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Proportion and Correlates of Children in the US-Affiliated Pacific Region Meeting Sleep, Screen Time, and Physical Activity Guidelines

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Introduction: Limited data on 24-hour movement behaviors of children aged 5–8 years exist globally. We describe the prevalence and sociodemographic associations of meeting physical activity (PA), sedentary recreational screen time (ST), and sleep guidelines among children from 11 jurisdictions in the US-Affiliated Pacific region. ***Methods:*** Cross-sectional representative data from 1192 children aged 5–8 years living in the US-Affiliated Pacific region were drawn from the baseline 2012–2014 Children's Healthy Living Program. Sleep and moderate- to vigorous-intensity PA were calculated from accelerometry. ST and sociodemographic data were collected from caregiver surveys. The percentage of children meeting the Asia-Pacific 24-hour movement guidelines for PA (≥60 min/d of moderate- to vigorous-intensity PA), sleep (≥9 and ≤ 11 h/d) and ST (≤2 h/d) were calculated. Generalized linear mixed models were used to examine associations with adiposity and sociodemographic variables. ***Results:*** Twenty-seven percent (95% confidence interval, 24.6–30.0) of children met integrated guidelines; 98% (96.2–98.0) met PA, 78% (75.4–80.0) met sleep, and 35% (32.6–38.0) met ST guidelines. Females (adjusted odds ratio = 1.40 [95% confidence interval, 1.03–1.91]) and those living in lower-middle-income jurisdictions (2.29 [1.49–3.54]) were more likely to meet ST guidelines. Overweight children (0.62 [0.40–0.96]), those aged 8 years (0.39 [0.22–0.69]), and children with caregivers of an education level of high school or beyond (0.44 [0.29–0.68]) were less likely to achieve ST guidelines. Children from midrange annual household incomes were less likely to meet combined guidelines (0.60 [0.39–0.92]). ***Conclusions:*** Three-quarters of children are not meeting integrated Asia-Pacific 24-hour movement guidelines. Future strategies for reducing ST and increasing integrated guidelines compliance are needed.

Keywords: cross-sectional study, socioeconomic disparities, movement guidelines

Regional guidelines for the Pacific recommend children and adolescents (5–17 y) to engage in a variety of physical activities, of at least moderate- to vigorous-intensity physical activity (MVPA), for an average of 60 minutes per day.[1,2] The guidelines also recommend, for a 24-hour period, limiting sedentary recreational screen time (ST),[2] to no >2 hours,[1,3–5] and that children aged 5–13 years get 9 to 11 hours of sleep.[1,3–5] Children aged 5–17 years who meet the 24-hour movement guidelines have healthier levels of adiposity, better cardiometabolic and psychosocial health, and higher academic achievement and cognition.[6] There is evidence that these behaviors are interrelated and should be considered in combination rather than in isolation.[7,8]

The current recommendations require children to attain an *average* level of physical activity (PA), ST, and sleep, in a 24-hour period, unlike the previous guidelines that mandated meeting each recommendation *daily* to qualify as meeting the requirement. Much of the present evidence is founded on the earlier recommendations, which could result in large disparities of the number of children meeting guidelines. According to the earlier guidelines, research findings from 146 countries indicated that four-fifths of children aged 11–17 years were not meeting PA recommendations.[9] A 12-country study among children aged 9–11 years found that only 7% met the current integrated 24-hour movement guidelines.[10] Specifically, 44% met the PA recommendation, 39% met ST, and 42% met sleep.[10]

Limited empirical evidence exists for children aged 5–8 years within Pacific Island Countries, the US territories, or states of Alaska and Hawaii.[11] To our knowledge, only one study met the 3 criteria for comparability in children: (1) conducted in the Pacific, (2) used the new integrated 24-hour movement guidelines, and (3) employed accelerometry for more precise measurement. A study from Majuro in the Marshall Islands found that 89% of children aged 5–13 years met the PA recommendation, 13% met

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sleep, and 29% met ST,[11] highlighting the variation in the percent meeting movement guidelines between geographically, culturally, and sociodemographically diverse populations.

The nuances and sociocultural contexts specific to these regions can influence PA behaviors and outcomes, adding complexity to the comparisons between the discourse of the Western-dominated literature in PA. The sociocultural context in the Pacific Islands significantly influences PA behaviors and outcomes, presenting unique challenges and considerations compared with Western contexts. For example, research has shown that Pacific people may be more interested in traditional forms of PA, such as agriculture and fishing sports, which are deeply rooted in their culture.[12] Additionally, gender roles and expectations can impact PA engagement in the Pacific with certain sociocultural factors acting as barriers.[13] Addressing these nuances is essential for designing targeted interventions that resonate with the specific cultural and social values of Pacific communities, ultimately promoting more effective and culturally relevant approaches to increasing PA levels.[14] Thus, evidence is needed from Pacific Island Countries, US territories in the US-Affiliated Pacific (USAP) region to understand and direct future health promotion efforts toward more effective strategies that are sensitive to the unique needs and contexts of these diverse populations.[15]

To address this research gap and to gain a deeper understanding of the intricate relationships between sociocultural influences and children's PA behaviors, it is essential to gather evidence from Pacific Island Countries and US territories in the USAP region. This study aimed to examine the proportion of children aged 5–8 years in the USAP region who meet the Asia-Pacific 24-hour movement guidelines for PA, sleep, and ST and the variation across sociodemographic factors and adiposity measures.

