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Inequalities in the uptake of Human Papillomavirus Vaccination: a systematic review and meta-analysis

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Background The human papillomavirus (HPV) vaccine offers an opportunity to reduce health inequalities associated with cervical cancer provided the vaccine is delivered equitably at population level.

Method We reviewed evidence of inequalities in HPV vaccine uptake in young women after undertaking a comprehensive search of databases from inception to March 2012. Studies that compared HPV vaccination initiation and/or completion by at least one ethnicity or socioeconomic-related variable in adolescent young women were included. There were no language restrictions. Data were extracted by two reviewers and pooled in a meta-analysis using a random-effects model; sub-analyses and meta-regression were undertaken to investigate sources of heterogeneity.

Results In all, 29 publications related to 27 studies were included in the review. Black young women were less likely to initiate HPV vaccination compared with White young women (combined OR: 0.89, 95% CI: 0.82–0.97). In the USA, young women without healthcare insurance were less likely to initiate (combined OR: 0.56, 95% CI: 0.40–0.78). There was no strong evidence that lower family income (combined OR: 1.16, 95% CI: 1.00–1.34) or lower parental education (combined OR 1.06, 95% CI: 0.92–1.22) influenced HPV vaccination initiation.

Conclusions We found strong evidence for differences in HPV vaccination initiation by ethnicity and healthcare coverage, but did not find a strong association with parental education or family income variables. The majority of studies originated from the USA. Population-based studies reporting both initiation and completion of the HPV vaccination programme are required to establish patterns of uptake in different healthcare contexts.

Keywords HPV vaccine, socioeconomic factors, ethnic disparity, immunization, adolescents, public health

Introduction

Since 2006, bivalent and quadrivalent HPV vaccines have been licensed globally for females aged between 9 and 26 years.[1] If administered before sexual debut, both vaccines offer protection against HPV 16 and 18 which are responsible for approximately 70% of cases of cervical cancer.[2] The World Health Organization recommends a three-dose immunization schedule for females aged between 9 and 13 years.[3]

Socioeconomic disparities of cervical cancer persist throughout countries and populations worldwide; the most disadvantaged groups of women experience an incidence approximately twice that of the least disadvantaged, regardless of the existence of national screening programmes.[4] In the USA, age-adjusted cervical cancer incidence is 2 and 1.5 times as frequent for Hispanic and African American women, respectively, in comparison with non-Hispanic White women.[5]

In recent years, many countries have introduced the HPV vaccine into their national immunization programmes. There is the potential to increase health inequalities if uptake is lower amongst already disadvantaged communities.[4,5] Therefore, the aim of this systematic review and meta-analysis is to summarize evidence on the uptake of HPV vaccination programmes in adolescent young womenby ethnicityand socioeconomic status.

Method

Data sources

We followed the PRISMA guidelines throughout the design, conduct and reporting of this systematic review.[6] A comprehensive search strategy was developed using a combination of text words and the following indexing terms (MeSH): 'papillomavirus', 'wart virus', 'vaccination', 'immunization', 'immunization programs', 'wart virus vaccines', 'socioeconomics', 'healthcare disparity', 'minority health', 'minority groups' and 'ethnic groups' (available from authors on request). The following databases were searched from inception to 9 March 2012: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, Medline, PsycINFO and ISI Web of Science and ISI Proceedings. Abstracts were saved using Endnote X3.

Study selection

Studies were eligible if vaccine uptake in young women aged $\leqslant$18 years was reported by at least one of the following: (i) primary caregiver/household highest educational attainment; (ii) area-level measures of deprivation; (iii) primary caregiver/household annual income; (iv) healthcare insurance coverage status (US-based studies only); (v) ethnicity; (vi) religion, and; (vii) frequency of religious attendance. Studies reporting country of birth as a proxy for ethnicity, or intention to receive the HPV vaccine, were excluded.

Conference abstracts were included if they reported sufficient information related to the variables of interest. Reviews, editorials, dissertations, letters and books were included if they presented original data. Where cohorts were reported in multiple publications, the priority for inclusion was the publication reporting the greatest number of variables of interest. Publications reporting initiation and completion separately were reported together.

Titles and abstracts of all identified studies and relevant full texts were assessed by two independent reviewers (H.F. and K.M-W.). Authors were contacted to provide additional information if data were not reported in a suitable format for data synthesis. If not provided, the study was excluded. No language restrictions were applied.

Quality assessment of the included studies was undertaken to illustrate potential sources of bias using an appraisal tool adapted for use in observational studies[7] by one reviewer (H.F.). Studies were not excluded on this basis in view of the predominantly observational nature of the primary studies.

Data extraction

Information relevant to the study characteristics including delivery site of vaccine, study methodology and study results were extracted by one reviewer (H.F.) and double-checked by another (S.A.).

For ethnicity, data were grouped by the following categories: 'White', 'Black', 'Latina' and 'Asian'. Adjusted and unadjusted ORs and the corresponding 95% CIs pertaining to each category were extracted, taking the White ethnic group as the reference group.

To facilitate comparisons, data relating to the highest and lowest category of primary caregiver/household education, primary caregiver/household income and area-level deprivation were extracted, taking the highest level as the reference category. Household/primary caregiver income and area-level deprivation data were treated separately throughout analyses. For USA-based studies only, healthcare insurance status indicators were grouped as insured and not insured and relevant data extracted. Insured was treated as the reference category. Additional data were extracted by sub-categories to investigate heterogeneity.

