Risk Factors for High-Risk Type Human Papillomavirus Infection among Mexican-American Women[1]

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Abstract

Minority women in the United States experience a disproportionately high burden of the more than 2 million yearly cases of squamous intraepithelial lesions of the cervix. Risk factors for squamous intraepithelial lesions of the cervix are infection with the sexually acquired human papillomavirus (HPV), an early age at first intercourse, history of multiple sexual partners, oral contraceptive use, high parity, lower socioeconomic status, poor diet, immunosuppression, and promiscuous male sexual partners. Although Hispanics are the largest growing minority population in the United States, few HPV risk factor studies have either included or focused on Hispanics in the United States. To determine risk factors for HPV infection among Mexican-American women, we conducted a cross-sectional study from 1992–1995. Nine hundred and seventy-one women, 18–47 years of age, with cytology results were included in this analysis. Overall, 13.2% of participants were HPV positive by the Hybrid Capture tube method for high-risk types 16, 18, 31, 33, 35, 45, 51, 52, or 56. Age [adjusted odds ratio (AOR) = 0.3 for ages >36 years compared with ages 18–20] and duration of oral contraceptive use (AOR = 0.4 for ≥4 years relative to nonusers) were inversely associated with these high-risk types of HPV infection. Marital status (AOR = 1.9 among single women compared with married) and lifetime number of sexual partners (AOR = 2.3 for women ≥5 partners relative to monogamous women) were positively associated with an increased risk. Participants born in Mexico were significantly ($P < 0.05$) older, had fewer sex partners, and older age at first intercourse. Despite this lower behavioral risk profile, women born in Mexico were significantly more likely (AOR = 1.9; CI = 1.2–3.2) to have an HPV infection compared with United States-born, Mexican-American women after adjustment for potential confounders. Collectively, these results suggest that an unmeasured factor, such as the sexual behavior of the male partner, may be influencing HPV risk. Further research is needed to define this factor and to assess cultural norms of sexual behavior.

Introduction

Cervical cancer is the second most common cancer among women worldwide, accounting for 11.7% of the total cancer burden (1). In Latin America, the rate of invasive cervical cancer is ~4-fold higher than in the United States and North America. Among Hispanics in the United States, the rate of cervical cancer has decreased significantly in some states (2), presumably due to the implementation of aggressive Pap smear screening programs. In other states, such as Arizona, Hispanic women experience a higher rate of cervical cancer compared with non-Hispanic white women (10.4 *versus* 7.5/100,000; Ref. 3). In addition, minority women in the United States experience a disproportionately high burden (4) of the >2 million yearly cases of the precursor SILs[3] (5). Although amenable to treatment, low- and high-grade SILs add a significant economic burden to the health care system due to the need for diagnostic follow-up and treatment of these lesions.

Primary risk factors for SILs are infection with the sexually acquired HPV, an early age at first intercourse, a history of multiple sexual partners, and immunosuppression (6). Other putative risk factors are oral contraceptive use, high parity, lower socioeconomic status, poor diet, and promiscuous male sexual partners (7). In the past decade, strong and consistent associations between HPV and cervical cancer and SILs have been published from studies conducted in the United States and worldwide (8), and HPV is now considered a cause of cervical cancer. HPV DNA is present in 85–100% of cervical cancer specimens and high-grade SILs, and the association between HPV infection and cervical cancer is specific to a limited number of oncogenic types found in the genital tract (6).

Despite the fact that Hispanics are the largest growing minority population in the United States (9), comprising ~10% of the population and as much as 44% of regions within the Southwest (10), few studies examining risk factors for HPV have either included or focused on Hispanics in the United States (11–13). Although case control studies have been conducted among Hispanics living in Latin America (14–17) and the United States (18), to date no large HPV screening study has been conducted among United States Hispanics. An understanding of the risk factors for high-risk type HPV infection

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[3] The abbreviations used are: SIL, squamous intraepithelial lesion; HPV, human papillomavirus; OC, oral contraceptive; OR, odds ratio; AOR, adjusted OR; ASCUS, atypical cells of undetermined significance; STD, sexually transmitted disease.