Methods

This study followed The Strengthening the Reporting of Observational Studies in Epidemiology Statement.[16] Ethics approval was obtained from the University of Hawai'i Committee on Human Studies (#18915).

Study Design, Setting, and Participants

Data were drawn from the baseline survey of the Children's Healthy Living (CHL) program, a community-based early childhood obesity prevention program.[17,18] Participants included children aged 2–8 years living in 11 jurisdictions in the USAP region: US territories—American Samoa, Guam, and Commonwealth of the Northern Mariana Islands; US-affiliated jurisdictions—Federated States of Micronesia (includes Yap, Chuuk, Pohnpei, and Kosrae), Republic of Palau, and Republic of the Marshall Islands; and US states of Hawaii and Alaska. The CHL program had 2 components: a community-randomized intervention and a prevalence survey. Eligibility criteria for the intervention included cohesive community groups with a population of >1000 people, >25% of the population identified as Indigenous to that jurisdiction, and >10% of the population were under the age of 10 years. Data were collected between 2012 and 2014. This study focused on children aged 5–8 years to allow reporting against specific guidelines for this age group.[1,3–5]

Variables and Measures

PA and Sleep

Time spent in PA and sleep was measured using an Actical accelerometer (Z series, Philips Respironics Inc), validated for assessment of PA and sleep in children.[19,20] Participants wore the device on their nondominant wrist continuously for 7 days. The accelerometers captured data in 1-second epochs,[18] and data were reprocessed into 15-second epoch.DAT files using a Python script. Data were scored using an automated count-scaled algorithm to determine time spent in nocturnal sleep[20] and at different intensities of waking behaviors (sedentary: 0–52 counts per minute [cpm], light: 53–387 cpm, MVPA: ≥388 cpm).[19] The algorithm detects sleep and wake times using a "time flag" of 8:00 PM and 7:00 AM, respectively. These times were selected based on advice from the local researchers in each participating country as to the earliest time when children this age were likely to go to bed, and the latest time they were likely to wake up. Nonwear periods during waking hours were defined as at least 20 minutes of consecutive 0s and were excluded from the analysis.

Data from days 1 and 7 were excluded from analyses to ensure only data captured during the full 24-hour periods were considered. These specific parameters were established based on a review of existing literature, considering for the plausibility of children attaining 6 hours of MVPA and 10 hours of total PA within a single day. Days were deemed invalid and excluded from the analysis if they met any of the following criteria: (1) waking wear time <8 hours,[21] (2) sedentary >1000 minutes,[22] (3) MVPA >360 minutes, or (4) total PA were >10 hours. Averages of each child's minutes spent in sleep and MVPA were then calculated. Only participants with valid accelerometer data for at least 3 days (including 1 weekend day) were included in the final analysis. Guidelines were based on daily recommendations and can be interpreted as an average of duration across valid days.[23]

Sedentary Recreational ST

Caregivers were asked "How long on an average day does your child spend playing inactive video games?" and "How many hours a day does your child spend watching television (TV) and/or videos/DVD?" on a usual weekday and weekend day. Responses were limited from 0 to 7 hours in 30-minute increments and responses from both questions totaled. Weighted daily ST data were calculated using the following formula: (weekday hours × 5) + (weekend hours × 2)/7 days.

Compliance With Asia-Pacific 24-Hour Movement Guidelines

Children were classified as meeting the individual and integrated movement guidelines if they met the recommendations for: (1) MVPA (≥60 min/d),[1–5,24] (2) ST (≤2 h/d),[1,3–5] and (3) sleep (≥9 and ≤11 h/d).[1,3,4,25]

Adiposity Measures

Height, weight, and waist circumference were measured using standardized protocols by trained research staff,[15] certified using the Zerfas criteria by a certified anthropometrist. Portable stadiometers (from Perspective Enterprises, PE-AIM–101) were used to assess height, with measurements recorded to the closest 0.1 cm. To assess weight, portable scales (Seca Model 876, Seca) were used, providing readings accurate to 0.1 kg. Waist circumference was measured using plastic tape (Seca Model 201, Seca) and recorded to the nearest 0.1 cm. Each of these metrics (weight, height, and waist circumference) were captured 3 times. If the initial 3 readings display discrepancies >2 units (eg, a 0.2 kg deviation in weight), 3 additional measurements were taken to ensure accuracy.[26] Body mass index (BMI) z-score was calculated

based on World Health Organization growth reference and used in the classification of weight status: (1) thinness: <–2 SD, (2) healthy weight: ≥–2 and ≤+1 SD, (3) overweight: >+1 SD, and (4) obesity: >+2 SD.[27] Waist-to-height ratio (WHtR) was computed as waist circumference (in centimeters) divided by height (in centimeters). A WHtR ≥0.50 was determined to be at risk for abdominal obesity.[28]

Sociodemographic Measures

Jurisdiction income was determined by the World Bank Classification (high, upper-middle, lower-middle-, and low-income levels).[29] Caregiver education was grouped into 3 categories for analysis (did not complete high school, completed high school or General Educational Development [GED], and attended college). Annual household income was grouped into 3 categories for analysis (under $10,000, $10,000–$35,000 and over $35,000) based on groupings previously used in national survey.[30]