Statistical methods

Total heterogeneity between studies independent of number of studies was evaluated using the Q-statistic and the I^2-statistics.[8] Evidence of heterogeneity was classified as weak, moderate and strong for corresponding I^2 of 25%, 50% and 75%, respectively. Pooled results from a random-effects model were reported if heterogeneity was weak or moderate. If heterogeneity was strong, studies were presented narratively. Final analyses comprized adjusted ORs (aORs) where available, with unadjusted ORs used if not reported.

To identify potential study-level factors contributing to heterogeneity, meta-regression modelling was undertaken. Dummy variables were created for study design, verification of HPV vaccination status, high uptake and adjustment for socioeconomic and other variables of interest. Study year was added to the model as a categorical variable. The natural logarithm OR of each socioeconomic and ethnicity variable was used as the dependent variable and study-level factors as the independent variables.

Results

Of 1093 records initially identified through the database searches, 699 abstracts were reviewed and 123 full-text articles were assessed for eligibility. Full-text studies were excluded for not reporting uptake of HPV vaccination by ethnicity or socioeconomic variable of interest ($n=48$), not reporting original data on uptake ($n=28$), duplication of study ($n=13$), and initiation not reported by the age group of interest ($n=2$). A total of 29 publications reporting uptake in 27 studies met the inclusion criteria (Figure 1).

Overall, 359 260 of 905 536 (39.7%, range 9.4–70.6%) young women aged between 8 and 18 years initiated HPV vaccination. In studies reporting completion, 78 327 of 157 017 (49.9%, range 26.9–85.3%) young women who had initiated HPV vaccination completed the series. The proportion of young women initiating and completing the HPV vaccine varied substantially both by ethnicity and socioeconomic indicators (Supplementary Table 1, available as Supplementary data at *IJE* online).

The majority of studies were from the USA ($n=22$, 81.5%) with additional studies from Canada (2) and Europe (one each from Belgium, The Netherlands and the UK). Most of the studies were cross-sectional questionnaires (13, 48.1%) or retrospective chart reviews (12, 44.4%). Two were prospective cohort studies. Study participants were sampled from the general population (15, 55.6%), from a healthcare setting (9, 33.3%) or schools (3, 11.1%). The majority of studies were in relation to healthcare based vaccination programmes (24, 88.8%). A wide range of demographic (daughters' age, parental age, primary caregiver education, parental marital status, race/ethnicity, region), socioeconomic (income and healthcare insurance coverage related), behavioural (sexually active), healthcare-related (healthcare visit type, usual source of care for daughter) and HPV-specific variables were adjusted for in the analyses (Table 1).

