

Physical Activity Participation by Parental Language Use in 4th, 8th, and 11th Grade Students in Texas, USA

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Abstract Research on physical activity (PA) by level of acculturation in Hispanic children is limited and findings have been mixed. We examined PA participation by primary language used with parents in a representative sample of 4th, 8th, and 11th grade Texas public school students. Mixed-effects regression models were conducted using cross-sectional data from the 2004–2005 School Physical Activity and Nutrition Study ($n = 22,049$). Self-reported PA was compared among three language-ethnic groups: Spanish-Hispanic (SH) (referent); English-Hispanic (EH); and English-Other (EO). EH and/or EO girls were generally

between 1.25 and 2.58 [OR] times more likely to participate in PA across grade levels, with the largest differences found for school sports in 8th grade girls. EH and EO 8th grade boys were 1.71 (CI: 1.40, 2.10) and 2.06 (CI: 1.68, 2.51) times, respectively, more likely to participate in school sports. Findings indicate important disparities in Spanish-speaking Hispanic children's PA participation.

Keywords Children · Adolescents · Physical activity · Acculturation · Spanish language

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Introduction

Childhood obesity in the United States has more than doubled since the 1970s [1], with recent estimates indicating that 16.3% of U.S. children and adolescents are obese¹ [2]. In Texas, obesity has reached unprecedented proportion in certain ethnic minority groups. Statewide prevalence estimates indicate that 30% or more of Hispanic boys and over 20% of Hispanic girls are overweight [3].

Dietary behaviors and physical activity are two key determinants of obesity [4] that may vary by level of acculturation in Hispanic populations in the United States. Less acculturated Hispanic adults, often defined by non-US birthplace, have been reported to consume generally healthier dietary intake compared to US-born Hispanics [5–9]. This pattern is also seen in adolescents, in which foreign-born Hispanics report healthier dietary patterns than US-born Hispanic [10] and White [11] adolescents.

The association between physical activity and acculturation level in Hispanic children and adolescents is less

¹ At or above the 95th percentile of the 2000 sex-specific Centers for Disease Control and Prevention BMI-for-age growth charts.

understood. Although some research on acculturation and physical activity in Hispanic adults indicates that less acculturated Hispanics engage in lower levels of leisure-time physical activity (PA) [12–18], a study based on data from the National Health Interview Survey found physical activity by acculturation status to vary by gender, with lower leisure-time PA found for less acculturated Hispanic women but no differences found among Hispanic men [19]. In children and adolescents, findings on physical activity are mixed, with some research indicating lower levels of sports participation and higher levels of inactivity in immigrant Hispanic children with foreign-born parents [20]; similar levels of physical activity of foreign-born or less acculturated Hispanic adolescents compared to US-born Hispanic adolescents [10], White adolescents [11] and more acculturated Hispanic adolescents [21]; and higher levels of physical activity among less acculturated Hispanic adolescents [22].

The variation in acculturation measures may be one explanation for inconsistency in findings in PA in Hispanic adolescents. Time in the United States, language use preference or ability, culture, and residence are common measures of acculturation [23] that may hold different associations with outcome variables of interest [23, 24]. These differences may result from the different phenomena that the measure is assessing. For example, primary language spoken at home may serve not only as a measure of culture, but also as a measure of other social phenomena that influence health behavior, such as communication, discrimination, or economic deprivation. As foreign-born Hispanic families in the United States have been found to have lower family income and maternal education, live in areas of higher immigrant density, and experience greater linguistic isolation [10], parents' Spanish language usage may represent an important marker for lower opportunities for children's engagement in PA.

Primary language spoken at home has been associated with healthier diets among adolescents of Spanish-speaking parents [25], yet research is limited on how language use may relate to child and adolescent engagement in physical activity. This study examined the likelihood of participation in PA behaviors by primary language used with parents in a representative sample of Hispanic and non-Hispanic 4th (mean age: 9.7 years), 8th (13.7 years), and 11th (16.7 years) grade public school students in Texas.

Methods

A secondary analysis was conducted on cross-sectional data from the 2004–2005 School Physical Activity and Nutrition (SPAN) study, a statewide survey that assessed the prevalence of child and adolescent overweight, diet and

physical activity behaviors of school-aged children in Texas [3]. SPAN is based on a multistage sampling plan that was designed to provide state representative data when stratified by ethnicity (African American, Hispanic and White/Other), gender, school grade (4th, 8th, and 11th), and by Texas Health Service Region [3]. Approval for the original study upon which these data are based was obtained from the Committee for the Protection of Human Subjects at the University of Texas Health Science Center at Houston and the Texas Department of State Health Services Institutional Review Board. Participating school districts also reviewed study protocols for compliance with school district human subjects and research regulations. Further description of SPAN study and methods is presented elsewhere [3].

Participants

The SPAN study surveyed three grade levels of public school students—4th, 8th, and 11th grades ($n = 23,190$)—with the aim of including distinct developmental stages of children in elementary, middle, and high school. Data obtained from the Texas Education Agency (TEA) for public school enrollment during the 2003–2004 school year were used as the reference base for the sampling plan.