Study Size and Bias

Each community in the CHL trial recruited approximately 180 children aged 2–8 years, of which 100 provided accelerometry data. Each jurisdiction recruited a minimum of 200 children aged 2–8 years, all of whom provided accelerometry. The prevalence jurisdictions were selected to cover most populated regions and to broadly represent the underlying population of children. The samples for the CHL trial were broadly representative of the underserved populations of the jurisdictions, with 2 exceptions. In Hawai'i, the sample largely represented rural populations (Honolulu excluded). In Alaska, the sample largely represented urban populations as rural villages were excluded due to their small size and remote locations.[17,18]

Statistical Analysis

Descriptive statistics were calculated for the proportions of children meeting the guidelines. Generalized linear mixed models were used to examine associations of meeting movement guidelines with sociodemographic variables and adiposity measures, with a random intercept of communities nested within jurisdictions. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were calculated to determine associations between meeting the guidelines and sex, BMI category, age, caregiver education, income, and jurisdiction income level. A series of 4 models were created to take a logical approach. Model 1 included sex, age, caregiver education, and household income to examine sociodemographic correlates of guideline compliance. Models 2 to 4 included an additional variable: BMI in model 2, WHtR in model 3, and jurisdiction income level in model 4. Survey weights were used to account for sampling bias and were based on community population census data for children aged <10 years. Missing data were considered missing at random and excluded from analysis. Analyses were conducted using R (version 4.1.2).

Results

Participants

Of the 1432 children aged 5–8 years with accelerometry data, 1216 met the criteria for valid accelerometry data; 24 did not report ST (Figure 1). The characteristics of the analytical sample were very similar to those of the total sample (Table A1 in Appendix).

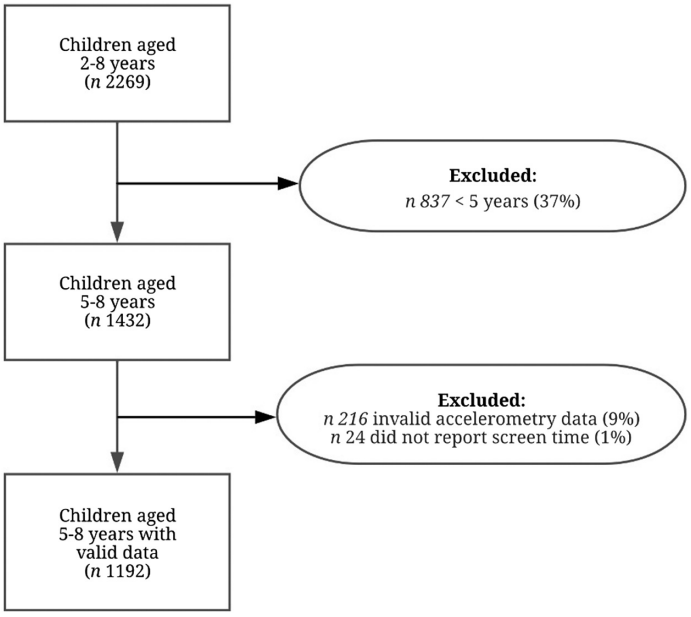

Figure 1 — Flow diagram of participant inclusion.

Descriptive Data

Descriptive characteristics of the children are shown in Table 1. Children's mean (SD) age was 6.5 (1.1) years. Fifty percent were males, 70% were of healthy weight, and 58% were from high-income jurisdictions. The mean (SD) minutes spent in ST was 210 (154) minutes per day, in sleep was 589 (49) minutes per day, and in PA was 130 (37) minutes per day. Almost all children (98%) met the PA guidelines. Seventy-eight percent of children met the sleep guidelines. The proportion of children who met the ST guidelines was lower (35%) compared with PA and sleep. The proportion of children who met integrated guidelines[1,3–5] was 27%. Jurisdictions meeting the PA guidelines ranged from 95% to 100%, excluding Alaska at 92%. Children meeting sleep guidelines varied by jurisdictions ranging from 70% to 90% and 20% to 73% for ST. Meeting integrated guidelines ranged from 14% to 44% excluding Chuck at 63%. These results are reported at a jurisdiction level in Table A2 (see Appendix).

Table 2 shows the adjusted associations between meeting the guidelines and selected sociodemographic factors and adiposity. ST recommendations were 1.4 times more likely to be met by females than males (aOR = 1.40 [95% CI, 1.03–1.91]). Children aged 8 years were less likely to meet the ST guidelines than those aged 5 years (aOR = 0.39 [95% CI, 0.22–0.69]). Children living in lower-middle-income jurisdictions were more likely to meet ST guidelines than their high-income jurisdiction peers (aOR = 2.29 [95% CI, 1.49–3.54]). Compared with healthy weight children, those who were overweight (aOR = 0.62 [95% CI, 0.40–0.96]) or obese (aOR = 0.43 [95% CI, 0.26–0.71]) were less likely to meet ST recommendations. Children who were at high risk for abdominal obesity were less likely to meet ST (aOR = 0.68 [95% CI, 0.49–0.97]) and PA (aOR = 0.26 [95% CI, 0.09–0.79]) recommendations than those at low risk. Participants whose caregivers completed high school education (aOR = 0.44 [95% CI, 0.29–0.68]) or attended college (aOR = 0.43 [95% CI, 0.29–0.66]) were less likely to meet ST recommendations compared to children whose caregivers did not complete high school.