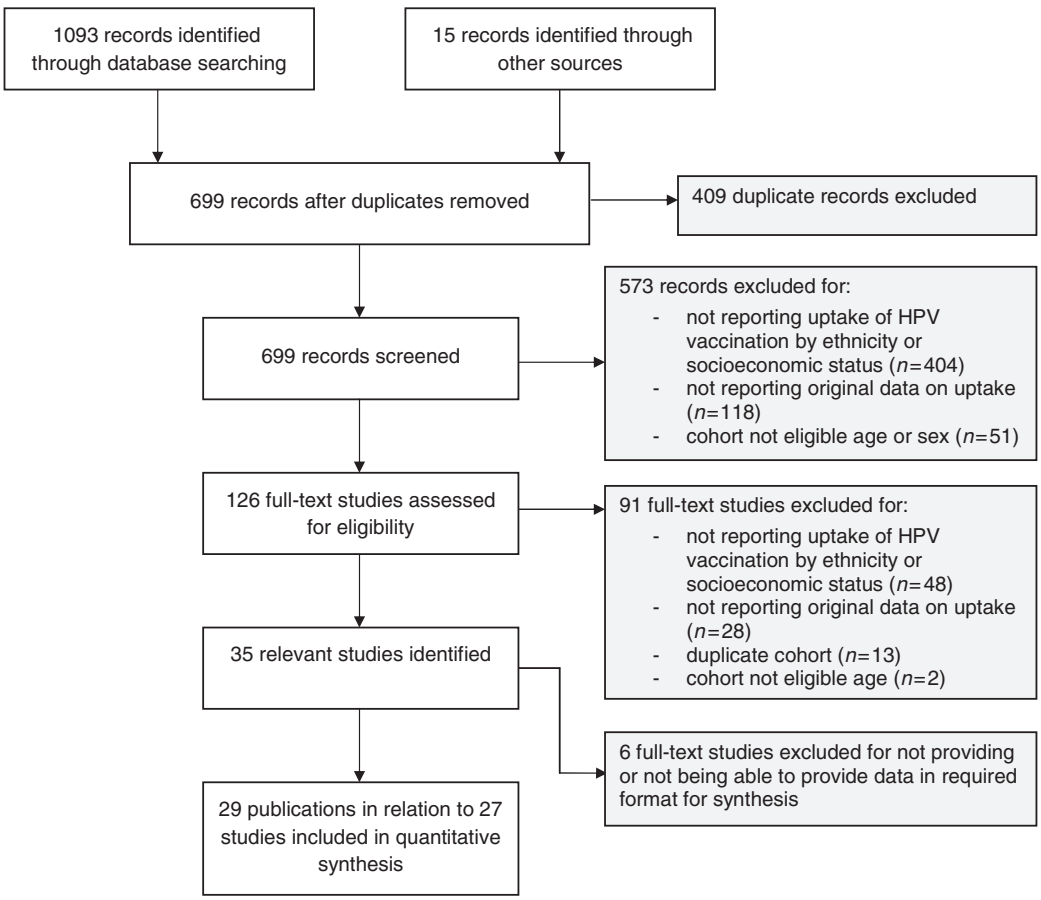

Figure 1 Flow diagram of study selection procedure

Table 1 Descriptive characteristics of studies eligible for the review

Year	Authors	Country	Study time period	Study design	Study location (geographical)	Study population	Vaccine delivery mechanism	Data extracted	Variables adjusted	Overall Risk of Bias
2011	Bastani R *et al*[26]	USA	January 2009 to November 2009	Cross-sectional survey	Los Angeles County	490 mothers, or primary caregivers, of girls aged 9 to 18 years	Healthcare setting	OR, aOR	Daughter age, parental age, parental education, race/ethnicity, usual source of care for daughter and HPV specific questions	Moderate
2009	Caskey R *et al*[19]	USA	November 2010	Cross-sectional survey	Nationally representative research panel of 60 000 US households	412 adolescents aged 13 to 17 years	Healthcare setting	Raw		Moderate
2009 2010	Chao C *et al*[34] Chao C *et al*[9]	USA	October 2006 to September 2007 October 2006 to March 2008	Retrospective chart review	Kaiser Permanente, Southern California, Los Angeles County	179 580 female members aged 9 to 17 years	Healthcare setting	Raw		Low
2010	Cook R, *et al*[10]	USA	July 2006 to June 2008	Retrospective chart review	Participants of Medicaid Florida	167 082 females aged 11 to 18 years	Healthcare setting	Raw, OR, aOR	Age, geographical region, Medicaid plan type, month of vaccination, number of enrolled months, outpatient visit (yes/no), race and sexually active	Low
2010	Dempsey A *et al*[15]	USA	January 2007 to March 2008	Retrospective chart review	University of Michigan Health System, Michigan	10 082 females aged 9 to 18 years	Healthcare setting	Raw, OR, aOR	Age, insurance coverage, race/ethnicity, medical specialty and visit type	Low
2011	Dorell C *et al*[16] Niccolai L *et al*[36]	USA	January 2008 to February 2010	Cross-sectional survey	50 states	18 228 girls aged 13 to 17 years	Healthcare setting	Raw, OR, aOR	Age, health insurance, maternal education, maternal marital status, poverty level, race/ethnicity, year, well-child visit at age 11-12 years	Moderate
2009	Gerend M *et al*[27]	USA	January 2008 to June 2008	Cross-sectional survey	4 paediatric clinics in southeastern USA	32 parents of girls aged 9 to 17	Healthcare setting	Raw		High
2011	Gold R *et al*[35]	USA	2007 to 2008	Retrospective chart review	School-based health centres, Oregon	450 adolescents aged 9 to 17 years	Healthcare setting	Raw		Low
2009	Gottlieb S *et al*[20]	USA	July to October 2007	Cross-sectional survey	5 counties in southeastern North Carolina	889 parents of girls aged 10 to 18 years	Healthcare setting	OR		Moderate
2011	Guerry S *et al*[31]	USA	October 2007 to June 2008	Cross-sectional survey	Schools in Los Angeles County	509 study caregivers of girls aged 11 to 18 years	Healthcare setting	OR		High

(continued)

Table 1 Continued

Year	Authors	Country	Study time period	Study design	Study location (geographical)	Study population	Vaccine delivery mechanism	Data extracted	Variables adjusted	Overall Risk of Bias
2012	Keenan K *et al*[12]	USA	2008	Prospective cohort study	Population-based sample, Pittsburgh	2098 adolescents aged 12 to 15 years	Healthcare setting	OR, aOR	Age, poverty, pubertal status race, sexual behaviour	Moderate
2011	Lefevere E *et al*[28]	Belgium	January 2007 and June 2009	Retrospective chart review	Members of the National Alliance of Christian Mutualities, Flanders, Belgium	117 151 mother-daughter pairs of girls aged 12 to 18 years	Healthcare setting	Raw		Low
2010	Mathur M *et al*[25]	USA	August 2007 to February 2008	Cross-sectional survey	Two schools, San Francisco Bay Area	156 high-school girls	Healthcare setting	Raw		High
2010	Rondy M *et al*[29]	Netherlands		Retrospective chart review	Netherlands	384 869 girls aged 11 to 16 years	Healthcare setting	Raw		Low
2010	Ogilvie G *et al*[17]	Canada	September 2008 to June 2009	Cross-sectional survey	Province of British Columbia	2025 parents of girls in grade 6 (aged 12 to 13 years)	School setting	Raw, OR		Moderate
2012	Palli S *et al*[18]	USA	2007 to 2008	Cross-sectional survey	USA	91 642 interviews of parents of adolescent girls aged 12 to 17 years	Healthcare setting	aOR	Age, ethnicity, healthcare coverage, medical home type, Metropolitan Statistical Area status, perceived health of child, preventive medical care visits, parental age, parental education, parental health and region	Moderate
2010	Pruitt S *et al*[21]	USA	2008	Cross-sectional survey	270 counties, and 6 US states	1709 girls aged 13 to 17 years	Healthcare setting	OR, aOR	Age, area level deprivation, annual household income, parental education, parental healthcare insurance, and race/ethnicity	Moderate
2010	Reiter P *et al*[14]	USA	July to October 2007	Cross-sectional survey	State of North Carolina	617 female adolescents aged 10 to 17 years and their parents	Healthcare setting	Raw, OR		Moderate
2008	Roberts S *et al*[11]	UK	February 2007 to July 2008	Prospective cohort study	Schools in 2 primary care trusts in Manchester	2817 girls aged 12 to 13 years	School setting	OR, aOR	Area level deprivation and ethnicity	Low
2008	Rosenthal S *et al*[32]	USA	April 2007 to January 2008	Cross-sectional survey	University-based primary care clinic	153 female care providers of adolescent girls aged 11 to 17 years	Healthcare setting	OR, aOR	Health belief statements, parental education, parenting and sexually transmitted infection history	High