Measures

Students completed a self-administered questionnaire (“School Physical Activity and Nutrition Project” [SPAN] survey) that was tailored to 4th and 8th/11th grade students. The SPAN questionnaires are based on the School-Based Nutrition Monitoring (SBNM) elementary-level and secondary-level surveillance instruments, which were designed to assess nutrition and physical activity behaviors and nutrition knowledge and attitudes [26, 27]. Questionnaires and protocols for SPAN were developed, pilot tested, and assessed for reproducibility as part of the SBNM project [26, 27].

For this study, we examined three indicator variables of physical activity: participation in vigorous physical activity on ≥ 3 of past 7 days; having played on ≥ 1 sports team during past 12 months; and current participation in *other structured PA* such as physical activity-related lessons (e.g., gymnastics). For 8th and 11th grade students, we also assessed past year participation on ≥ 1 sports team run by school and run by organizations outside of school. Lastly, as an indicator of sedentary behavior, we assessed television (TV)/video movie watching on ≥ 3 h per day. The cut points for the vigorous physical activity variable were based on previous recommendations of physical activity,

which were current at the time of the survey and have been used in reporting on national youth health behavior [28]; for TV/video movie watching, cut points were informed by the American Academy of Pediatrics recommendation of no more than 1–2 h of entertainment media programming per day [29]. The survey items upon which these variables are based were found to have an acceptable to good level of reproducibility, with Kappa statistics ranging from 0.51 to 0.82 [26, 27]. Table 1 presents the items, response options and Kappa statistics for the original questions.

A language-ethnic group variable (the independent variable) was created from an item that asked respondents to indicate the language most used with parents and crossed with respondents' self-identification of ethnicity. Language use options included English, Spanish, Vietnamese, Chinese, and Other. For this study, we limited the analyses to students who spoke English with parents and students who

spoke Spanish with parents. Students self-described their ethnicity from a list of seven ethnic group response options, which included the option “Mexican-American, Latino or Hispanic.” The language-ethnic group variable resulted in three groups: Hispanic students who speak Spanish with parents; Hispanic students who speak English with parents; and all other ethnic groups who speak English with parents.

An important critique of acculturation research has been the inattention to the potential confounding role of socio-economic status [30]. As such, we attempted to control for the role of socio-economic status in exploring the association between language use and physical activity participation by adjusting for the *percent school composition of economically disadvantaged students* (“*percent economically disadvantaged*”). This variable was created based on Texas Education Agency (TEA) data from 2004 to 2005, which classifies children based on eligibility criteria for

Table 1 Self-reported physical activity and sedentary behavior measures and their reproducibility for 4th, 8th, and 11th grade students from the school-based nutrition monitoring questionnaire

| 4th grade | Kappa ^{a,b} | 8th/11th grade | Kappa ^{b,c} |
|---|----------------------|---|----------------------|
| <i>Vigorous physical activity</i> | | <i>Vigorous physical activity</i> | |
| Yesterday, did you do any exercise that made your heart beat fast and made you breathe hard for at least 20 minutes? (For example: basketball, running or jogging, fast dancing, swimming laps, tennis, fast bicycling, or similar aerobic activities.) (Response options: “Yes”, “No”.) | 0.71 | On how many of the past 7 days did you exercise or take part in physical activity that made your heart beat fast and made you breathe hard for <i>at least 20 min</i> ? (For example: basketball, soccer, running or jogging, fast dancing, swimming laps, tennis, fast bicycling, or similar aerobic activities) (Response options: “0–7 days.”) | 0.77 |
| <i>Sports team participation</i> | | <i>Sports team participation</i> | |
| *During the past 12 months, on how many sports teams did you play? Sports teams include soccer, basketball, softball, swimming, gymnastics, cheerleading, wrestling, track, football, dance, tennis, and volleyball teams. (Response options: “0 teams” “one team” “two teams”, “three or more teams”.) | 0.51 | During the past 12 months, on how many sports teams <i>run by your school</i> did you play (do not include PE classes)? Sports teams include soccer, basketball, baseball, swimming, gymnastics, wrestling, track, football, tennis, and volleyball teams.(Response options: same as 4th grade) | 0.71 |
| | N/M | During the past 12 months, on how many sports teams run by organizations <i>outside of your school</i> (like the park district, summer leagues) did you play? Sports teams include soccer, basketball, baseball, swimming, gymnastics, wrestling, track, football, tennis, and volleyball teams. (Response options: same as above) | 0.60 |
| <i>Participation in other physical activity or lessons</i> | | <i>Participation in other physical activity or lessons</i> | |
| Do you currently take part in any other organized physical activities or take lessons, such as martial arts, dance, gymnastics, or tennis? (Response options: “Yes”, “No”) | N/M | Do you currently participate in any other organized physical activities or take lessons, such as martial arts, dance, gymnastics, or tennis? (Response options: “Yes”, “No”.) | N/M |
| <i>Watching television/video movies</i> | | <i>Watching television/video movies</i> | |
| Yesterday, how many hours did you watch TV or video movies away from school? (Responses options: “I didn’t watch TV yesterday”, “1–6 hours or more”.) | 0.82 | How many hours <i>per day</i> do you <i>usually</i> watch TV or video movies away from school? (Response options: “I don’t watch TV or video movies”, “1–6 h or more”) | 0.51 |

School Physical Activity and Nutrition Study (SPAN)—Texas, 2004–2005

N/M Data or item not measured

^a Penkilo et al. [27]

^b Kappa statistics based on a test-retest administration of questionnaire on the same day of the survey, with a time interval of two or more hours

^c Hoelscher et al. [27]

*Sports team participation stratified by school or organization outside of school not measured in 4th grade survey

free meals under the National School Lunch and Child Nutrition Program as well as other criteria such as annual income [31]. Economic disadvantage scores for each individual school were assigned to all students from a given school.

