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REGULAR ARTICLE

The Association of the Parent–Child Language Acculturation Gap with Obesity and Cardiometabolic Risk in Hispanic/Latino Youth: Results from the Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth)

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Abstract

Background Hispanic/Latino youth are disproportionately burdened by obesity and have a high prevalence of prediabetes and dyslipidemia. Differences in parent and child acculturation related to language use and preference (i.e., language acculturation) are associated with adverse cardiometabolic health behaviors, but no study has examined associations with cardiometabolic markers.

Purpose To determine whether discordance in parent–child language acculturation (parent–child acculturation gap) was associated with poor youth cardiometabolic health.

Methods Hispanic/Latino 8–16-year-olds (n = 1,466) and parents from the Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth) were examined. Mean scores for the Brief ARSMA-II's Anglo (AOS) and Latino (LOS) Orientation Scales represented language acculturation. Cardiometabolic markers included youth body mass index (BMI) percentile, blood pressure percentiles, and dysglycemia and hyperlipidemia measures. Missing data were imputed. Survey-weighted multivariable linear regression examined the association of youth, parent, and youth × parent (the acculturation gap) AOS and LOS scores separately with each cardiometabolic marker.

Results Youth reported greater English and lower Spanish use than parents. Greater discordance in AOS scores was associated with elevated BMI percentile only (p-for-interaction < .01). The LOS acculturation gap was not associated with any outcome. Adjustment for acculturative stress, family functioning and closeness, parenting style, and youth's diet and physical activity did not alter findings. Removal of nonsignificant acculturation gaps did not indicate an association between individual youth or parent AOS or LOS scores and any cardiometabolic marker.

Conclusions Discordance in Hispanic/Latino parent–child dyads' English use may relate to increased risk for childhood obesity. Future studies should identify mediators of this association.

Keywords Hispanics · Parent–child relations · Acculturation · Child · Youth · Language

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Introduction

Hispanic/Latino youth in the USA are disproportionately burdened by the obesity epidemic, with 26% of Hispanic/Latino 2–19-year-olds presenting with obesity compared with 14% of similarly-aged non-Hispanic White youth [1]. We recently showed that Hispanic/Latino youth also have adverse cardiometabolic health profiles, including a high prevalence of prediabetes and dyslipidemia (16.5% and 23.3%, respectively) [2]. The factors that put Hispanic/Latino youth at risk for obesity and poor cardiovascular health are complex, but acculturation may play a role [3, 4].

Acculturation is a complex process in which individuals retain parts of their original culture while also adopting beliefs, values, and behaviors from the new culture they are continuously exposed to [5, 6]. While the exchange of cultural practices, values, and identifications are interrelated, there is a call for research to examine these three dimensions separately to understand their unique contributions to health outcomes [7]. Existing acculturation scales primarily assess acculturation related to cultural practices, with an emphasis on language use and preference [7].

Hispanic/Latino immigrants in the USA with low language acculturation (i.e., low English language use and proficiency) have language barriers to healthcare that result in decreased health services use and decreased access to health education compared to non-Hispanic Whites [8–10]. As a result, language acculturation has been identified as an important determinant of cardiometabolic health among Hispanic/Latino immigrants in the USA. Specifically, results from two large multicenter studies of Hispanic/Latino adult populations in the USA, the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) and the Multi-Ethnic Study of Atherosclerosis (MESA), indicated that English compared to Spanish language use was associated with decreased dyslipidemia [10, 11], systolic blood pressure [10], and fasting blood glucose [10].

While low language acculturation has been associated with decreased cardiometabolic health in Hispanic/Latino adults [10, 11], studies have not examined this association in youth. Notably, youth's access to and use of healthcare is largely dependent on their parents' engagement with healthcare systems. Thus, the degree of language acculturation of both the parent and child is likely a key determinant of youth's cardiometabolic health.

There is evidence to support that parents and their children have differing degrees of language acculturation [6]. These differences can arise from discrepancies in parents' and children's degree of exposure to the new culture, immigrant generation (e.g., the child but not the parent was born in the USA), and age at immigration [6]. In general, youth are thought to adopt the English language more rapidly than their parents [12], perhaps due to regular learning and socializing in English-language schools [6].

The resulting differences in language acculturation can lead to parent–child discrepancies in language use and comprehension [13] that increase stress [14, 15], family conflict, and communication issues [6, 13]. Together, these stressors and communication issues can promote poor cardiometabolic health in youth. Specifically, familial and other types of stress have been shown to manifest physiologically as insulin resistance or high blood pressure in Hispanic/Latino individuals [16]. Further, the parenting practices that Hispanic/Latino parents use have been linked to youth's dietary and physical activity behaviors, but a language barrier could prevent effective communication of these expectations [17–19].

