Published in final edited form as:

J Phys Act Health. 2015 July ; 12(7): 1023–1030. doi:10.1123/jpah.2014-0014.

Family Cohesion and Moderate-to-Vigorous Physical Activity Among Mexican Origin Adolescents: A Longitudinal Perspective

Galya Bigman,

Dept of Epidemiology, Human Genetic, and Environmental Sciences, University of Texas School of Public Health, Austin, TX

Vandita Rajesh,

Dept of Epidemiology, Human Genetic, and Environmental Sciences, University of Texas School of Public Health, Austin, TX

Laura M. Koehly,

The Intramural Research Program, National Institutes of Health, Bethesda, MD

Larkin L. Strong,

Dept of Health Disparities Research, University of Texas MD Anderson Cancer Center, Houston, TX

Abiodun O. Oluyomi,

Michael & Susan Dell Center For Healthy Living, University of Texas School of Public Health, Austin, TX

Sara S. Strom, and

Dept of Epidemiology, Division of Cancer Prevention and Population Sciences, The University of Texas MD Anderson Cancer Center, Houston, TX

Anna V. Wilkinson

Michael & Susan Dell Center For Healthy Living, University of Texas School of Public Health, Austin, TX

Abstract

Background—Existing racial/ethnic disparities in physical activity during childhood increase Hispanics' risk of developing chronic diseases, which serves to increase health disparities. This study examined associations of family cohesion and conflict with self-reported moderate-to-vigorous physical activity (MVPA), controlling for psychosocial covariates such as subjective social status, anxiety, and sensation-seeking.

Methods—1000 Mexican origin adolescents reported their MVPA levels approximately 2 years apart. Psychosocial covariates, family cohesion and conflict were measured at the first assessment. Generalized Linear Models were used to prospectively examine the relationship between family cohesion and conflict and subsequent MVPA based on 711 participants who had low levels of baseline MVPA.

Results—35% of boys and 24% of girls reported adequate MVPA levels at follow-up; girls were less likely to report adequate MVPA (RR = 0.76; 95% CI: 0.61–0.93) than boys. Overall, family cohesion was associated with MVPA ($P = .01$), but family cohesion was not ($P = .41$). Gender-

based analyses revealed that adequate MVPA was associated with family cohesion (RR = 1.40; 95% CI: 1.03–1.88), sensation seeking (RR = 1.05; 95% CI: 1.00–1.10), and age (RR = 0.85; 95% CI: 0.74–0.98) among girls and with subjective social status (RR = 1.20; 95% CI: 1.08–1.33) among boys.

Conclusions—The family social environment and gender differences should be addressed in health promotion programs targeting MVPA.

Keywords

youth; cohort; active behavior; family interactions

Insufficient physical activity during childhood increases the risk of developing obesity¹ and comorbidities such as asthma,² depression, and attention deficit and hyperactivity disorder during adolescence, which impacts quality of life and healthy development.³ A fortiori, racial/ethnic disparities in physical activity during childhood⁴ will increase Hispanics' risk of physical inactivity later in life.⁵ Further, open communication between children and their parents (eg, sharing personal problems and talking about their relationships),⁶ as well as family cohesion, have been associated with higher levels of physical activity.⁶ Family cohesion is a global indicator of family functioning⁷ that includes familial support, affection, and caring for other family members⁸ leading to strong emotional bonds among family members. It has been studied in relation to the use of substances such as tobacco,⁹ alcohol,¹⁰ and drugs.¹¹

According to the 2011 Youth Risk Behavior Surveillance System (YRBSS),¹² the prevalence of youth engaging in at least 60 minutes of physical activity per day on 5 or more days of the week (the physical activity outcome in the current study), was 7.3% lower among Hispanic youth (45.4%) compared with non-Hispanic white youth (52.7%). Gender differences in the prevalence of physical activity are common across racial/ethnic groups. In 2011, while 38.3% of boys engaged in the recommended amount of physical activity, defined as engaging in at least 60 minutes of physical activity on all 7 days of the week,¹² only 18% of girls did so. This gap is wider among racial/ethnic minorities. Among Hispanics, 57.1% of males and 33.0% of females met these recommendations, while among non-Hispanic whites, 62.1% of males and 42.6% of females did so.¹²

Previous studies have shown that the family social environment plays a major role in shaping adolescents' health behaviors, including physical activity.^{6,13–15} For example, children who were surrounded with family support such as tangible support (providing transportation to physical activity-related activities), emotional support (encouragement and praise), or active support (parents and children exercising together) were more physically active than those who lacked family social support.¹⁵ Moreover, it has been suggested that with the appropriate family support, physical activity levels during childhood can be improved.¹³

In studies among Latino families, family cohesion has been noted to have a protective effect against problem behaviors during childhood^{16,17} serving as a buffer against cigarette smoking for example.¹⁸ In contrast, family conflict, such as arguments and physical violence in the home¹⁹ has been associated with increased substance use and deviant behavior.²⁰

However, few studies to date^{6,21} have examined the relationships of physical activity with family cohesion and family conflict, particularly among Latino families, among whom the influence of family cohesion and family conflict on behavior may be particularly strong²² and essential to understanding adolescent behavior.

In general, physical activity decreases with increasing age during adolescence²³ placing older adolescents at increased risk for insufficient MVPA. In the current study we seek to identify family-level factors such as family cohesion and conflict, associated with engaging in adequate physical activity during late adolescence among participants who reported inadequate physical activity during early adolescence. Our primary study hypothesis is that higher levels of family cohesion and lower levels of family conflict are associated with engaging in adequate levels of physical activity among adolescents of Mexican descent, after controlling for individual-level risk factors, such as subjective social status and sensation-seeking tendencies that we have previously found to be associated with physical activity.^{24,25} The results from this study contribute to our understanding of how the family social environment may be associated with increases in levels of physical activity during late adolescence and can be used to inform the design of health promotion programs tailored to motivate Mexican origin youth engage in adequate levels of physical activity.

