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The accuracy of human papillomavirus vaccination status based on adult proxy recall or household immunization records for adolescent females in the United States: results from the National Immunization Survey-Teen

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ABSTRACT

Purpose: We assessed the accuracy of human papillomavirus (HPV) vaccination status based on adult proxy recall and household immunization records for adolescent females in the United States.
Methods: We used data from the 2010 National Immunization Survey—Teen for females aged 13 to 17 years. The accuracy of HPV vaccination status (≥1 dose) based on adult proxy recall (unweighted n = 6868) and household immunization records (unweighted n = 2216) was assessed by estimating the sensitivity, specificity, and corresponding 95% confidence limits (CL) of these measures with provider-reported HPV vaccination status as the reference standard. Our analyses accounted for the complex survey design and population weights.
Results: The sensitivity and specificity of adult proxy recall were 83.9% (95% CL: 81.2%, 86.6%) and 90.4% (95% CL: 88.9%, 92.0%), respectively. Conversely, the sensitivity and specificity of household immunization records were 74.2% (95% CL: 69.1%, 79.2%) and 98.0% (95% CL: 96.8%, 99.1%), respectively. The accuracy of both measures varied by race/ethnicity, proxy respondent, and maternal education.
Conclusions: Our results suggest that adult proxy recall and household immunization records have reasonable accuracy for classifying HPV vaccination status for females aged 13 to 17 years in the United States, but these measures present a trade-off between sensitivity and specificity.

Introduction

The prominent etiologic role of human papillomavirus (HPV) infection in cervical cancer prompted the development and public dissemination of bivalent and quadrivalent HPV vaccines in 2006 to immunize against HPV-16 and -18, which account for 70% of cervical cancer cases [1,2]. The quadrivalent version also includes HPV-6 and -11 to immunize against genital warts [1,2]. The United States Advisory Committee on Immunization Practices currently recommends routine HPV vaccination with three doses (administered over 6 months) of either bivalent or quadrivalent vaccine for females aged 11 to 12 years (ie, before sexual debut), with "catch-up" vaccination recommended for females aged 13 to 26 years [3,4]. These recommendations were recently updated to promote routine use of the quadrivalent vaccine for males aged 11 to 12 years, and "catch-up" vaccination for males aged 13 to 21 years [5].

Many studies have assessed the prevalence of [6–23] and factors associated with HPV vaccine uptake among adolescents in the post-vaccination era [24–26]; adult proxy recall (largely maternal) has been the primary method of measuring vaccine uptake. Similar to any study design that uses proxy-reported measures [27], the validity of inferences from study results partially depends on the accuracy with which HPV vaccine uptake is measured. Misclassification of HPV vaccination status may bias not only prevalence estimates, but also measures of association, which might compromise the public health utility of study findings. Therefore, our aim for this study was to assess the accuracy of HPV vaccination status based on adult proxy recall and household immunization records, relative to health provider report, for adolescent females in the United States.

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Methods

Data source

We used data from the 2010 National Immunization Survey-Teen (NIS-Teen) [28], a nationally representative survey of adolescent vaccination coverage rates, to assess the accuracy of adult proxy recall and household immunization records of HPV vaccination status. The 2010 NIS-Teen survey design and methodology have been described in detail elsewhere [29]. Briefly, the NIS-Teen is a supplement to the National Immunization Survey (NIS) designed to estimate vaccination coverage rates among children aged between 13 and 17 years. Households contacted by random digit dialing during the NIS, which pertains to children aged between 19 and 35 months, are screened for the presence of children aged between 13 and 17 years. If an eligible adolescent resides in the household, an adult most knowledgeable about the adolescent's vaccinations is interviewed. For households with more than one eligible adolescent, one adolescent is randomly selected. In addition, the adult is requested for consent to contact the eligible adolescent's healthcare provider for access to immunization records maintained by the provider. Providers of consenting adults are subsequently requested to complete and return (on behalf of the eligible adolescent) a paper-based survey about immunization history for the eligible adolescent.

Study population

The eligible study population for our analysis comprised females aged 13 to 17 years with adequate provider data. Adequate provider data is defined in the NIS-Teen as individuals for whom providers reported sufficient vaccine history to determine up-to-date status for the recommended vaccine schedule [29]. In addition, eligible females were required to have information about HPV vaccination status by either adult proxy recall or household immunization records.

