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Clinician offering is a key factor associated with HPV vaccine uptake among Mexican mothers in the U.S. and Mexico: a cross-sectional study

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Introduction

Worldwide, cervical cancer is the fourth most common cancer and the third in terms of cancer-related deaths among women in developing regions (Ferlay et al. 2015). However, this disease continues to be a significant public health problem in more developed countries such as the United States (U.S.) and Mexico. In 2018, the American Cancer Society estimates that there will be 13,240 new cases of cervical cancer and 4,170 deaths in the U.S. (ACS 2018), and Latinas have the highest incidence rate and the second highest mortality rate after black women (ACS 2018; Centers for Disease Control and Prevention 2018). In California, Latinas are more likely to develop and die from cervical cancer than any other racial/ethnic groups (ACS 2017). The cervical cancer incidence rate for Latinas in Los Angeles County is still much higher than among non-Latina whites, African Americans, and certain Asian groups (Liu et al. 2016). In Mexico, cervical cancer is the second most common cancer among women, and the first among those 15 to 44 years (Bruni et al. 2017).

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Ethical statement

All study procedures were performed in accordance with the ethical standards of the UCLA and IMSS research committees and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of interest statement

The authors declare that they have no competing interests to disclose.

In 2012, there were 13,960 new cervical cancer cases and 4,769 deaths (Bruni et al. 2017). Although there has been a national cervical cancer screening program in Mexico since 1974 (Lazcano-Ponce et al. 1999), and the Pap test is widely used in the U.S. since the early 60s, this preventable disease remains an important cause of mortality in both countries.

The recognition of human papillomavirus (HPV) infection as a necessary cause of cervical cancer and the subsequent development of the HPV vaccine have brought about significant changes to prevention efforts. In the U.S., HPV vaccination is recommended for girls who are 9 or older with a catch-up vaccine for girls aged 13 to 26 who were not previously vaccinated (Markowitz et al. 2007; Markowitz et al. 2014; Petrosky et al. 2015). Under the Vaccines for Children Program, girls who are 18 years or younger that qualify for Medicaid, are uninsured, or have insurance that does not cover HPV vaccination, can receive the vaccine for free (Centers for Disease Control and Prevention 2014). In the U.S., the HPV vaccine is mainly administered through pediatric and primary-care providers. In Mexico, the first pilot HPV vaccination program took place in 2008, and a school-based HPV vaccine program for girls aged 9–10 began in 2011 (Centers for Disease Control and Prevention 2011). Over one million doses are applied each year through school-based vaccination programs that exclusively target girls in fifth grade. Eligible girls are vaccinated for free at schools or health centers during the National Vaccination Weeks.

The availability of HPV vaccines represents a landmark breakthrough in the primary prevention of HPV-associated disease, and they show high efficacy in preventing persistent infection with high-risk types that cause over 70% of cervical cancer cases. Despite widespread availability and free access, HPV vaccination rates in both the U.S. and Mexico are suboptimal. In 2016, 60% of girls aged 13–17 years received ≥ 1 dose of the HPV vaccine and 49.5% received the complete vaccination series, with higher rates of 71.8% and 55.3%, respectively, observed among Latina girls in the U.S. (Walker et al. 2017). Factors influencing HPV vaccine uptake in the U.S. include availability of culturally-appropriate information to improve awareness, access to free or low-cost vaccinations, child's age, and health care providers' recommendation of the vaccine (Glenn et al. 2015; Berenson 2015; Gerend et al. 2013; Tsui et al. 2013; Ylitalo et al. 2013). Other studies have examined how provider discomfort discussing the sexual transmission of HPV and the lack of adherence to practice guidelines are barriers that contribute to missed opportunities to recommend and offer the HPV vaccine (Bynum et al. 2014; Javanbakht et al. 2012; Perkins et al. 2013; Berenson 2015; Sussman et al. 2015). In Mexico, the HPV vaccine coverage is estimated to be 67% (Bruni et al. 2016). However, few published studies have investigated clinician offering and patient uptake of the HPV vaccine programs in Mexico (Ramírez-Rios and Bonnez 2013; Sánchez et al. 2013).

