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HPV Vaccination by Health Insurance and Usual Source of Care Status among US Young Adults

Yitong Wang

Department of Public Administration, Shenzhen University, Shenzhen, China
2023252024@email.szu.edu.cn

Abstract. Health insurance and a usual source of care may identify different groups of young adults with low human papillomavirus (HPV) vaccination coverage. Their joint associations with vaccination were examined using the 2022 National Health Interview Survey. The complete-case sample comprised 2,131 adults aged 18–26 years. Participants were classified by insurance coverage and the presence of a usual place for healthcare. Survey-weighted logistic regression adjusted for age, sex, race and ethnicity, and education; predictive margins summarized adjusted vaccination prevalence and absolute differences. Adjusted prevalence was 51.0% among insured participants with a usual source of care, 43.2% among insured participants without one, 37.3% among uninsured participants with a usual source, and 23.8% among uninsured participants without one. Compared with participants having both forms of access, those having neither had a 27.2-percentage-point lower adjusted prevalence (95% CI, −37.9 to −16.5). The corresponding difference among insured participants without a usual source was −7.8 points (95% CI, −14.6 to −0.9), although this group's odds-ratio association weakened after adjustment for recent physician contact. There was no clear evidence of multiplicative interaction (P=0.380). Joint classification identified a substantial vaccination gap among young adults lacking both insurance and a usual source of care. Current access measures and lifetime vaccination histories do not establish temporal or causal relationships.

Keywords: Human papillomavirus, Vaccination, Health insurance, Usual source of care

1. Introduction

Young adulthood remains an opportunity to initiate human papillomavirus (HPV) vaccination when it was not received earlier. US recommendations extend catch-up vaccination through age 26 for people who are not adequately vaccinated [1]. Identifying gaps in this age group requires attention to how young adults obtain healthcare, as well as to their demographic characteristics.

Earlier analyses of the National Health Interview Survey (NHIS) described variation in HPV vaccination by sex, education, and healthcare use [2]. Goel and Vasudevan also examined insurance, routine care, and service use in National Health and Nutrition Examination Survey participants aged 9–26 years [3]. More directly, the Centers for Disease Control and Prevention (CDC) reported insurance- and usual-care-related vaccination differences using the 2022 NHIS, and Kyei and colleagues examined multiple predictors of HPV vaccination among adults aged 18–26 using the

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same survey year [4, 5]. These findings motivate a closer examination of HPV vaccination differences across groups defined jointly by insurance coverage and usual source of care.

Insurance coverage and a usual source of care capture different aspects of healthcare access. An insured person may have no usual place to seek care, while an uninsured person may still regularly use a particular facility. Examining these measures separately can obscure differences between such groups. Adults aged 18–26 were therefore classified into four insurance–care combinations, and their adjusted HPV vaccination prevalence was compared. Absolute differences were also estimated to show the size of the gaps between groups. This joint classification captures different aspects of healthcare access and may help identify groups with unmet preventive-care needs.

2. Methods

2.1. Data source and study population

A cross-sectional analysis was conducted using the public-use 2022 NHIS Sample Adult file. NHIS represents the civilian noninstitutionalized US population and uses a complex probability sampling design. The file contained 27,651 sample adults; the reported adult response rate was 47.7% [6]. Of these respondents, 2,424 were aged 18–26 years. Participants with valid vaccination responses, both access measures, and the covariates required for the primary model were retained. No individual-level records were linked to external data.

2.2. Vaccination and joint access measures

The outcome was self-reported receipt of any HPV vaccine dose (SHTHPV_A). Yes and no responses were coded as vaccinated and unvaccinated; refused, unknown, and unascertained responses were treated as missing. This measure concerns vaccination at any time before the interview. Series completion and vaccination during the preceding year were not evaluated.

Insurance coverage was defined using the edited coverage variable NOTCOV_A: code 2 indicated coverage and code 1 indicated no coverage. NCHS recommends the edited variable for estimating uninsurance because follow-up information can change the initial insurance classification [7]. A usual source of care was defined from USUALPL_A. Responses indicating one usual place or more than one place were classified as having a source; a response indicating no place was classified as having none. This variable does not establish continuity with an individual clinician or describe the quality of care.

The joint exposure comprised four mutually exclusive groups: A, insured with a usual source; B, insured without a usual source; C, uninsured with a usual source; and D, uninsured without a usual source. Group A was the reference. The model did not additionally include the two component variables alongside this four-category exposure.

