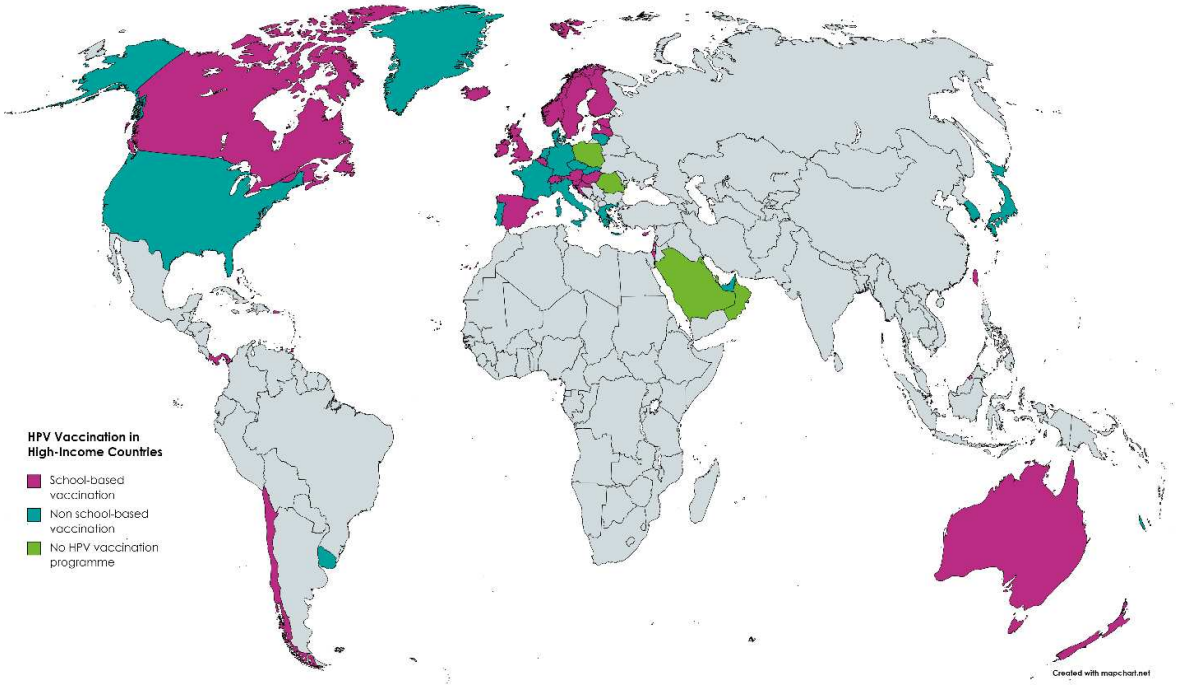
Supplementary Material

Supplementary Figure 1. HPV vaccination in high-income countries[a]



[a] School-based programmes may also include vaccination in other settings, such as healthcare clinics. High-income countries based on World Bank classification as of 2021. School-based programmes based on literature search as of February 2023.

Supplementary Figure 2. JBI critical appraisal checklist[1]

	Yes	No	Unclear	Not applicable
1. Was the sample frame appropriate to address the target population?	☐	☐	☐	☐
2. Were study participants sampled in an appropriate way?	☐	☐	☐	☐
3. Was the sample size adequate?	☐	☐	☐	☐
4. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
5. Was the data analysis conducted with sufficient coverage of the identified sample?	☐	☐	☐	☐
6. Were valid methods used for the identification of the condition?	☐	☐	☐	☐
7. Was the condition measured in a standard, reliable way for all participants?	☐	☐	☐	☐
8. Was there appropriate statistical analysis?	☐	☐	☐	☐
9. Was the response rate adequate, and if not, was the low response rate managed appropriately?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Supplementary Table 1. Search terms