Analysis

All analyses were conducted using the statistical software package Stata (version 9, College Station, Texas). Physical activity and sedentary behavior point prevalence estimates and confidence intervals stratified by gender were computed by grade level and language-ethnic group (Spanish-Hispanic, English-Hispanic, and English-Other), adjusting for age and percent economically disadvantaged and taking into account the nesting of students within schools. Mixed-effects regression models were run to assess the association between the physical activity and sedentary behavior outcomes by language-ethnic group, with Spanish-Hispanic students designated as the referent in order to make direct

comparisons on participation in the physical activity behaviors with the English-Hispanic and English-Other students. Mixed-effects regression models are appropriate for this study's design as they account for the variability in the dependent variable between schools, maintaining the nominal Type 1 error rate [32]. In carrying out the mixed-effects regression analyses, school was specified as a random effect, with language-ethnic group specified as a fixed effect and age and percent economically disadvantaged included as covariates. All outcome behaviors were dichotomized (yes/no) for the analyses based on the descriptions provided in the measures section. Differences were considered statistically significant if $P < .05$.

Results

Based on this study's English or Spanish language use selection criteria, 1,141 students were dropped from the original SPAN 2004-05 sample, resulting in a total sample of 22,049 students (Table 2). Across grade levels,

Table 2 Demographic characteristics of 4th, 8th, and 11th grade students who speak English or Spanish with parents^a

| | 4th Grade | | | 8th Grade | | | 11th Grade | | |
|--|---------------------------|--------------------------|---------------------------|---------------------------|--------------------------|---------------------------|---------------------------|--------------------------|---------------------------|
| | Girls <i>n</i> = 3,678 | Boys <i>n</i> = 3,709 | Total <i>n</i> = 7,387 | Girls <i>n</i> = 4,291 | Boys <i>n</i> = 4,148 | Total <i>n</i> = 8,439 | Girls <i>n</i> = 3,142 | Boys <i>n</i> = 3,081 | Total <i>n</i> = 6,223 |
| Age in years (mean, SD) | 9.7 (.58) | 9.8 (.62) | 9.8 (.60) | 13.7 (.60) | 13.8 (.60) | 13.7 (.62) | 16.7 (.55) | 16.7 (.56) | 16.7 (.56) |
| <i>Ethnicity (%)</i> | | | | | | | | | |
| African American | 10.6 | 11.8 | 11.2 | 11.7 | 10.5 | 11.1 | 13.5 | 10.9 | 12.2 |
| Hispanic | 48.6 | 42.7 | 45.6 | 48.9 | 45.5 | 47.2 | 37.9 | 37.1 | 37.5 |
| White | 30.0 | 32.7 | 31.4 | 34.3 | 38.1 | 36.2 | 44.5 | 47.2 | 45.8 |
| Other ^b | 10.8 | 12.8 | 11.8 | 5.1 | 5.9 | 5.5 | 4.1 | 4.8 | 4.5 |
| <i>Language-ethnic group^c (%)</i> | | | | | | | | | |
| Spanish-Hispanic | 22.5 | 20.8 | 21.6 | 22.8 | 22.0 | 22.4 | 15.8 | 16.0 | 15.9 |
| English-Hispanic | 26.1 | 21.9 | 24.0 | 26.0 | 23.5 | 24.8 | 22.2 | 21.1 | 21.6 |
| English-Other | 51.4 | 57.3 | 54.4 | 51.1 | 54.5 | 52.8 | 62.1 | 62.9 | 62.5 |
| Mean percent school composition of economically disadvantaged ^d students (mean, SD) | N/A | N/A | 63.5 (.27) | N/A | N/A | 56.7 (.26) | N/A | N/A | 41.2 (.25) |

School Physical Activity and Nutrition (SPAN) Study—Texas, 2004–2005

Results based on unweighted analysis

SD Standard Deviation, N/A not applicable

^a Sample represents students who speak Spanish or English with parents. For fourth graders, 520 students from the original SPAN study were excluded based on these criteria; for 8th graders, 388 students were excluded; for 11th graders, 233 students were excluded based on language criteria

^b “Other” includes the following ethnicities: American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and Other

^c Variable created from an item that asked respondents to indicate the language most used with parents and crossed with respondents' self-identification of ethnicity

^d Economic disadvantage data obtained from Texas Education Agency and represents percentage of students in a school that are classified as economically disadvantaged

A school's economic disadvantage score was assigned to all students from a specific school. The mean % represents the average percent score of economic disadvantage for this sample

approximately half the students were girls. Hispanic students comprised the largest ethnic group composition in 4th (45.6%) and 8th (47.2%) grades and the second largest composition in 11th grade (37.5%) (Table 2).

