



## Rural-urban differences in human papillomavirus knowledge and awareness among US adults

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### ABSTRACT

Rural residents of the United States have higher HPV-associated cancer incidence and mortality, and suboptimal HPV vaccine uptake compared to urban residents. This study aimed to assess differences in knowledge and awareness of HPV, the HPV vaccine, and HPV-associated cancers among rural and urban residents. We analyzed data from the Health Information National Trends Survey 2013–2017 on 10,147 respondents ages  $\geq 18$  years. Multivariable logistic regression analyses compared urban/rural differences in knowledge and awareness of HPV, associated cancers, and HPV vaccine. Models were adjusted for sex, age, race/ethnicity, education, household income, census region, health insurance, regular provider, internet use, and personal history of cancer. Overall, 67.2% and 65.8% of urban residents were aware of HPV and HPV vaccine, respectively, compared to only 55.8% and 58.6% of rural residents. Adjusted models illustrated that compared to urban residents, rural residents were less likely to be aware of HPV (OR = 0.68, 95% CI = 0.53–0.86) and HPV vaccine (OR = 0.78, 95% CI = 0.63–0.97). Among those who were aware of HPV, rural residents were less likely to know that HPV causes cervical cancer (OR = 0.62, 95% CI = 0.46–0.84) and that HPV can be transmitted through sexual contact (OR = 0.72, 95% CI = 0.56–0.94). No significant differences between rural and urban residents were noted for knowledge that HPV is transmitted sexually and that it causes oral, anal, and penile cancers. This study highlights significant rural health disparities in knowledge and awareness of HPV and the HPV vaccine compared to urban counterparts.

### 1. Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection that oftentimes spreads either during oral, anal, or vaginal sex (Centers for Disease Control and Prevention, 2016). It affects nearly all sexually active men and women, and it can be transmitted even when an individual is asymptomatic (Centers for Disease Control and Prevention, 2016). Persistent infections with high risk HPV strains can progress to cervical, anogenital, and oropharyngeal cancers (Centers for Disease Control and Prevention, 2016; Viens et al., 2016). According to the CDC, approximately 30,700 new cancers were attributable to HPV annually; 19,200 women and 11,600 men (Viens et al., 2016). The burden of HPV-associated cancers remains high across sociodemographic characteristics in the United States (U.S.) and the

disparities in the incidence and mortality rates persist among racial minorities, low socioeconomic status individuals, and those living in rural areas (Viens et al., 2016; Singh, 2012; Singh et al., 2004).

As a measure of prevention, three HPV vaccines have been licensed since 2006 and routinely recommended for both boys and girls starting at age 11 or 12 years, but can also be given to those aged 13 through 26 (Reagan-Steiner et al., 2015). However, vaccine uptake remains lower among rural residents compared to urban residents (Reagan-Steiner et al., 2015; Crosby et al., 2011). Likewise, cervical cancer screening with Papanicolaou (Pap) tests remains successful for early detection and prevention of invasive cervical cancer. However, adherence to cervical cancer screening remains low in general population and among rural American Indians and Hispanic women in Southwestern states, and rural Appalachian women relative to their urban peers (Nuno et al.,

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2012; Studts et al., 2013; Nelson et al., 2009).

Several factors have been identified to contribute to the low vaccine uptake including, but not limited to, lack of provider recommendation, vaccine cost and reimbursement issues for providers, vaccine safety concerns, limited knowledge and awareness of HPV and the HPV vaccine, parental beliefs that their children are too young to be vaccinated or they are not sexually active (Bailey et al., 2016; Ojeaga et al., 2017). Although the knowledge and awareness alone may not be sufficient to motivate cancer screenings and vaccination uptake, it remains an important first step.

Several studies have examined awareness and knowledge of HPV, the HPV vaccine and HPV-associated cervical cancer among rural population (Bell et al., 2011; Cates et al., 2009; Blake et al., 2015; Ruffin et al., 2012). Overall, lower rates of HPV knowledge and awareness were noted among rural residents compared to their urban counterparts. However, most of these studies have focused on specific states or subpopulations within specific rural areas limiting the generalizability of their findings to their confined populations. To broaden our understanding of the patterns of disparities in the knowledge and awareness of HPV in rural United States, this study sought to analyze a nationally representative sample of US adults using the Health Information National Trends Survey (HINTS) to: (1) determine the prevalence of knowledge and awareness of HPV, the HPV vaccine, and HPV-associated cancers among rural and urban residents; (2) examine the association of rural/urban status with knowledge and awareness. Understanding patterns of HPV and the HPV vaccine knowledge and awareness across different geographic areas will allow for better development of behavioral targeted interventions.

