The Relationships Among Acculturation, Biobehavioral Risk, Stress, Corticotropin-Releasing Hormone, and Poor Birth Outcomes in Hispanic Women

R. Jeanne Ruiz, PhD, RNC, WHCNP; Christyn L. Dolbier, PhD; Robin Fleschler, PhD, RNC, CNS

Objective: To determine the predictive ability of acculturation as an antecedent of stress, biobehavioral risk, corticotropin-releasing hormone levels, and poor birth outcomes in pregnant Hispanic women.

Design: A prospective, observational design with data collected at 22–25 weeks of gestation and at birth through medical record review.

Setting: Public prenatal health clinics in south Texas serving low-income women.

Participants: Self-identified Hispanic women who had singleton pregnancies, no major medical risk complications, and consented to answer questionnaires as well as a venipuncture and review of their prenatal and birth medical records.

Main Outcome Measures: Gestational age, Apgar scores, length, weight, percentile size, and head circumference of the infant at birth.

Results: Significant differences were seen in infant birth weight, head circumference, and percentile size by acculturation. English acculturation predicted stress, corticotropin-releasing hormone, biobehavioral risk, and decreased gestational age at birth.

Conclusions: Investigation must continue to understand the circumstances that give rise to the decline in birth outcomes observed in Hispanics with acculturation to the dominant English culture in the United States. (*Ethn Dis*. 2006;16:926–932)

Key Words: Acculturation, Biobehavioral Risk, Corticotropin-Releasing Hormone, Preterm Birth, Stress

From the University of Texas Medical Branch, School of Nursing, Galveston, Texas (RJR, RF); East Carolina University, Department of Psychology, Greenville, North Carolina (CLD).

Address correspondence and reprint requests to R. Jeanne Ruiz, PhD; University of Texas Medical Branch; School of Nursing; 3.310 Allied Health Sciences/Nursing Building; 301 University Boulevard; Galveston, TX 77555-1029; 409-772-8229; 409-772-3770 (fax); rojruiz@utmb.edu

Introduction

Despite sociocultural disadvantage and limited access to prenatal care, the rate of low birth weight and preterm birth in first-generation and unacculturated Hispanic immigrants is the same as that of non-Hispanic White women.[1] Acculturation is the process whereby new cultural traits are evident as two previously culturally distinct groups come into contact with one another.[2] As acculturation occurs, Dressler[3] hypothesizes that individuals choose behaviors based on their cultural beliefs; subsequently, these behaviors are key factors affecting their health. When Hispanics are exposed to US culture, they obtain both positive and negative values and behaviors. Therefore, higher levels of acculturation should not automatically be assumed to relate to more positive health outcomes.[4]

Recent studies have examined the epidemiologic paradox that Hispanic women, particularly Mexican women, despite their lower socioeconomic status, have rates of low birth-weight babies similar to those of more advantaged White women. Gould et al[5] confirmed the perinatal advantage of foreign-born Mexican Americans, speculating that psychosocial factors, social support, and nontraditional risk factors account for this advantage. Landale et al[6] examined Puerto Rican pregnant women and found generational differences in stressful life events and health habits during pregnancy. Their investigation showed that the most recent immigrants experienced the fewest stressful life events, reported the lowest levels of distress, and were the least likely to smoke or drink alcohol. US-born Puerto Rican women were the most likely to smoke cigarettes or drink alcohol, experience stressful events, and rate their stress levels as high.

Other findings indicate that birth outcomes are improved among first-generation women born in Mexico as compared to second or successive generations of US-born women of Mexican descent.[7] Guendelman et al[7] found that the risk of low birth weight is approximately four times greater for second- than first-generation primiparous Mexican American women. In another study by Guendelman and English,[8] Mexican immigrants who had lived in the United States more than five years had higher parity, more pregnancy complications, fewer planned pregnancies, and smoked more than recent Mexican immigrants. Thus, acculturation seems to affect risk in this population.

Higher prenatal stress has been preliminarily associated with greater acculturation, and has been related to preterm birth.[9] Prenatal stress was also linked to substance use. These authors note that as Mexican American women become more incorporated into the culture of the United States, they lose their native culture-specific protective factors of the environments in which they live. Scribner and Dwyer[10] concluded that acculturation status acts as a marker for certain beliefs, values, or lifestyles that protect mothers of Mexican descent from poor birth outcomes. However, a counter argument notes that measurement tools for acculturation are too simple and do not reflect the complex nature of culture.[2]

In order to truly measure the effect of acculturation on stress, consideration of the body's stress response is appropriate.

