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Rural-urban disparities in human papillomavirus vaccination: Findings from a cross-sectional survey of 13 southern U.S. states, December 2019 – January 2020

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Abstract

Background: Rural adolescents in the United States (U.S.) lag behind their urban counterparts in the uptake of the Human Papillomavirus (HPV) vaccine. However, a systematic assessment of factors associated with rural-urban disparities in HPV vaccination coverage to inform potential vaccination promotion interventions is lacking in the literature. Prioritizing HPV vaccination for rural adolescents is necessary for increasing overall HPV vaccination coverage for adolescents and for reducing the incidence of HPV infections and future HPV-related cancers.

Methods: We conducted a cross-sectional survey of caregivers of adolescents aged 9–17 years from 13 states located in the southern U.S. Participants were recruited from a nationally

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representative online survey panel and self-administered the survey from December 2019 – January 2020. The survey assessed HPV vaccination initiation and series completion for rural and urban adolescents, and sought to systematically identify modifiable factors (e.g., caregiver knowledge and attitudes about HPV/HPV vaccine, healthcare access) and non-modifiable factors (e.g., socio-demographic characteristics) that may be associated with rural-urban disparities in adolescent HPV vaccination. Rural vs. urban residence status of respondents was determined using the U.S. Census definition and Federal Information Processing System (FIPS) codes.

Results: Among 2262 sampled caregivers, data from 987 respondents (43.6%) were included in the analysis; 193 respondents (19.6%) were from rural areas and 794 (80.4%) were from urban areas. Overall, 333 (33.7%) adolescents had received at least 1 dose of HPV vaccination and 259 (26.3%) adolescents had completed HPV vaccination. In comparison to urban adolescents, fewer rural adolescents had initiated (–7.7 percentage points) or completed (–14.9 percentage points) HPV vaccination. Uptake of tetanus, diphtheria, and acellular pertussis (Tdap), meningococcal (MenACWY), and influenza vaccines was similar between urban and rural adolescents. Caregiver attitudes, but not their knowledge about HPV infection or the HPV vaccine, were associated with disparities in HPV vaccination initiation. Rural caregivers were more likely to report concerns with the HPV vaccine, lower access to a pediatric primary care provider, longer travel times to reach healthcare providers, and HPV vaccination at age 11 years or older compared with age 9 or 10 years. When compared with urban caregivers, fewer rural caregivers reported discussing HPV vaccination with their adolescent’s provider although difference in the receipt of a provider recommendation was not statistically significant between rural and urban adolescents.

Conclusion: Our findings confirm rural-urban disparities in HPV vaccination coverage for adolescents living in the 13 southern U.S. states. Future research efforts to reduce rural-urban disparities in HPV vaccination should evaluate impacts of interventions that increase positive caregiver attitudes about HPV vaccination, expand access to vaccination services and pediatricians for rural adolescents, enable strong provider recommendations, and increase the window of HPV vaccination by promoting vaccination initiation at younger ages (9–10 years). While this analysis focused on rural-urban disparities, lower rates of HPV vaccination overall suggest that interventions in rural areas be implemented alongside broader efforts to promote adolescent HPV vaccination coverage in the southern U.S.

Keywords

adolescents; health disparity; human papillomavirus; rural health; Southern United States; vaccination

INTRODUCTION

Rural areas in the United States (U.S.) face a high burden of cancers attributable to human papillomavirus (HPV).^{1,2} Chances of infection with high risk cancer-causing HPV types can be reduced by vaccinating persons against HPV.³ However, in the U.S., fewer rural adolescents are vaccinated against HPV in comparison with their urban counterparts.^{2,4–8} Increasing coverage of HPV vaccination among rural adolescents is necessary for reducing disparities in adolescent HPV vaccination coverage, and for reducing the incidence of future HPV infections and their associated cancers in the U.S. Factors associated with HPV

vaccination reported in the literature include school requirements for HPV vaccination, having a routine place of healthcare, receiving a strong recommendation in favor of vaccination from a health provider, and caregivers' knowledge and positive attitudes related to HPV infection and vaccination.^{9–18} Further research is necessary to identify how these and other multifaceted factors vary for rural versus urban adolescents.

While previous studies have examined factors associated with HPV vaccination among rural adolescents, there remain critical gaps in research evidence.¹⁹ First, most quantitative studies on barriers and facilitators of HPV vaccine uptake for rural adolescents have a narrow geographic focus (e.g., data from a single state) or examine a limited set of factors associated with vaccination.^{18,19} For instance, studies using National Immunization Survey (NIS)-Teen data examine socio-demographic characteristics associated with HPV vaccination in rural and urban areas, but do not include assessments of the broader set of factors (e.g., caregivers' attitudes) associated with HPV vaccination.^{4,6–8} Using data from the Health Information National Trends Survey 2013–2017, Mohammed et al. found lower awareness of HPV and the HPV vaccine and poorer knowledge of some HPV-associated cancers (e.g., cervical cancer) among rural versus urban respondents, but they did not examine other factors, such as differences in HPV vaccine-related attitudes.²⁰ There are also few studies investigating factors associated with rural-urban disparities in southern U.S. states, which have large and diverse rural populations, as well as some of the lowest reported coverage of HPV vaccination for adolescents in the country.^{9,21,22}