Topic*	**Keywords**	**MeSH terms (where applicable)**
HPV	hpv or human papillomavirus or papillomavirus or human papilloma virus	Papillomavirus Vaccines
Vaccination	vaccin* or immune*	Papillomavirus Vaccines
Sociodemographic factors	ethnic* or religi* or income or socioeconomic or sociodemographic or disparit* or inequal* or unequal* or educat* or race	Healthcare Disparities or Ethnicity or Religion or Socioeconomic Factors or Sociodemographic Factors or Health Status Disparities or Social Class or Education
School-based vaccination programmes	(Andorra or Australia or Austria or Bahamas or Barbados or Belgium or Brunei or Canada or Channel Islands or Chile or Croatia or Curacao or Cyprus or Estonia or Finland or Gibraltar or Guam or Hong Kong or Hungary or Iceland or Ireland or Isle of Man or Israel or Latvia or Liechtenstein or Macau or New Zealand or Northern Mariana Islands or Norway or Panama or Puerto Rico or (Saint Kitts and Nevis) or Seychelles or Singapore or Slovenia or Spain or Sweden or Switzerland or Taiwan or (Trinidad and Tobago) or United Kingdom or UK or Britain or England or Wales or Scotland or Northern Ireland) or grade or school or school-based	

*All topics combined using “AND” within search engines

Supplementary Table 2. Bias assessment using JBI critical appraisal checklist

Major Components	Sample frame	Sampling	Sample size	Study subject description	Sample coverage	Identification of vaccination	Reliable measurement	Statistical analysis	Response rate	**Overall appraisal**
Bedford et al[2]	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Include
Bjerke et al[3]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Bowyer et al[4]	Unclear	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Include
Brotherton et al (2022)[5]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Include
Brotherton et al (2015)[6]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Carpiano et al[7]	Yes	Unclear	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Include
Feiring et al[8]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Fisher et al[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Gertig et al[10]	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Include
Gilbert et al[11]	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Include
Hansen et al[12]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Krawczyk et al[13]	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Include
Lefevere et al[14]	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Include
Mak et al[15]	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Include
Meghani et al[16]	Yes	Unclear	Unclear	Yes	Unclear	Unclear	Yes	Unclear	Unclear	Exclude
Ogilvie et al[17]	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Include
Pollock et al[18]	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Exclude
Poole et al[19]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Include
Remes et al[20]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Riesen et al[21]	Yes	Unclear	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Include

Roberts et al[22]	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Shapiro et al[23]	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes	Yes	Unclear	Exclude
Sinka et al[24]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Include
Smith et al[25]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Spencer et al[26]	Yes	Unclear	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Include
Wang et al[27]	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes	Include
Wemrell et al[28]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Include
Yeung et al[29]	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Exclude

Supplementary Table 3. Strength of association between HPV vaccination and individual-level socioeconomic status (SES) among included studies which identified an association between these variables

Study	Country	Sociodemographic measure	Measure of association	Outcome	Adjusted for?	Reference group	Result	Summary
Lefevere et al[14]	Belgium	Household income (based on Beneficiary of Increase Reimbursement)	Proportion with confidence intervals	Vaccination	N/A	Low-income girls	0.91 (95%CI 0.90-0.91) high income v 0.81 (0.78-0.83) low income	Higher proportion initiating vaccination among higher income girls compared to lower income girls
Smith et al[25]	Canada	Neighbourhood income quintile	Adjusted Odds Ratio	Vaccination	Age, income, urban/rural, vaccination history, health service utilisation	Third income quintile	0.75 (95%CI: 0.57-0.99)	Girls in the fourth income quintile were less likely to receive the vaccine than those in the middle (third) income quintile
Remes et al[20]	Canada	Neighbourhood income quintile	Adjusted Odds Ratio	Vaccine refusal	Vaccination history, healthcare utilisation, medical history, area level deprivation	3rd income quartile	Lowest income quartile, 1.13 (95%CI 1.08-1.17); highest income quartile 1.21 (1.17-1.25)	Those in the lowest income quartile and highest income quartile were more likely to refuse vaccination compared to the 3rd quartile.
Hansen et al[12]	Norway	Maternal income	Adjusted Odds Ratio	Vaccination	Age, marital status, occupational status, maternal country of birth, children in household, maternal cervical screening, region, year of birth	Intermediate income	Lowest income bracket, 0.63 (95%CI 0.58-0.68); highest income, 1.27 (1.14-1.42)	Vaccine initiation increased with maternal income
Feiring et al[8]	Norway	Maternal income	Multivariable risk difference	Vaccination	Education, employment, country of origin, urbanity, maternal age at daughter's birth, number of siblings, region, year of birth	Lowest quintile	Highest maternal quintile, 10.1% (9.0% - 11.3%)	The highest maternal income quintile was associated with higher vaccine initiation compared to the lowest quintile

