Preliminary Evidence for Mediation of the Association Between Acculturation and Sun-Safe Behaviors

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Objectives: To identify and test mediators of the relationship between acculturation and sun-safe behaviors among Latinos in the United States. We hypothesized that the effect of acculturation on use of sunscreen, shade, and sun-protective clothing would be mediated by perceived health status, educational level, access to health care, and contact with social networks regarding health matters.

Design: The 2005 Health Information National Trends Survey, implemented by the National Cancer Institute.

Setting: Nationwide survey.

Participants: A probability-based sample of the US civilian, noninstitutionalized adult population, comprising 496 Latino respondents.

Main Outcome Measures: Use of sunscreen, shade, and sun-protective clothing when outdoors on sunny days, assessed by self-report on frequency scales.

Results: The positive association between acculturation and sunscreen use and the negative association between acculturation and use of sun-protective clothing were mediated by educational level ($P < .05$ for both). Perceived health status and contact with social networks regarding health matters were supported as mediators for sunscreen use only ($P < .05$). Health care access was not supported as a mediator for any of the outcomes.

Conclusions: Structural equation models revealed distinct direct and indirect paths between acculturation and each sun-safe practice. Our findings emphasize behavior-specific mediated associations and could inform sun safety programming for Latinos with low and high levels of acculturation. The models support educational level, contact with social networks regarding health matters, and perceived health status as mediators primarily for sunscreen use. Future research should test different mediators for use of shade or sun-protective clothing.

Arch Dermatol. 2011;147(7):814-819

A cross skin types, UV radiation has been linked with DNA damage and skin cancer. Current annual age-adjusted melanoma incidence among Latinos, who display considerable diversity in sun sensitivity, is 4.5 per 100,000 (a 28.6% increase since 1992). In addition, Latinos exhibit persistently higher rates of thick melanoma at diagnosis compared with non-Latino whites.

See Practice Gaps at end of article

The acculturation of Latinos (regarding English language use and duration of US residence) was negatively associated with some behaviors related to the primary prevention of melanoma. Acculturation predicts access to and use of health care, which itself has been associated with sunscreen use, skin cancer examinations by a physician, and sunburn. The potential mediating effect of health care access on health practices merits particular attention in Latinos because of decreased melanoma awareness among patients and physicians. Furthermore, the established positive association between acculturation and leisure-time physical activity suggests a link between favorable health status and increased sun exposure. In fact, sunburn frequency was higher among individuals reporting excellent or good health. Research has linked acculturation with cultural capital (ie, second-language acquisition and formal educational attainment), which itself might predict engagement in melanoma prevention, possibly because of increased awareness regarding risk factors or symptoms. A link between years of education and beach visits and sunscreen use also has been reported. Finally, as immigrants acculturate, their social connectedness in-
The composition of the social network of the individual has been suggested as a mediator between acculturation and certain risky behaviors and health outcomes. We expected that health care access, perceived health status, educational level, and involvement with social networks regarding health matters would have behavior-specific effects on the sun safety of Latinos. For example, we hypothesized that stronger health would be associated with decreased use of shade or sun-protective clothing but with increased sunscreen use. We also hypothesized that health care access, educational level, and the presence of social networks would predict a greater degree of sun safety across all behaviors. The postulated mediators were grounded in Bandura’s social cognitive theory, which reflects the reciprocal influence of personal factors and the sociocultural environment, and the mediated acculturation model summarized by Myers and Rodriguez.

METHODS

DATA SOURCE

We analyzed cross-sectional data from the 2005 Health Information National Trends Survey (HINTS), developed and implemented by the National Cancer Institute. Data were collected via geographic stratification and list-assisted random-digit dialing from a probability-based sample of the US civilian, non-institutionalized population. One adult was selected at random from each household and was given the option of responding in English or Spanish. Among the 5586 individuals who completed the full interview, 496 answered affirmatively to the question, “Are you Hispanic or Latino?” and thus were eligible for this study. Details regarding the HINTS concept and implementation are published elsewhere. The questionnaire is available at http://hints.cancer.gov/instrument.jsp. The HINTS, which contains deidentified data, has been assigned exempt status by the institutional review board of the National Cancer Institute and has received additional clearance from the US Office of Management and Budget.

