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Determinants of HPV vaccine awareness and healthcare providers' discussion of HPV vaccine among females

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ABSTRACT

Two human papillomavirus (HPV) vaccines are available and can prevent 98% of HPV 16 and 18 infections. This study aimed to explore determinants of 1) HPV vaccine awareness among a cohort of low-income women participating in a cancer prevention program in Central Texas and compare them to United States residents; 2) determinants of healthcare providers' discussion of HPV vaccine among female residents of the United States.

Bivariate and multivariable analysis of HPV vaccine awareness using survey data (n = 359) collected between 2014 and 2016 in Central Texas, and the Health Information and Nutrition Survey (HINTS) data which is a nationally representative dataset (unweighted n = 1214) collected in 2013 were conducted. Bivariate and multivariable regression analyses of healthcare providers' discussion of the HPV vaccine using the HINTS survey data were also conducted.

Compared to non-Hispanic Whites, there was a decreased likelihood of HPV vaccine awareness among non-Hispanic Blacks (OR = 0.50; 95% CI = 0.28–0.90) and Hispanics (OR = 0.55; 95% CI = 0.30–0.99) in the grant funded program, as well as non-Hispanic Blacks (OR = 0.28; 95% CI = 0.14–0.58) and Hispanics (OR = 0.22; 95% CI = 0.12–0.41) in the HINTS data. There was also a decreased likelihood of healthcare providers discussing the HPV vaccine with respondents who were 35–49 years (OR = 0.50; 95% CI = 0.30–0.84), 50–64 years (OR = 0.26; 95% CI = 0.14–0.49) or ≥65 years compared to those who were 18–34 years among the HINTS data respondents.

Interventions to increase HPV awareness among non-Hispanic Blacks and Hispanics, as well as encourage healthcare providers' discussion of the HPV vaccination during patient encounters regardless of the patient's age are needed.

1. Introduction

The human papillomavirus (HPV) is the most common sexually transmitted infection and can lead to cancers of the cervix, vulva, vagina, penis, anus, and oropharynx (Centers for Disease Control, 2015). According to the CDC, between 2008 and 2012, HPV was responsible for 19,200 new cases of cancers among females annually (Viens et al., 2016). Two HPV types-HPV 16 and 18 have been associated with 70% of cervical cancers (Muñoz et al., 2004; Schiffman et al., 2007); these HPV types lead to cervical dysplasia, a precursor to cervical cancer (Viens et al., 2016). Two HPV vaccines have been approved by the Food and Drug Administration (Centers for Disease Control, 2015). These vaccine series are reported to prevent 98% of HPV 16 and 18 infections (Jeudin et al., 2014), and recommended for boys and girls who are 11 or 12 years; catch up vaccination through age 26 is also recommended (Jeudin et al., 2014). Adherence to vaccination recommendation could further reduce cervical cancer incidence, and possibly eliminate disparities associated with cervical cancer (Jeudin et al., 2014). In spite of the documented benefits of HPV vaccination, utilization rates remain suboptimal (Jeudin et al., 2014; Centers for Disease Control, 2013; Reagan-Steiner et al., 2015) and uptake of HPV vaccine remains low compared to other vaccines such as the tetanus and meningococcal vaccines (Reagan-Steiner et al., 2015).

Inadequate knowledge about the HPV vaccine across various demographic groups in the United States is one of the factors that has been associated with suboptimal vaccination rates (Holman et al., 2014; Blake et al., 2015). A North Carolina study comprised of mainly African Americans reported that only about 19% of their study sample had heard about the HPV vaccine (Fazekas et al., 2008). Another study comprised

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of only Latina mothers reported that 78% of their respondents had not heard about the HPV; following education about the virus, 80% of the participants indicated willingness to allow their daughters receive the HPV vaccine (Bair et al., 2008). The restriction of these studies to specific sub-populations however, limits their generalizability to the entire U.S population. With regards to gender disparities, using a nationally representative dataset, Blake and colleagues reported that males had a decreased likelihood of HPV vaccine knowledge compared to females but this study did not explore whether disparities in HPV vaccine awareness exist among females (Blake et al., 2015). Lower income levels have been associated with inadequate HPV vaccine awareness (Blake et al., 2015). Since low-income women are disproportionately affected with cervical cancer (Singh et al., 2004), it necessary to explore determinants of HPV vaccine awareness among this group.

The role of healthcare providers in increasing HPV vaccine awareness and uptake is crucial (Gottlieb et al., 2009) because inadequate recommendation of HPV vaccine by health care providers contribute to suboptimal HPV vaccine awareness and vaccination rates (Ylitalo et al., 2013; Caskey et al., 2009). Disparities in vaccine recommendation exist; for example, non-Hispanic Whites and mothers who are college graduates are more likely to receive a vaccine recommendation for their daughters (Ylitalo et al., 2013). The President's Cancer Panel recommends reducing missed clinical opportunities to recommend and administer the HPV vaccines as a strategy to increase HPV vaccination rates (The President's Cancer Panel, 2014). It is therefore necessary to explore determinants of healthcare provider discussion of HPV vaccine.

