Sexual Activity–Related Outcomes After Human Papillomavirus Vaccination of 11- to 12-Year-Olds

WHAT'S KNOWN ON THIS SUBJECT: Concerns persist about sexual disinhibition after human papillomavirus (HPV) vaccination of preteenage girls. Self-reported surveys have indicated few anticipated behavior changes after HPV vaccination. Little is known about sexual activity–related clinical outcomes after HPV vaccination.

WHAT THIS STUDY ADDS: Utilizing managed care organization electronic data, we evaluated the incidence of adverse outcomes of sexual activity among vaccinated preteenage girls and found little difference between those who received HPV vaccine and those who did not.

abstract

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OBJECTIVE: Previous surveys on hypothesized sexual activity changes after human papillomavirus (HPV) vaccination may be subject to self-response biases. To date, no studies measured clinical markers of sexual activity after HPV vaccination. This study evaluated sexual activity–related clinical outcomes after adolescent vaccination.

METHODS: We conducted a retrospective cohort study utilizing longitudinal electronic data from a large managed care organization. Girls enrolled in the managed care organization, aged 11 through 12 years between July 2006 and December 2007, were classified by adolescent vaccine (HPV; tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed; quadrivalent meningococcal conjugate) receipt. Outcomes (pregnancy/sexually transmitted infection testing or diagnosis; contraceptive counseling) were assessed through December 31, 2010, providing up to 3 years of follow-up. Incidence rate ratios comparing vaccination categories were estimated with multivariate Poisson regression, adjusting for health care–seeking behavior and demographic characteristics.

RESULTS: The cohort included 1398 girls (493 HPV vaccine–exposed; 905 HPV vaccine–unexposed). Risk of the composite outcome (any pregnancy/sexually transmitted infection testing or diagnosis or contraceptive counseling) was not significantly elevated in HPV vaccine–exposed girls relative to HPV vaccine–unexposed girls (adjusted incidence rate ratio: 1.29, 95% confidence interval [CI]: 0.92 to1.80; incidence rate difference: 1.6/100 person-years; 95% CI: −0.03 to 3.24). Incidence rate difference for Chlamydia infection (0.06/100 person-years [95% CI: −0.30 to 0.18]) and pregnancy diagnoses (0.07/100 person-years [95% CI: −0.20 to 0.35]), indicating little clinically meaningful absolute risk differences.

CONCLUSIONS: HPV vaccination in the recommended ages was not associated with increased sexual activity–related outcome rates. *Pediatrics* 2012;130:798–805

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KEY WORDS

human papillomavirus, vaccine, sexual activity, disinhibition

ABBREVIATIONS

CI—confidence interval
HPV—human papillomavirus
ICD-9—*International Classification of Diseases, Ninth Revision*
IRD—incidence rate difference
IRR—incidence rate ratio
MCO—managed care organization
MCV4—quadrivalent meningococcal conjugate vaccine
r^2—bivariate correlation coefficient
STI—sexually transmitted infection
Tdap—tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed
VD-NOS—venereal disease, not otherwise specified

All authors are responsible for the reported research. Dr Bednarczyk conceptualized and designed the study, conducted the analysis of and interpreted the data, drafted the initial article and approved the final article as submitted; Dr Davis participated in the conceptualization and design of the study, participated in the analysis and interpretation of the data, reviewed and revised the article, and approved the final article as submitted; Dr Ault participated in the conceptualization and design of the study, participated in the interpretation of the data, reviewed and revised the article, and approved the final article as submitted; Dr Orenstein participated in the design of the study, participated in the interpretation of the data, reviewed and revised the article, and approved the final article as submitted; and Dr Omer participated in the conceptualization and design of the study, participated in the analysis and interpretation of the data, reviewed and revised the article, and approved the final article as submitted.

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In 2006, the Advisory Committee on Immunization Practices recommended that all US girls aged 11 to 12 receive the human papillomavirus (HPV) vaccine, with catch-up vaccination recommended through age 26, and administration permitted as young as 9 years.[1] The recommendation for preteenage girls to be vaccinated against a sexually transmitted infection (STI) is based on the need to develop immunity before HPV exposure.