MEASURES

The main outcome, sun-safe practice, was assessed by 4 primary prevention behaviors. Respondents were told that the questions pertained to protection of skin from the sun and they were asked how often they used sunscreen, wore long-sleeved shirts and long pants, and stayed in the shade when outside for more than 1 hour on a warm, sunny day (1=always; 5=never). These questions were comparable to the standardized set of survey measures of sun protection habits and are considered applicable across different populations. The items were reverse-coded; thus, higher scores reflected higher endorsement of the behaviors. The primary predictor, acculturation, was assessed with a 4-item index: interview language (ie, English or Spanish), perceived comfort with the English language (1=completely comfortable; 6=do not speak English), and 2 continuous measures applicable only to foreign-born respondents. Those measures included age at US arrival (calculated by subtracting the year of birth from the year of arrival) and duration of US residence (calculated by subtracting the year of arrival from the year of data collection, which was 2005). The acculturation index was obtained by computing the mean of all items that loaded on a single factor in exploratory factor analyses (mean=0.15; Cronbach α=0.73). This choice followed prior research, our hypotheses, and preliminary findings, as well as the nature and limitations of the HINTS 2005 data.

Health care access was assessed with 2 questions, the first regarding availability of health insurance coverage (yes/no) and the second regarding frequency of health care professional services use in the past 12 months (excluding emergency department visits). Perceived physical health was assessed with 1 item (1=excellent; 5=poor) that was reverse-coded, meaning that a higher score corresponded to stronger health. Educational level also was assessed with 1 item (1=never attended school; 11=obtained professional/graduate degree). Six variables were available for the assessment of social networks. One captured the number of community organizations in which the participant has current membership (church, sports league, etc) and another assessed whether any of these organizations provided health information (yes/no). We combined these 2 items into a single measure (0=no membership, 1=membership in a non–health-related organization, and 2=membership in a health-related organization). The next 2 questions assessed whether the participant had any family or friends with whom he or she talked regarding health matters (yes/no) and the frequency of talking with them. As before, we combined these 2 items (0=no family/friends; 3=have family/friends and talk to them very frequently). The next social networks item captured the number of neighbors on whom the participant could rely for health-care–related transportation. The last item measured the frequency of attending general religious services (0=never; 4=every week).

STATISTICAL ANALYSIS

We performed bivariate linear regression and exploratory and confirmatory factor analyses with SAS statistical software, version 9.1 (SAS Institute Inc, Cary, North Carolina) to assess clustering within latent factors and to select the most reliable measures. Next, we created a measurement model, specifying the relationships between the measured and the latent variables, and a structural model specifying the relationships among the latent factors. Because the HINTS data are cross-sectional, we made the explicit assumption that acculturation preceded each mediator, which preceded the outcome. The complete model included unidirectional paths from acculturation to each hypothesized mediator, unidirectional paths from each mediator to each sun-safe behavior, and correlations between each 2 mediators. Because of evidence that sex did not affect the relationship between acculturation and sun-safe behaviors, we did not model the effect of sex.

