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Perceived Risks and Benefits of HPV Vaccination: The Role of Cues to Action, Numeracy and, Literacy

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PERCEIVED RISKS AND BENEFITS OF HPV VACCINATION: THE ROLE OF CUES TO
ACTION, NUMERACY, AND LITERACY

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Dedication

To my family, whose unconditional love and unwavering belief in my success have been the foundation upon which my aspirations stand, your sacrifices and encouragement have been my greatest motivator to pursue higher education.

To my friends and classmates, who have shared their ears, provided invaluable insights, and offered their unwavering support, I am forever grateful for the camaraderie we share. Your faith in me has been my constant source of inspiration.

To the entire ensemble of Cheers, I raise a glass in honor of your enduring legacy. Thank you for reminding us that sometimes, all you need is to somewhere where everybody knows your name.

PERCEIVED RISKS AND BENEFITS OF VACCINATION: THE ROLE OF CUES TO
ACTION, NUMERACY, AND LITERACY

by

SIERRA RAE GALVAN, B.S.

THESIS

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Abstract

Background & Significance: The Human Papillomavirus (HPV) is a risk factor for both genital warts and cervical cancer. HPV strains 16 and 18 are recognized as precursors of cervical cancer. While strains 6 and 11 are estimated to cause 90% of genital warts. Latinas have the highest rate of cervical cancer in the U.S, approximately 66 % higher than non-Latino whites. These cancers are preventable in many cases through the administration of the HPV vaccine. The advisory committee on immunization practices recommends that children as young as 9 receive at least two doses of the three-dose HPV vaccine series. Consequently, parents are the primary vaccination decision-makers. Unfortunately, HPV vaccination rates among Latinos remain low. Past research on HPV vaccination uptake has been informed by prominent health behavior theories such as the health belief model and indicates that perceived severity and susceptibility of contracting HPV, perceived benefits and barriers to vaccination, and cues to action such as a health provider's recommendation to vaccinate are factors that influence vaccination uptake among parents. Although the influence of a provider's recommendation has been extensively documented, little research has been conducted to understand the manner in which health literacy and numeracy influence parents' understanding of information provided by healthcare providers about vaccination and its perceived utility and its link to perceived risks and benefits of vaccination.

Methods: The proposed study will consist of a secondary data analysis of a cross-sectional survey study conducted to understand the factors associated with uptake of the HPV vaccine among a sample of Latina mothers of vaccine eligible children. The study will analyze the influence of health literacy and numeracy on perceived utility of vaccine information provided

by health care providers about the HPV vaccine and perceived risks and benefits of vaccination. The sample will be 88 mothers of pre-teen children.

Contribution to Public Health: This thesis aims to expand the scant literature on the role of health literacy and numeracy on perceptions of the information provided by health care providers and the ensuing perceptions about risks and benefits of vaccination. Findings will have implications for the development of interventions and strategies to encourage Latino families to vaccinate their children against HPV.

Key words: Human Papillomavirus, Cervical Cancer, HPV Vaccine, Cues to Action, Health Numeracy, Health Literacy

Word Count: 375

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Introduction

The Human Papillomavirus

The Human Papillomavirus (HPV) is the most prevalent sexually transmitted infection (Centers for Disease Control and Prevention, 2021). The Centers for Disease Control and Prevention (CDC) estimate that in the United States, about 80 million people are currently infected with HPV, and about 14 million people are diagnosed with an HPV infection every year (CDC, 2021). According to the National Cancer Institute (NCI), around 80% of people who have engaged in sexual activity will contract HPV at least once in their lifetime.

The human papillomavirus virus is transmitted through sexual, and skin-to-skin contact between close partners (CDC, 2021). HPV can also be contracted by engaging in vaginal, anal, or oral sex with positive individuals who are asymptomatic (CDC, 2021). HPV does not always exhibit symptoms in patients, and because of this, many HPV-positive people are unaware that they are infected. Even without medical intervention, more than 90% of all new HPV infections clear or become undetectable within two years after initial diagnosis (CDC, 2021). However, some HPV infections can persist and cause symptoms such as genital warts. For most people, the infection is cleared on its own, but chronic or persistent infections, especially when caused by specific high-risk HPV strains, can eventually lead to cancer (CDC, 2021).

Types of HPV

HPV strains are categorized as either low or high-risk HPV types. Of the more than 150 HPV strains, 40 types are sexually transmitted and are likely to infect the genital area. A person may be infected with multiple HPV strains at once. However, many HPV types don't pose a significant health risk. Mucosal HPV types, which make up the other 25%, manifest in open

cavities in the body, such as on the vulva and penis, the cervix or vagina in women, the scrotum in men, or the anus in both men and women (American Cancer Society [ACS], 2020). Because mucosal HPVs often affect the anal and genital areas, they are sometimes called genital or anogenital HPV types (ACS, 2020). Approximately 90% of genital warts are attributed to HPV strains 6 and 11 and around 1% of sexually active Americans have genital warts, which must be treated to stop them from spreading to other genital areas and to sexual partners (CDC, 2022).

Mild cervical dysplasia, which is an abnormal alteration in the cells on the surface of the cervix, can be brought on by some low-risk HPV strains. However, most low-risk genital HPV variants are asymptomatic (CDC, 2022). Cancer may develop from high-risk, oncogenic, or "cancer-causing" HPV varieties. High-risk HPV infections can lead to severe cervical dysplasia and manifest as cancer (CDC, 2021). There are at least 12 high-risk HPV strains, although only HPV types 16 and 18 have been linked to cancers of the cervix, vagina, vulva, penis, and anus. (CDC, 2021).

Cancers Associated with HPV

The American Cancer Society indicates that HPV is linked to cancer and other malignancies and high-risk HPV varieties are responsible for 5% of all cancers (ACS, 2022). It is estimated that the HPV virus causes cancer in about 60,000 men and 570,000 women each year (ACS, 2021). High-risk HPV varieties are responsible for 3% of cancers in women and 2% of cancers in men in the United States and about 36,000 of these new cancer cases are caused by HPV (CDC, 2021). HPV is the cause of more than 90% of anal and cervical cancers, about 70% of vaginal and vulvar cancers, and 60% of penile cancers (CDC, 2022). Research also suggests that 60–70% of malignant oropharynx cancer cases are linked to HPV (CDC, 2021).

In addition, cervical cancer is caused by persistent human papillomavirus (HPV) infection (CDC, 2021). A persistent HPV infection caused by oncogenic HPV types can transform healthy cells into cancerous cells if the body's immune system is unable to eradicate it. The CDC estimates that 10% of women with HPV infections on their cervix will go on to have persistent HPV infections, which increases their risk of cervical cancer (CDC, 2022). Moreover, pre-cancers can develop when high-risk HPV remains and infects the cells of the vulva, vagina, penis, or anus (CDC, 2022). These malignancies are significantly less prevalent than cervical cancer. However, much less is known about how many people with HPV will develop cancer in these places (CDC, 2022).

The only cancer linked to HPV for which screening is advised is cervical cancer. Women between the ages of 21 and 65 should get regular tests for cervical cancer and pre-cancer (NCI, [National Cancer Institute], 2022). Women between the ages of 21 and 29 should undergo a Papanicolaou (Pap) test every three years to screen for any cervical abnormalities (NCI, 2022). The screening methods available and timing of screening for women between the ages of 30 and

65 are a Pap test every three years, an HPV test every five years, or both a Pap and an HPV test every five years (NCI, 2022). Any abnormal test results must be followed up on and treated (NCI, 2022).

Unfortunately, there are wide disparities in cervical cancer incidence and mortality in the United States by race and ethnicity. Disturbingly, however, race is a strong predictor for the development of cervical cancer in the United States. In 2019, the age-adjusted rate of new cases of cervical cancer among Latina women was 9.7 per 100,000. American Indian and Alaska Native, Non-Latina women had age adjusted rates of 9.0 per 100,000 (U.S. Cancer Statistics, 2022). Black, Non-Latina women had age-adjusted rates of 8.4 per 100,000 (U.S. Cancer Statistics, 2022). White, Non-Latina women had the lowest rates of new cervical cancer cases with 7.0 per 100,000 (U.S. Cancer Statistics, 2022). Despite Latina women having the highest rates of new cases of cervical cancer, Black, Non-Latina women had highest rates of deaths due to cervical cancer with 3.4 per 100,000. Latina women had mortality rates of 2.4 per 100,000 while non-Latina white women (NLW) had mortality rates of 2.0 per 100,000 (U.S. Cancer Statistics, 2022). Overall, the 5-year relative survival rate for cervical cancer is similar for Latina women (68%) and NLW women (67%) although, when confined to women younger than 50 years, Latina women have slightly lower 5-year survival than NLW of the same age range (75% vs 79%) (Miller et al., 2021). Unfortunately, for Black women, the 5-year relative survival rate is 56% and remain disproportionally affected by survival disparities when compared to other racial/ethnic group in the country (U.S. Cancer Statistics, 2022).