Early onset of sexual activity and multiple sexual partners are risk factors for HPV infection.[1] Rates of adolescent sexual activity among 15- to 17-year-olds have declined in recent years,[2] from 39% in 1995% to 27% between 2006 and 2010. Nearly half of sexually active girls reported >2 sexual partners.[3] Additionally, ~3% of high school girls report initiating sexual activity before age 13.[4] This early initiation of sexual activity is accompanied by a high prevalence of adolescent genital HPV infection, with 33% of 14- to 19-year-olds infected with at least 1 HPV strain,[5] and 12% infected with 1 of the 4 quadrivalent vaccine strains.[6]

Nationally, HPV vaccine 3-dose series initiation among 13- to 17-year-old girls increased from 25% in 2007% to 49% in 2010. The HPV vaccine coverage is lower than the uptake of other recently recommended adolescent vaccines among 13- to 17-year-old girls and boys, such as the combination tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed (Tdap) vaccine (69% in 2010) and quadrivalent meningococcal conjugate vaccine (MCV4, 63% in 2010).[7] Recommendations for Tdap and MCV4 vaccination were approved <18 months before the HPV vaccination recommendation.[1,8,9] Barriers to HPV vaccination exist at the structural (cost, multidose series, physicians not encouraging vaccination) and individual (concerns about vaccine safety and fear of needles) levels.[7,10–12]

A frequently discussed concern, both in peer-reviewed literature and mass media, about vaccinating preteenage girls against HPV is that vaccination against an STI could lead to increased promiscuity through risk compensation or behavioral disinhibition.[13–18] Most teenage girls surveyed on knowledge, attitudes, and practices related to HPV vaccination reported they would not modify their sexual behaviors after HPV vaccination.[15,19–25] Most of these studies were limited by the use of self-reported, cross-sectional surveys,[15,19–25] however, and it is unknown if these survey results would directly translate to clinical outcomes.

To date, there has been no evaluation of changes in sexual activity–related outcomes after HPV vaccination that avoids the risk of response bias that may occur in sexual activity surveys.[26–28] In this study, we directly examined sexual activity–related outcomes (ie, STI or pregnancy testing or diagnosis, or counseling on contraceptives) among girls enrolled in Kaiser Permanente Georgia, a large managed care organization (MCO) in the metropolitan Atlanta area. Specifically, we evaluated girls in the recommended age range for HPV vaccination (11–12 years) during its first 18 months of availability, with up to 3 years of follow-up to identify outcomes. We sought to test the hypothesis of a clinically meaningful increase (alternative hypothesis incidence rate ratio [IRR] of 1.5) in rates of testing or diagnosis for pregnancy or STIs or physician counseling on contraceptives after receipt of HPV vaccine in this age range.

METHODS

Data on health plan enrollment, vaccination history, and sexual activity–related outcomes of interest (ie, STI, pregnancy testing or diagnosis, or counseling on hormonal contraception) were obtained from clinical/administrative and laboratory databases maintained by the MCO. The cohort comprised girls who had the opportunity to receive the HPV vaccine within the recommended age range (11–12 years) between July 1, 2006 and December 31, 2007, with follow-up for outcomes through December 31, 2010. These time frames were selected to allow up to 3 years of follow-up while increasing homogeneity of the cohort by including girls receiving vaccines only during the prespecified window. Restricting eligibility to girls in the recommended ages for vaccination was done to minimize issues of confounding by indication related to sexually active girls potentially being more likely to seek HPV vaccination, by focusing on girls who were less likely to have already initiated sexual activity.

Girls born between July 2, 1993 and December 31, 1996 and enrolled in the MCO as of July 1, 2006 were identified. Girls were excluded from analysis if they: (1) disenrolled from the MCO before December 31, 2007; (2) received adolescent vaccines of interest after December 31, 2007 or before recommendations for use in the United States (HPV vaccine: July 2006; MCV4: January 2005; Tdap: May 2005); (3) were either <11 years or ≥13 years old when vaccinated; (4) had a history of any outcome of interest on or before December 31, 2007; and (5) did not receive any adolescent vaccines during the study period.