Methods

Study Population

Our data were obtained from Mexican origin adolescents who were enrolled in a prospective cohort study of smoking behavior that began in 2005. Participants for our study were drawn from a population-based cohort of Mexican American households launched in 2001 by the Department of Epidemiology at The University of Texas M. D. Anderson Cancer Center. Participants in this cohort, called the Mano-a-Mano Mexican American Cohort study (MACS), are all self-identified adults of Mexican origin.

Households were initially recruited into the MACS via probability random-digit dialing, door-to-door recruitment, intercepts, and networking approaches. Results from these recruitment methods indicated no significant differences in populations with respect to language preference, country of origin (Mexico or the United States), years living in the United States among those born in Mexico, and household income.²⁶ A detailed description of the MACS recruitment methodology has been published.²⁷ Briefly, Mexican origin adults who agreed to join the MACS, provided informed consent, and completed an interview-administered survey in their home in either English or Spanish.

For the current study, 3000 households with potential age-eligible participants (adolescents between the ages of 11 and 13 years) were identified from the MACS database. Of the first 1425 potential participants' parents or legal guardians who were contacted to assess interest in the study and were invited to participate, just over 90% agreed to enroll their child in the study (N = 1328). The Institutional Review Boards at The University of Texas M. D. Anderson Cancer Center and The University of Texas Health Science Center at Houston approved all aspects of this study.

Given our prospective study design, we excluded participants who engaged in adequate moderate-to-vigorous physical activity (MVPA) in 2008–09. In 2008–09, physical activity was assessed using 2 items adapted from the 2005 YRBSS²⁸: “Think about the activities you do at school, but not in physical education. On how many days of the past 7 did you exercise or participate in physical activity for at least 60 minutes per day?” and “Think about activities you do in your community or at home. On how many days of the past 7 did you exercise or participate in physical activity for at least 60 minutes per day?” Using both variables and regardless of context, participants were divided into 2 groups. Participants who reported being physically active for 60 minutes a day on at least 5 out of 7 days, which reflected completing adequate MVPA, were excluded from the current analysis. All other participants who reported less physical activity were included in the current analysis.

Data Collection

Data were collected via a personal interview in the home in 3 waves: at baseline in 2005–06 when the participants were between the ages of 11 and 13 years, at follow-up 1 in 2008–09, and at follow-up 2 in 2010–11 (see Figure 1). Procedures were identical for all 3 data collection waves: after a 5-minute interview in which demographic information was obtained, participants completed a survey on a personal digital assistant (PDA). Questions about physical activity were administered at follow-ups 1 and 2 only. Therefore, the current prospective analysis is based on covariates assessed in 2008–09, with the outcome, MVPA, assessed in 2010–11. Participants were given the choice of completing the interview in either English or Spanish. They received gift certificates in the amount of \$25 after baseline and each of the follow-up interviews. A detailed description of the baseline data collection procedures has been published elsewhere.²⁹

Outcome-Variable Assessed in 2010–11—MVPA was assessed using 1 item from the 2009 YRBSS³⁰: “During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time).” To be consistent with our previous work,^{24,25} we created a variable that reflected completing adequate aerobic MVPA. Participants who reported being physically active for 60 minutes a day on at least 5 out of 7 days were coded as “1,” which reflected completing adequate MVPA. All other participants who reported less MVPA were coded as “0,” which we labeled as sedentary and light behavior (SLB).

Demographics and Acculturation—Demographic information (gender, age, country of birth [either Mexico or US]) was provided by all participants when they enrolled at baseline. Female served as the reference category for gender, and Mexico was the reference category for country of birth. Age was treated as a continuous variable. We used parental educational attainment rather than household incomes as a marker of socioeconomic status (SES) because more than 40% of the parents did not report their income. Parental educational attainment, provided by at least 1 parent, was divided into 3 categories: “less than high school,” “high school/General Educational Development equivalency,” or “more than high school,” with those with highest level of education serving as the reference category.

Linguistic acculturation was assessed using 4 items that ascertain the language used when reading, speaking at home, speaking with friends, and thinking.³¹ Responses are made on a 5-point scale ranging from “only Spanish=1” to “only English=5.” Based on our data, the scale demonstrates excellent internal reliability (Cronbach's alpha = .92). For descriptive purposes, we created a 3-level variable with roughly equal numbers per level of acculturation based on the distribution of the data. Linguistic acculturation was assessed in 2008–09 and entered into the multivariate analyses as a continuous variable.

Covariates Assessed in 2008–09—Family cohesion and conflict were assessed using 2 subscales from the Family Life Questionnaire,³² a 20-item self-report instrument. Each subscale is comprised of 4 different items. For example, “In my family we really help and support one another” is from the cohesion scale and “In my family we don't often criticize each other” is from the conflict scale. Responses were made on a 4-point scale ranging from “strongly disagree = 1” to “strongly agree = 4” and then averaged separately to create the family cohesion and family conflict subscales. Based on data from our participants, the cohesion scale demonstrates very good internal reliability (Cronbach's alpha = .83) and the conflict scale demonstrates adequate internal reliability (Cronbach's alpha = .65). Higher scores on the scales reflect higher levels of cohesion and lower levels of conflict; the scales are positively correlated (Spearman correlation coefficient $r = .42$, $P < .0001$). The variables were dichotomized based on their median split and analyzed as categorical variables (low vs. high) with low serving as the reference group.

Two aspects of sensation seeking—thrill and adventure seeking (TAS) and social disinhibition (SDI) were assessed using the Sensation Seeking Scale for Children.³³ Participants endorsed the choice that best describes what they like or feel. For example, a) “I'd never do anything that's dangerous” or b) “Sometimes I like to do things that are a little scary” is taken from the TAS scale; and a) “I don't like being around kids who act wild and crazy” or b) “I enjoy being around kids who sometimes act wild and crazy” is taken from the SDI scale. Both scales have good internal reliability (for TAS, Cronbach's alpha = .81, and for SDI, Cronbach's alpha = .68). Both were entered into the multivariate analyses as continuous variables.