The HPV Vaccine

The US Food and Drug Administration has granted approval to three HPV vaccines: Cervarix®, a 2-valent HPV vaccination, Gardasil® 9, a 9-valent HPV vaccine, and Gardasil®, a 4-valent HPV vaccine (CDC, 2022). Most HPV-related cancers are caused by HPV types 16 and 18, which the available immunizations protect against (CDC, 2022). (CDC, 2022). As of 2016, the only vaccine distributed in the US is Gardasil-9 (9vHPV) which protects against nine HPV types, including strains that lead to cervical cancer (CDC, 2022)

More than 135 million vaccine doses have been distributed in the United States and over 15 years of monitoring and cumulative research indicates that the HPV vaccine is effective and safe (CDC, 2021). HPV infections, genital warts, and cervical pre-cancers have declined since the vaccine was approved for use in the United States (CDC, 2021). Since the first recommendation for HPV vaccination was issued in 2006, rates of genital warts infections and associated cancers have decreased by 88% in teenage girls and by 81% in young adult women (CDC, 2021). Furthermore, the number of cervical pre-cancers in young women has decreased by 40% (CDC, 2021). Each HPV vaccine, the 9-valent HPV vaccine (Gardasil® 9), quadrivalent HPV vaccine (Gardasil®), and the bivalent HPV vaccine (Cervarix®), went through a strict safety testing process before being licensed by the U.S. Food and Drug Administration (FDA) (CDC, 2021). As part of vaccine testing, more than 15,000 males and females have participated in clinical trials to examine the effects of Gardasil® 9. Currently, the only HPV vaccine accessible for use in the United States since late 2016 is Gardasil® 9 (CDC, 2021)

The CDC recommends that all preteens get the HPV vaccine to protect them from high-risk HPV types that can cause cancer later in life. Two doses of the HPV vaccine are recommended for children between the ages 11 to 12 but can be given to children starting at the

age of 9. The first dose is administered between the ages of 11 and 12, and the second dose is given 6–12 months later (CDC, 2021). Only two doses of the vaccine are needed for children who get both before their 12th birthday and children ages 9 to 14 get a third dose of the vaccine if they had two doses of the vaccine less than five months apart. It is recommended that children get two shots of the HPV vaccine before they turn 15 and prior to starting sexual relations (CDC, 2021). However, three doses of the HPV vaccine are required for teens and young adults who begin the series between the ages of 15 and 26 (CDC, 2021). Because the benefit of HPV vaccination declines with age, catch-up vaccination is not advised for some adults over the age of 26 (CDC, 2021). However, for adults between the ages of 27 and 45 who have not received the recommended number HPV vaccine doses, vaccination based on shared clinical decision-making between the patient and medical provider is recommended (CDC, 2021).

HPV Vaccination Rates

Trends in self-reported HPV vaccination initiation and completion among adults aged 18 to 26 between 2013 and 2018 in the United States are assessed through the National Health Interview Survey. Since 1957, the National Health Interview Survey (NHIS) has kept tabs on the country's health. Personal household interviews are used to collect data for the NHIS on a variety of health-related issues (CDC, 2022). The results of surveys have been crucial in giving information on health status, access to care, and advancements made toward achieving national health goals (CDC, 2022).

Overall, the percentage of persons aged 18 to 26 who have ever had one or more doses of the HPV vaccination increased from 22.1% in 2013 to 39.9% in 2018 (Boersma and Black, 2020).

During the same period, the percentage of women who had ever gotten one or more doses of the HPV vaccination rose from 36.8% to 53.6%, while the proportion of males who had received the vaccine more than quadrupled from 7.7% to 27% (Boersma & Black, 2020). Similarly, the rates of adults who have received the recommended number of doses of the HPV vaccine has increased over time. Specifically, rates rose from 13.8% in 2013 to 21.5% in 2018. The percentage of women who had received their recommended number of HPV vaccination doses also rose from 25.7% in 2013 to 35.3% in 2018 (Boersma & Black, 2020). In 2018, non-Latino white individuals had a higher likelihood of ever receiving one or more doses of the HPV vaccine than Latino adults (Boersma & Black, 2020). Compared to Latina (48.8%) and non-Latina black women (44.7%), NLW women (57.9%) were more likely to have ever had one or more doses of the HPV vaccine (Boersma & Black, 2020). Non-Latino black men (29.4%) had the highest percentage of adult men who had ever received one or more doses of the HPV vaccine. However, this percentage did not significantly differ when compared to non-Latino white (26.6%) or Latino (24.7%) men (Boersma & Black, 2020).

Non-Latino white individuals were more likely to have ever received one or more doses of the HPV vaccine compared to their black and Latino counterparts (Boersma & Black, 2020). Women were more likely than men to have ever received one or more doses and the recommended number of doses of the HPV vaccine across all racial and ethnic groups (Boersma & Black, 2020). Similarly, women (21.9%) who had one or more doses of the HPV vaccine were more likely than men (11.8%) to have had their first dose before the age of 13 (Boersma & Black, 2020). However, men between the ages of 18 and 26 (27.4%) were more likely than women (18.3%) to have received their first dose of the HPV vaccine (Boersma & Black, 2020).

To evaluate the level of immunization among teens aged 13 to 17 in all 50 U.S. states and U.S. territories, a random-digit-dialed telephone survey known as NIS-Teen is carried out every year (Pingali et al., 2022). The annual study collects data from the parents of roughly 20,000 teenagers and confirms each teenager's vaccination history with their doctor. Most of the teenagers who participated in the 2020 poll had been vaccinated before March 2020. Unfortunately, the data may be inaccurate as the COVID-19 pandemic affected vaccination rates, although the data does point to encouraging trends prior to the outbreak (Pingali et al., 2022).

Adolescents who had gotten at least one dose of the HPV vaccine have increased from roughly 68% in 2018 to 72% in 2019 and 75% in 2020 (Pingali et al., 2022). However, despite being able to prevent cervical and other cancers, over 40% of teenagers have not yet received their HPV vaccination (Pingali et al., 2022). Compared to their peers in urban cities like New York and Los Angeles, fewer youths in rural areas had received at least one dose of the HPV vaccine (Pingali et al., 2022). Approximately half of teenagers in rural areas were up to date with their vaccination course (Pingali et al., 2022).

According to Conrey et al. (2022), HPV vaccination rates vary considerably by U.S. state and across regions within a state. For example, there are substantial differences in the HPV vaccination rates for starting the series (1 + doses) and finishing it (3 + doses) across six different geographic areas in Texas. Across Texas regions, El Paso County exhibited the highest rate of initiation of the HPV vaccine (83%) and Dallas County exhibited the lowest rate of initiation (55%) (Conrey et al., 2022). Similarly, the rate of completion of the HPV vaccine series differed significantly between regions. El Paso County showed the highest rate of completion of the HPV vaccine series (51%) and Dallas County showed the lowest rate of completion (30%) (Conrey et al., 2022).

In fact, El Paso County had the fifth highest initiation rate and fourth highest completion rate of all the areas surveyed by the NIS-Teen in 2016 despite the state of Texas having one of the lowest HPV vaccination rates in the United States, Conrey et al., (2022) suggests various elements that may have contributed to the high HPV vaccination rate in El Paso County. For example, compared to other counties in Texas, El Paso County has a higher proportion of Latino population due to its location on the US-Mexico border (Conrey et al., 2022). Moreover, comparing Latino and NLW women, those who are diagnosed with cervical cancer are substantially more likely to be Latino (Conrey et al., 2022). In addition, Latino women who reside near the US-Mexico border are substantially more likely than those who do not to be diagnosed with cervical cancer. These facts, along with the findings of a recent study demonstrating a positive correlation between perceived risk of HPV-related cancers and HPV vaccine uptake, may help to explain why El Paso has such a high HPV vaccination rate (Conrey et al., 2022). Areas with higher rates of HPV-related cancers also had higher HPV vaccination rates (Conrey et al., 2022). Also, El Paso County launched a culturally appropriate HPV vaccine campaign that increased immunization rates all around the area and might serve as a template for other areas looking to increase HPV vaccine uptake (Conrey et al., 2022).

Background & Significance

Health Numeracy and Literacy and HPV Vaccination

According to the Center for Disease Control and Prevention (2023), personal health literacy is defined as an individual's ability to find, interpret, and use information and services to inform health-related decisions and actions for themselves and others. Health numeracy is defined as the ability to use numeric information in the context of health. The interpretation and application of numbers in health may vary across cultural groups (CDC, 2023).

Schapira et al. (2011) explored the influence of health numeracy among a purposeful sample of participants from clinical and community sites in the Milwaukee and Chicago metropolitan areas. Six focus groups were conducted with 50 participants, participant answers were analyzed using the principles of grounded theory. A theoretical framework of health numeracy was developed based upon categories and major themes that emerged from the analysis (Schapira et al, 2011). In addition, the research suggested that numeracy skills are applied to a broad range of communication and decision-making tasks in health, affective and cognitive responses to numeric information influence use of numbers in the health setting, and there exists a strong desire to understand the meaning behind numbers used in health (Schapira et al., 2011). The authors concluded that understanding numbers is an important part of a range of skills and has important applications in health decisions (Schapira et al, 2011). This study expands previous work that strives to understand the application of numeric skills to medical decision making and health behaviors (Schapira et al., 2011).