(continued)

Table 1 Continued

Year	Authors	Country	Study time period	Study design	Study location (geographical)	Study population	Vaccine delivery mechanism	Data extracted	Variables adjusted	Overall Risk of Bias
2011	Schluterman N *et al*[46]	USA	August 2006 to January 2010	Retrospective chart review	University of Maryland Medical Center, Maryland	8069 patients aged 9 to 26 years	Healthcare setting	OR, aOR	Age at first visit, insurance type and race	Low
2011	Shelton R *et al*[24]	USA	September 2007 to January 2008	Cross-sectional survey	Nationally representative research panel of 60 000 US households	836 primary caregivers of adolescent girls aged 9 to 17 years	Healthcare setting	OR, aOR	Age, education and race	Moderate
2011	Smith L *et al*[30]	Canada	September 2007 to April 2010	Retrospective chart review	Kingston, Frontenac, Lennox and Addington, Ontario	2519 girls aged 12 to 13 years	School setting	OR		Low
2011	Tan W *et al*[33]	USA	June 2008 to October 2009	Retrospective chart review	North Carolina Immunization Registry	105 922 girls aged 9 to 18 years	Healthcare setting	Raw		Moderate
2011	Taylor L *et al*[13]	USA	2007 to 2008	Cross-sectional survey	USA	620 girls aged 11 to 18 years	Healthcare setting	Raw		Moderate
2011	Tiro J *et al*[22]	USA	March 2007 to December 2009	Retrospective chart review	4 safety net clinics in Dallas, Texas	700 girls aged 11 to 18 years	Healthcare setting	OR		Moderate
2010	Yeganeh N *et al*[23]	USA	May 2008 to June 2008	Cross-sectional survey	Free community clinic in Los Angeles, California	95 primary caregivers of girls aged 11 to 17 years	Healthcare setting	Raw, OR		High

HPV vaccination initiation by ethnicity

Overall, 14 studies[9–22] reported data facilitating comparison of HPV vaccination initiation by ethnicity. There was strong evidence of heterogeneity for analyses comparing Latina and Asian young women with White young women and these estimates were not pooled ($P < 0.001$, $I^2 = 93.5\%$ and $P < 0.01$, $I^2 = 78.4\%$, respectively). Pooled estimates indicate that on average Black young women were less likely to initiate HPV vaccination than White young women (combined OR: 0.89, 95% CI: 0.82–0.97, $P < 0.01$, $I^2 = 63.5\%$) (Figure 2).

Of the eight studies comparing HPV vaccination initiation between White and Latina young women, two studies indicated that young Latina women had a higher odds of initiation[10,16,] two indicated lower odds of initiation[13,19] and three were equivocal.[19,22] In the remaining study the proportion of Latina women was too small to interpret the results with confidence.[20]

Of the four studies permitting comparison of HPV vaccination initiation between White and Asian young women, one study showed strong evidence that Asian young women were less likely to initiate HPV vaccination,[9] whereas the others showed no evidence of a difference.[11,16,17]

HPV vaccination initiation by religion and frequency of religious attendance

There was no strong evidence that religion and frequency of attendance at a place of worship were related to HPV vaccination initiation. Two studies showed no evidence of differences for HPV vaccination initiation by religious faith.[17,23] Another reported weak evidence that Catholic religious beliefs were associated with increased initiation.[24] One study reported that more frequent religious service attendance was associated with initiation,[24] whereas another suggested the opposite.[25]

HPV vaccination initiation by income or area-level indicators

There were nine studies[13,14,16,18–21,26,27] that facilitated comparison of HPV vaccination initiation by income indicators for primary caregiver or household, and five studies[11,21,28–30] by area-level deprivation. There was strong evidence of heterogeneity in the analysis comparing area-level deprivation and estimates were not pooled ($P < 0.001$, $I^2 = 97.9$). Four non USA-based studies indicated that young women living in the most deprived areas were less likely to initiate HPV vaccination than those living in the least.[11,28–30] One USA-based study reported findings