Although Latinas have the highest risk of developing cervical cancer in California and cervical cancer is the second leading cause of death due to cancer for women in Mexico, there is scarce information about the knowledge and preventive practices regarding HPV vaccination in these populations. Thus, the purpose of this study was to compare the knowledge, beliefs, and practices regarding HPV vaccination among Mexican mothers/ caregivers (henceforth, mothers) of vaccine eligible girls at health care clinics in Cuernavaca, Morelos and in Oxnard, California. To our knowledge, this is the first study to

examine HPV vaccination knowledge, beliefs, and practices among Mexican mothers in the U.S. and Mexico. A greater understanding of the barriers and facilitators of HPV vaccination in these high-risk groups could help guide the development of more appropriate and effective vaccine promotion strategies and programs in both countries.

Methods

Study sites

The U.S. surveys took place at two *Clinicas del Camino Real* clinics: (1) the Oxnard Clinic, and (2) the *Maravilla* Clinic, which offer the HPV vaccine to low income girls and adolescents in Oxnard County. *Clinicas del Camino Real, Inc.* is a Federally Qualified Health Center (FQHC) and a 501(c)(3) nonprofit organization that delivers a fully integrated system of health care services, at 13 locations. *Clinicas'* bilingual and bicultural staff reaches out to members of the community who are traditionally underserved due to limited income, resources, cultural, and language barriers. These clinics were selected because their patient population is mostly Latino, and the majority are of Mexican origin.

In Mexico, participants were enrolled and interviewed at two Mexican Institute of Social Security (IMSS) clinics in Cuernavaca. IMSS is the main social security institution in Mexico, offering health insurance coverage to current or formerly employed workers and their dependents, providing care to an estimated 44% of the Mexican population (INEGI 2013). In both countries, recruitment and surveys were conducted at clinical sites with vaccination services so all respondents had free or low-cost access to the HPV vaccine for their daughters. Additionally, these clinics were chosen because of a preexisting working relationship between the study researchers and the clinic administrators. The two IMSS clinics in Cuernavaca, Mexico and the two *Clinicas del Camino Real* clinics in Oxnard, U.S. are in urban environments within proximity of each other (approximately 4 km apart).

Identification of participants and study procedures

A sample of 200 Mexican women 18 to 65 years of age who are the mothers or medical decision-makers for at least one girl who is eligible to receive the HPV vaccine (9 to 12 years) were surveyed at two IMSS clinics in Cuernavaca from July to October 2012. A similar sample of 200 Mexico-born, Spanish-speaking mothers with a daughter(s) of vaccinating age (9 to 18 years) were surveyed at two clinics in Oxnard from August to November 2013. Our study population was restricted to women who were born in Mexico, whose primary language is Spanish, and who have access to free or low-cost medical services, in order to minimize the differences between the two groups.

Trained interviewers enrolled eligible participants in the waiting room areas of the clinics in Oxnard and Cuernavaca, using the same identification and recruitment procedures. Women who met the inclusion criteria were invited to participate and were provided with a detailed explanation of the study while emphasizing the voluntary and confidential nature of the survey. All subjects provided informed consent before participating in the survey, which took place in a separate room or private area of the waiting room to ensure confidentiality. The response rate among women who were eligible to participate in the study was over 80%.

Participants in the U.S. were paid \$10 dollars after completing the survey, but the women in Mexico were not compensated because subjects cannot be paid to participate in research studies. Approval for this study was obtained from the UCLA and IMSS Internal Review Boards prior to beginning any data collection activities.

Survey instruments and conceptual framework

The theoretical perspective of the Multi-Level Health Outcomes Framework, formerly known as the Health Behavior Framework, developed by Dr. Roshan Bastani and colleagues (Bastani et al. 2010), was used to develop the study questionnaires and guide the data analyses. Survey items were drawn from prior studies of the research team, as described previously (Glenn et al. 2015; Bastani et al. 2011). Since the focus of this study was on the mothers of HPV-vaccine eligible girls, a greater emphasis was placed on individual-level variables from the model such as mothers' knowledge regarding HPV, perceived susceptibility to disease, and the socio-demographics of the mother and daughter. We also examined perceived barriers to preventive services and medical care, vaccine-related attitudes and beliefs, as well as communication between mother and clinician. A sub-sample of 15 mothers in Mexico and 20 in the U.S. participated in in-depth semi-structured interviews eliciting participants' narratives regarding their HPV and other vaccine-related decision-making and values. These qualitative results are reported in a separate manuscript (Wentzell et al. 2016).

