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Barriers to human papillomavirus vaccine uptake among racial/ethnic minorities: a systematic review.

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Abstract

Background: Human papillomavirus (HPV) is associated with poor health outcomes, including cervical cancer. Racial/ethnic minority populations experience poor health outcomes associated with HPV at higher rates. A vaccine is available to protect against HPV infections and prevent HPV-related sequelae; however, vaccination rates have remained low in the United States (U.S.) population. Thus, there is an urgent need to increase HPV vaccination rate. Moreover, little is known about barriers to HPV vaccination in racial/ethnic minority groups. This paper highlights the most recent findings on barriers experienced by these groups.

Methods: The PubMed database was searched on July 30, 2020 for peer-reviewed articles and abstracts that had been published in English from July 2010 to July 2020 and covered racial/ethnic disparities in HPV vaccination.

Results: Similar findings were observed among the articles reviewed. The low HPV vaccination initiation and completion rates among racial/ethnic minority populations were found to be associated with lack of provider recommendations, inadequate knowledge and awareness of HPV and HPV vaccination, medical mistrust, and safety concerns.

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Authors' contributions

Both authors contributed to the study idea. Review of the literature was performed by Trisha Amboree. Synthesis of review findings was performed by Trisha Amboree and Charles Darkoh. The first draft of the manuscript was written by Trisha Amboree and both authors commented on previous versions of the manuscript. Charles Darkoh critically revised the work. Both authors read and approved the final manuscript.

Conflict of interest/Competing interests

The authors declare that they have no conflict of interest.

Availability of data and material

Not applicable.

Code availability

Not applicable.

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Conclusions: Provider recommendations and accurate distribution of information must be increased and targeted to racial/ethnic minority populations in order to bolster the rate of vaccine uptake. To effectively target these communities, multi-level interventions need to be established. Further, research to understand the barriers that may affect unvaccinated adults in the catch-up age range, including males, may be beneficial, as majority of the previous studies focused on either parents of adolescents or women.

Keywords

HPV; human papillomavirus; health disparities; racial/ethnic minority

Background

Infecting nearly 80 million people in the United States (U.S.), Human Papillomavirus (HPV) is currently the most common sexually transmitted infection. ^[1] HPV infection can cause genital warts, anal cancer, and cervical cancer as well as many other sequelae. ^[1] In 2006, the Food and Drug Administration (FDA) approved Gardasil vaccination to protect against HPV infections. ^[2] The U.S. Center for Disease Control and Prevention (CDC) currently recommends that all boys and girls aged 11 and 12 should be vaccinated, and persons who were not vaccinated in adolescence should be vaccinated anytime to age 26. ^[2] In 2018, the FDA approved an extension to the acceptable age for the catch-up vaccination to adults through the age of 45. ^[3] Despite CDC recommendations, less than 50% of females and 38% of males in the U.S. have completed the HPV vaccination. ^[4]

Racial/ethnic minority adult populations, specifically Black/African Americans and Latino/as, disproportionally carry the burden of poor HPV-related outcomes. Though studies have shown that racial/ethnic minority populations tend to have higher vaccine initiation than their White counterparts, there may be lower completion rates for additional vaccine doses. ^[5] Further, the barriers faced by racial/ethnic minority groups may differ significantly from White individuals. While health disparities regarding vaccine initiation and completion have been observed among Black/African Americans and Hispanics, specific barriers to explain these disparities have not been reviewed in racial/ethnic minority groups. Thus, this paper synthesizes available data collected over the past ten years to assess barriers faced by racial/ethnic minority populations on HPV vaccination. This information is critical because understanding these barriers will enable public health officials to target racial/ethnic minority populations with resources to increase HPV vaccination coverage, which would in turn decrease the burden of poor HPV-related outcomes in these vulnerable populations.

Methods

The PubMed database, which includes Ovid Medline, was used to identify peer-reviewed articles and abstracts that reported on health disparities related to HPV vaccination in racial/ethnic minority populations. The keyword search comprised a combination of terms “human papillomavirus (HPV) vaccine barriers”. The search was conducted on July 30, 2020. Studies conducted in the U.S. and published in English language over the past ten years from 2010 to July 2020, and primarily focused on HPV and HPV vaccination were included.

However, studies that were not conducted in the U.S. or focused solely on cervical cancer screening were excluded. Further, studies that did not examine racial/ethnic disparities were also excluded. To preserve the congruency of this review, systematic review articles and intervention studies were not included, but are referenced where applicable. Studies with qualitative outcome measures were included.

The study screening process was conducted independently and is presented in Figure 1. Initially, 532 articles were retrieved from the database and 14 articles were retrieved from keyword suggestions in PubMed. All studies were then transferred to Excel. Three duplicates and 496 other studies were eliminated due to the exclusion criteria, leaving 47 studies used in this systematic literature review. The selected articles utilized cross-sectional surveys and interviews, as well as focus groups, thus, each individual study may be at risk of inherent temporal bias. The populations covered in these articles were mostly female and consisted of racial/ethnic minority groups such as Hispanics/Latinos/as, Blacks/African Americans, Asians, and non-U.S.-born individuals, as well as Whites.

Table 1 presents a summary of the studies included in this review. Forty-six articles utilized a cross-sectional study design and collected data with questionnaires and interviews measuring outcomes with quantitative and qualitative methods, and one article utilized a longitudinal study design. Twenty-five studies gathered data from parents of adolescents, while nine studies gathered information from college-aged young adults and fourteen were focused on adults. Overall, thirty-three studies had a relatively large sample size ($N > 100$), and fourteen of the studies had smaller sample sizes ($N < 100$). Specified data collection dates for these studies ranged from 2006 to 2017.

Results

The data reviewed demonstrated various barriers to HPV vaccination among racial/ethnic minorities compared to the White counterparts. The major findings are presented in three major themes: (1) gaps in knowledge and provider recommendations, (2) medical mistrust and safety concerns, and (3) religious and cultural beliefs (Appendix Table 1). These barriers are discussed in detail below.