Second, many studies that focus on HPV vaccination among rural adolescents are qualitative in nature and lack comparisons with urban/suburban residents, precluding the identification of factors uniquely associated with vaccination uptake in rural areas.^{23–25} While such qualitative studies are critical for identifying locally relevant barriers and facilitators of HPV vaccination, further research is necessary to understand which interventions to prioritize for reducing vaccination disparities for rural adolescents. To bridge these gaps in the literature, a larger assessment of the multifaceted factors associated with rural-urban disparities in HPV vaccination uptake is needed. The findings of such an assessment may help inform interventions, public health programs, and policies for bridging the rural-urban divide in adolescent HPV vaccination coverage.

As part of a study funded by a cooperative agreement with the U.S. Centers for Disease Control and Prevention (CDC), we examined drivers of rural-urban disparities in adolescent HPV vaccination with the goal to inform potential interventions for promoting HPV vaccination for rural adolescents. In this study, we conducted a cross-sectional survey of caregivers from 13 states located in the southern U.S. The survey assessed HPV vaccination initiation and series completion for rural and urban adolescents who were between the ages of 9–17 years, and sought to systematically identify modifiable (e.g., caregiver knowledge and attitudes about HPV/HPV vaccine, healthcare access) and non-modifiable factors (e.g., caregiver age, race, ethnicity) that may contribute to rural-urban disparities in HPV vaccination.

METHODS

Detailed methods of the study have been published previously in accordance with the *STrengthening the Reporting of OBservational studies in Epidemiology (STROBE)* statement for cross-sectional studies.^{9,16,17,26} Key elements related to the assessment of rural-urban disparities in HPV vaccination are presented below.

Ethical approval

The study protocol was approved by Institutional Review Boards at authors' institutions. Since the CDC only had access to de-identified data, it was determined that the CDC was not engaged in human subjects research and the CDC's IRB approval was not required.

Study design, participants, and recruitment

From December 2019 – January 2020, caregivers (i.e., parents and legal guardians) of adolescents (ages 9–17 years) residing in 13 southern states were recruited through a pre-existing nationally-representative online survey panel.⁹ The 13 southern states (i.e., U.S. Department of Health and Human Services [HHS] regions 4 and 6) were Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas. Details of the survey panel have been reported elsewhere.^{27–29} Two considerations drove the designation of HHS regions 4 and 6 as the geographic sampling frame for this study. First, HHS regions 4 and 6 had the lowest HPV vaccination coverage in the U.S. at the time of the study (2018–19).^{21,22} Second, HHS region 4 included the two states (North and South Carolina) where an intervention to reduce rural-urban disparities in HPV vaccination was planned in future aims (not discussed), with the possibility of subsequent scale up across HHS regions 4 and 6.

The NIS-Teen estimates HPV vaccination coverage among adolescents who are between the ages of 13–17 years since the Advisory Committee on Immunization Practices (ACIP) recommends HPV vaccination at 11–12 years. However, ACIP recommendations allow initiation of HPV vaccination as early as age 9. In addition, the American Academy of Pediatrics recommends HPV vaccination for all children starting at age 9.³⁰ Hence, the survey was inclusive of caregivers of adolescents ages 9 years to 17 years.

Recruitment occurred through an electronic link shared via email, which directed interested individuals to an implied consent script communicating the survey purpose and contact information of the Principal Investigator, followed by an eligibility screener and a structured web-based survey. Responses to all survey questions beyond the eligibility screener were optional.

Classification of rural and urban residence status: Urban residence status was determined based on participants' ZIP code of residence, using criteria defined by the U.S. Census Bureau.³¹ For 66 records with zip codes in non-residential areas, rural-urban designation was based on participants' county of residence using the USDA Federal Information Processing System (FIPS) Codes.³²

Measurement and Statistical methods: The full list of survey questions and variables have been reported previously.⁹ Key question domains assessed caregivers' and adolescents' demographic characteristics, adolescents' vaccination status (as reported by the caregiver), caregivers' HPV knowledge, general vaccination attitudes, HPV vaccine-specific attitudes, HPV vaccination decision-making attitudes, and adolescents' healthcare access and use patterns.^{9,16,17} Eligible caregivers self-administered the survey online. Survey data were analyzed using SAS 9.4 (SAS Institute, Cary, NC) with bivariable and multivariable survey-analytic regression methods.

HPV vaccination initiation, defined as the receipt of ≥ 1 dose of the HPV vaccine ("yes" vs. "no") was the primary outcome (dependent variable), while HPV series completion (i.e., receipt of all recommended doses according to age at initiation) was the secondary outcome. Geo-demographically calibrated survey weights were used to ensure that results were statistically representative of the target population. Parametric (χ^2) tests were used to compare weighted differences by rural vs urban residence status. Weighted multivariable logistic regression models assessed correlations between the dependent variable and characteristics of caregivers and adolescents. Missing values were grouped with other response categories or excluded from the analysis. Odds ratios and 95% confidence intervals describe the extent to which differences in vaccination coverage were associated with variation in covariates; p-values < 0.05 were considered statistically significant. Response options with fewer than 5 participants were suppressed in tables and figures to preserve confidentiality.