Table 1 Weighted Proportion of USAP Region Children Meeting Guidelines for PA, ST, and Sleep

Characteristic	Sample size, n (%)	Guidelines met			
		PA,[a] % (95% CI)	Sleep,[c] % (95% CI)	ST,[b] % (95% CI)	PA + ST + sleep, % (95% CI)
Overall	1192 (100)	98 (96.2–98.0)	78 (75.4–80.0)	35 (32.6–38.0)	27 (24.6–30.0)
Sex					
Male	600 (50)	98 (96.8–99.5)	77 (73.8–80.9)	33 (28.5–36.6)	24 (19.9–27.4)
Female	584 (49)	97 (95.2–98.5)	78 (75.0–82.1)	38 (34.2–42.5)	31 (26.8–34.7)
Missing	8 (1)	—	—	—	—
Age, y					
5	486 (41)	98 (96.5–99.1)	80 (76.2–83.6)	41 (36.5–45.7)	33 (28.4–37.3)
6	309 (26)	98 (95.8–100.0)	79 (73.7–83.7)	32 (26.1–37.3)	24 (18.8–28.9)
7	236 (20)	97 (95.0–99.4)	76 (69.8–81.4)	38 (31.4–44.5)	27 (20.9–33.0)
8	161 (13)	96 (92.1–100.0)	74 (66.1–81.2)	20 (12.9–26.5)	15 (8.7–21.2)
Caregiver education					
Grades 11 or less	290 (24)	97 (94.8–99.7)	79 (74.5–84.4)	48 (42.0–53.9)	37 (30.7–42.4)
High school or GED	407 (34)	99 (97.7–99.8)	79 (74.9–83.5)	30 (25.1–34.8)	24 (19.5–28.6)
Attended college	491 (41)	97 (94.9–98.6)	76 (72.4–80.3)	32 (27.4–36.2)	24 (19.8–27.9)
Missing	4 (0)	—	—	—	—
Annual household income (US dollars)					
Under $10,000	424 (36)	98 (96.3–99.3)	79 (74.8–83.1)	36 (31.4–40.8)	30 (25.7–34.7)
From $10,000 to <$35,000	272 (23)	97 (94.7–99.8)	73 (66.8–78.2)	27 (21.4–30.9)	18 (12.4–23.0)
From $35,000 and more	210 (17)	98 (95.1–100.0)	81 (75.6–86.9)	35 (27.8–42.4)	29 (21.8–35.7)
Missing	286 (24)	—	—	—	—
BMI category					
Thinness	8 (1)	100 (100.0–100.0)	73 (41.3–100.0)	71 (42.2–100.0)	55 (15.4–84.6)
Healthy weight	835 (70)	98 (96.3–98.7)	79 (76.6–82.3)	40 (36.7–43.7)	32 (28.3–34.9)
Overweight	171 (14)	99 (96.9–100.0)	71 (64.1–78.6)	27 (19.8–34.0)	17 (10.6–22.5)
Obese	170 (14)	96 (92.3–100.0)	77 (69.4–84.2)	17 (11.1–22.9)	13 (7.6–18.0)
Missing	8 (1)	—	—	—	—
WHtR					
Normal risk (<0.5)	755 (63)	99 (98.3–99.7)	77 (73.7–80.1)	37 (33.4–40.6)	28 (24.5–31.2)
At risk (≥0.5)	391 (33)	96 (93.2–98.1)	80 (76.1–84.4)	31 (26.4–36.0)	25 (20.1–29.2)
Missing	46 (4)	—	—	—	—
Jurisdiction income					
High	693 (58)	97 (95.9–98.8)	75 (71.9–78.8)	28 (24.6–31.9)	21 (17.9–24.5)
Upper-middle	245 (21)	98 (96.6–99.9)	74 (67.9–79.8)	36 (29.6–41.9)	23 (17.6–28.8)
Lower-middle	254 (21)	97 (95.1–99.5)	87 (82.9–91.2)	51 (44.5–56.8)	43 (37.0–49.4)

Abbreviations: BMI, body mass index; CI, confidence interval; PA, physical activity; ST, screen time; USAP, US-Affiliated Pacific; WHtR, waist-to-height ratio. Note: Generalized linear mixed models were used to examine associations of meeting movement guidelines with sociodemographic variables and adiposity measures, with a random intercept of communities nested within jurisdictions.
[a]Defined as PA ≥ 60 minutes every day.[1,2] [b]Defined as ST ≤ 2 hours each day.[1,3–5] [c]Defined as sleep duration per night between 9 and 11 hours (ages 6–13 y).[1,3–5]