Gaps in Knowledge and Provider Recommendations

Differences in knowledge and awareness were demonstrated in various ways. Gender differences was shown to be a predictor of disparate knowledge and awareness of HPV and the HPV vaccine. In general, women and mothers of adolescent girls were more aware of HPV and the HPV vaccine as well as association between cervical cancer and HPV infection, while men and parents of adolescent boys were typically less aware of both HPV and HPV vaccine, and had little-to-no intention of vaccinating their sons. [6-9]

In some studies, racial/ethnic minority groups had significantly lower knowledge of HPV, the HPV vaccine, and the association between HPV and other cancers when compared to Whites (i.e. oral, anal, and penile cancers). [10-20] Not only were the parents of adolescents lacking knowledge, but adult individuals who were still in the catch-up age range lacked knowledge of HPV and the HPV vaccine. [7, 22-23] However, in other studies, women

reported higher levels of awareness (i.e., having heard of HPV and the HPV vaccine), but exhibited low levels of specific knowledge about HPV and the HPV vaccine. Specifically, in regards to the number of doses required for vaccination completion and the potential severity of HPV infection. [10, 24–26]

Table 2 summarizes the main quantitative findings on relative measures of association (i.e., odds ratios) regarding knowledge of HPV and the HPV vaccine, as well as vaccination willingness and intentions. When quantified, Hispanic adult individuals tended to have lower odds of having heard of the HPV vaccine when compared to non-Hispanics. [23, 27–28] Black and Asian adult individuals tended to have lower odds of having heard of HPV when compared to Whites. Also, Asian adult individuals had lower odds of having heard of the HPV vaccine compared to Whites. [23, 27–29]

Despite these disparities, racial/ethnic minority parents tended to be more likely to initiate the HPV vaccination in their children when compared to their White counterparts. [30–35] Notably, an inverse association between knowledge of HPV and willingness to vaccinate may exist among Black parents. [36] This may imply that having any knowledge of HPV may decrease willingness of Black parents to vaccinate their children when compared to having no knowledge of HPV. Conversely, in other individual adult racial/ethnic minorities, willingness to vaccinate was associated with higher levels of HPV knowledge. [36–37]

In addition to these findings, foreign-born Black and Latino/a individuals were less likely to know where they could obtain an HPV vaccine compared to their U.S.-born counterparts. [13] Studies were conflicting in their findings about the role that language preference may have in Hispanics with regards to willingness to vaccinate. Some studies suggest that Spanish-speaking parents were more willing to vaccinate their children when compared to English-speaking parents, while other findings suggest the opposite. [38–39]

The literature suggests that low knowledge may be tied to a lack of recommendations for HPV vaccination from healthcare providers. Receipt of a provider recommendation was found to be the strongest predictor of HPV vaccination and intent/willingness of racial/ethnic minority parents to vaccinate their children. [12, 15, 17, 25, 34, 40–42] In parents who had initiated vaccination in their children, provider recommendation was found to be the main reason. [12, 17, 32–33, 38, 40, 42] Similarly, racial/ethnic minority adult individuals reported that having discussed the vaccine with their healthcare provider was associated with increased likelihood of vaccination. [19, 37]

Further, lack of a strong recommendation from healthcare providers was also associated with decreased vaccine initiation and completion in racial/ethnic minority populations. [9, 16, 30, 38, 40, 41, 43–44] Results showed that some providers offered the vaccine as optional or of low importance. [30, 45] Lower perceived risk for HPV infection was also reported among these populations. [14, 17] Furthermore, some parents of racial/ethnic minority adolescents who had initiated vaccination but did not complete the vaccine series reported receiving no information from their healthcare providers about follow-up to receive subsequent, necessary doses of the vaccine at a later date. [17, 24, 45]

Medical Mistrust and Safety Concerns

The level of importance of medical mistrust and safety concerns regarding HPV vaccination among racial/ethnic minorities varies. In general, racial/ethnic minorities who had not initiated vaccination in their children were more likely to exhibit some level of mistrust with healthcare professionals and pharmaceuticals. [14, 24–25, 31–32, 44, 46–47] In adult individuals who reported medical mistrust as a barrier to vaccination, it was suggested that Hispanics and Blacks preferred a healthcare provider of the same-sex, and/or same race/ethnicity. [48–49] Further, Black and Asian women who had not been vaccinated demonstrated higher medical mistrust when compared to those who had been vaccinated, which was associated with preference to receive the HPV vaccine recommendation from a healthcare provider of the same race/ethnicity. [48–49]

In addition, racial/ethnic minority parents who were knowledgeable about HPV and the HPV vaccine tended to have concerns with the vaccine's safety and side effects. Those who reported safety and efficacy concerns noted that this was a very important factor in deciding whether or not to vaccinate their children against HPV. [24–25, 31, 46] Some parents believed vaccination may cause infertility in their daughters and were unsure of other potential side effects that might be associated with the vaccine. [24–25, 31, 46, 51] They were also concerned that other long-term health problems may be associated with vaccinating their children. [24–25, 31, 46]

In studies examining racial/ethnic minority adult individuals in the catch-up age range, some reported that they would be willing to vaccinate if they could be sure that side effects were not severe. [6–7, 50] Conversely, it was suggested that non-Hispanic White men may be more wary of potential side effects than their Black and Hispanic counterparts, leading to no intention of vaccination. [50]

Religious and Cultural Beliefs

Religious and cultural beliefs were mostly assessed in qualitative studies and non-U.S.-born populations. Asian-American parents and foreign-born Hispanic parents were found to demonstrate a belief that the HPV vaccine was unacceptable for their children, especially their daughters, due to fear of promoting promiscuous behavior. [25] With fathers acting as the ultimate decision-makers in these familial paradigms, most children are not vaccinated. [18] Further, cultural perceptions were reported to serve as the main source of knowledge in some non-U.S.-born parents' decisions about HPV and willingness to vaccinate their children. [18, 32]

Conclusions

Our findings suggest a considerable lack of accurate knowledge and awareness of HPV and the HPV vaccine within racial/ethnic minority communities. However, educational interventions have not been shown to be an effective strategy in increasing vaccine uptake. Further, with Black parents possibly showing an inverse correlation between knowledge and intent to vaccinate, targeting education towards increasing HPV knowledge may not have the intended effects across racial/ethnic minority communities. Thus, increasing strong provider

recommendations may be the most effective strategy in combatting low vaccine coverage among these populations. Specifically, an approach used by the American Academy of Pediatrics called “same day, same way” approach may be useful in heightening healthcare providers’ ability to introduce the HPV vaccine and to address the concerns of parents who have hesitance about the HPV vaccine. [54] This may be especially important in curtailing misinformation about HPV vaccination and easing concerns of safety and adverse vaccine reactions. Being that provider recommendations were shown to be the most important factor in parents’ willingness to vaccinate their children, this area should be targeted effectively.