2.3. Covariates and supplementary measures

The primary model adjusted for age in years, sex, race and ethnicity, and educational attainment. Race and ethnicity were grouped as non-Hispanic White, Hispanic, non-Hispanic Black, non-Hispanic Asian, and other non-Hispanic single or multiple races. Education was classified as below high school, high school or GED, some college or an associate degree, and a bachelor's degree or higher. Income and employment were not included, and no imputation was performed.

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Recent physician contact was derived from LASTDR_A and indicated a visit within the preceding 12 months. Respondents who had never seen a physician were included in the no-recent-visit category. Recent contact was considered in a sensitivity analysis because it overlaps with access and could plausibly lie along a pathway connecting access with vaccination; this dataset cannot identify that pathway.

2.4. Statistical analysis

Analyses incorporated the annual adult weight WTFA_A, pseudo-strata PSTRAT, and pseudo-primary sampling units PPSU. The survey design was specified using the full adult file before restricting it to the study subpopulation. Counts were unweighted; population characteristics and vaccination estimates were weighted. Weighted prevalence confidence intervals used a logit transformation. The primary logistic regression used a quasibinomial family and reported adjusted odds ratios (aORs) with Wald 95% confidence intervals (CIs). Age was entered as a continuous variable, assuming a linear association with the log odds of vaccination.A design-based Wald test evaluated the four-category exposure jointly.

Predictive margins standardized each access group to the survey-weighted covariate distribution of the complete-case sample [8]. Adjusted prevalence and contrasts B−A, C−A, D−A, and D−B were reported in percentage points. Marginal probability CIs used a logit-scale delta method with a normal approximation; difference CIs used the joint covariance matrix and a normal approximation. These contrasts were not corrected for multiple comparisons. A separate model containing insurance, usual source, and their product term tested multiplicative interaction on the odds scale.

Three sensitivity analyses examined the insurance definition, exclusion of respondents reporting multiple usual places, and additional adjustment for recent physician contact. The insurance comparison used the same respondents with valid edited and original insurance measures; the recent-contact comparison likewise used a common sample before and after adjustment. All tests were two-sided. Analyses used R 4.6.0 and the survey package, version 4.5. Estimates and uncertainty were emphasized alongside the conventional 0.05 significance threshold.

3. Results

3.1. Sample composition

Among 2,424 age-eligible respondents, 2,159 had valid HPV vaccination responses and 2,142 also had complete access information. Excluding 11 respondents with incomplete model covariates yielded 2,131 participants. Overall, 293 age-eligible respondents (12.1%) were excluded; missing vaccination information accounted for 265 of these exclusions. In an unweighted comparison, excluded respondents were more often male than included respondents (55.8% versus 48.0%), indicating that exclusions were not evenly distributed.

Group sizes were 1,547 for A, 289 for B, 173 for C, and 122 for D. The unweighted numbers reporting vaccination were 830, 137, 55, and 23, respectively. Group D had larger weighted proportions of men, Hispanic participants, and participants without a high-school qualification than group A (Table 1). Its small number of vaccinated respondents warrants particular caution.

Table 1. Characteristics of the complete-case sample by joint access status

Characteristic	A(n=1,547)	B(n=289)	C(n=173)	D(n=122)
Mean age, years	21.77	22.70	22.71	22.88

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Table 1. (continued)

Female, %	52.48	47.74	51.50	31.94
Male, %	47.52	52.26	48.50	68.06
Non-Hispanic White, %	55.11	62.14	41.91	28.48
Hispanic, %	19.68	20.04	34.92	55.61
Non-Hispanic Black, %	13.84	8.31	13.12	9.71
Non-Hispanic Asian, %	5.89	5.02	4.51	0.00
Other non-Hispanic races, %	5.47	4.49	5.54	6.21
Below high school, %	10.87	5.05	14.00	29.47
High school or GED, %	32.98	33.11	48.18	44.01
Some college or associate degree, %	38.95	28.68	28.05	21.16
Bachelor's degree or higher, %	17.20	33.17	9.77	5.36

A: insured with a usual source; B: insured without a usual source; C: uninsured with a usual source; D: uninsured without a usual source. Counts are unweighted; means and percentages are survey-weighted. Percentages may not sum to 100 because of rounding. No non-Hispanic Asian respondents were observed in group D.

3.2. Weighted and adjusted vaccination estimates

Weighted vaccination prevalence was 47.4% (95% CI, 44.9–50.0) among all 2,159 respondents with valid vaccination information and 47.7% (95% CI, 45.1–50.3) in the complete-case sample. Within the latter sample, unadjusted weighted prevalence ranged from 52.2% in group A to 15.8% in group D (Table 2).