A cross-sectional study was conducted at pediatric clinics in four academic institutions to examine the literacy and numeracy skills of Spanish-speaking caregivers, as well as to validate a Spanish version of the Parental Health Literacy Activities Test (PHLAT) (Yin et al., 2012). To

assess the health literacy of English-speaking parents of young children, the PHLAT2 was created. Although no previous psychometric evaluations of parent health literacy have been carried out in Spanish, past research with the PHLAT revealed the usefulness of this instrument as a functional parent health literacy assessment in English (Yin et al., 2012). The study consisted of examining the psychometric properties of the Spanish version of the PHLAT to analyze the health literacy and numeracy of Spanish-speaking parents (Yin et al., 2012). Results indicated that of 176 caregivers, 77% had adequate health literacy (S-TOFHLA), whereas only 0.6% had 9th grade or greater numeracy skills (Yin et al., 2012). From the sample, it was reported that less than half (45.5%) of participants were able to read a prescription label for a liquid antibiotic and show how much medicine to put in an oral syringe (Yin et al., 2012). Moreover, less than one-third (31.8%) were capable of understanding whether a food item complied with WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) from a label (Yin et al., 2012). The authors concluded that more strides should be taken in identifying parents who would benefit from receiving low-literacy child health information (Yin et al., 2012).

Holman et al. (2014) systematically reviewed the literature on barriers to HPV vaccination among US adolescents to inform future efforts to increase HPV vaccine coverage (Holman et al., 2014). The findings of 55 studies that included men, parents, underprivileged and disadvantaged communities, and health care professionals, were summarized (Holman et al., 2014). Healthcare experts identified finances as well as parental attitudes as challenges to administering the HPV vaccine (Holman et al., 2014). Parents cited several hurdles including worries about the vaccination may encourage the initiation of sexual relations, the child's low perceived risk of HPV infection, societal factors such as social norms, decreased access to

preventive health care services, lack of health insurance coverage, the price of the vaccine, and lack of pertinent information on the vaccine (Holman et al., 2014). Recommendations from medical professionals were frequently listed by parents as one of the most crucial elements in their choice to ultimately vaccinate their children (Holman et al., 2014).

Stakeholder views of the Human Papillomavirus HPV vaccine among Latino migrant farmworkers were investigated by Vamos et al. in 2021. Interviews with a variety of stakeholders, including those from the political, social services, and health sectors, were conducted using the PRECEDE-PROCEED framework and the Social Ecological Model (Vamos et al., 2021). Stakeholders were asked about their views on what prevents and promotes migrant farmworkers receive HPV vaccinations (Vamos et al., 2021). Parental acceptance of vaccinations and positive attitudes were classified as the micro-level facilitators of acceptance. Free or inexpensive health care clinics were categorized as meso-level facilitator while governmental vaccination initiatives and programs were a macro-level facilitator (Vamos et al., 2021). Low health literacy and lack of education were examples of the classification of micro-level hurdles. Poor patient-provider communication, lack of access, public perceptions/attitudes toward HPV vaccination, and lack of continuity in healthcare services due to migration patterns were some of the meso-level barriers (Vamos et al., 2021). Public perceptions and attitudes about HPV vaccination, transportation, vaccine accessibility and coverage for non-citizens, and a lack of mandatory immunization policies across academic institutions were some of the reported macro-level barriers (Vamos et al., 2021).

According to Galvin et al. (2021), individuals who receive a healthcare provider recommendation may find it easier to make vaccination decisions if they possess health literacy abilities such as finding, understanding, accessing, and applying the health information

associated with receiving HPV vaccine recommendation from a health care provider (Galvin et al., 2021). Galvin et al. (2021) hypothesized that various domains of health literacy will be more strongly associated with willingness to get the HPV vaccine after a provider recommendation than personal determinants alone. In the study conducted by Galvin et al. (2021), American adults who were married (60.7%) and mostly non-Latino white (74.4%) were asked about their desire to receive the HPV vaccine after their provider had recommended it. The Srensen's multidimensional European Health Literacy Scale, which assesses health literacy across four areas, was employed to assess health literacy (Galvin et al., 2021). Results indicated that higher perceived vulnerability to HPV-related cancer, ability to understand HPV information, and need for more information on vaccine safety were all significantly associated with higher willingness to vaccinate after the recommendation of a healthcare provider (Galvin et al., 2021).

A vast number of studies have been conducted to understand the factors that influence HPV vaccination uptake among parents of pre-teen children. This body of research has been conducted with parents as they are the primary decision makers when vaccinating their children. This body of work has been informed by prominent health behavior theories such as the health belief model (Galbraith et al., 2018). Consequently, factors often studied to understand influence on parental decision to vaccinate include perceived risk of contracting HPV, perceived negative consequences of being diagnosed with cervical cancer, perceived benefits of vaccination and perceived barriers to vaccination, recommendations by health care providers, and perceived self-efficacy to vaccinate. Other factors that influence perceived benefits of vaccination such as knowledge about the vaccine have also been studied.

Latinos and the HPV Vaccine

Sanderson et al. (2009) studied whether Latina mothers who were human papillomavirus (HPV) positive and those who were not differed in their awareness and acceptance of the HPV vaccine for their children. From April 2007 to April 2008, Sanderson et al. (2009) performed in-person interviews in two Texas-Mexico border counties as part of a broader clinic-based cohort study to evaluate knowledge gaps and information requirements of women who are HPV positive. Two sets of Latina women between the ages of 18 and 64 were recruited: 190 HPV positive women and 215 HPV negative women. Results indicated that 67% of HPV-positive women had heard of HPV compared to 61% of women who were negative for HPV (Sanderson et., 2009). Moreover, 73% of the HPV positive respondents had heard of the HPV vaccine versus 58% of the HPV-negative respondents (Sanderson et., 2009). Although vaccine acceptability was high in the study, Sanderson et al. (2009) discovered that HPV-positive women were more likely to support immunization for their children than HPV-negative women. Similarly, when compared to HPV-negative mothers, women with HPV were substantially more likely to state that they were "extremely likely to get their daughter vaccinated" (Sanderson et., 2009). Furthermore, nearly all HPV-positive women said they would have their children vaccinated against HPV to prevent cervical cancer, while a lower percentage of HPV negative women indicated so. According to Sanderson et al. (2009), HPV-negative women are marginally less motivated to vaccinate their children compared to HPV-positive women. This outcome could be explained by the perceived risk of cervical cancer, for herself and her children, between the HPV-positive and HPV-negative women (Sanderson et., 2009).

In another cross-sectional study, a sample of 229 predominantly Latina women who had received free PAP screenings over a three-year period in the city of Socorro, Texas was assessed

on their knowledge of and attitudes toward the HPV vaccine (Molokwu et al., 2014). Results indicated that 62% of those surveyed had heard of HPV, and 34.9% said it was the root of cervical cancer. Approximately 77% of people were willing to vaccinate daughters, while 63% said they themselves would be willing to receive the vaccination (Molokwu et al., 2014). There was no correlation between participants' willingness to receive the HPV vaccine or their willingness to allow their daughters to be vaccinated and the respondent's history of abnormal PAP smears, having a regular doctor, age at first sexual activity, or history of sexually transmitted diseases (Molokwu et al., 2014). Although women who previously had abnormal PAP smears were more likely to have heard of HPV and the HPV vaccine, they were not significantly more likely to report that they would be willing to receive the vaccine for themselves or their daughters (Molokwu et al., 2014). Authors concluded that in this population at high risk of cervical cancer, knowledge levels are still poor, but vaccine acceptance is strong despite limited access to care (Molokwu et al., 2014).

Ashing et al. (2016) surveyed 207 Latina participants, who resided in Southern California, about their beliefs and acceptance of the HPV vaccine as well as their understanding and knowledge of HPV, cervical cancer, and the HPV vaccine (Ashing et al, 2016). Latinas who preferred English rather than Spanish and were residing in Southern California reported more knowledge of the HPV vaccine, including where to get it and conveyed greater support for the vaccine's efficacy and safety (Ashing et al, 2016). Regardless of their preferred language, Latinas who knew where to get the vaccine and had access to relevant information on the vaccine endorsed the vaccine more favorably and had positive attitudes regarding the vaccine's effectiveness and safety (Ashing et al, 2016). In multivariate analyses, language and income were found to predict how well people would know how to get the vaccine and obtain other

information (Ashing et al, 2016). Only 15.6% of eligible Latinas (N=45) started the HPV vaccine, and only 8.9% of respondents finished the required rounds (Ashing et al, 2016).