This investigation enables a test of the acculturation hypothesis, that poor birth outcomes corresponding to increased length of stay in the United States are due to increases in stress and worsening of health habits and risk factors associated with acculturation to US culture.

Life is thought to exist because the body maintains a complex homeostasis that is challenged by intrinsic or extrinsic adverse forces, referred to as stressors.[11] In this study, the focus is on acculturation into US culture as a stressor, resulting in a change in homeostasis and a different physiologic response of the hypothalamic-pituitary-adrenal (HPA) axis. Corticotropin-releasing hormone (CRH) is a hypothalamic neuropeptide that plays a central role in regulating the activity of the HPA axis and physiological response to stress[12]; it is associated with stress and the timing of delivery[13] and has been recently linked to growth restriction in the fetus.[14] CRH is an appropriate biomarker to employ for examining the relationships among acculturation, stress, biobehavioral risk, and poor birth outcomes.

The purpose of this preliminary study was to determine the predictive ability of acculturation as an antecedent of stress, biobehavioral risk, CRH levels, and poor birth outcomes in pregnant Hispanic women. This investigation enables a test of the acculturation hypothesis, that poor birth outcomes corresponding to increased length of stay in the United States are due to increases in stress and worsening of health habits and risk factors associated with acculturation to US culture. Understanding these relationships will provide insight into the development of interventions to diminish these poor birth outcomes.

Table 1. Demographic characteristics of the sample

Characteristic	*n* (%)
Age (years)	
14–19	20 (18.9%)
20–35	78 (73.8%)
36–42	8 (7.5%)
Marital status	
Married	54 (50.9%)
Single	36 (34.0%)
Separated	13 (12.3%)
Divorced	3 (2.8%)
Educational level	
Less than high school	51 (48.1%)
High school	22 (20.8%)
Vocational school	17 (16.0%)
Some college	9 (8.5%)
Completed college	7 (6.6%)
Employment*	
Unemployed	69 (65.1%)
Employed	24 (22.6%)
Annual income	
<$10,000	31 (29.2%)
$10,000–$19,000	42 (39.6%)
>$19,000	14 (13.2%)
Unknown	6 (5.7%)

* Missing data for 12.3% of the sample ($n=13$).

Table 2. Characteristics of the sample in relationship to acculturation

Characteristic	*n* (%)
Self-identified ethnicity*	
Mexican	43 (40.6%)
Mexican American	39 (36.8%)
Puerto Rican	14 (13.2%)
South and Central American	3 (2.8%)
Hispanic	3 (2.8%)
Other	2 (1.9%)
Country of birth†	
Mexico	53 (50.0%)
Puerto Rico	2 (1.9%)
South and Central America	3 (2.8%)
Other	1 (.9%)
United States	43 (40.6%)
Years in the United States	
≤5	27 (25.5%)
6–10	24 (22.6%)
11–15	10 (9.4%)
16–20	21 (19.8%)
21–25	12 (11.3%)
26–30	7 (6.6%)
31–33	5 (4.7%)
Language preference	
Spanish	53 (50.0%)
English	36 (34%)
Bilingual	16 (15.1%)
Other	1 (.9%)

* Missing data for 1.9% of the sample ($n=2$).
† Missing data for 3.8% of the sample ($n=4$).

METHODS

Participants

The sample consisted of 106 women between the ages of 14–42 years (mean 25.4 ± 6.6 years) who self-identified as Hispanic ethnicity and were between 22–25 weeks of pregnancy. Tables 1 and 2 detail the demographic characteristics of the sample, as well as the characteristics of the sample that are related to acculturation. The socioeconomic status of the sample was low, with 68.8% having an income of $19,000 or less per year, and 68.9% having only a high school education or less. The inclusion criteria for the study included: 1) pregnant at gestational weeks 22–25 with a singleton, intrauterine pregnancy as confirmed by accurate last normal menstrual period or ultrasound to confirm dating; 2) self-identification as Hispanic ethnicity; and 3) 14–45 years of age. The exclusion criteria for the study included: 1) known uterine or cervical abnormalities; 2) multiple gestations; 3) medical diseases such as kidney disease, heart disease, or autoimmune disorders; 4) preeclampsia during the pregnancy or at delivery; 5) oral steroid use within one month of enrollment; 6) congenital anomalies as determined by fetal ultrasound; and 7) active cervico-vaginal bleeding or placenta previa.

