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Longitudinal differences in sleep duration in Hispanic and Caucasian children

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ABSTRACT

Background and aim: Short sleep duration is associated with significant negative consequences, including poor school performance, behavioral problems, obesity, and hypertension. There is prior evidence that there are disparities in sleep duration related to ethnicity; however, there are no specific data on Hispanic children. We aimed to test the hypothesis that there are ethnic differences in parent-reported sleep duration in a community-based cohort of Hispanic and Caucasian children.

Methods: We examined the parent-reported sleep patterns of a community-based prospective cohort (Tucson Children's Assessment of Sleep Apnea study [TuCASA]) involving 338 Hispanic and Caucasian children at two time points approximately five years apart.

Results: In the initial phase of the TuCASA study with a cohort median age of 8.8 years (interquartile range (IQR), 7.6–10.1 years), parent-reported sleep duration during weekdays was shorter in Hispanic (median, 9.5 h; IQR, 9.0, 10.0 years) than in Caucasian children (10 h; IQR, 9.5, 10.0 h; $p < 0.0001$); however, this difference was not seen 5 years later when the cohort was older (median age, 13.3 years; IQR, 11.9–14.6 years; $p = 0.43$). In addition, Hispanic children had a significantly later bedtime at both time points ($p < 0.02$). In the initial phase, parent-reported sleep duration during weekends tended to be shorter in Hispanic than in Caucasian children ($p = 0.06$).

Conclusions: Short sleep duration in Hispanic children may contribute to health disparities. Our research suggests that in Hispanic children, behavioral interventions toward improving sleep duration accomplished by earlier bedtimes or delayed school start times and mechanistic studies to unravel any inherent tendency toward a delayed sleep phase are needed.

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1. Introduction

Insufficient sleep has been identified as a growing problem in children, with an estimated 1 h of sleep time lost over the past century [1]. Up to 63% of adolescents report that they do not get sufficient sleep [2]. Insufficient sleep and short sleep duration have been associated with a variety of negative outcomes. There is significant evidence linking short sleep duration in children to an

increased risk of obesity [3–7], increased blood pressure [8], and worse diabetic control [9]. Decreased sleep duration of as little as 30 min has been shown to increase metabolic risk in adolescents [10]. Short sleep duration has also been associated with behavioral and cognitive problems [11], as well as worse performance in school [12–14]. Short sleep duration has also been related to increased risk-taking behaviors [15], accidents [16], and a greater risk of developing depressive symptoms [17], including an increased risk of suicidal ideation [18]. Such supporting data have led to the Healthy People 2020 objective that adolescent children get sufficient sleep [19]. However, social and demographic factors contributing to sleep deficiency in children remain inadequately described [20].

There is limited information related to ethnicity-related differences in sleep duration, particularly in children [20]. Previous adult literature has shown that Black race and Hispanic ethnicity are associated with an increased risk of short sleep duration [21,22],

Abbreviations: ANCOVA, Analysis of Covariance; BMI, Body Mass Index; TuCASA, Tucson Children's Assessment of Sleep Apnea study.

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although there is some conflicting evidence, with other studies showing that Hispanic ethnicity is not associated with an increased risk of short sleep duration [23]. Previous studies have shown that minority children (mostly African American) were more likely to have delayed bedtimes [24,25]. Minority boys (mostly African American) have also been shown to have decreased sleep duration relative to nonminority boys [24]. Although there is emerging evidence of such racial disparities in sleep duration in children, there are no specific data on the relationship between Hispanic ethnicity and sleep duration in children.

In adults, there is literature suggesting that ethnicity-related factors in sleep duration may contribute to health disparities. For example, in adults, decreased sleep duration is associated with an increased risk of obesity [26], and such an association is seen in Mexican Americans, but not in Cuban Americans or Puerto Ricans [27]. This association has also been described in Mexican-American children [28]. In our study, we aimed to test the hypothesis that there are ethnic differences in parent-reported sleep duration in a community-based cohort of Hispanic and Caucasian children. Knowledge derived from such a study would allow us to better identify and increase sleep duration in children, and to reduce health disparities that owe their origins to insufficient sleep.