In a cross-sectional study, 599 uninsured respondents between the ages of 21 and 65 located in the counties of El Paso and Hudspeth were surveyed about their knowledge and beliefs about the HPV vaccine as well as other psychosocial correlates of children's vaccination uptake (Calderon-Mora et al., 2020). Findings indicated that 89.3% of respondents reported that they would get vaccinated if their doctor recommended the HPV vaccine (Calderon-Mora et al., 2020). Similarly, 83.4% reported they would have their daughter(s) vaccinated, and 91.8% would have their son(s) vaccinated (Calderon-Mora et al., 2020). Approximately, 81.6% and 61.6% of respondents were aware of HPV infection and of the HPV vaccine, respectively (Calderon-Mora et al., 2020). Scores for mean perceived susceptibility of children contracting HPV were low while mean perceived benefits of vaccinating children was high. Moreover, respondents cited cost, accessibility, and lack of information as barriers for not vaccinating their children (Calderon-Mora et al., 2020). Surprisingly, participants with higher levels of perceived awareness, susceptibility, and severity of contracting HPV infection-conveyed hesitancy of immunizing their daughters against HPV (Calderon-Mora et al., 2020). The study did find that respondents older than 30 years and who had at least completed high school were more likely to vaccinate their daughters against HPV (Calderon-Mora et al., 2020).

In a three-arm randomized controlled trial, 765 Latina mothers born outside of the US were recruited to assess the efficacy of educational strategies to boost HPV vaccination (Rodriguez et al., 2018). Rodriguez et al. (2018) sought to uncover psychosocial predictors of HPV vaccine uptake among low-income female Latina adolescents, as well as relationships between parental psychosocial characteristics and daughters' intentions to receive the HPV

vaccine (Rodriguez et al., 2018). Results indicated that parents who believed their daughter was less vulnerable to contracting HPV were less likely to have a vaccinated daughter at 6 months after receiving the intervention than those who believed their daughter had the same or a higher chance of contracting HPV infection as others (Rodriguez et al., 2018). Parents who were concerned about the vaccine's negative side effects had a lower chance of having a vaccinated daughter at 6 months post intervention receipt than those who were not (Rodriguez et al., 2018). The study also found that parental concern about sexual disinhibition was significantly associated with a reduced likelihood of having a vaccinated daughter (Rodriguez et al., 2018). Similarly, compared to respondents who did not intend to vaccinate their daughters at baseline, parents who intended to vaccinate had nearly two and a half times the odds of having a vaccinated daughter at 6 months after receiving the intervention (Rodriguez et al., 2018). Lastly, researchers identified that correlates of parental vaccination included subjective norms regarding medical providers and their recommendations, beliefs in vaccine safety, and self-efficacy to obtain the vaccine (Rodriguez et al., 2018).

In a series of eight focus groups, 71 Latino parents with adult daughters eligible for a Pap Test living on the Texas-Mexico border were recruited and surveyed on their knowledge, beliefs, and attitudes on HPV and the HPV vaccine (Morales-Campos et al., 2021). Findings showed that there was a difference in awareness and knowledge among females with some females conveying that they had heard of HPV but knew nothing about the virus (Morales-Campos et al., 2021). Women who were familiar with HPV correctly identified that HPV is a sexually transmitted infection that affects the cervix and causes cancer (Morales-Campos et al., 2021). Several women, however, held false beliefs about the transmission and treatment of HPV (Morales-Campos et al., 2021). Parents associated susceptibility to HPV with being sexually

promiscuous and therefore believed that their daughters were not sexually active and thus not susceptible to contracting the infection (Morales-Campos et al., 2021). The causes of HPV and sexual activity were also discussed by women, but their interpretations were more nuanced and included topics on relationship infidelity, unprotected sex, and promiscuity (Morales-Campos et al., 2021). Male and female respondents who were parents agreed and echoed the importance of vaccinating their child (Morales-Campos et al., 2021). Although some participants voiced concerns about the vaccination's safety, they concluded that they would still vaccinate their child if their doctor deemed it safe and effective (Morales-Campos et al., 2021). Women between the ages of 18 and 26 concurred that if they had been informed about the vaccine's advantages and drawbacks, they would obtain the vaccine (Morales-Campos et al., 2021).

In a randomized experiment, Khodadadi et al. (2020), surveyed 317 Latina immigrant mothers on their awareness of HPV, HPV vaccine knowledge, vaccine acceptability and hesitancy, perceived risk of contracting HPV, and intention to vaccinate their daughters (Khodadadi et al., 2020). Findings indicated that daughter's health insurance status was the only significant demographic variable associated with intention. Moreover, 205 mothers were willing to vaccinate their daughter and 112 were hesitant despite receiving a provider recommendation (Khodadadi et al., 2020). Results indicated that compared to mothers who thought they were at risk for cervical cancer, mothers who did not perceive themselves to be at risk for the disease had increased vaccine hesitation (Khodadadi et al., 2020). Similarly, more than 82% of mothers reported worrying that their daughter would contract HPV, but only 51.1% of the sample perceived their daughter to be at risk of being infected with HPV in the future (Khodadadi et al., 2020). Even though several factors were linked to HPV vaccine reluctance, only five remained significant in a final multivariable model and included daughter's health insurance status, HPV

awareness, perceived risk of HPV infection for their daughters, perceived self-risk of cervical cancer, and a self-efficacy score of ability to finish the HPV vaccination series (Khodadadi et al., 2020).

In summary, Latino parents typically have favorable views toward vaccination, high levels of confidence in medical professionals, and report high rates of intention to vaccinate their children if recommended by a health care provider (Scarinci., Hansen, & Kim, 2020). However, research indicates that HPV vaccination hesitation in Latino households is linked to lack of awareness and knowledge of HPV, perceived risk of cervical cancer (and related HPV health conditions), perceived risk of HPV among children, self-efficacy to finish the vaccination series, and vaccine cost and health insurance status (Scarinci., Hansen, & Kim, 2020). Although a large body of research has been conducted to understand parental HPV vaccine uptake, the role of constructs such as health literacy and numeracy have been understudied (Scarinci., Hansen, & Kim, 2020). These constructs are determinants of uptake of preventative behaviors for children. In light of concerns with vaccine side-effects and the importance of a provider recommendation for vaccine uptake, it is important to study the factors that can influence whether information about the vaccine provided by health care providers is perceived as useful (Scarinci., Hansen, & Kim, 2020).

Theoretical Framework

The proposed study was informed by the Health Belief Model (HBM). The HBM was first created in the 1950s to predict whether people would participate in health awareness campaigns (Glanz et al., 2008). The constructs of the HBM aim at explaining the factors that determine the likelihood that a person will engage in a certain health behavior to prevent an undesirable or negative health outcome. The five constructs that constitute the HMB include

perceived susceptibility, perceived severity, perceived benefits and barriers, cues to action, and self-efficacy (Glanz et al., 2008). The success of the model can be attributed in part to the operationalization of several cognitive characteristics in a way that makes sense and is relevant to the performance of health behaviors (Glanz et al., 2008).

Health Belief Model Constructs

The six constructs that constitute the HMB include perceived susceptibility, perceived severity, perceived benefits and barriers, cues to action, and self-efficacy (Glanz et al., 2008). Beliefs regarding the likelihood of contracting a disease or condition are referred to as perceived susceptibility. A person's perception of the negative consequences of contracting a disease is known as perceived severity. A person's perception of the value or utility of adopting a behavior to mitigate the risk of disease is referred to as the perceived benefits. Perceived barriers are the perceived obstacles to behavior change (Glanz et al., 2008). Cues to action are environmental factors that remind a person that a course of action is available to mitigate the risk of contracting the disease. Lastly, self-efficacy is the degree of assurance in one's capacity to carry out or adopt a behavior or behavior change (Glanz et al., 2008). The present study will focus on the constructs of perceived benefits and barriers (operationalized as perceived risks and benefits of vaccination) and cues to action (operationalized as the evaluation that participants give to information provided by a health care provider about vaccination).

Research Gaps

A health care provider's recommendation has consistently emerged as the strongest variable associated with HPV vaccination acceptability among parents. However, little is known about factors associated with perceptions of information shared by providers about the vaccine. Moreover, few research has explored the role of health numeracy and literacy on perceptions of information shared by providers among Latina women. In Northern Virginia, Painter et al., (2019) assessed the knowledge, attitudes, and decision-making among uninsured, Latina mothers regarding immunizations for their children (Painter et al., 2019). The findings revealed that Latina mothers had a generally positive view of the vaccines. However, participants had limited knowledge regarding the vaccines (Painter et al. 2019). Authors conclude that efforts are needed, particularly in states with a large segment of the Latino population, to better understand factors associated with perceptions of vaccine benefits (Painter et al. 2019).

Methods

Study Purpose

The purpose of the study is to determine the mediating influence of perceived utility of the information about HPV provided by health care providers on the association between health literacy and health numeracy and perceived risks and benefits of vaccination. The hypotheses for the proposed study are the following:

Hypotheses:

1. Health literacy and numeracy will be positively related to participants' perceived utility of vaccine information provided by health care providers.
2. Health literacy and numeracy will be positively related to participant's perceived benefits of vaccination.
3. Perceived utility of vaccine information will mediate the relationship between health literacy, numeracy, and perceived benefits of vaccination.

Study Overview

The study is a secondary data analysis of a cross-sectional survey study conducted to understand the factors associated with uptake of the HPV vaccine among a sample of Latina mothers. For the purposes of this study only responses to the measures described below will be analyzed.