Procedures

Participants were recruited from the University of Texas Health Science Center public health clinic in San Antonio, Texas, and the San Antonio Metropolitan Health District clinics that serve low-income women. Prenatal charts of potential participants were screened for gestational age of 22–25 weeks. Participants were then approached before or after their routine prenatal visit, and the study was explained thoroughly; informed consent was obtained in the participant's preferred language of Spanish or English. Demographic, language preference, and risk factor information was obtained from surveys and the prenatal chart. A questionnaire measuring stress was administered. Ten milliliters of venous blood were drawn from the participants' arms to assess CRH. The prenatal chart was reviewed for ultrasound dating criteria, and any prenatal infections or complications were noted. After delivery, the medical records of participants were reviewed at the delivery hospital for birth outcome data. Thirty of the 106 medical records for infant outcomes were unattainable.

Measures

Acculturation

A four-item language-based acculturation scale was used to assess acculturation.[15] Respondents answered the following questions with the response options of English, Spanish, and both: 1) "What was your first language as a child?" 2) "What language do you prefer to speak?" 3) "What language is most often spoken in your home?" and 4) "What language are you most comfortable reading?" A total score was calculated by assigning one point for each response that was positive for English. Each participant obtained a score ranging from zero, indicating the lowest English acculturation or maintaining native Spanish culture, to four, indicating the highest English acculturation. Language use is widely used as an indicator of level of acculturation. The investigators chose this instrument for this reason and because it is brief and easily administered, easy to understand, and has been used in a similar population of individuals of Mexican origin.[15] This scale has been shown to meet the requirements of a Guttman scale, meaning that a positive response to any question predicted positive responses to all questions before it.[15] The measure of acculturation predicted years in the United States with an R^2 of .574, $P<.001$, indicating strong prediction as a linear measure of acculturation. The internal consistency of the acculturation scale in the current study was $\alpha=.91$.

Biobehavioral Risk

A modified version of a risk factor scoring system that has been used extensively to assess risk in clinical decisionmaking[16] was used to assess biobehavioral risk. It involves assessment of traditional medical risk factors as well as nonmedical and lifestyle factors; points are assigned based on the extent of risk. In the modified risk factor scoring system, points were assigned for spontaneous abortion, multiple gestation, vaginal bleeding, urinary tract infection, smoking, maternal age >40 and <18, more than three induced abortions, previous preterm delivery, cervical suture, uterine anomaly, pre-pregnancy weight <100 pounds, height less than five feet, current hypertension, low socioeconomic status, single status, single parent status, paid work outside the home, and <12th grade education.

Perceived Stress

The degree to which situations in one's life during the past month were perceived as stressful was assessed by using the 10-item version of the Perceived Stress Scale (PSS).[17] On a Likert scale ranging from zero (never) to four (very often), respondents answered questions about how frequently they felt a certain way in the past month. Sample items include "How often have you felt that you were unable to control the important things in your life?" and "How often have you felt difficulties were piling up so high that you could not overcome them?" The PSS is a brief and easy-to-use measure that works well for lower literacy levels in a low-income, poorly educated population and has been translated into Spanish. The scale is a good indicator of stress in that it highly correlates with symptom measures and life event scores.[18] The internal consistency of the PSS in the current study was $\alpha=.87$. Although this scale has been used in numerous populations, including pregnant women and in Hispanics, it has not been tested for cross-cultural relevancy.

Corticotropin-Releasing Hormone

Ten milliliters of venous blood were drawn from the participants' arms with a sterile butterfly needle, tubing, and syringe. All materials for drawing specimens were propylene to prevent CRH from sticking to the tubes. Tubes containing the blood were centrifuged for 10 minutes in a portable centrifuge after EDTA (adjusted per amount of blood) was added to prevent clotting. After centrifugation, the blood was separated with a pipette; plasma was retained, and the red blood cells were discarded. The chemical aprotonin was added to prevent breakdown of CRH. The samples were placed on ice for less than four hours and then stored at -70°C (-94°F). Corticotropin-releasing hormone (CRH) levels were determined by using an enzyme-linked immunosorbent assay in the Biobehavioral Research Laboratory in the School of Nursing at the University of Texas Health Science Center at San Antonio. The distribution of CRH levels was positively skewed; therefore, a natural log transformation was conducted.