2. Methods

2.1. Study population

This analysis was done on phase 1 and phase 2 of the Tucson Children's Assessment of Sleep Apnea cohort (TuCASA) study. A detailed description of the TuCASA study and recruitment has been reported elsewhere [29,30]. In brief, a representative sample of 503 elementary school-aged Caucasian and Hispanic children were recruited from the Tucson Unified School District, a large district representative of the Tucson population. Approximately five years later (mean, 4.7 years), 348 children participated in phase 2 of the study. The TuCASA study was approved by the University of Arizona Institutional Review Board, and by the Tucson Unified School District Research Committee. Before undergoing study-related procedures, written informed consent and minor's assent were obtained from the parents and children, respectively. Families completed detailed sleep questionnaires, including socioeconomic information, and children underwent anthropomorphic measurements.

2.2. Questionnaires

Families filled out sleep questionnaires about their child, including questions related to bedtime, wake time, and average sleep duration. This information was obtained for weekdays as well as for weekends. Socioeconomic information was also derived from the questionnaires. This information included family-reported household income, parental education, as well as ethnicity. Household income was obtained on a scale ranging from <\$5000 annual income to >\$50,000 annual income, in \$5000 increments. Parental education (of the caregiver filling out the survey) was assessed using a scale starting at high school education or less to greater than four years of college or professional school. The scale was subdivided into 1-year increments for the completion of technical/trade school or college.

2.3. Anthropometry

Anthropometric measurements were completed in the children's home. Weight was obtained as the average of three measurements, to the nearest of 0.1 kg. Height was measured using a folding ruler on a level surface after the removal of shoes, and the head in the Frankfort plane. The average of three measurements to

the nearest of 0.1 cm was used for data analysis. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. BMI percentiles for age and gender were calculated using Center for Disease Control growth charts [31].

2.4. Data analysis

Statistical analysis was performed using Statistical Package for Social Science (SPSS) Version 22 (IBM, Armonk, NY, USA). Data were assessed for a normal distribution using a one-sample Kolmogorov–Smirnov test. For data analysis, household income was collapsed into a binary value of less than or greater than \$40,000 annual income. This threshold income was chosen because it was close to the median annual household income in Tucson, AZ, at the time of data collection (\$38,800) [32]. Parental education was converted into a binary value of less than or greater than four years of college. Subjects were grouped by ethnicity for data analysis. For demographic factors, χ^2 tests were used to determine significant differences for categorical variables (gender, household income, and parental education), and two-sided *t*-tests were used to determine significance for continuous variables. Measures included weekday and weekend sleep duration, as well as weekday bedtime and awakening time at both phases 1 and 2. Sleep duration was measured as a continuous variable because the two time points examined represent different developmental phases, with different sleep requirements. Ethnicity was used as a fixed factor for modeling. Covariates included age, gender, BMI percentile, household income, and parental education. Analyses of covariance (ANCOVAs) were performed at time points one and two, and a generalized linear model with repeated measures was constructed to evaluate the change in variables over time. A *p*-value of <0.05 was considered to be significant.

3. Results

Of the 348 children who participated in both phase 1 and phase 2 of the TuCASA study, 338 children provided sufficient information to be included in data analysis. With respect to demographic data, significant differences were seen in BMI, parental education, and household income between Hispanic and Caucasian children (Table 1). During weekdays, Hispanic children slept less than Caucasian children at phase 1 (9.5 h vs. 10 h, $p < 0.0001$), and they went to bed at a later time (9 pm vs. 8:30 pm, $p < 0.0001$). At phase 2, however, sleep duration was not significantly different between Hispanic and Caucasian children (8.5 h vs. 9.0 h, $p = 0.13$). There continued to be, however, a significant difference in bedtime with delayed bedtime in Hispanic than in Caucasian children (Table 1, $p = 0.013$). A significant difference in unadjusted parent-reported sleep duration on weekends was observed in phase 1, with Hispanic children getting less sleep than Caucasian children (median, 9.5 h compared with 10 h). This was no longer significant at phase 2.

To adjust for the significant demographic differences between the two groups, ANCOVAs were performed at phase 1 and phase 2 (Tables 2 and 3). Covariates included age, gender, parental level of education, household income, and BMI at the time of survey. All 338 children were included for analysis at phase 1, and 313 (114 Hispanic and 199 Caucasian) children were included at phase 2, because of some children with missing data for BMI at phase 2 ($n = 25$). Exclusion of these children from the analysis of phase 1 data did not materially change the results.

At phase 1, after adjustment for covariates, there continued to be a significant difference in weekday sleep duration between Hispanic and Caucasian children (adjusted mean, 9.4 vs. 9.7 h, $p = 0.001$). A significant difference in bedtime continued to be seen as well (adjusted mean, 8:58 pm in Hispanic children vs. 8:31 pm in Caucasian children, $p < 0.0001$). No significant difference was seen in awakening

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