Further, because some racial/ethnic minority adult individuals reported being more trusting of educators and healthcare providers who look like them, diversity among health educators and healthcare providers, and presenting information in a way that is tailored to each community may be beneficial in the effort to increase HPV vaccination rates. Though the role of patient-physician racial/ethnic concordance has not been thoroughly studied in HPV vaccination, it is an idea to be considered.

Moreover, an increase in awareness and vaccination recommendations for boys is needed and parents of both girls and boys must equally be educated. Also, awareness and recommendations must increase for adult individuals in the age range for catch-up vaccination. Gender differences should be addressed if vaccine uptake is to increase.

Over half of the literature covered in this review involved parents of adolescent children. There is low representation of adults who are in the catch-up age range for vaccination as well as males. Though the priority population for HPV vaccination remains 11–12 year olds, there may be benefit in understanding the disparities faced by persons in the catch-up age range. This is due to the fact that even if someone has already been exposed to HPV, catch-up vaccination through age 45 has been shown to be efficacious in protecting against persistent infection and other strains of HPV. [55–56] Both children and adults in the vaccine-appropriate age range should be vaccinated, since recommendations for HPV vaccination have now been expanded through age of 45.

It is critical to identify and address barriers to vaccination, in order to increase vaccine initiation and completion and decrease the disparate burden of poor HPV-related health outcomes experienced by racial/ethnic minority groups. Low provider recommendations as well as lack of accurate knowledge and awareness among racial/ethnic minority populations is associated with a decrease in HPV vaccine initiation and completion. The most common barriers to HPV vaccination were lack of healthcare provider recommendations, low knowledge and awareness of HPV and the HPV vaccine, as well as safety concerns. To effectively target these communities, multi-level interventions need to be established. An increase in provider recommendations along with distribution of accurate information to these communities is necessary to combat the lack of HPV vaccination initiation and completion. As the recommended interventions are completed, prospective studies will be needed to assess the effectiveness of such intervention programs on HPV vaccination.

Limitations

There is limited literature available that specifically examines barriers in racial/ethnic health disparities related to HPV vaccination, thus, this review was limited to the few available literature. The decision to use PubMed was because it is believed that this database provides good coverage of the available English-language literature; however, it is possible that additional relevant articles not represented in PubMed were missed. Further, the data included in this review were cross-sectional in nature and so there is a risk of temporal ambiguity. The survey data collection used by most of the studies leaves room for self-report bias. Specifically, self-reported vaccination has been shown to be racially biased thus linking barriers to self-reported vaccination may be inherently biased. [5, 57] Additionally, the classifications of race in these studies may be a limitation as not all studies used the same classifications, thus making it difficult to compare across studies.

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APPENDICES

APPENDIX A:: Table 1

Appendix Table 1.

Summary of main qualitative findings related to barriers to HPV vaccine uptake among racial/ethnic minorities

Themes	Major findings
Gaps in knowledge and provider recommendations	<ul style="list-style-type: none"> • Provider recommendation was found to be the most important factor in deciding to initiate and complete the HPV vaccine in racial/ethnic minority populations. • Some HCPs present the vaccine as optional or of low importance, therefore many racial/ethnic minorities reported a lower perceived risk of HPV infection. • Some Black, Latino/a, and Asian women who were not vaccinated report increased medical mistrust and preferred recommendations from HCP that was of the same race/ethnicity. • Racial/ethnic minority adolescents who had initiated the vaccine did not complete it because they reported receiving no knowledge from HCP about follow-up vaccination schedules. • Overall, knowledge and acceptability of the HPV vaccine was found to be low in racial/ethnic minority groups when compared to non-Hispanic Whites. • Gender differences showed disparate knowledge and awareness as racial/ethnic minority women typically knew more about HPV than men. • Foreign-born Black and Latino/a individuals were much less likely to know about HPV vaccine when compared to their US-born counterparts. • Women reported receiving recommendations for HPV vaccination from their HCP at higher rates than men.
Medical mistrust and safety concerns	<ul style="list-style-type: none"> • Some racial/ethnic minority parents who were knowledgeable about the HPV vaccine believed that it was unsafe and ineffective. Some parents believed it could cause infertility and other long-term health effects. • Some non-U.S.-born non-Hispanic parents reported mistrust of medical professionals and preferred an HCP that was of the same race/ethnicity. • Some racial/ethnic minority parents reported mistrust of pharmaceuticals. • Young adult White men tended to be more concerned with safety and side effects than young adult men of other races.

Themes	Major findings
Religious and cultural beliefs	<ul style="list-style-type: none"> • Non-U.S.-born parents tended to believe that vaccinating their children would promote promiscuous behavior. • In non-U.S.-born non-Hispanic parents, cultural perceptions tended to serve as a source of knowledge for decisions to not vaccinate rather than HCP recommendations.

Note. US = United States; HCP = Health Care Provider; HPV = Human papillomavirus.