RESULTS

After excluding respondents who did not opt in ($n=1,012$), were ineligible ($n=71$), did not complete the survey ($n=74$) and did not answer residence question ($n=118$), data from 987 out of 2,262 sampled caregivers were included in the final analysis.⁹

Table 1 shows the characteristics of caregivers by rural or urban residence status. In total, 193 (19.6%) caregivers were from rural areas, while the remaining 794 (80.4%) caregivers were from urban areas. Compared with urban caregivers, more rural caregivers had completed less than a Bachelor's degree, were not working at the time of the survey, identified as non-Hispanic White, and had an adolescent who was enrolled in home or online school. There were no significant differences between the rural and urban groups in the age of adolescents.

Figure 1 shows rural-urban disparities in vaccination status of adolescents as reported by their caregivers. Compared to rural caregivers, urban caregivers were more likely to report that their adolescent had initiated HPV vaccination (urban: 38.8% versus rural: 31.1%). Among those initiating HPV vaccination, a larger subset of urban adolescents (73%) had completed all recommended doses of HPV vaccination compared with the subset of rural adolescents (58.1%). There were no statistically significant differences in the uptake of other recommended vaccines (Tdap, MenACWY, or seasonal influenza vaccine) between rural and urban adolescents. Figure 2 shows the distribution of adolescent ages at the time of HPV vaccination initiation in rural and urban settings. A small proportion (4.2%) of urban

adolescents initiated HPV vaccination early (i.e., at 9 or 10 years), and this proportion was comparatively larger than the proportion of rural adolescents (<1%) initiating HPV vaccination at those ages. As shown in Supplementary Table 1, fewer rural caregivers reported discussing the HPV vaccine with their adolescent's provider although receipt of a provider recommendation for HPV vaccination was not statistically different between the groups. Among those without series completion, more rural caregivers said that it was very likely that their adolescent would receive an/another HPV vaccine dose in the next 12 months. Among those caregivers who reported that their adolescent was not likely to receive an/another HPV vaccine dose in the next 12 months, more rural caregivers expressed concerns about the HPV vaccine.

Figures 3 and 4 show caregiver attitudes about the HPV vaccine and vaccination decision-making, stratified by rural or urban residence. HPV vaccine-specific and HPV vaccination decision-making attitudes were significantly more negative among rural caregivers when compared with urban caregivers. On HPV vaccine-specific attitudes, rural caregivers had significantly greater negative attitudes on 4 out of 7 items (related to worry of long-term health problems from the vaccine, profit for pharmaceutical companies, adequacy of research on the HPV vaccine, and perceived harm from the HPV vaccine [Figure 3]). On HPV vaccination decision-making attitudes, rural caregivers had significantly more negative attitudes on 5 out of 8 items (related to benefits of vaccination, support from important people on the decision to vaccinate, healthcare provider recommendation in favor of vaccination, support for school HPV vaccine requirement, and perceived severity of HPV infection [Figure 4]).

Supplementary Table 2 and Supplementary Figure 1 summarize HPV knowledge and general vaccination attitudes, respectively, among urban and rural caregivers. The overall HPV knowledge score as measured by the HPV-Knowledge Questionnaire (HPV-KQ) was similar for urban and rural caregivers (Supplementary Table 2). Statistically significant differences on specific questionnaire items were noted; rural caregivers were less likely than urban caregivers to know that HPV can cause cancer in areas such as the head and neck, and that nearly all sexually active people will contract HPV at some point (Supplementary Table 2). There were no differences between rural and urban caregivers in their general adolescent vaccination attitudes (Supplementary Figure 1),

Figure 5 shows patterns of healthcare use and access for adolescents as reported by their caregivers. Fewer rural caregivers reported a healthcare provider visit for their adolescent in the last year (80.3% vs 89.4% among urban caregivers). The doctor's office was the most common place for adolescent health care visits in both groups. Fewer rural caregivers reported that their adolescent saw a pediatrician (47.4%) compared with urban caregivers (72.4%). Rural caregivers also reported longer travel times and greater use of public insurance when compared to urban caregivers.

DISCUSSION

Vaccination against HPV has been associated with decreases in the occurrence of cervical and vulvar cancer known to be caused by HPV.^{33–38} Increasing coverage of HPV

vaccination is critical for reducing the significant burden of cervical cancer morbidity and mortality in rural communities in the U.S.^{37–40} This study examined multifaceted factors associated with rural-urban disparities in HPV vaccination among adolescents ages 9–17 years using a large, cross-sectional survey of caregivers from 13 southern U.S. states. Our findings confirm the presence of rural-urban disparities in HPV vaccination for adolescents and suggest that lower HPV vaccine coverage in rural areas in the southern U.S. may, in part, be associated with more negative attitudes among rural caregivers related specifically to the HPV vaccine and healthcare access issues.^{4–8,18} In our study, rural caregivers reported significantly fewer instances of discussing HPV vaccination with health providers and longer travel times to health providers. Put together, these findings suggest the need for further research on the impact of interventions to bolster positive caregiver attitudes about HPV vaccination, increase access to pediatric providers or providers who care for children/adolescents in rural settings in southern U.S, promoting strong provider recommendation in favor of vaccination, and reduce missed opportunities for vaccination at primary care and non-primary care visits. Although only a small proportion of urban adolescents initiated vaccination at younger ages (9–10 years), their higher numbers compared to rural adolescents suggest the need to further study the impact of promoting vaccination initiation at younger ages (9–10 years) on reducing rural-urban disparities in HPV vaccination.