Figures 1 and 2 present the percentage of girls and boys who reported participating in physical activity behaviors and TV watching by language-ethnic group and grade level, adjusting for age and economic disadvantage. With the exception of vigorous physical activity in 4th grade girls which showed similar physical activity levels across language-ethnic groups, Spanish-Hispanic (SH) girls tended to report the lowest engagement in the three physical activity indicators followed by English-Hispanic (EH) and English-Other (EO) girls, a pattern that persisted across grade levels (Fig. 1). The largest difference in physical activity engagement was found in 8th grade girls' sports team participation, with 55.3% (95% CI: 49.0, 61.5) of Spanish-Hispanic girls reporting sports team participation at or outside of school compared to 74.5% (CI: 69.9, 78.6) of English-Other girls. In exploring differences by 8th grade girls' sports team participation run by school or

organization outside of school, the largest prevalence differences were observed for sports team participation run by school, with a 23.3% prevalence difference between Spanish-Hispanic students (39.1%, CI: 33.2, 45.4) and English-Other students (62.4%, CI: 57.0, 67.6). Spanish-Hispanic girls reported higher levels of TV/video movie watching in 4th and 8th grade compared to their English-Hispanic and English-Other counterparts; in 11th grade, prevalence of TV watching was similar across language-ethnic groups (Fig. 1).

Fewer differences in physical activity patterns were observed for boys (Fig. 2). Prevalence of boys' engagement in vigorous physical activity was generally similar by language-ethnic group classifications across grade levels, as was participation in other physical activity/lessons for 4th and 8th grade boys and sports team participation for 4th and 11th grade boys. The largest differences were observed in 8th grade boys' sports team participation at school, with only 55.2% (CI: 49.5, 60.8) of Spanish-Hispanic boys compared to 67.9% (CI: 62.9, 72.5) of English-Hispanic and 71.7% (CI: 67.8, 74.5) of English-Other boys. Few

Fig. 1 Prevalance of physical activity-related behaviors by language used at home among Hispanic and Non-Hispanic 4th, 8th, 11th grade girls in Texas. *School Physical Activity and Nutrition (SPAN) Study, 2004–2005.* **a** Vigorous physical activity; **b** Played on ≥ 1 sports team (run by school or outside organization outside); **c** played on ≥ 1 sports team (run by school); **d** played on ≥ 1 sports team (run by outside organization school); **e** Participated in other organization physical activity or took lessons; **f** watched television ≥ 3 h per day