This study explores factors associated with HPV vaccine awareness among two populations: 1) low-income women receiving free cervical cancer screening through a grant-funded program and, 2) female residents of the United States using a nationally representative dataset. We also explore the determinants of healthcare providers' discussion about the HPV vaccine using the national dataset.

Identifying determinants of HPV-related disparities could aid development and implementation of interventions aimed at increasing HPV vaccine awareness and utilization.

2. Methods

Two datasets were used for this study: 1) a de-identified dataset from a grant-funded cancer screening program known as Texas Cancer Screening, Training, Education and Prevention (Texas C-STEP) program and 2) the public use version of the Health Information National Trends Survey (HINTS) data. The two datasets were used in order to compare HPV-vaccine awareness among the Texas C-STEP respondents who were all low-income women compared to the HINTS data respondents.

The Texas C-STEP program provides free or subsidized cervical cancer screening to low-income female residents of nine counties in Central Texas. Patients seeking financial assistance for cervical cancer screening at a family medicine residency clinic completed a form to determine eligibility for based on income level and household size. Surveys were administered in Spanish or English by bilingual community health workers and included information on demographics, and knowledge of HPV vaccine. Patients were consented as part of usual care procedures at the clinic. All patient data were de-identified, as approved by the Texas A&M Institutional Review Board. A total of 469 women received free cervical screenings and 374 women participated in the survey. Individuals who had incomplete survey responses (15 individuals) and those who did not identify their race as White or Black/African American (2 individuals) were excluded from the analyses. Final sample size for the data which was obtained over a 27-month period was 359.

The HINTS data is a nationally representative survey data that contains information about cancer-related knowledge and utilization of such knowledge among the American public. Two-stage probability sampling is used for sample selection. The first stage is the sampling of random households from The HINTS sampling frame which was a database of addresses used by the Marketing Systems Group, and the second stage is the random selection of an adult from each household (National Cancer Institute, n.d.). The HINTS 4 cycle 3 data, which was collected from September 2013 through December 2013, was used for the analysis. The response rate was 35%. Analysis was restricted to only females who did not have missing information on our variables of interest. The final unweighted sample size was 1241 while the weighted population size was 82,208,821. The use of the HINTS dataset was exempt by the Texas A&M Institutional Review Board because the HINTS data is a de-identified public use dataset.

3. Measures

We had two dependent variables. The first dependent variable was whether the respondent was aware of the HPV vaccine (coded as 1 = yes, 0 = no). Among Texas C-STEP respondents, HPV vaccine awareness was measured using the question *"Are you aware that there is a 3-part vaccine that helps protect against cervical cancer?"* The HINTS survey data measured HPV vaccine awareness using the question *"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?"*

The second dependent variable was whether a health care provider had ever talked to a patient about the HPV vaccine (coded as 1 = yes, 0 = no). This was measured in the HINTS data using the question *"A vaccine to prevent HPV infection is available and is called the HPV shot, cervical cancer vaccine, GARDASIL®, or Cervarix®. Has a doctor or other health care professional ever talked with you about the HPV shot or vaccine?"* The Texas C-STEP data did not contain information on healthcare provider discussion of HPV vaccine.

For the Texas C-STEP dataset, the independent variables were educational attainment (more than high school education, some high school education, less than high school education), race/ethnicity (White, Black/African American, Hispanic/Latino), age group (18–35, 35–49 and 50–64 years), residence (urban, rural) and last checkup (≤1 year, >1 year). Rural/urban classification was achieved by merging the data set with the Rural Urban Commuting Area Codes Data for the state of Texas (United States Department of Agriculture, 2014). The final sample size was 359.

The independent variables used for the HINTS data analyses included similar variables to those contained in the Texas C-STEP dataset including educational attainment (some college/vocational training, high school/12 years of education completed, less than high school), race/ethnicity (Non-Hispanic White, Non-Hispanic Black/African American, Hispanic), age (18–35, 35–49, 50–64 and ≥65 years), residence (urban metropolitan area and urban non-metropolitan area/rural area) and last checkup (≤1 year, >1 year). Other independent variables were insurance status (insured, uninsured), and household income (<$20,000, $20,000–$49,000, $50,000–$74,999 and ≥$75,000).

