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Sleep patterns in children differ by ethnicity: cross-sectional and longitudinal analyses using actigraphy

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ABSTRACT

Objectives: To determine whether sleep patterns (duration, timing, efficiency) differ by ethnicity.
Design: Longitudinal study.
Setting: Dunedin, New Zealand.
Participants: A total of 939 children (48% male) aged 4-12 years (572 European, 181 Māori, 111 Pacific, 75 Asian).
Measurements: All measurements were obtained at months 0, 12, and 24. Anthropometry was obtained using standard techniques, and parents completed questionnaires assessing demographics, dietary intake, and television habits of children. Sleep and physical activity were measured using Actigraph accelerometers over 1 week. Differences in sleep outcomes according to ethnicity were adjusted for demographics, weight status, and behavioral variables using mixed models.
Results: Pacific children had greater body mass index and were more likely to live in deprived areas than children from other ethnic groups (all $P < .001$), but few differences were observed in behavioral variables. Pacific Island children slept 16 (95% confidence interval, 7-25) minutes less per night than New Zealand European children, predominantly as a result of later bedtimes (29; 20-38 minutes). By contrast, sleep efficiency did not differ by ethnicity or over time (all $P \geq .118$). Māori children did not show the same relative deficits in sleep, displaying similar results to European children. Sleep duration decreased by 8 minutes (95% confidence interval, 6-10) a night each year over 2 years, and change over time did not differ by ethnicity (all $P \geq .165$).
Conclusions: From a young age, Pacific children had poorer sleep patterns than European children, and these patterns were maintained over 2 years.

Introduction

Sufficient good-quality sleep is important for physical and psychosocial health across the lifespan but can be challenging to achieve with today's modern lifestyle. Deficits in sleep are associated with a wide range of adverse health and educational outcomes in children. Children with insufficient sleep do not achieve as well at school, are more likely to have behavioral problems,[1] report less physical activity,[2] have poorer dietary habits than children who sleep for longer periods,[3] and are at greater risk of obesity[4] than children with sufficient sleep. Although much of the literature has concentrated on the effect of "usual" sleep duration on health, other aspects of sleep behavior are increasingly being investigated including sleep/wake timing, various measures of sleep quality, and whether the stability of sleep patterns is important.[5]

Ethnic minority and low socioeconomic groups are potentially at greater risk of poorer sleep due to the physical environments where household crowding, light, and noise are more common.[6] In addition, the potential for presleep worries related to daytime stressors is higher in lower-SES groups, resulting in greater cognitive arousal before bedtime.[6] There is a growing recognition that ethnicity influences sleep, with a recent meta-analysis illustrating shorter

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sleep duration in African American compared with White American adults.[7] Comparable data in children also illustrate that shorter sleep duration is often reported for Asian or ethnic minority groups compared with White children,[8–10] although data are not always in agreement.[11] However, most studies have used questionnaires to assess sleep, only some of which meet evidence-based assessment criteria,[12] and concern has been expressed that cultural differences in reporting health information might account, at least in part, for some of the ethnic differences observed.[13] Although use of objective measures of sleep would more clearly identify whether ethnic differences in sleep patterns do exist in children, there are relatively few studies to draw this information from. Two studies using actigraphy to measure sleep found that African American children sleep around 20 minutes less a night than European American children.[14,15] African American children may also sleep less than Hispanic children (12 minutes),[16] although others have observed no difference in actigraphy-measured sleep duration in Hispanic compared with non-Hispanic children.[17] Differences in other population groups are uncertain, and whether variation by ethnicity changes over time is also unclear because of a dearth of longitudinal data. Such information is important to understand whether interventions attempting to change sleep might be best targeted to certain ethnic groups. Targeted interventions have the potential to be more cost-effective, as the intervention is only delivered to those in most need and likely to benefit.[18]

Poor sleep has also been associated with lower socioeconomic status, which is intertwined with ethnicity.[15] As such, investigation of sleep patterns in the New Zealand population is of particular interest because marked ethnic disparities exist in many of the health outcomes associated with poor sleep (eg, poor diet leading to obesity, poor mental health). For example, Pacific children are almost 4 times more likely and Māori children (indigenous population) 1.6 times more likely to be obese than non-Pacific and non-Māori children (respectively) after adjusting for age and sex. In addition, ethnic differences in dietary intake, television viewing, and physical activity have all been observed.[19] The primary aim of this study was to determine how sleep (duration, sleep-wake timing, and sleep efficiency) differs in New Zealand children aged 4-12 years old according to ethnicity, both cross-sectionally and longitudinally.