We used structural equation models (SEM) with standardized covariance matrices as input, the maximum likelihood function with robust estimation, and the Lagrange multiplier tests. The hypothesized mediators were entered simultaneously, in line with the theoretical rationale, hypotheses, and recommendations from the methodologic literature, as well as to reduce the possibility of type I error. Model fit was evaluated with the χ2 goodness-of-fit statistic, as well as the comparative fit index (CFI) and the root mean square error of approximation (RMSEA), both of which are robust to sample size biases. Conventionally, CFI ≥0.95 and RMSEA ≤0.06 signify appropriate fit. All SEM analyses were performed with EQS.
The mean (SD) age of the participants in the sample was 41.3 (15.5) years, 61.5% were women, approximately one-third (35.7%) were US born, and slightly more than half (54.6%) were interviewed in Spanish. The prevalence of the hypothesized mediating variables is summarized in the Table. Exploratory factor analyses revealed that wearing long-sleeved shirts and long pants clustered into a single factor (sun-protective clothing; eigenvalue=1.56). Both items had factor loadings of greater than 0.78. Because use of shade and use of sunscreen did not show a clear factor pattern, these outcomes were assessed in separate models. The 2 health care access items (each factor loading=0.86) clustered favorably into a single factor. The standardized solutions (effect sizes) from the SEM analyses for use of sunscreen, shade, and sun-protective clothing are summarized in Figures 1, 2, and 3, respectively. In all 3 models, the direct path between acculturation and each mediator attained statistical significance and represented a positive association. In turn, increased contact with one’s social network regarding health matters, higher educational level, and stronger per-

Table. Prevalence of the Hypothesized Mediating Variables Among 496 Latinos in the HINTS 2005

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%) (N=496)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care access</td>
<td></td>
</tr>
<tr>
<td>Health insurance coverage</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>299 (60.3)</td>
</tr>
<tr>
<td>No</td>
<td>196 (39.5)</td>
</tr>
<tr>
<td>Other/missing</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>Health care use/past 12 mo/non-ED, No. of times</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>132 (26.6)</td>
</tr>
<tr>
<td>1</td>
<td>106 (21.4)</td>
</tr>
<tr>
<td>2-4</td>
<td>144 (29.0)</td>
</tr>
<tr>
<td>5</td>
<td>112 (22.6)</td>
</tr>
<tr>
<td>Missing</td>
<td>2 (0.4)</td>
</tr>
<tr>
<td>Social network</td>
<td></td>
</tr>
<tr>
<td>Organization membership</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>277 (55.8)</td>
</tr>
<tr>
<td>Non–health-related organization</td>
<td>119 (24.0)</td>
</tr>
<tr>
<td>Health-related organization</td>
<td>97 (19.6)</td>
</tr>
<tr>
<td>Missing</td>
<td>3 (0.6)</td>
</tr>
<tr>
<td>Have family and/or friends, frequency of talking</td>
<td></td>
</tr>
<tr>
<td>with them about health matters</td>
<td></td>
</tr>
<tr>
<td>No, none</td>
<td>112 (22.6)</td>
</tr>
<tr>
<td>Yes, do not talk frequently</td>
<td>141 (28.4)</td>
</tr>
<tr>
<td>Yes, talk somewhat frequently</td>
<td>133 (26.8)</td>
</tr>
<tr>
<td>Yes, talk frequently</td>
<td>109 (22.0)</td>
</tr>
<tr>
<td>Missing</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
</tr>
<tr>
<td>&lt;High school diploma</td>
<td>208 (41.9)</td>
</tr>
<tr>
<td>High school graduate/GED</td>
<td>111 (22.4)</td>
</tr>
<tr>
<td>Vocational certificate/some college/associate’s</td>
<td>100 (20.2)</td>
</tr>
<tr>
<td>degree</td>
<td></td>
</tr>
<tr>
<td>=Bachelor’s degree</td>
<td>75 (15.1)</td>
</tr>
<tr>
<td>Other/missing</td>
<td>2 (0.4)</td>
</tr>
<tr>
<td>Perceived physical health status</td>
<td></td>
</tr>
<tr>
<td>Excellent/very good</td>
<td>120 (24.2)</td>
</tr>
<tr>
<td>Good</td>
<td>162 (32.7)</td>
</tr>
<tr>
<td>Fair/poor</td>
<td>212 (42.7)</td>
</tr>
<tr>
<td>Other/missing</td>
<td>2 (0.4)</td>
</tr>
</tbody>
</table>

Abbreviations: ED, emergency department; GED, general equivalency degree; HINTS, Health Information National Trends Survey.
ceived health were associated with increased sunscreen use ($P < .05$ for all) (Figure 1). The direct effect between acculturation and sunscreen use was nonsignificant, but the indirect effects of acculturation, educational level, perceived health status, and social networks on sunscreen use reached significance. The model had favorable statistical fit ($\chi^2 = 12.93$, $P > .16$; CFI=0.993, RMSEA=0.030).

