GENDER AND RACIAL/ETHNIC DIFFERENCES IN THE TIMING OF INITIATING THE HPV VACCINE

by

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

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The HPV vaccine is highly effective in providing protection against the human papillomavirus (HPV). Targeting young adolescents to initiate on-time vaccinations is crucial in curtailing HPV and HPV-related morbidity and mortality. To date, no study has examined 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. To address this gap, this study used an intersectional and biopower-focused approach to examine how gender, race/ethnicity, and their intersections predict age-specific probabilities of initiating HPV vaccinations. Multinomial logistic regression—with on-time vaccination as the base outcome—was used to examine the timing of initiating HPV vaccinations. Data from the 2011-2016 National Health and Nutrition Examination Survey (NHANES) was used to study this relationship. Results show that overall and within each status group, respondents have yet to initiate the HPV vaccine. Additionally, gender and the intersection of gender and sexuality were significant predictors of the timing of initiating the HPV vaccine, especially for females and Asian Americans. Policy makers and healthcare officials interested in increasing HPV vaccine uptake should provide culturally sensitive information to parents and young adolescence that balances advocating the overall benefits of the vaccine for both genders, while addressing sexuality in the context of HPV vaccinations, to emphasize the importance of uptake before the exposure of HPV.

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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; Hildesheim et al. 2007; Schiller 2012). 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

[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.

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 and, to some degree, racialized implications for perceiving HPV, HPV-related illness, and the HPV vaccine, and further implications regarding which subject bodies benefit from the vaccine. To date, studies on the HPV vaccine have not focused on how the sexualization and desexualization of HPV and the HPV vaccine has gendered and, to some extent, racialized implications for vaccine uptake. Moreover, while most studies 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. Rather, studies on HPV vaccinations have examined uptake disparities by gender (Johnson et al. 2016) and across racial/ethnic groups (Charlton et al. 2017; Daniel-Ulloa, Gilbert, and Parker 2016). 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 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 used an intersectional and biopower-focused approach to *examine how gender, race/ethnicity, and their intersections determine age-specific probabilities of initiating HPV vaccinations: on-time, late, or never*. An intersectional framework, which focuses on the multidimensionality of social statuses, can yield more insight than studying a single-axis because it illuminates how many axes can coalesce to influence the experiences of identity, health outcomes, and social inequality. This intersectional age, gender, and racial/ethnic specific focus will inform "how patterns of privilege and power associated with one dimension may vary when considered in combination with another dimension" for understanding the timing of initiating HPV vaccinations (Del Toro and Yoshikawa 2016). Multinomial logistic regression—with on-time vaccination as the base outcome—was used to examine the timing of initiating HPV vaccinations. 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.

BACKGROUND

The Human Papillomavirus (HPV)

HPV is the most common sexually transmitted infection (STI) in the United States. (Satterwhite et al. 2013). The virus can be contracted through skin-to-skin contact, oral sex, vaginal sex, and/or anal sex. Condoms only provide partial protection against HPV (Lam 2014). HPV transmission is the highest after engaging in sexual activity for the first time (Collins et al. 2002; Moscicki 2007), and the risk of infection increases with each new sexual partner and/or if a male sexual partner has had two or more lifetime sexual partners (Winer 2013). HPV is asymptomatic, can remain dormant for a number of years, and can recur. As a result, HPV can be spread and contracted without the infected person's knowledge.

There are over 150 strains of HPV. HPV strains are classified into two broad groups: low-risk types which cause genital warts and other benign or low-grade genital neoplasia, and high-risk types which can cause HPV-related cancers—cervical, vaginal and vulvar, penile, anal, and oropharyngeal cancers. Every year, between 500,000 to one million new cases of genital warts are diagnosed each year in the United States (Yanofsky, Patel, and Goldenberg 2012). Currently, about 79 million people in the United States are infected with HPV and one half of those infections are considered a high risk for causing cancer. The 2017 National Center for Health Statistics (NCHS) data brief, which reports the prevalence of HPV in noninstitutionalized adults aged 18 to 69 in the United States for the years 2011 to 2014, found that the prevalence of any genital HPV was 42.5 percent of the total population and the prevalence of any high-risk genital HPV was 22.7 percent of the population, adults aged 18-69.[3,4] Additionally, the

[3] Any genital HPV: Vaginal or penile swab sample tested positive to one or more of the 37 HPV types listed under "All HPV Types."
[4] High-risk genital HPV: Vaginal or penile swab sample tested positive to one or more of the 14 high risk types out of the 37 HPV types.

prevalence of any and high-risk oral-HPV and any and high-risk genital HPV is higher among males than females (McQuillan et al. 2017).

The HPV Vaccine

There are three types of HPV vaccines: Gardasil, Cervarix, and Gardasil 9.[5] The first available HPV vaccine, Gardasil, was initially administered only to females. In 2009, Gardasil also became available to males, although the vaccine was not recommended to males by the Centers for Disease Control and Prevention (CDC) until 2011. The ACIP recommends routine HPV vaccination for adolescents at age 11 or 12 years. 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).

The vaccine is a two or three shot series given over several months. Currently, the HPV vaccine consists of two shots for adolescents 14 and under and three shots for individuals 15 and over (Meites et al. 2016). While one dose of Cervarix induces protection against HPV strains 16 and 18 by nine and almost five-fold, respectively (Safaeian et al. 2013), one does of Gardasil is not as effective and, therefore, a second or third dose is needed to have stronger immunogenicity (Sankaranarayanan et al. 2016). Thus, as previously stated, the vaccine's high level of effectiveness is dependent on the number and timing of vaccine doses (Harper and DeMars 2017).

[5] In 2012, Gardasil 9, which protects against nine types of HPV strains, replaced Gardasil, which protects against four types of HPV strains.

Although the vaccine is widely available, proven to be effective, and considered one of the greatest health care advances (Markowitz et al. 2016), uptake remains low. Two recent studies examined disparities in HPV vaccine uptake for the year 2013. Daniel-Ulloa, Gilbert, and Parker (2016) used the 2013 National Health Interview Survey to assess national differences in initiating and completing the HPV vaccine series for adults aged 18 to 30. The authors focused on three social statuses: gender, race/ethnicity (white, African American, Latinx, and multi-racial/other race), and sexual orientation (heterosexual and gay/lesbian/bisexual).[6] The study found significant gender and racial/ethnic differences. Specifically, among men, only five percent initiated the vaccine series, with no differences in uptake by race/ethnicity. In contrast, 30 percent of women initiated the vaccine series. When compared to white women, non-white women had lower odds of initiating and completing the series. There were no statistically significant findings for sexual orientation for both genders.

In another study, Johnson et al. (2016) used the 2013 National Immunization Survey-Teen to analyze gender, racial, and regional disparities in HPV vaccine uptake acceptability, initiation, and completion for adolescents aged 13 to 17. They found that among teens, only 19 percent initiated the HPV vaccine series and that the completion rate among those who initiated the vaccine was only 26 percent. Similar to other studies, adolescent boys initiated and completed the series at lower rates than adolescent girls. Specifically, 14 percent of males completed the vaccine series as compared to 38 percent of females. Moreover, higher vaccine

[6] Latinx is a decolonial, gender-neutral, and non-gender binary alternative to Hispanic, Latino, Latina, and Latin@ (Rodríquiz 2017).

initiation was associated with younger age and residing in the Midwest for females, and racial/ethnic adolescents and adolescent boys who were eligible for the "Vaccine for Children" program, a federally funded program that provides no-cost vaccines to children without health insurance.