4. Statistical analysis

Descriptive statistics for the independent variables were calculated for both datasets. Bivariate and multivariable logistic regression analyses were used to estimate odds ratios and 95% confidence intervals for both datasets. Weighted logistic regression analyses of the HINTS data set was conducted using the Stata *svy* command suite to account for the HINTS data multi-stage probability sampling. All statistical tests were two-sided, and findings were considered statistically significant at $p < 0.05$. All analyses were conducted using Stata 13.1 (StataCorp, 2013).

5. Results

5.1. Texas C-STEP data

Non-Hispanic Whites, non-Hispanic Blacks and Hispanics comprised 30.9%, 28.7% and 40.4% of the study sample respectively (Table 1). About

Table 1
Descriptive statistics of respondents in the Texas C-STEP dataset collected between 2014 and 2016 (n = 359).

		Freq.	Percent
Race	Non-Hispanic White	111	30.92
	Non-Hispanic Black	103	28.69
	Hispanic	145	40.39
Educational attainment	More than high school (HS)	54	15.04
	Some HS/HS graduate	241	67.13
	Less than HS	64	17.83
Residence	Urban	280	77.99
	Rural	79	22.01
Last checkup	≤1 year	310	86.35
	>1 year	49	13.65
Age (year)	18–34	124	34.54
	35–49	144	40.11
	50–64	91	25.35
HPV vaccine awareness	No	238	58.77
	Yes	167	41.33

Table 2
Descriptive statistics of respondents in the HINTS dataset collected in 2013 (unweighted n = 1241).

		Freq.	Percent
Race/ethnicity	Non-Hispanic White	773	62.29
	Non-Hispanic Black	243	19.58
	Hispanic	225	18.13
Educational attainment	College graduate/post-graduate	506	40.77
	Some college/vocational training	387	31.18
	High school/12 years completed	256	20.63
	<High school	92	7.41
Residence	Urban metropolitan area	1043	84.05
	Urban non-metropolitan/rural area	198	15.95
Age (years)	18–34	213	17.16
	35–49	312	25.14
	50–64	442	35.62
	>65	274	22.08
Last checkup	≤1 year	943	75.99
	>1 year	298	24.01
Income	≥$75,000	355	28.61
	$50,000–$74,999	193	15.55
	$20,000–$49,999	377	30.38
	<$20,000	316	25.46
Insurance status	Insured	1109	89.36
	Uninsured	132	10.64
HPV vaccine awareness	No	510	26.70
	Yes	1400	73.3
Doctor discussed HPV vaccine	No	920	74.13
	Yes	321	25.87

15% of the study sample had more than a high school education, 67% had some high school education or were high school graduates, and 17.8% had less than high school education. Urban residents comprised of 78% of the study sample while rural residents comprised of 22% of the study sample. About 41% of the study sample were aware of the HPV vaccine while about 59% were not aware of the vaccine.

5.2. HPV vaccine awareness

On bivariate analysis, (Table 3) there was a significantly decreased likelihood of HPV vaccine awareness among non-Hispanic Blacks (OR = 0.51; 95% CI = 0.30–0.89) and Hispanics (OR = 0.50; 95% CI = 0.30–0.82) compared to non-Hispanic Whites. Individuals who had some high school education or who were high school graduates (OR = 0.54; 95% CI = 0.30–0.98) and those who had less than high school education (OR = 0.34; 95% CI = 0.16–0.72) were less likely to be aware of the HPV vaccine compared to those who had more than a high school education. Compared to those who were ages 18–34 years, those who were 35–49 years (OR = 0.51; 95% CI = 0.31–0.83) or 50–64 years (OR = 0.28; 95% CI = 0.15–0.50) were less likely to be aware of the vaccine.

On multivariable analysis, non-Hispanic Blacks (OR = 0.50; 95% CI = 0.28–0.90) and Hispanics (OR = 0.55; 95% CI = 0.30–0.99) still had a decreased likelihood of HPV vaccine awareness compared to non-Hispanic Whites; however, educational attainment was no longer significantly associated with HPV awareness. The significantly reduced likelihood of HPV vaccine awareness among those who were 35–49 years (OR = 0.50; 95% CI = 0.30–0.84) and those who were 50–64 years (OR = 0.26; 95% CI = 0.14–0.49) compared to those who were 18–34 years persisted.