Table 1 Prevalence of high-risk type HPV infection by cytology among low-income Hispanic women (n = 971)

Cytology[a]	n (%)	HPV positive (%)[b]
Normal	911 (93.8)	92 (10.1)
ASCUS	23 (2.4)	7 (30.4)
Lg SIL	23 (2.4)	16 (69.6)
Hg SIL	14 (1.4)	13 (92.9)
Total	971	128 (13.2)

[a] Lg SIL, low-grade SIL; Hg SIL, high-grade SIL.
[b] Significantly different by χ^2 test, $P < 0.001$.

among Mexican-Americans, the largest group of United States Hispanics, is important to the development of programs that can impact rates of SILs in this high-risk population.

To determine risk factors for HPV infection, we conducted a large cross-sectional study among Mexican-American women attending a family planning clinic in southern Arizona from 1992–1995.

Materials and Methods

Subjects. Nine hundred and ninety-eight low income Mexican-American women self-referring for a gynecological examination at the Pima County Health Department in Tucson, AZ were recruited and enrolled in an HPV and SIL screening study from April 1992 through June 1995. More than 95% of women, approached to participate, consented and completed the study protocol. Most of the women attending this clinic had low incomes, qualifying them for a reduced fee for services. Only women 18 years and older, who self-identified as Hispanic, had no previous treatment for SILs, no history of a chronic illness (*e.g.*, renal failure, diabetes, cancer, liver disease, or gastrointestinal malabsorption), were not pregnant and >2 months postpartum, and were still having menstrual periods were enrolled in this study. After reviewing and signing an informed consent form, women completed a self-administered detailed health questionnaire.

Questionnaire. The questionnaire was made available to the participant in the language of her choice, Spanish or English. The language chosen by the participant was recorded in the database as the participant's preferred language. The bilingual, bicultural interviewer reviewed the questionnaire with the participant to insure that all questions were answered appropriately. The questionnaire included questions on country of birth, reproductive, sexual, medical and contraceptive history, as well as questions to assess socioeconomic status. Total years of OC use was determined by summing the duration of use at each of the various times in the participant's life that OCs were used. Participants who reported never using OCs, or whose total use was <12 months, were recorded as having 0 years of use.

Clinical Examination. After the administration of the questionnaire, participants completed the routine gynecological examination. During this examination, the collection of exfoliated cervical cells for HPV analyses was conducted after the collection of cells for the clinical Pap smear. Cytology results from this visit were obtained from each participating subject from their medical charts. Cytology results showed that 911 (91.3%) participants had normal Pap smears at enrollment.

HPV Analyses. Exfoliated cervical cells for the measurement of HPV were collected and suspended in transport medium (ViraType; Digene). HPV status was determined by the Digene Hybrid Capture Tube System using the high-risk probe that detects HPV types 16, 18, 31, 33, 35, 45, 51, 52, and 56. The sensitivity of this test is 1 pg of viral DNA per 100-μl sample. All equivocal samples (relative light unit of sample/positive control of 0.8–1.2) by the Digene Hybrid Capture Tube method were analyzed by PCR with the L1 consensus primer system, followed by detection of the amplified product with the Hybrid Capture Tube assay (19). Only samples that were positive by both methods were categorized as positive in this study. The Digene Hybrid Capture Tube System is a rapid and relatively inexpensive and reliable method for detecting HPV in exfoliated cells (20–23). In addition to the relative ease in using the Digene Hybrid Capture Tube System, this method was chosen for this study because its decreased sensitivity relative to PCR appears to provide a more predictive assay for persistent SILs among reproductive-age women (24) and, therefore, may be more biologically relevant.