When compared to other recommended vaccines, HPV vaccine uptake remains low. According to the 2016 National Immunization Survey-Teens (NIS-Teen) report, which examines U.S. adolescents' vaccination coverage, 60.4 percent of adolescents aged 13 to 17 years received at least one dose of the HPV vaccine in 2016, 65.1 percent females and 56.0 percent males. In contrast, at least 88 percent of adolescents received the tetanus, diphtheria and acellular pertussis vaccine (Tdap), 90.9 percent received the quadrivalent meningococcal conjugate vaccine (MMR), 91.4 percent completed the Hepatitis B vaccine series, and 95 percent received the varicella vaccine (Walker et al. 2017). In other words, HPV vaccinations remains 22 to 28 percentage points lower than Tdap vaccinations and over 50 points lower than other recommended vaccines.

Nonetheless, the NIS reports that HPV vaccination rates have gradually increased over the years. Specifically, 60 percent of adolescents initiated the HPV vaccine series in 2016, an increase by four percentage points from 2015. This increase can be seen when comparing the findings from the 2016 reports to the previously stated 2013 studies. Additionally, the NIS report showed that the gender disparity in vaccination rates has recently been narrowing. Between 2015 and 2016, 56 percent of boys and 65.1 percent of girls, respectively, have initiated the HPV vaccine series, which is a 6.2 percentage point increase for boys and a 2.3 percentage point increase for girls. Vaccination disparities occur in less urban areas and among adolescents living at or above the poverty level (Walker et al. 2017).

To understand these low HPV vaccine uptake rates, scholars have focused on two factors. The first is awareness of HPV and the HPV vaccine. Johnson et al. (2016) discovered that lack of parental knowledge was the third most significant reason for refusing the HPV vaccine.[7] Compared to African American parents, white parents were more knowledgeable of the vaccine (Reiter 2011). Additionally, parents in all racial/ethnic groups had low rates of awareness regarding male vaccinations. Moreover, individuals living in rural areas were less knowledgeable of the HPV vaccine (Cates et al. 2009), as well as Southeast Asian Americans. Lastly, males of all racial/ethnic groups had low awareness of the vaccine availability for males (Cooper 2017; Johnson 2016).

HPV vaccine acceptability—whether parents believe the vaccine to be useful—is the second factor scholars have examined to understand low HPV vaccine uptake rates. Research on HPV vaccine acceptability have analyzed parents' intent to vaccinate their children. Scholars have found that parents' lack of HPV vaccine intention occur for several reasons: (1) the belief that the vaccine is unnecessary because their offspring is not yet sexually active (Dorell et al. 2011; Johnson et al. 2016; Myers et al. 2008; Oldach et al. 2012), (2) concerns over vaccine safety (Johnson et al. 2016; Myers et al 2008; Oldach et al. 2012), and (3) a fear that the vaccine will increase the likelihood of teens initiating sexual acts and engaging in risky sexual behaviors (Charo 2007; Lechuga et al. 2014; Zimmerman 2006). Thus, the sexualization of HPV, HPV-related illness, and the HPV vaccine has renewed moral ideas about health, virtue, disease risk, sex and stigma (Mamo and Esptein 2017; Velan and Yadgar 2017).

[7] The primary reason for refusal was that the vaccine was not recommended by a health care provider. The secondary reason was parental belief that vaccine was unneeded.

To mitigate parents' concerns over the sexualization of the HPV vaccine and to increase vaccine uptake, policymakers and healthcare officials have attempted to desexualize the HPV vaccine. According to Velan and Yadgar (2017), desexualization is the "narration and (re)presentation of the disease, viruses and vaccinations as unrelated to sex or sexual activity" (p.2). Hence, to avoid discussion on HPV as the most common sexually transmitted infection, the HPV vaccine is marketed strictly as a cancer preventative (Mamo and Epstein 2017; Rothman and Rothman 2009; Velan and Yadgar 2017). This desexualization can also been seen between the vaccines. While both males and females can be administered Gardasil and Gardasil 9 to receive protection against both high-risk HPV strains that cause cancer and low-HPV strains that can cause genital warts, Cervarix is strictly administered to females to protect against cancer-causing high-risk HPV strains. This desexualization fosters and maintains "symbolic associations between sex, health and morality as stigma," which is projected onto particular subject bodies and sexualities (Mamo and Espstein 2017:383). Yet, complete desexualization of the HPV vaccine is unfeasible. Thus, the sexualization and desexualization of HPV, HPV-related illnesses, and the HPV vaccine can have implications on the interrelationships between which subject bodies initiate the HPV vaccine and when.

Theoretical Framework

Intersectionality

Intersectionality is an important framework that can illuminate uncovered disparities in timing of initiating HPV vaccinations. First coined by Crenshaw (1991), intersectionality is a

theory of knowledge which posits that gender, race/ethnicity, class, sexuality, and other social categories are not mutually exclusive categories that affect one's experience but are instead joint and simultaneous interactions that shape the multiple dimensions of oppression and privilege (p.358). Since the intersectional experience is greater than the sum of racism and sexism, various experiences of oppressions are simultaneous and cannot be understood separately. According to Crenshaw (1989), using a single-axis framework that prioritizes one category of social identity—such as gender, race/ethnicity, class, or sexual orientation—distorts and theoretically erases the experiences of individuals with two or more axes of oppression in the "conceptualization, identification and remediation of race and sex discrimination by limiting inquiry to the experiences of other-wise-privileged members of the group" (p.23). To mitigate this erasure, an intersectional approach demarginalizes the intersection of multiple categories of social identity to illuminate how these axes of oppression affect and reinforce one another. Therefore, using an intersectional paradigm provides insight into experiences of identity and social inequality (Risman 2004).

Thus, intersectionality is an important theoretical framework that can be used to understand how multiple categories of social identity intersect to influence health and health outcomes. Specifically, gender and race/ethnicity jointly and simultaneously structure the production and maintenance of health across the life course in myriad ways (Schulz and Mullings 2006). By examining how multiple social statuses jointly influence health, researchers can uncover important differences in how health is produced and maintained. This new knowledge can aid in the understanding of and the reduction in health disparities.

Yet, relatively few quantitative studies on health have used an intersectional approach. For example, Cummings and Braboy Jackson (2008) utilized the intersectionality paradigm to

examine how race, gender, and socioeconomic status converge to produce disparities in self-assessed health. Warner and Brown (2011) used an intersectional approach grounded in life course theory to explore how race/ethnicity and gender jointly define age trajectories of disabilities. Etherington (2015) analyzed racial disparities in the development of psychosocial resources and good health among women with different social statuses.

To expand on intersectional quantitative research on health, I used an intersectional framework 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.

Biopower and Health

Biopower is a theoretical framework that can be used to explain gender and racial/ethnic differences in timing of initiating HPV vaccinations. According to Foucault (1978/1990), biopower is a form of social control practiced by modern nation states to subjugate human life at the individual and population level. The central aim of biopower is to obtain a "power over life" by preventing "imminent risks of death" and controlling mortality (p.139). In other words, biopower's main goal is to preserve life and avoid morbidity and mortality. This preservation of life is achieved by institutions of power formulating knowledge, dispensing discursive practices, and instilling discipline—the regulation of social behavior and activities of individuals. Accordingly, biopower is a political tool that distributes value and utility to visible subjects' bodies by measuring, ranking, and regulating human life. Consequently, biopower becomes a

form of social control used to categorize some individuals as having greater value and others as requiring regulation and control for the greater good of public health.