Bjerke et al[3]	Norway	Household income	Multivariable risk difference	Vaccination	Country background, year of birth, parental education, number of siblings, maternal age at daughter's birth, region	Lowest quintile	Highest maternal quintile, 4.9% (4.3%-5.5%)	Compared to girls in quintile 1 (lowest) for household income, higher quintiles were more likely to initiate HPV vaccination
Wang et al[27]	Sweden	Family income quintiles	Adjusted Hazard Ratio	Vaccination	County of residence, education, country of birth	Highest quintile	Lowest quintile, 0.87 (0.85-0.88)	Lower vaccine uptake among lower socioeconomic status compared to higher socioeconomic status.
Wemrell et al[28]	Sweden	Parental income	Adjusted Odds Ratio	Non-vaccination	Parental education, parental country of birth, region, random effects	High income	Low income, 1.73 (95%CI: 1.69-1.78)	Non-vaccination was higher among girls with lower income parents compared to higher income parents.
Bedford et al[2]	UK	Household income	Adjusted Odds Ratio	Vaccination	Parental ethnic background, religious faith, school exclusion, school type, age at interview	High income	Lowest income, 0.44 (95%CI 0.30-0.64)	Girls in the poorest households were less likely to have initiated vaccination compared to higher income households.

Supplementary Table 4. Strength of association between HPV vaccination and area-level socioeconomic status (SES) among included studies which identified an association between these variables

Study	Country	Sociodemographic measure	Measure of association	Outcome	Adjusted for?	Reference group	Result	Summary
Mak et al[15]	Australia	Relative socioeconomic disadvantage (RSED) based on school location	Odds ratio	Vaccination	Clustering by school	Least RSED	Most RSED, 0.7 (95%CI: 0.6-0.9))	Lower vaccine uptake in most disadvantaged SES (68.8%) compared to least disadvantaged (75.1%)
Brotherton et al (2022)[5]	Australia	ABS Socio-economic Index for Areas (SEIFA) quintiles	Chi square	Non-vaccination	N/A	Lowest SEIFA	18.1% v 15.1%, p<0.0001	Unvaccinated girls more likely to reside in areas of lowest SES quintile than vaccinated girls
Gertig et al[10]	Australia	ABS Socio-economic Index for Areas (SEIFA) quintiles	Chi square	Non-vaccination	N/A	Lowest SEIFA	18.4% v 15.5%, p<0.0001	Unvaccinated girls more likely to have lower SES than vaccinated girls
Remes et al[20]	Canada	Area deprivation index	Adjusted Odds Ratio	Vaccine refusal	Vaccination history, healthcare utilisation, medical history, income	Lowest quartile of deprivation	Highest area-level quartile, 0.82 (95%CI: 0.79-0.86)	Compared to those in the lowest quartile of area-level deprivation, those in the highest quartile (most deprived) were less likely to refuse vaccination
Poole et al[19]	New Zealand	School decile (socioeconomic status)	Odds ratio	Vaccination	N/A	Decile 1 (poorest decile)	Decile 10, 5.72 (95%CI 3.36-9.71)	School-level SES was inversely associated with vaccination, with higher rates among the poorest decile (93%) compared to the wealthiest decile (66%).
Riesen et al[21]	Switzerland	Socioeconomic position (neighbourhood level SEP)	Adjusted Odds Ratio	Vaccination	Nationality, urbanization, political opinion, religion, language, survey, school-based vaccination	Middle SEP	Lowest SEP, 1.18 (95%CI 1.00-1.38)	Vaccination uptake was higher in municipalities in the lower SES quartile, though there were not any differences between high and medium SES quartiles.
Roberts et al[22]	UK	Index of multiple deprivation (IMD) 2010	Odds ratio	Vaccination	N/A	Per 10-point increase in IMD	0.89 (95%CI: 0.85-0.95)	Vaccine uptake was highest among girls living in the least deprived areas

Spencer et al[26]	UK	Index of multiple deprivation (IMD) 2010	Odds ratio	Vaccination	N/A	Least deprived	Most deprived, 1.09 (95%CI 1.00-1.17)	There were weak associations between vaccine initiation and area level deprivation (IMD), with higher uptake in the most deprived compared to least deprived
Fisher et al[9]	UK	Index of multiple deprivation (IMD) 2010	Adjusted Odds Ratio	Vaccination	Ethnicity, local authority, programme year, educational setting	Least deprived	Unadjusted OR, 3rd quintile, 0.79 (0.66-0.93); unadjusted OR, 4th quintile 0.68 (0.58-0.80)	The 3rd and 4th most deprived quintiles were less likely to initiate vaccination compared to the least deprived in an unadjusted analysis, but this association did not remain in an adjusted analysis (p=0.48).