Previous studies have found associations between intergenerational differences in language acculturation (i.e., a parent–child acculturation gap) and youth health behaviors, such as substance abuse [12, 20], that may increase risk for cardiometabolic disease [21, 22]. However, no published study has investigated the association between the parent–child acculturation gap (in any domain of acculturation) and markers of cardiometabolic health.

The objective of this study was to determine how the parent–child acculturation gap in language acculturation is associated with markers of cardiometabolic health in Hispanic/Latino 8–16-year-olds in the Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth). We hypothesized that discordant acculturation status among parents and their children—specifically, parents who were less English language dominant and more Spanish language dominant than their children—would be associated with poor cardiometabolic health in youth.

Methods

Study Population

SOL Youth is a cross-sectional, ancillary study of HCHS/SOL [23]. HCHS/SOL is a prospective, community-based cohort study of 16,415 self-identified Hispanic/Latino adults (ages 18–74 years) who were selected using a stratified, two-stage probability sampling design across four U.S. communities (Bronx, NY; Chicago, IL; Miami, FL; San Diego, CA), supported by a Coordinating Center at the University of North Carolina at Chapel Hill [23, 24]. Between 2012 and 2014, SOL Youth [25] enrolled 1466 children aged 8–16 years living in the household of a parent/caregiver (henceforth referred to as the parent) who completed the HCHS/SOL baseline examination (2008–2011). Of the 6,741 households screened, 1,777 households had eligible youth, of which 1,466 enrolled in SOL Youth, corresponding to 1,020 parents. SOL Youth study participation included three components: (a) an initial clinical examination at the field center, (b) 7 days of wearing a physical activity monitor, and (c) a second 24-hr dietary recall via telephone within a month of the initial clinic visit. Protocols for HCHS/SOL and SOL Youth are published elsewhere [23–25].

Acculturation Gap

The acculturation gap was assessed using the Brief Acculturation Rating Scale for Mexican Americans-II (Brief ARSMA-II), which primarily assesses language use and preference [26]. Example items from the Brief ARSMA-II include, "I enjoy English language movies" and, "My thinking is done in the Spanish language." Wording of the original questionnaire was modified for SOL Youth by replacing the term "Anglos" with "non-Hispanics." Both parents and youth completed the Brief ARSMA-II [26, 27].

The Brief ARSMA-II is comprised of two subscales: the six-item Anglo Orientation Scale (AOS; Cronbach's α = 0.64 [child] and 0.86 [parent]) and the six-item Hispanic/Latino Orientation Scales (LOS; Cronbach's α = 0.84 [child] and 0.82 [parent]). Individuals received an average score (range: 1–5) for each [26]. Two items that related to friendship with "non-Hispanics" (the only two items which did not address language acculturation) were removed from the youth AOS scale after a review of response patterns indicated that youth did not seem to understand the term "non-Hispanics" [28]. Removing these two items improved internal consistency of the AOS scale for youth (Cronbach's α = 0.69) [28, 29].

BMI Percentile

Youth's height (cm) was measured in triplicate by trained examiners using a wall-mounted stadiometer, and weight (kg) was measured with the youth in light clothing and no shoes using a digital scale (Tanita Body Composition Analyzer, TBF-300A; Tanita Corporation, Tokyo, Japan). BMI was calculated as kg/m^2. BMI percentile was calculated using mean height and weight and a SAS program from the Centers for Disease Control (CDC) [30].

Blood Pressure Percentiles

Blood pressure was measured in triplicate by trained examiners using an OMRON HEM-907XL sphygmomanometer (Omron Healthcare Co. Ltd., Kyoto, Japan) after 5 min of seated rest. The mean of the three measurements was used for analysis [31]. Systolic and diastolic blood pressure (SBP and DBP, respectively) percentiles were calculated based on the National Heart, Lung, and Blood Institute's (NHLBI) blood pressure tables [32] and on height-for-age *z*-scores [30].