Participants

The survey responses of 88 Latina mothers of 10–14-year-old daughters were analyzed to test the proposed hypotheses. Participants had a mean age of 38 (SD = 9.061). Approximately 46% of women were between the ages of 35–45 years. Participants belonging to the 24 to 34 age range represented 35.2% of the sample while 15.2% made up the 46 to 56 age range and 3.3% reported being 57 and above. Regarding prior experience with an HPV diagnosis, 97.7% of respondents reported not having a prior diagnosis of HPV. Similarly, most women (90.9%) had not been diagnosed with cervical abnormalities. Participants were also asked whether they had been vaccinated against HPV and where a minority of participants (4.5%) reported getting vaccinated. Regarding marital status and education, 65.9% reported being married or living with their partner. In terms of education, 60.2% reported having high school education only, 23.9% reported having completed trade or technical school, and 12.5% reported having completed 1 to 3 years of college or an associate degree. In terms of employment and income, 48.9% reported being unemployed and 20.4% had a monthly income of less than \$599, 23.9% between \$600-\$999, and 31.8% between \$1,000-\$1,599. Only 20.4% of participants reported having a monthly income of \$1,600 or more. Approximately 60% of participants reported having no health insurance. Additional demographic characteristics are presented in Table 1.

Measures

Participants were asked to answer the following measures as part of the cross-sectional survey:

Demographic Questions. Participants were asked to self-report their age, marital status, medical insurance status, employment, monthly income, history of STI, HPV, and cervical cancer diagnosis. The following ten questions assessed demographic characteristics: “*How old are you?*”; “*What do you consider your ethnicity to be?*” Response options were: (1) Mexican/Mexican American, (2) Other/Hispanic, (3) Non-Hispanic/White, (4) Black/African American, (5) Asian/Pacific Islander, (6) American Indian, and (7) Other (specify); “*What is your marital status?*” Response options were: (1) Married, (2) Living together, (3) Separated, (4) Divorced, (5) Widowed and (6) Other (specify); “*What was the last grade in school you completed?*” Response options were: (1) Grade 0-12 (write in number of last grade), (2) Trade of technical training after high school, (3) 1-3 years college/associate degree/Junior college, (4) 4-year college graduate/bachelor’s degree, (5) Postgraduate/Masters/Doctorate/Law degree; “*What type of medical insurance do you have?*” Response options were: (1) Don’t have insurance, (2) Medicaid, (3) Private insurance, (4) Other (Please specify); “*What is your employment status?*” Response options were: (1) Unemployed, (2) Part-time, (3) Full-time; “*What is your total monthly income for all members in your household?*” Response options were: (1) \$0-\$399 a month, (2) \$400-\$599 a month, (3) \$600-\$799 a month, (4) \$800-\$999 a month (5) \$1,000-\$1,199 a month (6) \$1,200 - \$1,399 a month (7) \$1,400-\$1,599 a month (8) \$1,600-\$1,799 (9) \$1,800-\$1,999 a month (10) \$2,000 or more a month; “*What was the last grade in school you completed?*” Response options were: (1) Grade 0-12 (write in number of last grade), (2) Trade of technical training after high school, (3) 1-3 years college/associate degree/Junior college, (4) 4-year college graduate/bachelor’s degree, (5) Postgraduate/Masters/Doctorate/Law degree; “*Have*

you ever been diagnosed with the Human Papillomavirus (HPV)?” and *“Have you ever been diagnosed with cervical abnormalities?”* Response options were: (1) Yes, (2) No, (3) If yes, date of diagnosis, (4) If yes, what was the diagnosis? *“Do you know someone who has been diagnosed with cervical abnormalities?”* Response options were: (1) Yes, (2) No, (3) If yes, how is the person related to you? (3a.) Friend, (3b.) Relative, (3c.) Other, (4) If other, please specify who.

Perceived Risks and Benefits of Vaccination. Perceived risks and benefits of vaccination were measured with one single item: *“At this moment, how do you feel about the risks and benefits of the vaccine?”* Response options include the following: (1) Risks are greater than the benefits, (2) Risks and benefits are about equal, (3) Benefits are greater than the risks, (4) I am not sure, I need more information.

Health Literacy. Health Literacy was measured with the Short Assessment of Health Literacy–English (SAHL–E) which consists of 18 test items (Lee et al., 2010). Participants were presented with 18 words, one at a time, and were instructed to read the word and choose the word closer in meaning to the test term from two options – a key word with a related meaning and a distractor word unrelated in meaning to the test term. This measure assesses the participant’s comprehension of health-related terms. The words were the following *“Kidney.”* Response options were: (1) Urine, (2) Fever, (3) Neither. *“Occupation.”* Response options were: (1) Work, (2) Education, (3) Neither. *“Medication.”* Response options were: (1) Instrument, (2) Treatment, (3) Neither. *“Nutrition.”* Response options were: (1) Healthy, (2) Soda, (3) Neither; *“Miscarriage”* Response options were: (1) Loss, (2) Marriage, (3) Neither; *“Infection.”* Response options were: (1) Plant, (2) Virus, (3) Neither; *“Alcoholism.”* Response options were: (M1) Addiction, (2) Recreation, (3) Neither; *“Pregnancy.”* Response options were: (1) Addiction, (2) Recreation, (3) Neither; *“Seizure.”* Response options were: (1) Dizzy, (2) Calm, (3) Neither;

“Dose.” Response options were: (1) Sleep, (2) Amount, (3) Neither; “Hormones.” Response options were: (1) Growth, (2) Harmony, (3) Neither; “Abnormal.” Response options were: (1) Growth, (2) Harmony, (3) Neither; “Directed.” Response options were: (1) Instructions, (2) Decision, (3) Neither; “Nerves.” Response options were: (1) Bored, (2) Anxiety, (3) Neither; “Constipation.” Response options were: (1) Bored, (2) Anxiety, (3) Neither; “Diagnosis.” Response options were: (1) Evaluation, (2) Recovery, (3) Neither; “Hemorrhoids.” Response options were: (1) Veins, (2) Heart, (3) Neither; “Syphilis.” Response options were: (1) Contraception, (2) Condom, (3) Neither. Each response is scored as (0) incorrect or (1) correct. The responses are aggregated into an overall score with greater scores indicating greater health literacy. A score between 0-14 indicates low literacy. Cronbach Alpha was .58.

Health Numeracy. Health numeracy was assessed with the newest vital sign measure (Weiss et al., 2005). The measure consists of six items that assess numerical ability using a nutritional label. Participants are read the nutritional label and are asked to respond to the following six questions: 1) “If you eat the entire container, how many calories will you eat?”; 2) “If you are allowed to eat 60g of carbohydrates as a snack, how much ice cream could you have?”; 3) “Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42g of saturated fat each day, which includes 1 serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?”; 4) “If you usually eat 2500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving?”; 5) “Pretend that you are allergic to the following substances: Penicillin, peanuts, latex gloves, and bee stings. Is it safe for you to eat this ice cream?” Response options for question 5 are: (1) Yes, (2) No. 6) if the patient responds “no” to question 5, ask 6) Why not?” Each response is scored as (0) incorrect or (1) correct. The responses are

aggregated into an overall score with greater scores indicating greater health numeracy.

Cronbach Alpha was .56.

Perceived Utility of Vaccine Information. Participants answered 12 items assessing whether information about HPV and the vaccine was shared by health care providers: “I received information about the effectiveness of the vaccine”; The extent to which the information received was perceived as useful: “The information that I received about effectiveness was useful”; Whether information was shared about the side-effects of the vaccine: “I received information about the side-effects of the vaccine”; Whether the information shared about side effects was perceived as useful: “The information that I received about side-effects was useful”; The extent to which the information about effectiveness and risk of side effects shared was comprehended: “I feel capable of explaining to other people what an effectiveness rate of 90% means”, and “I feel capable of explaining to other people what a side-effects rate of 6% means;” Whether the information shared was understood: “I felt that I understood all the information that health care professionals gave me about the vaccine” and was believed accurate and comprehensive: “Health care professionals gave me accurate and complete information (including numeric information) about the vaccine”; The degree of satisfaction with the information provided and the extent to which it was comprehended: “I feel satisfied with the amount of information I received about the vaccine” and “I felt that I understood all the information that I received about the vaccine.” Response options were: (1) Strongly Disagree, (2) Disagree, (3) Slightly Disagree, (4) Neutral, (5) Slightly Agree, (6) Agree, (7) Strongly Agree. The Cronbach alpha was .96.

Statistical Analyses

All data analysis was computed with statistical software SPSS (IBM, 2017). An analysis was conducted to determine if significant missing data was present (i.e., over 50% of measures). Results indicated that missing values were between 0 and 5% for each variable. Missing values were replaced by single imputation as simulation studies have demonstrated that this procedure produces similar values to regression and expectation maximization techniques when missing values fall below the 5% threshold (Ruben et al., 2007).

Inspection of Data Normality. The Kolmogorov–Smirnov test was computed to test for normality. Results were non-significant indicating that the data is normally distributed. Additionally, skewness and kurtosis measures were inspected and found to be between -1 and $+1$, indicating variables were normally distributed.

