicians conducted in 2003 (and therefore not representative of current levels of knowledge)—found that only 20% listed HPV as a risk factor for cervical cancer.³⁷ These prior estimates of low physician awareness are concerning given that the recent President’s Cancer Panel report encourages patient–provider communication about the vaccine.¹³

Limitations

HINTS data are cross-sectional and represent an assessment of HPV awareness and knowledge at one point in time. Temporality and causal inference cannot be established, nor can associations among awareness, knowledge, and actual vaccination patterns, which were not assessed in the survey. HINTS was designed to assess Americans’ need for, access to, and use of health information, and is not solely focused on HPV. HINTS also is not a provider survey and cannot assess current provider awareness, knowledge, and practice regarding HPV. The response rate, although an improvement over declining response rates from telephone surveys, is low.^{38,39} Low response rates can lead to biases in the data; however, significant efforts were made to reduce potential for bias through modality coverage and sampling.⁴⁰ Additionally, recent methodologic research suggests that the potential for bias resulting from declining response rates may be less significant than previously assumed.^{39,41,42}

Conclusions

Awareness and knowledge about HPV and the HPV vaccine are socially patterned by important sociodemographic divides. When targeting communication strategies to increase awareness and knowledge about HPV and the HPV vaccine, practitioners may consider the population knowledge gaps outlined by this analysis, in order to increase awareness and knowledge where gaps and disparities exist.

Acknowledgments

Dr. Robert Jacobson serves on a safety review committee for a Merck & Co. study of safety with HPV4 (Gardasil) in males. He also serves on a data monitoring committee for a set of studies funded by Merck & Co. testing the immunogenicity, safety, and reactivity of a 15-valent pneumococcal conjugate vaccine.

References

1. Satterwhite CL, Torrone E, Meites E, Dunne EF, Mahajan R, Ocfemia MC. Sexually transmitted infections among U.S. women and men: prevalence and incidence estimates, 2008. *Sex Transm Dis*. 2013; 40(3):187–193. <http://dx.doi.org/10.1097/OLQ.0b013e318286bb53>. [PubMed: 23403598]
2. CDC. Human Papillomavirus. In: Atkinson, W.; Wolfe, S.; Hamborsky, J., editors. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. (2nd printing) ed.. Vol. 12. Washington, DC: Public Health Foundation; 2012.
3. National Cancer Institute. , editor. National Cancer Institute. HPV and Cancer: NCI Fact Sheet. Bethesda, MD: 2012.
4. Chaturvedi AK, Engels EA, Pfeiffer RM, et al. Human Papillomavirus and Rising Oropharyngeal Cancer Incidence in the United States. *J Clin Oncol*. 2011; 29(32):4294–4301. <http://dx.doi.org/10.1200/JCO.2011.36.4596>. [PubMed: 21969503]
5. Munoz N, Bosch FX, Castellsague X, et al. Against which human papillomavirus types shall we vaccinate and screen? The international perspective. *Int J Cancer*. 2004; 111(2):278–285. <http://dx.doi.org/10.1002/ijc.20244>. [PubMed: 15197783]
6. CDC. Human papillomavirus-associated cancers - United States, 2004–2008. *MMWR*. 2012; 61:258–261. [PubMed: 22513527]
7. National Program of Cancer Registries, Division of Cancer Prevention and Control, National Center for Chronic Disease Prevention and Health Promotion, CDC. , editor. U.S. Cancer Statistics Working Group. *United States Cancer Statistics: 1999–2009 Incidence and Mortality Web-based Report*. Atlanta: 2013.
8. Ries, LA.; Eisner, MP.; Kosary, CL., et al. *SEER Cancer Statistics Review, 1975–2002*. National Cancer Institute. , editor. Bethesda: 2002.
9. Newmann SJ, Garner EO. Social inequities along the cervical cancer continuum: a structured review. *Cancer Causes Control*. 2005; 16(1):63–70. <http://dx.doi.org/10.1007/s10552-004-1290-y>. [PubMed: 15750859]
10. Schiffman M, Castle PE, Jeronimo J, Rodriguez AC, Wacholder S. Human papillomavirus and cervical cancer. *Lancet*. 2007; 370(9590):890–907. [http://dx.doi.org/10.1016/S0140-6736\(07\)61416-0](http://dx.doi.org/10.1016/S0140-6736(07)61416-0). [PubMed: 17826171]
11. CDC. Human Papillomavirus Vaccination Coverage Among Adolescent Girls, 2007–2012, and Postlicensure Vaccine Safety Monitoring, 2006–2013 — United States. *MMWR*. 2013; 62(29): 591–595. [PubMed: 23884346]
12. Dunne EF, Markowitz LE, Chesson H, et al. Recommendations on the Use of Quadrivalent Human Papillomavirus Vaccine in Males-Advisory Committee on Immunization Practices (ACIP), 2011 (Reprinted from *MMWR*, vol 60, pg 1705, 2011). *JAMA*. 2012; 307(6):557–559.
13. National Cancer Institute. Accelerating HPV Vaccine Uptake: Urgency for Action to Prevent Cancer. In: U.S. DHHS. , editor. *A Report to the President of the United States from the President's Cancer Panel*. Bethesda: 2014.