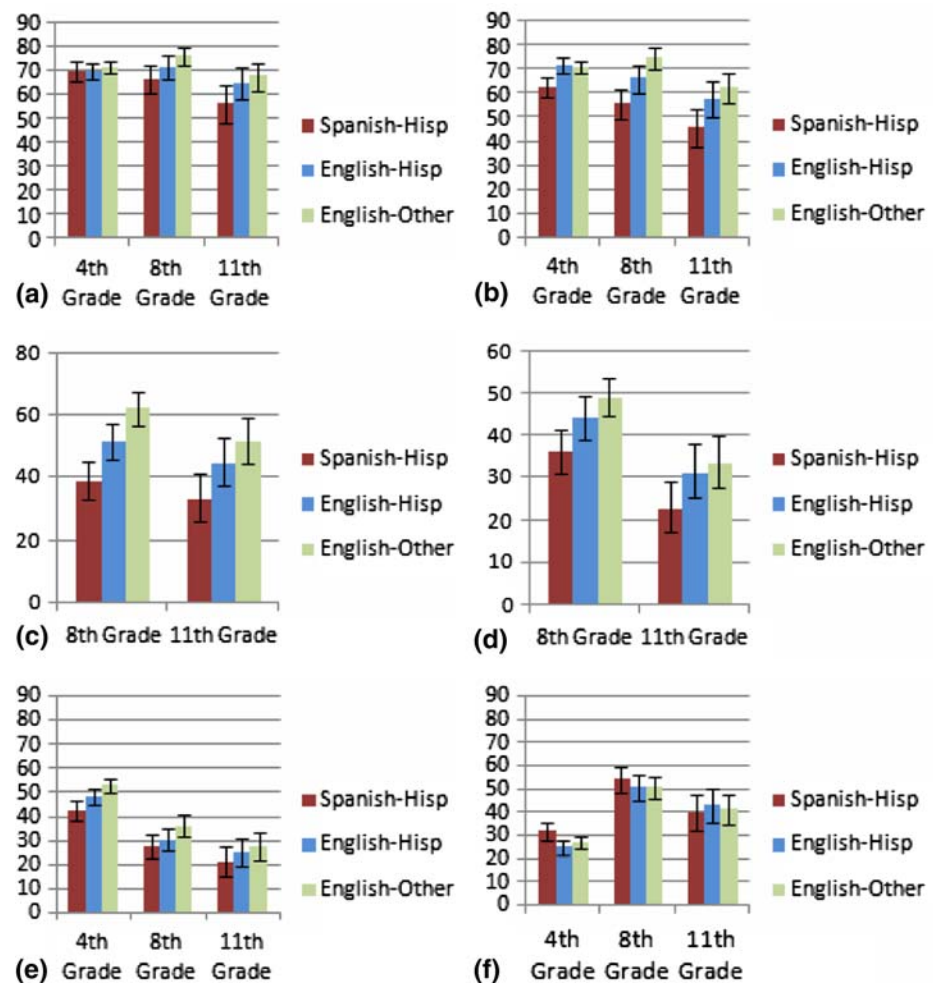
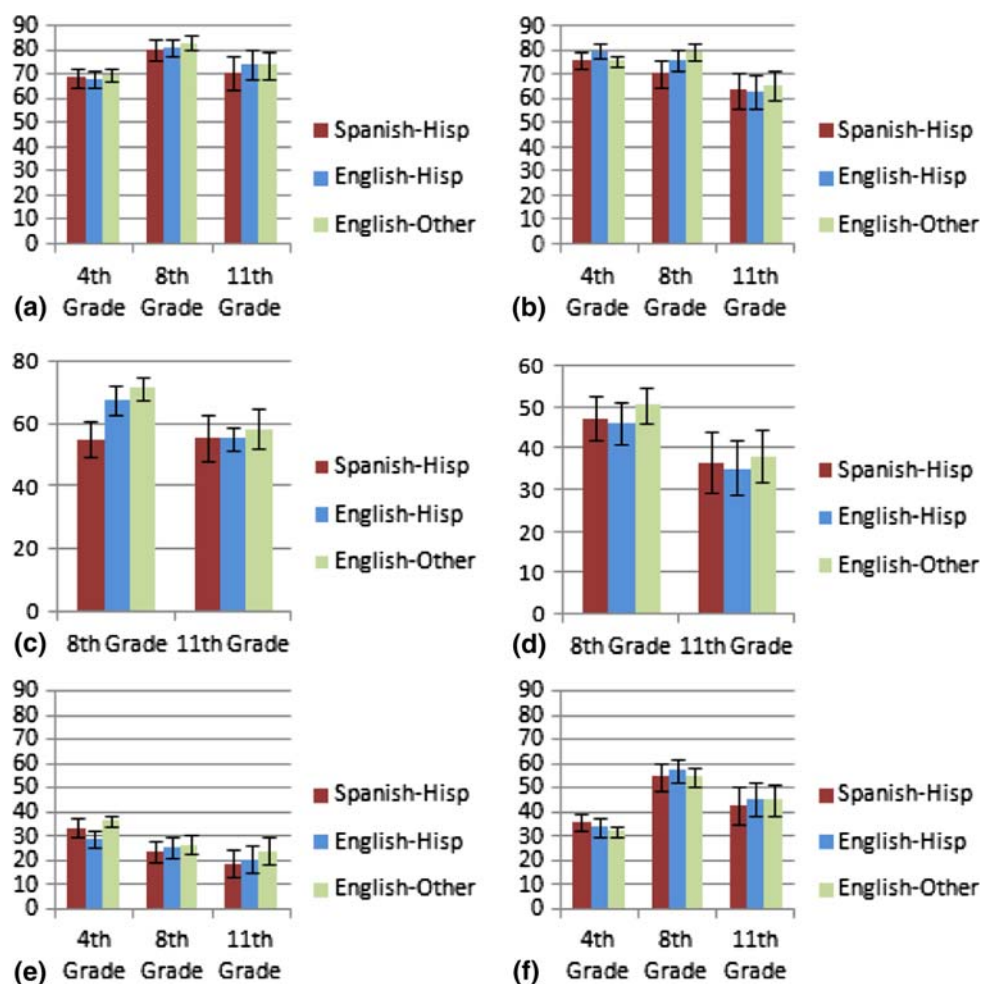


Fig. 2 Prevalance of physical activity-related behaviors by language used at home among Hispanic and Non-Hispanic 4th, 8th, 11th grade boys in Texas. *School Physical Activity and Nutrition (SPAN) Study, 2004–2005*. **a** Vigorous physical activity; **b** Played on ≥ 1 sports team (run by school or outside organization outside); **c** played on ≥ 1 sports team run by school; **d** played on ≥ 1 sports team (run by outside organization school; **e** Participated in other organization physical activity or took lessons; **f** watched television ≥ 3 h per day



prevalence differences were observed in 8th grade boys' sports team participation outside of school (SH: 47.4%, CI: 41.9, 52.8; EH: 46.1%, CI: 41.0, 51.3; EO: 50.6%, CI: 46.3, 54.9). Prevalence estimates were similar for TV watching in boys among the language-ethnic group classifications (Fig. 2).

Table 3 presents odds ratios from the mixed-effects regression model analyses adjusted for age and economic disadvantage. With the exception of vigorous physical activity in 4th grade girls, we found English-Hispanic and/or English-Other girls were between 1.25 and 2.58 times as likely to report engagement in the three physical activity indicators (*sports team participation, vigorous physical activity, and participation in other physical activity/lessons*) across grade levels. The largest differences were found for sports team participation at school in 8th grade girls, with English-Other girls and English-Hispanic girls 2.58 (CI: 2.10, 3.17) and 1.67 (CI: 1.36, 2.04) times, respectively, more likely to report participation in sports at school compared to Spanish-Hispanic girls. While fewer significant differences were found in physical activity indicators by language-ethnic group in boys, English-Other

and English-Hispanic 8th grade boys were 2.06 (CI: 1.68, 2.51) and 1.71 (CI: 1.40, 2.10) times, respectively, more likely to participate on ≥ 1 or more sports team at school in the past year (Table 3). No language-ethnic differences were found for boys' participation in sports team outside of school.