Girls were considered HPV vaccine–exposed if they received at least 1 dose of HPV vaccine, regardless of receipt of any other adolescent vaccine, and HPV vaccine–unexposed if they received any doses of Tdap and/or MCV4 in the absence of HPV vaccination. For the final cohort, follow-up for outcomes began on a common date, January 1, 2008. Person-time at risk began accruing on this date and ended at the first of either (1) the date of incident outcome, (2) MCO disenrollment date, or (3) December 31, 2010. The age at vaccination of interest was the age at

receipt of the first dose of HPV vaccine for HPV vaccine–exposed girls and the earliest of the date(s) of first Tdap or MCV4 vaccine(s) for HPV vaccine–unexposed girls.

Data on outcomes occurring through December 31, 2010 were obtained using *International Classification of Diseases, Ninth Revision* (ICD-9) and *Current Procedural Terminology* codes for pregnancy or *Chlamydia trachomatis* testing; diagnoses of pregnancy, *C. trachomatis*, trichomoniasis, cervicitis or unspecified STI; or physician counseling about contraceptives. Outcomes of trichomoniasis, cervicitis, or unspecified STI were grouped into the single outcome of venereal disease, not otherwise specified (VD-NOS). Because hormonal contraceptive medications can be prescribed for medical conditions other than birth control (eg, dysmenorrhea or acne), we excluded contraceptive counseling with previous or concomitant dysmenorrhea or acne diagnoses from the category of contraceptive outcomes; other outcomes that these girls may have had at different medical encounters were retained for analysis. For girls with ICD-9 or *Current Procedural Terminology* testing codes in their records without a corresponding diagnosis code (eg, V74.5, Screening examination for venereal disease), we consulted laboratory test records to confirm diagnoses of interest. To assess baseline health care–seeking behaviors, we counted the number of all-cause medical encounters in the year before the vaccination of interest.

We used 2 main outcome definitions. The first ("Testing/Diagnosis/Counseling") incorporated medical outcomes relating to sexual activity and includes any occurrence of testing for *C. trachomatis* or pregnancy; diagnoses of *C. trachomatis* infection, pregnancy, or VD-NOS; and physician counseling on contraceptives. The second ("Diagnosis Only") includes any occurrence of diagnostic outcomes for *C. trachomatis* infection, pregnancy, or VD-NOS, to capture actual STI or pregnancy findings. Incidence of these composite outcomes was defined as the first occurrence of any of the component findings, and the age at incident outcome was the age at the first component finding. Secondary analysis examined each component separately. Recurrent findings of the same outcome were not considered, although a girl could be positive for multiple different outcomes.

Incidence counts and total person-time at risk were calculated for each outcome. IRRs comparing HPV vaccine–exposed to unexposed girls were computed with multivariate Poisson regression, by using the log of person-years at risk as the offset variable, with a robust error variance to account for overdispersion in the Poisson model. Models for more common outcomes (Testing/Diagnosis/Counseling, *C. trachomatis* testing, pregnancy testing, and contraception counseling) were adjusted for health care–seeking behavior in the previous year, age at vaccination, race, and census tract–level socioeconomic status (proportions of residents living at or above the poverty line and with at least a high school diploma or equivalent). Socioeconomic status data were obtained from the 2009 American Community Survey 5-year estimates.[29] Models for less common outcomes were adjusted for health care–seeking behavior and age at vaccination (pregnancy, *C. trachomatis*) or health care–seeking behavior only (VD-NOS). Unadjusted incidence rate differences (IRDs) were computed. Age at incident outcome was compared by vaccine exposure by using Student's *t* test.

Sample size and power calculations were performed to determine if this analysis would be sufficiently powered for the Testing/Diagnosis/Counseling outcome. Using a Poisson regression framework, for 35% HPV vaccine coverage in an anticipated adolescent population of 1400, a control group incidence of 5/100 person-years over 3 years of follow-up and potential bivariate correlation coefficient (r^2) between modeled covariates to be 0.00, the study had 83% power to detect an IRR of 1.5. With a potential r^2 of 0.05 between modeled covariates to be 0.05, the study had 81% power to detect an IRR of 1.5. In the final analysis, the r^2 between exposure and modeled covariates was 0.06, which corresponds to a power of 80%.

