What explains the different rates of human papillomavirus vaccination among adolescent males and females in the United States?

Yoonyoung Choi [a], Efe Eworuke [a,b], Richard Segal [a,*]

[a] Department of Pharmaceutical Outcomes and Policy, College of Pharmacy, University of Florida, P.O. Box 100496, Gainesville, FL 32610, USA
[b] Division of Epidemiology II, Office of Surveillance and Epidemiology, Office of Pharmacovigilance and Epidemiology, Center for Drug Evaluation and Research, Food and Drug Administration, Silver Spring, MD 20993, USA

ARTICLE INFO

ABSTRACT

Purpose: To identify factors that explain differences in HPV vaccination rates for male and female adolescents and to determine self-reported barriers by parents affecting vaccination decisions.
Methods: The sample included adolescents 13–17 years old with a vaccination record documented in the 2012 and 2013 National Immunization Survey-Teen dataset. A logistic regression model was developed with 13 socio-demographic factors and survey year, along with significant interaction pairs with gender.
Results: Subjects included 20,355 and 18,350 adolescent boys and girls, respectively. About half of the females (56%) received at least one dose of HPV vaccine, compared to 28% of males. Several factors differed between males and females, including higher vaccination rates among non-Hispanic Black males and lower vaccination rates for non-Hispanic Black females compared to Whites; and a stronger association with health care provider recommendation among males. The most common parental reasons for not vaccinating their children included 'not recommended by a health care provider' for males (24%), and 'unnecessary' for females (18%).
Conclusion: We found a significant gender interaction with several socio-demographic variables in predicting vaccination uptake. These gender differences may be partially an artifact of timing, because male vaccination became routine approximately five years after female vaccination.

1. Introduction

Considerable attention has been given to human papillomavirus (HPV) infection's association with cervical cancer in women [1]. However, HPV is also associated with a variety of other cancers in women and men including anal cancer and a subset of penile and oral cancers. A three-dose series of HPV vaccine was initially recommended for females by the Advisory Committee on Immunization Practices (ACIP) in 2007 [2]. Later in 2011, the ACIP added a recommendation of the quadrivalent HPV vaccine for males aged 11–12 years for routine vaccination as well as at 13–21 years for a catch up vaccination [3]. During the year prior to ACIP's recommendation, only 14% of young males were vaccinated, which was considerably lower than the 44% of adolescent females vaccinated during the same time period [4].

For adolescents aged 18 years and younger, the decision to vaccinate is largely influenced by a parent or caregiver [5]. Therefore, strategies aimed at heightening parental acceptance or attitudes toward vaccination are important for ensuring that vaccines are administered before adolescents becomes sexually active, which is important for realizing the full benefits of the vaccine [6]. Studies have appeared in the literature to show the role of certain factors, including socioeconomic status and ethnicity, in predicting which individuals are vaccinated for HPV. While these studies have been useful in guiding interventions intended to improve adherence to ACIP guidelines, the majority of these studies suffer from poor generalizability because they used samples drawn from small geographic areas in the US or because they have not identified factors that explain why females are more likely to be vaccinated than males [4,7–9]. These limitations form the basis for the present study, which aims to explore which factors explain differences in vaccination rates by gender among adolescents who received at least one HPV vaccine dose in a national sample. In addition, we also explore barriers identified by parents or caregivers that shape a decision to vaccinate a child.

* Corresponding author. Tel.: +1 352 273 6265; fax: +1 352 273 6270.
E-mail addresses: chyoonyo@ufl.edu (Y. Choi), efe1odia@ufl.edu (E. Eworuke), segal@cop.ufl.edu (R. Segal).

2. Methods

2.1. Study design

We analyzed data from the National Immunization Survey-Teen (NIS-Teen), which was conducted by the Centers for Disease Control and Prevention (CDC). This survey reports immunization coverage estimates for adolescents aged 13–17 years [10] during the periods between January 2012 and February 2013 (reported in the 2012 NIS-Teen) and between January 2013 and February 2014 (reported in the 2013 NIS-Teen) [11,12]. Since the routine use of HPV vaccine for males was recommended in October 2011 [3], the responses captured in both NIS-Teen surveys reflect its most recent recommendation for the catch up vaccination. Vaccination information was collected in two ways: (1) a Random Digit Dialing (RDD) telephone survey of households with children 13–17 years of age, and (2) a survey mailed to health care providers asking for immunization records of children for whom parents or guardians gave consent to share records with the survey collectors [11,12]. If more than one adolescent between 13 and 17 years was identified in a sampled household, one child was randomly chosen as the subject of the interview [11,12]. Details of NIS-Teen methods including data collection and weights generation were previously published [11–13].