Just over one-quarter of children met the integrated guidelines (27%). Females were 1.5 times more likely to meet all recommendations than males (aOR = 1.54 [95% CI, 1.10–2.16]). Children aged 8 years were half as likely to meet all recommendations compared with those aged 5 years (aOR = 0.43 [95% CI, 0.23–0.80]). Those living in lower-middle-income jurisdictions were 2.3 times more likely to meet all recommendations compared with those from high-income jurisdictions (aOR = 2.33 [95% CI, 1.48–3.67]). Those who were overweight (aOR = 0.47 [95% CI, 0.28–0.78] or obese (aOR = 0.42 [95% CI, 0.24–0.74]) were less likely to meet all 3 recommendations compared with their healthy weight peers. Children whose caregivers completed high school or attended college were half as likely to meet all recommendations compared with those who did not complete high school (aOR = 0.52 [95% CI, 0.33–0.83]) and (aOR = 0.49 [95% CI, 0.32–0.76]). Those with an annual household income between 10,000–35,000 USD were less likely to meet all recommendations compared with those who earned <10,000 USD (aOR = 0.60 [95% CI, 0.39–0.92]).

Discussion

Three-quarters of children surveyed did not meet integrated 24-hour movement guidelines. Males, children from high-income jurisdictions, those with higher adiposity levels, and those with

Table 2 Weighted, Adjusted Associations Between Meeting (vs Not Meeting) Single and All 3 Guidelines and Sex, BMI Category, Age, Caregiver Education Level, and Income

	Guidelines met			
	PA[a] aOR (95% CI)	Sleep[c] aOR (95% CI)	ST[b] aOR (95% CI)	PA + ST + sleep aOR (95% CI)
Model 1				
Sex				
Male	—		—	—
Female	0.69 (0.25–1.93)	0.95 (0.68–1.33)	**1.40 (1.03–1.91)**	**1.54 (1.10–2.16)**
Age, y				
5	—	—	—	—
6	1.34 (0.24–7.58)	0.88 (0.56–1.37)	0.85 (0.57–1.25)	0.78 (0.51–1.19)
7	0.63 (0.21–1.96)	0.86 (0.55–1.35)	1.04 (0.70–1.56)	0.86 (0.55–1.33)
8	0.56 (0.13–2.42)	0.65 (0.39–1.08)	**0.39 (0.22–0.69)**	**0.43 (0.23–0.80)**
Caregiver education				
Grades 11 or less	—	—	—	—
High school or GED	2.87 (0.63–13.04)	1.10 (0.66–1.84)	**0.44 (0.29–0.68)**	**0.52 (0.33–0.83)**
Attended college	1.30 (0.31–5.54)	0.91 (0.55–1.48)	**0.43 (0.29–0.66)**	**0.49 (0.32–0.76)**
Annual household income				
Under $10,000	—	—	—	—
From $10,000 to <$35,000	0.77 (0.22–2.71)	0.74 (0.50–1.09)	0.82 (0.56–1.20)	**0.60 (0.39–0.92)**
From $35,000 and more	1.10 (0.24–4.98)	1.29 (0.79–2.10)	1.31 (0.86–1.99)	1.24 (0.80–1.93)
Model 2				
BMI category				
Healthy weight	—	—	—	—
Overweight	1.88 (0.37–9.53)	0.68 (0.44–1.06)	**0.62 (0.40–0.96)**	**0.47 (0.28–0.78)**
Obese	0.47 (0.16–1.41)	0.87 (0.53–1.46)	**0.43 (0.26–0.71)**	**0.42 (0.24–0.74)**
Model 3				
WHtR				
Low risk (<0.5)	—	—	—	—
High risk (≥0.5)	**0.26 (0.09–0.79)**	1.22 (0.84–1.77)	**0.68 (0.49–0.97)**	0.75 (0.52–1.09)
Model 4				
Jurisdiction income				
High	—	—	—	—
Upper-middle	1.94 (0.50–7.52)	1.08 (0.70–1.67)	1.08 (0.72–1.64)	0.93 (0.59–1.45)
Lower-middle	1.21 (0.36–4.10)	2.46 (1.36–4.45)	**2.29 (1.49–3.54)**	**2.33 (1.48–3.67)**

Abbreviations: aOR, adjusted odds ratio; BMI, body mass index; CI, confidence interval; PA, physical activity; ST, screen time; WHtR, waist-to-height ratio. Note: Boldface indicates statistical significance ($P < .005$). Model 1 included sex, age, caregiver education, and household income. Model 2 included BMI z score categories, adjusted for sex, age, caregiver education, and household income. Model 3 included WHtR categories, adjusted for sex, age, caregiver education, and household income. Model 4 included jurisdiction income categories, adjusted for sex, age, caregiver education, and household income. All models were a generalized linear model with logit link with state of jurisdiction, clusters of communities and weighted for underlying populations size.
[a]Defined as PA ≥ 60 minutes every day.[1,2] [b]Defined as ST ≤ 2 hours each day.[1,3–5] [c]Defined as sleep duration per night between 9 and 11 hours (ages 6–13 y).[1,3–5]

caregivers with a midrange income were less likely to meet the guidelines than their respective peers.

