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HPV Vaccination and Hearing Trouble: A Population-Based Analysis

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Introduction

Hearing loss is a widespread public health concern associated with cognitive, social, and quality-of-life impairments. Although the human papillomavirus (HPV) vaccine is primarily administered to prevent HPV-related cancers, there is growing interest in its broader health associations, including potential effects on hearing. To date, little is known about whether HPV vaccination is associated with hearing-related outcomes at the population level.

Methods

We analyzed data from 11,737 participants in the 2021–2023 cycles of the National Health and Nutrition Examination Survey (NHANES). Hearing status was determined through self-report and dichotomized as good hearing versus hearing trouble. HPV vaccine status was based on self-reported receipt of at least one dose. Multivariable logistic regression was used to examine the association between HPV vaccination and hearing trouble, adjusting for age, gender, education, and marital status.

Results

Among participants, 80.2% reported good hearing and 19.8% reported some degree of hearing trouble. HPV vaccination rates were slightly lower among those with hearing trouble (33.5%) compared to those with good hearing (36.9%). However, HPV vaccine status was not significantly associated with hearing trouble in adjusted analysis (OR = 1.05, 95% CI: 0.80–1.37, p = 0.717). Older age was associated with higher odds of hearing trouble (OR = 1.03 per year, p < 0.001), while female gender was protective (OR = 0.73, p = 0.007). Marital status and education level were not significantly associated with hearing outcomes.

Discussion

In this nationally representative sample, we found no evidence that receipt of the HPV vaccine is associated with increased risk of hearing trouble. These findings align with prior research indicating a lack of strong population-level evidence for otologic side effects following HPV vaccination. Our results also reinforce the well-established associations between hearing trouble, older age, and male gender. Further research using longitudinal data and objective audiologic assessments is warranted to confirm these findings and explore potential long-term effects.

INTRODUCTION

Hearing loss is a prevalent public health issue affecting over 1.5 billion people globally and is projected to increase to 2.5 billion by 2050.[1,2] It is associated with a range of adverse outcomes, including social isolation, communication difficulties, cognitive decline, and reduced quality of life.[3,4] In the United States, approximately 15% of adults report some degree of hearing difficulty.[5] While age-related hearing loss is the most common form, the condition can affect individuals across the lifespan due to various medical, environmental, and behavioral factors.[6]

The human papillomavirus (HPV) vaccine is primarily known for its role in preventing cervical and other anogenital cancers and is recommended for both males and females starting in early adolescence.[7,8] With widespread implementation of HPV vaccination programs, research has primarily focused on its efficacy in reducing HPV-related

malignancies and conditions such as genital warts.[9,10] However, as with many vaccines, there is growing interest in exploring broader health associations with HPV vaccination, including both beneficial and unintended effects.[11]

To date, little research has examined the relationship between HPV vaccine status and hearing-related outcomes. While otologic adverse events have been reported anecdotally after various vaccinations, including for HPV, population-level studies remain limited.[12] Additionally, sociodemographic factors such as gender, age, education, and marital status may influence both vaccine uptake and risk of hearing loss, making it important to control for these variables when assessing any association.

In this study, we utilized nationally representative data from the National Health and Nutrition Examination Survey (NHANES) to examine whether self-reported HPV vaccine status is associated with the presence of hearing trouble. By adjusting for demographic factors, we aimed to clarify whether individuals who received the HPV vaccine exhibit different rates of hearing difficulty compared to those who did not.

METHODS

This study utilized data from the National Health and Nutrition Examination Survey (NHANES), a nationally representative cross-sectional survey conducted by the Centers for Disease Control and Prevention (CDC). We used data collected from 2021 to 2023 across multiple NHANES files, including Demographics, Vaccinations, and Medical Conditions.

Participants were included if they had available data on HPV vaccination status and hearing health. Hearing health was assessed through self-reported responses to the question, "Which statement best describes your hearing (without a hearing aid, personal sound amplifier, or other listening devices)?"

The primary outcome variable was hearing status, which was recoded into a binary variable: participants reporting "Excellent" or "Good" hearing were categorized as having good hearing, while those reporting "A little trouble," "Moderate trouble," "A lot of trouble," or being "Deaf" were categorized as having hearing trouble. The main independent variable was HPV vaccine status, defined as receiving one or more doses of the vaccine based on responses from both male and female vaccine questions. Additional covariates included age, gender, education level, and marital status, all recoded for consistency and analysis.

Descriptive statistics were used to summarize demographic characteristics across hearing status groups. A multivariable logistic regression model was conducted to assess the association between HPV vaccination and hearing trouble, adjusting for age, gender, marital status, and education. Odds ratios (ORs) with 95% confidence intervals (CIs) and p-values were reported. Analyses were performed using R version 4.2.0.

RESULTS

A total of 11,737 participants were included in the analysis. Among them, 9,418 individuals (80.2%) reported good hearing, while 2,319 individuals (19.8%) reported some degree of hearing trouble. The average age of participants with good hearing was 34.16 years (SD = 24.17), compared to 58.33 years (SD = 20.20) among those with hearing trouble.