A total of 58 geographic areas comprising all 50 states, the U.S. Virgin Islands, Guam (only available in NIS-Teen 2013), and 6 urban areas (Bexar County, TX; City of Houston, TX; Chicago, IL; District of Columbia; New York City; Philadelphia County, PA) were included. The datasets included 32,825 and 33,949 adolescents from the 2012 and 2013 NIS-Teen dataset respectively, representing a Council of American Research Organization (CASRO) response rate of 55.1% and 51.1% for households contacted on landline telephones and a CASRO response rate of 23.6% and 23.3% for households contacted on their cell-phones, excluding U.S. Virgin islands or Guam [11,12]. Of these 66,774 adolescents (referred to as the source population in the present study), the CDC collected additional data for 38,705 of these adolescents from their health care providers about the status of their vaccine schedule (referred to as the study population in the present study) [11,12].

2.2. Measures

The primary variable of interest was whether a teen received at least one HPV vaccination in the series or was not vaccinated at all. Vaccination status was identified from a field in the dataset that specified the subject having an "Up-to-date flag: 1+ human papillomavirus shot, excluding any vaccinations after the interview date." We also examined whether the following socio-demographic factors, as well as survey year, was associated with vaccination status: age of the child at the screener completion date calculated from the best date of birth [11,12]; race/ethnicity; child's insurance coverage; number of visits by the child to a health care provider in the previous year; vaccination status for Tetanus–diphtheria/Tetanus–diphtheria–acellular–pertussis vaccine (Td/Tdap) or Meningococcal vaccine (MCV); a recommendation of HPV vaccine by a health care provider; income of the household; census region; number of children in the household; and mother's age, education level, and marital status.

In the source population, parents or their caregivers whose children did not receive a dose of the vaccine were asked how likely their child would be vaccinated for HPV in the next 12 months. For those who said they were not likely to complete the full vaccine series, reasons for this decision were requested.

2.3. Data analysis

We recoded the number of health care visits during the previous year (originally 9 levels) to "none," "1," "2–3," and "4 or more"; insurance type was also re-classified as either "employer or union," "others including Medicaid," or "none." The category "others including Medicaid" includes Medicaid, State Children's Health Insurance Program (S-CHIP), TRICARE, or Indian Health Service. It should be noted that children less than 19 years who are eligible for Medicaid, underinsured, or American Indian/Alaska native descent can access vaccines at no cost from a part of the federally funded Vaccine For Children (VFC) program. Also, children enrolled in either S-CHIP or TRICARE are eligible for CDC recommended free vaccines, including HPV [14,15]. While many commercial plans cover HPV vaccines, the level of benefit coverage for HPV vaccination varies by plan [16]. When the dataset reported that a teen had multiple forms of insurance including "employer or union," and "others including Medicaid," the subject was categorized as "others including Medicaid."

When calculating the descriptive statistics, different weights were used for the study population and the source population. For the primary outcome, the study population with 38,705 households was standardized with survey weights to represent all teens aged 13–17 years old that were reported in the provider dataset. For the secondary outcome, the source population with the 66,774 households was weighted generalizable to all teens aged 13–17 years in U.S. We calculated a Pearson's chi-square to compare vaccination rate, parental willingness to vaccinate, and reasons for declining vaccination by gender.

A logistic regression model was developed to test the hypothesis that an association between socio-demographic factors and HPV vaccination was not mediated by sex. The model adjusted for the complex sample design employed in the survey data (strata, cluster and weight) using PROC SURVEY command in SAS 9.4. To determine effect modification by sex, we examined all interaction pairs between 14 independent variables (13 socio-demographic variables and survey year) and sex. Then, the significant interaction pairs as well as the 14 variables and sex were included in the multivariate analysis. We intended to derive estimates taking fourteen variables into account given that over fitting was not a concern for our study [17]. Therefore, additional model selection (e.g. forward selection, backward elimination, or stepwise) was not employed. For variables with significant gender effects, we reported odds ratios (ORs) stratified by sex, while pooled ORs were generated for variables without gender interactions. Multicollinearity was examined by adding each variable to check whether a meaningful increase in standard error (50%) occurred [18]. All statistical tests were conducted at a significance level of $p < 0.05$ for a two-sided test. The study was approved by the Institutional Review Board at the University of Florida.

3. Results

3.1. Participant characteristics

Socio-demographic characteristics in the study population were similar for both adolescent males and females. The mean age of the adolescents was 15.0 years. The majority were non-Hispanic whites (55.0%) and had healthcare coverage (93.1%). Most teens had at least one encounter with a healthcare provider during the previous year (83.1%) and were immunized for Td/Tdap (89.6%) or Meningococcus (76.9%). Most mothers were 35 years and older (90.0%), married (65.0%), and had at least some college education (61.6%). The majority of parents or caregivers reported that their household incomes were higher than the poverty threshold level (71.7%) and had fewer than four children (87.3%). More than one-third of the adolescents lived in the South (37.3%) (Table 1). However, the frequency in which HPV