English-Other and English-Hispanic 4th grade girls were less likely to report TV watching for ≥ 3 h/day compared to Spanish-Hispanic girls (Adjusted Odds Ratio [AOR]: 0.80, CI: 0.65, 0.98; AOR: 0.73, CI: 0.59, 0.90, respectively) [data not shown in tables]. No significant language-ethnic TV watching differences were found in girls for 8th and 11th grades or for boys across the grade levels.

Discussion

This study assessed physical activity behaviors in three language/ethnic groups: *Spanish-speaking Hispanic children, English-speaking Hispanic children, and English-speaking children* from other ethnic backgrounds. We

Table 3 Adjusted odds ratios for engagement in physical activity behaviors by language used at home in a representative sample of 4th, 8th, and 11th grade students in Texas

| | Vigorous PA 3 or more days per week | | Played on ≥ 1 sports teams (run by school or other org.) | | Played on ≥ 1 sports teams run by school | | Played on ≥ 1 sports teams run by organization outside school | | Participated in other PA or took lessons | |
|----------------------------|-------------------------------------|--------------------|--|--------------------------|--|--------------------------|---|--------------------|--|--------------------------|
| | Girls Exp(B) 95% CI | Boys Exp(B) 95% CI | Girls Exp(B) 95% CI | Boys Exp(B) 95% CI | Girls Exp(B) 95% CI | Boys Exp(B) 95% CI | Girls Exp(B) 95% CI | Boys Exp(B) 95% CI | Girls Exp(B) 95% CI | Boys Exp(B) 95% CI |
| <i>4th Grade</i> | | | | | | | | | | |
| Spanish-Hisp | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| English-Hisp | 1.01 (0.82, 1.25) | 0.96 (0.77, 1.21) | 1.52 (1.23, 1.88) | 1.24 (0.97, 1.58) | N/A | N/A | N/A | N/A | 1.25 (1.02, 1.52) | 0.81 (0.65, 1.02) |
| English-Other ^a | 1.08 (0.88, 1.34) | 1.04 (0.84, 1.28) | 1.46 (1.18, 1.80) | 1.00 (0.80, 1.24) | N/A | N/A | N/A | N/A | 1.50 (1.23, 1.83) | 1.12 (0.92, 1.38) |
| <i>8th Grade</i> | | | | | | | | | | |
| Spanish-Hisp | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| English-Hisp | 1.25 (1.03, 1.52) | 1.07 (0.84, 1.35) | 1.56 (1.28, 1.89) | 1.33 (1.08, 1.66) | 1.67 (1.36, 2.04) | 1.71 (1.40, 2.10) | 1.40 (1.15, 1.69) | 0.95 (0.78, 1.16) | 1.15 (0.94, 1.41) | 1.09 (0.87, 1.36) |
| English-Other ^a | 1.60 (1.30, 1.96) | 1.24 (0.98, 1.58) | 2.36 (1.93, 2.88) | 1.61 (1.29, 2.00) | 2.58 (2.10, 3.17) | 2.06 (1.68, 2.51) | 1.70 (1.40, 2.06) | 1.14 (0.94, 1.38) | 1.49 (1.22, 1.83) | 1.16 (0.93, 1.45) |
| <i>11th Grade</i> | | | | | | | | | | |
| Spanish-Hisp | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| English-Hisp | 1.42 (1.10, 1.83) | 1.20 (0.91, 1.58) | 1.60 (1.24, 2.07) | 0.97 (0.75, 1.27) | 1.64 (1.26, 2.13) | 0.99 (0.77, 1.27) | 1.54 (1.17, 2.04) | 0.95 (0.73, 1.23) | 1.24 (0.92, 1.66) | 1.12 (0.82, 1.54) |
| English-Other ^a | 1.63 (1.28, 2.08) | 1.20 (0.92, 1.56) | 1.97 (1.54, 2.53) | 1.08 (0.84, 1.39) | 2.17 (1.67, 2.81) | 1.13 (0.88, 1.44) | 1.71 (1.30, 2.25) | 1.08 (0.84, 1.38) | 1.43 (1.08, 1.90) | 1.37 (1.01, 1.86) |

School Physical Activity and Nutrition Study, 2004–2005

Results based on multilevel regression analysis with school as a random effect. Adjusted for age and school percent economically disadvantaged. Bold test indicates statistical significance

Hisp Hispanic, Org Organization, PA Physical Activity, CI, Confidence Interval, N/A Information Not Available

^aOther: represents students from all other non-Hispanic ethnic groups that speak English with parents (White, African American, Asian, Black, Native Hawaiian or Other Pacific Islander)

found Spanish-Hispanic girls participated in significantly less organized PA such as sports team participation and PA lessons across 4th, 8th, and 11th grade levels and in less vigorous PA in 8th and 11th grades compared to English-Hispanic and English-Other girls. While fewer differences in the PA indicators were observed for boys, 8th grade English-Hispanic and English-Other boys were roughly two times more likely to participate in sports teams at school compared to Spanish-Hispanic boys. These findings indicate important disparities in physical activity participation for Hispanic children who speak Spanish at home and contribute to a limited body of research on children's physical activity participation in diverse language groups in the United States.