Two manifestations of power operate together to form biopower. The first type of power is anatomo-politics of the human body. This type of power centers on the body to discipline the individuals into becoming "docile" "machines" fit to be integrated "into systems of efficient and economic controls" (p.139). Specifically, anatomo-politics subjugates human bodies to conform to and internalize the norms of a society for the purpose of controlling those bodies' behavior and capitalizing on their capabilities as functioning mechanisms within society. When individuals submit to these norms, they become subjugated. An example of anatomo-politics is the regulation of teenage girls' sexualities. Teen pregnancy is perceived in the United States as detrimental to a young girl's social status and socioeconomic future. Mollborn et al. (2014) found that when teenage girls submit to this norm, they police their own sexual behavior by engaging in less sexual activity and increasing their use of contraception.

The second form of power is biopolitics of the population. Biopolitics aims to control and regulate populations, specifically in regard to biological processes such as population health, size, and quality. Distinct institutions of power within the state—such as health institutions, pharmaceutical companies, and policymakers—regulate populations by methods of power, knowledge, and technology. An example of biopolitics is the U.S. military government's wartime public health policies in Hawai'i from 1941 to 1944 (Nebolon 2017). During this time, martial law mandated Native Hawaiians, Asian immigrant workers, and white settlers to be vaccinated, submit to sanitation laws, and receive health education for the purpose of securing the health and productivity of military officials. As a result, 90 percent of the target population was vaccinated during World War II. Together, anatomo-politics and biopolitics "ensure the

physical vigor and the moral cleanliness of the social body," while socially sanctioning "defective individuals, degenerate and bastardised populations" (Foucault 1978/1990:54). Thus, biopower controls human life at the individual and population levels by socializing subject bodies into being model citizens and by acting as an agent of surveillance, segregation, and social ranking.

Biopower exercises its social control vis-à-vis the regulation of sex and sexuality. Specifically, biopower operates as a "mechanism of attraction" toward sex, to know sex, and to regulate sex (Foucault 1978/1990:45). Foucault argues that "[s]ex was a means of access both to the life of the body and the life of the species" (p.146). This regulation of sex at the individual and population level is a means for modern societies to correlate their moral and economic prosperity with the sexual practices of its citizens. Through "subtle and calculated attempts" at regulating citizens' bodies and sexual acts, the state is able to analyze, classify, and intervene for the perceived "greater good" of society (p.26). Consequently, societies have the authority to determine which sexual bodies, sexual acts, and sexualities are socially acceptable or perceived as dangerous. Biopower classifies two types of sexualities: (1) a normative sexuality that is seldom questioned and minimally policed, and (2) a dangerous sexuality that is placed on "perpetual alert" (p.54). This classification creates a sexual surveillance in which the nation state, institutions of power, and subject bodies police and subordinate themselves and other individuals. Thus, this sexual regulation is a means of social control that privileges some individuals while subjugating others.

A biopower approach is particularly useful for examining the timing of initiating HPV vaccination. On the surface, the HPV vaccine can be perceived as a mechanism to preserve life and avoid death. As a biomedical technology, the HPV vaccine thus thwarts morbidity and

mortality and promotes wellness. In biopower terms, the HPV vaccine is a biopolitical technique used to subjugate bodies and control population health by using the technology, public health practices, and health institutions to preserve life, regulate risk, and avoid death. Additionally, the HPV vaccine is supported by distinct institutions of power within the state: the vaccine is created and marketed by large pharmaceutical corporations, advocated by health care officials, and legally mandated for some individuals.[8] On a deeper level, the HPV vaccine can be seen as a medical mechanism used to categorize and regulate subjects' bodies and sexualities. HPV and the HPV vaccine are linked to sex, sexually transmitted infections, and sexuality. Foucault argues that through the social construction of the moral and social panic discourse regarding sex and population health, society uses sex as a way to classify, police, and subordinate vulnerable and dangerous sexualities. Hence, using biopower as a theoretical framework to analyze timing of initiating HPV vaccinations illuminates how bodies are ranked and which gendered and/or racialized bodies are valued and regulated through public health practices.

Moreover, as a means of social control, biopower can be used to hypothesize the gendered, racial/ethnic, and intersectional differences in the timing of initiating HPV vaccinations. Biopower illustrates how sexuality is often gendered to regulate female sexual bodies and sustain patriarchy. As previously stated, biopower operates as a "mechanism of attraction" to regulate sexual bodies, sexual acts, and sexualities. Foucault argues that female sexual bodies and sexualities in particular have historically been saturated with sexuality and policed for the purpose of socializing the body through family space to safeguard the family

[8] From August 1, 2008 to December 13, 2009, initiating the HPV vaccine was legally mandated for immigrant women aged 11-26 years under the 1996 Illegal Immigration Reform and Immigrant Responsibility Act. Currently, the District of Columbia, Rhode Island, and Virginia legally mandate the HPV vaccine for school aged children; only Rhode Island requires both genders to receive the vaccine.

institution (p.147). In contrast, male bodies and sexualities have not been called to question, maintaining patriarchal privilege and control over women. Additionally, female sexual bodies have been hystericized and medicalized as a means of control (Cixous et al. 1976; Riessman 1983). Thus, the HPV vaccine is a mechanism of social control. While the HPV vaccine can protect against strains that causes HPV-related cancers in both genders, it is a biomedical technology that specifically targets females to prevent cervical cancer. Thus, biopower genders sexuality for the means of policing and regulating females, while ignoring males. Therefore, I hypothesize that relative to on-time vaccinations, males are more likely than females to never vaccinate or vaccinate late (*hypothesis 1*).

Additionally, biopower can be used to illustrate how sexuality is racialized and simultaneously how race becomes sexualized. JanMohamed (1995) expands on Foucault's conception of biopower by intersecting sexuality with race/ethnicity—defined as racialized sexuality. Specifically, JanMohamed uses Foucault's argument that biopower maintains the homeostasis of the social body to illustrate how white hegemonic powers use biopower to subordinate and subjugate non-whites and their sexual bodies to maintain white supremacy. This form of biopower occurs when white hegemonic power (1) saturates non-white bodies with sex to hystericize and "other" racial subjects (Said 1978) and (2) implements jurdico-discursive prohibitions that regulates these racialized and sexualized bodies. This othering categorizes and regulates white sexual bodies and non-white sexual bodies differently—the former (bourgeois sexuality) perceived as licit, universal, and indubitable and the latter (racialized sexuality) stereotyped as illicit, anomalous, and in need of policing. JanMohamed asserts that this otherness negates non-whites of their human rights and exploits the racial subject bodies through "institutional prohibitions that mediated all their social relations, including sexuality" (p.97).