14. Tichenor PJ, Donohue GA, Olien CN. Mass Media Flow and Differential Growth in Knowledge. *Public Opin Q.* 1970; 34(2):159–170. <http://dx.doi.org/10.1086/267786>.
15. Viswanath, K.; Finnegan, JR. The knowledge gap hypothesis: Twenty five years later. In: Burleson, B., editor. *Communication Yearbook 19*. Thousand Oaks: Sage Publications; 1996. p. 187–227.
16. Tiro JA, Meissner HI, Kobrin S, Chollette V. What do women in the U.S. know about Human Papillomavirus (HPV) and cervical cancer? *Cancer Epidemiol Biomarkers Prev.* 2007; 16:288–294. <http://dx.doi.org/10.1158/1055-9965.EPI-06-0756>. [PubMed: 17267388]
17. Kobetz E, Kornfeld J, Vanderpool RC, et al. Knowledge of HPV among United States Hispanic women: opportunities and challenges for cancer prevention. *J Health Comm.* 2010; 15(Suppl 3): 22–29.
18. Fang CY, Coups EJ, Heckman CJ. Behavioral Correlates of HPV Vaccine Acceptability in the 2007 Health Information National Trends Survey (HINTS). *Cancer Epidemiol Biomarkers Prev.* 2010; 19(2):319–326. <http://dx.doi.org/10.1158/1055-9965.EPI-09-0918>. [PubMed: 20142234]
19. Lai JY, Tinker AV, Cheung WY. Factors influencing the willingness of U.S. women to vaccinate their daughters against the human papillomavirus to prevent cervical cancer. *Med Oncol.* 2013; 30(2) <http://dx.doi.org/10.1007/s12032-013-0582-z>.
20. Ramirez AS, Finney Rutten LJ, Oh A, et al. Perceptions of cancer controllability and cancer risk knowledge: the moderating role of race, ethnicity, and acculturation. *J Cancer Educ.* 2013; 28(2): 254–261. <http://dx.doi.org/10.1007/s13187-013-0450-8>. [PubMed: 23355279]
21. Ashok M, Berkowitz NA, Hawkins F, Tangka F, Saraiya M. Recency of Pap testing and future testing plans among women aged 18–64: analysis of the 2007 Health Information National Trends Survey. *J Womens Health.* 2012; 21(7):705–712. <http://dx.doi.org/10.1089/jwh.2012.3562>.
22. Kobetz E, Mendoza AD, Menard J, et al. One Size Does Not Fit All: Differences in HPV Knowledge between Haitian and African American Women. *Cancer Epidemiol Biomarkers Prev.* 2010; 19(2):366–370. <http://dx.doi.org/10.1158/1055-9965.EPI-09-1180>. [PubMed: 20142238]
23. Kontos EZ, Emmons KM, Puleo E, Viswanath K. Contribution of communication inequalities to disparities in human papillomavirus vaccine awareness and knowledge. *Am J Public Health.* 2012; 102(10):1911–1920. <http://dx.doi.org/10.2105/AJPH.2011.300435>. [PubMed: 22970692]
24. Finney Rutten LJ, Davis T, Beckjord EB, Blake K, Moser RP, Hesse BW. Picking Up the Pace: Changes in Method and Frame for the Health Information National Trends Survey (2011 – 2014). *J Health Commun.* 2012; 17(7):979–989. <http://dx.doi.org/10.1080/10810730.2012.700998>. [PubMed: 23020763]
25. Association of Reproductive Health Professionals. Association of Reproductive Health Professionals National Cervical Cancer Prevention Survey. <http://www.arhp.org/Publications-and-Resources/Studies-and-Surveys/HPV-Survey>.
26. Cummings J. Seventy percent of U.S. adults support use of the human papillomavirus (HPV) vaccine. *The Wall Street Journal Online.* 2006
27. Selden TM. Compliance with well-child visit recommendations: Evidence from the medical expenditure panel survey, 2000–2002. *Pediatrics.* 2006; 118(6):E1766–E1778. <http://dx.doi.org/10.1542/peds.2006-0286>. [PubMed: 17142499]
28. Rand CM, Shone LP, Albertin C, Auinger P, Klein JD, Szilagyi PG. National health care visit patterns of adolescents - Implications for delivery of new adolescent vaccines. *Arch Pediatr Adolesc Med.* 2007; 161(3):252–259. <http://dx.doi.org/10.1001/archpedi.161.3.252>. [PubMed: 17339506]
29. Rand CM, Szilagyi PG, Albertin C, Auinger P. Additional health care visits needed among adolescents for human papillomavirus vaccine delivery within medical homes: A national study. *Pediatrics.* 2007; 120(3):461–466. <http://dx.doi.org/10.1542/peds.2007-0012>. [PubMed: 17766516]
30. Kester L, Shew M, Zimet G, Fortenberry JD, Jessica K. A National Study of HPV Vaccination of Adolescent Girls: Rates, Predictors, and Reasons for Non-Vaccination. *J Adolesc Health.* 2011; 48(2):S5–S6. <http://dx.doi.org/10.1016/j.jadohealth.2010.11.018>.
31. Holman DM, Benard V, Roland KB, Watson M, Liddon N, Stokley S. Barriers to human papillomavirus vaccination among us adolescents: A systematic review of the literature. *JAMA*