5.3. HINTS data

Non-Hispanic Whites, non-Hispanic Blacks and Hispanics comprised 62.3%, 19.7% and 18.1% of the study sample respectively (Table 2). About 41% of the study sample were college graduates or had a postgraduate education, 31.2% had some college education or vocational training, 20.6% were high school graduates or had completed 12 years of education, and 7.4% had less than high school education. Urban metropolitan area residents comprised 84% of the study sample while urban non-metropolitan/rural residents comprised 16% of the study sample. About 79% of respondents were aware of the HPV vaccine, while about 21% were not aware of the vaccine. About 74% of the study sample reported that no healthcare provider had discussed the HPV vaccine with them while 25.9% reported that a healthcare provider had discussed the HPV vaccine with them. Among those who were aware of the vaccine, only about 31% reported that a healthcare provider had ever talked to them about the vaccine, and only about 20% of those who had a physician visit within the past year reported that a healthcare provider had ever talked to them about the HPV vaccine (data not shown)

5.4. HPV vaccine awareness

On bivariate analysis (Table 4), there was a significantly decreased likelihood of HPV vaccine awareness among Blacks (OR = 0.36; 95% CI = 0.21–0.64) and Hispanics (OR = 0.29; 95% CI = 0.17–0.49) compared to Whites. There was also a significantly decreased likelihood of HPV vaccine awareness among those who were high school graduates or had completed 12 years of education (OR = 0.29; 95% CI = 0.16–0.52) and those who had less than high school education (OR = 0.26; 95% CI = 0.12–0.57), compared to college graduates or individuals who had a post-graduate education. There was a decreased likelihood of HPV vaccine awareness among those who were ages 65 and older (OR = 0.33; 95% CI = 0.16–0.68) compared to those who were 18–34 years. Compared to those who earned ≥$75,000, those who earned between $20,000 and $49,999 (OR = 0.34; 95% CI = 0.14–0.82) or <$20,000 (OR = 0.26; 95% CI = 0.13–0.50) were less likely to be aware of the vaccine.

Adjusting for only the variables contained in the Texas C-STEP analyses (race/ethnicity, educational attainment, residence, age and last checkup), non-Hispanic Blacks (OR = 0.24; 95% CI = 0.12–0.48) and Hispanics (OR = 0.20; 95% CI = 0.11–0.38) still had a decreased likelihood of HPV vaccine awareness compared to Whites. High school graduates or those who had at least 12 years of education (OR = 0.26; 95% CI = 0.14–0.47) continued to have a significantly decreased likelihood of HPV vaccine awareness compared to college graduates or those who had a post-graduate education. Respondents who were ages 65 and older (OR = 0.31; 95% CI = 0.14–0.66) were less likely to be aware of the vaccine awareness compared to those who were younger than 65 years.

The fully adjusted model showed that non-Hispanic Blacks (OR = 0.28; 95% CI = 0.14–0.58), Hispanics (OR = 0.22; 95% CI = 0.12–0.41), high school graduates or those who completed 12 years of education (OR = 0.31; 95% CI = 0.15–0.63) and those who were 65 years and

Table 3
Bivariate and multivariate analysis of the HPV vaccine awareness C-STEP data collected between 2014 and 2016 (n = 359).

		Bivariate Odds ratio (95% CI)	Multivariable Odds ratio (95% CI)
Race	White	Ref.	Ref.
	Black	**0.51 (0.30–0.89)**	**0.50 (0.28–0.90)**
	Hispanic	**0.50 (0.30–0.82)**	**0.55 (0.30–0.99)**
Educational attainment	More than high school (H/S)	Ref.	Ref.
	Some HS/HS graduate	0.54 (0.30–0.98)	0.61 (0.32–1.14)
	Less than HS	0.34 (0.16–0.72)	0.51 (0.22–1.23)
Residence	Urban	Ref.	Ref.
	Rural	1.13 (0.68–1.88)	1.07 (0.62–1.85)
Age	18–34 years	Ref.	Ref.
	35–49 years	**0.51 (0.31–0.83)**	**0.50 (0.30–0.84)**
	50–64 years	**0.28 (0.15–0.50)**	**0.26 (0.14–0.49)**
Last checkup	≤1 year	Ref.	Ref.
	>1 year	1.22 (0.67–2.24)	1.15 (0.60–2.19)

*Bold figures indicate statistical significance.

older (OR = 0.29; 95% CI = 0.13–0.64) continued to have a significantly decreased likelihood of HPV vaccine awareness compared to their counterparts.

5.5. Healthcare providers' discussion of HPV vaccine

On bivariate analysis (Table 5), there was a significantly decreased likelihood of healthcare providers' talking about the HPV vaccine among high school graduates or those who completed 12 years of education (OR = 0.41; 95% CI = 0.19–0.89), compared to college graduates or those who had a post graduate education. Compared to respondents who were 18–34 years, there was a significantly decreased likelihood of healthcare providers' talking about the HPV vaccine among those who were 35–49 years (OR = 0.42; 95% CI = 0.25–0.69), 50–64 years (OR = 0.25; 95% CI = 0.16–0.37) or ≥65 years (OR = 0.03; 95% CI = 0.02–0.07).