Sample Description. Descriptive statistics were computed on demographic characteristics to describe the sample including means and frequencies.

Testing Associations. Bivariate correlations between variables were computed using SPSS. Results of bivariate correlations are presented in Table 2. As Table 2 indicates, neither numeracy ($r = .08, p = ns$) nor literacy ($r = .12, p = ns$) were related to perceived utility of the information about the HPV vaccine provided by health care providers and perception that benefits of vaccination are greater than risks was related to numeracy ($r = .31, p = .003$) and literacy ($r = .28, p = .007$). Other correlations are presented in Table 2.

Tests of direct and indirect effects were tested with SPSS Process. Two models were tested. In figure 1, the independent variable was the perceived utility of information (how useful the information was perceived to be), while the dependent variable was the perceived benefits of vaccination. Numeracy was tested as the mediating variables in the analysis. In figure 2, the

independent variable was perceived utility of information provided by health care providers (how useful the information was perceived to be), while the dependent variable was the perceived benefits of vaccination. Literacy was tested as the mediating variable in the analysis. Figures 1 and 2 present the models that were tested. The lines depict the corresponding associations that were tested to yield answers to the proposed hypotheses.

Results

Analysis with process allowed for the estimation of direct effects to test the association between health literacy and numeracy, evaluation of the information provided by health care providers, and perceived risks and benefits of vaccination and indirect effects to test the mediating effect of evaluation of information provided by health care providers on the relationship between health literacy and numeracy and perceived risks and benefits of vaccination. To test mediation, repeated bootstrapped samples yielding 1000 randomly selected samples were generated to derive estimates of the mediated effects ($k=1000$) which approximate an empirically derived sampling distribution that is then used to create a 95% confidence interval (Hayes, 2012). A bias correction was applied as the sampling distribution that is derived can be, and often is, skewed (i.e., confidence intervals are often asymmetrical with respect to the upper and lower bound estimates surrounding the mediated effect) (Hayes and Rockwood, 2020). Analysis allowed for the estimation of direct effects to test the association between perceived utility of information provided by health care providers and perceived benefits of vaccination and indirect effects to test the mediating effect of numeracy and literacy on the association between perceived utility of information provided by health care providers and perceived benefits of vaccination. For the purposes of the analysis, the variable perceived risks and benefits of vaccination was recoded to ease interpretation. The variable was re-coded as a

dichotomous variable such that the response options “Risks are greater than the benefits”, “Risks and benefits are about equal”, and “I am not sure” were aggregated and coded as “0” and the response option “Benefits are greater than the risks” was coded as “1” such that “1” captures perceived benefits.

Results of direct and indirect effects analyses are presented in Tables 3 and 4. Table 3 and 4 illustrates that perceived utility of the information was not found to be a mediator between health numeracy and literacy and benefits of vaccination. However, perceived utility of information was significantly associated with perceived benefits of vaccination ($\beta=.51, p <.01$), ($\beta=.46, p <.01$). Furthermore, numeracy was associated with perceived benefits of vaccination ($\beta=3.2, p <.01$). Results indicated that the indirect effect of numeracy and perceived benefits of vaccination was not significant. Literacy was found to be associated with perceived benefits of vaccination ($\beta=9.1, p <.05$). Additionally, the indirect effect of literacy and perceived benefits of vaccination was not significant.

Discussion

The purpose of the study was to determine the mediating influence of utility of information on the association between numeracy and literacy and perceived benefits of vaccination. Results did not corroborate the mediation hypotheses. In other words, the utility of vaccine information did not mediate a relationship between health numeracy and literacy and the perceived benefits of vaccination. However, this thesis did find that there was an association between the relationship of health numeracy and literacy on the benefits of vaccination. As well as a positive association between the relationship between perceived utility of vaccine information and perceived benefits of vaccination. While findings suggest that perceived utility of information did not emerge as significant mediator, health literacy and numeracy constructs were indeed associated and identified as an important precursor of the benefits of vaccination. While the mechanism through which these constructs may influence vaccine uptake is not entirely understood, emerging research on the nature of these constructs may reveal possible ideas as to why that is.

According to Nutbeam & Llyod (2021), literacy refers to “skills that include greater knowledge and comprehension of the factors that influence health and motivation to engage in health-related behaviors, as well as increased self-efficacy in carrying out health-related tasks and behavioral changes. Furthermore, Nutbeam & Llyod (2021) differentiates between three distinct levels of health literacy. The first level, functional health literacy, is defined as having the fundamental reading and writing skills necessary to get by in everyday contexts. The second level, labeled communicative health literacy, is the ability to comprehend the meaning of medical information to engage with the healthcare sector. The third level is labeled critical health literacy, and it allows an individual to have more influence over life occurrences and develop

skills needed to critically assess medical information. Due to these essential skills observed in people with high literacy, the hypothesis of possible mediation was reasonable. However, one aspect of the study is that the literacy measure employed only assessed functional literacy. Consequently, it is probable that critical health literacy in the parent study, the aspect of literacy that allows individuals to distinguish between credible and incredible sources of health information, assessed not the perceptions of utility on vaccination information but rather the risks and benefits of vaccination (Aharon et al., 2017). Furthermore, Nutbeam & Llyod (2021), recognize that the growth of one's critical health literacy requires the development of transferable skills. These transferable skills, which include obtaining, understanding, interpreting, and acting on health information, enable people to engage and make health decisions in a range of contexts (Nutbeam & Llyod, 2021). Assessing these transferable skills offers the opportunity to evaluate a patient's critical health literacy more accurately in addition to the other measures being utilized.

Similar to health literacy, numeracy was not related to the perceived utility of information. This lack of association can be explained by how numeracy is defined. According to Peters (2012), health numeracy is defined as “the degree to which individuals can obtain, process, and understand the basic health information and services they need to make appropriate health decisions.” According to Peters (2012), there is significant variability among individuals in their numeracy skills, which refers to their capacity to comprehend mathematical and probabilistic concepts. It is important to note that disparities in numerical proficiency exist among individuals, and even individuals with advanced education may not consistently grasp numerical information when making decisions (Lipkus, Samsa, & Rimer, 2001). When making decisions, it is often necessary to consider how numeric and nonnumeric information may

conflict with one another. Numeracy tends to play a moderating role in the relative impact of different types of information, as those with lower numeracy skills are more influenced by nonnumerical information (Peters, 2012). Furthermore, the findings of studies on framing illustrate that the way information is presented can have an impact on decision-making. In the case of the parent study, the survey did not assess what type of information was provided by the health professionals about vaccination. It may have been that non-numerical information was provided making numeracy irrelevant.

Moreover, numeracy was assessed by asking participants to provide responses to questions pertaining to a nutritional label. Participants were asked to imagine that this information is located on a 1-pint container of ice-cream and answer questions based on the nutrition label. While highly numerate individuals may be more likely to know, retrieve, and use appropriate data from the measure, this measure of numeracy may not be associated with perceptions of utility of information that may not be numerical in nature. The parent study did not assess other plausible variables that may be more closely related to perceptions of utility of information and perceived benefits of vaccination such as trust in medical providers. Trust in medical providers emerges as an important variable regarding perceptions of health-related information disseminated by providers.

A study utilizing mixed methods approach was undertaken to examine parental vaccine decision-making behaviors and assess the level of trust in physician recommendations among parents with different childhood immunization patterns (Glanz et al., 2013). The findings of the study revealed that parents who declined or postponed immunizations were eight times more inclined to report engaging in regular re-evaluation or “rethinking” of their vaccine decision making choices when compared to parents who accepted vaccines (Glanz et al., 2013). Parents

commonly expressed trust in their pediatrician's recommendations regarding nutrition, behavior, and physical examinations. However, they expressed skepticism regarding the pediatrician's ability to deliver unbiased information regarding the advantages and potential drawbacks of vaccination and this was associated with lack of trust (Glanz et al., 2013).

The results of the study indicated that perceptions of utility of information were related to perceived benefits of vaccination. The importance of this finding is underscored by prior research which indicates that parental acceptance of the HPV vaccine is significantly influenced by the receipt of a healthcare provider's advice. In other words, perceptions of the information shared by providers about a health choice matter. Regrettably, a growing body of research suggests that physician recommendations for HPV vaccination are perceived as infrequent, inadequate, and “weak” (Gilkey et al., 2015). In a study conducted by Gilkey et al. (2015), a national sample of 776 pediatricians and family doctors were surveyed to evaluate the caliber of their recommendations about the HPV vaccine. The assessment focused on various aspects, including the level of endorsement, timeliness, consistency, and urgency when recommending the HPV vaccine. The findings of the study revealed that a 27% of physicians, reported providing timely suggestions to both female (26%) and male (39%) patients. In addition, approximately 51% of doctors advised same-day immunization, but a significant proportion of physician (59%) endorsed the administration of the HPV vaccine based on their assessment of the perceived risk of contracting HPV (Gilkey et al., 2015). The results of the study suggest that the impression of the usefulness of information plays a significant role and carries important implications when it comes to making decisions regarding health behaviors. Unfortunately, an increasing number of literature suggests that numerous healthcare practitioners exhibit a lesser degree of endorsement towards the HPV vaccine in comparison to other vaccines, opting to label

it as "optional" during patient interactions (Gilkey et al., 2015). Furthermore, physicians exhibit discomfort when engaging in discussions regarding the HPV vaccine and there is a correlation between the quality of provider recommendations and the intention to follow through with vaccination (Gilkey et al., 2015).

