"Gender and Racial/Ethnic Differences in the Timing of Initiating the HPV Vaccine Series"

Introduction

The HPV vaccine is highly effective in protecting against the human papillomavirus (HPV), the most commonly sexually transmitted infection (STI), and HPV-related illnesses. Within six years of the introduction of the vaccine, HPV has decreased by 64 percent among teen girls and 34 percent in young women (Markowitz et al. 2016). The vaccine's effectiveness is dependent on the number and timing of vaccine doses (Harper and DeMars 2017). Because the vaccine protects against new HPV infections and is ineffective in treating established HPV infections and HPV-related illnesses, initiation of the HPV vaccine should occur before the onset of sexual activity to maximize its effectiveness (Chatterjee 2014). Hence, the Advisory Committee on Immunization Practices (ACIP) recommends routine HPV vaccination for adolescents aged 11 to 12 years.[1] These on-time HPV vaccinations induce near-complete protection against HPV for individuals.[2] In other words, on-time vaccinations have the highest protection against HPV and HPV-related illnesses. For individuals who have not yet initiated the vaccine, the ACIP recommends catch-up vaccinations for males aged 13 through 21 and females aged 13 through 26 (Meites et al. 2016). Yet, those who delay initiation may have only partial protection against HPV. In contrast, those who never initiate HPV vaccine uptake will have no protection. Because 50 to 80 percent of HPV infections are transmitted shortly after initiating intercourse for the first time, and because sexually active adolescents have the highest rates of HPV (Collins et al. 2002; Moscicki 2007), targeting young adolescents to initiate on-time vaccinations is crucial in curtailing HPV and HPV-related morbidity and mortality. Despite the vaccine's proven effectiveness, uptake remains strikingly low compared to other vaccines (Holman 2014).

The HPV vaccine's relation to sex may deter higher uptake rates. For example, parents may be apprehensive toward vaccinating young adolescents from a sexually transmitted infection (Charo 2007; Lechuga, Vera-Cala, and Martinez-Donate 2016; Zimmerman 2006). To overcome this apprehension, policy makers and healthcare officials have attempted to desexualize the HPV vaccine by marketing the vaccine as a cervical cancer preventative (Mamo and Epstein 2017; Velan and Yadgar 2017). Yet, these attempts to desexualize the vaccine have gendered a implications for perceiving HPV, HPV-related illness, and the HPV vaccine, and further implications regarding which subject bodies benefit from the vaccine. Most studies on HPV vaccinations have examined the number of vaccine doses (initiation and completion). To date, there has been no study on the timing of initiating the HPV vaccine—never or late, relative to on-time vaccinations—or how differences in timing among populations may be due to gender and race/ethnicity intersecting to affect HPV vaccine uptake. Because multiple axes of social identities are intertwined and mutually constitutive, scholars must examine how social identities jointly and simultaneously influence health outcomes (López and Gadsden 2016). One way of analyzing how multiple social statuses and their intersections shape inequalities is by examining social disparities in health. By uncovering who initiates the HPV vaccine, and when, we can see how gender and/or racial inequalities are reproduced. Examining the timing of initiating HPV vaccine uptake, using an intersectional lens, can shed light on how social inequalities may arise

[1] According to the CDC, adolescents aged 9 and 10 can also receive the HPV vaccine.
[2] If initiating the vaccine before exposure to HPV.

from disparities in HPV vaccinations, as well as provide insight into future disparities likely to result from HPV-related illnesses.

To address these gaps, I examine how gender, race/ethnicity, and their intersections determine age-specific probabilities of initiating HPV vaccinations: on-time, late, or never. Multinomial logistic regression—with on-time vaccination as the base outcome—was used to assess (1) *how age-specific probabilities of initiating HPV vaccinations differs by gender, race/ethnicity, and their intersections* and (2) *if these intersectional differences between gender and race/ethnicity are also explained by socioeconomic status*. I analyze vaccination timing among participants who were in the appropriate age cohorts for on-time vaccination (at age 9 to 12). Data from the 2011-2016 National Health and Nutrition Examination Survey (NHANES) was used to study this relationship. NHANES is the only nationally representative study that asks adolescents and adults, both males and females and several racial/ethnic groups, if they have ever initiated HPV vaccine uptake and, if so, at what age.

Data

This study analyzed individual data from the 2011 to 2012, 2013 to 2014, and 2015 to 2016 National Health and Nutrition Examination Survey (NHANES). NHANES uses a multistage sampling design to create a sample that is representative of non-institutionalized U.S. population. The survey combines interviews and physical examinations to assess the health and nutritional status of children and adults, aged 0 months to 80 years old. NHANES is ideal for this study's analyses because the data are current and includes self-reported sociodemographic indicators. Additionally, beginning in 2011 to 2012, NHANES began asking both males and females from the ages of 9 to 59 whether they have initiated the HPV vaccine series and, if vaccinated, their age at initiation. No other nationally representative survey asks these two HPV questions to both adolescents and adults in one survey.