Laboratory Measures

All blood specimens were drawn in the morning under fasting conditions (at least 8 hr), processed on site, and stored at −70°C. The University of Minnesota's Advanced Research and Diagnostic Laboratory performed all laboratory assays. Fasting glucose was measured in EDTA plasma on a Roche Modular P Chemistry Analyzer (Roche Diagnostics Corporation) using a hexokinase enzymatic method (Roche Diagnostics, Indianapolis, IN). Fasting insulin was measured in serum on a Roche Elecsys 2010 Analyzer (Roche Diagnostics Corporation) using a sandwich immunoassay method (Roche Diagnostics, Indianapolis, IN). Hemoglobin A1c (HbA1c) was measured from whole blood using high-performance liquid chromatography (HPLC) using a Tosoh G8 Automated HPLC Analyzer (Tosoh Bioscience, Inc, South San Francisco, CA) and was standardized to the Diabetes Control and Complications Trial assay. Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) was calculated as (fasting insulin [µU/mL] × fasting glucose [mg/dL])/405 [33].

Triglycerides and total cholesterol were measured using an enzymatic method (Roche Diagnostics, Indianapolis, IN). High density lipoprotein cholesterol (HDL-C) was measured using a direct precipitation method (Roche Diagnostics, Indianapolis, IN). Low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald equation. High-sensitivity C-reactive protein (hs-CRP) was measured from serum using an immunoturbidimetric method on the Roche COBAS 6000 Chemistry Analyzer (Roche Diagnostics, Indianapolis, IN). Laboratory inter-assay coefficients of variation were 1.3% to 3.1% for fasting glucose, fasting insulin, and HbA1c; 1.3%–5.2% for lipids; and 6.7% for hs-CRP.

Covariates

Age, sex, nativity (i.e., born in mainland USA vs. foreign-born or born in U.S. territory), and Hispanic/Latino background were self-reported by the youth and parent. The youth and parent measures for each of these four variables were used in all analyses. The parent reported annual household income and their educational attainment.

Exploratory Covariates

Acculturative stress

Parent and youth acculturative stress were reported using average scores (range: 1–5) from a nine-item acculturative stress index that measured perceived discrimination, intergenerational conflict, and language conflict over the past year (Cronbach's α = 0.73 [child] and 0.77 [parent]) [15]. The index included questions relevant to the language acculturation gap examined in this study including, "How often has it been hard for you to get along with others because you don't speak English well?" and, "How often do you get upset at your parents/children because they don't know US ways?"

Family dynamics

General family functioning was assessed using an average score (range: 1–4) from the youth-completed 12-item general family functioning subscale of the Family Assessment Device (Cronbach's α = 0.77) [34, 35]. Closeness of youth with their mothers and fathers was assessed using an average score (range: 1–5) from a youth-completed six-item questionnaire on how close to, cared for, and loved the youth felt by their mother and father (Cronbach's α = 0.70) [36]. Parenting style was assessed using the parent-completed Authoritative Parenting Index, which assesses the two dimensions of authoritative parenting [37]: demandingness and responsiveness (Cronbach's α = 0.78 and 0.55) [38]. Individuals received a total score for the demandingness and responsiveness subscales (ranges: 7–28 and 9–36, respectively).

Statistical analysis

Missing data were addressed using fully conditional specification (FCS) methods of multiple imputation [39, 40]. All analytic variables, as well as variables that may explain missingness, were used in 10 imputations, with Box–Cox transformations applied as needed.

Participants were excluded from specific analyses if their lab value was ≥3 standard deviations from the sample mean and, for analyses related to glucose metabolism and lipids, if they fasted <8 hr. The number of individuals excluded according to these criteria varied across imputations, but the smallest sample size used in any given imputation was 1,459 for HbA1c, 1,454 for fasting glucose and HDL-C, 1,453 for cholesterol, 1,452 for LDL-C, 1,442 for HOMA-IR, 1,441 for hsCRP, and 1,436 for triglycerides. All other analyses used a sample size of 1,466.

The parent–child acculturation gap was operationalized as an interaction term between parent and youth scores on the AOS or LOS subscale [6, 41]. This approach allowed for examination of both the type and direction of the difference in parent–child scores and, unlike a variable representing the simple difference between parent and youth scores, does not ignore the importance of the main effects of parent and youth acculturation scores [6, 41].

Potential interactions between parent and youth scores were explored using locally weighted smoothing (LOESS) curves (smoothing parameter = 0.7) applied to the unadjusted, nonimputed data. LOESS curves were fit to scatterplots of youth AOS or LOS score and each cardiometabolic marker, using parent AOS or LOS score, respectively, as the stratification variable. To aid with interpretation, parent AOS and LOS scores were rounded to the nearest integer. When <10% of the total sample had the same score, up to two neighboring groups were combined (i.e., parents with an AOS score of 4 or 5 were combined into one category, and parents with an LOS score of 1 or 2 were combined into one category).