In a prior publication, we showed that HPV knowledge, as measured by the mean HPV-Knowledge Questionnaire (HPV-KQ) score, was higher for caregivers of adolescents who had received the HPV vaccine when compared with caregivers of unvaccinated adolescents.¹⁶ However, our assessment of mean HPV-KQ score between rural and urban caregivers did not yield a statistically significant difference, suggesting that attitudes (how people feel) rather than knowledge (what people know) are associated with rural-urban disparities in HPV vaccination in our study. In a prior study, rural respondents differed from urban respondents in awareness of HPV and links to cervical cancer, but were similar in knowledge of other HPV-associated cancer types.²⁰ Our finding that more rural respondents reported concerns about the vaccine is in agreement with a recent study by Boyce et al.¹⁸ Collectively, these findings suggest the need for co-interventions that alleviate caregiver concerns and promote greater positive attitudes towards HPV vaccination. Further investigation is needed to assess whether and how caregivers' attitudes may be impacted by availability of -- and trust in -- healthcare versus non-healthcare sources of information in rural settings.

Rural-urban disparities in vaccine uptake are not unique to the HPV vaccine. In a prior study, O'Leary and colleagues showed lower influenza vaccination coverage for rural children.⁴¹ Other data suggest the presence of rural-urban disparities in routine childhood vaccinations, pneumococcal vaccination for adults, and COVID-19 vaccinations.^{42–44} In our study, rural adolescents showed similar uptake of other recommended vaccines such as Tdap and MenACWY compared with urban adolescents. These data suggest that the observed rural-urban disparities in HPV vaccination are due to HPV vaccine-specific hesitancy as opposed to hesitancy towards vaccines in general. Since HPV and influenza vaccines are not required for school entry in the southern states included in this study, they may be underprioritized for recommendation or administration by healthcare providers when compared with other, required vaccines. While our data did not show statistically significant

differences in provider recommendation for urban versus rural adolescents, fewer rural caregivers reported discussing HPV vaccination with their adolescent's provider. CDC's "same day same way" bundled recommendations script may be a useful tool to ensure all recommended vaccines are presented by healthcare providers to caregivers making vaccination decisions for adolescents.⁴⁵ In addition, efforts to promote a strong provider recommendation may be beneficial to increase HPV vaccination for rural adolescents, and should be evaluated.

Strengthening healthcare infrastructure and human resources for vaccine delivery remains a critical priority for reducing healthcare access-related disparities for rural residents.¹¹ Potential challenges with implementing provider-based approaches documented in the literature include access-related challenges, such as lack of pediatric providers in rural areas, general healthcare provider shortages, lower health insurance coverage, providers' hesitancy towards the HPV vaccine, and other social determinants of health (e.g., poverty, transportation vulnerability).⁴⁶ To overcome some of these barriers, expanding provider recommendations in rural community pharmacy settings has been suggested.⁴⁷ Expanded use of telemedicine could also offer novel touchpoints for rural providers to promote HPV vaccination and explain its role in cancer prevention to eligible families.¹¹ In addition, strategies to promote vaccine recommendation among non-pediatric providers and medical office staff in rural settings need further exploration.

A detailed description of the strengths of the survey sample and study design has been published previously.^{9,16,17} In brief, the strengths include the use of a nationally representative online survey panel for recruitment and the post-hoc application of geo-demographically calibrated weights to the analytic sample for preserving generalizability of findings to the southern U.S. The inclusion of caregivers of 9–10 year olds is another strength of this study as it provides preliminary data on the frequency of initiation of HPV vaccination at this age in urban and rural populations. Finally, the study provides insight into patterns of HPV vaccination and factors associated with rural-urban disparities in the southern U.S., a region with high burden of HPV-attributable cancers.² Importantly, our study was completed prior to the start of the COVID-19 pandemic, and estimates from 2021–2023^{8,48,49} suggest plateauing of HPV vaccination coverage among 13–17 year olds. Our study findings on caregiver knowledge and attitudes, hence, serve as valuable baseline data for comparisons of pre- vs. post-pandemic rural-urban vaccination disparities for adolescents.