One-quarter of children aged 5–8 years met integrated guidelines, which is driven by the low proportion of children who met the ST guideline. Seventy-eight percent of children met the sleep guideline, which is slightly higher than global studies in comparable ages.[31] Thirty-five percent of children met the ST guideline which is similar to other reported proportions.[32,33] Nearly all children met the PA guideline, which is comparable to a study in Republic of the Marshall Islands.[11] Although studies in rural Pacific regions suggest that higher rates of PA may be linked to traditional practices,[34] this may not necessarily apply to all jurisdictions in this study. In the context of rural Pacific regions, traditional practices may include cultural activities, fishing, agriculture, or forms of exercise integrated into daily life.[34] However, it is important to note that the diversity of traditional practices can vary widely across regions. We hypothesize that the high prevalence of PA may be linked to social–ecological factors at the environmental, organizational, or policy level.[11] For example, weather supporting outside activity all year-round, walking for transport, or PA policies within schools. Further research is needed to better explain this finding.

No statistical differences were observed between males and females meeting the PA guidelines. This is because almost all children met the guideline, resulting in smaller variability to detect significant differences. Females were more likely to meet ST

guidelines, which is consistent with existing literature.[35] This could be due to different types of ST activities males and females engage in, particularly considering the caregiver-reported ST survey only asked about TV, DVDs, and playing video games. Studies have found that males and females spend similar time watching TV; however, males accumulate more ST due to their use of technology for gaming purposes,[32,36] while females spend more time in texting, video chatting, and social networking.[37] This highlights the need for more recent data on ST usage in this population, given the rapid evolution of technology and increased access to technology in the last decade.

Children living with overweight or obesity were less likely to meet the ST guidelines, compared with children of a healthy weight. This is consistent with the literature, where children who meet the ST guidelines are less likely to be obese.[10] Exceeding ST recommendations is associated with higher-energy dense diets, lower intake of fruit and vegetables, higher intake of sugar-sweetened beverage computation, and fast food intake, which are all linked to unhealthy weight gain.[38] Increased ST leads to higher exposure to food marketing, which has been shown to increase snacking, particularly in overweight and obese children.[39,40] Children who were deemed at risk of abdominal obesity were less likely to meet the PA guidelines than children in the low-risk category; however, this association was not observed for BMI measure. While there are few child studies comparing associations between PA and WHtR and BMI, one study found that WHtR had a stronger inverse relationship with PA than BMI in adults.[41] This suggests the importance of including multiple measures in future studies to more accurately report adiposity levels.

Children aged 8 years had higher proportions of ST than 5-year-olds. Higher rates of ST in older children may be attributed to later bedtimes, increasing the likelihood of watching TV with their household or perhaps increased presence of TVs in bedrooms.[42] Family-related factors such as caregiver role modeling, ST rules, and access to screens are more likely to impact young children's behaviors, whereas older children are additionally impacted by social, cultural, and physical environments.[42] This suggests that social and cultural environmental interventions focusing on young children's ST levels are required to maximize the establishment of healthy screen behaviors in early life and into adolescence and adulthood.[42]

Higher education of caregivers was negatively associated with children meeting ST guidelines. This contrasts a study, which found that lower caregiver education was negatively associated with ST in children 0–18 years in both high-income and upper-middle-income countries.[43] Another review reported equivocal findings on caregiver education and associations with ST.[42] Our findings differ from other higher-income countries, where families with higher levels of education tend to have higher proportions of children meeting the ST guidelines.[43,44] This may be due to the large number of middle-income jurisdictions within the sample. Evidence from middle-income countries suggests that children of highly educated caregivers spend more time using electronic media for recreation than children of less educated caregivers.[45] While a higher disposable income may provide greater access to screens and electronic devices, there may be other reasons within the local context. Educated parents may be more likely to work longer hours, or they may spend more time traveling to and from work.[46]

Children from lower-middle-income jurisdictions were twice as likely to meet the guidelines for ST (and combined guidelines) compared with children from high-income jurisdictions. Greater access to screens has been shown to increase ST duration in children and adolescents.[47] World Bank data show lower rates of individuals using the internet in middle-income countries compared with high-income jurisdictions.[48] This suggests less access to screens in lower-income jurisdictions. The lower proportions meeting ST guidelines in high-income jurisdictions may be explained by the greater availability of mobile devices, cable TV, and multiple TVs in households, compared with lower-middle-income jurisdictions that may have fewer screens and channels available or less access to reliable internet and subsequent platforms (eg, YouTube). The scarcity of screen-based options in lower-middle-income settings could inadvertently lead to a higher likelihood of children meeting ST guidelines. This may also contribute to unique behavioral patterns, where children in lower-middle-income jurisdictions are more likely to adhere to ST recommendations and to also exhibit higher proportions of meeting all 3 combined guidelines.

Findings indicate that children from families within the midrange annual household income were less likely to meet the integrated movement guidelines compared to those in the lower or higher household income category. These children were also less likely to meet each guideline individually; however, none of these associations were significant, suggesting that guidelines should be considered holistically in addition to individually.[7,10] While few studies have reported results for integrated guidelines in this age group,[7] these results suggest that children from families with midrange incomes may face unique challenges that prevent them from achieving the recommended levels of PA, sleep, and ST.