On multivariable analysis, educational attainment was no longer significantly associated with healthcare providers' discussing the HPV vaccine. Compared to those who were 18–34 years, there continued to be a decreased likelihood of healthcare providers discussing the HPV vaccine with respondents who were 35–49 years (OR = 0.50; 95% CI = 0.30–0.84), 50–64 years (OR = 0.26; 95% CI = 0.14–0.49) or ≥65 years.

6. Discussion

In this study we analyzed HPV vaccine awareness among low-income women presenting for cervical cancer screening at a family medicine clinic. We also explored determinants of HPV vaccine awareness and healthcare providers' discussion about the HPV vaccine among female respondents in the HINTS data, a nationally representative data.

6.1. HPV vaccine awareness

The proportion of women who were not aware of the HPV vaccine among the Texas C-STEP (59%) respondents compared to the HINTS respondents (21%) suggests a need for targeted interventions to raise HPV vaccine awareness among the Texas C-STEP target population. Among both study samples, non-Hispanic Blacks and Hispanics were less likely to be aware of the HPV vaccine compared to non-Hispanic Whites. In their study that utilized the same wave of the HINTS data, and which was comprised of both males and females, found no significant association between Black race and HPV vaccine awareness (Blake et al., 2015), the difference in our findings is likely because our study was restricted to females. Blake and colleagues however, found that Hispanics were

Table 4
Bivariate and multivariate analysis of the HPV vaccine awareness HINTS data collected in 2013 (unweighted n = 1241; weighted n = 82,208,821).

		Bivariate Odds ratio (95% CI)	Multivariable Odds ratio (95% CI)	Odds ratio (95% CI)
Race/ethnicity	Non-Hispanic White	Ref.	Ref.	Ref.
	Non-Hispanic Black	**0.36 (0.21–0.64)**	**0.24 (0.12–0.48)**	**0.28 (0.14–0.58)**
	Hispanic	**0.29 (0.17–0.49)**	**0.20 (0.11–0.38)**	**0.22 (0.12–0.41)**
Educational attainment	College graduate/post-graduate	Ref.	Ref.	Ref.
	Some college/vocational training	0.75 (0.42–1.32)	0.53 (0.30–0.95)	0.63 (0.35–1.15)
	High school/12 years completed	**0.29 (0.16–0.52)**	**0.26 (0.14–0.47)**	**0.31 (0.15–0.63)**
	<High school	**0.26 (0.12–0.57)**	0.45 (0.20–1.03)	0.58 (0.22–1.53)
Residence	Urban metropolitan area	Ref.	Ref.	Ref.
	Urban non-metropolitan/rural area	0.91 (0.50–1.65)	0.70 (0.40–1.22)	0.75 (0.42–1.36)
Age (years)	18–34	Ref.	Ref.	Ref.
	35–49	0.93 (0.40–2.13)	1.18 (0.49–2.86)	1.05 (0.42–2.63)
	50–64	0.79 (0.44–1.42)	0.81 (0.42–1.59)	0.70 (0.36–1.38)
	≥65	**0.33 (0.16–0.68)**	**0.31 (0.14–0.66)**	**0.29** (0.13–0.64)
Last checkup	≤1 year	Ref.	Ref.	Ref.
	>1 year	1.01 (0.54–1.88)	0.80 (0.42–1.53)	0.85 (0.42–1.68)
Income	≥$75,000	Ref.	Ref.	Ref.
	$50,000–$74,999	0.49 (0.19–1.25)		0.52 (0.20–1.31)
	$20,000–$49,999	**0.34 (0.14–0.82)**		0.52 (0.21–1.28)
	<$20,000	**0.26 (0.13–0.50)**		0.44 (0.20–1.01)
Insurance status	Insured	Ref.	Ref.	Ref.
	Uninsured	0.85 (0.44–1.65)		0.91 (0.42–1.98)

*Bold figures indicate statistical significance.

Table 5
Bivariate and multivariable analysis of the doctor's discussion of HPV vaccine HINTS data collected in 2013 (unweighted n = 1241; weighted n = 82,208,821).