Study limitations include the cross-sectional nature of the survey, which limits assessments of temporal impacts and confounding factors. In addition, caregiver-reported vaccination status of adolescents may be subject to desirability bias, although we would expect the impact of this bias to be similar among rural and urban respondents. While HPV vaccination status was self-reported and not validated using medical records, the HPV vaccination coverage among adolescents 13–17 years in our survey was 54.2% which is comparable to HPV vaccination coverage of 55% reported in the same age group and geographic area in the 2019 National Immunization Survey-Teen.^{9,22} The sample of rural caregivers in our survey was limited by the availability of eligible individuals in the panel. Although panel recruitment methods and data weighting were designed to produce results representative of

the southern U.S., the sample may not be representative of the general U.S. population of adolescents' caregivers.

CONCLUSION

Our findings confirm the presence of rural-urban disparities in HPV vaccination coverage for adolescents and provide support for further research on impact of interventions that increase positive caregiver attitudes about HPV vaccination, expand access to vaccination services, and reduce missed opportunities for vaccination. In addition, future studies that investigate the effects of earlier initiation of HPV vaccination on coverage rates, particularly in rural settings, are necessary to assess the effectiveness of this strategy for bridging rural-urban disparities in adolescent HPV vaccination.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Declaration of interests

Dr. Walter has received funding support from Pfizer, Moderna, Sequiris, Najit Technologies Inc., and Clinetic for the conduct of clinical trials and clinical research. He has also served as an advisor to Vaxcyte and Pfizer, a consultant to ILiAD biotechnologies and a data safety monitoring board member for Shionogi. All other authors have no conflicts of interests to declare. The research presented in this manuscript was supported by a cooperative agreement with the Centers for Disease Control and Prevention and was intended to help identify factors contributing to disparities in adolescent vaccination coverage between those residing in urban and rural areas within the United States.

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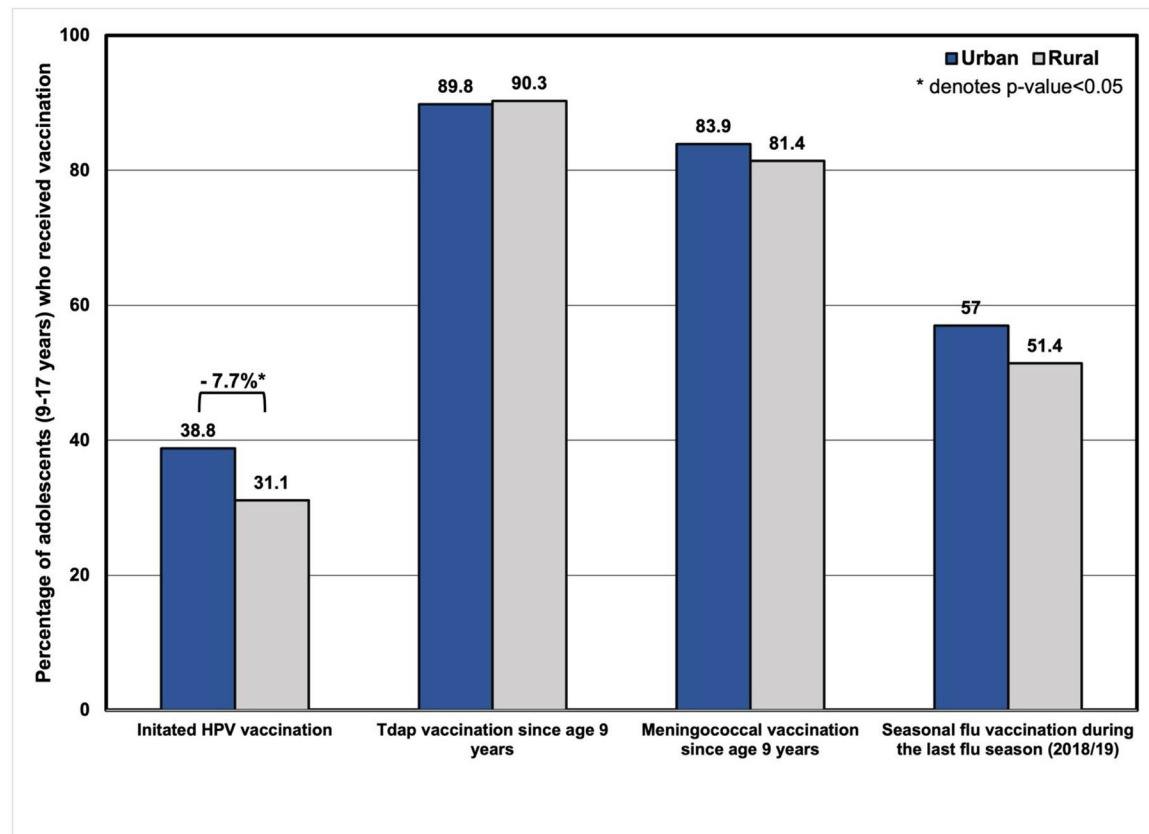


Figure 1:

Disparities in vaccination status of rural versus urban adolescents (ages 9–17 years), cross-sectional survey of caregivers from 13 southern US states, December 2019 – January 2020.

Abbreviations: HPV, human papillomavirus; Tdap, tetanus, diphtheria, acellular pertussis. Vaccination status was reported by caregivers of adolescents.