Birth Outcomes

After delivery, the medical records of participants were reviewed at the de-

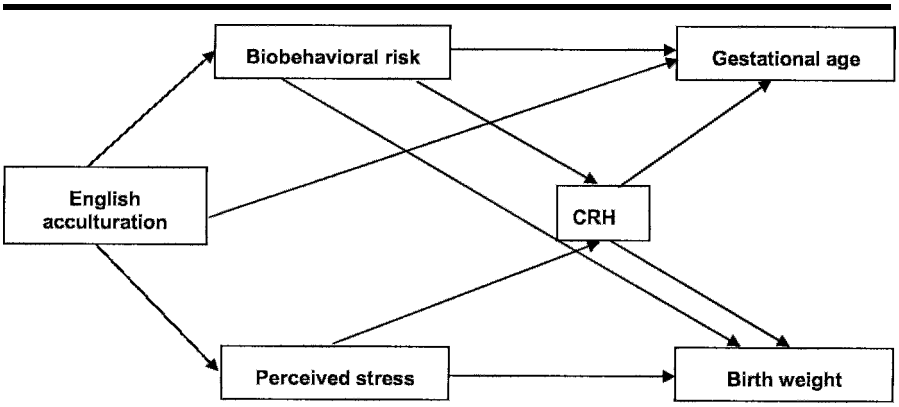

Fig 1. Proposed conceptual model

livery hospital. Reviewers blinded to the survey and assay results examined the records for birth outcome data, including birth weight at delivery in grams, weeks of gestation at delivery, Apgar scores, length and head circumference in centimeters, and percentile size.

Data Analysis

Descriptive statistics for all variables were computed by using the Statistical Program for the Social Sciences (SPSS 14.0, SPSS Inc., Chicago, Ill). Counts and percentages for categorical variables and means and standard deviations for continuous variables were calculated. The distributions of the variables were reviewed, and distributional anomalies and the need for transformations were identified. Suitable transformations were based on visual inspection and Box-Cox procedures.

Pearson correlations were used to determine linear relationships between study variables also by using SPSS.

A series of analysis of variance (ANOVA) computations using SPSS were conducted comparing the key variables in the Spanish-speaking, English-speaking, and bilingual groups. For each ANOVA, if the between-subjects F test was significant, post hoc multiple comparisons were conducted to examine whether any significant pairwise differences were seen with the least significant difference test.

A path analysis was conducted with the path analysis and structural equation modeling software package AMOS 4.0[19] to test a proposed conceptual model of the relationships among acculturation, perceived stress, biobehavioral risk, CRH, and birth outcomes (Figure 1). We deleted any insignificant paths to produce a more parsimonious model and re-evaluated the model. Goodness of fit was examined by using the chi-square test, comparative fit index (CFI), normed fit index (NFI), and Tucker-Lewis index (TLI). The chi-square includes a significance test, where $P>.05$ indicates good fit. Rules of thumb for the other indices suggest that an NFI, CFI, and TLI $>.95$ indicate good model fit.[20]

Table 3. Means and standard deviations for continuous study variables

Variable	Mean	Standard Deviation
English acculturation	1.33	1.67
Biobehavioral risk	7.74	6.50
Perceived stress	17.86	7.95
Corticotropin-releasing hormone	372.14	138.82
Weeks of gestation at delivery	38.93	2.09
Total birth weight in grams	3235.18	581.57
Apgar score at 5 minutes	8.95	.46
Length in centimeters	49.66	3.70
Percentile size	.36	.28
Head circumference in centimeters	34.22	2.36

RESULTS

The means and standard deviations of English acculturation, biobehavioral risk, perceived stress, CRH levels, gestational age, birth weight, Apgar score at five minutes, length, percentile size, and head circumference are depicted in Table 3. For English acculturation, 44.3% of participants scored a zero, indicating the lowest English acculturation, 5.7% scored a one, 6.6% scored a two, 6.6% scored a three, and 17.0% scored a four, indicating the highest English acculturation. The sample had 19.8% missing data for the acculturation variable. Socioeconomic status was not considered as an interaction variable for acculturation because 68.8% were low income with minimal education. Therefore, previous results from other studies that showed higher income Hispanic women with more education had better birth outcomes did not apply to this study population.