## 2. Methods

### 2.1. Data source and collection

This study involved analyses of data obtained from three iterations of the Health Information National Trends Survey (HINTS) collected from September through December 2013 for HINTS 4 cycle 3, from August through November 2014 for HINTS 4 cycle 4, and from January through May 2017 for HINTS 5 cycle 1. HINTS is administered by the National Cancer Institute. It is a cross sectional survey of a nationally-representative sample of health communication and information among civilian non-institutionalized U.S. adults aged  $\geq 18$ . The survey design for the HINTS consisted of two stages; in the first stage, a stratified sample of residential addresses was randomly selected. In the second stage, one adult was selected, using the Next Birthday Method and a mail survey was sent to each sampled household. All three cycles combined generated a sample size of 10,147 respondents, with a response rate of 35.2% for HINTS 4 cycle 3, 34.4% for HINTS 4 cycle 4, and 32.4% for HINTS 5 cycle 1 (Westat, 2014; Westat, 2015; Westat, 2017). Additional information about HINTS design, data collection, and procedure is available elsewhere (Westat, 2014; Westat, 2015; Westat, 2017; Nelson et al., 2004). HINTS 4 was approved by the Westat's Institutional Review Board in an expedited review and was deemed exempt from IRB review by the NIH Office of Human Subjects in January 2011.

### 2.2. Outcome variables

The two primary outcome variables, awareness of HPV and awareness of the HPV vaccine, were ascertained from the survey questions, (1) "Have you ever heard of HPV? HPV stands for Human Papillomavirus. It is not HIV, HSV, or herpes" and (2) "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?" Both questions allowed for a yes or no response from participant.

Secondary outcome variables included knowledge about HPV

causing cervical, oral, anal, and penile cancers as well as the knowledge about HPV being transmitted through sexual contact. These analyses were restricted to respondents who answered "yes" to HPV awareness question. Each of these outcome variables were derived from the following survey questions included in cycle 4 data only: "Do you think HPV can cause cervical cancer?" (yes/no/not sure), "Do you think HPV can cause oral cancer?" (yes/no/not sure), "Do you think HPV can cause anal cancer?" (yes/no/not sure), "Do you think HPV can cause penile cancer?" (yes/no/not sure), "Do you think you can get HPV through sexual contact?" (yes/no/not sure). For the purpose of this analyses, those who answered "no" and "not sure" were coded as "no."

### 2.3. Independent variables

Geographic area (rural/urban) of the respondents was the main independent variable of interest in this analysis. Rural/urban designation was determined based on the 2013 rural/urban continuum codes outlined by the U.S. Department of Agriculture's Economic Research Service (U.S. Department of Agriculture Economic Research Service, 2013). Other sociodemographic variables that were included in the analyses and adjusted for but were not reported in the tables included: sex (male, female); the age variable in HINTS data originally categorized as 18–34, 35–49, 50–64, 65–74,  $\geq 75$  years was recategorized to 18–34, 35–49, 50–64,  $\geq 65$  years; the race/ethnicity variable was originally categorized as non-Hispanic White, non-Hispanic Black or African American, Hispanic, non-Hispanic Asian, non-Hispanic other, however, fewer observations were noted for non-Hispanic Asians, therefore, we included them in the category "non-Hispanic other"; education (less than high school, high school graduate, some college, college graduate or more), household income (< \$20,000, \$20,000 to < \$35,000, \$35,000 to < \$50,000, \$ 50,000 to < \$75,000, \$75,000 or more), census region (Northeast, Midwest, South, West), health insurance (yes, no), regular healthcare provider (yes, no), internet use "Do you ever go online to access the Internet or World Wide Web, or to send and receive e-mail?" (yes, no), and cancer status "Have you ever been diagnosed as having cancer?" (yes, no). HINTS original coding scheme was retained or recoded when necessary for analytic purposes.

### 2.4. Missing values

The missing values for sociodemographic and other predictor variables ranged from 2% to 10%. To reduce potential bias in the estimation of parameters, missing values for each predictor variable were treated as a separate category in the logistic regression models and included in all analyses. Missing values on outcome variables were excluded from the analyses.

### 2.5. Statistical analysis

Weighted frequencies and 95% confidence intervals were calculated to obtain prevalence of HPV awareness by rural/urban status. Several univariate and multivariate binary logistic regression models were constructed to evaluate the associations between awareness and knowledge of HPV, the HPV vaccine, and HPV-associated cancers and respondents' rural/urban status while controlling for the effect of other sociodemographic and predictor variables. All analyses were conducted in SAS System version 9.4 (SAS Institute Inc., Cary, North Carolina). All associations were deemed statistically significant with  $p < 0.05$ . All analyses were adjusted using appropriate weighting variables, including Jackknife replicate weights, provided by HINTS to calculate standard errors and nationally representative estimates.

## 3. Results

Differences in respondents' sociodemographic characteristics, internet use, and history of cancer by rural/urban status are found in

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