Measures

The main study outcome was adolescent HPV vaccine receipt as reported by the mother, through the question: "Has your daughter received any doses of the HPV vaccine?" If applicable, the participants were asked to indicate how they heard about the HPV vaccine, and if they had been offered the HPV vaccine by a doctor or nurse. The mothers were also asked "Have you ever heard of HPV? HPV stands for Human Papilloma virus." (yes/no), and among mothers who were aware of HPV, various follow-up questions assessed if they knew about the association between HPV and cervical cancer, the mechanism of HPV transmission, and whether infections normally clear on their own. Demographic data obtained included: age, education level, household income, marital status, health insurance status, and usual source of medical care.

Statistical analysis

The results reported by Mexican mothers in the U.S. and Mexico were compared using chi-square tests for categorical variables (health insurance status, income, and level of education), and T-tests for continuous variables. Chi-square analyses were also used to compare knowledge, access, and vaccine receipt variables, as well as the potential barriers to vaccination uptake among unvaccinated girls, and differences in beliefs between the mothers of vaccinated and unvaccinated girls in both countries. Multivariate logistic regression analyses were performed to identify independent correlates of HPV vaccine uptake, after adjusting for other factors. The variables included in the final multivariate model were selected based on their statistical significance in the bivariate model ($p < 0.05$), tests of multicollinearity, and the conceptual importance of predictor covariates. Unadjusted and adjusted odds ratios (OR) with 95% confidence intervals (95% CI) are reported, and for all

analyses, a two-sided p -value <0.05 was considered statistically significant. Data were analyzed using SAS version 9.3 (SAS Institute, 2011).

Results

The demographic characteristics of the study participants at two Mexican Institute of Social Security (IMSS) clinics in Mexico (Hospital and Clinic) and two clinics in the United States (Oxnard and *Maravillas*) are presented in Table 1. The mean age of participants in Mexico (36.8 years) is younger than in the U.S. (39.6 years). Mothers in Mexico are more likely to have health insurance (72% vs. 6%, respectively) and are more educated (10.1 vs. 7.4 average years of education) than participants in the U.S. Most mothers in both countries report a household income under \$25,000 USD per year (85% in Mexico and 91% in U.S.) The mean age of girls in Mexico (10.6 years) is younger than in the U.S. (13.1 years).

The HPV knowledge, access, and HPV vaccine uptake rates reported by the respondents at two IMSS clinics in Mexico and two clinics in the United States are compared in Table 2. Most of the participants in Mexico have heard of HPV (97%, vs. 65% in the U.S.) and know that HPV causes cervical cancer (94%, vs. 87% in the U.S.). Mothers in Mexico are also more likely to have heard of the HPV vaccine (90% vs. 72% in the U.S.) and that the vaccine is most effective if administered before sexual debut (99% vs. 89% in the U.S.). A higher proportion of mothers in the U.S. indicate that they have discussed the HPV vaccine with their daughter's clinician (69% vs. 44%), their daughter has been offered the HPV vaccine by a clinician (77% vs. 55%), and their daughter has received at least one dose of the HPV vaccine (49% vs. 40%), than those in Mexico. Only 19% of the mothers in the U.S. and 16% in Mexico report that their daughters received all the required HPV vaccine doses.

Figure 1 compares some of the decision factors reported by the mothers who did not vaccinate their daughters in Mexico and the U.S. Mexican mothers in the U.S. are more likely to believe their daughters will think it is alright to have sex if they get the HPV vaccine (15% vs. 3% in Mexico), they also believe that the HPV vaccine might cause problems getting pregnant (21% vs. 1% in Mexico) or other future health problems (20% vs. 2% in Mexico). A larger proportion of Mexican mothers in the U.S. said they do not have enough information about the HPV vaccine to make a decision (66% vs. 49% in Mexico) and that they are very worried about the vaccine's side-effects (63% vs. 31% in Mexico). The mothers with unvaccinated daughters in both countries report that they would have their daughter vaccinated if their doctor recommends it (100% in Mexico vs. 93% in U.S.), and that getting the HPV vaccine for their daughter would be a good idea (100% in Mexico vs. 84% in U.S.). (Data not shown)

Table 3 contrasts the difference in beliefs between mothers of vaccinated and unvaccinated girls in the U.S. and Mexico. In the U.S., a greater proportion of mothers with vaccinated daughters agree that the HPV vaccine is effective/very effective than mothers of unvaccinated girls (93% vs. 79%). A few respondents in Mexico (2%) and the U.S. (10%) believe that vaccines cause more harm than good, with significant differences observed between the mothers of vaccinated and unvaccinated girls in the U.S. (5% vs. 14%, respectively). Mexican mothers in the U.S. are more likely to agree that vaccination to

prevent serious diseases should be required by law, than mothers in Mexico, regardless of whether they vaccinated their daughters or not. U.S. mothers are also more likely to agree with a school mandate for the HPV vaccine than mothers in Mexico, whether they vaccinated their daughters or not.