Several significant correlations among the study variables were observed. English acculturation was positively related to biobehavioral risk ($r=.28$, $P=.009$) and perceived stress ($r=.31$, $P=.004$). Biobehavioral risk was positively related to perceived stress ($r=.24$, $P=.014$) and negatively related to weeks of gestation at delivery ($r=-0.29$, $P=.012$), birth weight in grams ($r=-0.24$, $P=.041$), and length in centimeters ($r=-0.24$, $P=.036$). Perceived stress was positively related to CRH levels ($r=.21$, $P=.039$). Weeks of gestation at delivery was

Table 4. Analysis of variance results for mean differences between language preference groups

Variable	F	*P*	*df*	Spanish	English	Both Spanish and English
Maternal age	20.19	<.001	2, 102	28.51 (E,B)*	20.86 (S,B)	24.81 (S,E)
Years in the United States	42.54	<.001	2, 102	7.20 (E,B)	20.00 (S)	17.41 (S)
English acculturation	319.95	<.001	2, 82	.10 (E,B)	3.71 (S,B)	1.46 (S,E)
Biobehavioral risk	3.73	.027	2, 102	6.64 (E)	10.11 (S,B)	6.25 (E)
Perceived stress	6.84	.002	2, 101	15.43 (E)	21.51 (S)	17.56
Gestational age in weeks	2.84	.065	2, 73	39.18 (B)	39.08 (B)	37.50 (S,E)
Birth weight in grams	10.45	<.001	2, 73	3414.93 (B)	3192.13 (B)	2583.60 (S,E)
Apgar score at 5 minutes	7.43	.001	2, 72	9.05 (B)	8.96 (B)	8.44 (S,E)
Length in centimeters	2.97	.058	2, 71	50.20 (B)	49.75	46.98 (S)
Head circumference in centimeters	8.49	<.001	2, 71	34.99 (E,B)	33.79 (S,B)	31.88 (S,E)
Percentile size	4.90	.010	2, 71	.44 (E,B)	.30 (S)	.18 (S)

* Groups that were significantly different are included in parentheses (S=Spanish, E=English, B=Both Spanish and English).

positively related to birth weight in grams (r=.75, P<.001), length in centimeters (r=.58, P<.001), head circumference in centimeters (r=.46, P<.001), and percentile size (r=.28, P=.015).

Table 4 gives the mean differences between language preference groups of Spanish, English, and both Spanish and English, with groups that were significantly different in the post hoc analyses indicated in parentheses. Many significant differences were apparent between the groups. Compared to the English speakers, the Spanish speakers had been in the United States a much shorter time, were significantly older, had less English acculturation, had less perceived stress, and were less at risk. Their infants had better Apgar scores, were born later, and were significantly larger (birth weight, head circumference, length, percentile size) than the more acculturated, English-speaking subjects.

Results of a path analysis supported the model as presented in Figure 2. Path coefficients for the model are given in Table 5. Estimation of the model suggested it fit the data well as indicated by the nonsignificant chi-square value, $\chi^2(6)=9.0$, P=.174. English acculturation demonstrated a positive relationship with and accounted for a portion of the variance in biobehavioral risk (R^2=.09), which then had a negative relationship with and accounted for a portion of the variance in weeks of gestation at delivery (R^2=.07). English acculturation also demonstrated a positive relationship with and accounted for a portion of the variance in perceived stress (R^2=.11), which then had a positive relationship with and accounted for a portion of the variance in CRH (R^2=.05). All of the values of the descriptive goodness-of-fit tests met the criteria (NFI=.993, CFI=.998, TLI=.994). All of the critical ratios of the paths in the final model appear in Table 5, and all exceeded a value of 2.0.