- Pediatrics. 2014; 168(1):76–82. <http://dx.doi.org/10.1001/jamapediatrics.2013.2752>. [PubMed: 24276343]
32. Freeman, HP.; Wingrove, BK. Excess Cervical Cancer Mortality: A Marker for Low Access to Health Care in Poor Communities. National Cancer Institute. , editor. Rockville, MD: Center to Reduce Cancer Health Disparities; 2005.
 33. Anhang R, Stryker JE, Wright TC, Goldie SJ. News media coverage of human papillomavirus. Cancer. 2004; 100(2):315–320. <http://dx.doi.org/10.1002/cncr.20007>. [PubMed: 14716766]
 34. Koshiol J, Rutten LF, Moser RP, Hesse N. Knowledge of human papillomavirus: differences by self-reported treatment for genital warts and sociodemographic characteristics. J Health Commun. 2009; 14(4):331–345. <http://dx.doi.org/10.1080/10810730902873067>. [PubMed: 19466646]
 35. Irwin K, Montano D, Kasprzyk D, et al. Cervical cancer screening, abnormal cytology management, and counseling practices in the United States. Obstet Gynecol. 2006; 108(2):397–409. <http://dx.doi.org/10.1097/01.AOG.0000230258.07737.fa>. [PubMed: 16880312]
 36. Jain N, Irwin KL, Montano D, et al. Family physicians' knowledge of genital human papillomavirus (HPV) infection and HPV-related conditions, United States, 2004. Fam Med. 2006; 38(7):483–489. [PubMed: 16823673]
 37. Ruffin MT. Family physicians' knowledge of risk factors for cervical cancer. J Womens Health. 2003; 12(6):561–567. <http://dx.doi.org/10.1089/154099903768248267>.
 38. Blumberg SJ, Luke JV, Cynamon ML. Telephone coverage and health survey estimates: evaluating the need for concern about wireless substitution. Am J Public Health. 2006; 96(5):926–931. <http://dx.doi.org/10.2105/AJPH.2004.057885>. [PubMed: 16571707]
 39. Fahimi M, Link M, Mokdad A, Schwartz DA, Levy P. Tracking chronic disease and risk behavior prevalence as survey participation declines: statistics from the behavioral risk factor surveillance system and other national surveys. Prev Chronic Dis. 2008; 5(3):A80. [PubMed: 18558030]
 40. Cantor, D.; Coa, K.; Crystal-Mansour, S.; Davis, T.; Dipko, S.; Sigman, R. Health Information National Trends Survey (HINTS) 2007. Rockville, MD: Westat; 2009.
 41. Gentry E, Kalsbeek W, Hogelin G, et al. The behavioral risk factor surveillance surveys: II. Design, methods, and estimates from combined state data. Am J Prev Med. 1985; 1(6):9–14. [PubMed: 3870927]
 42. Nelson DE, Powell-Griner E, Town M, Kovar MG. A comparison of national estimates from the National Health Interview Survey and the Behavioral Risk Factor Surveillance System. Am J Public Health. 2003; 93(8):1335–1341. <http://dx.doi.org/10.2105/AJPH.93.8.1335>. [PubMed: 12893624]