All analyses were conducted by using SAS (version 9.2; SAS Institute Inc, Cary, NC), at a significance level of $\alpha = .05$. This study was approved by the MCO's institutional review board.

RESULTS

A total of 6795 girls met the initial birth date criteria and were enrolled in the MCO on July 1, 2006. After applying the exclusion criteria, 5393 girls were excluded from the final analysis (1874 disenrolled from the MCO before December 31, 2007; 1817 received vaccine [s] of interest on or after age 13; 678 received vaccine[s] of interest after December 31, 2007; 66 received vaccine [s] of interest before their 11th birthday or vaccine recommendation; 23 had an incident outcome on or before December 31, 2007; and 939 did not receive any adolescent vaccines). Hence, the analysis cohort included 1398 girls.

In this cohort, nearly all girls received either Tdap (93%) or MCV4 (91%), whereas 35% initiated the HPV vaccine series. Exposure classification for analysis resulted in 493 HPV vaccine–exposed girls and 905 HPV vaccine–unexposed girls (Fig 1). Nearly all (474/493) HPV vaccine–exposed girls received at least 1 of the comparison vaccines (Fig 1). The age at vaccination of interest was higher for HPV vaccine–exposed girls than unexposed girls (11.9 years versus 11.6 years, respectively, $P < .001$). HPV vaccine–exposed girls had more

all-cause medical encounters in the previous year than HPV vaccine–unexposed girls (mean: 2.6 vs 2.1; $P = .024$). HPV vaccine uptake was more common in white girls than in those who were African American. Census tract–level socioeconomic status measures were similar across vaccination groups (Table 1).

The Testing/Diagnosis/Counseling outcome was more common than the Diagnosis-Only outcome ($n = 137$, 9.8%, and $n = 8$, 0.6%, respectively). There were 107 girls tested for pregnancy and 55 tested for *C. trachomatis*, but only 4 pregnancies and 4 *C. trachomatis* infections (Table 2).

Girls receiving HPV vaccine did not have a significantly higher incidence rate of Testing/Diagnosis/Counseling (5.5/100 person-years; adjusted IRR: 1.29; 95% CI: 0.92 to 1.80) compared with the HPV vaccine–unexposed group (3.9/100 person-years; IRD: 1.6/100 person-years; 95% CI: −0.03 to 3.24) (Table 2).

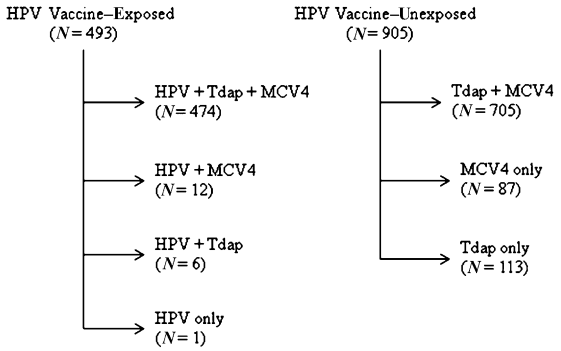

FIGURE 1
Receipt of HPV, MCV4, or Tdap vaccines by adolescent girls in a large MCO, highlighting the frequent receipt of >1 type of vaccine.

TABLE 1 Uptake of Routinely Recommended Adolescent Vaccines and Baseline Health Care–Seeking Behavior Among 11- to 12-Year-Old Girls in a Large MCO, Between July 1, 2006 and December 31, 2007