The bivariate and multivariate correlates of vaccine initiation are presented in Table 4. In the bivariate logistic regression analyses, the following factors predict a higher likelihood of receiving ≥ 1 dose of the HPV vaccine: daughter's age, heard of HPV, heard about the HPV vaccine from a clinician, discussed the HPV vaccine with a doctor, were offered the HPV vaccine by a clinician, think daughter has a lower risk of HPV than other girls, agree with school mandate for HPV vaccine, and report a younger acceptable age for HPV vaccination ($p < 0.05$). These variables as well as the mother's age and study site were included in the multivariate logistic regression analyses. Model 1 excluded the variable "has discussed the HPV vaccine with a doctor," while Model 2 excluded "daughter has been offered the HPV vaccine by a clinician." Six factors are associated with a greater likelihood of HPV vaccine uptake: mother's age, daughter's age, discussed the HPV vaccine with a doctor, offered the HPV vaccine by a clinician, think daughter has a lower risk of HPV, and reporting a younger acceptable age for HPV vaccination ($p < 0.05$). The two variables with the strongest association to vaccine initiation are "having discussed the HPV vaccine with a doctor" (OR 8.33, 95% CI 4.37, 15.91) and "having been offered the HPV vaccine by a clinician" (OR 12.37, 95% CI 6.21, 24.63) ($p < 0.001$). (Table 4)

Discussion

This is the first study to assess the knowledge, beliefs, and preventive practices regarding HPV vaccination in a binational sample of Mexican mothers in the U.S. and Mexico. Our findings indicate that even though Mexican mothers in the U.S. are less knowledgeable and have more negative attitudes toward the HPV vaccine compared to their counterparts in Mexico, the uptake rates reported by the study participants in Oxnard are higher than those in Cuernavaca. Other studies in the U.S. have reported low levels of knowledge regarding HPV and the HPV vaccine among Latinos in the U.S. (Fernandez et al. 2009; Kepka et al. 2012; Kepka et al. 2015; Vanslyke et al. 2008). An explanation for the higher vaccine uptake rates in the U.S. may be that while most participants at the Oxnard clinics had lower levels of knowledge and were also uninsured, they were able to obtain the HPV vaccine for their daughters at a low or no cost through programs such as the Vaccines for Children Program and Medi-Cal. Nonetheless, the HPV vaccination rate we observed among our sample of Mexican-American mothers in Oxnard is lower than the national rate reported among Latinas in 2013 (67.5%) (Elam-Evans et al. 2014). We also expected to find a higher vaccine uptake rate in this low-income population, since HPV vaccination coverage is higher among adolescents living below the federal poverty level than among those at or above the poverty level (Walker et al. 2017).

The higher levels of knowledge regarding the association between HPV and cervical cancer, as well as the greater awareness about the HPV vaccine reported among the mothers in Mexico, is expected among a group that is more educated. Nearly half of the participants in Mexico have a high school degree or greater, as compared to 19% among the U.S.

respondents. However, this greater knowledge about HPV and the HPV vaccine among the women in Mexico is not as strongly correlated to increased HPV vaccination uptake rates as other factors. The Mexican mothers in the U.S. sample were significantly more likely to report that they have discussed the HPV vaccine with their daughter's physician/nurse and have been offered the HPV vaccine by a clinician. Our multivariate analyses confirm that having a clinician discuss or offer the HPV vaccine are more strongly associated with having received ≥ 1 dose of the HPV vaccine, than other factors such as knowledge and beliefs. Our results concur with other studies that report physician recommendation as one of the most influential motivators for HPV vaccination (Javanbakht et al. 2012; Glenn et al. 2015; Berenson 2015; Gerend et al. 2013; Tsui et al. 2013; Ylitalo et al. 2013). A recent systematic review and meta-analysis of 79 studies conducted with 840,838 parents across 15 countries (Newman et al. 2018) also reports that physician recommendation had the greatest influence on vaccine uptake. This suggests that factors such as health systems, clinics, or providers may be the main drivers of vaccine receipt among this binational sample of Mexican mothers.