Lower levels of physical activity have been reported in Hispanic adolescents compared to non-Hispanic White (NHW) adolescents [21, 22] and in Hispanic girls compared to NHW girls in the United States [28, 33–36]. Hispanic secondary school students in the United States have also been found to participate less in interscholastic sports and in intramural sports and to attend schools that have lower rates of sports participation [37]. While research is limited on PA participation by acculturation level and Spanish/English language use at home in children, findings from a recent national study indicated that immigrant Hispanic children with foreign-born parents were two times as likely to not participate in sports and to be physically inactive as native White children [20].

Our findings of a lower participation in physical activity behaviors for Spanish-speaking Hispanic girls across grade levels but mixed results for Spanish-speaking boys suggest language and culture may operate differently on PA participation for girls and boys. Gender has been found to be a key factor in understanding PA participation in adolescents in the United States [28, 35, 38–40], and our findings reinforce the importance of gender for understanding cultural influences on physical activity participation as well. A gendered perspective may provide further insights into the mixed findings of previous research on physical activity and acculturation in Hispanic children [10, 11, 20–22].

The important gender-specific differences in the language-PA associations found in this study provide a foundation for exploring both cultural and socio-ecological factors for lower physical activity in Hispanic children. Cultural factors related to modesty (i.e., feeling embarrassed by how one looks in gym attire), *machismo* (i.e., spouses/partners who do not want women to go out and exercise with other men), and *familismo* (i.e., importance of putting family needs before one's own needs) have been cited in qualitative research in low-income Hispanic women in Texas as important barriers to engaging in physical activity [41]. Hispanic girls may also have less opportunity to frequent physical activity settings outside

the home due to greater family obligations. Grieser and colleagues [41] found three-fourths or more of Hispanic middle school girls reported child care as among the most common activities carried out in the past week, compared to roughly half of African American and Caucasian girls.

Safety concerns are another important consideration for gender differences in Hispanic children's physical activity that may interact with gender-specific cultural values of heightened parent protectiveness for Hispanic girls. Safety concerns are an important barrier for children's participation in physical activity [43–45] and have been cited as barriers to physical activity for Hispanic women and families living in Texas [41, 46]. Although cultural considerations may account in part for safety concerns, safety concerns may also have structural roots that go beyond a cultural explanation. Zhu and Lee [47] found that schools in Austin, Texas with higher percentages of Hispanic students were exposed to more dangers from traffic and crime. The important gender differences in the language/ethnic group-PA association found in the present study may stem from cultural values that include a heightened parent protectiveness as well as greater family obligations for Spanish-speaking girls compared to boys, factors that may result from or interact with neighborhood socioeconomic disadvantage.

In much acculturation research, there is an implicit connection between culture and lifestyle. An important critique of acculturation research has been the failure to examine the presence or absence of specific behaviors and practices in a country of origin in order to truly understand the influence of culture on a given practice [30]. While cross-national research on physical activity in children is limited, a representative study of 5,406 ninth-grade students in public schools in Matamoros (Tamaulipas, Mexico) and Lower Rio Grande Valley (Texas, US) found gender-specific participation rates in sports teams to be similar between the two countries [48]. Qualitative research with low-income Hispanic women from Texas and four additional underserved populations from around the US indicate that underserved ethnic groups feel physical activity is important and believe that being physically active is part of their culture [49].

Our non-significant differences among the three language/ethnic groups for sports participation outside school but significant differences within school for 8th grade boys add to this literature base that questions the premise that physical activity is not embraced by the Hispanic culture. Our findings suggest the need to move beyond a pure cultural explanation for lower physical activity in Hispanic populations to one that takes into consideration the social context- and specifically social barriers- that may influence PA behaviors in Hispanic children. Three specific social barriers to physical activity that may be represented by

parent language use include communication, exclusion from social organization, and socio-economic disadvantage.

Language has often been studied as a dimension of acculturation yet has received less attention in physical activity research for its functional role in communication. Lack of English-speaking ability has been cited as an important barrier to parents' access to and comprehension of information on out-of-school programs, education, and health care [50]. Data from the 2003 National Household Education Surveys Program (NHES) indicate that more parents of students from English-speaking households than Spanish-speaking households reported receiving personal notes or e-mails about their child from school and receiving school newsletters, memos or notices [51]. Furthermore, parents of students in poor English-speaking households were more likely than parents of students in poor Spanish-speaking households to report receiving personal notes or e-mails about their child and to report receiving school newsletters, memos, or notices [51]. These communication disparities for Spanish-speaking families may represent an important barrier to learning about extracurricular opportunities for physical activity at school and in the broader community.