The 13 southern US states were in HHS regions 4 and 6 and included Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

Urban residence status was determined based on participants' ZIP code of residence, using criteria defined by the US Census Bureau.³¹ For 66 records with zip codes in non-residential areas, rural-urban designation was based on participants' county of residence using the USDA Federal Information Processing System (FIPS) Codes.³²

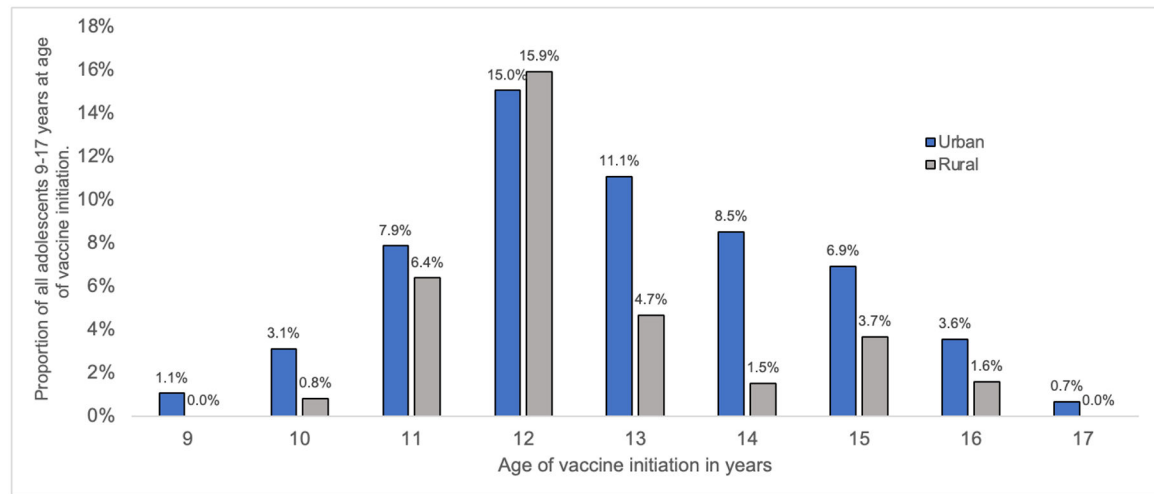


Figure 2:

HPV vaccination by age at series initiation, among rural versus urban adolescents (ages 9–17 years), cross-sectional survey of caregivers from 13 southern US states, December 2019 – January 2020.

Abbreviations: HPV, human papillomavirus

Vaccination status was reported by caregivers of adolescents and calculated based on % of adolescents of a given age or older who were reported to have received the vaccination at that age. Excludes children with missing age (N=5), unknown age at vaccination (N=15) or vaccination age after their age at the time of the survey (N=2).

The 13 southern states were in HHS regions 4 and 6 and included Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

Urban residence status was determined based on participants' ZIP code of residence, using criteria defined by the US Census Bureau.³¹ For 66 records with zip codes in non-residential areas, rural-urban designation was based on participants' county of residence using the USDA Federal Information Processing System (FIPS) Codes.³²