Subjective social status (SSS) was assessed using a modified version³⁴ of the MacArthur Social Status ladder. Participants were given a pictorial representation of a ladder with the following instructions: “At the top of the ladder (=10) are kids who are best off—get good grades, have lots of friends, or do well at sports. At the bottom are kids who are worst off—get poor grades, have few friends, or do poorly in sports (=1). Choose the 1 rung where you think you are on the ladder.” SSS was entered into the multivariate analyses as a continuous variable.

Anxiety was assessed using Spielberger's trait anxiety scale.³⁵ The scale has 20 items that assess trait anxiety, with response options ranging from “not at all” to “very much so” on a 4-point scale. The scale has been validated in US Spanish-speaking samples^{36,37} and has been shown to have good reliability based on data from our participants (Cronbach's alpha = .86). Participant anxiety scores, the average of all 20 items, were entered into the multivariate analysis as a continuous variable.

Statistical Analyses

Analyses were conducted to examine associations between 2010–11 MVPA and the independent variables, measured during the 2008–09 assessment, conditional on not completing adequate MVPA in 2008–09. First, we conducted Pearson's chi-square analyses to assess the associations between MVPA and the categorical variables, while Student's *t*-tests were used to examine mean differences on the continuous variables by MVPA. Second, crude relative risks (RR) were calculated for each study covariate separately with MVPA. Next, we conducted Generalized Linear Models (GLM) to examine the relationship between MVPA and family cohesion and conflict adjusting for covariates that demonstrated a bivariate association ($P < .25^{38}$) with MVPA. These GLM analyses were conducted overall and stratified by gender. Age was forced into the model as a control variable. We used the likelihood ratio test to compare significant ($P < .05$) differences between the full model, which included all bivariate covariates that demonstrated an association ($P < .25$) with the outcome, to reduced models in which the covariate demonstrating the least significant association with the outcome (excluding the main covariate of interest, family conflict) was removed, to eventually create the most parsimonious model. In addition, we compared those lost to follow-up with those who remained in the study on all the study variables.

Results

Of the 711 participants who completed follow-ups 1 and 2, and engaged in inadequate MVPA at follow-up 1 (see Figure 1), full data for the multivariate analyses were available on 706 participants. Participants lost to follow-up ($n = 105$) had lower SSS (7.4 vs. 7.7; $P = .026$) and were slightly older (mean age 12.1 vs. 11.8 years; $P = .003$) than participants included in the current analysis. Out of the 711 participants, 57% were females, 24% were born in Mexico, and the average age in 2010–11 was 16.8 years ($SD = 1.1$ years).

Table 1 presents the prevalence of MVPA by demographic and psychosocial characteristics. Overall, 28.4% reported adequate MVPA, with a higher prevalence among boys (34.5%) compared with girls (24.0%; $P = .002$). The proportion of participants reporting adequate MVPA did not differ significantly by age, country of birth, parental education, or linguistic acculturation. Participants who reported adequate MVPA reported higher levels of family cohesion (3.15 vs. 3.06 respectively; $P = .013$), than participants who did not. Levels of family conflict did not vary by level of MVPA. Participants who reported adequate MVPA reported significantly higher levels of TAS (7.16 vs. 6.26; $P = .001$) and SSS (7.94 vs. 7.66; $P = .013$) and significantly lower levels of anxiety (37.31 vs. 39.12; $P = .01$) compared with those who reported SLB.

Table 2 presents results from the GLM analyses for all participants. Based on the reduced model, engaging in adequate MVPA was significantly associated with family cohesion ($RR = 1.32$; 95% C.I. 1.07–1.63; $P = .010$), but not with family conflict ($RR = 0.91$; 95% C.I. 0.74–1.13; $P = .410$) controlling for gender, age, SSS, and TAS. Girls were less likely to report adequate MVPA than boys ($RR = 0.76$; 95% C.I. 0.61–0.93; $P = .010$). Among the individual characteristics, higher levels of TAS were significantly associated with adequate MVPA ($RR = 1.05$; 95% C.I. 1.02–1.09; $P = .002$) as were higher levels of SSS ($RR = 1.10$;

95% C.I.: 1.03–1.19; $P = .007$). The likelihood test indicated that the final reduced model was as good as the full model LR [$\chi^2 = 3.24$ (df = 3) $P = .355$].

The results from the reduced GLM analyses for MVPA stratified by gender are presented in Table 3. Among boys, only SSS was significantly associated (RR = 1.20; 95% C.I. 1.08–1.33; $P < .0001$) with engaging in adequate MVPA. Among girls, family cohesion (RR = 1.40; 95% C.I. 1.03–1.88; $P = .028$), TAS (RR = 1.05; 95% C.I. 1.00–1.10; $P = .031$), and age (RR = 0.85; 95% C.I. 0.74–0.98; $P = .029$) were significantly associated with adequate MVPA. Since the sample size for the girls was larger than that for the boys (401 vs. 307) and therefore afforded more power to detect associations, we randomly selected 307 girls and reran the analysis. The results showed no significant changes in the RR values among girls based on the reduced sample size ($N = 307$).

Discussion

In the current study, we used a prospective study design to examine associations of family cohesion and conflict with self-reported MVPA among a cohort of Mexican origin youth, while controlling for several psychosocial covariates of physical activity. Among the 711 participants who did not report adequate MVPA in 2008–09, 28.4% reported engaging in adequate MVPA roughly 2 years later in 2010–11. A higher proportion of boys (34.5%) reported engaging in adequate MVPA in late adolescence compared with girls (24.0%) and among girls, completing adequate MVPA was associated with younger age. These discrepancies may partly reflect traditional expectations related to gender roles; as girls grow-up they are expected to share household responsibilities requiring them to stay at home more³⁹ and thereby limiting their time for MVPA. In addition, the discrepancies also may reflect that in general among older adolescents, girls derive less enjoyment from physical activity⁴⁰ when compared with boys and many hold negative attitudes toward physical activity.⁴¹

In Mexican families, familism and cohesion are 2 different concepts. Familism, namely “familismo,” refers to loyalty, reciprocity, and solidarity toward one's family⁴² while cohesion describes the emotional bond that family members have toward one another and is an expression of belonging and acceptance of one another.⁴³ These 2 concepts define family interactions to establish the social environment in which children are raised. In our study, the measure of family cohesion reflects youths' perceptions of the quality of their relationships with family members across a diversity of emotional experiences. Participants who reported high family cohesion in 2008–09 were 32% more likely to report adequate MVPA 2 years later than their peers who reported low levels of family cohesion. Accordingly, our results suggest that among youth who were not physically active during early adolescence, those that lived in cohesive families were more likely to engage in adequate MVPA in their late adolescence than their peers who lived in less cohesive families.

