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Short communication

Geographic variation in human papillomavirus vaccination uptake among young adult women in the United States during 2008–2010☆

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ABSTRACT

Very little is known about geographic variation in human papillomavirus (HPV) vaccine uptake among young adult women in the US. To investigate this, we analyzed data from 12 US states collected through the Behavioral Risk Factor Surveillance System between 2008 and 2010. Among 2632 young adult women (18–26 years old) who responded to HPV vaccine uptake questions, weighted vaccine initiation and completion rates were: 28.0% and 17.0% overall, 14.0% and 6.6% in the South, 28.7% and 19.3% in the Midwest/West, and 37.2% and 23.1% in the Northeast ($P<0.001$), respectively. Log-binomial regression analysis showed that women living in the South were less likely to initiate (adjusted prevalence ratio (aPR) 0.71, 95% confidence interval (CI) 0.60–0.83) or complete (aPR 0.61, 95% CI, 0.53–0.71) the HPV vaccine series compared to women living in the Northeast. Interventions programs to improve HPV vaccine uptake in the Southern states are warranted.

1. Introduction

In 2006, the United States Food and Drug administration (FDA) approved a quadrivalent vaccine which offers protection against human papillomavirus (HPV) types 6, 11, 16, and 18 [1] In 2009, a bivalent HPV vaccine was approved against HPV types 16 and 18 [2]. Both vaccines have demonstrated reasonably high efficacy (90–100%) in preventing infections and precancerous lesions caused by vaccine type-HPV among sexually active adolescents and young women who have not been infected with those strains [3,4]. As a result, the Advisory Committee on Immunization Practices (ACIP) now recommends routine vaccination for all US girls 11–12 year age and "catch-up" vaccination for those 13–26 years old not previously vaccinated [1,2].

In spite of its proven efficacy, 2010 National Health Interview Survey (NHIS) data demonstrated that HPV vaccination rates have been very low in the US. Only 23% of women 18–26 years of age have initiated the vaccine and 13% completed the three dose series [5], which is lower than that observed among 11–17 year old adolescent girls (29% and 14%, respectively) [6]. Wei et al. [7] observed in their analysis of this database that geographic location was a correlate of HPV vaccine uptake among 18–26 old women in the US, but not among those 11–17 years old [6]. As compared to the Northeast, HPV vaccine initiation was significantly higher in the West/Midwest and North Central regions and lower in the South, although this difference did not achieve statistical significance. The NIS-Teen data showed a similar pattern among 13–17 year old adolescent girls [8]. However, those studies are all based on a single year of data and describe vaccine initiation only. Thus, further studies which include both initiation and completion rates, and assess multiple years are needed. The objective of this study was to examine the association between geographic region of the US and HPV vaccine initiation and completion rates among 18–26 year old women using the Behavioral Risk Factor Surveillance System (BRFSS) data collected between 2008 and 2010.

2. Methods

2.1. Study population

The BRFSS is a continuous cross-sectional monthly telephone health survey among adults ≥ 18 years of age conducted by the Centers for Disease Control (CDC) and Prevention since 1984. Adults from all 50 U.S. states, the District of Columbia, and U.S. territories are queried on their health-related risk behaviors and events, chronic health conditions, and use of preventive services. This

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survey is the largest ongoing health survey in the world with more than 400,000 interviews conducted each year during 2008–2010. Details of the survey methods used have been published elsewhere [9]. This study was limited to 2008–2010 BRFSS data as the adult HPV module was introduced in 2008. In total, 12 U.S. states (Connecticut, Delaware, Kansas, Massachusetts, Minnesota, Nebraska, Oklahoma, Pennsylvania, Rhodes Island, Texas, West Virginia, and Wyoming) conducted the adult HPV module survey during 2008–2010 in different combinations with the response rate ranging from 43.4% to 66.9% in different years. For this study, we restricted our sample to women aged 18–26 years as ACIP recommends "catch-up" vaccination for those 13–26 years old not previously vaccinated. This study was exempt from review by the UTMB Institutional Review Board as we used a publicly available de-identified database.

2.2. Data collection

This study focused on survey questions related to HPV vaccination status, region of residence, and other socio-demographic variables of interest. The main outcomes of interests were HPV initiation and completion. HPV initiation was based on the question: "A vaccine to prevent the human papilloma virus or HPV infection is available and is called the cervical cancer or genital warts vaccine, HPV shot (GARDASIL or CERVARIX). Have you ever had the HPV vaccination?" The response options were "yes" or "no. Those who responded "yes" to the question were considered as HPV vaccine initiators. A follow-up question was asked among those who had responded "yes" to the first question: "How many HPV shots did you receive?" Those who responded "all shots" were considered as HPV vaccine completers. The main exposure of interest in this study was region of residence. We categorized data from 12 states into four distinct regions: Northeast (Connecticut, Massachusetts, Pennsylvania, Rhode Island), Midwest (Kansas, Minnesota, Nebraska), West (Wyoming) and South (Delaware, Oklahoma, Texas, West Virginia) [10]. We combined Midwest and West together to balance the sample size for each region.