Supplementary Table 5. Strength of association between HPV vaccination and parental education among included studies which identified an association between these variables

Study	Country	Sociodemographic measure	Measure of association	Outcome	Adjusted for?	Reference group	Result	Summary
Ogilvie et al[17]	Canada	Parental education	Chi square	Vaccination	N/A	High school diploma	More than high school diploma, 63.3% v 72.9%, p<0.01	Parents with more education (more than high school diploma/vocational training v high school diploma) were less likely to consent to their daughter being vaccinated
Hansen et al[12]	Norway	Parental education	Adjusted Odds Ratio	Vaccination	Age, marital status, occupational status, maternal country of birth, children in household, maternal cervical screening, region, year of birth	Intermediate education	Primary school only, 1.76 (95%CI: 1.40-2.21); postgraduate, 1.40-2.21)	Vaccine initiation was higher among girls with less educated mothers and lower among highest education, compared to intermediate education.
Feiring et al[8]	Norway	Parental education	Multivariable risk difference	Vaccination	Income, employment, country of origin, urbanity, maternal age at daughter's birth, number of siblings, region, year of birth	Compulsory education only	Highest education, -5.5% (95%CI -7.0% - -4.0%)	Highest maternal education was associated with a lower probability of being vaccinated compared to mother's with only compulsory education.
Bjerke et al[3]	Norway	Parental education	Multivariable risk difference	Vaccination	Country background, year of birth, parental income, number of siblings, maternal age at daughter's birth, region	Compulsory education only	Undergraduate, -0.8% (-1.4% - -0.3%); graduate, -1.6% (-2.3% - -0.8%)	Girls with parents in higher education were less likely to initiate HPV vaccination compared to parents with less education.
Wang et al[27]	Sweden	Parental education	Adjusted Hazard Ratio	Vaccination	County of residence, income, country of birth	High education	Low education, 0.92 (95%CI 0.91-0.94)	Vaccine uptake was lower among girls whose parents had low education compared to those with higher education
Wemrell et al[28]	Sweden	Parental education	Adjusted Odds Ratio	Non-vaccination	Parental income, parental country of birth, region, random effects	High education	Low education, 1.73 (95%CI: 1.69-1.78)	Non vaccination was higher among girls whose parents had lower education compared to high education

Supplementary Table 6. Strength of association between HPV vaccination and religion among included studies which identified an association between these variables

Study	Country	Sociodemographic measure	Measure of association	Outcome	Adjusted for?	Reference group	Result	Summary
Mak et al[15]	Australia	School religion	Odds ratio	Vaccination	Clustering by school	Government schools	Catholic schools, 1.2 (95%CI 1.0-1.5)	Higher uptake among girls attending Catholic schools compared to government schools (77.3% v 73.1%).
Krawczyk et al[13]	Canada	Parental religion	Chi square	Vaccination	N/A	Girls with non-Christian parents	Christian parents, 89.9% v 79.55%, p<0.01	Girls with Christian parents were more likely to be vaccinated compared to non-Christian girls
Bowyer et al[4]	UK	Religion	Adjusted Odds Ratio	Vaccination	Ethnicity	Christian girls	Unadjusted OR, No religion 1.77 (95%CI 1.16-2.70)	Girls with no religion were more likely to be fully vaccinated than Christian girls, but this association did not remain after adjustment.
Bedford et al[2]	UK	Parental religion	Adjusted Odds Ratio	Vaccination	Parental ethnic background, income, school exclusion, school type, age at interview	No religious faith	Unadjusted OR, 0.76 (95%CI 0.59-0.97)	Girls whose parents reported any religious faith were less likely to be vaccinated, but this association did not remain after adjustment.