	HPV Vaccine–Exposed ($N = 493$)	HPV Vaccine–Unexposed ($N = 905$)	*P*
Age at vaccination			
Age at vaccination of interest, y; mean (SD)[a]	11.9 (0.60)	11.6 (0.51)	<.001
Received vaccination of interest when 11 y old, *N* (%)[a]	272 (55.2)	697 (77.0)	<.001
Health care–seeking behavior			
All-cause medical encounters in year before vaccination of interest, mean (SD)[a]	2.6 (3.9)	2.1 (3.3)	.024
Had 0 all-cause medical encounters in year before vaccination of interest, *N* (%)[a]	104 (21.1)	269 (29.7)	<.002
Race			
White, *N* (%)	189 (38.3)	235 (26.0)	<.001
Black, *N* (%)	159 (32.3)	389 (43.0)	
Other, *N* (%)	35 (7.1)	52 (5.8)	
Unknown	110 (22.3)	231 (25.3)	
Socioeconomic status[b,c]			
Percent of population living at or above poverty level, mean (SD)	87.5 (10.1)	87.2 (8.9)	.579
Percent of population with at least a high school diploma or equivalent, mean (SD)	87.0 (8.8)	87.1 (8.2)	.708
Length of enrollment			
Years enrolled from January 1, 2008; mean (SD)	2.3 (0.82)	2.2 (0.90)	.028

[a] For HPV vaccine–exposed, the age at first HPV vaccine dose; for HPV vaccine–unexposed, the earliest age at either first Tdap and/or MCV4 dose.
[b] As estimated from census tract–level data obtained from 2009 American Community Survey 5-y estimates.
[c] Socioeconomic status data missing for 2 HPV vaccine–exposed girls and 5 HPV vaccine–unexposed girls.

The Diagnosis-Only incidence rate was low (0.26/100 person-years in the HPV vaccine–exposed group versus 0.25/100 person-years in the HPV vaccine–unexposed group; adjusted IRR: 1.11; 95% CI: 0.26 to 4.64) (Table 2). The mean age at first Testing/Diagnosis/Counseling outcome for HPV vaccine–exposed girls (14.4 years) was similar to that of the unexposed group (14.6 years, $P = .33$). A similar pattern in age at first diagnostic outcome was observed (HPV vaccine–exposed: 14.8 years; HPV vaccine–unexposed: 14.6 years; $P = .82$) (Fig 2).

Incidence rates, IRR, and IRD estimates for each of 6 individual secondary outcomes (*C. trachomatis* testing and diagnosis, pregnancy testing and diagnosis, VD-NOS diagnosis, and contraceptive counseling) are presented in Table 2. No significantly increased IRRs were estimated for individual outcomes comparing HPV vaccine–exposed and unexposed girls. The unadjusted IRD for counseling on contraceptive use was slightly higher in HPV vaccine–exposed girls (0.90/100 person-years, 95% CI: 0.15 to 1.65), although the adjusted IRR was not significantly elevated (2.31, 95% CI: 0.99 to 5.38) (Table 2).

DISCUSSION

We present the first evaluation of sexual activity–related outcomes after adolescent HPV vaccination in the recommended age range of 11 to 12 years to use clinical outcomes and show that receipt of HPV vaccine is not associated with an increased rate of sexual activity–related outcomes. This study's results are not limited by the use of self-reported surveys,[26,27] and instead use administrative data from a large MCO. This study provides a clinical validation and extends our understanding of numerous surveys reporting that most young women did not plan to modify their sexual behaviors after HPV vaccination.[15,19–25] Although most previous surveys have been cross-sectional, a

TABLE 2 Incidence Rates and Unadjusted and Adjusted IRRs for Sexual Activity–Related Outcomes After Receipt of Routinely Recommended Adolescent Vaccines Among 11- to 12-Year-Old Girls in a Large MCO, Between January 1, 2008 and December 31, 2010