Results for use of shade (Figure 2) were markedly different from those for sunscreen use. Specifically, the direct negative association between acculturation and use of shade was statistically significant, but neither the direct effects of the hypothesized mediators nor the indirect effect of acculturation on use of shade reached significance. The model had favorable statistical fit (CFI=0.998, RMSEA=0.017). Regarding the relationship between acculturation and use of sun-protective clothing (Figure 3), the results revealed a statistically significant mediated association with educational level (controlling for the other hypothesized mediators), such that higher educational level was linked to less use of sun-protective clothing outdoors ($P=.049$). The direct negative association between acculturation and the outcome reached significance, indicating that the mediated effect was partial. The model fit was, again, favorable ($\chi^2 = 22.63$, $P > .09$; CFI=0.988, RMSEA=0.033). Health care access did not display any mediated associations in any of the models.

**COMMENT**

Using a sample of US Latino adults, we observed that use of sunscreen, shade, and sun-protective clothing when outdoors on warm, sunny days, when modeled simultaneously, was associated with acculturation in distinctive ways. Specifically, perceived health status, educational level, and contact with social networks regarding health matters mediated the positive association between acculturation and sunscreen use, supporting our hypothesis. Social networks displayed the largest effect size, consistent with evidence that sunscreen use, skin self-examinations and those conducted by a physician or a nurse, and knowledge regarding skin cancer prevention cluster within peer groups. Furthermore, the negative association between acculturation and use of sun-protective clothing was mediated only by educational level, but use of shade did not display any mediated paths. The direct effect of acculturation attained significance for use of shade and sun-protective clothing but not for sunscreen. Hence, our findings indicate distinct and outcome-specific direct and indirect effects of acculturation among Latinos. Because most of the hypothesized mediators were supported primarily for sunscreen use, future research should test different constructs regarding other sun-safe behaviors. For example, plausible mediators for use of shade or sun-protective clothing might include body image and social norms, and such information was not available in the HINTS 2005 data set.

This study augments knowledge pertaining to modification of different health and risk behaviors as a result of acculturation to the host society. The observed negative association between acculturation and use of shade is consistent with findings that beach use (ie, increased sun exposure) in California was higher among US-born Latinos whose primary language is English than among their Mexico-born counterparts whose primary language is Spanish, after controlling for socioeconomic status (SES). Furthermore, the links among acculturation, educational level, and use of sun-protective clothing are somewhat in line with evidence of leisure-time behavior patterns among non-Latino whites. In particular, in adjusted models, college graduates were shown to be 63% more likely than those without a high school diploma to report sunburn during the previous year. Furthermore, clothing customs might be incorporated more quickly with increasing acculturation than less tangible qualities, such as values. This finding suggests that acculturation might lead to a relatively rapid adoption of US outdoor sun-protective clothing practices and possibly increased sun exposure, which has the potential for a negative effect on the melanoma rates of Latinos.

Health care access was the only hypothesized mediator that did not display any mediated associations. Although consistent evidence exists that acculturation leads to increased health care access, its effects on engagement in health-promoting behaviors are somewhat divergent and outcome specific. Findings with non-Latino whites have shown that having visited a physician within the previous year and having health insurance coverage (ie, the indicators used in the present study) were associated with a greater likelihood of reporting sunburn. Nevertheless, the odds ratios for use of sunscreen and for reporting having undergone a recent skin cancer examination conducted by a physician were increased among individuals (primarily non-Latino whites) who reported having recently undergone a general physical examination.