Research indicates that high-quality recommendations have a greater impact on boosting the initiation and completion of HPV vaccination compared to low-quality recommendations (Gilkey et al., 2015). Researchers identified two communication approaches that were proven to have a positive correlation with enhanced suggestion quality scores. Gilkey et al., (2015), noted that an enhancement of recommendation quality was observed when emphasis was placed on being due for the vaccine, as opposed to when physicians only disseminated information or posed questions to parents about the vaccine. Second, providing parents with comprehensive information about the vaccine's efficacy in preventing cancers and physical manifestations such as genital warts correlated with improved recommendation quality (Gilkey et al., 2015). In addition, it is recommended by researchers that healthcare providers ardently advocate for HPV vaccine to parents of adolescents, emphasizing the importance of cancer prevention, and proposing the implementation of same-day immunization (Gilkey et al., 2015).

In a subsequent study, Gilkey et al. (2016) administered an online survey to a sample of 1,495 parents with adolescent children ranging in age from 11 to 17 years. According to Gilkey et al. (2016), parents were asked to provide information regarding the level of support healthcare professionals exhibited towards HPV vaccination, their promotion of same-day vaccination, and their discussion of the relationship between HPV vaccine and the prevention of cancer. According to the study, over 48% of parents stated that their healthcare provider did not recommend HPV vaccination for their children (Gilkey et al., 2016). Furthermore, 16% of

parents reported receiving substandard advice, while 36% reported obtaining a favorable recommendation (Gilkey et al., 2016). There was a significant association between high-quality recommendations and the likelihood of parents initiating the HPV vaccine for their children. The odds of parents starting the vaccine were found to be over nine times higher when high-quality recommendations were provided, compared to when no recommendation was given.

Additionally, the odds of parents following through with the vaccine were over three times higher in cases where high-quality recommendations were received (Gilkey et al., 2015). Parents who received high-quality recommendations were less likely to report delaying or refusing the HPV vaccine compared to those who got low-quality recommendations (Gilkey et al., 2016). There exists a considerable dearth of evidence that substantiates the necessity for healthcare practitioners to enhance their efforts in promoting HPV vaccination on a more frequent basis (Gilkey et al., 2016). The findings of the study provide empirical support for the hypothesis that the quality of a vaccine recommendation can influence parental behavior in initiating the HPV vaccine (Gilkey et al., 2016).

The promotion of patient empowerment can be achieved by various means, including education and the cultivation of a strong patient-provider connection relationship. This notion is supported by Glanz et al. (2013), who argue that well-educated parents are more likely to make informed decisions regarding the health of their children. This association places significant emphasis on the manner in which vaccine information is communicated to parents. The simultaneous efforts of educating and empowering parents regarding vaccines should be accompanied by healthcare professionals' endeavors to enhance vaccine confidence and foster a productive patient-provider relationship. Approximately 33% of parents who initially decline a vaccine will alter their stance after being exposed to educational intervention strategies (Weiner

et al., 2015). This highlights the significance of effective communication and ongoing education regarding the risks associated with diseases and the advantages of vaccination. It is recommended that healthcare personnel adopt the presumption strategy, wherein they proceed with the assumption that parents would adhere to the Advisory Committee on Immunization Practices schedule and recommend the vaccination as a customary process. According to Opel et al. (2013), this technique has been observed to enhance the likelihood of immunization by 17.5%.

Strengths and Limitations

The proposed study has several strengths and limitations. Among the strengths are the assessment of constructs rarely studied in parental HPV vaccine acceptability research among Latinas. One weakness is the way literacy and perceived utility of information provided by health care professionals was assessed. Questions about perceptions of utility of information were very general and additional questions inquiring about the type of information shared were not included. Health literacy was measured with the Short Assessment of Health Literacy–English (SAHL–E) which consists of 18 test items where participants were instructed to choose the option closest in meaning to the key word being shown. This measure did not assess other aspects of literacy such as critical health literacy. Health numeracy was assessed as the ability to process numerical information and other aspects relevant to vaccination were not included. In addition, both measures exhibited low reliability. Another limitation includes the administration of the survey face to face which may have resulted in social desirability. Nonetheless, the results are an important contribution to the field of study and has implications for providers' recommendations and to develop vaccination promotion and public health campaigns.

Future Research

In general, the findings indicate a current lack of adequate data to definitively determine the optimal provider-parent communication method for influencing parental attitudes towards immunizations. Future research should be conducted with other measures of health literacy and numeracy while also assessing trust in health care providers.

Future research should also focus on how best to enhance vaccination confidence. There have been several strategies and frameworks recommended for how best providers could interact with vaccine-hesitant parents. Unfortunately, there is currently no substantial evidence for efficacy (William, 2014). Williams (2014), recognizes that it is critical to continue assessing the motivating factors, at the provider level, that may influence parents to reject or accept immunizations. Many documented interventions are generally educational in nature, however the decision-making process for vaccine-hesitant families is likely to be complex. While it is important to provide parents with accurate information to counter their misinformed beliefs, further research is needed.

According to the study by Gilkey et al. (2016), there is a clear need for research on methodologies aimed at aiding physicians in enhancing their recommendations for the HPV vaccine. The factors of timeliness, consistency, urgency, and strength of endorsement quality offer a useful framework for organizing these endeavors. The communication strategies exhibit considerable potential and warrant further examination with regards to parent's efficacy and acceptability. This phenomenon can be attributed to the fact that the individuals who had the highest level of support for the HPV vaccine, exhibited a preference for a communication style that is characterized by directness and clarity, together with comprehensive messaging pertaining to prevention strategies. Future research should prioritize the development of written teaching

materials, web-based resources, decision aids, and risk-communication messages for healthcare practitioners (Glanz et al., 2013). It is crucial to carefully assess the content of these materials, as well as the timing and frequency of their application. The data presented indicates that interventions may be more effective when implemented in a balanced fashion that includes comprehensive information regarding the benefits and risks associated with vaccination. Different framing techniques such as storytelling and open dialog need to be utilized and evaluated to determine its effectiveness in strengthening patient-provider relationships.

For over 50 years the Health Belief Model (HBM) has had a transformative effect on the field of public health. The HBM provides a framework that has been used for decades to help create behavior change interventions and expand research. The HBM is framed as an explanatory framework used for understanding how people analyze and respond to perceptions regarding their health. In terms of this thesis, the health belief model was used to identify and test the different constructs that may implicate a parent's decision to vaccinate their children. This thesis hopes to inform and expand on the mediation analysis and identify other mediating variables that explains the process through which health literacy and health numeracy and perceived benefits of vaccination are related. Future research must ensure content validity, it is important to measure the full range of factors that may influence the behavior of participants, including the emotional aspect of the decision-making process. The importance of HBM is expansive and has had significant impact on not only the field of public health but has been utilized in disciplines such as communication science.

Implications for Public Health

The invention of safe and effective vaccinations against illnesses that have had a significant influence on worldwide mortality and morbidity has emerged as a crucial scientific advancement in the twenty-first century. Racial and ethnic minority groups suffer disproportionately when it comes to getting the advised vaccinations. A multitude of factors can contribute to decreased rates of vaccination, including concerns regarding vaccine safety and limited availability of therapy and insurance coverage. Researchers can enhance the existing body of literature on vaccination by providing a more comprehensive analysis of the social, cultural, and political factors that significantly influence the acceptance or rejection of vaccines. Moreover, it is within the purview of public health experts to debunk vaccine misconceptions and disinformation, tackle structural obstacles to immunization, and execute evidence-based interventions aimed at enhancing vaccination rates.

Numerous studies have provided substantial evidence supporting the notion that public health messages, when crafted with careful consideration, possess the ability to effectively stimulate adaptations in behavior (Hornik, 2002; Wakefield et al., 2010). The corpus of evidence is derived from communication science, which pertains to the investigation of communication processes and their impacts within the realm of social sciences (Berger et al., 2010; Nabi & Oliver, 2009). Vaccine hesitancy is a widely acknowledged phenomena that exerts an impact on vaccination choices within the Latino community. However, there exists a dearth of research aimed at comprehending the intricate aspects of vaccine communication and the subsequent adoption of vaccination within this population (Ortiz et al., 2022).

The lack of appropriate vaccination messaging to enhance acceptance among diverse Latino groups shows a disregard for the varying health risk factors that different subgroups face. To comprehensively address racial and ethnic health disparities, it is imperative for research to incorporate an examination of Latino communities. Furthermore, it is imperative to adopt more nuanced and inclusive frameworks that supersede antiquated and oversimplified messages. The implementation of vaccine campaigns that specifically target the fundamental issues impacting vaccine accessibility and hesitation among the Latino population may serve as a viable approach to enhancing messaging and narrowing the vaccination disparity. This evaluation of vaccine messaging not only is crucial in Latino subgroups but can also potentially impact different racial and ethnic minorities as well as children and the elderly.