In the good hearing group, 45.3% were male and 54.7% were female. In contrast, males accounted for 51.5% of participants with hearing trouble, while females comprised 48.5%. Racial distribution showed that the majority of participants with good hearing were White (56.4%), followed by Hispanic (26.3%) and Black (17.3%). Among those with hearing trouble, 76.1% were White, 15.2% were Hispanic, and 8.7% were Black.

Educational attainment differed by hearing status. Participants with good hearing were more likely to have completed higher levels of education, including 35.6% who were college graduates or above. Among those with hearing trouble, 28.7% were college graduates or above, and a larger proportion had only a high school diploma or some college. Marital status was similarly distributed across groups, with just over half of each group being married, as shown in Table 1.

As seen in Table 2, in the logistic regression analysis, HPV vaccine status was not significantly associated with hearing trouble (OR = 1.05, 95% CI: 0.80–1.37, p = 0.717). Age was significantly associated with hearing trouble, with higher age increasing the odds (OR = 1.03, 95% CI: 1.01–1.04, p < 0.001). Female gender was associated with lower odds of hearing trouble compared to males (OR = 0.73, 95% CI: 0.58–0.93, p = 0.007). Other variables, including marital status and education level, did not show significant associations.

DISCUSSION

In this nationally representative analysis, we found no statistically significant association between HPV vaccine status and self-reported hearing trouble among adults in the United States. Although a slightly lower proportion of individuals with hearing trouble reported HPV vaccination compared to those with good hearing, this difference was not significant after adjusting for key sociodemographic factors. Our findings are consistent with prior systematic reviews that identified only anecdotal reports of otologic adverse events following HPV vaccination without strong population-level evidence.[12]

The observed associations of age and gender with hearing trouble align with existing literature.[3-5] Older age was strongly associated with increased odds of hearing difficulty, while female gender appeared to confer a protective effect. These findings emphasize the importance of controlling for age and gender when studying hearing outcomes.

Given the limited research on the relationship between HPV vaccination and hearing, our study provides valuable evidence suggesting no apparent adverse association be-

Table 1. Demographic and Clinical Characteristics of Participants by Hearing Status

Variable	No Hearing Trouble N (%)	Hearing Trouble N (%)	Total N
Total	9,418 (80.2%)	2,319 (19.8%)	11,737
Gender			
Male	4,270 (45.3%)	1,195 (51.5%)	5,465 (46.6%)
Female	5,148 (54.7%)	1,124 (48.5%)	6,272 (53.4%)
Race			
Black	1,394 (17.3%)	181 (8.7%)	1,575 (13.4%)
Hispanic	2,119 (26.3%)	316 (15.2%)	2,435 (20.7%)
White	4,553 (56.4%)	1,583 (76.1%)	6,136 (52.3%)
Education			
<9th grade	255 (4.5%)	118 (5.5%)	373 (3.2%)
9–11th grade	455 (8.0%)	211 (9.9%)	666 (5.7%)
High school/GED	1,219 (21.6%)	530 (24.9%)	1,749 (14.9%)
Some college/AA	1,712 (30.3%)	657 (30.9%)	2,369 (20.2%)
College graduate+	2,014 (35.6%)	611 (28.7%)	2,625 (22.4%)
Marital Status			
Married	3,000 (53.0%)	1,136 (53.5%)	4,136 (35.3%)
Not Married	2,657 (47.0%)	989 (46.5%)	3,646 (31.1%)
HPV Vaccine on File	1,569 (36.9%)	163 (33.5%)	1,732 (24.2%)

Regarding HPV vaccination, 36.9% of participants with good hearing had received the HPV vaccine, compared to 33.5% of those with hearing trouble.

Table 2. Logistic Regression Results Examining the Association Between HPV Vaccination and Hearing Trouble

Variable	Odds Ratio (OR)	95% CI	P-value
HPV Vaccine	1.05	0.80 – 1.30	0.717
Gender: Female	0.73 **	0.56 – 0.93	0.007
Age (years)	1.03 ***	1.01 – 1.04	<0.001
Marital Status: Not Married	1.14	0.91 – 1.33	0.251
Education: 9–11th grade	0.73	0.35 – 1.50	0.385
Education: High school/GED	1.15	0.62 – 1.69	0.662
Education: Some college/AA	1	0.58 – 1.54	0.998
Education: College graduate+	0.66	0.35 – 1.28	0.191

Significance Legend: * p < 0.05 ** p < 0.01 *** p < 0.001

tween HPV vaccination and hearing health at the population level. However, it remains essential to continue monitoring vaccine safety and to conduct longitudinal studies that could capture delayed or rare adverse outcomes.

CONCLUSION

This study did not identify a significant association between HPV vaccination and hearing trouble in a large, nationally representative sample. These findings provide reassuring evidence regarding the safety of the HPV vaccine concerning hearing-related outcomes. Future research may benefit from exploring this relationship using longitudinal designs and objective audiometric testing to complement self-reported measures.

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