Conversely, family conflict was not significantly associated with MVPA in our study sample neither in the bivariate nor the multivariate analyses. Although the Spearman's correlation coefficient was significant ($r = .42$; $P < .0001$) between family cohesion and family conflict, our results suggest that the 2 subscales measure different types of family interactions and are

not the antithesis of each other. Our results might reflect a lack of relationship between family conflict and MVPA among Mexican origin adolescents. Alternatively, the cohesion scale we used demonstrated very good internal reliability (Cronbach's $\alpha = .83$) while the conflict scale demonstrated lower internal reliability (Cronbach's $\alpha = .65$), which could reflect the need for improved measurement of family conflict in this population.

In addition and importantly, we observed several gender-based differences with regard to our study covariates and their association with increased MVPA during older adolescence. Among girls who reported adequate MVPA, family cohesion, TAS, and younger age were all significant correlates, compared with boys for whom SSS was the only significant correlate. In addition, the associations between anxiety and adequate MVPA among girls, and between TAS and adequate MVPA among boys, while not statistically significant ($P = .053$ and $P = .057$ respectively) provide meaningful insights.

Few studies have prospectively explored the relationship between family cohesion and conflict and physical activity among youth.⁶ The positive benefit of family cohesion on MVPA that we observed, in particular among girls, is consistent with other study findings and may reflect a greater need for family social approval among girls compared with boys for activities that occur outside the home, such as physical activity.³⁹ For example, Ornelas et al⁶ found that family cohesion, parent-child communication, and parental engagement related positively to physical activity and predicted weekly physical activity for both boys and girls 1 year later among a nationally representative cohort. Another study by Wiley et al⁴⁴ found that physical activity among older Mexican adolescents (ages 16–25 years) was influenced by their parents' physical activity, while other studies have demonstrated that parental support for physical activity is a key correlate of children's physical activity.^{6,13–15} In our study, among girls who reported their families as cohesive, 55% reported that a parent exercises compared with 45% among girls who reported low levels of family cohesion ($P = .05$; data not shown). This suggests that among the girls in our study, and especially those in cohesive families, consistent with previous research, parents may influence their girl's physical activity directly by modeling the behavior and perceived importance assigned to physical activity.^{14,44}

We and others^{25,45} have previously reported that higher levels of thrill and adventure seeking were associated with adequate MVPA for both genders. Yet in the current prospective analyses we note that higher levels of thrill and adventure seeking are significantly associated with increased MVPA for girls ($P = .031$) but only marginally so for boys ($P = .057$). Perhaps this reflects a more salient role for thrill and adventure seeking in the establishment of physical activity habits among girls compared with boys. Of note, among girls, although social disinhibition was not associated with adequate MVPA ($P = .098$), it was retained in the final model, because when social disinhibition was removed from the model, family cohesion no longer demonstrated a significant relationship with completing adequate MVPA. In other words, social disinhibition functioned as a suppressor variable in the model.

We have previously reported, based on cross-sectional analyses, that higher SSS is associated with higher levels of physical activity²⁴ among all participants in the cohort. In

the current stratified analysis in which we examine the relationship between SSS and behavior change, boys with higher SSS were more likely to report adequate MVPA than their counterparts with lower SSS. This finding is consistent with previous research demonstrating that for boys, playing sports and their popularity on sport teams is directly related to higher levels of social status.^{46,47} In addition, boys tend to have a greater need for peer-social approval for physical activity than girls, underscoring the importance of SSS for boys relative to girls.⁴⁸ Therefore it is possible that SSS plays a more salient role in the establishment of physical activity habits for boys when compared with girls. However it is also possible that the relationship between SSS and physical activity we reported in previous analyses was driven by the male participants; the strength of the association obtained in the current study based on boys only (OR = 1.20; 95% CI: 1.08–1.33; $P < .000$) is similar in magnitude to the strength of the association we reported previously based on both boys and girls (OR = 1.27; 95% CI: 1.08–1.50; $P < .003$).²⁴

In our study, more girls with higher levels of anxiety were sedentary at the second follow-up and reported inadequate MVPA than their less anxious counterparts. There is paucity of studies that examine the impact of anxiety on physical activity among adolescents in general and in particular, among girls and youth of different ethnic groups.⁴⁹ Consistent with our results, adults with a lifetime diagnosis of anxiety are more likely to be physically inactive than those without a diagnosis,⁵⁰ and results from an aerobic fitness intervention with youth found beneficial effects of aerobic fitness on anxiety.⁵¹ In addition, Niven et al,⁵² report that among girls (mean age 11.8 ± 0.3 years) who were motivated to be physically active, anxiety related to their social physique was likely to lead to lower levels of physical activity. Our results underscore the need for additional research to understand the role between anxiety and engaging in adequate MVPA among adolescents.