Biopower and racialized sexuality can be exemplified in three ways. First, Hill Collins (2004) argues that since slavery, hegemonic ideology has classified African American sexuality as inherently promiscuous and uncivilized. Although the oversexualization and procreation of African American slaves was beneficial to white hegemonic powers, it is now seen as a threat to society and population health. Similarly, the procreation of Latinx populations, specifically the high rates of Latinx teen pregnancies is seen as a threat to society and population health (Fields 2005). Moreover, Asian American sexual bodies have also been perceived as a threat to population health through the stereotyping of the "yellow peril" (Lee 1999; Tchen 2010). As a result, non-white populations have been and continue to be racialized by public health officials through forced sterilizations (Roberts 1997), sex education programs (Fields 2005), and immigration restriction policies (Luibhéid 2002). Hence, biopower racializes sexuality and simultaneously sexualizes race to categorize non-white sexualities as illicit, dangerous to society and population health, and in need of social control. Thus, I hypothesize that relative to on-time vaccinations, non-white respondents are less likely than white respondents to never initiate the HPV vaccine or initiate late (*hypothesis 2*).

Finally, biopower can also be used to hypothesize how intersectional sexualities are subjugated and predict differences in the timing of initiating HPV vaccinations. Earlier, I argued biopower sustains patriarchy by regulating female sexual bodies. Above, I argued that biopower sustains white hegemonic power by regulating non-white sexual bodies. Therefore, I would expect that this regulation would be further complicated when gender and racial/ethnic oppressions intersect. Although non-white females' sexual bodies have historically been hyperpoliced and categorized as dangerous to society and population health, white females' sexual bodies have also been hyperpoliced to maintain the innocence and purity of white female

and white families. That is, while white and non-white females' sexualities are valued and policed differently, the former are depicted as in need of protection and the latter are stereotyped as dangerous.

While both white and non-white female sexualities are highly policed and socially controlled within society, this is not the same for white and non-white males. In contrast, white and non-white males are not equally regulated. On one hand, white hegemonic patriarchy constructs white male sexuality as universal and is, therefore, invisible and unquestioned. On the other hand, non-white males' sexual bodies are seen as violent and vectors of disease. For example, both African American and Latinx males are labeled as having higher morbidity and mortality rates caused by sex, sexually transmitted infections, and HIV/AIDS (Cockerham 2012). Additionally, through the "yellow peril," Asian American men were labeled as seducers, rapists, and disease infested, which supposedly threatened the purity of white females' sexual bodies and white families (Lee 1999). Thus, biopower sustains white hegemonic patriarchy and subjugates all females (as needing protection or protection from) and non-white males (as vectors of sexual aggressiveness and sexual diseases). I, therefore, hypothesize that the timing of initiating HPV vaccine for females across racial groups will not be significantly different when I interact gender and race (*hypothesis 3*). In contrast, I hypothesize that there will be significant differences in the likelihood of timing of initiating HPV vaccinations for males across racial groups. Specifically, I hypothesize that relative to on-time vaccinations, non-white males are significantly less likely than white males to never initiate the HPV vaccine or to initiate the vaccine late, relative to on-time vaccinations (*hypothesis 4*).

An additional factor that may influence timing of initiating HPV vaccinations is socioeconomic status (SES). According to Cockerham (2012), race/ethnicity is closely linked to

class, the strongest variable for examining health disparities. Specifically, adverse health is produced by socioeconomic variables that are associated with race/ethnicity, such as where one lives and if one has access to health knowledge and health resources.

Yet, while scholars have noted how lower SES negatively affects health, vaccine scholars have uncovered the opposite finding. In a study on the phenomenon of vaccine refusal, Reich (2016) found that parents with high socioeconomic status are able to assert their medical and parental expertise, negotiate with providers, and choose to abide by or delay routine vaccine schedules. In other words, mothers with high socioeconomic status are provided with the opportunity to choose if and when their children receive routine and recommended vaccinations. Consequently, these mothers often chose to not vaccinate or delay vaccination for their children because they perceive the routine vaccine schedule as unrepresentative of their child's unique health needs. These mothers are often white, college-educated, married, and live in a household with an annual family income over $75,000.

In contrast, Reich found that mothers with lower socioeconomic status are not presented with the same opportunity of choice. Instead, these mothers are viewed by healthcare providers as ill-equipped in making vaccination decisions for their children because of their lack of knowledge and time to conduct their own research on health issues. As a result, vaccinations in general and the timing of initiating vaccines in particular become non-negotiable for parents with lower SES. Moreover, the parents with lower-SES often abide by provider recommendations. These mothers are often non-white, have less than a college education, have public health insurance or no health insurance, and predominately speak a non-English language.

Thus, because a respondent's racial/ethnic background is closely tied to socioeconomic status, and a respondent's socioeconomic status is closely linked to being able to negotiate if and

when vaccinations occur, socioeconomic status can account for the relation between the race/ethnicity and timing of initiating the HPV vaccine. Therefore, I hypothesize that socioeconomic status will mediate disparities in the timing of initiating HPV vaccine uptake (*hypothesis 5*).

METHODS

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. Interviews are conducted by trained interviewers using the Computer-Assisted Personal Interviewing (CAPI) system in respondents' homes. The CAPI system is an electronic questionnaire used to expedite the survey interview and reduce data entry errors by electronically skipping, adding, changing, and/or checking the forms and documents. Respondents aged 16 and older are interviewed directly. Respondents under the age of 16 are represented by a proxy, generally a parent. 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.

Data from the NHANES interview and immunization questionnaire were used. Of the combined total sample of 39,873 respondents for the three waves, 21,658 individuals aged 9 to 59 responded to the question on whether they have initiated HPV vaccine uptake. The other respondents were ineligible to answer the survey question due to the age restriction of the question (age 9 to 59) and were, therefore, skipped. As illustrated in Figure 1, not all respondents in the study were granted an equal opportunity to initiate the HPV vaccine on-time (at age 9 to 12) because of their age when medical recommendations were initiated. Taking this into account, I restricted the sample to respondents who had at least a one-year opportunity to be vaccinated on-time after the vaccine was recommended for their gender: females born in 1994 to 2007 and males born in 1996 to 2007. The age range of the respondents at time of survey is between 9 to 21. In addition, because the HPV vaccine was not available to the public until 2006, I limited the sample to those who initiated the HPV vaccine in 2006 and later. Accordingly, respondents who claimed they received the HPV vaccine before 2006 were coded to missing. The resulting final sample size is 6,574 individuals, of which 1,781 respondents were white, 1,583 respondents were African American, 2,182 respondents were Latinx, 635 respondents were Asian American, and 393 respondents reported some other race. Other race combined Native Americans, Alaska Natives, and multiracial individuals because these categories are too small to include separately. While this study included other race in the analysis, this study will not focus on the results due to the limited knowledge on the makeup of the group and due to their small sample size.