Measures of HPV vaccination status

We designated the reference ("gold") standard for our analysis as the provider-reported HPV vaccination status, which constituted ever receiving at least one dose or receiving no doses of either the bivalent or quadrivalent vaccine. If the adolescent had multiple health providers, vaccination records were requested from all providers and synthesized into one complete report for the adolescent, which included HPV vaccination status [29]. We selected ever receiving at least one dose as our measure of HPV vaccination status because limiting the analysis to those with all three doses could misclassify participants who were currently within the active series window (ie, between 1 and 3 doses).

Our index (comparison) measures were adult proxy recall and household immunization records. During the interview, the adult proxy was asked whether a written record of the adolescent's immunization history is available [29] (ie, household immunization record). For eligible females without household immunization records available, adult proxy recall was defined as the HPV vaccination status based on the adult proxy's memory of whether the eligible female received at least one dose of the bivalent or quadrivalent HPV vaccine [29]. Otherwise, household immunization records were defined as the HPV vaccination status (bivalent or quadrivalent vaccine) based on the adult proxy's direct reading of the immunization records maintained by the family [29].

Table 1
Characteristics of the study population with adequate provider data by proxy recall and household immunization record groups in the 2010 United states national immunization Survey-Teen*

Characteristic	Adult proxy recall (n = 6868), n (%)	Household immunization record (n = 2216) n (%)
Adolescent's age (yrs)		
13	1382 (20.1)	460 (20.8)
14	1430 (20.8)	436 (19.7)
15	1404 (20.4)	444 (20.0)
16	1388 (20.2)	484 (21.8)
17	1264 (18.4)	392 (17.7)
Adolescent's race/ethnicity		
Non-Hispanic white	4608 (67.1)	1631 (73.6)
Non-Hispanic black	808 (11.8)	136 (6.14)
Hispanic	891 (13.0)	275 (12.4)
Other	561 (8.17)	174 (7.85)
Proxy respondent		
Mother or female guardian	5433 (79.1)	1934 (87.3)
Father or male guardian	1086 (15.8)	231 (10.4)
Other	349 (5.08)	50 (2.26)
Maternal age (yrs)		
≤34	541 (7.88)	111 (5.01)
35–44	2880 (41.9)	825 (37.2)
≥45	3447 (50.2)	1280 (57.8)
Maternal marital status		
Currently married	5051 (73.5)	1839 (83.0)
Not currently married†	1817 (26.5)	377 (17.0)
Maternal education		
Did not graduate high school	674 (9.81)	150 (6.77)
High school graduate or some college	3488 (50.8)	965 (43.6)
College graduate or higher	2706 (39.4)	1101 (49.7)

* Unweighted frequencies.
† Mother never married, divorced, separated, widowed, or deceased.

Data analysis

We reported descriptive characteristics of the study population as proportions. We assessed the accuracy of HPV vaccination status based on adult proxy recall and household immunization records by estimating the sensitivity and specificity with provider-reported HPV vaccination status as the reference standard. Sensitivity and specificity are more relevant than predictive values for assessing how accurately a measure (or test) reflects the true status [30], which was consistent with our objective. Overall and stratum-specific sensitivity, specificity, and corresponding 95% confidence limits (CL) were computed using standard formulas [30] while accounting for the complex survey design and population weights using STATA version 12 (STATA Corp, College Station, TX). The a priori characteristics potentially related to reporting accuracy that we selected were proxy respondent, race/ethnicity, maternal age, maternal marital status, and maternal education.

Results

Our unweighted study population comprised 6868 females for whom adult proxy recall with adequate provider data were available and 2216 females for whom household immunization records with adequate provider data were available. Table 1 describes the characteristics of the study population. Briefly, racial/ethnic minorities comprised approximately 26% and 33% of the adult proxy recall group and household immunization records group, respectively. Mothers were the main proxy respondents for both the adult proxy recall group (79%) and household immunization records group (87%). The majority of mothers of adolescents in our study population were 35 years or older (adult proxy recall, 92%; household immunization record, 95%) and currently married (adult proxy recall, 74%; household immunization record, 83%). The