APPENDIX B:: Search Strategy (PubMed) – MeSH Terms

- (((“papillomaviridae”[MeSH Terms] OR “papillomaviridae”[All Fields]) OR ((“human”[All Fields] AND “papillomavirus”[All Fields]) AND “hpv”[All Fields])) OR “human papillomavirus hpv”[All Fields]) AND (((((((((((((((“vaccin”[Supplementary Concept] OR “vaccin”[All Fields]) OR “vaccination”[MeSH Terms]) OR “vaccination”[All Fields]) OR “vaccinable”[All Fields]) OR “vaccinal”[All Fields]) OR “vaccinate”[All Fields]) OR “vaccinated”[All Fields]) OR “vaccinates”[All Fields]) OR “vaccinating”[All Fields]) OR “vaccinations”[All Fields]) OR “vaccination s”[All Fields]) OR “vaccinator”[All Fields]) OR “vaccinators”[All Fields]) OR “vaccine s”[All Fields]) OR “vaccined”[All Fields]) OR “vaccines”[MeSH Terms]) OR “vaccines”[All Fields]) OR “vaccine”[All Fields]) OR “vaccins”[All Fields]) AND ((“barrier”[All Fields] OR “barrier s”[All Fields]) OR “barriers”[All Fields])

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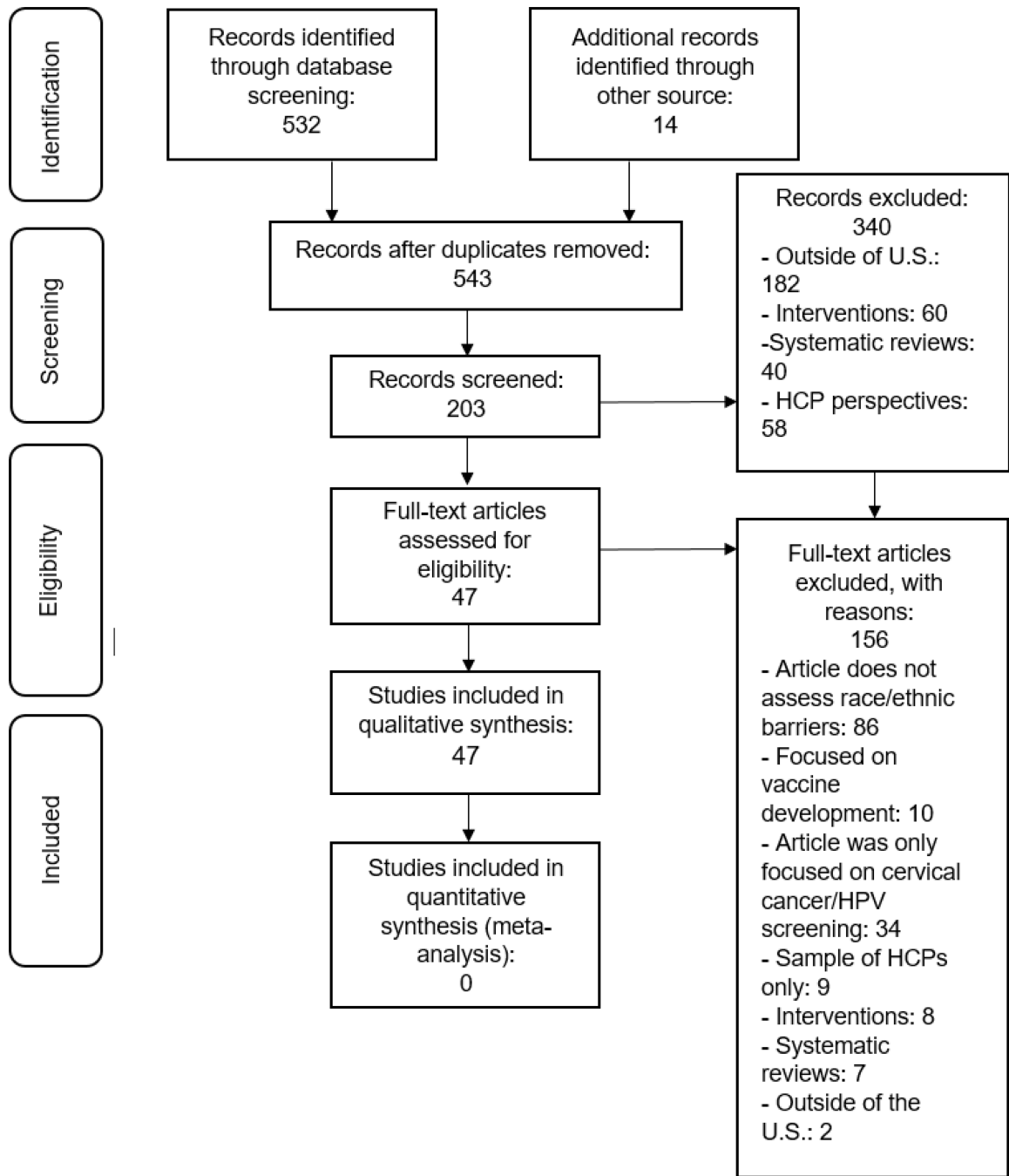


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

Table 1. Summary of Included Studies Evaluating Barriers to HPV Vaccine Uptake among Racial/Ethnic Minorities (N=47)