We also found that daughter's age is associated with HPV vaccine uptake. In Mexico, the average age of the daughters was 10.6 years and in the U.S. it was 13.1 years. This is probably due to the higher age range for HPV vaccination in the U.S., which includes youths ages 9 to 18 years, while in Mexico only girls who are in 5th grade are vaccinated (ages 9 to 10 years). Our multivariate analyses indicate that increasing age is associated with a greater likelihood of being vaccinated, which is consistent with the higher uptake rates observed among girls in the U.S., as compared to Mexico (49% vs. 40%, respectively). Since more girls (aged 9 to 18 years) were vaccinated in the U.S. and a lower number of girls (aged 9 to 10) were vaccinated in Mexico, it follows that average age in the U.S. sample would be older than the sample in Mexico and that increasing age would be associated with receipt of the HPV vaccine. Interestingly, our multivariate analyses also indicate that the likelihood of vaccine uptake is significantly higher among the daughters of mothers who report a younger acceptable age for HPV vaccination.

One of our aims was to investigate the reasons why certain mothers did not vaccinate their daughters. A substantial portion of mothers of unvaccinated girls in both countries report that they do not have enough information to make a decision about vaccinating their daughter and that they are very worried about the HPV vaccine side-effects. Mothers of unvaccinated girls in the U.S. are significantly more likely to believe that the HPV vaccine might cause future health problems, including trouble getting pregnant, than mothers in Mexico. Fortunately, most of the mothers with unvaccinated daughters in both countries report that they would vaccinate their daughter(s) if their doctor recommends it (>90%). This finding also reinforces the importance of having clinicians discuss and promote the HPV vaccine among their eligible patients.

This study has some limitations. Data collection activities in Mexico took place during 2012, while the U.S. data were obtained in 2013. Ideally, the data should have been collected simultaneously. This study is cross-sectional, so we can only report on the observed associations between certain predictors of HPV vaccine uptake and cannot establish causality. We did not verify the daughters' vaccination history through a medical record

review, which could result in an under or over-reporting of the actual HPV vaccination rates. Participants were recruited at clinics where they can obtain free or low-cost preventative healthcare services, so they may have more favorable attitudes regarding HPV vaccination than parents without access to such services. Another limitation is that mothers in Mexico were significantly more likely to be younger, insured, more educated, and have a higher income than mothers in the U.S. However, except for mother's age, these specific factors were not found to be significantly associated with increased vaccine uptake in this binational study. This sample of mothers may not be representative of other Mexico-born women living in the U.S. or Mexico, or other Latina women in the U.S. or abroad. While these results may not be generalizable to other groups, they do suggest key shared beliefs and experiences regarding HPV vaccination among Mexico-born mothers in Southern California and central Mexico who have access to healthcare services.

Despite these limitations, this study explores some of the factors that might help explain why HPV vaccination rates in the U.S. and Mexico remain suboptimal. Our findings support the need for more education among clinicians in both countries to inform them how important it is that they discuss and offer the HPV vaccine to their eligible patients. Future studies should explore the role of specific barriers, the experiences of parents/caregivers without access to preventive healthcare services, as well as other racial/ethnic groups in Mexico and the U.S., since their beliefs and practices may differ. Additionally, more research is needed to understand the low rates of HPV vaccination completion among Mexican mothers and other underserved populations.

In conclusion, this study provides some insight regarding certain barriers and facilitators to HPV vaccination among Mexican mothers of adolescent girls in the U.S. and Mexico. We found that having discussed or been offered the HPV vaccine by a clinician are the main predictors of uptake in this binational sample of Mexican mothers. Another important finding is the fact that most mothers would vaccinate their unvaccinated daughters if recommended by a doctor. These results highlight the importance of the clinician's role in helping to increasing HPV vaccine uptake in the U.S. and Mexico. Interventions and programs that encourage clinicians to offer the HPV vaccine to all vaccine-eligible girls and boys should be developed to help increase vaccine uptake rates in both countries. Ideally, clinicians should consistently recommend and co-administer the HPV vaccine along with other age-appropriate vaccines (such as Tdap and MenACWY) to increase uptake and completion rates. This will optimize the protection of adolescents against vaccine-preventable diseases, including several HPV-associated cancers. Efforts to increase the rates of HPV vaccination through clinician recommendation are likely to improve uptake and completion of the vaccine series among eligible Latino adolescent in the U.S. and Mexico.