To date, the majority of existing PA and sleep data on children aged 5–8 years in the Pacific Islands has been collected from parent reports, likely due to the lack of accessibility to accelerometers and the cost-effectiveness of parent reports. The findings of this study differ somewhat from the existing literature, particularly in the relationship between income and health behaviors. This difference may be attributed to the greater accuracy of accelerometry over parent- or self-report in measuring PA and sleep in children. Accelerometers offer more precise measurements, overcoming limitations with parent-report, such as recall bias and social desirability bias.[49] Research has demonstrated that accelerometry data can highlight insights missed by self-report measures, as evidenced by a study on Pacific adolescents' PA levels.[50] Additionally, by capturing real-time, continuous data, accelerometers provide a nuanced understanding of daily activity patterns, which may be influenced by various factors, including cultural practices. This allows accelerometers to better capture activities and practices contributing to PA and sleep compared with retrospective parent reports. This enhanced accuracy could contribute to the disparities in the existing literature regarding children meeting PA and sleep recommendations in the Pacific Islands. Consequently, when comparing against the existing literature, it is important to consider most comparisons are made against parent-reported data and guidelines that historically required daily adherence to each recommendation. The current guidelines recommend achieving an average level of PA, ST, and sleep over a 24-hour period, which may contribute to disparities in the reported number of children meeting these guidelines when compared with earlier evidence.

Implications

This study adds to the literature by providing device-based evidence on the proportions of children meeting PA and sleep, as well as caregiver-reported ST guidelines. These data are comparable to international prevalence data, which to date have not been available

in the USAP region and highlight differences from Western-dominated discourses. Contrasting our results with the literature offers insights into the potential influence of sociocultural and environmental considerations. It emphasizes the need to shift from a one-size-fits-all approach to a more tailored understanding of health promotion within the USAP region. Moreover, these differences underline the importance of locally driven research that accounts for sociocultural intricacies, ultimately fostering more effective health interventions.

Strengths and Limitations

Strengths of this study include reporting compliance with integrated movement behavior guidelines from a large sample size in an underresearched population. Device-based measures of PA and sleep, which are more reliable than self-reported data, were used. Limitations include the caregiver-reported ST only capturing TVs, videos, DVDs, and inactive video games, which may have failed to capture time spent on computers, handheld devices, or time spent using screens for educational purposes. Additionally, the non-weighted calculation of sleep averages, based on specific days rather than distinguishing between weekends and weekdays, may introduce bias due to sampling variations. Data were collected in 2012–2014 and may not reflect current levels of movement behaviors in the USAP region. ST data will likely have changed due to increasing access and reliance to the internet, screens, and devices. Despite these limitations, we present these most recent data available on this population. Future research may consider collecting more comprehensive ST data to account for changes in technology and up-to-date device-based PA and sleep data across both the USAP and wider Pacific regions.

Conclusions

In conclusion, almost all children aged 5–8 years assessed met the PA guidelines, three-quarters met the sleep guidelines, and one-third of children assessed met the ST guidelines, with only one-quarter meeting the integrated guidelines. Both sociodemographic factors (sex, age, jurisdiction income level, and caregiver education level) and adiposity level partly explain the variability of children meeting ST and sleep guidelines within the USAP region. Future intervention efforts should aim to increase compliance with the integrated guidelines, specifically ST guidelines, and should prioritize males, those who are overweight, older children, and those living in high-income jurisdictions.

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Appendix

Table A1 Descriptive Characteristics of the Study Population

Characteristic	Total sample, n = 1432	Analytical sample size, n = 1192
Sex, n (%)		
Male	727 (51)	600 (50)
Female	697 (48)	584 (49)
Missing	8 (1)	8 (1)
Age, y, n (%)		
5	580 (41)	486 (41)
6	378 (26)	309 (26)
7	284 (20)	236 (20)
8	190 (13)	161 (13)
Caregiver education, n (%)		
Grades 11 or less	343 (24)	290 (24)
High school or GED	499 (35)	407 (34)
Attended college	586 (41)	491 (41)
Missing	4 (0)	4 (0)
Annual household income (US dollars), n (%)		
Under $10,000	503 (35)	424 (36)
$10,000 to <$35,000	341 (24)	272 (23)
≥$35,000	254 (18)	210 (17)
Missing	334 (23)	286 (24)
BMI category, n (%)		
Thinness	8 (1)	8 (1)
Healthy weight	990 (69)	835 (70)
Overweight	219 (15)	171 (14)
Obese	207 (14)	170 (14)
Missing	8 (1)	8 (1)
WHtR, n (%)		
Low risk (<0.5)	895 (62)	755 (63)
High risk (≥0.5)	483 (34)	391 (33)
Missing	54 (4)	46 (4)
Jurisdiction income, n (%)		
High	813 (57)	693 (58)
Upper-middle	334 (23)	245 (21)
Lower-middle	285 (20)	254 (21)

Abbreviations: BMI, body mass index; WHtR, waist-to-height ratio.