Multivariable linear regression models were used to examine adjusted associations between youth, parent, and youth × parent AOS or LOS scores and cardiometabolic markers. For models with a significant interaction term, a joint *F*-test for youth, parent, and youth × parent scores combined determined whether there was an overall effect of acculturation. If the interaction term was not significant, models were rerun with the term removed to determine the association between acculturation and each cardiometabolic marker.

Covariates in adjusted models included youth and parent's age group, sex, nativity, and Hispanic/Latino background; household income; parent's educational attainment; and field center (i.e., Bronx, Chicago, Miami, San Diego). Acculturative stress (two variables: parent and youth), family functioning and closeness, and responsiveness and demandingness were added as covariates in separate exploratory analyses given they may be associated with the acculturation gap or the cardiometabolic markers. Sensitivity analyses were similarly conducted with adjustment for youth Healthy Eating Index-2010 (HEI-2010) score [42, 43] and total counts per minute the accelerometer was worn on adherent days (details on these measures are provided elsewhere [25, 44]). Effect modification by youth's age group and sex was additionally explored.

All analyses were adjusted for multiple testing using the Holm method, a more powerful correction than the commonly used Bonferroni adjustment [45–47]. An adjusted $p < .05$ was used for all analyses [48, 49]. All regression analyses and descriptive statistics accounted for stratification and for clustering by primary sampling units and were weighted to adjust for sampling probability of selection and nonresponse with the use of complex survey procedures. Analyses were conducted for each imputation separately and combined using a multiple imputation analysis procedure in SAS software version 9.4 (SAS Institute).

A multiple regression power analysis was conducted using the *pwr* package in R [50]. A minimum sample size of 1,138 individuals was determined to be needed to have 80% power to detect a small effect size (f^2 = 0.02, Cohen's standard small effect size for regression power analysis [51]). This power analysis assumed α = 0.0045 (0.05/11, multiple testing correction), $df_{\text{numerator}}$ = 3 (the number of variables of interest: youth, parent, and youth × parent score), a design effect of 1.25 [24], and 25 covariates (including dummy variables). Given the sample size of n = 1,466, we were sufficiently powered for the main analyses.

Results

A description of the demographic characteristics of the youth and parents in the SOL Youth target population is provided in **Table 1**. Approximately half of the sample was male (51.2%) and 12–16 years of age (56.7%). The most frequently reported Hispanic/Latino background was Mexican (46.4% of youth and 49.4% of parents) and most youth were from low socioeconomic status households (51.2% of parents with household income ≤$20,000). Youth were predominately born in the USA (78.0%) and preferred to complete the questionnaires in English (79.5%), while the majority of parents were born outside the USA (84.4%) and preferred to complete the questionnaires in Spanish (78.1%). Youth reported using the English language more than their parents (average AOS scores of 4.4 vs. 2.7, respectively) and the Spanish language less than their parents (average LOS scores of 3.1 vs. 4.2, respectively). Examination of concordance between youth and parent AOS and LOS scores using Cicchetti–Allison weighted kappa [52] indicated large differences in the degree of youth and parent English and Spanish language use (kappa = 0.04 and 0.10, respectively).

Unadjusted correlations between all exposures, outcomes, and potential mediators are provided in Supplementary Tables 1 and 2. **Fig. 1** shows the LOESS curves for the unadjusted association between youth AOS score and youth BMI percentile according to parent AOS category. When parent English language use was low (AOS = 1), greater youth English language use was associated with a higher youth BMI percentile. Conversely, when parent English language use was high (AOS = 5), greater youth English language use was associated with a lower youth BMI percentile. LOESS curves for the remaining cardiometabolic markers (using the AOS or LOS subscale) did not suggest presence of effect modification (data not shown).

Table 2 shows the adjusted associations of the individual youth and parent AOS scores and their interaction (i.e., the acculturation gap) with each cardiometabolic marker. Parent and youth AOS scores were significantly associated with youth BMI percentile (overall F-test: adjusted p = .02), with the association between youth AOS score and BMI percentile depending on the parent AOS score (interaction term adjusted p < .01). As depicted in Fig. 1, greater discordance in scores (e.g., parent AOS = 4 or 5 and youth AOS = 2; parent AOS = 1 and youth AOS = 5) was associated with a higher youth BMI percentile. The AOS acculturation gap was not significantly associated with other cardiometabolic markers. Removal of the interaction term did not indicate an association between youth or parent AOS score and any cardiometabolic marker.