Conclusion

In conclusion, while this research thesis found that literacy and numeracy were not found to be significantly associated with the perceived utility of vaccine information provided by healthcare professionals, there was an association between literacy and numeracy to the perceived benefits of vaccination. This underscores the notion that health literacy and numeracy are pivotal factors in shaping individuals' beliefs and attitudes regarding vaccination. These findings contribute to emerging literature among Latino populations, where notable gaps exist on vaccination messaging and patient-physician relationship.

IRB Approval

The survey and study have been approved by the University of Texas at El Paso Institutional Review Board (IRB).

MPH Program Foundational Competencies

1. Evidence-based Approaches to Public Health

2. Select quantitative and qualitative data collection methods appropriate for given public health context
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate
4. Interpret results of data analysis for public health research, policy or practice.

2. Public Health and Health Care Systems

6. Discuss the means by which structural bias, social inequities and racism undermine health and create challenges to achieving health equity at organizational, community and societal levels

3. Planning and Management to Promote Health

7. Assess population needs, assets and capacities that affect community health.
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs.

6. Communication

18. Select communication strategies for different audiences and sectors
19. Communicate audience-appropriate public health content, both in writing and through oral presentation

20. Describe the importance of cultural competence in communicating public health content

8. *Systems Thinking*

22. Apply systems thinking tools to a public health issue

MPH Program Hispanic and Border Health Concentration Competencies

1. State the principles of prevention and control of disease and discuss how these can be modified to accommodate cultural values and practices in Hispanic and border communities.
2. Differentiate quantitative health indicators in major communicable and non-communicable diseases in US/Mexico border vs non-border communities.

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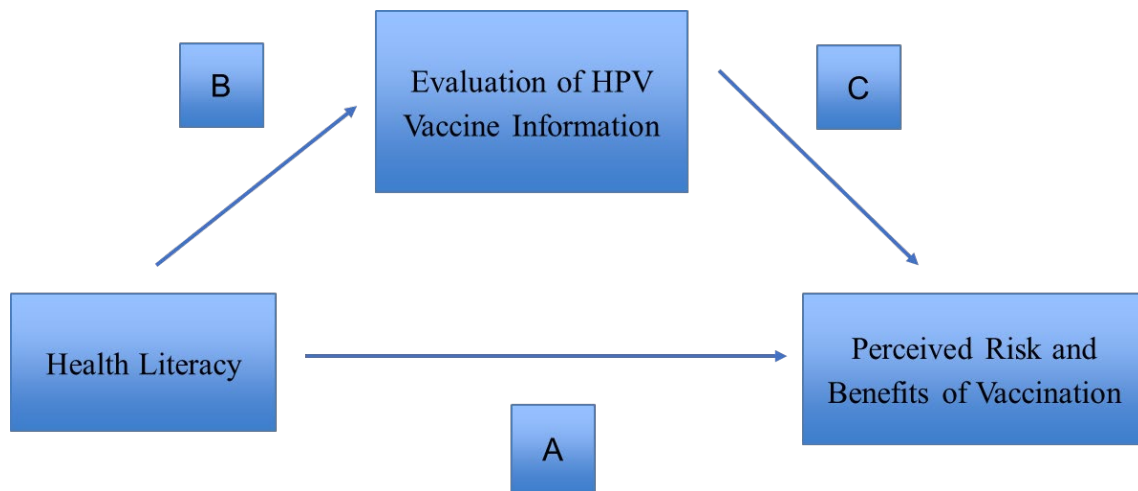


Figure 1. Mediation Model (Literacy)

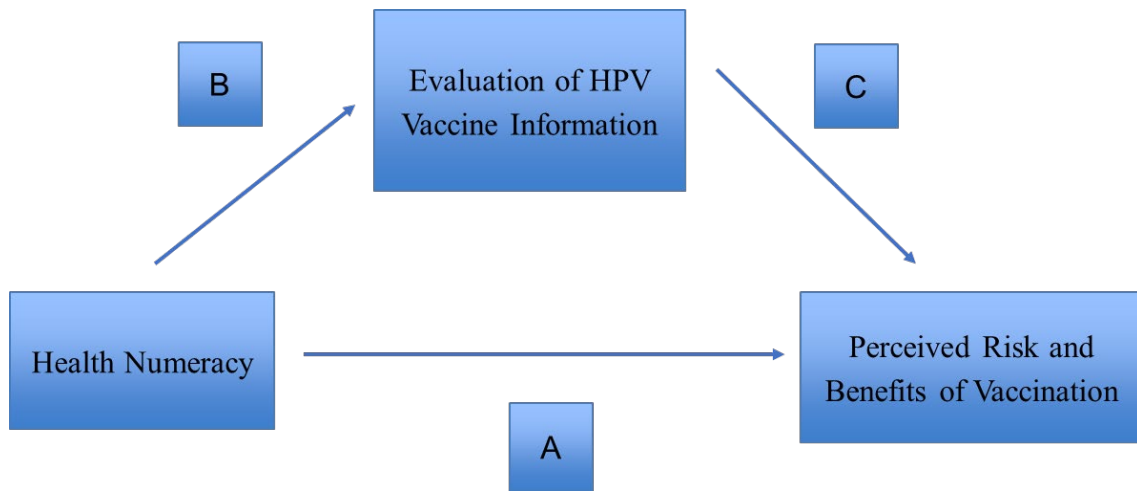


Figure 2. Mediation Model (Numeracy)

Table 1. Demographic Characteristics (N = 88)		
	<i>f</i>	%
Age		
24 to 34	31	35.2
35 to 45	41	46.4
46 to 56	13	15.2
57 and above	3	3.3
Monthly Income		
Less than \$599	18	20.4
\$600-\$999	21	23.9
\$1,000-\$1,599	28	31.8
\$1,600 or more	18	20.4
Marital Status		
Married/Living Together	58	65.9
Separated/Divorced	24	11.4
Widowed	2	2.3
Other	3	3.3
Last Grade in School Completed (Education Level)		
Grade 0-12	53	60.2
Trade or Technical School	21	23.9
1-3 of college (associate degree)	11	12.5
Bachelor's degree and above	3	3.4
Medical Insurance		
No Insurance	55	62.5
Medicaid	5	5.7
Private Insurance	11	12.5
Other	9	10.2
Employment		

Unemployed	43	48.9
Employed	34	38.6
Prior Diagnosis of HPV		
No	86	97.7
Yes	2	2.3
Prior Diagnosis of Cervical Abnormalities		
No	80	90.9
Yes	7	8.0
<i>Note.</i> Numbers have been rounded to the nearest 100 ^t		

Table 2. *Bivariate Correlations (N = 88)*

	1	2	3	4	5
1. Numeracy	--	.42**	.31**	.06	.08
2. Literacy		--	.28**	.12	.15
3. Perceived Benefits			--	.24*	.50**
4. Perceived Information Utility				--	.55*
5. Vaccination Intentions					--

Note. ** $p < .01$. Perceived Benefits = Perceived benefits were coded 1 = Benefits greater than risks and 0 = Perceived risks greater than benefits.

Table 3. *Path Analysis Direct and Indirect Effects* (N=88)

Direct Effects	β	<i>SE</i>	<i>p</i>
Perceived Utility of Information → Perceived Benefits of Vaccination	.518	.14	<.01
Literacy → Perceived Utility of Information	.005	.01	.68
Literacy → Perceived Benefits of Vaccination	3.26	.12	<.01
Indirect Effects	β	<i>SE</i>	<i>p</i>
Literacy → Perceived Benefits of Vaccination	.04	.04	.97

Note. β standardized path coefficient, *SE* standard error.

Table 4. *Path Analysis Direct and Indirect Effects* (N=88)

Direct Effects	β	<i>SE</i>	<i>p</i>
Perceived Utility of Information → Perceived Benefits of Vaccination	.46	.13	<.01
Literacy → Perceived Utility of Information	.005	.00	.21
Literacy → Perceived Benefits of Vaccination	9.18	4.55	<.05
Indirect Effects	β	<i>SE</i>	<i>p</i>
Literacy → Perceived Benefits of Vaccination	.04	.04	.97

Note. β standardized path coefficient, *SE* standard error.

Vita

Sierra Galvan, B.S.

Sierra Galvan received her Bachelor of Science in Health Promotion with minor in Nutrition from the University of Texas at El Paso in the Spring of 2021. She then continued her education and pursued her Master of Public Health with a concentration in Hispanic and Border Health from the University of Texas at El Paso, with prospects to graduate in December 2023. During her Graduate School career, Sierra served as a Graduate Assistant and Masters Assistant for UTEP's Spirit Operations Department. Through this position she aided the Spirit Operations Department in administrative and leadership tasks, organized and promoted student events and created focus groups and satisfaction surveys to evaluate the quality of the department. Additionally, she aided Dr. Julia Lechuga contributing to several research grants as well with data analysis and coding through independent studies. Sierra plans on traveling extensively after graduation and hopes to gain some work experience before ultimately pursuing a Ph.D.