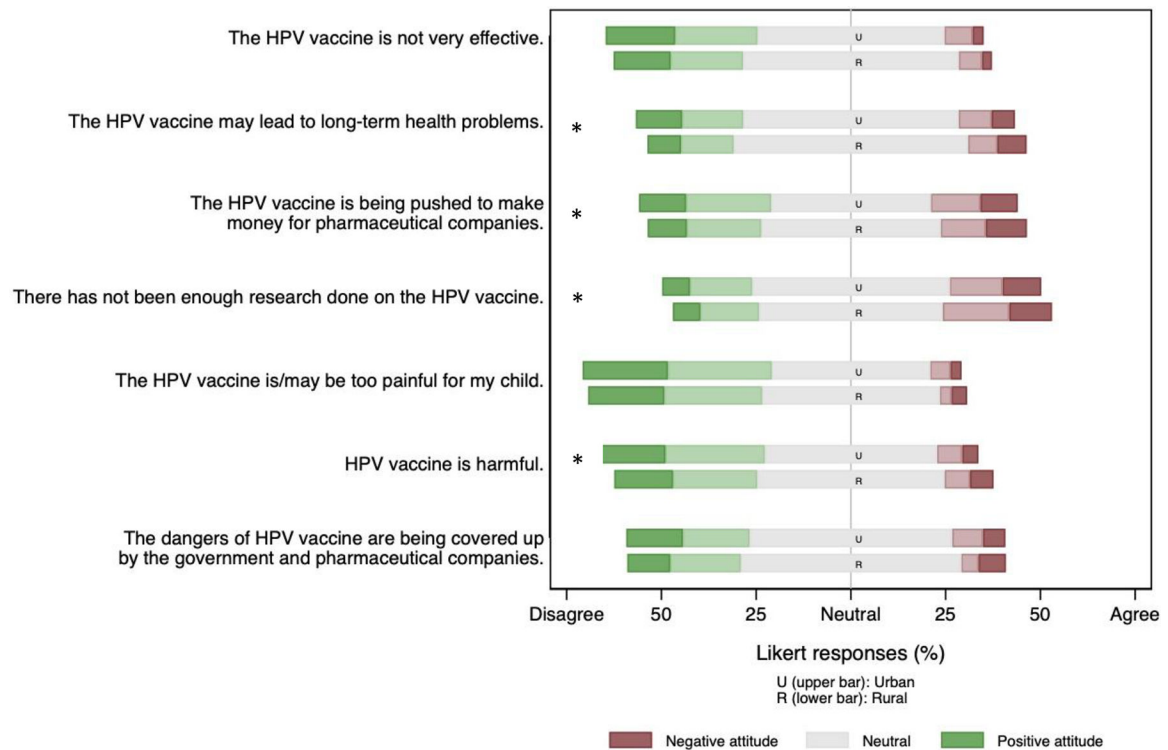


Figure 3:
HPV vaccine attitudes among caregivers of adolescents from 13 southern US states,
December 2019 – January 2020

Abbreviations: HPV, human papillomavirus

* represents p-value < 0.05

The 13 southern states were in HHS regions 4 and 6 and included Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

Urban residence status was determined based on participants' ZIP code of residence, using criteria defined by the US Census Bureau.³¹ For 66 records with zip codes in non-residential areas, rural-urban designation was based on participants' county of residence using the USDA Federal Information Processing System (FIPS) Codes.³²

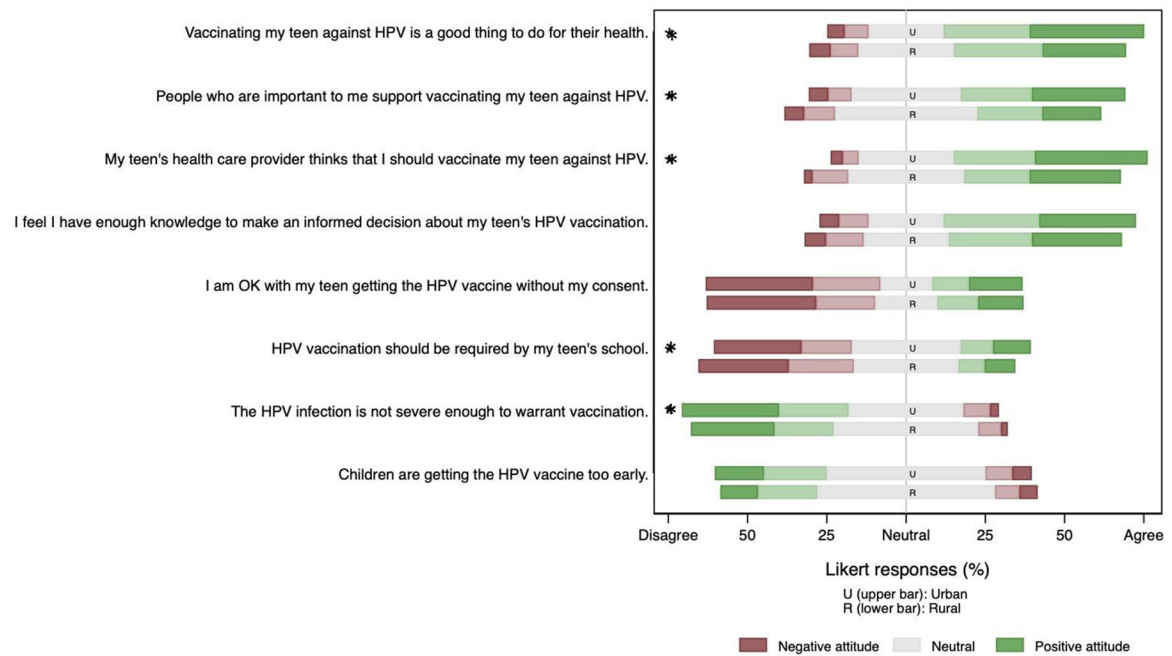


Figure 4:

HPV vaccination decision-making attitudes among caregivers of adolescents from 13 southern US states, December 2019 – January 2020.

Abbreviations: HPV, human papillomavirus

* represents p-value <0.05

The 13 southern states were in HHS regions 4 and 6 and included Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

Urban residence status was determined based on participants' ZIP code of residence, using criteria defined by the US Census Bureau.³¹ For 66 records with zip codes in non-residential areas, rural-urban designation was based on participants' county of residence using the USDA Federal Information Processing System (FIPS) Codes.³²