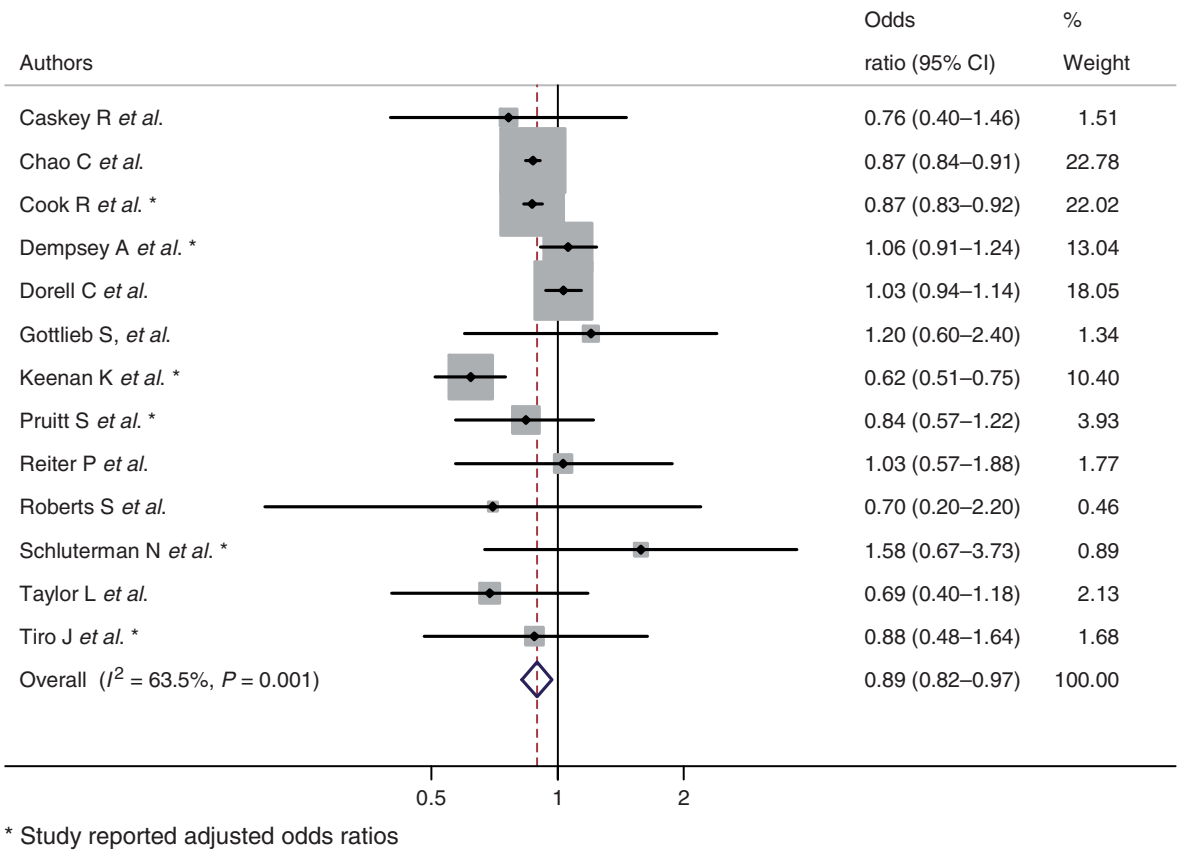

Figure 2 Odds ratios of HPV vaccination initiation of Black young women in comparison with White young women

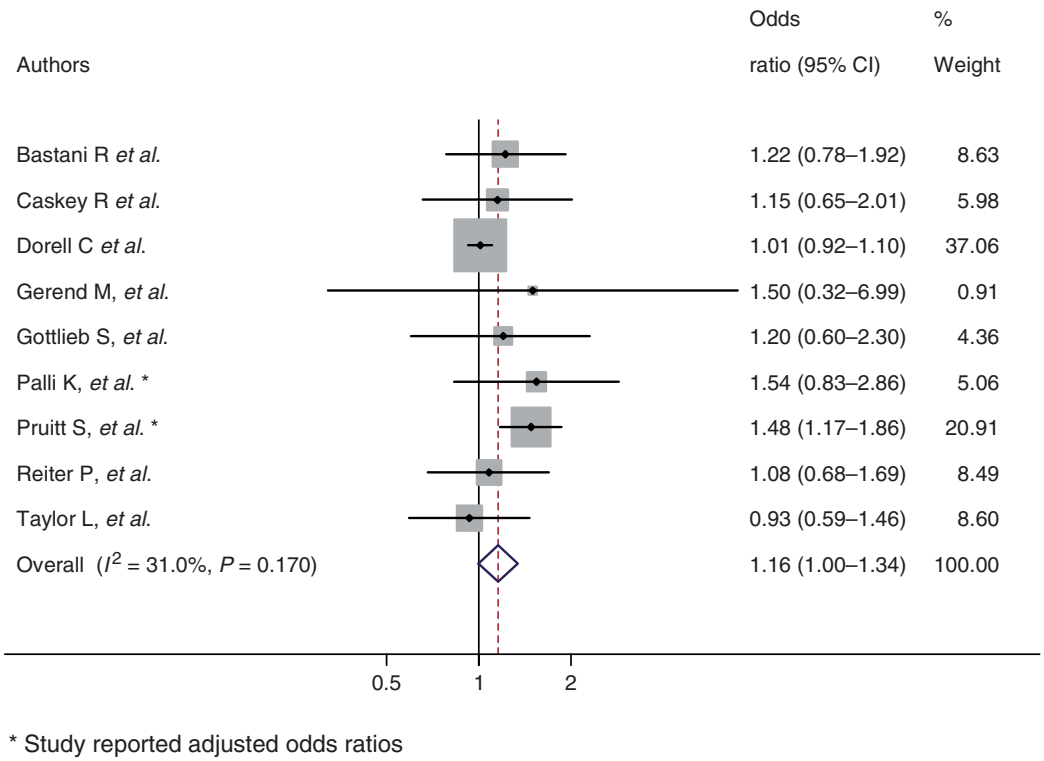

Figure 3 Odds ratios of HPV vaccination initiation in young women belonging to lowest family or household annual income category in comparison with highest

counter to this.[21] The combined OR showed no strong association between low income and initiation of HPV vaccination (combined OR: 1.16, 95% CI: 1.00–1.34) (Figure 3).