Source	Study Design	Data collection dates	Participants, n	Age Range (years)	Inclusion Criteria	Method of Data Collection
Blake et al, 2015	Cross-sectional	September-December 2013	3185 participants (males=1197, females=1906)	18+	Men and women 18 years or older who were HINTS 4 cycle 3 participants in 2013	HINTS survey
McBride et al, 2018	Cross-sectional	August-November 2014	3185 participants (males=1197, females=1906)	18+	Men and women 18 years or older who were HINTS 4 cycle 4 participants in 2014	HINTS survey
Boakye et al, 2017	Cross-sectional	September-December 2013 and August-November 2014	6862 participants (males=2621, females=4090)	18+	Men and women 18 years or older who were HINTS 4 cycle 3 and cycle 4 participants in 2013 or 2014	HINTS survey
Niccolai et al, 2016	Cross-sectional	May 2013-January 2014	38 participants (parents=33, grandparents=4, step-parents=1)	Parents of children 10–18 years	English- and Spanish-speaking parents of children 10–18 years who were seen in an urban hospital-based outpatient clinic in Northeastern US	Semi-structured recorded qualitative survey
Kim et al, 2015	Qualitative cross-sectional data from parent RCT	2010–2012	26 women (community health workers=14, Korean American study participants=12)	21–65	Met inclusion criteria of parent RCT: aged 21–65, self-identified Korean female, no mammogram and/or Pap test within the last two years, able to read or write either Korean or English, willing to offer written consent AND were a participant in the control group of the RCT and willing to participate in focus group	Focus group qualitative data
Davlin et al, 2015	Cross-sectional	September 2011-September 2012	638 women	Women who had at least one child between ages 9–17 years	Women who sought care at one of three regional maternal child health program clinics at UTMB between sept 2011-	Self-administered questionnaire
Glenn et al, 2015	Cross-sectional	January 2009-January 2010	490 participants	Primary medical decision maker for a girl aged 9–18 years	2012 who had at least one child between ages 9–17 years Women who called the UCLA office of women's health education hotline between ages 18–65 who spoke either English, Spanish, Mandarin, Cantonese, Korean, or Armenian, and were the primary medical decision maker for a girl 9–18 years of age	Telephone survey instrument
Ashing et al, 2017	Secondary data analysis of cross-sectional data	2009–2011	383 women (African born in US=129, African immigrants=53, Hispanic born in US=57, Hispanic immigrants=144)	18+	Women 18+ who self-identified as Black/African American or Hispanic/Latina, had no history of cancer, and had at least a 4th grade fluency in English and/or Spanish who signed informed consent	Mailed self-administered study questionnaire
Hernandez et al, 2017	Cross-sectional	November-December 2011	187 women	18+	Women who attend a large public university in southeast US who self-reported as Hispanic/Latina and had not received at least one dose of HPV vaccine	Web-based self-administered survey

Source	Study Design	Data collection dates	Participants, n	Age Range (years)	Inclusion Criteria	Method of Data Collection
Romaguera et al, 2015	Population- based cross- sectional	December 2010- April 2013	566 women	16-64	Women aged 16-64 who were residents of San Juan, Puerto Rico, sexually active, not pregnant, not HIV- positive, and not physically or cognitively impaired	Face-to-face interviews and computer-assisted interviews
Kolar et al, 2015	Cross- sectional	November- December 2011	711 women	18+	Women who attend a public university in Southeast US who were on file at the university's registrar's office and responded to the web- based survey	Web-based survey
O'Leary et al, 2018	Cross- sectional	August-October 2013	244 parents	Parents of girls aged 12-15 years	Parents of girls aged 12-15 years who were in the Denver Health immunization registry, spoke English or Spanish, and responded to the mailed survey	Qualitative mailed surveys
Kashani et al, 2019	Retrospective data collection: Longitudinal analysis	2006-2015	4722 American Indian/Alaskan Native and 679,787 non-Hispanic White adolescents	9-18 years	American Indian and non- Hispanic White Michigan residents who were born in Michigan between 1 January 1997 and 5 July 2004 and were in Michigan's immunization information system	Chart review
Dela Cruz et al, 2017	Cross- sectional	October 2013- January 2014	20 parents	Parents of children 11-18 years	Parents of children between 11 to 18 years old who were the parent or guardian who takes their child(ren) to get vaccinated, and lived in Hawai'i.	Face-to-face interviews
Sledge, 2015	Cross- sectional	September 2011- May 2012	68 African American male college students	18-26 years	African American male students in St. Louis, Missouri between the ages of 18-26	Web-based survey
Victory et al, 2019	Cross- sectional	2017	622 parents	Parents of children 4th-12th grade	Parents of children in 4th-12th grade in Rio Grande Independent School District	Survey
Galbraith-Gyan et al, 2018	Cross- sectional	June 2014- October 2015	30 parents and 34 daughters	Parents of daughters aged 12-17 years; girls aged 12-17 years	African-American or Black parents of a 12-17-year-old girl; 12-17 year old girls	Face-to-face semi- structured interviews
Kepka et al, 2015	Cross- sectional	August-October 2013	67 parents	Parents of children aged 11-17 years	Spanish-speaking Latino parents/guardians of children aged 11-17 years in Utah	Self-administered survey
Lechuga et al, 2016	Cross- sectional	October 2010- February 2011	296 women	18+	Woman aged 18 years or older who self-identified as Hispanic and self-reported being a resident of Dane County	Telephone survey instrument
Guerry et al, 2011	Cross- sectional	October 2007- June 2008	509 parents	Parents of children aged 11-18 years	Parents/guardians of children aged 11-18 years who attended public middle and high schools in economically disadvantaged populations in Los Angeles County.	Telephone survey instrument
Broush et al, 2019	Cross- sectional	January- December 2015	132 mothers	Mothers of children aged 11-18 years	Latinas aged 18 years or older who had at least one child aged 11-18 years who attended a multi-site community health center or a clinic of an urban community hospital in the Newark/Eltzabeth area in New Jersey	Focus group qualitative data
Bastani et al, 2011	Cross- sectional	January- November 2009	490 mothers	Mothers of daughters aged 9-18 years	Women 18 years of age or older who was the primary medical decision-maker for a girl 9 to 18 years old	Telephone survey instrument