A strength of the present study was the use of SEM procedures to test for mediation. Unlike traditional regression, SEM allows for the simultaneous assessment of
observed and latent variables as well as direct and indirect effects of multiple mediators; it provides unbiased estimates by explicitly modeling measurement error. Additional advantages of SEM over the popular causal steps model created by Baron and Kenny are direct hypothesis tests for mediation and greater statistical power. Another strength of the study was its reliance on the dynamic and culturally applicable framework offered by the social cognitive theory, which emphasizes the importance of observing and modeling the behavior of others. We also used a model highlighting the indirect effects of acculturation on health, with many of the mediated paths not yet empirically examined.

Although many of the demographic characteristics of the sample paralleled those of the cohorts in nationally representative reports, we acknowledge the inability to distinguish among Latino subgroups or among skin types. Skin color might be a confounding factor in acculturation (which could not be assessed with the HINTS data) because it might affect motivation or the ability to acculturate due to perceived SES discrimination against dark-skinned individuals. Furthermore, because our data were cross-sectional, it is possible that educational attainment might precede or cause acculturation if it had occurred before coming to the United States. Although our data were consistent with the hypothesized models, they should be reassessed longitudinally. We sought to support assumptions of causality (rather than to prove causality), to inform mediation analyses with cross-sectional and longitudinal data, and to advance the theoretical and empirical rationale development. Many Latino men are employed in outdoor occupations with potentially increased sun exposure, and many outdoor Latino workers exhibit low acculturation, with access to non–manual labor opportunities improving with acculturation. The HINTS 2005 did not include occupational data, but the household income item had 37% missing responses. Because of a correlation between educational level and income among Latinos, we believe that our findings were not seriously compromised by the inability to model SES covariates. Another limitation was the reliance on several single-item measures, which might have limited reliability. Finally, the HINTS 2005 data allowed for the assessment of acculturation only on a unidirectional scale, and in computing the acculturation index, the mean of all available variables for all available participants was used. For the foreign-born participants, the mean acculturation score included interview language, comfort level with the English language, duration of US residence, and age at US arrival; for their US-born counterparts, the corresponding score included language of interview and comfort level with the English language. Although language items generally explain much of the variance in acculturation scales, future research should replicate these models with other acculturation measures.

In conclusion, sun safety practice is critical for the prevention of skin cancer regardless of skin type, but no ethnoracial group appears to meet current primary prevention recommendations. A recent report revealed that between 1992 and 2004, melanoma incidence doubled across all SES strata, with the lowest SES groups exhibiting the highest increase and the sharpest rise in tumor thickness. Because the number of Latinos has risen, and Latinos have disproportionate representation among low-SES strata and increased rates of advanced-stage melanoma at diagnosis, the public health effect of their skin cancer–related behaviors is likely to intensify, especially as this population continues to expand. Our results, denoting variability in the mediation mechanisms for different sun-safe behaviors, could guide primary prevention program development for Latinos and future public health research.

Accepted for Publication: December 7, 2010.
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Author Contributions: Drs Andreeva, Cockburn, Yaroch, and Reynolds had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Andreeva, Cockburn, Rueda and Reynolds. Analysis and interpretation of data: Andreeva, Cockburn, Yaroch, Unger, Rueda, and Reynolds. Drafting of the manuscript: Andreeva, Cockburn, and Unger. Critical revision of the manuscript for important intellectual content: Cockburn, Yaroch, Unger, Rueda, and Reynolds. Statistical analysis: Andreeva and Unger. Obtained funding: Reynolds. Study supervision: Cockburn, Yaroch, Unger, Rueda, and Reynolds.

Financial Disclosure: None reported.

Role of the Sponsor: The sponsors had no role in the design and conduct of the study; in the collection, analysis, and interpretation of data; or in the preparation, review, or approval of the manuscript.

Funding/Support: Dr Andreeva was supported by a doctoral dissertation fellowship at the Department of Preventive Medicine, Keck School of Medicine, University of Southern California. Dr Cockburn was supported in part by grant U55/CCU921930-02 from the Centers for Disease Control and Prevention, grant SP30 ES07048 from the National Institute of Environmental Health Sciences, and grant R01 CA121052 from the National Cancer Institute. Dr Reynolds was supported by grant CA100285 from the National Cancer Institute.

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