		Bivariate Odds ratio (95% CI)	Multivariable Odds ratio (95% CI)
Race/ethnicity	Non-Hispanic White	Ref.	Ref.
	Non-Hispanic Black	0.78 (0.47–1.28)	0.63 (0.36–1.08)
	Hispanic	0.73 (0.45–1.19)	0.55 (0.29–1.06)
Educational attainment	College graduate/post-graduate	Ref.	Ref.
	Some college/vocational training	0.93 (0.65–1.35)	0.70 (0.43–1.14)
	High school/12 years completed	**0.41 (0.19–0.89)**	0.42 (0.17–1.02)
	<High school	0.60 (0.31–1.18)	0.94 (0.35–2.51)
Residence	Urban metropolitan area	Ref.	Ref.
	Urban non-metropolitan/rural area	1.21 (0.58–2.53)	1.41 (0.66–2.99)
Age (years)	18–34	Ref.	Ref.
	35–49	**0.42 (0.25–0.69)**	**0.39 (0.21–0.73)**
	50–64	**0.25 (0.16–0.37)**	**0.22 (0.13–0.38)**
	>65	**0.03 (0.02–0.07)**	**0.03 (0.01–0.07)**
Last checkup	<=1 year	Ref.	Ref.
	>1 year	1.11 (0.59–2.07)	0.70 (0.31–1.59)
Income	> = $75,000	Ref.	Ref.
	$50,000–$74,999	0.87 (0.52–1.45)	0.68 (0.33–1.38)
	$20,000–$49,999	1.08 (0.68–1.72)	1.13 (0.57–2.25)
	<$20,000	0.99 (0.49–1.99)	0.88 (0.29–2.66)
Insurance status	Insured	Ref.	Ref.
	Uninsured	1.60 (0.89–2.88)	1.27 (0.60–2.69)

*Bold figures indicate statistical significance.

less likely to be aware of the HPV vaccine compared to non-Hispanics (Blake et al., 2015). Other studies have also reported a decreased likelihood of HPV vaccine awareness (Williams et al., 2013; Ford, 2011), and receiving HPV vaccination (Williams et al., 2013; Ford, 2011; Fisher et al., 2013) among Blacks and Hispanics compared to Whites. These findings highlight a continued need for culturally-relevant educational efforts to raise HPV vaccine awareness among non-Hispanic Blacks and Hispanic females (Beavis & Levinson, 2016). Since it has been reported that compared to Whites, Blacks and Hispanics who initiate HPV vaccination are less likely to complete the vaccine series (Jeudin et al., 2014; Niccolai et al., 2011), it is crucial that such interventions incorporate strategies to ensure HPV vaccine uptake as well as completion of the three doses.

In agreement with the study by Blake et al. (2015) among the HINTS respondents, there was a significantly decreased likelihood of HPV vaccine awareness among individuals who had completed high school or 12 years of education; however, educational attainment was not significantly associated with HPV vaccine awareness among the Texas C-STEP respondents. A study comprised of residents of Puerto Rico reported decreased awareness of HPV vaccine among those with lower educational attainment (Reyes et al., 2015). Further studies are required to identify factors that could contribute to the decreased HPV vaccine awareness found among high school graduates, and whether educational interventions targeting high school graduates could raise HPV vaccine awareness.

Previous studies have reported a decreased likelihood of HPV vaccine awareness among older individuals (United States Department of Agriculture, 2014; Romaguera et al., 2016). Blake et al. also reported increased awareness of HPV vaccine among those who were <65 years compared to those who were 65 years and older (Blake et al., 2015). In our study, compared to those who were 18–34 years, there was a significantly decreased likelihood of HPV vaccine awareness among the Texas C-STEP respondents who were older than age 34 years; among the HINTS respondents, individuals who were 65 years and older had a significantly decreased likelihood of being aware of the HPV vaccine. Since individuals who are older than 34 years could have children who are age-eligible for the vaccine, the decreased likelihood of HPV vaccine awareness among Texas C-STEP respondents within this age group presents an opportunity for educational interventions aimed at raising HPV vaccine awareness among the Texas C-STEP target population.

6.2. Healthcare providers discussion of the HPV vaccine

Although about 79% of the female HINTS respondents were aware of the HPV vaccine, a healthcare provider had only talked to about 26% of the respondents about the vaccine. Only about 31% of those who were aware of the vaccine reported that a healthcare provider had ever talked to them about the vaccine; a healthcare provider had discussed the vaccine with only about 20% of those who had a physician visit within the past year. Another study comprised of only Hispanic females, found that among women who were aware of the HPV vaccine, only 39.6% had heard about the vaccine from a physician. These findings could be an indication of the success of educational efforts such as media campaigns and community outreach aimed at raising HPV vaccine awareness (Romaguera et al., 2016), and the need for such efforts to continue. The findings, however, highlight a need for specific interventions aimed at increasing healthcare providers' discussion of the vaccine during patient encounters.