The current study has both strengths and limitations. The participants were from a population-based cohort and included roughly equal numbers of girls and boys. In addition, all covariates were assessed using validated measures, and the data were collected in the participants' homes using PDAs to ensure their privacy. The high retention rate over roughly 24 months — 87% of the youth provided data at both contacts—is study strength. In addition, we prospectively analyzed the relationship between study covariates and the main outcome to examine potentially more lasting associations between family factors and physical activity. Furthermore, the study participants represent a large ethnically homogenous and predominantly low-income sample of Mexican origin youth, which is an understudied population. The households in the population-based cohort from which our participants are drawn are representative of the Mexican origin population in Houston, Texas.²⁷

Conversely, a limitation of this study stems from the fact that the participants were all of Mexican origin, and therefore the results may not generalize to youth from other ethnic backgrounds, including Hispanics from different countries of origin. In addition, the instrument that we used to assess sensation seeking in this study was designed for use in elementary and middle school children, while the participants in the current study were attending elementary, middle, or high schools. However, we found that the instrument has good internal reliability. Furthermore, the physical activity data were self-reported;

therefore, derived estimates may be subject to reporting bias. This limitation notwithstanding, unlike many previous studies of children, these data were obtained from the participants themselves, and not from a parent/guardian proxy.⁵³ Although the psychometric properties of this instrument have been previously evaluated in similarly aged children,^{54,55} the reliability and validity of the adapted questions used in this study have not been examined. Future studies utilizing more direct measurements of PA might yield different findings. In addition, PA was assessed using 2 items in 2008–09, but only 1 item in 2010–11. In both cases the items were used to create a single variable that reflected completing adequate MVPA or not; participants completing adequate MVPA in 2008–09 were excluded from the analysis. It is possible that different participants may have been excluded had we used the same items to assess MVPA in both 2008–09 and 2010–11, which in turn could influence the final risk estimates obtained in this study. Furthermore, the acculturation measure that was used assesses language use only, rather than a broader range of factors that are influenced by the acculturation process (eg, values, behaviors), and implicitly assumes that greater English usage is associated with increased orientation to American society and decreased orientation to Latino culture. Finally, in our model we did not adjust for several established correlates of physical activity such as peer and family physical activity,⁵⁶ which may impact our final risk estimates.

Conclusions

Ours is among the first studies to prospectively examine associations of family cohesion and family conflict with self-reported physical activity among Mexican origin youth. Our findings suggest that the family environment should be targeted as part of health promotion programs designed to improve MVPA among adolescents in general, and girls in particular. Our results further suggest that among older adolescent girls, higher levels of anxiety, and among older adolescent boys, lower levels of subjective social status, may be barriers to engaging in adequate MVPA, and therefore should be targeted in health promotion programs. Finally our results further suggest that additional research is needed to understand the mechanism by which family cohesion is associated with sufficient MVPA among adolescents.

Acknowledgments

We thank the field staff for their on-going work with participant recruitment and follow-up. Most importantly, we thank our study participants and their parents for their cooperation and participation, without which this research would not be possible. This research is supported by the National Cancer Institute grants [CA126988 to AVW] and partially supported by the Intramural Research Program of the National Human Genome Research Institute at the National Institutes of Health [Z01HG200335–LMK]. The Mexican American Cohort receives funds collected pursuant to the Comprehensive Tobacco Settlement of 1998 and appropriated by the 76th legislature to The University of Texas M. D. Anderson Cancer Center; from the Caroline W. Law Fund for Cancer Prevention, and the Dan Duncan Family Institute for Risk Assessment and Cancer Prevention. The funders did not contribute to the design and conduct of the study, the data collection, analysis, and interpretation of the data, the preparation, review, or approval of the manuscript.

References

1. Rauner A, Mess F, Woll A. The relationship between physical activity, physical fitness and overweight in adolescents: a systematic review of studies published in or after 2000. *BMC Pediatr*. 2013; 13 19-2431-13-19.

2. Papoutsakis C, Priftis KN, Drakouli M, et al. Childhood overweight/ obesity and asthma: Is there a link? A systematic review of recent epidemiologic evidence. *J Acad Nutr Diet.* 2013; 113(1):77–105. DOI: 10.1016/j.jand.2012.08.025 [PubMed: 23260726]
3. Pulgarón ER. Childhood obesity: a review of increased risk for physical and psychological comorbidities. *Clin Ther.* 2013; 35(1):A18–A32. DOI: 10.1016/j.clinthera.2012.12.014 [PubMed: 23328273]
4. Gordon-Larsen P, McMurray RG, Popkin BM. Adolescent physical activity and inactivity vary by ethnicity: The National Longitudinal Study of Adolescent Health. *J Pediatr.* 1999; 135(3):301–306. DOI: 10.1016/S0022-3476(99)70124-1 [PubMed: 10484793]
5. Telama R, Yang X, Viikari J, Valimaki I, Wanne O, Raitakari O. Physical activity from childhood to adulthood: a 21-year tracking study. *Am J Prev Med.* 2005; 28(3):267–273. DOI: 10.1016/j.amepre.2004.12.003 [PubMed: 15766614]
6. Ornelas IJ, Perreira KM, Ayala GX. Parental influences on adolescent physical activity: a longitudinal study. *Int J Behav Nutr Phys Act.* 2007; 4:3.doi: 10.1186/1479-5868-4-3 [PubMed: 17274822]
7. Bear J. Is family cohesion a risk or protective factor during adolescent development? *J Marriage Family.* 2002; (64):668–675.
8. Barber BK, Buehler C. Family cohesion and enmeshment, family ethnic in influence on adolescent alcohol usage: A growth curve approach. *J Fam Psychol.* 2001; 15(2):301–314. DOI: 10.1037/0893-3200.15.2.301 [PubMed: 11458635]
9. Wagner KD, Ritt-Olson A, Chou CP, et al. Associations between family structure, family functioning, and substance use among Hispanic/Latino adolescents. *Psychol Addict Behav.* 2010; 24(1):98–108. DOI: 10.1037/a0018497 [PubMed: 20307116]
10. Marsiglia FF, Kulis S, Parsai M, Villar P, Garcia C. Cohesion and conflict: family influences on adolescent alcohol use in immigrant Latino families. *J Ethn Subst Abuse.* 2009; 8(4):400–412. DOI: 10.1080/15332640903327526 [PubMed: 20057918]
11. Lac A, Unger JB, Basáñez T, Ritt-Olson A, Soto DW, Baezconde-Garbanati L. Marijuana use among Latino adolescents: gender differences in protective familial factors. *Subst Use Misuse.* 2011; 46(5):644–655. DOI: 10.3109/10826084.2010.528121 [PubMed: 20977294]
12. Centers for Disease Control and Prevention. Youth Risk Behavior Survey. 2011. <http://www.cdc.gov/mmwr/pdf/ss/ss6104.pdf>
13. Trost SG, Sallis JF, Pate RR, Freedson PS, Taylor WC, Dowda M. Evaluating a model of parental influence on youth physical activity. *Am J Prev Med.* 2003; 25(4):277–282. DOI: 10.1016/S0749-3797(03)00217-4 [PubMed: 14580627]
14. Hsu YW, Chou CP, Nguyen-Rodriguez ST, McClain AD, Belcher BR, Spruijt-Metz D. Influences of social support, perceived barriers, and negative meanings of physical activity on physical activity in middle school students. *J Phys Act Health.* 2011; 8(2):210–219. [PubMed: 21415448]
15. Lawman HG, Wilson DK. A review of family and environmental correlates of health behaviors in high-risk youth. *Obesity (Silver Spring).* 2012; 20(6):1142–1157. DOI: 10.1038/oby.2011.376 [PubMed: 22282044]
16. Varela RE, Sanchez-Sosa JJ, Biggs BK, Luis TM. Parenting strategies and socio-cultural influences in childhood anxiety: Mexican, Latin American descent, and European American families. *J Anxiety Disord.* 2009; 23(5):609–616. DOI: 10.1016/j.janxdis.2009.01.012 [PubMed: 19264444]
17. Farrell MP, Barnes GM, Banerjee S. Family cohesion as a buffer against the effects of problem-drinking fathers on psychological distress, deviant behavior, and heavy drinking in adolescents. *J Health Soc Behav.* 1995; 36(4):377–385. DOI: 10.2307/2137326 [PubMed: 8719055]
18. Rajesh, V. Unpublished Doctoral Dissertation. 2011. Parental influence on adolescent smoking initiation among Mexican origin youth.
19. Amato PR, Sobolewski JM. The effects of divorce and marital discord on adult children's psychological well-being. *Am Sociol Rev.* 2001; 66:900–921. DOI: 10.2307/3088878
20. McQueen A, Getz JG, Bray JH. Acculturation, substance use, and deviant behavior: examining separation and family conflict as mediators. *Child Dev.* 2003; 74(6):1737–1750. DOI: 10.1046/j.1467-8624.2003.00635.x [PubMed: 14669893]

