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Short communication

Prevalence of oral human papillomavirus by vaccination status among young adults (18–30 years old)

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ABSTRACT

Background: Although there is evidence that human papillomavirus (HPV) vaccination may protect against oral HPV infection, no current research has demonstrated this in the general population.
Methods: We used repeated cross-sectional data from the National Health and Nutrition Examination Survey (NHANES) between 2009 and 2014. Participants 18–30 years who indicated whether they had received the HPV vaccine and provided an adequate oral sample were included (N = 3040). Oral HPV types were grouped by vaccine-type (types 6, 11, 16, 18) and by risk (high or low risk). Chi-square analyses compared oral HPV prevalence by vaccination status.
Results: Vaccinated adults had a lower prevalence of vaccine-type oral HPV (types 6, 11, 16, 18) compared to unvaccinated adults. Prevalence of non-vaccine high-risk oral HPV was similar between HPV vaccinated and unvaccinated participants.
Conclusions: HPV vaccination appears to provide protection against vaccine-type oral HPV infection among males and females in the general population.

1. Introduction

High-risk oral human papillomaviruses (HPV), particularly type 16, are responsible for some head and neck squamous cell carcinoma cancers, most notably in the oropharynx [1,2]. In fact, the prevalence of HPV-related cancers has increased from 16% of all oropharyngeal squamous cell carcinoma cancers (OPSCC) in the 1980s to >70% in the 2000s [3]. HPV-positive OPSCC incidence is increasing, and may exceed cervical cancer incidence by 2020, which provides impetus for prevention of this disease [3]. The HPV vaccine was recommended for primary prevention of HPV-related anogenital cancers for females in early 2007 and for males in 2011 by the Advisory Committee on Immunization Practices (ACIP) [4,5]. While HPV vaccination is expected to reduce oral HPV-related cancers due to reduction in circulation of the most common high-risk types of the virus [6], it is unclear whether the vaccine will provide direct primary protection in the general population. Evidence indicates that the vaccine produces an immune response in the oral cavity, but it is not known whether this is adequate to prevent infection with vaccine-type HPV [7]. The purpose of this investigation is to compare the prevalence of vaccine-type HPV between vaccinated and unvaccinated young adults who participated in the 2009–2014 cycles of the National Health and Nutrition Examination Survey (NHANES).

2. Methods

Three cycles of the nationally representative repeated cross-sectional survey called NHANES dataset were examined, using data from household surveys and medical exams conducted 2009–2014. All participants (18–30 years old) that responded to a question about whether they had received the HPV vaccine and had an oral sample collected were included if their samples were considered adequate for analysis. The oral sample collection and procedures are published elsewhere [8]. Briefly, the oral sample consisted of a 30-s oral gargle and rinse with either Scope or saline. Samples were examined to determine whether they were sufficient for analyses, and 37 HPV DNA types were evaluated using the

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Table 1
Oral HPV Prevalence among 18–30 year olds by HPV vaccination status, NHANES 2009–2014 (N = 3040).