Table 2 Sociodemographic factors: associations with high-risk type HPV infections among low-income Hispanic women (n = 971)[a]

	No. (%)	HPV+ (%)	OR	
			Crude	Age adjusted (95% CI)
Age, yr				
18–20	124 (12.8)	28 (22.6)	1.00	
21–25	283 (29.2)	48 (17.0)	0.70	
26–30	249 (25.6)	31 (12.5)	0.49	
31–35	190 (19.6)	13 (6.8)	0.25	
36–47	125 (12.9)	8 (6.4)	0.23	
P for trend			<0.001	
Marital status				
Married	526 (57.1)	46 (8.8)	1.00	1.00
Cohabitating	50 (5.4)	7 (14.0)	1.70	1.41 (0.60–3.35)
Divorced/Separated	65 (7.1)	10 (15.4)	1.90[b]	2.09 (0.99–4.41)[b]
Single	278 (30.2)	58 (20.9)	2.75	2.14 (1.38–3.32)
Widowed	3 (0.3)	0 (0.0)		
Education				
Less than high school	385 (39.7)	40 (10.4)	1.00	1.00
Completed high school	303 (31.2)	43 (14.2)	1.43	1.17 (0.73–1.87)
More than high school	206 (21.2)	33 (16.0)	1.65	1.46 (0.88–2.41)
P for trend			0.046	0.130
Occupation				
Housewife	623 (64.2)	67 (10.8)	1.00	1.00
Professional	57 (5.9)	10 (17.5)	1.77	1.77 (0.85–3.71)
Skilled worker	54 (5.6)	6 (11.1)	1.04	1.07 (0.44–2.61)
Unskilled worker	90 (9.3)	15 (16.7)	1.66	1.70 (0.91–3.16)[b]
Student	35 (3.6)	6 (17.1)	1.72	1.13 (0.44–2.88)
Unemployed	36 (3.7)	8 (22.2)	2.37	1.85 (0.80–4.30)
Current smoking				
No	817 (88.0)	104 (12.7)	1.00	1.00
Yes	112 (12.1)	17 (15.2)	1.23	1.35 (0.76–2.38)
Country of birth				
United States	276 (28.4)	36 (13.0)	1.00	1.00
Mexico	626 (64.5)	82 (13.1)	1.00	1.25 (0.81–1.93)

[a] Due to missing data, all categories do not total 971.
[b] $P < 0.10$.

Data Management and Statistical Analyses. All completed interviews were carefully reviewed by the study coordinator for completeness prior to entering data into computer files. IBM PCs were used for data entry using the Epi Info version 5.0 program (CDC). Data were quality controlled for range and cross-file field checked. Randomly selected questionnaires were double-checked for coding and entry errors.

STATA Release 5.0 (Stata Corporation, College Station, TX) was used for all data analyses. In addition to simple descriptive statistics, comparisons of categorical variables were

Table 3 Sexual, reproductive, and contraceptive history: associations with high-risk type HPV infection among low-income Hispanic women ($n = 971$)

	No. (%)	HPV+ (%)	OR	
			Crude	Age-adjusted (95% CI)
Lifetime no. of sexual partners				
1	519 (53.5)	54 (10.4)	1.00	1.00
2–4	310 (31.9)	48 (15.5)	1.58	1.59 (1.04–2.43)
≥5	94 (9.7)	19 (20.2)	2.18	2.06 (1.15–3.70)
P for trend			0.003	0.005
Age at first intercourse, yr				
≥20	244 (25.1)	20 (8.2)	1.00	1.00
18–19	256 (26.4)	33 (12.9)	1.66[a]	1.31 (0.72–2.39)
16–17	258 (26.6)	39 (15.1)	1.99	1.44 (0.80–2.62)
9–15	147 (15.1)	24 (16.3)	2.19	1.51 (0.78–2.93)
P for trend			0.009	0.374
STD history				
Never	920 (94.8)	119 (12.9)	1.00	1.00
Ever	51 (5.3)	9 (17.7)	1.44	1.39 (0.65–2.96)
Pregnancy history				
Never	72 (7.4)	18 (25.0)	1.00	1.00
Ever	858 (88.4)	103 (12.0)	0.41	0.60 (0.33–1.10)[a]
No. of children				
0	89 (9.2)	21 (23.6)	1.00	1.00
1–2	470 (48.4)	62 (13.2)	0.49	0.64 (0.36–1.13)
3–9	293 (30.2)	28 (9.6)	0.34	0.66 (0.33–1.33)
P for trend			0.002	0.479
Total OC use (yr)				
0	252 (26.0)	461 (18.3)	1.00	1.00
1–3	480 (49.4)	66 (13.8)	0.71	0.66 (0.44–1.01)[a]
≥4	200 (20.6)	13 (6.5)	0.31	0.38 (0.20–0.74)
P for trend			<0.001	0.003
Current OC use				
No	573 (59.0)	79 (13.8)	1.00	1.00
Yes	398 (41.0)	49 (12.3)	0.88	0.76 (0.51–1.12)
Condom use				
Never	821 (84.6)	112 (13.6)	1.00	1.00
Ever	150 (15.5)	16 (10.7)	0.76	0.81 (0.46–1.43)
Current condom use				
No	871 (89.7)	115 (13.2)	1.00	1.00
Yes	100 (10.3)	13 (13.0)	0.98	0.95 (0.51–1.77)