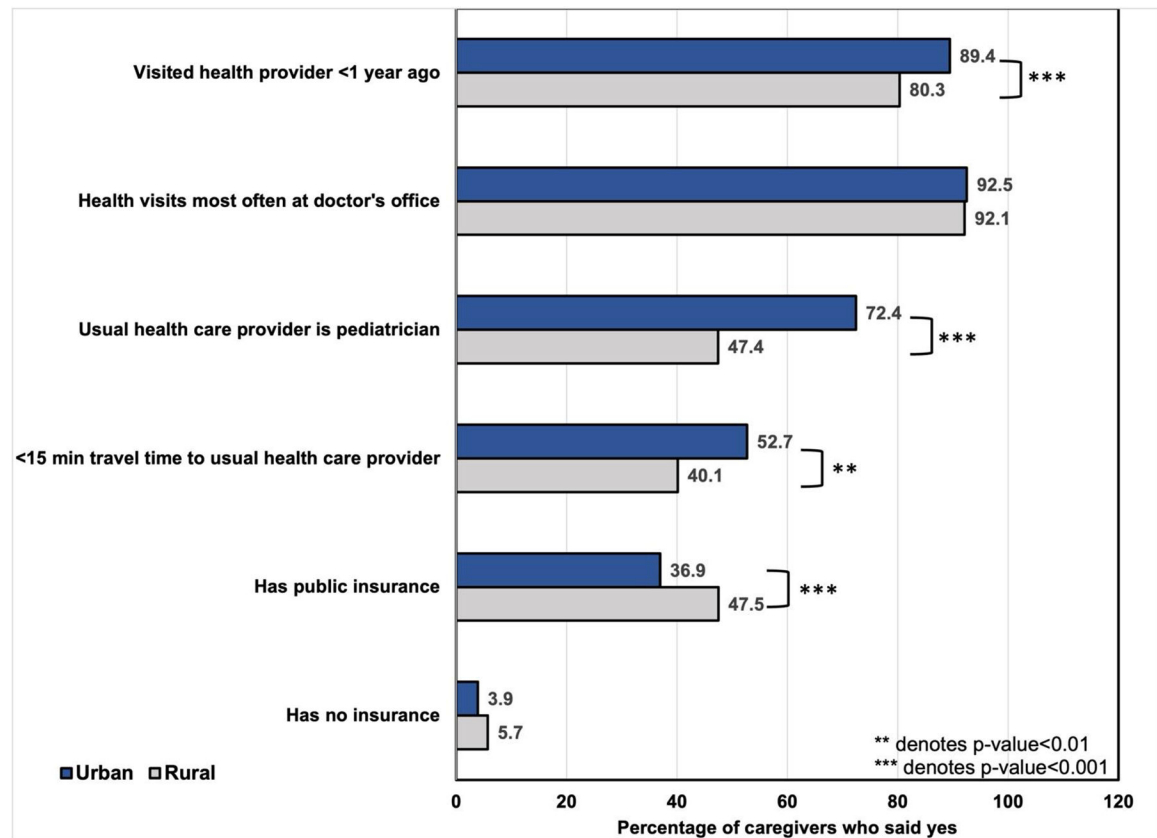


Figure 5:

Differences in health care use and access for rural and urban adolescents, cross-sectional survey of caregivers from 13 southern US states, December 2019 – January 2020.

Abbreviations: HPV, human papillomavirus

The 13 southern states were in HHS regions 4 and 6 and included Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

Urban residence status was determined based on participants' ZIP code of residence, using criteria defined by the US Census Bureau.³¹ For 66 records with zip codes in non-residential areas, rural-urban designation was based on participants' county of residence using the USDA Federal Information Processing System (FIPS) Codes.³²

Characteristics of caregivers and their adolescents aged 9–17 years (N=987), cross-sectional survey of caregivers from 13 southern US states, December 2019 – January 2020.

Table 1:

Covariate	Level	Residence		Parametric P-value ^a
		Rural N=193	Urban N=794	
Characteristics of caregivers				
Education	Less than Bachelor's degree	146 (75.5%)	514 (64.8%)	0.004
	Bachelor's degree or higher	47 (24.5%)	280 (35.2%)	
Currently working	Yes	145 (75.0%)	648 (81.6%)	0.04
	No/Don't know	48 (25.0%)	146 (18.4%)	
Characteristics of adolescents ages 9–17 years				
Age at the time of the survey	9–10 years	39 (20.2%)	188 (23.7%)	0.10
	11–12 years	33 (16.9%)	169 (21.2%)	
	13–14 years	56 (28.9%)	169 (21.3%)	
	15–17 years	66 (34.1%)	268 (33.7%)	
Race and ethnicity	Non-Hispanic Black or African American	27 (13.9%)	130 (16.4%)	<.001
	Non-Hispanic White	109 (56.6%)	323 (40.6%)	
	Hispanic	21 (10.8%)	86 (10.9%)	
	Other	36 (18.7%)	255 (32.1%)	
Type of school	Public school	149 (77.1%)	659 (83.0%)	<.001
	Home/Online school	30 (15.4%)	51 (6.4%)	
	Other school ^b	14 (7.5%)	84 (10.6%)	

Number of observations may not add up to 987 due to missing values of variable of interest. The 13 southern US states were in HHS regions 4 and 6 and included Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

Urban residence status was determined based on participants' ZIP code of residence, using criteria defined by the US Census Bureau.³¹ For 66 records with zip codes in non-residential areas, rural-urban designation was based on participants' county of residence using the USDA Federal Information Processing System (FIPS) Codes.³²

Abbreviations: HPV, human papillomavirus

^aThe parametric p-value is calculated by chi-square test on unweighted data. Bolded values indicate statistically significant values at p<0.05.

^bOther school type included private religious and non-religious schools as well as students who are no longer enrolled in school.