	Vaccinated (n = 668)			Unvaccinated (n = 2372)			
	Freq.[a]	Prevalence (w%)[a]	95%CI[a]	Freq.[a]	Prevalence (w%)[a]	95% CI[a]	p-value
Any High-risk	20	1.99	1.25–3.16	83	3.52	2.49–4.96	**0.04**
HPV16	1	0.09[b]	0.01–0.69	18	0.84[b]	0.45–1.55	**0.01**
HPV18	1	0.07[b]	0.01–0.50	6	0.29[b]	0.11–0.75	0.15
HPV26	0	0	NA	1	0.03[b]	0.004–0.23	NA
HPV31	0	0	NA	1	0.02[b]	0.003–0.17	NA
HPV33	0	0	NA	0	0	NA	NA
HPV35	1	0.04[b]	0.01–0.30	4	0.21[b]	0.05–0.83	0.27
HPV39	3	0.30[b]	0.05–1.60	5	0.25[b]	0.08–0.79	0.88
HPV45	2	0.13[b]	0.03–0.58	3	0.21[b]	0.06–0.72	0.62
HPV51	0	0	NA	12	0.57[b]	0.24–1.34	NA
HPV52	1	0.13[b]	0.02–0.96	3	0.19[b]	0.04–1.00	0.76
HPV53	1	0.05[b]	0.01–0.40	8	0.18[b]	0.09–0.37	0.15
HPV56	1	0.11[b]	0.01–0.83	6	0.27[b]	0.11–0.71	0.35
HPV58	1	0.10[b]	0.01–0.71	3	0.10[b]	0.03–0.31	0.97
HPV59	6	0.79[b]	0.37–1.66	12	0.40[b]	0.22–0.75	0.23
HPV66	3	0.21[b]	0.06–0.75	10	0.35[b]	0.18–0.69	0.43
HPV68	1	0.08[b]	0.01–0.63	2	0.04[b]	0.01–0.17	0.60
HPV73	1	0.13[b]	0.02–0.99	3	0.16[b]	0.04–0.57	0.88
HPV82	0	0	NA	1	0.08[b]	0.01–0.59	NA
Low-risk types	20	2.65	1.52–4.58	72	2.82	2.16–3.67	0.84
HPV06	0	0	NA	8	0.39[b]	0.15–1.01	NA
HPV11	0	0	NA	1	0.04[b]	0.01–0.32	NA
HPV40	0	0	NA	0	0	NA	NA
HPV42	0	0	NA	5	0.23[b]	0.08–0.63	NA
HPV54	1	0.27[b]	0.04–1.92	0	0	NA	NA
HPV55	5	0.51[b]	0.19–1.31	18	0.67	0.39–1.13	0.50
HPV61	1	0.05[b]	0.01–0.36	6	0.20[b]	0.07–0.56	0.20
HPV62	1	0.10[b]	0.01–0.71	8	0.22[b]	0.11–0.44	0.33
HPV67	0	0	NA	2	0.06[b]	0.01–0.25	NA
HPV69	1	0.06[b]	0.01–0.49	2	0.04[b]	0.01–0.20	0.72
HPV70	0	0	NA	0	0	NA	NA
HPV71	0	0	NA	0	0	NA	NA
HPV72	2	0.16[b]	0.04–0.68	4	0.13[b]	0.05–0.37	0.83
HPV81	0	0	NA	4	0.21[b]	0.07–0.65	NA
HPV83	0	0	NA	2	0.14[b]	0.03–0.80	NA
HPV84	8	1.37[b]	0.53–3.52	9	0.36[b]	0.16–0.80	0.15
HPV89	2	0.20[b]	0.04–0.96	7	0.24[b]	0.10–0.55	0.83
Any type of HPV	38	4.47	3.34–6.00	140	5.88	4.48–7.68	0.18
HPV16/18	2	0.16[b]	0.04–0.68	23	1.03	0.60–1.77	**0.006**
HPV06/11	0	0	NA	9	0.44[b]	0.18–1.04	NA
4 valent vaccine-type HPV (6,11,16,18)	2	0.16[b]	0.04–0.68	32	1.47	0.93–2.32	**<0.001**
Nonvaccine type HPV	36	4.31	3.12–5.94	117	4.76	3.53–6.41	0.64
Nonvaccine low-risk	20	2.65	1.52–4.58	64	2.43	1.75–3.35	0.78
Nonvaccine high-risk	18	1.83	1.14–2.93	65	2.70	1.88–3.88	0.16
9 valent vaccine-type HPV (6,11,16,18,31, 33, 45, 52, 58)	6	0.52[b]	0.22–1.21	40	1.80	1.15–2.81	**0.001**

HPV type 64 and subtype IS39 HPV-82 were not detected in these samples.
w% = weighted percent, Freq. = frequency.
Bolded p-values indicate a significance of $p < 0.05$.
[a] All data were weighted, and %s and 95% confidence intervals (95% CI) were estimated using the weighted data. Percentages may not add up to 100% due to weighting.
[b] Estimates with a relative standard error (RSE) of >30%.

Roche Linear Array HPV Genotyping Test and Roche Linear Array Detection Kit. For our analyses, only females were included in the 2009–2010 cycle, while both males and females were included in 2011–2012 and 2013–2014 cycles. We conducted a sensitivity analysis which included males (all considered unvaccinated, as vaccine data were unavailable) from the 2009–2010 cycle to determine whether the results would differ with their inclusion. Due to differences in when the HPV vaccine was available to males, information about HPV vaccination data were not collected for that group until 2011. However, there is evidence that males were receiving the HPV vaccine before it was recommended [9]. Therefore, we excluded males from the 2009–2010 NHANES cycle to avoid biases that might have resulted from undocumented HPV vaccination. The protocol for this investigation was exempted by the University of Texas Medical Branch Institutional Review Board (IRB).

For this investigation, HPV types were examined individually, as well as grouped according to risk. Eighteen high-risk types consisted of those associated with cervical cancer, while other types were classified as low risk. The same 18 types that were categorized as high-risk in another NHANES study were used so that prevalence could be compared between the 2 studies [10]. Four types that are protected against by the quadrivalent HPV vaccine (types 6, 11, 16, 18) were also grouped and called "vaccine-type." We also included groupings based on the risk type, but excluded vaccine-type HPV from those groups to increase power, and determine whether any observed differences occur in those groups as opposed to vaccine-type groups. Another analysis investigated the difference in HPV types by gender, and examined whether prevalence of oral vaccine-type HPV by gender according to vaccination status. Bivariate analyses were conducted using Rao-Scott chi-square statistics to examine differences in HPV prevalence and behaviors associated with oral HPV-infection by vaccination status using a 2-sided test at alpha<0.05. To examine whether observed differences in HPV could be due to differences in known risk factors as opposed to HPV vaccination, we examined variations