[a] $P < 0.10$.

Table 4 Independent risk factors for high-risk type HPV infection among low-income Hispanic women ($n = 971$)

	AOR[a] (95% CI)
Age, yr	
18–20	1.00
21–25	0.72 (0.39–1.32)
26–30	0.49 (0.25–0.96)
31–35	0.29 (0.12–0.68)
36–47	0.29 (0.12–0.73)
P for trend	0.001
Marital status	
Married	1.00
Cohabitating	0.76 (0.24–2.22)
Divorced/Separated	1.44 (0.63–3.29)
Single	1.87 (1.45–3.05)
Country of birth	
United States	1.00
Mexico	1.91 (1.15–3.16)
Total OC use, yr	
0	1.00
1–3	0.70 (0.45–1.10)
≥4	0.40 (0.20–0.80)
P for trend	0.003
Lifetime no. of sexual partners	
1	1.00
2–4	2.04 (1.26–3.31)
≥5	2.28 (1.14–4.57)
P for trend	0.006

[a] Simultaneous adjustment for all variables in table. Backward step-wise logistic regression analysis. Variables with $P < 0.20$ were retained in the final model. CI, confidence interval.

analyzed by χ^2 tests. ORs for HPV infection were calculated. Backward step-wise logistic regression analyses were conducted using the methods of maximum-likelihood estimation of the models, with the significance level for removal from the model set at $P > 0.20$.

Results

Clinical Characteristics. The proportion of study participants positive for high-risk type HPV infections 16, 18, 31, 33, 35, 45, 51, 52, or 56 is presented in Table 1. Of the 998 women enrolled, cytology results were available for 971 women. The majority (93.8%) of participants had normal Pap smears, with 23 (2.4%) presenting with ASCUS, 23 (2.4%) low-grade SILs, and 14 (1.4%) high-grade SILs. The proportion of participants positive for HPV increased significantly ($P < 0.001$) with increasing levels of cervical abnormality: 10.1% of cytologically normal women were HPV positive compared with 92.9% of women with high-grade SILs. The overall prevalence of HPV was 13.2%.

Sociodemographic Factors and Risk for HPV Infection. Table 2 contains sociodemographic data of study participants and the association between these factors and HPV infection. Participants ranged in age from 18 to 47 years, with a mean of 27.8 ± 6.3 years. The majority of participants were married (57.1%), had completed high school (52.4%), and were housewives (64.2%). A small proportion of women (12.1%) reported current tobacco use. Among this population of Mexican-American women, 64.5% were born in Mexico, and most used Spanish as their preferred language (64.7%; data not shown).

HPV infection risk was significantly inversely associated (*P* for trend < 0.001) with age (OR, 0.2 for ages 36–47 years, compared with ages 18–20). In the age-adjusted analyses, only marital status (OR, 2.1 among single women relative to married) was significantly ($P < 0.05$) associated with HPV infection.

Sexual, Reproductive, and Contraceptive History and Risk for HPV Infection. The majority of study participants reported one lifetime sexual partner (53.5%), an age at first intercourse between 16 and 19 years (53.0%), and no history of STDs (94.8%; Table 3). Mean age at first sexual intercourse was 18.2 ± 2.8 years (data not shown). Most participants (88.4%) had ever been pregnant, with 48.4% having 1–2 children. Only 26.0% reported no use or <12 months use of OCs, and 41.0% reported current OC use.

