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Associations Between Breaks in Sedentary Time and Body Size in Pacific Mothers and Their Children: Findings From the Pacific Islands Families Study

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***Background*:** Breaks in sedentary behavior are associated with reduced body size in general populations. This study is the first to consider the relationship between objectively assessed sedentary breaks and body size in Pacific children and their mothers. ***Methods*:** Pacific children aged 6 years (n = 393) and their mothers (n = 386) residing in New Zealand were invited to participate in 2006. Sedentary time was assessed via accelerometry. Average frequency, duration, and intensity of breaks in sedentary time per hour were calculated. Waist circumference was assessed and demographic factors collected via questionnaire. Relationships between waist circumference and potential associated factors for participants were assessed using linear regression analyses. ***Results*:** Accelerometer data were obtained from 126 children (52 boys) and 108 mothers. Mean (standard deviation) waist circumference values for mothers and children were 114 cm (20.1 cm) and 59.4 cm (7.8 cm), respectively. For mothers, time spent sedentary and being an ex/nonsmoker were positively related to waist circumference. For children, watching television every day and having a mother with a high waist circumference was associated with a greater waist circumference. ***Conclusion*:** Strategies that focus on reducing sedentary time in Pacific mothers and on encouraging television free days in young Pacific children are recommended.

***Keywords*:** physical activity, child health, accelerometry, obesity

A substantive body of evidence demonstrates the overwhelming health benefits of physical activity in children and adults, perhaps most salient being a reduced risk of obesity, cardiovascular disease, and type 2 diabetes.[1–3] More recently, the negative effect of sedentary behaviors on health independent of the positive effects of physical activity has become evident.[4,5] Sitting time in adults has been associated with mortality (predominantly due to cardiovascular disease), irrespective of physical activity levels.[6,7] Likewise, television viewing has been associated with increases in biomarkers of metabolic syndrome in adults, independent of confounders including physical activity.[8]

There is also a convincing body of evidence for the negative effect of television watching and accelerometer-derived sedentary time on body size in children. Children's television watching has consistently been related to increased body size in longitudinal, cross-sectional, and intervention studies.[9–11] For example, a longitudinal investigation of New Zealand children assessed biannually between the ages of 3–15 years showed significant associations between television watching and body mass index and prevalence of overweight at all ages.[12] In a nationally representative sample of United States (US) boys and girls aged 8–16 years, a dose-response relationship was found, with obesity prevalence lowest in children who watched television for 1 hour or less per day and highest in those who watched 4 or more hours of television per day.[13] Mediators for this relationship may include increased snacking, increased consumption of foods dense in fat, sugar, and calories, and decreased activity levels.[9]

The physiological processes that occur in direct response to sedentariness may also help to explain these findings. Prolonged periods of inactivity initiate cellular processes in skeletal muscle that determine glucose and plasma triglyceride metabolism.[14] These processes result in reduced insulin sensitivity and altered lipid metabolism, both of which are key symptoms of the metabolic syndrome. Accordingly, it is of interest to consider both the amount and patterns of sedentary behavior individuals accumulate. Advancing on earlier research, Healy et al.[15,16] investigated the effect of breaks in sedentary

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behavior on biomarkers of cardio-metabolic disease in Australian and US adults. Their findings showed that independent of both time spent sedentary and in moderate-to-vigorous physical activity (MVPA), increased breaks in sedentary time were beneficially associated with reduced body size, triglycerides, 2-hour blood glucose, and C-reactive protein. It remains to be determined if these relationships also exist in childhood, or for specific population groups.

Pacific peoples living in New Zealand exhibit high levels of cardiovascular disease, obesity, and type 2 diabetes.[17] Accordingly, this is a population group who may especially benefit from reduced sedentary behavior and perhaps increased breaks in sedentary time. Previous research in Pacific children has shown that watching television every day was associated with body fatness, however no relationships were found for objectively-derived time spent sedentary, in light physical activity, moderate physical activity, or in MVPA.[18] Moreover, it is likely that television watching is more easily amenable than other more potentially intimidating behaviors (eg, increasing MVPA) for those who are least active and, therefore, most at risk for suboptimal health outcomes associated with sedentariness. Whether breaks in sedentary behavior are associated with body size in this population is not known. Further, no examination of objectively assessed activity in relation to body size has been conducted in Pacific adults. The aim of the current study was thus to investigate the relationship between sedentary breaks and body size in a sample of Pacific children and their mothers.

Methods

Participants and Recruitment

The Pacific Islands Families: Child and Parental Physical Activity and Body Size (PIF:PAC) study was a nested cross-sectional subsample (n = 393) of 6-year-old Pacific children and their families participating in the longitudinal Pacific Islands Families (PIF) study.[19] Detailed methodology and participant characteristics from the PIF[19] and PIF:PAC[20] studies have been reported previously. The first 393 children and their mothers contacted for the PIF study 6-year phase (2006–2007) were concurrently invited to participate in the PIF:PAC study. Only those families who consented to participate in the PIF:PAC study with singleton full-term births to mothers without a history of diabetes are included here.

Ethical approval for the PIF and related studies was obtained from the Northern X Ethics Committee, the Royal New Zealand Plunket Society and the South Auckland Health Clinical Board. Conduct of the study complies with the ethical standards for human experimentation as established by the Helsinki Declaration.