Table 1

Respondent characteristics, HINTS 4, Cycle 3, 2013 (N=3,185)

	N (%)
Sex	
Male	1,197 (48.4)
Female	1,906 (51.6)
Age	
18 – 34	413 (27.2)
35 – 49	671 (30.5)
50 – 65	1,064 (27.0)
Over 65	733 (15.3)
Education	
Less than high school	297 (9.7)
12 years or completed high school	699 (24.5)
Technical, vocational, or some college	933 (32.7)
College graduate or postgraduate	1,167 (33.2)
Race	
White	2,078 (78.3)
Black	546 (12.9)
Other	163 (6.6)
Multiple races	104 (2.2)
Hispanic ethnicity	
Not Hispanic	2,301 (85.0)
Hispanic	511 (15.0)
Number of children under 18 in household	
0	1,884 (62.0)
1 or more	811 (38.0)
Income	
0 – \$19,999	680 (20.2)
\$20,000 – \$49,999	812 (29.2)
\$50,000 – \$74,999	446 (17.7)
\$75,000 or more	801 (33.0)
Metropolitan area	
Rural	476 (17.9)
Urban	2,709 (82.1)
Insurance	
No	354 (17.0)
Yes	2,728 (83.0)
Internet use	
No	880 (21.7)
Yes	2,284 (78.3)

HINTS, Health Information National Trends Survey

Table 2

Weighted, Unadjusted Population Estimates for HPV Awareness and Knowledge, HINTS 4 Cycle 3, 2013
(N=3,185)

	No n (%)	Yes n (%)	Not Sure n (%)
Have you ever heard of HPV?	1,097 (32.3)	2,009 (67.7)	--
Before today, have you ever heard of the cervical cancer vaccine or HPV shot?	1,048 (31.8)	2,022 (68.2)	--
Do you think HPV can cause cervical cancer?	99 (3.8)	1,149 (62.2)	723 (34.1)
Do you think that HPV is a sexually transmitted disease?	402 (20.5)	1,075 (55.7)	495 (23.8)
Do you think that HPV will often go away on its own without treatment?	1,288 (64.1)	92 (4.8)	587 (31.1)

HINTS, Health Information National Trends Survey; HPV, Human Papillomavirus

Table 3

Weighted, Fully Adjusted Multivariable Logistic Regression Models Predicting HPV and Vaccine Awareness, by Sociodemographic Variables

	Heard of HPV (N=2,055)	Heard of HPV Vaccine (N=2,041)
	OR (95% CI)	OR (95% CI)
Sex		
Male	0.27 (0.20 – 0.36) ***	0.25 (0.17 – 0.38) ***
Female	Ref	Ref
Age		
18 – 34	5.13 (2.62 – 10.06) ***	3.06 (1.69 – 5.54) ***
35 – 49	3.30 (1.69 – 6.42) ***	2.25 (1.32 – 3.82) **
50 – 65	1.97 (1.26 – 3.07) **	1.90 (1.23 – 2.91) **
Over 65	Ref	Ref
Education		
Less than high school	0.64 (0.33 – 1.23)	0.86 (0.41 – 1.81)
12 years or completed high school	0.58 (0.34 – 0.98) *	0.55 (0.30 – 0.98) *
Technical, vocational, some college	0.87 (0.57 – 1.32)	0.79 (0.52 – 1.19)
College graduate or postgraduate	Ref	Ref
Race		
White	Ref	Ref
Black	0.74 (0.41 – 1.34)	0.70 (0.38 – 1.30)
Other	0.19 (0.08 – 0.46) ***	0.36 (0.17 – 0.75) **
Multiple races	1.02 (0.06 – 17.08)	0.90 (0.14 – 5.72)
Hispanic ethnicity		
Not Hispanic	Ref	Ref
Hispanic	0.74 (0.43 – 1.27)	0.50 (0.30 – 0.82) **
# Children under 18 in household		
0	Ref	Ref
1 or more	0.71 (0.43 – 1.18)	0.75 (0.50 – 1.12)
Income		
0 – \$19,999	0.52 (0.29 – 0.93) *	0.56 (0.32 – 0.99) *
\$20,000 – \$49,999	0.71 (0.43 – 1.17)	0.62 (0.33 – 1.15)
\$50,000 – \$74,999	0.50 (0.25 – 0.97) *	0.44 (0.26 – 0.75) **
\$75,000 or more	Ref	Ref
Metropolitan area		
Rural	0.66 (0.44 – 1.00)	0.71 (0.46 – 1.08)
Urban	Ref	Ref
Insurance		
No	0.57 (0.36 – 0.92) *	0.72 (0.40 – 1.30)