After adjusting for age, lifetime number of sexual partners (OR, 2.1 for 5 or more compared with 1 partner, *P* for trend $<$ 0.01) and total years of OC use were significantly (OR, 0.4 for 4 or more years relative to nonusers; *P* for trend < 0.01) associated with HPV infection.

Multivariate Predictors of HPV Infection. All variables listed in Tables 2 and 3 were entered into a step-wise multivariate logistic regression analysis with high-risk type HPV positivity for type 16, 18, 31, 33, 35, 45, 51, 52, or 56 as the outcome. Age, marital status, country of birth, duration of OC use, and lifetime number of sexual partners were retained in the

Table 5 Sociodemographic factors and HPV prevalence among low-income Hispanic women by country of birth (United States *versus* Mexico; $n = 971$)

	Country of birth			
	Mexico		United States	
	No. (%)	HPV+ (%)	No. (%)	HPV+ (%)
Age, yr[a]				
18–20	57 (9.1)	15 (26.3)	60 (21.7)	12 (20.0)
21–25	171 (27.3)	30 (17.5)	91 (33.0)	17 (18.7)
26–30	171 (27.3)	21 (12.3)	58 (21.0)	5 (8.6)
31–35	138 (22.0)	10 (7.3)	44 (15.9)	1 (2.3)
36–47	89 (14.2)	6 (6.7)	23 (8.3)	1 (4.4)
Marital status[a]				
Married	394 (62.9)	33 (8.4)	115 (41.7)	11 (9.6)
Cohabitating	39 (6.2)	6 (15.4)	10 (3.6)	1 (10.0)
Divorced/Separated	41 (6.6)	9 (22.0)	23 (8.3)	1 (4.4)
Single	145 (23.2)	34 (23.5)	125 (45.3)	23 (18.4)
Education[a]				
<High School	274 (45.4)	31 (11.3)	97 (36.7)	9 (9.3)
High School	188 (31.2)	26 (13.8)	106 (40.2)	15 (14.2)
>High School	141 (23.4)	21 (14.9)	61 (23.1)	11 (18.0)
Current smoker				
No	560 (89.6)	68 (12.1)	230 (83.3)	33 (14.4)
Yes	65 (10.4)	14 (21.5)	46 (16.7)	3 (6.5)

[a] Distribution of risk factor significantly different by country of birth; χ^2 analysis, $P < 0.05$.

Table 6 Sexual, reproductive, and contraceptive history and HPV prevalence among low-income Hispanic women by country of birth (United States *versus* Mexico; $n = 971$)

	Country of birth			
	Mexico		United States	
	No. (%)	HPV+ (%)	No. (%)	HPV+ (%)
Lifetime no. partners[a]				
1	400 (63.9)	38 (9.5)	96 (34.8)	13 (13.5)
2–4	180 (28.8)	33 (18.3)	123 (44.6)	14 (11.4)
≥5	35 (5.6)	9 (25.7)	54 (19.6)	9 (16.7)
Age at first sex, yr[a]				
≥20	201 (32.1)	16 (8.0)	35 (12.7)	3 (8.6)
18–19	177 (28.3)	21 (11.9)	72 (26.1)	11 (15.3)
16–17	155 (24.8)	26 (16.8)	95 (34.4)	13 (13.7)
9–15	74 (11.8)	16 (21.6)	68 (24.6)	7 (10.3)
STD history[a]				
Never	589 (95.5)	77 (12.9)	253 (91.7)	32 (12.7)
Ever	28 (4.5)	5 (17.9)	23 (8.3)	4 (17.4)
No. of children[a]				
0	39 (6.2)	9 (23.1)	45 (16.3)	11 (24.4)
1–2	329 (52.6)	42 (12.8)	131 (47.5)	18 (13.7)
3–9	205 (32.8)	25 (12.2)	77 (27.9)	3 (3.9)
Condom use[a]				
Never	512 (81.8)	70 (13.7)	245 (88.8)	33 (13.5)
Ever	114 (18.2)	12 (10.5)	31 (11.2)	3 (9.7)
Current condom use[a]				
No	551 (88.0)	72 (13.1)	255 (92.4)	34 (13.3)
Yes	75 (12.0)	10 (13.3)	21 (7.6)	2 (9.5)
Total OC use, yr				
0	148 (23.6)	28 (18.9)	56 (20.3)	11 (19.6)
1–3	327 (52.2)	44 (13.5)	139 (50.4)	20 (14.4)
≥4	128 (20.5)	8 (6.3)	65 (23.6)	4 (6.2)
Current OC use[a]				
No	372 (59.4)	52 (14.0)	144 (52.2)	18 (12.5)
Yes	254 (40.6)	30 (11.8)	132 (47.8)	18 (13.6)