Outcome	HPV Vaccine–Exposed, *N* = 493			HPV Vaccine–Unexposed, *N* = 905			HPV Vaccine–Exposed Versus HPV Vaccine–Unexposed	
	N per Person-Years	IR	% Without Outcome	*N* per Person-Years	IR	% Without Outcome	aIRR (95% CI)	IR Difference (95% CI)
Testing/Diagnosis/Counseling	61/1106.2	5.51	87.63	76/1944.1	3.91	91.6	1.29 (0.92 to 1.80)	1.61 (−0.03 to 3.24)
Diagnosis Only	3/1155.0	0.26	99.39	5/2020.4	0.25	99.45	1.11 (0.26 to 4.64)	0.01 (−0.35 to 0.38)
Chlamydia testing	25/1138.8	2.20	94.93	30/1997.9	1.50	96.69	1.28 (0.74 to 2.22)	0.69 (−0.32 to 1.71)
Chlamydia diagnosis	1/1155.4	0.09	99.8	3/2023.4	0.15	99.67	0.68 (0.06 to 7.71)	−0.06 (−0.30 to 0.18)
Pregnancy testing	48/1111.6	4.32	90.26	59/1956.7	3.02	93.48	1.28 (0.88 to 1.85)	1.30 (−0.14 to 2.75)
Pregnancy diagnosis	2/1156.1	0.17	99.59	2/2024.3	0.10	99.78	1.89 (0.33 to 10.79)	0.07 (−0.20 to 0.35)
VD-NOS diagnosis	1/1155.8	0.09	99.8	2/2023.3	0.10	99.78	0.90 (0.09 to 9.07)	−0.01 (−0.23 to 0.21)
Counseling on contraceptives	16/1147.1	1.39	96.75	10/2015.0	0.50	98.9	2.31 (0.99 to 5.38)	0.90 (0.15 to 1.65)

The following outcomes were adjusted for health care–seeking behavior in the previous year, age at vaccination of interest, race, and socioeconomic status: Testing/Diagnosis/Counseling, Chlamydia testing, pregnancy testing, and counseling on contraceptives. The following outcomes were adjusted for health care seeking in the previous year and age at vaccination of interest: Diagnosis Only, Chlamydia diagnosis, and pregnancy diagnosis. The VD-NOS diagnosis outcome was adjusted only for health care seeking in the previous year. Some girls may have had >1 type of testing performed or >1 type of diagnosis. The summary outcomes (Testing/Diagnosis/Counseling and Diagnosis Only) only address the occurrence of any component finding, so the total outcomes for individual components may not add up to the values observed for the summary outcomes. aIRR, adjusted incidence rate ratio; IR, incidence rate (per 100 person-years).

recent longitudinal survey conducted in the United Kingdom documented no difference in the proportion of women reporting initiation of sexual activity after HPV vaccination[30]; however, that study was conducted in women aged 16 to 18, of whom 37% had already become sexually active.[30] In our analysis, HPV vaccination at ages 11 through 12 did not increase the likelihood of seeking medical attention for outcomes related to sexual activity with up to 3 years of follow-up. This study was designed with sufficient power to detect a meaningful difference in the main outcome by HPV vaccine exposure, so the probability of type II error was relatively low.

Similarities in the age at first outcome by vaccination category indicate that there may not be any earlier onset of sexual activity after HPV vaccination. It is likely that any disinhibition or risk compensation would occur closer to the time of vaccination (ie, within 18 months) rather than much later. If HPV vaccination was "a license for sex,"[31] we would have expected to see more adverse outcomes shortly after vaccination, when the girls were more aware of their recent vaccination status. These findings are predicated on the assumption that adverse outcomes after initiation of sexual activity would be followed by health care seeking; within this framework, we are unable to identify girls who initiated sexual activity and did not seek reproductive health care.

Recently, Liddon et al[22] reported that more than a quarter of young women may overestimate the scope of protection of the HPV vaccine, extending it to other STIs. Women in that study were older than girls in this cohort, and there may be age-related differences in education about, or understanding of, the effect of HPV vaccination. Additionally, that study documented no difference in self-reported sexual activity between girls who did and did not receive the HPV