Analysis

All analyses were conducted using Stata 14.1. Descriptive analyses determined bivariate patterns between the independent and dependent variables. Multinomial logistic regression analyses predicted the likelihood of the timing of initiating HPV vaccine uptake, comparing both never vaccinating and late vaccination to on-time vaccinations as the base outcome. Multinomial logistic regression analysis is the best method to predict the probability of the timing of initiating HPV vaccinations because the dependent variable is nominal and has more than two levels. For Model 1, a multinomial logistic regression was used to predict the timing of initiating HPV vaccinations by gender and race/ethnicity. Next, a two-way interaction was tested in Model 2 to examine whether the joint effect of gender and race/ethnicity influenced the timing of initiating HPV vaccinations. The final model, Model 3, added the mediating variables to Model 2 to examine the extent to which these differences are the result of socioeconomic patterns. NHANES's complex sampling design was factored into the analysis for this study. Specifically, the design oversampled African Americans, Latinx populations, Asian Americans, and low-income white respondents. To produce reliable estimates that are representative and, thus, generalizable to the noninstitutionalized U.S. population, all analyses accounted for complex sampling design using probability and replication weights with the "svy" command available in Stata. To multiply impute data, the mi package in Stata was used to create 20 datasets.

Preliminary Findings

I am currently working on expanding the preliminary findings and refining my analyses. The finalized version of the paper will be posted should the paper be accepted. Descriptive statistics used in the timing of HPV vaccination are displayed in Table 1. Table 2 presents results from imputed and weighted multinomial logistic regression models predicting the odds of initiating HPV vaccinations never and late, relative to on-time vaccinations. There are gender differences in HPV vaccinations in model 1 of Table 2. Generally, relative to on-time vaccinations, males are significantly more likely than females to never initiate the HPV vaccine ($p \leq 0.01$). Specifically, compared to males, females are 35 percent less likely to never vaccinating, compared to on-time vaccinations. Table 1 presents race/ethnicity results from model 1. Surprisingly there were no statistically significant racial/ethnic differences in never vaccinating or late vaccinations, relative to on-time vaccinations. Model 2 introduces the multiplicative interaction term between gender and race/ethnicity, which represents intersectionality. This interaction produced significant results. To better comprehend the interaction effect, this study included two additional multinomial logistic regression disaggregated first by gender, illustrated in Table 3, and then by race/ethnicity for white respondents and Asian Americans, illustrated in Table 4. Results from introducing socioeconomic status variables is illustrated in model 3 of Table 2. Introducing the socioeconomic status variables into the model produced no significant effects.

Table 1. Weighted Means for Timing of Initiating HPV Vaccinations in the U.S.

	Overall (N=6,574)			**Never** (N=4,650)			**On-Time 9 to 12** (N=948)			**Late 13 to 26** (N=976)		**Diff**
Variables	Mean	SE		Means	SE		Means	SE		Means	SE	
Demographics												
Gender												
Male[a]	0.43	0.01		0.78	0.02		0.13	0.01		0.09	0.01	*
Female	0.57	0.01		0.61	0.02		0.16	0.01		0.22	0.01	
Race/Ethnicity												
White[a]	0.55	0.03		0.68	0.02		0.14	0.02		0.18	0.02	*
African American	0.14	0.02		0.66	0.02		0.16	0.02		0.18	0.02	
Latinx	0.22	0.03		0.67	0.01		0.17	0.01		0.16	0.01	
Asian American	0.04	0.01		0.73	0.03		0.10	0.02		0.17	0.03	
Other Race	0.05	0.01		0.79	0.04		0.10	0.02		0.11	0.03	
Socioeconomic Status												
Parental Education												
High School or Less[a]	0.16	0.02		0.67	0.03		0.15	0.01		0.18	0.03	*
High School Graduate	0.16	0.01		0.65	0.02		0.18	0.02		0.17	0.02	
Some College	0.32	0.01		0.69	0.02		0.16	0.02		0.16	0.01	
College Graduate and Above	0.35	0.02		0.70	0.02		0.12	0.01		0.17	0.02	
Family Income												
<$20,000[a]	0.13	0.01		0.66	0.02		0.19	0.02		0.15	0.02	
$20,000 to $44,999	0.26	0.01		0.68	0.02		0.15	0.01		0.17	0.01	
$45,000 to $74,999	0.21	0.01		0.69	0.02		0.15	0.02		0.15	0.02	
$75,00 and Over	0.40	0.02		0.69	0.02		0.13	0.01		0.18	0.02	
Control												
Birth Year	2000.12	0.10		2000.77	0.11		2000.04	0.17		1997.58	0.14	
	SD	7.76		SD	7.36		SD	5.14		SD	4.44	

Source: National Health and Nutrition Examination Survey (2011-2016)

Notes: [a] Reference category. Weighted means account for sample design effects (stratification and clustering). SE is the standard error. SD is the standard deviation.