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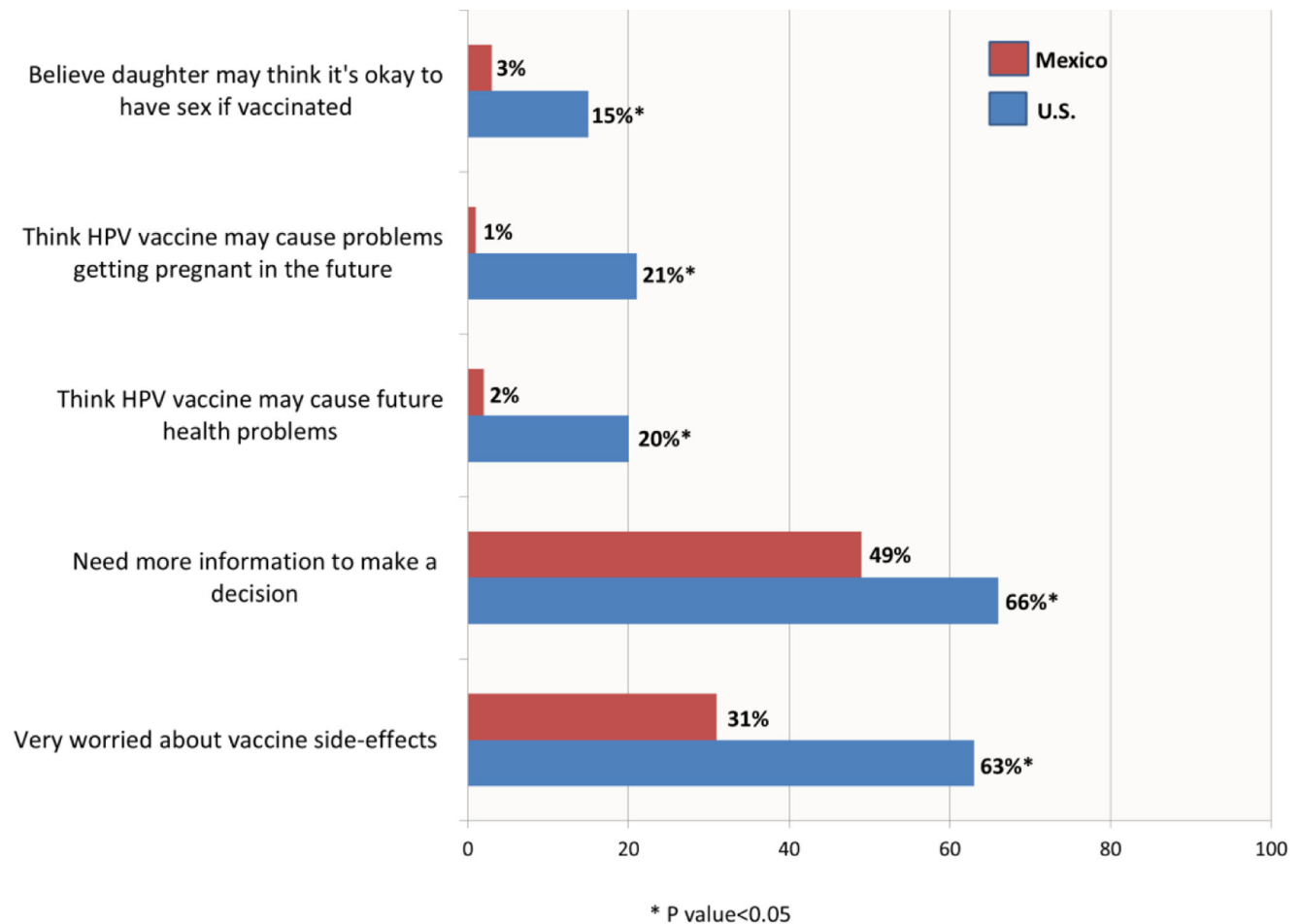
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[±] Differences between proportions in total Mexico sample vs. total United States sample were performed using Chi square tests of homogeneity.
Cuernavaca, Mexico and Oxnard, United States 2012-2013

Figure 1.