Source	Study Design	Data collection dates	Participants, n	Age Range (years)	Inclusion Criteria	Method of Data Collection
Pierce et al, 2013	Cross- sectional	May 2008–April 2009	242 parents	Parents of girls aged 11–12 years	Parents of girls aged 11–12 years who had been since at a University of Virginia medical practice during the data collection timeframe	Telephone survey instrument
Cheruvu et al, 2017	Cross- sectional	2008–2012	23,722 parents	Parents of females aged 13–17 years	Parents of girls aged 13–17 years who had not received the HPV vaccine series and who completed the National Immunization Survey - Teen from 2008–2012	Survey
Kepka et al, 2018	Cross- sectional	May 2014–October 2014; October 2014–February 2015	228 parents	Parents of children aged 11–17 years	Adult parents of teens aged 11–17 years who were vaccination decision-makers for their children.	Self-administered survey
Stram et al, 2019	Cross- sectional	2016	43,071 parents	Parents of children aged 13–17 years	Parents or guardians of teens 13–17 years old who completed the National Immunization Survey- Teen in 2016.	Survey
Dela Cruz et al, 2018	Cross- sectional	2014	799 parents	Parents of children aged 11–18 years	Parents or guardians of child aged 11–18 years who is the primary parent that takes the child(ren) to get vaccinated of Native Hawaiian, Filipino, Japanese, or Caucasian ancestry and a Hawai'i resident	Telephone survey instrument
Pierre-Victor et al, 2018	Qualitative cross-sectional	June 2014–March 2015	30 females	17–26 years	Females aged 17–26 years who self-identified as Haitian	Qualitative interviews
Ramirez et al, 2014	Cross- sectional	Not specified	17 guardians	Guardians of daughters aged 8–17 years	Hispanic mothers and grandmothers who were the primary caretakers of daughters aged 8–17 years	Qualitative interviews
Mehta et al, 2012	Cross- sectional	January 2008–December 2010	269 women	18–27 years	Women aged 18–27 years who were residents of New Haven County and had interviews and medical record reviews complete	Chart review
Reiter et al, 2014	Cross- sectional	2010–2011	2,786 parents	Parents of children aged 13–17 years	Hispanic parents of children aged 13–17 years who completed the National Immunization Survey-Teen in 2010 or 2011	Secondary data analysis of surveys
Daley et al, 2011	Cross- sectional	Not specified	477 men	18–70 years	Men aged 18–70 who participated in the Natural History Study of HPV Infection in Men study and completed the questionnaire	Computer assisted survey instrument
Liddon et al, 2012	Cross- sectional	July 2007 to December 2008	1243 women	15–24 years	Females aged 15–24 years who participated in the National Survey of Family Growth during the specified timeframe	Questionnaire
Taylor et al, 2014	Cross- sectional	2012–2013	86 mothers	Mothers of daughters aged 9–17 years	Cambodian mothers of daughters aged 9–17 years	Qualitative survey instrument
Miller et al, 2014	Mixed methods	July–November 2012	50 adolescents	14–18 years	Adolescents aged 14–18 years receiving services at participating CBOs who spoke English	Survey and focus group
Pierre Joseph et al, 2014	Cross- sectional	December 2010–October 2011	89 men	18–22 years	Men aged 18–22 who spoke English, Spanish, or Haitian Creole and attended a clinic for preventive care or a problem-related visit	Qualitative survey instrument

Source	Study Design	Data collection dates	Participants, n	Age Range (years)	Inclusion Criteria	Method of Data Collection
Cunningham- Erves et al., 2018	Mixed methods	Not specified	246 mothers	Mothers of daughters aged 9–12 years	Black mothers of daughters aged 9–12 years who were Alabama residents	Survey and semi-structured qualitative interviews
Oranez et al. 2018	Cross-sectional	2007	5675 adults	18+	Men and women 18 years or older who were HINTS participants in 2007	HINTS survey
Strohl et al. 2015	Cross-sectional	Not specified	215 women	18–70 years	English-speaking women who self-identified as African American and were aged 18–70 years	Self-administered paper survey
Kobetz et al., 2011	Qualitative cross-sectional	2010	41 women	21–71 years	Women who self-identified as Haitian, currently lived in Little Haiti, and were between the ages of 21 and 75 years	Focus group qualitative data
Warner et al., 2015	Cross-sectional	August-October 2013	52 parents	Parents of children aged 11–17 years	Parents/guardians of Latino male and female adolescents who were ages 11–17 years and could speak or read Spanish	Self-administered survey
JL Ford, 2011	Cross-sectional	2007–2008	1019 women	18–24 years	Women aged 18–24 years who completed the National Survey of Family Growth in 2007 or 2008	National Survey of Family Growth Survey
Allen et al., 2010	Cross-sectional	September 2007-January 2008	563 parents	Parents of daughters aged 9–17 years	Parents of a daughter aged 9–17 years and self-identified as Black, Hispanic, or White	Web-based survey
Sanders et al., 2012	Qualitative cross-sectional	February-June 2009	30 parents	Parents of daughters aged 9–17 years	African American parents of a daughter aged 9–17 years with no history of HPV infection	Face-to-face interview
Hennebery et al, 2020	Cross-sectional	June 2014-December 2017	102 parents; 149 young adult women	Parents of daughters aged 12–17 years; young adult women aged 18–26 years	Parents of daughters aged 12–17 years or young adult women aged 18–26 years who attended Obstetrics & Gynecology and Pediatric clinics in urban and suburban New Orleans, Louisiana during the specified timeframe	Survey
Chando et al., 2013	Cross-sectional	2007	1090 parents	Parents of daughters aged 11–17 years	Parents of daughters aged 11–17 years who completed the 2007 California Health Interview Survey and reported their racial group as White	California Health Interview Survey
Jones et al., 2017	Cross-sectional	Not specified	840 students (male=317, females=523)	18–64	State university and community college students in South Florida who could read and write in English	Survey

Note. HINTS = Health Information National Trends Survey; US = United States of America; RCT = randomized controlled trial; UTMB = University of Texas Medical Branch, UCLA = University of California, Los Angeles

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Table 2. Summary of Main Quantitative Findings For Studies That Reported Relative Measures of Association