Figure 1: On-Time and Late Vaccinations by Year and Birth Year

Birth Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1980	26	27	28	29	30	31	32	33	34	35	36
1981	25	26	27	28	29	30	31	32	33	34	35
1982	24	25	26	27	28	29	30	31	32	33	34
1983	23	24	25	26	27	28	29	30	31	32	33
1984	22	23	24	25	26	27	28	29	30	31	32
1985	21	22	23	24	25	26	27	28	29	30	31
1986	20	21	22	23	24	25	26	27	28	29	30
1987	19	20	21	22	23	24	25	26	27	28	29
1988	18	19	20	21	22	23	24	25	26	27	28
1989	17	18	19	20	21	22	23	24	25	26	27
1990	16	17	18	19	20	21	22	23	24	25	26
1991	15	16	17	18	19	20	21	22	23	24	25
1992	14	15	16	17	18	19	20	21	22	23	24
1993	13	14	15	16	17	18	19	20	21	22	23
1994	12	13	14	15	16	17	18	19	20	21	22
1995	11	12	13	14	15	16	17	18	19	20	21
1996	10	11	12	13	14	15	16	17	18	19	20
1997	9	10	11	12	13	14	15	16	17	18	19
1998	8	9	10	11	12	13	14	15	16	17	18
1999	7	8	9	10	11	12	13	14	15	16	17
2000	6	7	8	9	10	11	12	13	14	15	16
2001	5	6	7	8	9	10	11	12	13	14	15
2002	4	5	6	7	8	9	10	11	12	13	14
2003	3	4	5	6	7	8	9	10	11	12	13
2004	2	3	4	5	6	7	8	9	10	11	12
2005	1	2	3	4	5	6	7	8	9	10	11
2006	0	1	2	3	4	5	6	7	8	9	10
2007	0	0	1	2	3	4	5	6	7	8	9

Year

On-Time | Delayed

Of the 6,574 respondents, 4,476 respondents did not initiate the HPV vaccine series and 2,098 respondents reported receiving at least one dose of the HPV vaccine. Of the 2,098 respondents who reported receiving the HPV vaccine, 1,860 respondents reported their age at vaccine initiation. Twenty imputations filled in missing data on the 238 respondents who did not report their age of initiating the HPV vaccine (11.34%). Thus, 6,574 respondents were retained by conducting multiple imputation in Stata.

Dependent Variables

The measure of timing of initiating the HPV vaccine was constructed through two steps. The first step used the participant's retrospective response to the question, "[Have you/Has SP] ever received one or more doses of the HPV vaccine?" NHANES asked this survey question separately for males (aged 9 to 59) and for females (aged 9 to 59). Separate responses were combined to create one binary measure, coded 0 if an individual never received the HPV vaccine and coded as 1 if an individual received at least one dose of the HPV vaccine series.

The second step used a follow-up question for respondents who stated that they initiated the HPV vaccine: how old was the respondent when they initiated the HPV vaccine? Respondents retrospectively answered by stating their age at first dose. NHANES coded their answer as a continuous variable. Then, a categorical variable was created to represent the timing of initiating HPV vaccinations. Respondents who answered that they have never initiated the HPV vaccine series were coded as 0 and were categorized as having never initiated HPV vaccination. Respondents who reported that they initiated HPV vaccination between the ages of 9 to 12 were coded as 1 and were categorized as initiating HPV vaccination on-time (referent).

Respondents who reported that they initiated HPV vaccination between the ages of 13 to 23 were coded as 2 and were categorized as having late initiation of the HPV vaccine. The categorization of the timing of initiating HPV vaccination is based on the CDC's vaccination schedule—ages 12 and under are considered on-time vaccinations, whereas ages 13 to 26 are considered catch-up vaccinations. As previously stated, timing of initiating the HPV vaccine is crucial in curtailing HPV and HPV related-illnesses: on-time vaccinations provide the highest protection against HPV and HPV-related illnesses, while late vaccinations may provide only partial protection. Missing values for age at initiating the HPV vaccine series were imputed (11.34%).

Independent Variables

There are three key independent variables. The first is a binary indicator for female, with males as the referent. The second independent variable is race/ethnicity, which is a series of dummy variables that measure respondents' self-reported race/ethnicity. This measure is captured in the mutually exclusive categories of white (referent), African American, Latinx, Asian American, and other race. The last key variable is a multiplicative interaction term between female and race/ethnicity, which represents the intersections of gender and race/ethnicity. Using a multiplicative interaction term between female and race/ethnicity is the best way to measure "an intersection as an identity beyond the sum of its parts" in survey data (Dubrow 2008:85).

Control Variable

This study uses year of birth as a control variable. While other variables, such as region, could be useful as a control variable, this study could not use additional control variables due to the small sample size of important groups within the study. Including these additional control variables would cause statistical power issues for the multiplicative interaction term between female and race/ethnicity.

Respondent's year of birth is an important control variable because younger cohorts have longer time periods in which they were presented with the opportunity to have an on-time and catch-up vaccinations while older cohorts have a shorter window opportunity to receive an on-time and catch-up vaccination opportunity. The continuous variable, birth year, was created by taking the respondent's self-reported age and subtracting the age from the survey year.

Mediating Variables

There are two key mediating variables that represent family of origin socioeconomic status. The first is a categorical indicator for annual family income. NHANES computed family income into 15 dummy variables that included specific ranges (i.e. $20,00-24,999) and estimated ranges (i.e. $20,000 and over). Annual family income was categorically coded as: (1) less than $20,000 (referent), (2) $20,000 to $44,999, (3) $45,000 to $74,999, and (4) $75,000 and over. Annual family income for respondents aged 18 and over at time of interview was coded to missing to account for the possibility that these respondents may be living outside of their family's residence. Likewise, estimated ranges were coded to missing. Next, annual family income for respondents 18 and over, estimated ranges, and missing values for adolescents were imputed (22.3%).

Parental education is the second mediating variable. Parental education is a categorical indicator of the highest degree earned by the head of household or the average of the head of household and their spouse. Because NHANES does not explicitly inquire about the respondent's parents' education level, I followed Al Agili et al.'s (2015) study by using the head of household's education level and, if the head of household has a spouse, used the spouse's education level instead of the head of household's education level to obtain the highest level of parental education. This choice in using the highest level of education between the head of household and spouse is done because the highest level of parental education, regardless if it is the head of household's or the spouses, greatly influences health outcomes for the respondent. Parental education was measured using four mutually exclusive categories: less than high school (referent), high school graduate or GED, some college, and college graduate or above. To account for the possibility that respondents aged 18 and over at time of interview may be living outside of their parental residences, their parental education was coded to missing. Missing values for respondents aged 17 and younger and 18 and over were imputed (18.26%).

Additionally, this study could not use health insurance as a socioeconomic variable. While this study recognizes the importance testing if intersectional differences between gender and race/ethnicity can also explained by health insurance, this study could not use health insurance as a socioeconomic variable due to the retrospective nature of the study. In other words, the time in which the respondent was interviewed and received the first dose of the HPV vaccine could differ. Furthermore, health insurance is complicated by the type of health insurance a respondent has and the year the type of health insurance began covering the vaccine—the year in which the HPV vaccine was covered differs by private and public health

insurance. Therefore, holding constant the respondent's current health insurance status in this retrospective study threatens the validity of results of the study.

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.

RESULTS

Descriptive statistics used in the timing of HPV vaccination are displayed in Table 1. The weighted means for timing of initiating HPV vaccinations suggest that more than half of respondents overall and within each social demographic group in the sample have never initiated the HPV vaccine. Never initiating the HPV vaccine is extremely high among males—males are significantly more likely to never initiate the HPV vaccine, than to vaccine late ($p \leq 0.05$). Additionally, there are also uptake differences among white respondents. Specifically, white respondents significantly initiate the HPV vaccine late, relative to on-time vaccinations ($p \leq 0.05$). Timing of initiating the HPV vaccine also varies for respondents with parents who do not have a high school diploma. Compared to late vaccinations, respondents with parents who do not have a high school diploma significantly initiate the vaccine on-time ($p \leq 0.05$).

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 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.