21. de la Haye K, de Heer HD, Wilkinson AV, Koehly LM. Predictors of parent-child relationships that support physical activity in Mexican-American families. *J Behav Med.* 2014; 37(2):234–44. [PubMed: 23203139]
22. Miranda AO, Estrada D, Firpo-Jimenez M. Differences in family cohesion, adaptability, and environment among Latino families in dissimilar stages of acculturation. *Fam J (Alex Va).* 2000; 8(4):341–350. DOI: 10.1177/1066480700084003
23. Gordon-Larsen P, Nelson MC, Popkin BM. Longitudinal physical activity and sedentary behavior trends: adolescence to adulthood. *Am J Prev Med.* 2004; 27(4):277–283. DOI: 10.1016/j.amepre.2004.07.006 [PubMed: 15488356]
24. Wilkinson AV, Gabriel KP, Wang J, et al. Sensation-seeking genes and physical activity in youth. *Genes Brain Behav.* 2013; 12(2):181–188. DOI: 10.1111/gbb.12006 [PubMed: 23190435]
25. Wilkinson AV, Okeke NL, Springer AE, et al. Experimenting with cigarettes and physical activity among Mexican origin youth: a cross sectional analysis of the interdependent associations among sensation seeking, acculturation, and gender. *BMC Public Health.* 2012; 12:332. [PubMed: 22559717]
26. Wilkinson AV, Spitz MR, Strom SS, et al. Effects of nativity, age at migration, and acculturation on smoking among adult Houston residents of Mexican descent. *Am J Public Health.* 2005; 95(6): 1043–1049. DOI: 10.2105/AJPH.2004.055319 [PubMed: 15914831]
27. Saunders, KM. Unpublished Master's Thesis. 2005. Evaluation of recruitment strategies for obtaining a representative cohort of urban Mexican Americans.
28. Centers for Disease Control and Prevention. Youth Risk Behavior Survey. 2005. ftp.cdc.gov/pub/d16/ata/yrbs/2005/YRBS_2005_National_User_Guide.pdf
29. Wilkinson AV, Waters AJ, Vasudevan V, Bondy ML, Prokhorov AV, Spitz MR. Correlates of susceptibility to smoking among Mexican origin youth residing in Houston, Texas: a cross-sectional analysis. *BMC Public Health.* 2008; 8:337. [PubMed: 18822130]
30. Centers for Disease Control and Prevention. Youth Risk Behavior Survey. 2009. <http://www.cdc.gov/healthyyouth/yrbs/pdf/questionnaire/2009HighSchool.pdf>
31. Norris AE, Ford K, Bova CA. Psychometrics of a brief acculturation scale for Hispanics in a probability sample of urban Hispanic adolescents and young adults. *Hisp J Behav Sci.* 1996; 18:29–38. DOI: 10.1177/07399863960181004
32. Foxcroft D, Lowe G. Adolescent drinking, smoking and other substance use involvement: links with perceived family life. *J Adolesc.* 1995; 18:159–177. DOI: 10.1006/jado.1995.1011
33. Russo MF, Stokes GS, Lahey BB, et al. A sensation seeking scale for children: further refinement and psychometric development. *J Psychopathol Behav Assess.* 1993; 15(2):69–86. DOI: 10.1007/BF00960609
34. Goodman E, Adler NE, Kawachi I, Frazier AL, Huang B, Colditz GA. Adolescents' perceptions of social status: development and evaluation of a new indicator. *Pediatrics.* 2001; 108:E31. doi: 10.1542/peds.108.2.e31. [PubMed: 11483841]
35. Spielberger CD. Assessment of state and trait anxiety: conceptual and methodological issues. *South Psychol.* 1985; (2):6–16.
36. Diane M, Novy DM, Nelson DV, Smith KG, Rogers PA, Rowzee RD. Psychometric comparability of the English-and Spanish-Language versions of the State-Trait Anxiety Inventory. *Hisp J Behav Sci.* 1995; 17(2):209–224.
37. Ginsburg GS, Silverman WK. Phobic and anxiety disorders in Hispanic and Caucasian youth. *J Anxiety Disord.* 1996; 10(6):517–528. DOI: 10.1016/S0887-6185(96)00027-8
38. Mickey RM, Greenland S. The impact of confounder selection criteria on effect estimation. *Am J Epidemiol.* 1989; 129(1):125–137. [PubMed: 2910056]
39. Evenson KR, Sarmiento OL, Macon ML, Tawney KW, Ammerman AS. Environmental, policy, and cultural factors related to physical activity among Latina immigrants. *Women Health.* 2002; 36(2): 43–57. DOI: 10.1300/J013v36n02_04
40. Butt J, Weinberg RS, Breckon JD, Claytor RP. Adolescent physical activity participation and motivational determinants across gender, age, and race. *J Phys Act Health.* 2011; 8(8):1074–1083. [PubMed: 22039125]