Table A2 Weighted Proportion of USAP Region Children Meeting Guidelines for PA, ST, and Sleep by Jurisdiction

	Total % (95% CI)	Palau[U,d]	Yap (FSM)[L,d]	Guam[H]	CNMI[H]	Chuuk (FSM)[L,d]	Pohnpei (FSM)[L,d]	Kosrae (FSM)[L,d]	Republic of the Marshall Islands[U,d]	American Samoa[U]	Hawaii[H]	Alaska[H]
Total n	1192	51	52	228	226	65	55	82	63	131	130	109
PA[a] % (95% CI)												
Males	98 (96.8–99.5)	100 (100.0–100.0)	100 (100.0–100.0)	100 (100.0–100.0)	98 (95.8–100.0)	96 (87.5–100.0)	97 (90.1–100.0)	100 (100.0–100.0)	96 (89.4–100.0)	100 (100.0–100.0)	100 (100.0–100.0)	93 (85.5–100.0)
Females	97 (95.2–98.5)	100 (100.0–100.0)	95 (84.6–100.0)	98 (94.7–100.0)	96 (92.4–99.9)	100 (100.0–100.0)	92 (80.3–100.0)	98 (94.0–100.0)	97 (92.0–100.0)	97 (93.3–100.0)	100 (100.0–100.0)	91 (80.1–100.0)
Total	98 (96.2–98.0)	100 (100.0–100.0)	97 (92.3–100.0)	99 (97.3–100.0)	97 (95.0–99.4)	98 (92.8–100.0)	95 (88.4–100.0)	99 (97.2–100.0)	97 (92.7–100.0)	98 (96.4–100.0)	100 (100.0–100.0)	92 (86.0–98.9)
Sleep[c] % (95% CI)												
Males	77 (73.8–80.9)	65 (44.7–84.9)	86 (72.2–99.4)	70 (60.0–79.0)	72 (63.2–80.1)	89 (79.3–98.0)	90 (79.1–100.0)	82 (69.3–94.4)	75 (57.8–91.3)	71 (59.6–82.9)	84 (73.1–94.0)	82 (71.4–91.7)
Females	78 (75.0–82.1)	78 (59.4–96.0)	85 (69.7–99.4)	77 (68.6–85.3)	75 (66.5–83.3)	95 (87.2–100.0)	88 (74.2–100.0)	86 (74.7–96.5)	74 (59.0–89.6)	79 (69.1–88.8)	75 (65.0–85.9)	72 (57.0–88.0)
Total	78 (75.4–80.0)	70 (56.4–84.5)	85 (75.5–95.3)	73 (67.0–79.6)	73 (67.2–79.2)	90 (83.7–96.7)	89 (81.1–97.5)	84 (75.9–92.3)	74 (63.1–85.7)	75 (67.7–82.9)	79 (71.8–86.6)	78 (69.1–86.8)
ST[b] % (95% CI)												
Males	33 (28.5–36.6)	22 (4.6–39.5)	49 (28.8–68.5)	21 (13.1–29.7)	19 (12.0–26.5)	65 (48.2–86.3)	41 (22.1–59.2)	26 (12.0–39.6)	58 (39.4–76.9)	25 (14.0–36.2)	22 (11.0–33.6)	49 (33.7–63.7)
Females	38 (34.2–42.5)	23 (2.9–42.7)	50 (29.3–71.0)	19 (11.4–27.0)	33 (23.7–41.6)	87 (72.5–100.0)	67 (48.7–86.1)	39 (24.0–54.7)	56 (39.5–73.4)	29 (17.8–39.5)	23 (12.5–33.6)	54 (36.7–70.8)
Total	35 (32.6–38.0)	22 (9.2–35.5)	49 (34.4–63.0)	20 (14.6–26.0)	26 (19.9–31.5)	73 (60.7–84.7)	55 (41.8–68.4)	32 (21.4–41.7)	57 (44.6–69.7)	27 (19.2–34.7)	23 (14.9–30.3)	51 (39.5–62.0)
PA + ST + sleep % (95% CI)												
Males	24 (19.9–27.4)	13 (0.0–27.6)	40 (20.9–59.9)	14 (6.6–20.9)	14 (7.5–19.9)	50 (32.0–67.4)	34 (15.9–52.0)	19 (6.3–30.8)	33 (14.7–50.6)	15 (6.0–24.0)	18 (8.0–28.8)	38 (23.1–52.3)
Females	31 (26.8–34.7)	17 (0.0–35.2)	48 (26.9–68.7)	14 (6.7–20.6)	22 (14.4–30.1)	84 (69.2–99.5)	51 (31.3–71.0)	37 (22.1–52.5)	37 (21.2–53.8)	22 (11.9–31.6)	19 (9.4–29.3)	45 (28.8–62.1)
Total	27 (24.6–30.0)	15 (3.6–26.3)	44 (29.3–57.7)	14 (8.7–18.7)	18 (12.8–22.8)	63 (49.8–75.5)	44 (31.0–57.6)	27 (17.3–36.6)	35 (23.3–47.5)	19 (11.8–25.3)	19 (11.6–26.0)	41 (29.8–51.8)

Abbreviations: CI, confidence interval; CNMI, Comm of the Northern Mariana Islands; FSM, Federated States of Micronesia; PA, physical activity; USAP, US Affiliated Pacific. Note: A generalized linear model with logit link with state of jurisdiction, clusters of communities, and weighted for underlying population size.

[a]Defined as PA ≥ 60 minutes every day.[1,2] [b]Defined as screen time ≤ 2 hours each day.[2–5] [c]Defined as sleep duration per night between 9 and 11 hours (ages 6–13 y). [d]Freely associated states. [2–5] [H]High-income jurisdiction. [L]Lower-middle-income jurisdiction. [U]Upper-middle-income jurisdiction.