Source	Racial/ethnic group	Comparison Group	Knowledge and awareness, aOR (95% CI)		HPV Vaccination, aOR (95% CI)				Safety Concerns
			Heard of HPV	Heard of HPV Vaccine	Intent-to-initiate	Vaccine Initiation	Vaccine Completion		
Blake et al, 2015	Black	White	0.74 (0.41 – 1.34)	0.70 (0.38 – 1.30)	NA	NA	NA	NA	
	Hispanic	Non-Hispanic	0.74 (0.43 – 1.27)	0.50 (0.30 – 0.82)					
	Other	White	0.19 (0.08 – 0.46)	0.36 (0.17 – 0.75)					
McBride et al, 2018 *	Black	White	0.67 (0.50 – 0.90)	0.82 (0.60 – 1.12)	NA	NA	NA	NA	
	Hispanic	Non-Hispanic	0.86 (0.67 – 1.11)	1.00 (0.91 – 1.10)					
	Asian	White	0.44 (0.28 – 0.71)	0.61 (0.44 – 0.85)					
	Other	White	0.70 (0.42 – 1.16)	0.90 (0.57 – 1.45)					
Boakye et al, 2017	Non-Hispanic Black	Non-Hispanic White	0.68 (0.47 – 0.98)	0.57 (0.40 – 0.84)	NA	NA	NA	NA	
	Hispanic	Non-Hispanic White	0.73 (0.52 – 1.02)	0.49 (0.35 – 0.67)					
	Other	Non-Hispanic White	0.29 (0.19 – 0.46)	0.42 (0.27 – 0.66)					
Glenn et al, 2015	Non-Korean	Korean	1.68 (0.86 – 3.28)		NA	NA	NA	NA	
Kashani et al, 2019	American Indian/Alaska Native	Non-Hispanic White	NA	NA	NA	1.55 (1.46 – 1.64)	1.05 (0.95 – 1.15)	NA	
Guerry et al, 2011	English-speaking Latino	Spanish-speaking Latino	NA	NA	NA	1.2 (0.3 – 1.45)	NA	NA	
	Black	Spanish-speaking Latino				0.6 (0.8 - 2.1)			
	Other	Spanish-speaking Latino				0.1 (0.96 – 1.1)			
Bastani et al, 2011	Latina	Non-Latina	NA	NA	NA	0.84 (0.41 – 1.71)	NA	NA	
Pierce et al, 2013	Black	Non-Hispanic White	NA	NA	NA	4.9 (1.8 – 13.6)	NA	NA	

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Source	Racial/ethnic group	Comparison Group	Knowledge and awareness, aOR (95% CI)		HPV Vaccination, aOR (95% CI)			Safety Concerns
			Heard of HPV	Heard of HPV Vaccine	Intent-to-initiate	Vaccine Initiation	Vaccine Completion	
Cheruvu et al, 2017	Other	Non-Hispanic White					4.2 (1.1 – 16.6)	
	Non-Hispanic Black	Non-Hispanic White	NA	NA	0.96 (0.81 – 1.12)	NA	NA	0.75 (0.57 – 0.98)
	Hispanic	Non-Hispanic White			0.79 (0.66 – 0.95)			0.80 (0.59 – 1.10)
	Other	Non-Other White			0.96 (0.76 – 1.22)			0.70 (0.52 – 0.94)
Sitram et al, 2019	Hispanic	Non-Hispanic White	NA	NA	NA		1.47 (1.24 – 1.74)	NA
	Other	Non-Hispanic White					1.75 (1.48 – 2.07)	
Dela Cruz et al, 2018	Native Hawaiian daughters	Japanese daughters	NA	NA	NA		1.38 (0.71 – 2.67)	NA
	Native Hawaiian sons	Japanese sons					0.89 (0.48 – 1.65)	
	Filipino daughters	Japanese daughters					0.94 (0.48 – 1.84)	
	Filipino sons	Japanese sons					0.64 (0.32 – 1.27)	
	Caucasian daughters	Japanese daughters					0.56 (0.31 – 1.04)	
	Caucasian sons	Japanese sons					0.47 (0.26 – 0.85)	
	Black	White	NA	NA	NA		1.14 (0.67 – 1.96)	1.20 (0.70 – 2.06)
	Other	White					1.03 (0.60 – 1.77)	1.05 (0.62 – 1.79)
	Non-Hispanic Black	Non-Hispanic White	NA	NA	NA		NA	NA
	Hispanic	Non-Hispanic White						0.72 (0.41 – 1.26)
Oranez et al, 2018	Hispanic	White	NA	NA	1.30, p<.01	NA	NA	NA
	Black	White			0.82, p<.05			
Ford, 2011	Hispanic	Non-Hispanic White	0.10 (0.05 – 0.19)	0.13 (0.07 – 0.27)	NA		0.44 (0.21 – 0.90)	NA
	Non-Hispanic Black	Non-Hispanic White	0.23 (0.13 – 0.40)	0.27 (0.14 – 0.52)			0.16 (0.07 – 0.35)	

Source	Racial/ethnic group	Comparison Group	Knowledge and awareness, aOR (95% CI)		HPV Vaccination, aOR (95% CI)			Safety Concerns
			Heard of HPV	Heard of HPV Vaccine	Intent-to-initiate	Vaccine Initiation	Vaccine Completion	
Allen et al, 2010	Black	White	NA	NA	0.69 (0.30 – 1.58)	NA	NA	NA
	Hispanic	White			1.08 (0.47 – 2.48)			
Hennebery et al, 2020	Non-Hispanic White young adults	Other	NA	NA	NA	1.77 (0.60 – 5.22)	NA	NA
	Non-Hispanic White guardians	Other				0.66 (0.24 – 1.82)		
Chando et al, 2013	Spanish- speaking Hispanics	English- speaking Hispanics	NA	NA	NA	0.55 (0.31 – 0.98)	NA	NA

Note. aOR = adjusted odds ratio; 95% CI = 95% confidence interval; HPV = Human Papillomavirus; NA = not assessed

Note. Provider recommendations and medical mistrust, religious and cultural beliefs, and safety and efficacy concerns were not assessed using relative measures of association in these studies.

* This study reported measures of association as regression coefficients and standard errors. For uniformity, these estimates have been converted to odds ratios and 95% confidence intervals. Equation used for converting regression coefficient to OR: $e^{\hat{\beta}}$; Equation used for converting standard error into 95% CI: $e^{\hat{\beta} \pm 1.96(SE(\hat{\beta}))}$.

Summary of Main Quantitative Findings For Studies That Reported Frequency Measures

Table 3.