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

† $p \leq .10$ (compared with "on-time"); * $p \leq .05$ (compared with "on-time"); ** $p \leq .01$ (compared with "on-time"); *** $p \leq .001$ (compared with "on-time");

[a] $p \leq .05$ (compared with "never"); [b] $p \leq .05$ (compared with "late")

Hypothesis 1: Relative to on-time vaccinations, males are more likely than females to never initiate the HPV vaccine or to initiate the vaccine late.

Previous research has found that there are statistically significant gender differences in HPV vaccinations. I echo these findings, demonstrating 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. There are no significant gender differences in late vaccinations, compared to on-time vaccinations. Not illustrated in the table are the gender differences when never vaccinating and late vaccinations are the base outcome. Relative to never initiating the HPV vaccine, females are significantly more likely than males to vaccinate late. Specifically, compared to males, females are 79 percent more likely to vaccinate late, relative to never vaccinating ($p \leq 0.01$). Thus, Hypothesis 1 is partially supported.

Hypothesis 2: Relative to on-time vaccinations, white respondents are more likely than non-white respondents to never initiate the HPV vaccine or to initiate the vaccine late.

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. Therefore, Hypothesis 2 is not supported.

Hypothesis 3: Relative to on-time vaccinations, the timing of initiating HPV vaccine for females across racial groups will not be significantly different when I interact gender and race.

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.

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

† $p \leq .10$ (compared with "on-time"); * $p \leq .05$ (compared with "on-time"); ** $p \leq .01$ (compared with "on-time"); *** $p \leq .001$ (compared with "on-time");
[a] $p \leq .05$ (compared with "never"); [b] $p \leq .05$ (compared with "late")

To explore intersectional differences in timing of initiating HPV vaccinations for females, Table 3 presents the same multinomial logistic regression model disaggregated by gender for female respondents. In contrast to model 2 in Table 2, marginally significant results were produced for Latinx females in Table 3. When compared to white females, Latinx females are marginally significantly less likely to vaccinate late, relative to on-time vaccinations, ($p \leq 0.10$). Specifically, compared to white females, Latinx females are 29 percent less likely to vaccinate late, compared to on-time vaccinations. When running the other base outcomes, there were no significant findings. Therefore, hypothesis 3 is partially supported.

Hypothesis 4: Relative to on-time vaccinations, white males are more likely than non-white males to never initiate the HPV vaccine or to initiate the vaccine late.

To explore intersectional differences in timing of initiating HPV vaccinations for males, Table 3 presents the same multinomial logistic regression model disaggregated by gender for male respondents. There were significant findings in the disaggregated model only for Asian American males. Compared to white males, Asian American males are 160 percent more likely to never initiate the vaccine, relative to on-time vaccinations. Additionally, compared to white males, Asian American males are over two times as likely to vaccinate late, relative to on-time vaccinations. There were no significant findings when running the other base outcomes.

Table 4 presents interesting findings from the multinomial logistic regression disaggregated race/ethnicity for white and Asian American respondents. The disaggregated model in Table 4 found no statistically significant findings for white respondents, relative to on-time vaccinations. However, there were significant findings after running the other base outcomes in the disaggregated model. When compared to white males, white females are over

100 percent more likely to vaccinate late, relative to never vaccinating ($p \leq 0.01$). Additionally, when compared to white females, white males are over half as likely to never vaccinate ($p \leq 0.01$), relative to late vaccinations.

Alternatively for Asian Americans, I found significant differences in the disaggregated model in Table 4. Compared to Asian American males, Asian American females are 69 percent less likely to never initiate the HPV vaccine, relative to on-time vaccinations ($p \leq 0.01$). Additionally, compared to males, females over 50 percent less likely to vaccinate late, relative to on-time vaccinations ($p \leq 0.05$). When running the other base outcomes, there were no significant findings.

Although I hypothesized that white males are more likely than non-white males to never initiate the HPV vaccine or to initiate the vaccine late, Asian American males are significantly more likely than white males to never vaccinate, compared to on-time vaccinations. Additionally, relative to on-time vaccinations, Asian American males are significantly more likely than white males initiate the vaccine late. Therefore, Hypothesis 4 is rejected.

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

† $p \leq .10$ (compared with "on-time"); * $p \leq .05$ (compared with "on-time"); ** $p \leq .01$ (compared with "on-time"); *** $p \leq .001$ (compared with "on-time");

[a] $p \leq .05$ (compared with "never"); [b] $p \leq .05$ (compared with "late")

Hypothesis 5: Socioeconomic status accounts for some of the variation in timing of initiating HPV vaccinations.

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. Thus, the fourth hypothesis is unsupported.

DISCUSSION

This study used an intersectional and biopower framework to illuminate how gender, race/ethnicity, and their intersections may be associated with the timing of initiating HPV vaccinations. Timing of initiating HPV vaccine uptake was defined by the CDC's vaccination schedule. Although the HPV vaccine has been proven to curtail high rates of HPV and HPV-related illness with no adverse effects, when compared to other adolescent vaccines such as Tdap and meningitis, HPV vaccine uptake remains substantially low (Walker et al. 2017). An underlying assumption regarding low HPV vaccine uptake is parents' apprehension in vaccinating young adolescents with a vaccine that is highly correlated with sex and sexually transmitted infections. An additional underlying assumption is that HPV, HPV-related illness, and the HPV vaccine are highly gendered and, to a lesser degree, racialized. Gendered conceptions of who the vaccine will benefit, as well as gendered and racialized conceptions of which subject sexualities require regulation, may predict timing of initiating the HPV vaccine.

Five major findings emerged from this study. First, this study echoes similar findings of low HPV vaccine uptake in other studies. This study descriptively adds to HPV vaccine research by underscoring the extreme low uptake overall and across status groups—more than half of the

respondents overall and within each status group have yet to initiate the HPV vaccine. Several broad factors have been examined to understand low HPV vaccinations. Brewer et al. (2008) reported that the top reasons parents do not vaccinate their children is due to lack of information about the vaccine, lack of visiting a healthcare provider, lack of provider recommendation, being born-again Christians, and barriers to getting the vaccine. In contrast, Walter et al. (2016) found that parents do not vaccinate their children out of fear that the vaccine will encourage early sexual debut and risky sexual behavior. Additionally, due to psychological barriers that prevent parents accepting that their children are not sexually active, will not be sexually active, and/or not at-risk of contracting a sexually transmitted infection, some parents believe that the vaccine is unnecessary for their children (Grandahl et al. 2014).

This finding is alarming because HPV and HPV-related morbidity and mortality can easily and significantly be reduced with the HPV vaccine. Parallel to this study's findings of extremely low uptake are the pervasive high rates of HPV in the population. As previously stated, the national estimates of the prevalence of any genital HPV is 42.5 percent of the total population and the prevalence of any high-risk genital HPV is 22.7 percent of the population, for noninstitutionalized adults aged 18-69 for the year 2012 to 2014. In other words, almost 50 percent of the population are at-risk of developing genital warts and other benign or low-grade genital neoplasia and almost an additional 25 percent of the population are at-risk of developing HPV-related cancers. While the reduction of HPV and HPV-related morbidity and mortality can easily and significantly be reduced with the HPV vaccine, presently more than half of the population are not initiating HPV vaccinations. This finding exposes the "countless missed opportunities to prevent cancers and other HPV-associated health outcomes" (McGhee et al. 2017).