[a] Distribution of risk factor significantly different by country of birth, χ^2 analysis, $P < 0.05$.

model as factors independently associated with HPV infection (Table 4). In this model, age (AOR, 0.3 for ages 36–47 years compared with ages 18–20) and duration of OC use (AOR, 0.4 for ≥4 years use compared with nonusers) were significantly inversely associated with risk. Risk was increased among single participants (AOR, 1.9 relative to married), among participants born in Mexico (AOR, 1.9 compared with United States-born), and among women with ≥2 sexual partners (AOR, 2.0–2.3 relative to monogamous women). Because country of birth was an independent risk factor for HPV status, we conducted analyses to examine differences in the distribution of HPV risk factors of Mexican-American women by country of birth.

HPV Risk Profile by Country of Birth. Tables 5 and 6 present the distribution of risk factors by country of birth and the prevalence of HPV for each category of the risk factors. Analysis was limited by the small number of cases in each category.

Overall, women born in the United States had a higher HPV risk profile compared with Mexican-born women (Tables 5 and 6). Mexican-American participants born in the United States were younger ($P < 0.05$), had higher educational levels ($P < 0.05$), had higher rates of current tobacco use ($P < 0.01$), were more likely to be single ($P < 0.001$), reported more lifetime number of sexual partners ($P < 0.001$), a younger age at first intercourse ($P < 0.001$), had a higher proportion reporting current OC use ($P < 0.05$) and a history of STD infections ($P < 0.05$), and had a smaller proportion reporting current condom use ($P < 0.05$) compared with Mexican-American women born in Mexico.

Discussion

The overall percentage of women positive for high-risk type HPV infections 16, 18, 31, 33, 35, 45, 51 52, or 56 in our study of Mexican-American women (13.2%) was similar to that observed by the Vira Pap assay among Hispanic women living in New Mexico (11). In that study, ~9% of Hispanics were positive for HPV types 16, 18, 31, 33, and 35. Using the Hybrid Capture Tube assay, Schneider *et al.* (25) found a similar percentage of German women to be HPV positive among those self-referring for a routine gynecological exam.

HPV DNA detection by the Hybrid Capture Tube assay was strongly associated ($P < 0.001$) with grade of cervical cytology in this study population. Approximately 10% of participants with normal Pap smears were HPV positive compared with 30.4% of women with ASCUS, 69.6% with low-grade SILs, and 92.9% with high-grade SIL. These findings are similar to those reporting good agreement between the percentage of women HPV positive using the Hybrid Capture Tube assay and the grade of cervical pathology based on histology in other populations (26–29).

Overall, risk for HPV infection among Mexican-American women was associated with younger age, a marital status of single, birth in Mexico, no OC use, and increasing numbers of sexual partners. The percentage of women HPV positive decreased significantly with increasing age. In the multivariate adjusted model, age was the variable most strongly associated with HPV risk. This inverse association with age has been shown in numerous other studies (11–13, 25, 30–33).

Duration of OC use was significantly inversely associated with high-risk type HPV infection 16, 18, 31, 33, 35, 45, 51, 52, or 56 among study participants. This inverse association observed with duration of OC use may reflect the different patterns of use by population and country of origin. In Mexico, women are more likely to use OCs at a time in their life when

they are in an established relationship and have completed childbearing.[4] In this study, use of OCs was significantly higher among married and parous women (data not shown). These data add to the inconsistent findings in the literature where some studies show increased risk for HPV infection with OC use (13, 31, 33) and others find no independent associations with risk (12, 34–36).