Table 3 shows the adjusted association of the individual youth and parent LOS scores and their interaction with each cardiometabolic marker. The LOS acculturation gap was not associated with any cardiometabolic health measure. Removal of the interaction term indicated no association between either youth or parent LOS score and any cardiometabolic marker.

Adjustment for acculturative stress, family functioning, family closeness, and responsiveness and demandingness in exploratory analyses did not alter the effect estimates or their statistical significance. Sensitivity analyses with adjustment for youth's Healthy Eating Index-2010 (HEI-2010) score and total counts per minute of accelerometer wear also did not alter these findings. Additional exploratory analyses indicated youth's age group and sex did not modify any of the observed associations (data not shown).

Discussion

This is the first study to investigate the association of the parent–child acculturation gap with youth cardiometabolic health markers in Hispanic/Latino youth. In the target population of Hispanic/Latino youth and their parents living in four distinct U.S. cities, we found that associations between the AOS and LOS acculturation gaps and youth cardiometabolic health markers were largely null with one exception. Notably, greater discordance between parent and youth AOS scores (i.e., differences in their English language use) was associated with higher youth BMI percentile only. Although this study was sufficiently powered to detect an association between the acculturation gap and cardiometabolic health markers, there is a need for future research to replicate this finding given its novelty.

We hypothesized that parent–child dyads with discordant language acculturation statuses would have less optimal cardiometabolic health due to the parent–child acculturation gap (i.e., the language discordance)

Table 1. Characteristics of the target population of SOL Youth

	Youth	Parent		
	(n = 1,466)	Overall (n = 1,020)	AOS < 2.5* (n = 487)	AOS ≥ 2.5* (n = 525)
Sex (n and %)				
Female	738 (48.8)	877 (88.2)	437 (91.5)	436 (85.8)
Male	728 (51.2)	141 (11.8)	49 (8.5)	89 (14.2)
Missing	–	*2*	*1*	–
Youth (parent) age, years (n and %)				
8–≤11 (24–≤40)	631 (43.3)	649 (57.3)	162 (40.0)	206 (45.3)
12–16 (40–75)	793 (56.7)	370 (42.7)	325 (60.0)	319 (54.7)
Missing	–	*1*	–	–
Annual household income (n and %)				
≤$20,000	–	516 (51.2)	278 (59.7)	235 (44.3)
$20,000–$40,000	–	324 (32.1)	156 (33.9)	165 (30.0)
>$40,000	–	148 (16.7)	34 (6.4)	113 (25.6)
Missing	–	*32*	*19*	*12*
Parent's educational attainment (n and %)				
Less than high school	–	378 (37.6)	242 (50.4)	135 (26.8)
High school graduate/equivalent	–	279 (27.7)	139 (29.6)	137 (25.7)
More than high school	–	361 (34.8)	106 (20.0)	252 (47.5)
Missing	–	*2*	–	*1*
Nativity (n and %)				
Foreign born	326 (22.0)	872 (84.4)	479 (98.2)	387 (72.4)
USA born	1128 (78.0)	144 (15.6)	7 (1.8)	136 (27.6)
Missing	*12*	*4*	*1*	*2*
Language preference (n and %)				
Spanish	287 (20.5)	813 (78.1)	480 (98.6)	327 (60.1)
English	1175 (79.5)	204 (21.9)	6 (1.4)	197 (39.9)
Missing	*4*	*3*	*1*	*1*
Hispanic/Latino background (n and %)				
Dominican	167 (12.8)	128 (14.8)	58 (14.6)	69 (15.2)
Central American	112 (6.0)	103 (8.4)	65 (11.2)	36 (5.6)
Cuban	103 (5.4)	85 (6.5)	47 (6.4)	38 (6.6)
Mexican	648 (46.4)	483 (49.4)	250 (53.9)	229 (45.3)
Puerto Rican	128 (9.5)	119 (12.3)	16 (4.3)	103 (19.5)
South American	68 (4.0)	71 (5.7)	47 (9.0)	24 (3.0)
Other/Unknown/>1	240 (16.0)	31 (2.8)	4 (0.7)	26 (4.8)
Brief ARSMA-II (mean and SE)				
Anglo Orientation Scale	4.4 (0.03)	2.7 (0.1)	1.81 (0.02)	3.53 (0.04)
Latino Orientation Scale	3.1 (0.04)	4.2 (0.04)	4.62 (0.02)	3.83 (0.06)
Missing	*2*	*8*	–	–

ARSMA-II, Brief Acculturation Rating Scale for Mexican Americans II.