After covariate adjustment, participants in groups B, C, and D had lower odds of HPV vaccination than those in group A, with aORs of 0.71 (95% CI, 0.52–0.96), 0.54 (95% CI, 0.36–0.82), and 0.27 (95% CI, 0.15–0.50), respectively.The overall exposure test was F (3,497) =8.84, P<0.001. Male sex was associated with lower vaccination odds (aOR, 0.49; 95% CI, 0.40–0.61), as was greater age within the study range (per-year aOR, 0.91; 95% CI, 0.87–0.95).

Table 2. Vaccination estimates by joint access status

Group	Weighted prevalence, % (95% CI)	Adjusted OR(95% CI)	Adjusted prevalence, %(95% CI)	Difference vs A, pp(95% CI)
A	52.2 (49.3–55.0)	1.00 (reference)	51.0 (48.2–53.7)	Reference
B	45.3 (38.6–52.1)	0.71 (0.52–0.96)	43.2 (37.0–49.7)	−7.8 (−14.6 to −0.9)
C	32.8 (25.0–41.5)	0.54 (0.36–0.82)	37.3 (29.1–46.3)	−13.7 (−22.7 to −4.7)
D	15.8 (9.6–25.1)	0.27 (0.15–0.50)	23.8 (14.9–35.8)	−27.2 (−37.9 to −16.5)

Groups are defined in Table 1. Adjusted estimates include age, sex, race and ethnicity, and education. Predictive margins use the weighted covariate distribution of the complete-case sample. OR, odds ratio; CI, confidence interval; pp, percentage points. Difference intervals are unadjusted for multiple comparisons.

The adjusted prevalence estimates were 51.0%, 43.2%, 37.3%, and 23.8% in groups A–D (Figure 1). The largest contrast was D−A, at −27.2 percentage points (95% CI, −37.9 to −16.5). The B−A contrast was −7.8 points (−14.6 to −0.9), while C−A was −13.7 points (−22.7 to −4.7). Group D also had lower adjusted prevalence than group B, with a difference of −19.4 points (−31.4 to −7.4).

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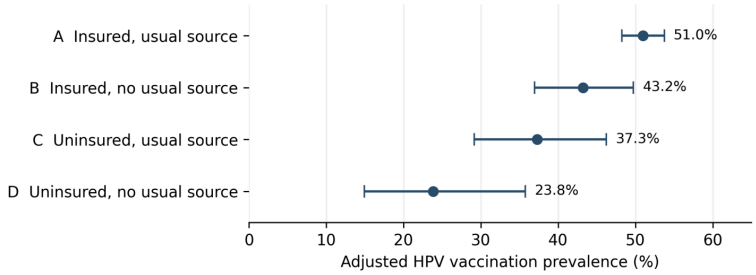


Figure 1. Adjusted HPV vaccination prevalence by joint access status with 95% confidence intervals (picture credit: original)

3.3. Interaction and sensitivity analyses

The insurance-by-usual-source interaction did not provide clear evidence of departure from multiplicativity on the odds scale (F (1,497) =0.77, P=0.380).

Table 3 summarizes the sensitivity analyses of the associations between joint access status and HPV vaccination. Using the original insurance response instead of the edited measure produced similar directions of association in the common sample of 2,128 respondents. Excluding the 57 participants who reported multiple usual places also left the main pattern largely unchanged. Additional adjustment for recent physician contact, however, attenuated the group B estimate from 0.72 (95% CI, 0.53–0.97) to 0.78 (0.58–1.07; P=0.119) in the same 2,125 respondents. Associations for groups C and D remained below one with CIs excluding one. Recent contact itself was positively associated with vaccination (aOR, 1.41; 95% CI, 1.07–1.84; P=0.013).

Table 3. Sensitivity analyses of the joint access associations

Analysis	n	B vs AaOR (95% CI)	C vs AaOR (95% CI)	D vs AaOR (95% CI)
Edited insurance, common sample	2,128	0.71 (0.52–0.96)	0.55 (0.36–0.83)	0.27 (0.15–0.50)
Original insurance, common sample	2,128	0.69 (0.52–0.94)	0.50 (0.32–0.78)	0.26 (0.14–0.48)
Exclude multiple usual places	2,074	0.71 (0.52–0.97)	0.52 (0.34–0.80)	0.27 (0.15–0.50)
Recent-contact sample, no contact adjustment	2,125	0.72 (0.53–0.97)	0.54 (0.36–0.82)	0.28 (0.15–0.51)
Recent-contact sample, add contact adjustment	2,125	0.78 (0.58–1.07)	0.59 (0.39–0.91)	0.32 (0.17–0.61)

All models adjust for age, sex, race and ethnicity, and education. The first two rows use the same respondents; the final two rows also use an identical sample. Recent contact means a physician visit within 12 months. These are sensitivity analyses, not alternative models selected by statistical significance.