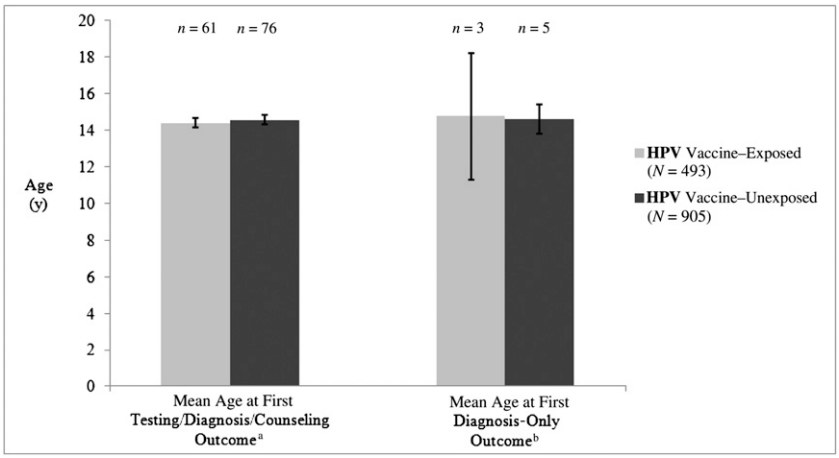

FIGURE 2

Mean ages at first Testing/Diagnosis/Counseling and Diagnosis-Only outcomes among adolescent girls who received ≥1 adolescent vaccine in a large MCO. Error bars represent 95% CIs for the mean. [a] *t* test $P = .325$; [b] *t* test $P = .818$.

vaccine, and an increasedlikelihood of condom use among HPV-vaccinated girls, possibly indicating a greater understanding of reproductive health and prevention.[22] A recent study from Australia supports this finding, with HPV-vaccinated women aged 18 to 30 equally likely to be sexually active than nonvaccinated women, with vaccinated women holding stronger attitudes toward safer sexual behaviors, although there was no difference in condom use by vaccination group.[32] Our finding of slightly, but not significantly, increased contraceptive counseling among HPV vaccine–exposed girls supports this previous finding regarding contraception use, and may actually have a positive impact on adolescent preventive health services by establishing a long-term relationship between these girls and their physician. The administrative data used for this study did not provide an opportunity to do a detailed examination of the reasons for this counseling or of the extent of hormonal contraceptive use among girls in this cohort.

We attempted to address issues of confounding by indication related to sexually active girls potentially being more likely to seek HPV vaccination by restricting the analysis to younger girls who are less likely to already be sexually active. Additionally, most health care decisions for girls age 11 through 12 are made by parents or guardians,[33] and it is not likely that perceptions of sexuality led at these ages to the decision to receive the HPV vaccine. If this type of confounding by indication were present, it would result in an overestimation of risk of sexual activity–related outcomes; the lack of significant associations in the presence of potential overestimation further supports our findings.

We identified differences in baseline health care–seeking behavior in the year before receipt of the vaccine of interest. HPV vaccine–exposed girls were more likely to have had any all-cause medical encounters in this period than HPV vaccine–unexposed girls. Although we adjusted for this difference in health care–seeking behavior in the multivariate regression analysis, there may still be differences between these groups with respect to health care–seeking behaviors, particularly with the need for receipt of 3 doses of HPV vaccine. This increased exposure to health care providers presents more opportunities for medical counseling and evaluation through the adolescent and young adult period.[34]

This study has some limitations. First, the study was conducted by using a retrospective analysis of administrative data. Although the MCO captures all medical encounters within their practices, some girls may have received vaccines in outside clinics (eg, school-located vaccination clinics) or received reproductive health care outside of the MCO (eg, at independent reproductive health centers). Second, the use of this type of data precludes an assessment of motivations for care; because most outcomes were coded by using ICD-9 codes specifying screening, we could not determine if these tests were part of standard clinical practice or if they were due to presenting complaints related to sexual activity. Third, our population was restricted in terms of age at vaccine uptake, which may limit our ability to generalize outside of this age range. Further analysis with wider time frames and age ranges is needed to examine adolescent vaccination and reproductive health care practices among other segments of the adolescent population. Fourth, as our analysis was powered to address the most sensitive outcome (Testing/Diagnosis/Counseling), the low incidence of pregnancy or STI diagnoses in this cohort resulted in imprecise IRR estimates for these outcomes. More precise estimates for these individual diagnoses will need additional, future analyses. Finally, there is the possibility of confounding on the part of the physicians (eg, physicians who are more likely to administer HPV vaccine may be more likely to initiate conversations about contraception or conduct more routine screening pregnancy or STI-screening tests). We were unable to examine any potential clustering of outcomes by specific providers of practice offices within the MCO.

CONCLUSIONS

Receipt of HPV vaccine by 11- to 12-year-old girls was not associated with clinical markers of increased sexual activity–related outcomes, such as sexually transmitted diseases or pregnancy.

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