All statistics are weighted with the sampling weights.

*Eight parents were missing AOS scores, making stratified analyses total to n = 1,012 instead of 1,020.

promoting increased disagreement, tension, or problems of communication and distress between the parent and child [14]. This parent–child acculturation gap has been associated with intergenerational conflict, elevated stress, and anxiety in Hispanic/Latino youth [53, 54]. We suspected that some of these indicators would be captured as part of the acculturative stress index used in SOL Youth [15], which has been associated with increased depression/anxiety symptoms and smoking susceptibility in SOL Youth [55]. However, adjustment for acculturative stress and other measures of family conflict and closeness that were also associated with adverse health in SOL Youth [55] did not alter our findings. This is likely due to the lack of association between these measures and BMI percentile, as shown by the unadjusted correlations in Supplementary Tables 1 and 2. This suggests that other unmeasured variables may explain the association.

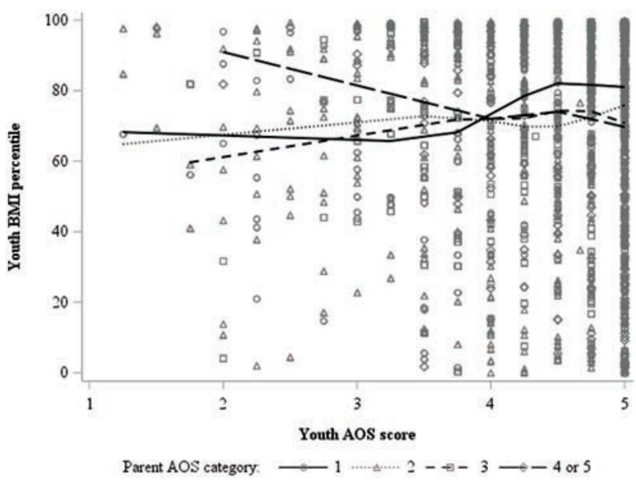

Fig. 1. Unadjusted association between youth AOS score and youth BMI percentile in SOL Youth, stratified by parent AOS score. *Note*. AOS, Anglo Orientation Scale. 1, low English use and 5, high English use.

The Brief ARSMA-II primarily assessed acculturation related to language use and preference, but there was no measure in SOL Youth that assessed English language fluency. Lack of a common language between parents and children leads to decreased effective communication, which is essential for youth's growth and development [17]. Inability to communicate within a family can also promote types of stress that were not captured by the acculturative stress measure in SOL Youth, including chronic stress.

In a previous qualitative study of Hispanic/Latino youth, adolescents reported that when they have greater English language fluency than their parents, they feel overwhelmed by the burden to serve as translators and experience family stress and conflict due to their parents' mistrusting them when they are speaking English in front of them, particularly when they are around peers [56]. Nearly half of the SOL Youth sample (44.4%) was characterized by this type of pairing (i.e., youth AOS score ~4 or 5 and parent AOS score ~1 or 2), and thus it is possible that many of the youth were experiencing a combination of these stressors. These factors can lead to chronic stress (not assessed in SOL Youth), which increases the risk for poor mental health in adolescents (e.g., depression) [57]. Given that existing literature has shown a link between the parent–child acculturation gap and depression [58, 59], and the established relationship between depression and increased risk for obesity [60], future longitudinal research should consider depression, as well as chronic stress and English language fluency, as

Table 2. Beta (95% CI) for associations between youth and parent AOS scores and youth cardiometabolic risk factors in SOL Youth (n = 1,466)

	Youth	Parent	Interaction term
BMI percentile	11.66 (5.35, 17.98)**	17.76 (6.46, 29.05)*	−4.49 (−7.05, −1.93)**
HbA1c	0.02 (−0.01, 0.04)	−0.01 (−0.04, 0.01)	–
Fasting glucose	0.56 (−0.05, 1.18)	−0.02 (−0.57, 0.53)	–
HOMA-IR	0.10 (−0.11, 0.31)	0.00 (−0.18, 0.19)	–
Total cholesterol	0.39 (−2.11, 2.89)	0.91 (−1.62, 3.44)	–
LDL-C	−0.01 (−2.03, 2.02)	0.55 (−1.44, 2.54)	–
HDL-C	−0.14 (−1.23, 0.96)	0.94 (−0.01, 1.90)	–
Triglycerides	0.60 (−3.31, 4.52)	−1.05 (−4.78, 2.69)	–
SBP percentile	1.48 (−1.38, 4.33)	−2.47 (−4.73, −0.21)	–
DBP percentile	0.81 (−1.39, 3.01)	−1.19 (−3.05, 0.67)	–
hsCRP	0.15 (0.03, 0.26)	−0.02 (−0.18, 0.14)	–

AOS, Anglo Orientation Scale; BMI, body mass index; HbA1c, hemoglobin A1c; HOMA-IR, Homeostatic Model Assessment of Insulin Resistance; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; hsCRP, high sensitivity C-reactive protein.