Source	Racial/ethnic group	Category	Knowledge and awareness and provider recommendations				Religious and cultural beliefs	Safety concerns and medical mistrust
			n/N (%)	Heard of HPV Vaccine	Received provider recommendation	Lack of provider recommendation		
Davlin et al, 2015	Total sample			312/468 (66.8)	NA	NA	NA	
	White		83/96 (86.5)					
	Black		141/191 (73.8)					
	Hispanic		239/409 (58.4)					
	Other		5/5 (100.0)					
Glenn et al, 2015	Total sample		306/489 (62.6)	294/490 (60.0)	193/294 (65.6)	NA	32/59 (54.2)	
	Korean		30/66 (45.4)					
	Non-Korean		276/423 (65.2)					
Ashing et al, 2017	US-born African		70/129 (54.3)	91/129 (70.6)	NA	NA	40/129 (31.0)	
	African Immigrant		36/53 (67.9)	30/53 (57.7)			22/53 (42.3)	
	US-born Latina		29/57 (50.9)	44/57 (76.8)			25/57 (44.6)	
	Latina Immigrant		84/144 (58.7)	73/144 (50.7)			78/144 (54.3)	
Hernandez et al, 2017	Total sample		NA	NA	NA	NA	NA	
Romaguera et al, 2015	Total sample		463/566 (81.8)	366/566 (64.8)	NA	6/54 (12.2)	17/54 (32.7)	
Kolar et al, 2015	Total sample		NA	NA	NA	NA	59/105 (56.2)	
	Hispanic						**	
	Black						7/31 (22.6)	
O'Leary et al, 2018***	Total sample	Very Important	NA	NA	NA	NA	93/131 (74.4)	
		Somewhat Important					123/131 (18.4)	
		Unimportant					9/131 (7.2)	

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Source	Racial/ethnic group	Category	Knowledge and awareness and provider recommendations				Religious and cultural beliefs n/N (%)	Safety concerns and medical mistrust n/N (%)
			Heard of HPV n/N (%)	Heard of HPV Vaccine	Received provider recommendation	Lack of provider recommendation		
			n/N (%)					
Dela Cruz et al, 2017	Total sample		10/20 (50)		NA	NA	NA	
Sledge, 2015	Total sample		58/68 (85)	9/68 (13.2)	NA	NA	NA	
Victory et al, 2019	Total sample		539/622 (86.7)	520 (83.6)	NA	NA	34/622 (5.5)	
Kepka et al, 2015	Total sample		52/67 (77.6)	52/67 (77.6)	NA	NA	19/67 (30.7)	
Lechuga et al, 2016	Total sample		218/296 (73.6)	164/296 (55.4)	NA	NA	NA	
Guerry et al, 2011	Total sample		365/509 (72.4)	267/509 (53.1)	149/509 (29.6)	NA	66/509 (13.0)	
Btoush et al, 2019	Total sample		NA	73/132 (55.3)	NA	NA	NA	
Bastani et al, 2011	Latina		163/255 (64)	158/255 (62)	NA	NA	NA	
	Chinese		65/98 (66)	63/98 (64)				
	Korean		30/66 (46)	27/62 (44)				
	Black		26/38 (68)	25/38 (65)				
	Other		22/32 (69)	21/32 (66)				
Kepka et al, 2018	Total sample	Parents of daughters	NA	21/99 (21.21)	NA	NA	14/99 (14.14)	
	Total sample	Parents of sons		30/100 (30.00)			18/100 (18.00)	
Sriram et al, 2019	Total sample		NA	NA	NA	70/17073 (0.41)	2420/16900 (14.32)	
Dela Cruz et al, 2018	Native Hawaiian daughters		NA	14/48 (29.2)	NA	NA	32/48 (66.7)	
	Native Hawaiian sons			38/74 (51.4)			42/74 (56.8)	
	Filipino daughters			30/67 (44.8)			42/67 (62.7)	
	Filipino sons			35/66 (53.0)			33/66 (50.0)	
	Caucasian daughters			9/62 (14.5)			41/62 (66.1)	
	Caucasian sons			19/80 (23.8)			43/80 (53.8)	
	Japanese daughters			21/45 (46.7)			24/45 (53.3)	

Source	Racial/ethnic group	Category	Knowledge and awareness and provider recommendations				Religious and cultural beliefs	Safety concerns and medical mistrust
			Heard of HPV	Heard of HPV Vaccine	Received provider recommendation	Lack of provider recommendation		
			n/N (%)			n/N (%)	n/N (%)	
			Heard of HPV	Heard of HPV Vaccine	Received provider recommendation	Lack of provider recommendation		
Mehta et al., 2012	Japanese sons		NA	24/55 (43.6)	143/183 (78.1)	33/55 (60.0)	27/55 (49.1)	
	White		NA	90/99 (90.9)	26/36 (72.2)	NA	NA	
	Black			19/25 (76.0)				
	Other			9/15 (60.0)	13/22 (59.1)			
	Non-Hispanic			105/120 (87.5)	165/214 (77.1)			
	Hispanic			20/29 (69.0)	28/44 (63.6)			
Reiter et al., 2014	Hispanic		2319/2856 (81.2)	2446/2936 (83.3)	1467/2946 (49.8)	54/529 (10.2)	156/739 (21.1)	
Daley et al., 2011	Non-Hispanic White		NA	NA	NA	NA	205/306 (67.0)	
	Non-Hispanic Black						40/80 (50.0)	
	Hispanic						53/90 (59.0)	
Liddon et al., 2012	Total sample		NA	NA	NA	89/144 (14.6)	57/104 (11.8)	
Taylor et al., 2014	Cambodian American		NA	NA	10/24 (42.0)	12/49 (24.0)	40/86 (47.0)	
Miller et al., 2015	Total sample		NA	24/50 (48.0)	NA	NA	NA	
Oranez et al., 2018	Total sample		63%	65%	NA	NA	31%	
Strohl et al., 2015	Black		NA	NA	NA	27/164 (16.5)	8/163 (4.9)	
Hennebery et al., 2020	Total sample	Young adults	86/146 (59.0)	NA	52/133 (39)	8/24 (33.0)	5/97 (5)	
	Total sample	Guardians	67/103 (65)		73/99 (74)	2/6 (33.0)	7/93 (8)	

Note: HPV = Human Papillomavirus; NA = not assessed

** Upon review of the findings, an error was found in the reporting of this specific category thus the numbers were not included in this table.

*** This study reported proportions of parents who thought safety and efficacy was very important, somewhat important, or unimportant in deciding whether or not to vaccinate their children.