41. Davison KK, Schmalz DL, Downs DS. Hop, skip... no! explaining adolescent girls' disinclination for physical activity. *Ann Behav Med*. 2010; 39(3):290–302. DOI: 10.1007/s12160-010-9180-x [PubMed: 20393818]
42. Cortes DE. Variations in familism in two generations of Puerto Ricans. *Hisp J Behav Sci*. 1995; 17(2):249–255. DOI: 10.1177/07399863950172008
43. McKeown RE, Garrison CZ, Jackson KL, Cuffe SP, Addy CL, Waller JL. Family structure and cohesion, and depressive symptoms in adolescents. *J Res Adolesc*. 1997; 7(3):267–282. DOI: 10.1207/s15327795jra0703_2
44. Wiley AR, Flood TL, Andrade FC, Aradillas C, Cerda EM. Family and individual predictors of physical activity for older Mexican adolescents. *J Adolesc Health*. 2011; 49(2):222–224. DOI: 10.1016/j.jadohealth.2010.11.258 [PubMed: 21783059]
45. De Moor MH, Beem AL, Stubbe JH, Boomsma DI, De Geus EJ. Regular exercise, anxiety, depression and personality: a population-based study. *Prev Med*. 2006; 42(4):273–279. DOI: 10.1016/j.ypmed.2005.12.002 [PubMed: 16439008]
46. Sweeting H, West P, Young R, Kelly S. Dimensions of adolescent subjective social status within the school community: description and correlates. *J Adolesc*. 2011; 34(3):493–504. DOI: 10.1016/j.adolescence.2010.06.001 [PubMed: 20579723]
47. Jago R, Brockman R, Fox KR, Cartwright K, Page AS, Thompson JL. Friendship groups and physical activity: qualitative findings on how physical activity is initiated and maintained among 10–11 year old children. *Int J Behav Nutr Phys Act*. 2009; 6:4.doi: 10.1186/1479-5868-6-4 [PubMed: 19138411]
48. Edwardson CL, Gorely T, Pearson N, Atkin A. Sources of activity-related social support and adolescents' objectively measured after-school and weekend physical activity: gender and age differences. *J Phys Act Health*. 2013; 10(8):1153–1158. [PubMed: 23223792]
49. Ortega FB, Ruiz JR, Castillo MJ, Sjostrom M. Physical fitness in childhood and adolescence: a powerful marker of health. *Int J Obes*. 2008; 32(1):1–11. DOI: 10.1038/sj.ijo.0803774
50. Strine TW, Mokdad AH, Dube SR, et al. The association of depression and anxiety with obesity and unhealthy behaviors among community-dwelling US adults. *Gen Hosp Psychiatry*. 2008; 30(2):127–137. DOI: 10.1016/j.genhosppsych.2007.12.008 [PubMed: 18291294]
51. DiLorenzo TM, Bargman EP, Stucky-Ropp R, Brassington GS, Frensch PA, LaFontaine T. Long-term effects of aerobic exercise on psychological outcomes. *Prev Med*. 1999; 28(1):75–85. DOI: 10.1006/pmed.1998.0385 [PubMed: 9973590]
52. Niven A, Fawcner S, Knowles AM, Henretty J, Stephenson C. Social physique anxiety and physical activity in early adolescent girls: the influence of maturation and physical activity motives. *J Sports Sci*. 2009; 27(3):299–305. DOI: 10.1080/02640410802578164 [PubMed: 19153865]
53. Bender JM, Brownson RC, Elliott MB, Haire-Joshu DL. Children's physical activity: using accelerometers to validate a parent proxy record. *Med Sci Sports Exerc*. 2005; 37:1409–1413. DOI: 10.1249/01.mss.0000174906.38722.2e [PubMed: 16118590]
54. Troped PJ, Wiecha JL, Fragala MS, et al. Reliability and validity of the YRBS physical activity items among middle school students. *Med Sci Sports Exerc*. 2007; 39:416–425. DOI: 10.1249/mss.0b013e31802d97af [PubMed: 17473767]
55. Hoelscher DM, Day RS, Kelder SH, Ward JL. Reproducibility and validity of the secondary level school-based nutrition monitoring student questionnaire. *J Am Diet Assoc*. 2003; 103(2):186–194. DOI: 10.1053/jada.2003.50031 [PubMed: 12589324]
56. Silva P, Lott R, Mota J, Welk G. Direct and indirect effects of social support on youth physical activity behavior. *Pediatr Exerc Sci*. 2013

Figure 1.
Final analytic study sample: from baseline (2005–06) through follow-up (2010–11).