All models adjusted for youth's age, parent's age, youth's sex, parent's sex, household income, youth's Hispanic/Latino background, parent's Hispanic/Latino background, field center, parent's educational attainment, youth's nativity, and parent's nativity.

*Adjusted $p < .05$,

**Adjusted $p < .01$.

Table 3. Beta (95% CI) for associations between youth and parent LOS scores and youth cardiometabolic risk factors in SOL Youth (n = 1,466)

	Youth	Parent	Interaction term
BMI percentile	1.34 (−0.61, 3.30)	−0.43 (−3.08, 2.23)	–
HbA1c	0.00 (−0.02, 0.02)	−0.03 (−0.06, 0.00)	–
Fasting glucose	−0.09 (−0.57, 0.38)	−0.09 (−0.85, 0.66)	–
HOMA-IR	0.00 (−0.15, 0.15)	−0.10 (−0.31, 0.11)	–
Total cholesterol	−0.77 (−2.63, 1.09)	−2.87 (−5.52, −0.21)	–
LDL-C	−1.05 (−2.71, 0.60)	−1.65 (−3.85, 0.55)	–
HDL-C	0.20 (−0.52, 0.92)	−0.93 (−1.96, 0.11)	–
Triglycerides	−2.00 (−4.88, 0.88)	−1.74 (−5.71, 2.23)	–
SBP percentile	0.62 (−1.43, 2.67)	1.04 (−1.72, 3.81)	–
DBP percentile	0.42 (−1.46, 2.29)	0.81 (−1.36, 2.98)	–
hsCRP	0.06 (−0.05, 0.17)	0.00 (−0.16, 0.15)	–

LOS, Latino Orientation Scale; BMI, body mass index; HbA1c, hemoglobin A1c; HOMA-IR, Homeostatic Model Assessment of Insulin Resistance; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; hsCRP, high sensitivity C-reactive protein.

All models adjusted for youth's age, parent's age, youth's sex, parent's sex, household income, youth's Hispanic/Latino background, parent's Hispanic/Latino background, field center, parent's educational attainment, youth's nativity, and parent's nativity.

potential mediators. Additionally, while youth who were *less* English language dominant than their parent also had a high BMI percentile in the present study, only two parent–child dyads met this criterion (i.e., youth AOS score ~1 or 2 and parent AOS score ~4 or 5). Thus, this association should be interpreted with caution and future research should aim to examine more parent–child dyads with this type of AOS acculturation gap to replicate our findings.

Previous work has suggested that diet may explain the association between the parent–child acculturation gap and BMI percentile. In a previous study by Soto et al. [61], the authors examined how parent-child acculturation gaps (assessed using the Bidimensional Acculturation Scale for Hispanics [62], another primarily language-based acculturation measure) were associated with maternal dietary intake in Mexican American mother-child (7- to 13-year-olds) dyads. They found that mothers who were traditional (e.g., low AOS/high LOS) had greater intake of sugary beverages, calories from fat, and away-from-home foods the more assimilated their children were (e.g., higher AOS/lower LOS) [61].

Because Soto et al. examined maternal instead of child health behaviors and assessed AOS and LOS scores in combination instead of separately, it is difficult to compare their results to the present study. Nevertheless, if one focuses on the AOS scores specifically, their findings are similar to the present study's in that parents with low AOS scores in combination with children having high AOS scores was associated with increased youth BMI percentile (which could have resulted from poor diet quality [63]). It should be noted though, that because Soto et al. assessed AOS and LOS scores in combination, their findings would also seem to suggest a potential link between the LOS acculturation gap and youth BMI percentile. It is possible that this association was not detected in the present study due to unmeasured interaction effects of AOS and LOS scores or due to differential effects of the parent–child acculturation gap on parent versus youth health outcomes.