HPV vaccination initiation by primary caregiver educational attainment

There were 12 studies[14,16–18,20,21,23,25–27,31,32] that reported data facilitating comparison by primary caregiver educational attainment. The pooled estimates indicate no evidence for difference in HPV vaccination initiation in young women by primary caregiver educational attainment category (combined OR 1.06, 95% CI: 0.92–1.22, $P = 0.09$, $I^2 = 37.3$) (Figure 4).

HPV vaccination initiation by healthcare insurance coverage

Eight USA-based studies[13–16,18,20,21,26] reported initiation by healthcare insurance coverage. The pooled results indicated lower odds of initiating HPV vaccination for young women who had no healthcare insurance coverage in comparison with those who had healthcare insurance coverage (combined OR: 0.56, 95% CI: 0.40–0.78) (Figure 5).

Other sub-analyses

Further *ad hoc* sub-analyses excluding studies considered to be at high risk of bias resulted only in minor changes to combined effect sizes and heterogeneity by ethnic and socioeconomic variables of interest. There were insufficient studies to permit sub-analysis either by vaccination programme delivery setting or countries with publicly funded HPV vaccination programmes.

Investigating sources of heterogeneity

To investigate sources of heterogeneity, meta-regression analysis was undertaken. Adjustment for the study-level variables 'self-report measurement of HPV status' and 'adjustment for primary caregiver education status' reduced heterogeneity for the analysis comparing initiation by White and Black ethnic group ($I^2 = 45.0\%$). Reductions in heterogeneity were not observed across other analyses.

HPV vaccination completion by ethnicity

Completion of the HPV vaccine course by ethnicity was reported by six studies.[10,15,21,33–35] Four studies[10,33–35] provided evidence that young Black women were less likely to complete the HPV vaccine course, whereas two were equivocal.[15,21] Two studies provided evidence that Latina young women were less likely to complete HPV vaccination series than White young women, whereas results from four other studies showed no difference.[21,34–36] Two studies reported that Asian young women were more likely to complete HPV vaccination series than White young women.[33,34]

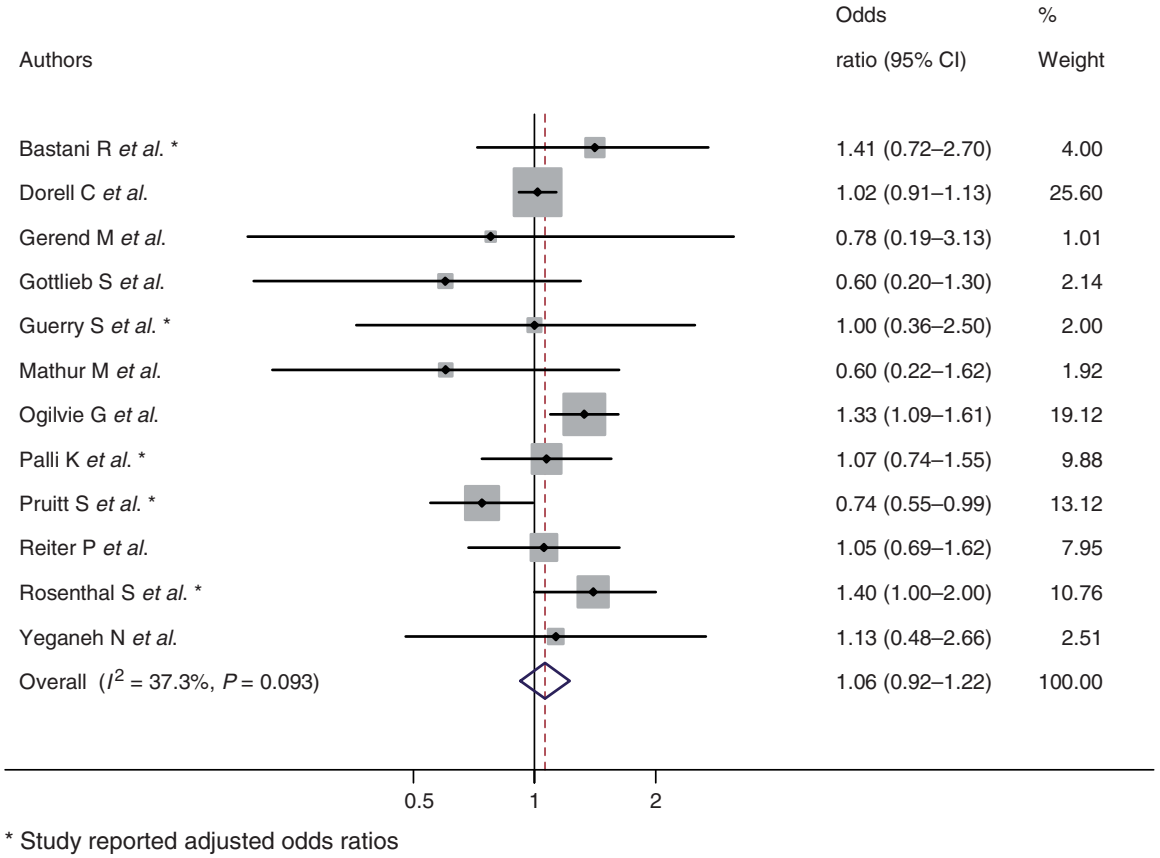

Figure 4 Odds ratios of HPV vaccination initiation by lowest primary caregiver education category in comparison with highest