Percentage of participants with unvaccinated daughters who reported potential barriers to vaccine uptake in Mexico compared to the United States (n=223)[±]

Table 1.

Demographic characteristics of study participants at two sites in Mexico (hospital and clinic) and two sites in the United States (Oxnard and Maravillas). (n=400)

	Hospital n=100	Clinic n=100	Mexico Total ^a n=200	Oxnard Clinic n=100	Maravillas Clinic n=100	United States Total ^a n=200
Mothers/Caregivers						
Age (years, mean)	37.5	36.0	36.8	39.9	39.3	39.6 ^{**}
Uninsured (%)	7%	4%	6%	68%	75%	72% ^{**}
Household Income (< \$25,000 US dollars/year)	85%	85%	85%	86%	97%	91% [*]
Education (years, mean)	9.9	10.4	10.1	7.9	6.9	7.4 ^{**}
< High school (%)	52%	49%	51%	77%	86%	82% ^{**}
Complete high school (%)	35%	32%	33%	15%	6%	11% ^{**}
> High school (%)	13%	19%	16%	8%	8%	8% ^{**}
Girls/Adolescents						
Age (years, mean)	10.4	10.8	10.6	12.9	13.3	13.1 ^{**}

^a Differences between proportions in total Mexico sample vs. total United States sample were performed using Chi square tests of homogeneity; differences between means were performed using t test.

* P value < 0.05

** P value < 0.01

Table 2.

Differences in HPV knowledge, access and vaccine uptake reported by the participants at two sites in Mexico (hospital and clinic) and two sites in the United States (Oxnard and Maravillas).

	Hospital n (%)	Clinic n (%)	Mexico Total ^a n (%)	Oxnard Clinic n (%)	Maravillas Clinic n (%)	United States Total ^a n (%)
Awareness: Has heard of HPV (yes)	96 (96)	98 (98)	194 (97)	64 (64)	66 (66)	130 (65)**
Knowledge: HPV is transmitted sexually (yes, among aware of HPV)	87 (91)	96 (98)	183 (94)	57 (89)	56 (85)	113 (87)*
Knowledge: HPV causes cervical cancer (yes, among aware of HPV)	86 (90)	93 (95)	179 (92)	59 (92)	62 (94)	121 (93)
Awareness: Has heard of HPV vaccine (yes)	83 (83)	97 (97)	180 (90)	70 (70)	74 (74)	144 (72)**
Knowledge: HPV vaccine is most effective if administered prior to sexual debut (yes, among aware of HPV vaccine)	82 (99)	96 (100)	179 (99)	65 (94)	62 (84)	127 (89)**
Access: Has discussed HPV vaccine with daughter's doctor (yes, among aware of HPV vaccine)	33 (40)	45 (47)	78 (44)	42 (60)	58 (78)	100 (69)**
Access: Daughter has been offered the HPV vaccine by a doctor or nurse (yes, among aware of HPV vaccine)	47 (57)	52 (54)	99 (55)	54 (78)	56 (76)	110 (77)**
Receipt: Initiated HPV Vaccine (received ≥ 1 dose)	40 (40)	40 (40)	80 (40)	45 (45)	52 (52)	97 (49)
Receipt: Daughter completed HPV vaccination	13 (13)	19 (19)	32 (16)	15 (15)	22 (22)	37 (19)

^aDifferences between proportions in total Mexico sample vs. total U.S. sample were performed using Chi square tests of homogeneity. Total sample at each clinic in Mexico is 100 and Total sample at each clinic in US is 100.

* P value < 0.05

** P value < 0.01

Table 3.

Proportion of mothers with vaccinated or unvaccinated daughters who report specific beliefs regarding the HPV vaccine in Mexico and the United States.