Table 1
The Prevalence of Physical Activity in 2010–11 by Study Covariates Assessed in 2008–09
Among Participants Who Completed Inadequate MVPA in 2008–09 (N = 711)

	N (%)	Physical Activity		P
		SLB	MVPA	
	N (%)	N (%)	N (%)	
Overall	711 (100.0)	509 (71.6)	202 (28.4)	
Gender				0.002
Female	403 (56.7)	307 (76.0)	96 (24.0)	
Male	308 (43.3)	202 (65.5)	106 (34.5)	
Age (years)				0.613
13	179 (25.2)	120 (67.3)	59 (32.7)	
14	232 (32.6)	173 (74.6)	59 (25.4)	
15	216 (30.8)	151 (69.9)	65 (30.1)	
16	84 (11.8)	65 (77.4)	19 (22.6)	
Mean (SD)	14.3 (1.1)	14.3 (1.0)	14.2 (1.0)	
Country of birth				0.620
Mexico	174 (24.5)	122 (70.1)	52 (29.9)	
USA	537 (75.5)	387 (72.1)	150 (27.9)	
Parental educational attainment				0.923
< High school	463 (66.3)	331 (71.5)	132 (28.5)	
High school	117 (16.7)	83 (70.9)	34 (29.1)	
> High school	119 (17.0)	87 (73.1)	32 (26.9)	
Linguistic acculturation				0.199
Lowest	216 (30.6)	162 (75.0)	54 (25.0)	
Medium	304 (43.1)	207 (68.1)	97 (31.9)	
Highest	185 (26.3)	135 (73.0)	50 (27.0)	
Mean (SD)	3.49 (0.7)	3.49 (0.7)	3.49 (0.7)	0.536
Family cohesion				
Low	407 (57.3)	306 (75.2)	101 (24.8)	0.013
High	303 (42.7)	202 (66.7)	101 (33.3)	
Mean (SD)	3.08 (0.5)	3.06 (0.5)	3.15 (0.5)	0.011
Family conflict				
Low	354 (49.9)	253 (71.5)	101 (28.5)	0.981
High	355 (50.1)	254 (71.5)	101 (28.5)	
Mean (SD)	2.61 (0.6)	2.60 (0.6)	2.63 (0.5)	0.742
Thrill & adventure seeking				
Mean (SD)	6.5 (3.3)	6.26 (3.3)	7.16 (3.2)	0.001
Range	0–12	0–12	0–12	
Social disinhibition				0.084
Mean (SD)	3.16 (1.7)	3.10 (1.7)	3.26 (1.7)	

	Physical Activity			<i>P</i>
	N (%)	SLB	MVPA	
		N (%)	N (%)	
Range	0–7	0–7	0–7	
Subjective social status				0.013
Mean (SD)	7.75 (1.5)	7.66 (1.5)	7.94 (1.5)	
Range	1–10	1–10	1–10	
Anxiety				0.010
Mean (SD)	38.61 (9.5)	39.12 (9.6)	37.31 (9.0)	
Range	20–71	20–71	20–71	

Abbreviations: MVPA, moderate-to-vigorous physical activity; SLB, sedentary and light behavior.

Table 2
Crude and Adjusted Relative Risks for Physical Activity (SLB vs. MVPA) in 2010–2011 Among Participants Who Completed Inadequate MVPA in 2008–09

	Crude RR (N = 711)			Full model (N = 706)			Reduced model (N = 706)		
	RR	95% CI	P	RR*	95% CI	P	RR*	95% CI	P
Age (years)	1.02	0.88–1.17	0.826	0.91	0.82–1.01	0.077	0.92	0.83–1.02	0.112
Gender	0.69	0.54–0.87	0.002	0.77	0.62–0.95	0.015	0.76	0.61–0.93	0.010
Linguistic acculturation	1.01	0.86–1.19	0.889	0.97	0.83–1.20	0.643	–	–	–
Family cohesion	1.32	1.04–1.68	0.023	1.32	1.06–1.64	0.012	1.32	1.07–1.63	0.010
Family conflict	1.07	0.87–1.32	0.528	0.91	0.74–1.13	0.410	0.91	0.74–1.13	0.408
Thrill & adventure seeking	1.06	1.02–1.10	0.002	1.05	1.01–1.08	0.010	1.05	1.02–1.09	0.002
Social disinhibition	1.05	0.98–1.12	0.170	1.06	0.99–1.13	0.093	–	–	–
Subjective social status	1.10	1.01–1.19	0.024	1.11	1.03–1.19	0.009	1.10	1.03–1.19	0.007
Anxiety	0.99	0.97–0.99	0.022	0.99	0.98–1.06	0.306	–	–	–

* Adjusted for all other variables listed in the model.

Abbreviations: RR, relative risks; MVPA, moderate-to-vigorous physical activity; SLB, sedentary and light behavior.

Note. Gender—males served as the reference category; Family cohesion and family conflict—low served as the reference category.

Adjusted Relative Risks for Physical Activity (SLB vs. MVPA) in 2010–2011 Stratified by Gender Among Participants Who Completed Inadequate MVPA in 2008–09

Table 3

	Boys (N = 305)				Girls (N = 401)			
	RR*	95% CI	P		RR*	95% CI	P	
Age (years)	1.00	0.86–1.17	0.979		0.85	0.74–0.98	0.029	
Linguistic acculturation	–	–	–		–	–	–	
Family cohesion	1.17	0.86–1.59	0.296		1.40	1.03–1.88	0.028	
Family conflict	–	–	–		–	–	–	
Thrill & adventure seeking	1.05	0.99–1.10	0.057		1.05	1.00–1.10	0.031	
Social disinhibition	–	–	–		1.08	0.99–1.17	0.098	
Subjective social status	1.20	1.08–1.33	0.000		–	–	–	
Anxiety	–	–	–		0.98	0.97–1.00	0.053	

* Adjusted for all other variables listed in the model.

Abbreviations: RR, relative risks; MVPA, moderate-to-vigorous physical activity; SLB, sedentary and light behavior.