HPV vaccination completion by income or area-level indicators

Few studies reported completion by income; one study presented strong evidence to support that young women belonging to lower family income categories are less likely to complete HPV vaccination.[36] Similarly for area-level deprivation indicators: one study offered evidence to suggest that young women living in the most deprived neighbourhood quintile were less likely to complete the vaccine series.[30]

HPV vaccination completion by primary caregiver educational attainment

Few studies reported completion by primary caregiver education; one study indicated young women belonging to families with lower education attainment are less likely to complete.[36]

HPV vaccination completion by healthcare insurance coverage

In one study, young women with private insurance were more likely to have completed the vaccination series that those with public insurance.[33]

Discussion

Key findings

This systematic review indicates that Black young women are less likely to initiate HPV vaccination in comparison with White young women (combined OR: 0.89, 95% CI: 0.82–0.97). In the USA, young women without healthcare insurance coverage were less likely to initiate HPV vaccination (combined OR: 0.56, 95% CI: 0.40–0.78). However, there was no strong evidence for differences of initiation by family income or primary caregiver educational achievement.

Strengths and limitations

We followed a systematic and comprehensive process including: a search strategy applied to multiple databases to uncover all relevant studies; no restrictions on the basis of publication date or language; titles, abstracts and full-text studies independently reviewed by two of the authors; and study authors contacted to provide additional information to minimize study selection bias. We were also able to incorporate some meta-analyses and investigate sources of heterogeneity through sub-analyses and meta-regression techniques.

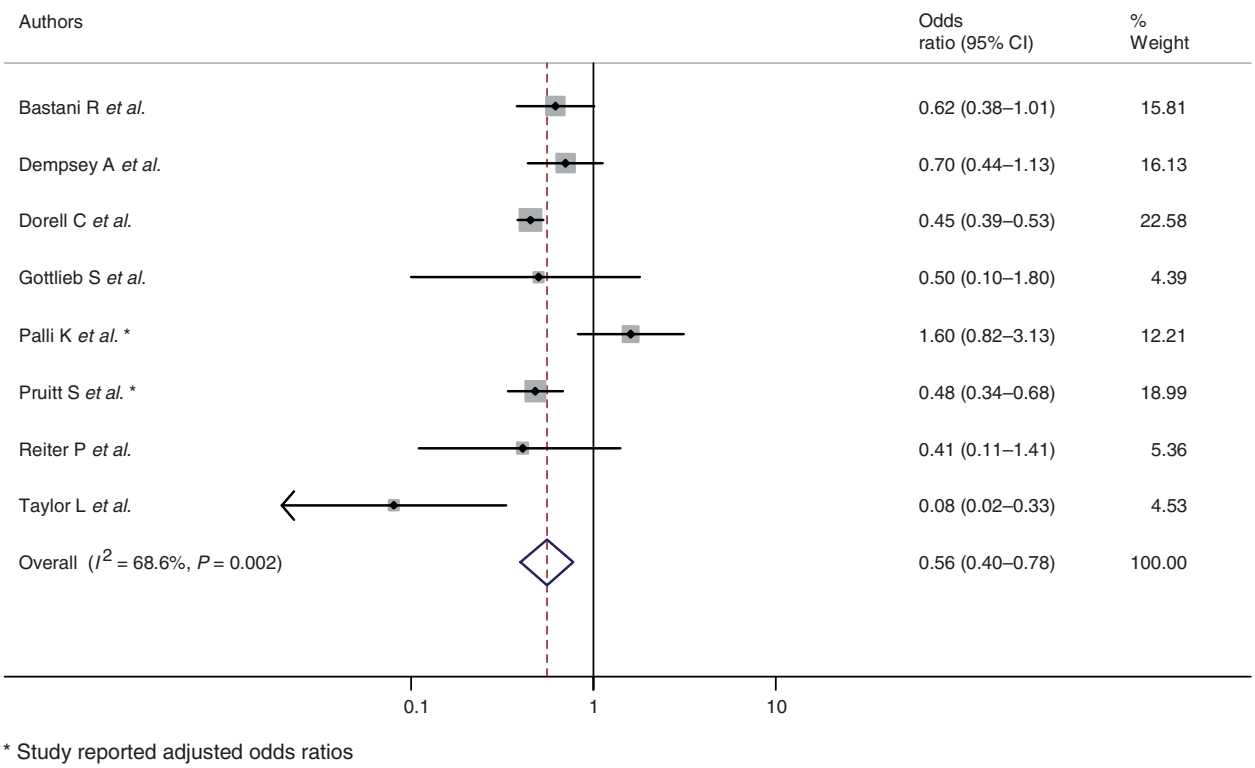

Figure 5 Odds ratios of HPV vaccination initiation by young women without healthcare insurance coverage in comparison with young women with healthcare insurance coverage

Nonetheless there are several potential limitations. There was considerable heterogeneity between studies including differences in study design, reporting of socioeconomic and ethnicity variables, type and number of confounders, and definition of reference groups. This limited the application of meta-analysis. Examining possible causes of heterogeneity by meta-regression yielded little additional insight into sources of heterogeneity. Potential explanations for residual heterogeneity include: variation in the populations from which study samples were drawn; modality of healthcare insurance coverage scheme, and; vaccination delivery setting.