	Heard of HPV (N=2,055)	Heard of HPV Vaccine (N=2,041)
	OR (95% CI)	OR (95% CI)
Yes	Ref	Ref
Internet use		
No	0.49 (0.31 – 0.78) **	0.68 (0.48 – 0.98) *
Yes	Ref	Ref

Note: Boldface indicates statistical significance (*p < 0.05; **p < 0.01; ***p < 0.001).

HPV, Human Papillomavirus

Table 4

Weighted, Fully Adjusted Multivariable Logistic Regression Models Predicting Knowledge about HPV, by Sociodemographic Variables

	Cause Cervical Cancer (N=1,467)	HPV is an STD (N=1,467)	Go Away on Its Own Without Treatment (N=1,465)
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Sex			
Male	0.66 (0.45 – 0.97) *	0.84 (0.59 – 1.20)	0.65 (0.27 – 1.58)
Female	Ref	Ref	Ref
Age			
18 – 34	2.12 (1.12 – 4.00) *	1.24 (0.60 – 2.59)	2.26 (0.48 – 10.75)
35 – 49	1.43 (0.73 – 2.81)	1.11 (0.66 – 1.87)	1.81 (0.37 – 8.92)
50 – 65	1.39 (0.81 – 2.39)	0.88 (0.53 – 1.45)	0.78 (0.18 – 3.38)
Over 65	Ref	Ref	Ref
Education			
Less than high school	0.37 (0.15 – 0.92) *	0.44 (0.15 – 1.31)	0.18 (0.01 – 4.83)
12 years or high school	0.33 (0.18 – 0.62) ***	0.49 (0.25 0.96) *	0.22 (0.04 – 1.37)
Tech, vocation, some college	0.55 (0.37 – 0.82) **	0.58 (0.38 0.89) *	0.54 (0.27 – 1.08)
College grad or postgraduate	Ref	Ref	Ref
Race			
White	Ref	Ref	Ref
Black	0.57 (0.31 – 1.04)	0.43 (0.22 – .84) *	1.13 (0.20 – 6.30)
Other	0.73 (0.28 – 1.91)	1.25 (0.39 – 4.01)	1.42 (0.02 – 118.51)
Multiple races	0.78 (0.34 – 1.77)	0.40 (0.17 – .96) *	0.57 (0.12 – 2.74)
Hispanic ethnicity			
Not Hispanic	Ref	Ref	Ref
Hispanic	0.63 (0.32 – 1.23)	1.30 (0.73 – 2.31)	0.89 (0.30 – 2.62)
# Children <18 in household			
0	Ref	Ref	Ref
1 or more	1.43 (0.87 – 2.36)	1.17 (0.79 – 1.73)	0.47 (0.20 – 1.12)
Income			
0 – \$19,999	0.79 (0.34 – 1.81)	0.65 (0.34 – 1.22)	0.43 (0.06 – 3.30)
\$20,000 – \$49,999	0.94 (0.53 – 1.66)	1.08 (0.65 – 1.79)	1.13 (0.41 – 3.14)
\$50,000 – \$74,999	0.93 (0.50 – 1.74)	0.88 (0.53 – 1.46)	1.05 (0.28 – 3.97)
\$75,000 or more	Ref	Ref	Ref
Metropolitan area			
Rural	0.54 (0.30 – 0.98) *	0.65 (0.34 – 1.23)	0.50 (0.14 – 1.78)
Urban	Ref	Ref	Ref
Insurance			
No	1.29 (0.71 – 2.33)	1.00 (0.53 – 1.86)	1.67 (0.29 – 9.52)

	Cause Cervical Cancer (N=1,467)	HPV is an STD (N=1,467)	Go Away on Its Own Without Treatment (N=1,465)
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Yes	Ref	Ref	Ref
Internet use			
No	0.80 (0.46 – 1.40)	0.76 (0.42 – 1.36)	0.70 (0.13 – 3.71)
Yes	Ref	Ref	Ref

Note: Boldface indicates statistical significance (*p < 0.05; **p < 0.01; ***p < 0.001).

HPV, Human Papillomavirus; STD, sexually transmitted disease