In contrast to a previous study (Ylitalo et al., 2013), among our study population, there was no significant association between race or ethnicity and healthcare providers' HPV vaccine discussion. The difference between our findings and those of Ylitalo and colleagues could be because their study specifically focused on children ages 13–17 years (Ylitalo et al., 2013). The only significant predictor of healthcare providers' discussion of the HPV vaccine among our study sample was age; healthcare providers' were less likely to discuss the vaccine with those who were older than 34 years. This finding could be due to the age-recommendation for the HPV vaccination (Centers for Disease Control, 2015). However, since individuals who are older than 34 years could have children, relatives or other people in their social networks who are age-eligible for this vaccine, this finding could provide an opportunity to implement the cancer panel's recommendation of reducing missed clinical opportunities to recommend and administer the HPV vaccine (The President's Cancer Panel, 2014). It might be pertinent to explore the utility of encouraging healthcare providers to discuss HPV vaccine even when the patient is not age-eligible, and the impact of such practice on HPV vaccine awareness and uptake. However, because of the time constraints experienced during patient encounters, care should be taken to ensure that such interventions do not worsen the time constraints. Such an intervention could have potential for reducing HPV-related disparities since physician recommendation has been associated with increased HPV vaccine awareness and acceptance (Romaguera et

al., 2016), as well as increased uptake of vaccination (Ylitalo et al., 2013; Caskey et al., 2009; Bhatta & Phillips, 2015).

Our study has some limitations. The differences between variables contained in the Texas C-STEP dataset and the HINTS dataset limited the ability for more extensive comparison between the two groups. The Texas C-STEP data was comprised of only residents of a nine-county area presenting to a family medicine clinic; therefore, results may not be generalizable to low-income residents from other areas. We were unable to assess factors that could influence health care providers' discussion of the HPV vaccine such as knowledge, time constraints, and perception and attitude towards the patients; however, this is beyond the scope of our study.

In spite of these limitations, our study has various strengths. Using a nationally representative dataset, our study provides information on disparities in HPV vaccine awareness among female residents of the United States further expanding our knowledge of HPV vaccine-related disparities. Our ability to explore health care providers' discussion of the vaccine could also aid stakeholders working to develop intervention to reduce these disparities. The use of a nationally representative dataset enhances the generalizability of our study findings. The results of our analyses that explored vaccine awareness among low-income women could provide useful insights to stakeholders working to increase HPV vaccine awareness among low-income women.

In conclusion, there has been a steady decline in cervical cancer incidence and mortality rates for over three decades (National Cancer Institute, n.d.); disparities still exist. Black race (Siegel et al., 2015; DeSantis et al., 2016), Hispanic ethnicity (Siegel et al., 2015) and low-socio-economic status (Singh et al., 2004) have been associated with cervical cancer disparities. Increasing HPV vaccine awareness among these subpopulations could lead to increased HPV vaccination rates, potentially reducing cervical cancer disparities, as well as the other types of HPV-related cancers. Increasing health care providers' discussion of the vaccine with patients regardless of patients' age should also be explored as means of increasing HPV vaccine awareness, as well as vaccination rates.

Conflict of interest statement

The authors declare there is no conflict of interest.

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References

Bair, R.M., Mays, R.M., Sturm, L.A., Zimet, G.D., 2008 Dec. Acceptability of the human papillomavirus vaccine among Latina mothers. J. Pediatr. Adolesc. Gynecol. 21 (6), 329–334.

Beavis, A.L., Levinson, K.L., 2016 Feb 1. Preventing cervical cancer in the United States: barriers and resolutions for HPV vaccination. Front. Oncol. 6, 19.

Blake, K.D., Ottenbacher, A.J., Finney Rutten, L.J., et al., 2015 Feb 17. Predictors of human papillomavirus awareness and knowledge in 2013: gaps and opportunities for targeted communication strategies. Am. J. Prev. Med. (pii: S0749-3797(14)00629-1).

Bhatta, M.P., Phillips, L., 2015 Winter. Human papillomavirus vaccine awareness, uptake, and parental and health care provider communication among 11- to 18-year-old adolescents in a rural Appalachian Ohio county in the United States. J. Rural. Health 31 (1), 67–75.

Caskey, R., Lindau, S.T., Alexander, G.C., 2009 Nov. Knowledge and early adoption of the HPV vaccine among girls and young women: results of a national survey. J. Adolesc. Health 45 (5), 453–462.

Centers for Disease Control, 2015. Human Papillomavirus (HPV) Vaccine. http://www.cdc.gov/hpv/parents/cancer.html 11/08/2016.

Centers for Disease Control, 2013. Human Papillomavirus Vaccination Coverage Among Adolescent Girls, 2007–2012, and Postlicensure Vaccine Safety Monitoring, 2006–2013 — United States. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6229a4.htm.

DeSantis, C.E., Siegel, R.L., Sauer, A.G., et al., 2016 Jul. Cancer statistics for African Americans, 2016: progress and opportunities in reducing racial disparities. CA Cancer J. Clin. 66 (4), 290–308.

Fazekas, K.I., Brewer, N.T., Smith, J.S., 2008 May. HPV vaccine acceptability in a rural southern area. J. Women's Health (Larchmt) 17 (4), 539–548.