The measures of ethnicity as used in this study are crude and do not reflect different cultural beliefs and norms within ethnic sub-populations. Few studies reported other ethnicity-related variables, such as religion, which could conceivably influence HPV vaccination uptake.

Recall and response bias may be present in studies using self-report measures of HPV vaccination status.[13,14,17–19,21,24–26,31,32] Both, unadjusted and aORs have been presented because of inconsistency of reporting. Examining HPV vaccination uptake by ethnicity, without accounting for socioeconomic circumstances, does not accurately portray the impact of cultural differences. Adjustment for these confounders in the studies included in this review generally resulted in ORs deviating towards the null and results may be overestimated. Studies reporting both socioeconomic position and ethnicity allowing adjustment for confounding are required.

The majority of studies included in the review are from the USA where insurance is the predominant model of healthcare and the HPV vaccine is usually delivered in the primary care setting. The results may not be generalizable to different healthcare systems offering universal health care, population types or different vaccination delivery methods, such as school-based programmes delivered free at the point of care, frequently implemented in other countries. All of the studies meeting the inclusion criteria were from higher resource countries. No studies were retrieved from the African and Asian continents, where the majority of cases of cervical cancer occur,[37] despite the availability of the HPV vaccine in a number of countries.

Finally, completion (rather than initiation) of the HPV vaccination series was reported too infrequently to permit meta-analyses.

Findings in relation to other studies

A systematic review reporting hypothetical acceptance suggested there would be no difference in acceptability of HPV vaccination by ethnicity, but lower

education and higher income was associated with higher acceptability.[38] Our meta-analyses indicate that high acceptability has not been translated into HPV vaccination uptake in Black young women, which is of concern given the higher incidence of cervical cancer in this population group.[5]

The factors affecting HPV vaccination uptake in Black young women are not yet fully understood. They may relate to lower socioeconomic status experienced by many ethnic groups, or cultural differences in relation to attitudes to preventive health care. Qualitative studies to elicit cultural or religious beliefs related to HPV vaccination initiation may help explain some differences. In addition, targeted media publicity campaigns and physician recommendation may be helpful to promote vaccination uptake.

We found that young women without healthcare insurance coverage were less likely to initiate HPV vaccination. This is an important finding as lower uptake could exasperate existing inequalities in cervical cancer incidence[4] and screening attendance[39] in disadvantaged populations. Cost and access to healthcare are perceived as barriers to vaccination by young women without healthcare insurance coverage, despite free availability through the Vaccines for Children programme in the USA.[40] Informing uninsured young women and their primary caregivers who are eligible about available resources may help alleviate some of the perceived barriers to vaccination.

A previous systematic review reported that higher HPV vaccine initiation was associated with having numerous factors, including health insurance, older age, receipt of childhood vaccines and positive vaccine attitudes.[41] The authors also suggested that African American young women are less likely to initiate, although the results from individual studies were not pooled in a meta-analysis. The current study supports and strengthens this argument by focusing on ethnic and socioeconomic differences in uptake, reporting the results from approximately double the number of studies, and including some meta-analysis.

The highest uptake rates reported in this study were achieved through school-based vaccination programmes[11,17,30] which have been shown to be acceptable and convenient to parents/carers.[42,43] The observed lower uptake of the HPV vaccine in the general practice setting may be as a result of a reliance on opportunistic strategies for vaccine delivery. For a population who typically utilize healthcare infrequently, this approach may not be appropriate if high coverage is to be achieved. This study demonstrated inequalities in uptake in general practice-based setting, even in a setting with universal healthcare.[29] School-based programmes could be advantageous in overcoming practical barriers to healthcare access in the primary care setting, such as transport issues or appointment restrictions,[44,45] and promoting more equitable coverage of the HPV vaccine. More detailed understanding of the contextual factors contributing to differences of uptake by vaccination delivery setting would be beneficial to inform future HPV vaccination programmes or other health initiatives.

Conclusions

We found strong evidence for differences in HPV vaccination initiation by ethnicity and healthcare coverage, but not for parental education or family income. Future population-based studies reporting initiation and completion of the HPV vaccination series are required to establish whether the patterns of initiation reported here are replicated in healthcare settings outside the USA. Further research should identify barriers and develop interventions to improve uptake in specific populations identified with lower uptake.

Supplementary Data

Supplementary data are available at *IJE* online.

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Conflict of interest: None declared.

KEY MESSAGES

- Widespread HPV vaccination has the potential to reduce existing cervical cancer inequalities.
- Published studies, predominantly from the USA, show initiation of HPV vaccination is lower in Black young women and young women without healthcare cover insurance, but there is no evidence for a difference of HPV vaccination initiation by parental education or income.
- Population-based studies reporting both initiation and completion of the HPV vaccination programme are required to establish patterns of uptake in different countries and healthcare contexts.
- Further research is required to identify barriers to initiation and completion of HPV vaccination and develop interventions to improve uptake in populations identified with lower uptake.

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Commentary: The uptake of human papillomavirus vaccination: the power of belief

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The systematic review and meta-analysis of 'Inequalities in the uptake of human papillomavirus vaccination' in this issue of *IJE* reveals the complexities of identifying the diverse factors which determine HPV vaccination uptake. The authors note 'the factors affecting HPV vaccination in Black young women are not yet fully understood'.[1]

Although the review particularly focuses on socioeconomic and ethnic disparities in HPV vaccine uptake among young women in the USA, it