4. Discussion

The largest vaccination gap was observed among young adults who reported neither health insurance nor a usual source of care. Their adjusted HPV vaccination prevalence was 23.8%, compared with 51.0% among those reporting both. The two remaining groups fell between these estimates. This pattern shows that a simple insured–uninsured comparison does not fully describe how vaccination histories vary across healthcare access circumstances.

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Previous studies have linked HPV vaccination to insurance, healthcare access, and service use [2, 3]. Analyses of the 2022 NHIS have also examined vaccination coverage and its predictors [4, 5]. Building on previous research, this study jointly examined insurance coverage and usual source of care across four mutually exclusive groups, providing adjusted absolute differences in HPV vaccination prevalence. The 27.2-percentage-point gap between participants with both forms of access and those with neither makes the size of this disparity easier to interpret than an odds ratio alone. These estimates identify a group with particularly low coverage, although they do not explain how that gap developed.

Previous research on barriers to HPV vaccination among young adults and changes in vaccination patterns during the COVID-19 pandemic provides additional context for considering outreach strategies [9, 10]. The comparison between the two insured groups warrants cautious interpretation. In the primary model, insured participants without a usual source of care had an adjusted vaccination prevalence 7.8 percentage points lower than those with a usual source. In the common sample used for the recent-contact sensitivity analysis, additional adjustment for recent physician contact shifted the aOR from 0.72 to 0.78, with the latter 95% CI including one. The estimate remained in the same direction, but evidence for this association was less conclusive after adjustment. This comparison does not establish whether recent contact acts as a confounder, an intermediate factor, or another indicator of healthcare access.

For vaccination outreach, the four groups provide a more detailed description of whom routine services may be missing. Insurance status alone would not distinguish insured young adults who lack a usual place for care. At the same time, outreach conducted only through established care settings may have limited reach among people who report no usual source. These findings provide a reason to evaluate approaches that extend beyond routine clinic visits. They do not show which approach would be effective, and the outcome used here—receipt of any HPV vaccine dose—does not establish whether an individual has completed the recommended series.

The main limitation is the timing of the measures. Insurance and usual-source status describe circumstances at interview, whereas HPV vaccination may have occurred years earlier, including during adolescence. The observed associations therefore cannot establish that current access preceded vaccination. Reliance on self-reported vaccination introduces potential recall and reporting bias. Overall, 12.1% of age-eligible respondents were excluded from the complete-case analysis, primarily because of missing or invalid vaccination responses, which affected 10.9% of age-eligible respondents. In an unweighted comparison, the proportion of men was higher among excluded respondents than among those retained. Survey weighting does not necessarily remove bias arising from these exclusions.Residual confounding is also possible because the models did not account for income, nativity, health literacy, or provider recommendations.

Precision and model assumptions also matter. The group with neither insurance nor a usual source contained 122 respondents, only 23 of whom reported vaccination. No non-Hispanic Asian respondents were observed in this group, so standardization to the full sample partly relies on extrapolation. The models assumed a linear association between age and the log odds of vaccination, and the absolute prevalence contrasts were not adjusted for multiple comparisons. The large difference between groups A and D does not by itself demonstrate interaction, and the formal test provided no clear evidence of interaction on the multiplicative odds scale. A useful next step would be to examine insurance and care access at the time vaccination was offered or received, using longitudinal data to clarify the sequence of events.

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5. Conclusion

Among US adults aged 18–26 years in the 2022 NHIS, joint classification by health insurance and usual source of care identified substantial differences in HPV vaccination prevalence. Adjusted prevalence was 51.0% among participants with both forms of access and 23.8% among those with neither, a difference of 27.2 percentage points. This classification provides a more detailed description of vaccination disparities than insurance status alone. The association among insured participants without a usual source of care was attenuated after adjustment for recent physician contact, and no clear multiplicative interaction was observed. These findings may inform assessments of vaccination needs, particularly among young adults lacking both forms of access. However, current access measures and prior vaccination histories do not establish temporal or causal relationships. Longitudinal research is needed to clarify these relationships.

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