Socio-demographic characteristics were also assessed. Age (18–21 vs. 22–26), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and others), education (≤high school, some college hours, and college degree), marital status (never married vs. ever married), annual household income (<50,000$, 50,000–75,000$ and >75,000$), length of time since last routine medical check-up (within the past year vs. 2 years or more), influenza vaccination in the past season (yes vs. no), and health care coverage (yes vs. no) were categorized for the purpose of analysis.

2.3. Statistical analysis

We used STATA 12 *svy* commands (STATA Corporation, College Station, TX) for data analysis by incorporating probability sampling weights in conjunction with strata and primary sampling units (psu) generated by BRFSS complex survey design. Poststratification weight was used to correct for the complex BRFSS study design, and bias originated from nonresponse and non-telephone coverage. We also considered interview year as a stratum and generated a new weight variable that is consistent across years. We used chi square tests to compare demographic characteristics among different geographic regions of the US. We also estimated weighted rates of HPV vaccine initiation and completion and their 95% confidence intervals (CIs) by region. We used log-binomial regression models to examine the association between region of residence and the HPV vaccine initiation and completion of the vaccine series after adjusting for socio-demographic characteristics and year of study. These models were used as the vaccine uptake rates were relatively common. Adjusted prevalence ratios (aPR) and 95% CIs for HPV vaccine initiation and completion were reported for each of the geographic regions. In addition, aPR (95%) was also reported for all other demographic variables. The interaction terms between region and race/ethnicity, and region and income were also included in the model to examine the effects of race/ethnicity and income on HPV vaccine uptake by region.

3. Results

A total of 97.5% (2632/2700) of 18–26 year old women from 12 states responded to the questions on HPV vaccination during 2008–2010. Overall, 28.0% and 17.0% of women (weighted values) reported initiating and completing the 3-dose series (Table 1). Weighted HPV vaccine initiation and completion rates were 14.0% and 6.6% in the South (S), 28.7% and 19.3% in the Midwest/West (MWW) and 37.2% and 23.1% in the Northeast (NE) ($P < 0.001$), respectively. Women living in the Midwest/West were more likely to be younger, white and have history of influenza vaccination in the past season while women in the South were more likely to be married and have annual household income <50,000$, and less likely to have college degree compared to their counterparts. Women residing in the Northeast had the highest health coverage and routine medical check-up during the past year. HPV vaccine initiation rate in the South was the lowest consistently over time.

After adjusting for age, race/ethnicity, marital status, education, income, health coverage, routine medical check-up in the past year, influenza vaccination in the past season and year of vaccination, we observed that women living in the South were still less likely than women in the Northeast to initiate (aPR 0.71, 95% confidence interval (CI) 0.60–0.83) or complete (aPR 0.61, 95% CI, 0.53–0.71) the HPV vaccination (Table 2). Women residing in the Midwest/West region were also less likely to initiate the HPV vaccination (aPR 0.81, 95% CI, 0.69–0.95). Several other characteristics were associated with the HPV initiation and completion after adjusting for confounders. Women who were younger (18–21 year old), never married, graduated college, and had an annual household income >75,000$, healthcare coverage, routine medical check-up during the past 12 months, influenza vaccination in the past season and HPV injections in later years were more likely to initiate the HPV vaccination. Almost similar correlates were also observed for vaccine completion. In addition, white women were more likely to complete the 3-dose series than other race/ethnicities. A separate analysis based on the Midwest/West region as the reference category showed that, women living in the South were also less likely to complete (aPR 0.70, 95% CI 0.59–0.83, $P \leq 0.001$) the HPV vaccine while women in the Northeast were more likely to initiate (aPR 1.24 95% CI 1.05–1.45; $P = 0.009$) it (data not shown). No significant interaction effects were observed between race/ethnicity and region, and between income and region on HPV vaccine uptake.

4. Discussion

We observed that young adult women residing in the South had the lowest HPV vaccine uptake rates in the US between 2008 and 2010. This is similar to data published on 13–17 year old girls showing that the HPV vaccination uptake rates are lower in the southeastern U.S. compared with those living in other regions in that age category [8]. In contrast, Wei et al. [7] did not observe any significant difference between the Northeast and Southern regions of the US in their analysis of NHIS 2010 data. Several factors could be responsible for the discrepancies between the Wei et al. report and our study. Less representation from the South ($n = 695$) and Northeast ($n = 242$) regions in the Wei et al. study compared to our study (South, $n = 1050$; Northeast, $n = 1075$) may have impacted their results. Further, our study was based on 2008–2010 data

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