To increase HPV vaccine uptake, public health officials and healthcare providers in particular should balance advocating the overall benefits of the vaccine while addressing sexuality in the context of HPV vaccinations. For example, to refute parents' assumption that the vaccine is unnecessary because HPV can be prevented with safer sex practices, such as having sex when one is married or using condoms, healthcare officials and providers should underscore the prevalence of HPV infections and that the HPV vaccine is the only method that prevents HPV infection. Also, parents should be reminded of the importance of vaccinating children before exposure to HPV, as well as the proven effectiveness of the vaccine. Additionally, to contest parents' belief that HPV-related cancers can be prevented with pap smears, emphasis should be placed on the risk of contracting other HPV-related cancers that cannot be detected with pap smears, especially for males. Moreover, healthcare officials and providers should increase parental and adolescent knowledge on HPV and the HPV vaccine, especially with culturally sensitive information, and maximize access to vaccination services. Healthcare providers are key to HPV vaccine uptake because studies have found that a strong provider recommendation of the HPV vaccine increases parents' decision to vaccinate their offspring 5-fold (Ylitalo et al. 2013). Yet, as Cheng et al. (2018) underscore, healthcare providers must actively inform and engage with adolescents and parents to deliver effective patient-centered care, instead of making firm recommendations.

A second major finding is that gender is predictive of timing of initiating HPV vaccinations. Females are significantly more likely than males to initiate the HPV vaccine compared to on-time vaccinations and never vaccinating. Low HPV vaccinations among males illustrates how females are regulated in ways that males are not. Nathanson (1991) argues that female sexuality is socially constructed as more fragile and endangered than male sexualities,

and, therefore, requires protection. On the other hand, young female sexualities may also be a threat to society if uncontrolled. Consequently, gendering sexualities creates a double standard that regulates female sexualities while holding (most) males unaccountable. This double standard is illustrated in the gender disparities of HPV vaccine uptake. Because biopower regulates female sexualities and subject bodies, the discourse on HPV and HPV-related illnesses becomes gendered. For example, while the HPV vaccine protects against strains found in all HPV-related cancers, the vaccine is marketed as a cancer preventative for women—cervical, vulvar and vaginal, and anal[9] cancer. This marketing centers females as the sole benefactors of the vaccine, resulting in the negation of male health. Yet, males also need the HPV vaccines to obtain adequate protection against the virus and are key actors in population health.

This finding is alarming because, as previously stated, prevalence of any and high-risk oral-HPV and any and high-risk genital HPV is higher among males than females (McQuillan et al. 2017). In other words, males are more likely to have HPV, transmit HPV to their sexual partner(s), and develop HPV-related illnesses. For example, approximately three to four million males are diagnosed with genital warts each year, with the majority of diagnoses occurring under the age of 30 (Insinga 2003).[10] Additionally, while cervical cancer is the second leading HPV-related cancer for women, the oropharyngeal cancer for men is currently the most prevalent HPV-related cancer (Perkins 2012). In 2017, it is estimated that there was a 61 percent increase in oropharyngeal cancer diagnosis, 70 percent of which is caused by HPV. Also, males are at higher risk of having persistent reoccurring HPV diagnoses because of the underdevelopment of antibody level responses to HPV. Moreover, males are more likely to be at higher risk of HPV

[9] Anal cancers are more prevalent among females than males.
[10] 500 per 100,000 diagnoses of genital warts for males aged 25-29

infections due to the likelihood of having an increased number of sexual partners (Moscicki and Palesky 2012). Therefore, targeting males to increase HPV vaccine uptake is crucial in curbing the transmission of HPV and HPV-related illness for both males and females.

To mitigate this gender disparity, the HPV vaccine should be marketed as beneficial to both males and females. For example, instead of marketing the HPV vaccine as a cervical cancer preventative, it should be marketed as preventing against high-risk HPV strains 16 and 18, which are found in all six HPV-related cancers for both genders: cervical, vaginal, vulvar, penile, oropharyngeal, and anal. Zimet and Rosenthal (2010) echo this recommendation by underscoring the cost-effectiveness of the HPV vaccine for males by emphasizing that the HPV vaccine protects against genital warts and provides some degree of preventing transmission to their partners.

A third key finding is the lack of significant differences in the timing of initiating the HPV vaccine racial/ethnic groups overall in model 1, among white, African American, and Latinx males in Table 4, and after socioeconomic status variables are introduced in model 3. These null findings are surprising because contrary to theories that predict vaccine uptake, this study could not predict the timing of initiating the HPV vaccine for these groups. The null findings could be due to this study's inability to account for healthcare provider characteristics and choice of healthcare facilities, parental agency, child agency, health insurance and type of healthcare insurance, and region. Healthcare provider characteristics and choice of healthcare facilities is important because they influence the availability of the HPV vaccine, quality of care, vaccine decisions. Parental agency and child agency are also crucial in the vaccine decision making process. Health insurance and the type of health insurance are strong facet of socioeconomic status and can greatly increase the access to and utilization of vaccines. Region

can be a mediating factor because different regions contain varying degrees of racial/ethnic population makeups as well as different policies regarding sexual health, sexual rights, and vaccination resources. This study could not account for healthcare provider characteristics and choice of healthcare facility, parental agency, and child agency because it was not measured in the survey data. As previously stated, health insurance could not be used as a mediating socioeconomic status variable because of the retrospective nature of this study. Moreover, this study could not use region as a control variable because of the small sample size of important groups within the study, which would cause statistical power issues for the multiplicative interaction term between gender and race/ethnicity.

A fourth key finding is the vaccination disparities for Asian American males. While Asian American males more likely than white respondents to never initiate the HPV vaccine, Asian American males are more likely than white males to initiate the HPV vaccine late. While there is a dearth of health research on Asian Americans, there are two possible explanations for the low uptake disparity. The first explanation could possibly be due to Asian American mothers' low levels of awareness and knowledge of HPV and the HPV vaccine. Mothers' knowledge of HPV and HPV vaccinations is important because mothers are primarily responsible for their children's health, attending health care appointments, interacting with healthcare providers, and making vaccine decisions (Cockerham 2012; Reich 2016; Taylor et al. 2014). Studies have found that Asian American mothers, particularly Asian American mothers who have low English proficiency, are less knowledgeable about HPV and the HPV vaccine and are, therefore, less likely to ask for the vaccine for their children (Lee et al. 2016; Taylor et al. 2014). Yet, this explanation places too much responsibility on mothers and ignores the fact that healthcare providers play a key role in vaccine uptake and that they can

influence parents vaccine decisions by 5-fold. This leads me to the second, more plausible explanation.

The second explanation of Asian American male vaccination disparities is the lack of provider recommendations. Studies on vaccine recommendations in general and the HPV vaccine in particular underscore the importance of provider recommendations in influencing uptake. A common cited barrier to HPV vaccine uptake for Asian American females is the lack of provider recommendation (Taylor et al. 2014). While not yet studied, provider recommendations can be further reduced for Asian American males due to providers' implicit biases. Providers may have implicit bias toward Asian American males due to popular culture representations of Asian American male sexualities. According to Shimizu (2012), contemporary images of racialized and sexualized masculinities exclude Asian American men from normative definitions of masculinity. Although Asian American males were depicted as sexual predators and vectors of diseases in the early 20th century, Asian American males today are typecast as "model minorities" who are nonsexual, effeminate, and sexually lacking (Shimizu 2012). In other words, while non-white males and females continue to be hypersexualized subjects, Asian American males have transformed from being seen as a "yellow peril" into a hyposexualized subject. This characterization of Asian American sexuality is done by hegemonic powers to, appositionally, define one's own racialized sexuality. As a result, Asian American males are also no longer seen as threatening to white heteronormative patriarchy nor to population health. Instead, the model minority myth converges with stereotypes of hyposexualization to postulate that with respect to their health, all Asian American males "are better off than other racial and ethnic groups, which has led policymakers, healthcare works, and researchers to ignore the plight many of them experience" (Kim, Keefe, and Linn 2014).