Despite an overall lower risk profile for HPV infection among women born in Mexico, we observed a significantly elevated risk for HPV infection (AOR, 1.9) among these participants compared with Mexican-Americans born in the United States. In this study, country of birth may be a marker of the behavior of the participant's male partner or an unmeasured sexual activity behavior pattern of the woman. Male promiscuity in Latin America may play a crucial role in a woman's risk for HPV infection and cervical cancer (37). Data from studies conducted in Latin America (36, 38) and in the United States among Hispanics (39, 40) suggest that women are at an increased risk for HPV infection and cervical cancer if their partners have had multiple sexual partners, frequented prostitutes, or did not use condoms. Using the control groups of four Spain/Colombia case control studies, HPV infection among monogamous women was significantly linearly associated with the number of sexual partners of her male partner (37). In both Spain and Colombia, the average number of partners of the males was 7–8-fold higher than the average number of partners of the women.

In Mexico, "machismo" is expressed sexually through an emphasis on multiple, uncommitted sexual contacts that start in adolescence and may continue after marriage (41). In addition, female prostitution is an accepted part of sexual life of Mexican men, regardless of socioeconomic status (41). In the border state of Sonora, Mexico, where most of the study participants were born, prostitution is institutionally permitted and regulated. Unfortunately, male partners were not interviewed in this study, leaving important unanswered questions about the differences in male sexual partner behavior between immigrant and nonimmigrant Mexican-American women.

Another factor that may explain our observations of higher risk among women born in Mexico is the pattern of barrier contraceptive use. In a study of Hispanic sexual behavior in 23 cities, Sabogal *et al.* (42) found that unmarried, younger Hispanic men were significantly more likely to have had multiple sexual partners in the last year, and only 20–29% reported always using a condom with their primary and secondary partners. Although Hispanic women more acculturated to United States language and lifestyle were more likely to have had multiple sexual partners, they were also more likely to use condoms compared with less acculturated Hispanic women (43, 44). To further study this hypothesis related to HPV infection, detailed measurement of condom use is necessary.

Caution must be taken in generalizing these results to all United States Mexican-American populations. This study only included Hispanic, predominantly Mexican-American women, of low socioeconomic status living in southern Arizona who accessed family planning services at the local County Health Department clinic. The observed HPV prevalence and risk factors for HPV may have been biased by the fact that only women who self-referred for gynecological care were included in this study. Low-risk type HPV infections (*e.g.*, 6 and 11) were not assessed in this study. It is possible that women negative for high-risk type HPV infections (types 16, 18, 31, 33, 35, 45, 51, 52, or 56) were positive for low-risk type HPV infections. In addition, this study did not provide type-specific estimates of HPV infections.

Limitations to be considered in the interpretation of these results include the decreased sensitivity of the Hybrid Capture Tube method compared with PCR testing and the actual number of high-risk types of HPV detected. Since the time of this study, new HPV types have been identified, and the number considered to be high-risk types has increased with the addition of types 39, 58, 59, and 68. The women testing HPV negative in this study may have tested HPV positive with a more sensitive procedure or with a newly identified high-risk type.

Collectively, the results from this study suggest that there is intragroup variability in the distribution of HPV risk factors. After adjustment for potential confounding factors, Mexican-born women were significantly more likely to have an HPV infection compared with women born in the United States, although their own behavioral profile is one of lower risk. These results suggest that an unmeasured factor, such as the sexual behavior of the male partner, may be influencing HPV risk in this immigrant population. Further research is needed to define this factor. Until primary prevention using vaccines is feasible, more research is needed to assess whether barrier contraceptive methods, such as condoms, can effectively reduce risk for HPV. Finally, cultural norms of sexual behavior and use of barrier contraceptives needs to be evaluated among immigrant and nonimmigrant populations of Mexican-Americans, a population at high risk for STDs and cervical neoplasia.

[4] C. Denman, personal communication.

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