In the present study, we explored adjusting for diet (measured as overall diet quality), and physical activity (measured as average activity per day); however, neither variable significantly altered the effect estimates in our sensitivity analyses. It may be that other diet and physical activity measures, such as consumption of away-from-home-foods or sedentary time, better explain the observed association between the AOS acculturation gap and BMI percentile. Away-from-home foods is of particular interest given that (a) they were associated with the acculturation gap in Soto et al. [61], (b) they are generally higher in calories, fat, and sugar and lower in nutrients than foods consumed at home [64], and (c) communication barriers between parents and children may encourage youth to eat more meals or snacks out rather than having dinner with the family [17]. Examining these specific diet and physical activity factors as potential mediators was beyond the scope of this paper but should be considered as part of future longitudinal research.

It is surprising that the AOS acculturation gap was associated with BMI percentile but no other cardiometabolic health markers. As such, there is a need to interpret this result with caution and future studies should aim to replicate this finding. No previous studies, in Hispanic/Latino or other cultures, have examined the association between language acculturation gaps and cardiometabolic health measures. However, one potential explanation for the AOS acculturation gap only being associated with BMI percentile is that having a high BMI percentile is a proximal risk factor for elevations in the other cardiometabolic markers [65, 66]. In other words, it is possible that an association between the acculturation gap and the other cardiometabolic health markers would not emerge until later in life. This is supported by existing prospective cohort studies that link childhood obesity to the development of adulthood type 2 diabetes and cardiovascular disease [65]. Given that SOL Youth is a cross-sectional study, future prospective cohort studies are needed to examine this explanation.

This study also did not detect an association between the individual youth or parent acculturation measures and any of the cardiometabolic health measures. This is consistent with the one previous study to examine associations between acculturation and cardiometabolic risk in Hispanic/Latino youth which reported no association between youth social acculturation and any diabetes-related measures, including insulin sensitivity, acute insulin response, disposition index, and HOMA-IR [67]. However, future studies are needed to confirm these null findings, especially given acculturation has generally been associated with maladaptive health behaviors, such as higher fast food intake and lower fruit and vegetable intake [68, 69], which promote decreased cardiometabolic health [70]. Again, it is possible that examining this research question in a prospective cohort study which extends into young adulthood may indicate an association between acculturation and cardiometabolic measures that could not be detected here.

Strengths and Limitations

This study has a number of strengths. Notably, we used a large, representative sample of Hispanic/Latino youth living in multiple geographic areas and across pre-adolescence and adolescence to examine associations between acculturation and cardiometabolic health markers. The collection of both parent- and youth-reported acculturation allowed us to examine associations between acculturation and cardiometabolic health that had not previously been researched. Further, our findings add to the literature to suggest that previously reported inconsistencies in the association between parent and youth acculturation and Hispanic/Latino youth BMI [71] may be due to the inability to account for the influence of the parent–child acculturation gap.

However, our study is not without limitations. SOL Youth is cross-sectional, and thus additional longitudinal research is needed to determine temporality of the reported associations. Longitudinal data would also be beneficial to determine potential mediators of the observed association between the AOS acculturation gap and BMI percentile [72]. Although the communities enrolled in SOL Youth were among the U.S. metropolitan areas with the largest concentration of Hispanics/Latinos [73], the sample is not representative of the overall Hispanic/Latino youth population in the USA. Additionally, while the Brief ARSMA-II is a non-linear measure of acculturation, it does not capture other types of acculturation (e.g., social acculturation) that may be important to cardiometabolic health. Future studies should examine whether parent–child differences in social acculturation, for example, are more strongly associated with youth cardiometabolic health.

Conclusions

In this examination of parent–child dyads of 8- to 16-year-old Hispanic/Latino youth, we found that discrepancies in English language use in parent-child dyads were associated with increased youth BMI percentile. Future longitudinal research should examine whether English language fluency, additional measures of parent–child dynamics and stress not captured in this study, and specific aspects of diet and physical activity are potential mediators of the association between the parent–child acculturation gap and risk for obesity. This research contributes to the development of public health messages that may promote cardiometabolic health in Hispanic/Latino immigrant families.

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Compliance with Ethical Standards

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards: The authors declare that they have no conflict of interest

Authors' Contributions: K.P.P., G.X.A., M.R.C., A.M.D., and C.R.I. contributed to data collection. All authors provided input on the study design. G.S.M. conducted preliminary data analyses, which were verified and modified by M.N.L. M.N.L. is the primary author responsible for the literature search, data analysis and interpretation, tables/figures generation, and manuscript writing. C.R.I. is the senior author and oversaw all aspects of study design, data analysis and interpretation, and writing. All authors were involved in writing the paper and had final approval of the submitted and published versions.

Ethical Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Written informed consent and assent were obtained from the parent and youth, respectively.

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