Fisher, H., Trotter, C.L., Audrey, S., MacDonald-Wallis, K., Hickman, M., 2013 Jun. Inequalities in the uptake of human papillomavirus vaccination: a systematic review and meta-analysis. Int. J. Epidemiol. 42 (3), 896–908.

Ford, J.L., 2011 Nov–Dec. Racial and ethnic disparities in human papillomavirus awareness and vaccination among young adult women. Public Health Nurs. 28 (6): 485–493. http://dx.doi.org/10.1111/j.1525-1446.2011.00958.x (Epub 2011 Jun 6).

Gottlieb, S.L., Brewer, N.T., Sternberg, M.R., et al., 2009 Nov. Human papillomavirus vaccine initiation in an area with elevated rates of cervical cancer. J. Adolesc. Health. 45 (5), 430–437.

Holman, D.M., Benard, V., Roland, K.B., Watson, M., Liddon, N., Stokley, S., 2014 Jan. Barriers to human papillomavirus vaccination among US adolescents: a systematic review of the literature. JAMA Pediatr. 168 (1), 76–82.

Jeudin, P., Liveright, E., Del Carmen, M.G., Perkins, R.B., 2014 Jan 1. Race, ethnicity, and income factors impacting human papillomavirus vaccination rates. Clin. Ther. 36 (1), 24–37.

Muñoz, N., Bosch, F.X., Castellsagué, X., et al., 2004 Aug 20. Against which human papillomavirus types shall we vaccinate and screen? The international perspective. Int. J. Cancer 111 (2), 278–285.

National Cancer Institute, d. Health Information National Trends Data. Accessed from. https://hints.cancer.gov.

National Cancer Institute. (n.d.). SEER stat fact sheets: cervix uteri cancer. http://seer.cancer.gov/statfacts/html/cervix.html

Niccolai, L.M., Mehta, N.R., Hadler, J.L., 2011 Oct. Racial/ethnic and poverty disparities in human papillomavirus vaccination completion. Am. J. Prev. Med. 41 (4), 428–433.

Reagan-Steiner, S., Yankey, D., Jeyarajah, J., et al., 2015 Jul 31. National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 years–United States, 2014. MMWR Morb. Mortal. Wkly Rep. 64 (29), 784–792.

Reyes, J.C., Sánchez-Díaz, C.T., Tortolero-Luna, G., Colón, H.M., Ortiz, A.P., 2015 Dec. Demographic and high-risk behaviors associated with HPV and HPV vaccine awareness among persons aged 15–74 years in Puerto Rico. P. R. Health Sci. J. 34 (4), 195–200.

Romaguera, J., Caballero-Varona, D., Tortolero-Luna, G., et al., 2016 Jun. Factors associated with HPV vaccine awareness in a population-based sample of Hispanic women in Puerto Rico. J. Racial Ethn. Health Disparities 3 (2), 281–290.

Schiffman, M., Castle, P.E., Jeronimo, J., Rodriguez, A.C., Wacholder, S., 2007 Sep 8. Human papillomavirus and cervical cancer. Lancet 370 (9590), 890–907.

Siegel, R.L., Fedewa, S.A., Miller, K.D., et al., 2015 Nov–Dec. Cancer statistics for Hispanics/Latinos, 2015. CA Cancer J. Clin. 65 (6), 457–480.

Singh, G.K., Miller, B.A., Hankey, B.F., Edwards, B.K., 2004 Sep 1. Persistent area socioeconomic disparities in U.S. incidence of cervical cancer, mortality, stage, and survival, 1975–2000. Cancer 101 (5), 1051–1057.

StataCorp, 2013. Stata Statistical Software: Release 13. StataCorp LP, College Station, TX.

The President's Cancer Panel, 2014. Accelerating HPV Vaccine Uptake: Urgency for Action to Prevent Cancer. http://deainfo.nci.nih.gov/advisory/pcp/annualReports/HPV/PDF/PCP_Annual_Report_2012-2013.pdf (Accessed 7/1/2016).

United States Department of Agriculture, 2014. Rural-Urban Commuting Area Codes. http://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx Last updated 06/02/2014.

Viens, L.J., Henley, S.J., Watson, M., et al., 2016 Jul 8. Human papillomavirus-associated cancers-United States, 2008–2012. MMWR Morb. Mortal. Wkly Rep. 65 (26), 661–666.

Williams, W.W., Lu, P.J., Saraiya, M., et al., 2013 Jun 19. Factors associated with human papillomavirus vaccination among young adult women in the United States. Vaccine 31 (28), 2937–2946.

Ylitalo, K.R., Lee, H., Mehta, N.K., 2013 Jan. Health care provider recommendation, human papillomavirus vaccination, and race/ethnicity in the US National Immunization Survey. Am. J. Public Health 103 (1), 164–169.