Table 2. Relative Risk Ratios from Multinomial Logistic Regression Predicting Whether HPV Vaccinations Are Never Initiated or Initiated Late, Compared to Base Category of On-Time Vaccinations

	Model 1						Model 2						Model 3					
	Never			Late 13 to 26			Never			Late 13 to 26			Never			Late 13 to 26		
Variable	RRR	SE		RRR	SE		RRR	SE		RRR	SE		RRR	SE		RRR	SE	
Gender (Male)																		
Female	0.65	0.09	**,b	1.15	0.16	a	0.67	0.16	†,b	1.34	0.35	a	0.67	0.16	b	1.36	0.36	a
Race/Ethnicity (White)																		
African American	0.87	0.16		0.91	0.20		0.92	0.24		1.01	0.40		1.03	0.29		1.26	0.51	
Latinx	0.81	0.13		0.82	0.16		0.85	0.21		1.11	0.43		0.92	0.24		1.27	0.44	
Asian American	1.55	0.49		1.47	0.46		2.62	0.97	*	3.09	1.39	*	2.58	0.99	*	3.11	1.41	*
Other Race	1.66	0.44	†,b	0.70	0.20	a	1.15	0.41		0.61	0.43		1.18	0.42		0.64	0.45	
Intersectionality																		
Female##Race																		
African American Female							0.92	0.24		0.87	0.35		0.90	0.24		0.83	0.34	
Latinx Female							0.93	0.31		0.65	0.26		0.92	0.31		0.63	0.26	
Asian American Female							0.47	0.17	*	0.35	0.15	*	0.47	0.17	*	0.34	0.15	*
Other Race Female							1.86	1.02		1.34	1.25		1.85	0.98		1.32	1.23	
Socioeconomic Status																		
Parental Education (High School or Less)																		
High School Graduate													0.74	0.13	†	0.63	0.16	†
Some College													0.84	0.16		0.68	0.19	
College Graduate and Above													1.01	0.22		0.83	0.26	
Family Income (<$20,000)																		
$20,000 to $44,999													1.37	0.22	†	1.46	0.35	
$45,000 to $74,999													1.28	0.21		1.34	0.36	
$75,00 and Over													1.36	0.24	†	1.99	0.62	*
Control																		
Birth Year	1.07	0.02	***	0.76	0.02	***,a	1.07	0.02	**,b	0.76	0.02	***,a	1.07	0.02	**,b	0.75	0.02	***,a

Notes: Reference groups are listed in parentheses. N= 6,574 individuals.
Source: NHANES 2011-2016
† p ≤ .10 (compared with "on-time"); * p ≤ .05 (compared with "on-time"); ** p ≤ .01 (compared with "on-time"); *** p ≤ .001 (compared with "on-time");
[a] p ≤ .05 (compared with "never"); [b] p ≤ .05 (compared with "late")

Table 3. Relative Risk Ratios from Multinomial Logistic Regression Predicting Whether HPV Vaccinations Are Never Initiated or Initiated Late, Compared to Base Category of On-Time Vaccinations, Disaggregated by Gender

	Male Respondents						Female Respondents					
	Never			Late 13 to 26			Never			Late 13 to 26		
Variable	RRR	SE		RRR	SE		RRR	SE		RRR	SE	
Race/Ethnicity (White)												
African American	0.90	0.23		0.98	0.39		0.84	0.17		0.87	0.20	
Latinx	0.86	0.21		1.11	0.44		0.79	0.18		0.71	0.15	†
Asian American	2.60	0.96	*	3.02	1.42	*	1.24	0.44		1.07	0.36	
Other Race	1.12	0.41		0.59	0.43		2.16	0.86	†,b	0.83	0.34	a
Control												
Birth Year	0.99	0.02	b	0.65	0.02	***,a	1.11	0.03	***,b	0.79	0.02	***,a

Notes : Reference groups are listed in parentheses. N= 6,574 individuals.
Source : NHANES 2011-2016
† p ≤ .10 (compared with "on-time"); * p ≤ .05 (compared with "on-time"); ** p ≤ .01 (compared with "on-time"); *** p ≤ .001 (compared with "on-time");
[a] p ≤ .05 (compared with "never"); [b] p ≤ .05 (compared with "late")

Table 4. Relative Risk Ratios from Multinomial Logistic Regression Predicting Whether HPV Vaccinations Are Never Initiated or Initiated Late, Compared to Base Category of On-Time Vaccinations, Diaggregated by Race/Ethnicity

	White Respondents						Asian Americans					
	Never			Late 13 to 26			Never			Late 13 to 26		
Variable	RRR	SE		RRR	SE		RRR	SE		RRR	SE	
Gender (Male)												
Female	0.69	0.16	b	1.43	0.38	a	0.31	0.10	**	0.43	0.17	*
Control												
Birth Year	1.10	0.03	**,b	0.79	0.03	***,a	1.04	0.06	b	0.71	0.04	***,a

Notes : Reference groups are listed in parentheses. n= 2,416 individuals.
Source : NHANES 2011-2016
† p ≤ .10 (compared with "on-time"); * p ≤ .05 (compared with "on-time"); ** p ≤ .01 (compared with "on-time"); *** p ≤ .001 (compared with "on-time");
[a] p ≤ .05 (compared with "never"); [b] p ≤ .05 (compared with "late")