Consequently, it is inferred that Asian American males no longer require biopower's regulation vis-a-vis biopolitics, causing Asian American males to be negated from being recommended the HPV vaccine.

There are also two possible explanations for the phenomenon of late HPV vaccinations for Asian American males. One reason could be that providers are recommending the vaccine later for Asian American males because Asian American males are more likely to delay sexual debut (Haydon et al. 2014) and are less likely to engage in risky sexual behaviors (Cockerham 2012) and are less likely to diagnosed with HPV (Meites et al. 2017). Yet, this explanation is refuted when taking into account that males, older adolescents (Cockerham 2012), and Asian Americans (Takada et al. 1998) tend to underutilize healthcare services. Instead, Asian American males may be late in initiating HPV vaccinations after hearing about the vaccine and having the agency to request it from their providers.

Disparities in timing of initiating HPV vaccinations for Asian American males is alarming for several reasons. First, vaccinating later creates an economic burden for patients because of the additional visitations required of late vaccinations set outside of the routine schedule of on-time vaccinations. Instead of receiving two shots with on-time vaccinations, patients will need to receive three shots. Each HPV vaccine shot costs about $350. Secondly, late vaccinations increase the chances of not completing the vaccine series. Moreover, Asian Americans are the fastest growing racial/ethnic population in the United States and will be the largest immigrant group by 2055 (Lopez, Ruiz, and Patten 2017). If vaccinations do not increase for Asian American males, future HPV and HPV-related disparities may occur. Lastly, the few studies on Asian American health have shown that cancer and accessing cancer preventive screenings are a major challenge for Asian Americans (Ponce, Gatchell, and Brown 2003).

To mitigate these disparities, the HPV vaccine should be recommended to all social demographic groups, with a particular emphasis in the target age group, to impact the overall U.S. population health. Additionally, healthcare officials should provide culturally sensitive educational materials on the HPV vaccine to increase understanding of disease prevention measures and knowledge about HPV and the HPV vaccine.

The last key finding is the importance of accounting for intersectionality in health disparities research. By including the multiplicative term that represents the intersection of gender and race, this study produced significant results that highlight how multiple social statuses are the driver of differences in initiating HPV vaccinations. Without this multiplicative term, the underlying intersectional oppressions Asian American males experience would not have been uncovered. Reducing the analysis to any one single determinant would be inadequate for understanding the various dimensions that are at play in shaping and influencing social positions and power relations. For example, sole attention to gender carries the risk of treating all males or all females the same. Thus, intersectionality is an important framework for examining health inequities and should be utilized by medical sociologists.

Limitations

This study's limitations emphasize the importance of future work on HPV vaccine uptake. One limitation is right censoring—many respondents still have the opportunity to be vaccinated on-time and late because they have not yet aged out the vaccination schedule. With observational cross-sectional survey data, this study could not detect if respondents initiated the vaccine after the survey year. Longitudinal research will be an important complement to these

findings. This study was also limited by the lack of variables measuring healthcare provider characteristics and choice of healthcare facilities, health insurance and type of health insurance, parental agency, child agency, and region. My future qualitative research will attempt to shed light on these factors by conducting participant observations in healthcare facilities and interviews with providers, parents, and young adolescents. Finally, there may be conflation of the diverse characteristics of Latinx and Asian American populations. Although NHANES oversampled on Latinx and Asian American populations, the diverse cultures and experiences were not captured. For example, a single country-of-origin group does not dominate the Asian American population. Moreover, individuals from both populations may have limited English proficiency and/or be undocumented and, therefore, may have declined to participate in national-level research. Alternatively, respondents who participated may have higher levels of socioeconomic status, resulting in a sampling limitation. Lastly, within both groups, different countries have varying immigration waves. Improved data collection is needed to capture and understand within-group variation and ethnic diversity. For example, collecting data on multiple measures of characteristics such as country of birth, parents' country of birth, year of arrival in the United States, and (great/grand) parents' year of arrival in the United States should be conducted.

Despite these limitations, this work contributes to the literature on vaccines overall and HPV vaccinations in particular by illustrating that increasing HPV vaccinations overall and on-time vaccinations in particular for all social status groups needs improvement. To date, no other study has examined timing of initiating HPV vaccinations, which is crucial in curtailing HPV and HPV-related morbidity and mortality. These findings expanded on existing vaccine literature by examining how timing of HPV vaccinations differ by gender, race/ethnicity, and

their intersections. Additionally, these findings challenge existing HPV vaccine literature by analyzing how, as a biomedical, biopower technology, the HPV vaccine can be used to regulate and subjugate gendered and racialized sexualities.

Conclusion

Although the timing of initiating the HPV vaccine is an important for curbing HPV and HPV-related illness, to date, no studies have examined the timing initiating the HPV vaccine and how this timing differs by social groups. By using an intersectional and biopower framework, this study highlights how the de/sexualization of the HPV vaccine has gendered and, to some extent, racialized HPV, HPV-related illnesses, and the HPV vaccine. Subsequently, this gendering and racialization is associated with disparities in HPV vaccinations by regulating subject bodies through public health practices. By focusing on the multidimensionality of social statuses, this study sheds light on how biopower marginalizes females and Asian American males. This focus on otherwise-privileged group members—males—creates a distorted analysis of sexism and racism because the operative conceptions of race and sex become grounded in experiences that actually represent only a subset of a much more complex phenomenon. Thus, intersectionality theory illuminates the complexity of individuals. A biopower framework illustrates how individuals and populations are categorized, valued, and regulated in the name of population health. The body is a medium in which the significance of gender, race/ethnicity, and sexuality is most dramatically seen in health regulation. The HPV vaccine becomes another mechanism to gender and racialize bodies, illnesses, and regulation. These findings contribute to a growing body of literature on vaccine timing in general and HPV vaccines in particular. As

shown here, the different positions that gendered and/or racialized bodies occupy affect their timing of initiating HPV vaccine uptake. Consequently, this has profound impact on health disparities.

Reducing disparities in HPV vaccine uptake is an important goal for improving population-level health. The results presented in this study provide several new insights for understanding how gender and the intersection of gender and race/ethnicity produce inequalities in health. To understand this complexity, gender and race cannot be treated as mutually exclusive categories of experience and analysis. Scholars analyze health disparities with an intersectional lens to understand which identities are advantaged and which are disadvantaged and in what contexts.

This study is an important preliminary step toward an understanding of how gender, race/ethnicity, and their intersections determine age-specific probabilities of initiating HPV vaccinations: on-time, late, or never. Future studies should examine the ways in HPV vaccine uptake is shaped by provider-parent-adolescent interactions. Healthcare policies, healthcare facilities, providers' implicit biases, and parent and child agency are social influences on vaccine decision making that have yet to be studied with the HPV vaccine. This will likely require multimethod research.

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