Supplementary Table 7. Strength of association between HPV vaccination and ethnicity/country of birth among included studies which identified an association between these variables

Study	Country	Sociodemographic measure	Measure of association	Outcome	Adjusted for?	Reference group	Result	Summary
Krawczyk et al[13]	Canada	Ethnicity	Chi square	Vaccination	N/A	Non-White girls	White girls, 89.9% v 74.6%, p<0.01	White girls were more likely to be vaccinated compared to non-White girls
Gilbert et al[11]	Canada	Parental country of birth	Adjusted Odds Ratio	Non-vaccination	Age, region, place of birth	Canadian-born parents	Parents born in Americas (not Canada), 1.69 (95%CI 1.03-2.77); Parents born in Europe, 2.66 (1.58-4.49)	Girls with parents born outside of Canada were more likely to not be vaccinated compared to girls with Canadian-born parents (no association for Africa/Asia/Oceania)
Poole et al[19]	New Zealand	Ethnicity	Odds ratio	Vaccination	N/A	European	Pacific, 4.30 (95%CI 3.69-5.02)	Vaccination was highest among Pacific girls (88%) compared to Asian (79%), Maori (78%), and Europeans (63%)
Bjerke et al[3]	Norway	Country of birth	Multivariable risk difference	Vaccination	Income, year of birth, parental education, number of siblings, maternal age at daughter's birth, region	Norwegian girls	Western Europe, -7.9% (95%CI: -9.1% - -6.1%); Central and Eastern Europe, -3.3% (-4.6% - -2.1%); Sub Saharan Africa, -3.4% (-5.0% - -1.8%); America and Oceania, -5.5% (-8.8% - -2.2%)	Girls from Western Europe, Central and Eastern Europe, Sub Saharan Africa, America and Oceania were less likely to initiate HPV vaccination compared to Norwegian girls.
Wang et al[27]	Sweden	Country of birth	Adjusted Hazard Ratio	Vaccination	County of residence, education, income	Girls born in Sweden	Born outside of Sweden, 0.82 (95%CI 0.81-0.83)	Lower vaccine uptake was associated with girls born outside of Sweden compared to those born in Sweden
Wemrell et al[28]	Sweden	Parental country of birth	Adjusted Odds Ratio	Non-vaccination	Parental education, parental income, region, random effects	Swedish-born parents	Immigrant background, 1.53 (95%CI 1.50-1.57)	Non vaccination was higher among girls who had parents with an immigrant background, compared to Swedish born parents
Bowyer et al[4]	UK	Ethnicity	Adjusted Odds Ratio	Vaccination	Religion	White girls	Black, 0.41 (95%CI: 0.27-0.60); Other, 0.56 (0.38-0.82)	Girls from Black and Other ethnic groups were less likely to be fully vaccinated compared to White girls

Roberts et al[22]	UK	Ethnicity	Odds ratio	Vaccination	N/A	White girls	Non-White, 0.67 (95% CI 0.49-0.92)	Non-White girls were less likely to be vaccinated than White girls, but there was no association by specific ethnic groups.
Spencer et al[26]	UK	Area-level ethnicity	Odds ratio	Vaccination	N/A	White	Asian, 0.90 (95% CI 0.88-0.92); Black, 0.85 (0.77-0.94); Other, 0.65 (0.51-0.83)	Girls living in areas with high proportions of Asian, Black (OR 0.85 (0.77-0.94)), and Other ethnic groups were less likely to initiate vaccination.
Fisher et al[9]	UK	Ethnicity	Adjusted Odds Ratio	Vaccination	IMD, local authority, programme year, educational setting	White girls	Asian/Asian British, 0.59 (95%CI 0.44-0.80); Black/Black British, 0.50 (0.32-0.79); Chinese/other, 0.48 (0.33-0.71)	Girls from Asian/British Asian, Black/Black British, and Chinese/Other ethnic groups were less likely to initiate HPV vaccination compared to White girls
Bedford et al[2]	UK	Parental ethnicity	Adjusted Odds Ratio	Vaccination	IMD, income, school exclusion, school type, age at interview	White girls	Black African, 0.49 (95%CI 0.26-0.95); Any other, 0.43 (0.17-0.66))	Young girls whose parents were from Black African or Any Other ethnic groups were less likely to be vaccinated compared to White girls.

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