Methods

Data for these analyses were obtained from children who had participated in 2 randomized controlled trials comparing different approaches to effective weight management (not including sleep) in children over a 2-year period. PLAY was a 2-year randomized controlled trial undertaken in 2 regions of New Zealand (Otago and Auckland) that investigated whether altering the primary school play environment influenced physical activity.[20] Children in school years 2 and 4 (n = 759) were recruited from 16 participating schools. Ethical approval was obtained from the University of Otago (10/077) and Auckland University of Technology (10/95) Ethics Committee, and the trial was registered with the Australia New Zealand Clinical Trial registry (ACTRN12612000675820). MInT (Otago only) investigated the effectiveness of a tailored family-based intervention in overweight children.[21] Overweight children (n = 180) were included in the trial following a weight screening initiative in over 1000 children recruited through 9 general practices and several secondary care clinics. Ethical approval was obtained from the Lower South Regional Ethics Committee (LRS/09/09/039), and the trial was registered (ACTRN12609000749202). Parents in both studies provided informed consent, and assent was also obtained from all children. Data for both studies were collected from March 2010 to December 2011 (baseline) and March 2012 to December 2013 (follow-up).

Both studies had measurements of relevant outcomes at baseline (month 0), 1 years (month 12), and 2 (month 24) years collected using comparable equipment and measures. Height was measured using portable stadiometers (Seca 213 for PLAY, Tanita for MInT) and weight using electronic scales (Seca 813 for PLAY, Tanita BC-418 for MInT) using standard techniques. Waist circumference was measured at the umbilicus using a nonelastic tape (Lufkin 2-m Executive Thinline w606PM), and all measures were obtained in duplicate. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2), and BMI *z*-scores were calculated using WHO 2007 reference data.[22] *Obesity* was defined as a BMI *z*-score ≥ 95th percentile. Demographic information on the child's age, sex, ethnicity and the level of household deprivation was obtained from parents at baseline. Ethnicity was determined using the New Zealand (NZ) census questions, which allow prioritization into specific categories: NZ European and others (hereafter referred to as *NZEO* for simplicity), Māori, Pacific, and Asian. The New Zealand Deprivation Index is a measure of household (not individual) deprivation that is derived from New Zealand Census data that reflects 9 dimensions of deprivation (income, home ownership, home support, employment, education, living space, communication, and transportation). Deprivation scores range from 1 (low deprivation) to 10 (high deprivation) and reflect the area in which an individual lives rather than the individual themselves.[23]

Sleep variables of interest were provided from questionnaires and actigraphy. At all 3 time points (0, 12, and 24 months), parents were asked to indicate the usual time the child typically went to bed each night and got up in the morning, separately for weekdays and weekend days. All children wore an accelerometer (ActiGraph GT3X, Pensacola, FL) on an elastic belt, positioned over the right hip, for 8 days (24 hours a day only removing for water-based activities such as bathing or swimming). Accelerometers were initialized using ActiLife (version 6, Pensacola, FL) in uniaxial mode with 15-second epochs. Data were cleaned and scored using a count-scaled algorithm and an automated script developed in MATLAB (MathWorks, Natick, MA), which allows batch scoring of large data sets while simultaneously identifying sleep and wake timings for each individual day for each participant.[24] Data on sleep onset (evening sleep time), sleep offset (morning wake time), sleep duration (minutes), and sleep efficiency (time asleep as a percentage of time in bed) are provided for each day. Once sleep times have been identified, awake-time physical activity and sedentary behavior were determined. A day is scored as valid if there are at least 8 valid awake hours, and participants had to have at least 2 valid days of data to be included in the analysis. *Nonwear time* was defined as 20 minutes of consecutive zeros. Physical activity data are expressed as counts per minute (overall activity) and minutes of moderate-vigorous activity (MVPA) defined using the cut points of Evenson et al.[25]

Data on dietary intake were assessed using the Children's Dietary Questionnaire.[26] The Children's Dietary Questionnaire comprises 28 questions and assesses patterns of food intake over the previous week. The following subscales are generated: fruit and vegetable score (possible score 0-28, recommended ≥14), sweetened beverages score (possible score 0-5.9, recommended ≤1), and non–core foods score (possible score 0-10.3, recommended ≤2), and represent scores rather than serves per day. Television usage (time spent watching daily and whether a television is in their bedroom) was determined at each time point by parental questionnaire.

Statistical analysis

Because the age of the participants was 4-12 years at baseline, regression analysis, with robust standard errors to allow for the sampling strategy, adjusting for age and sex was used to compare the study characteristics. A Bonferroni inequality (0.05/6) was used

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