Language may also represent a marker for exclusion from social organization within the school or community context for both children and parents. Adolescents in the US who speak a language other than English at home have been found to have a higher risk of alienation from classmates and to be bullied [52]. Schools may also lack the ability or will to create a space for participation in and leadership of school organization by Spanish-speaking parents. Griffith [53] found that being Hispanic, being of lower socio-economic status, and having a child enrolled in English-as-a-second language were associated with lower parent involvement in elementary schools. National data on parent involvement in schools indicate that parents of students from English-speaking households were more likely than parents of students from Spanish-speaking households to report that the school had a general meeting, that the school or class held an event that parents could attend, or that the school had opportunities for parents to volunteer [51]. With continuing US government-sponsored raids on worksites that employ undocumented workers [54], it is possible that undocumented Spanish-speaking parents may also be less likely to take an active role in their children's school or community due to fear of government persecution. Our finding of significant differences in sports team participation at school in 8th grade boys but no differences in sports team participation outside of the school setting may speak to both the exclusion of Spanish-speaking Hispanic children and families from extracurricular physical activity opportunities as well as the lack of leadership or volunteer opportunities for parents in the

school setting. Efforts to increase involvement of Spanish-speaking parents in school and community organization may facilitate participation of children in sports and other extracurricular physical activity opportunities.

Some acculturation research has been criticized for its failure to take into consideration the influence of socio-economic status on health and health behavior [30]. While we attempted to control for socio-economic status by adjusting for school-level economic disadvantage, we cannot completely rule out the role of SES in explaining differences among the language-ethnic groups studied as we lacked individual-level SES data. The Hispanic population in the US is confronted with a poverty rate that is over double that of Whites [55], and Spanish-speaking children have been found to be more likely than English-speaking children to come from low-income families [56]. Lower socio-economic status has been associated with lower physical activity participation and lower access to PA facilities and recreational areas [37, 57, 58], and safety concerns such as crime and untrustworthiness of neighbors have been reported to be higher in low income compared to high income neighborhoods in the United States [59]. Furthermore, Hispanic youth have been found to have less access to and use of high quality institutions and programs, including after-school programs [50]. Clearly, further research is needed to better understand the relationship of language, socio-economic status, and culture in physical activity participation among Hispanic children.

Although some research has found that Hispanic children watch more television compared to non-Hispanic White children [35, 36], findings on television watching by level of acculturation in Hispanic youth have been mixed, with one study finding similar levels of television watching by generational status [11] and two studies finding lower levels of TV watching in less acculturated or foreign-born Hispanic children [10, 20]. Our findings indicated generally similar levels of television watching across the three language-ethnic groups examined with the exception of 4th grade girls. The higher TV watching among 4th grade Spanish-speaking girls may result from greater time spent at home due to higher levels of responsibility for taking care of siblings [42] and/or greater parent protectiveness.

This study's focus on parent language use may hold important implications for the measurement of physical activity in immigrant children. Unger and colleagues [22], in their study of physical activity and fast food consumption in Hispanic and Asian 6th grade students in the United States, averaged together English language items that measured English language usage "in general" and "at home" in order to develop an overall student English language usage score. They found that student English language usage was not associated with physical activity or fast food consumption. Our findings of significant

differences in physical activity in girls and boys who speak Spanish with their parents may point to the key role parents play in facilitating and supporting organized physical activity participation of their children- regardless of whether the child can speak English. These findings suggest the need to differentiate context-specific language usage (e.g., at home versus in general) in Hispanic children in order to better understand the underlying phenomena that language may represent.

Strengths and Limitations

This study is among the first to assess differences in children's physical activity participation by language use at home in a large, ethnically diverse sample that spans three age groups of children and adolescents. The strengths of the study notwithstanding, an important limitation of our data was the lack of other traditional acculturation variables such as place of birth or length of residency in the United States. By comparing the association of a range of acculturation variables with physical activity participation, we may better understand the specific impact of language on physical activity participation. Another important limitation worth noting was our low sample size for examining the influence of the student's language, in addition to the parents' language, on physical activity. While we found that >99% of our 4th, 8th, and 11th grade students who took the survey in Spanish also spoke Spanish with their parents, SPAN was not designed to oversample students who completed the survey in Spanish, and our sample size was insufficient for running analyses stratified on gender and grade level. By distinguishing between the influences of parent language and student language on physical activity participation, we may develop a better understanding of the role both language and parents play in physical activity participation of children. Lastly, our sports team variable for our 4th grade sample did not specify the school versus community setting. As setting is a key factor in understanding behavior [60] and the strongest differences in sports team participation in this study were found at school for 8th and 11th grade students, it is possible that our findings underestimated differences in sports team participation by language-ethnic group in 4th grade.

Conclusion

In this study, Hispanic girls who speak Spanish with their parents reported significantly lower participation in physical activity indicators across grade levels, while significant differences in physical activity in boys were generally limited to sports team participation at school in 8th grade. These mixed findings by gender and grade level along with

differing associations by school and community settings suggest that a cultural/lifestyle perspective may provide only limited insight into physical activity participation in Hispanic children. Physical activity research in Hispanic children should be broadened to take into account the social, structural, and organizational barriers and facilitators as well as the interaction of these factors with culture and gender. Lastly, while language has been examined as a measure of acculturation, we need to move beyond a pure cultural framework of language to explore how language may influence behavior through practical considerations of communication, as a target for social exclusion, and as a marker for socio-economic status and social opportunity.

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