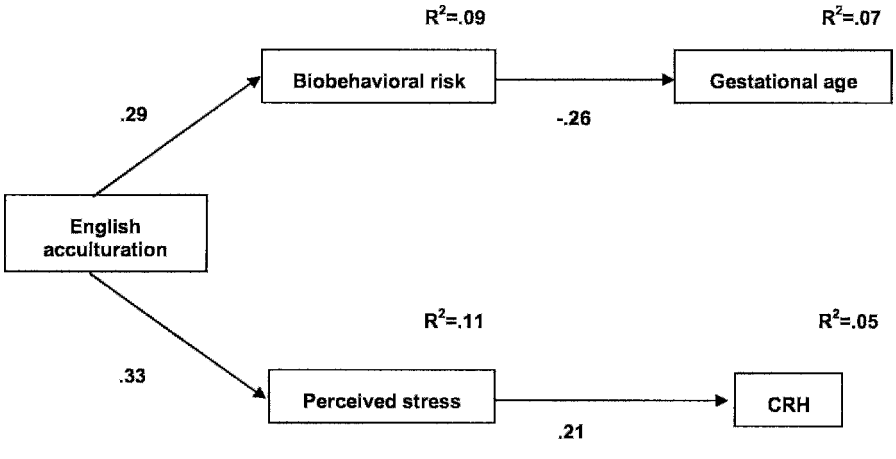

Fig 2. Final model

DISCUSSION

Analysis of perinatal outcomes and the factors predictive of poor birth outcomes is important for directing health education, research, and health-care funds toward improving these outcomes. Traditional risk factors alone do not sufficiently explain outcomes in different ethnic populations, particularly in Hispanics. An analysis of factors affecting perinatal outcomes in Hispanics is necessary to help design future strategies to improve infant health. This study included participants of self-identified Mexican and Mexican American (n=82) and Puerto Rican (n=14) ethnicities. Future studies might improve the preliminary results from this investigation by employing and comparing large numbers of each subgroup of Hispanics, since various subgroups differ in terms of risky behavior.

The findings from this study are consistent with the acculturation hy-

Table 5. Path coefficients for the final model

Predicted Variable	Predicting Variable	Standardized Estimate	Nonstandardized Estimate	SE	CR
Biobehavioral risk	English acculturation	.29	1.13	.39	2.87
Weeks of gestation at delivery	Biobehavioral risk	−.26	−.08	.04	−2.34
Perceived stress	English acculturation	.33	1.57	.47	3.32
Corticotropin-releasing hormone	Perceived stress	.21	.01	.01	2.15

All path coefficients exceeded the absolute critical ratio (nonstandardized estimate/standard error) value of 2.0 and thus are significant beyond the .05 level.
SE=standard error; CR=critical ratio.

pothesis, that infant birth outcomes deteriorate the more a woman acculturates and the longer a woman is in the United States. This study is the first to show the path effect of English acculturation on psychological stress and the resultant physiologic stress response as initiated by CRH. Placental CRH participates in the physiology of pregnancy and the onset of labor,[21,22] and therefore, factors that predict stress and CRH are important to understand in relationship to labor. Although the complete pathway from acculturation to preterm labor is not explicated in this dataset, this preliminary study provides justification for further investigative efforts into the role of acculturation in triggering the stress response with resultant poor birth outcomes. The data presented from this investigation confirm that increases in perceived stress and biobehavioral risk are associated with English acculturation.

The results from the current study are comparable with the results from a growing number of studies that find traditional indicators of acculturation are not positively related to health and well-being, consistent with the report from the Institute of Medicine/National Research Council.[23] Therefore, we must continue investigations into the circumstances that give rise to the decline in birth outcomes. Such questions as when the mother and fetus are most vulnerable to stress, and which types of stress are most amenable to change need to be investigated. Likewise, investigating factors that are protective against poor birth outcomes and are maintained with acculturation is essential. Such research is necessary to improve the future health of children.

This study is the first to show the path effect of English acculturation on psychological stress and the resultant physiologic stress response as initiated by CRH.

In interpreting the results of this study, several limitations need to be considered. Self-report has inherent weaknesses, although whenever possible, participant reports were verified with prenatal chart information. Birth outcomes for 30 participants were not obtainable, indicating the difficulty in tracking this target population and the need for improved tracking methods. Although the measure of biobehavioral risk used in this study is a composite of well-documented risk factors, tests of specific risk factors predictive of birth outcomes were not possible because of the sample size. Future research should include measures that assess multidimensional aspects of acculturation in addition to language use. The measure of acculturation in this research assumed acculturation is a linear process, and as such limits the conceptualization of acculturation. In addition, study of high-risk behaviors that are thought to be adopted and protective cultural practices that are thought to be reduced during the acculturation process is key to elucidate this complex phenomenon.

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AUTHOR CONTRIBUTIONS

Design concept of study: Ruiz
Acquisition of data: Ruiz
Data analysis interpretation: Ruiz, Dolbier, Fleschler
Manuscript draft: Ruiz, Dolbier, Fleschler
Statistical expertise: Dolbier, Fleschler
Acquisition of funding: Ruiz
Administrative, technical, or material assistance: Ruiz, Fleschler
Supervision: Ruiz