	Mexico			United States		
	Not vaccinated n=120	Vaccinated n=80	Total n=200	Not vaccinated n=103	Vaccinated n=97	Total n=200
Agree HPV vaccine is effective/very effective *	95% ^d	88%	92%	79% ^{b,d}	93% ^b	88%
Agree vaccination to prevent disease is good	100%	100%	100%	96%	100%	99%
Agree vaccines cause more harm than good	0% ^{a,d}	4% ^a	2%	14% ^{b,d}	5% ^b	10%
Agree vaccination to prevent serious diseases should be required by law	71% ^d	67% ^c	69%	83% ^d	90% ^c	86%
Agree with school mandate for HPV vaccine	30% ^d	27% ^c	29%	56% ^{b,d}	75% ^{b, c}	66%

^aP value < 0.05 for differences between vaccinated vs. not vaccinated in Mexico

^bP value < 0.05 for differences between vaccinated vs. not vaccinated in United States

^cP value < 0.05 for differences between vaccinated in Mexico vs. vaccinated in the United States

^dP value < 0.05 for differences between not vaccinated in Mexico vs. not vaccinated in the United States

* is only applied to participants who had heard HPV vaccine.

Table 4.

Bivariate and multivariate correlates of vaccine initiation (Received ≥ 1 dose of HPV vaccine), odds ratios (OR) and 95% confidence intervals (95% CI)

	Bivariate analysis OR (95% CI)	Multivariate model 1 ^a OR (95% CI)	Multivariate model 2 ^b OR (95% CI)
CAREGIVER CHARACTERISTICS			
Age (Continuous)	1.02 (0.99, 1.05)	0.96 (0.912, 1.00)	0.95 (0.91, 0.99)[*]
Study sites			
Cuernavaca, Mexico (Reference)		1.22 (0.56, 2.69)	0.97 (0.45 2.09)
Oxnard, United States	1.41 (0.95, 2.10)		
Income (Reference: at or below poverty level or unemployed)		-	-
Above poverty level	1.14 (0.76, 1.71)		
Education (Reference: < High school diploma)		-	-
High school diploma or more	1.09 (0.72, 1.65)		
Marital status (Reference: Not married)		-	-
Married	0.89 (0.52, 1.51)		
DAUGHTER'S CHARACTERISTICS			
Daughter's age (Continuous)	1.23 (1.14, 1.34)^{**}	1.46 (1.23, 1.72)^{**}	1.51 (1.28, 1.77)^{**}
Insurance status of daughter (Reference: Uninsured)			
Insured	1.67 (0.95, 2.95)	-	-
HPV AND HPV VACCINE-RELATED FACTORS			
Heard of HPV (Reference: No)			
Yes	1.80 (1.07, 3.05)[*]	2.01 (0.80 5.02)	2.25 (0.92, 5.49)
Heard about HPV vaccine from a clinician (Reference: No)		-	-
Yes=244	6.75 (4.19, 10.89)^{**}		
Has discussed HPV vaccine with a doctor (Reference: No/Don't know)		-	
Yes	8.69 (5.52, 13.69)^{**}		8.33 (4.37,15.91)^{**}
Daughter offered HPV vaccine by clinician (Reference: No/Don't know)			-
Yes	13.08 (7.98, 21.4)^{**}	12.37 (6.21, 24.63)^{**}	
Perceived severity of HPV infection (Reference: Not serious)		-	-
Serious	1.12 (0.64, 1.96)		
Perceived risk of HPV infection (Reference: Same/ more risk)			
Daughter has less risk than other girls	2.84 (1.87, 4.32)^{**}	3.47 (1.78, 6.77)^{**}	4.65 (2.37, 9.13)^{**}
Immunization should be required by law (Reference: Disagree/Neither agree nor disagree/Don't know)			-
Agree	1.18 (0.73, 1.91)		
School mandate for HPV vaccine (Reference: No/Don't know)			

	Bivariate analysis OR (95% CI)	Multivariate model 1^a OR (95% CI)	Multivariate model 2^b OR (95% CI)
Yes	1.57(1.06,2.34)[*]	1.56(0.803,0.03)	1.70 (0.88, 3.28)
Acceptable age for HPV vaccination (Continuous, older to younger)	1.21 (1.11, 1.33)^{**}	1.33 (1.16, 1.54)^{**}	1.35 (1.17, 1.55)^{**}

^{*}
P- value < 0.05

^{**}
P- value < 0.001 using logistic regression analysis

^aModel 1 included the following variables: mother's age, study site, daughter's age, heard of HPV, offered HPV vaccine by a clinician, perceived risk of HPV infection, school mandate for HPV vaccine, and acceptable age at vaccination.

^bModel 2 included the following variables: mother's age, study site, daughter's age, heard of HPV, discussed HPV vaccine with a clinician, perceived risk of HPV infection, school mandate for HPV vaccine, and acceptable age at vaccination.