Measures

Body Size. A Lufkin W606 PM anthropometric tape was placed around the waist (under clothing) with the participant breathing quietly. The perimeter at the level of the noticeable waist narrowing located approximately half-way between the costal border and the iliac crest was measured to the nearest 0.1 cm. Measurements were made in duplicate and the average of these measures used. If the measurements differed by more than 1 cm, a third measure was taken and the average of the closest 2 measures used. Waist circumference was classified as high or otherwise using the criteria established by Taylor et al[21] for 6-year-old boys (60.4 cm) and girls (59.2 cm) and an ethnic-specific threshold for Polynesian females (98 cm) was used for mothers.[22]

Participant Demographics and Potential Covariates. Maternal demographic information was collected from the full PIF study 6-year measurement wave, including marital status (married/de-facto or single), current employment status (full/part time employment, student/caregiver, or unemployed/seeking work), education status (no formal education, secondary school qualification, postsecondary school qualification), and household income (classified into tertiles: low, medium, or high). Information on alcohol intake (never or at least sometimes) and smoking status (current smoker or ex-smoker/nonsmoker) was also gathered. Child and maternal age were calculated as at the date of the interview, using date of birth data collected at PIF baseline. Mothers were also asked whether their child watched television almost every day or not.

Physical Activity. Participants were provided with an Actical accelerometer (Mini-Mitter, Bend, OR) attached to a purpose-made belt, shown appropriate placement of the accelerometer (above the right iliac crest), and asked to wear the belt for waking hours over the next 8 days except when bathing or participating in water sports. Parents were asked to ensure their child wore the accelerometer belt. Accelerometers were set to record data in 1 minute epochs.

Accelerometer Data Reduction

Start and end times of daily accelerometer wear were manually set using the custom interval feature within the Actical software, using the first and last data points of the day and cross-checks with compliance questionnaires. Custom interval and raw accelerometer count data were extracted from the Actical software, and the custom interval information used to automatically extract data for wear times only. Full details of this process have been described previously.[23] Individuals with at least 7 hours of data on at least 3 days were included in analyses.[24,25] Previous research with youth has shown no benefit to stipulating inclusion of a weekend day in terms of reliability of data.[24,25] Therefore, in the interest of data retention, existence of a weekend day was not required for inclusion in analyses. For children, accelerometer count thresholds per minute (cpm) of < 100 cpm and ≥ 1500 cpm were applied to determine minutes spent sedentary (SED^t) and in MVPA ($MVPA^t$), respectively.[26] Although a threshold of 0 counts per 15-second epoch using Actical accelerometers has been recommended for classifying sitting in office-based working adults, large individual differences were found in the accuracy of this threshold in this small, specific sample.[27] As no other validated count thresholds exist for Actical accelerometer data in general adult populations, the Actical software-derived classification of activity intensity was used to calculate average minutes per hour spent sedentary (SED^t) and in MVPA ($MVPA^t$; software-derived moderate and vigorous categories were combined for MVPA). Bouts of time spent in each category were determined. Within any given MVPA bout, an allowance of 2 epochs (minutes) where accelerometer cpm were below the specified threshold was made, and these epochs included as part of the active bout. Breaks in sedentary time were treated as any interruptions in sedentary time; for children this was defined as instances where the accelerometer counts reached or exceeded 100 cpm, for adults this was classified as instances where epochs were classified as nonsedentary using the software-derived classification of intensity. Descriptive information for time and percentage of time spent in each activity intensity as well as the average frequency of breaks from being sedentary per hour (SED^b), average accelerometer cpm when being nonsedentary (SED^{bi}), and average duration (minutes) of sedentary breaks (SED^{bd}) was calculated for the time worn.

Statistical Analysis

Waist circumference was used to characterize body size in this study. It was treated as a continuous variable in all analyses to maximize statistical power and to mitigate potential issues with the homogeneity found in maternal waist circumference classification (ie, high versus low/normal). The distribution of waist circumference values was investigated using histograms, symmetry plots, normal probability plots, and normal quantile plots. Data transformations were undertaken, where necessary, to improve the normality of this primary dependent variable of interest. To aid interpretation and analytical robustness, maternal waist circumference measurements were centered around their mean for analyses where this variable was considered as a potential predictor variable for children's waist circumference.

Pearson correlation coefficients between physical activity variables (SED^b, SED^{bi}, SED^{bd}, SED^t, $MVPA^t$) were calculated for children and for mothers. Comparisons between children's activity variables and maternal activity variables were examined using paired (ie, mother and child matched) 2-sample *t* tests. Bivariable linear regression between 1) waist circumference and activity variables, and 2) waist circumference and potential demographic associates were conducted separately for mothers and children.

All factors with Wald's *P*-values < 0.20 in the bivariable analyses were considered simultaneously in multiple linear regression analyses.[28] Before eliminating any variables, multicollinearity between variables included in the initial multivariable model was determined using the variance inflation factor (VIF). A VIF > 10 was used to define serious multicollinearity.[29,30] Backward elimination of factors with p-values of > 0.05 was then conducted until the most parsimonious model (all factors *P* < .05) was identified. Two factor interaction terms for all remaining variables were then included in the model and retained if all factors in the model remained significantly associated with the dependent variable (*P* < .05). Residuals of the final model were tested to check for normality (using Shapiro-Wilk's test and histograms). Independent *t* tests and 1-way analysis of variance were employed to identify whether any significant differences existed between participants included and excluded from analyses for demographic factors and factors remaining in the multivariable models. All analyses were undertaken using Stata IC version 10.0 (StataCorp, TX, US).

Table 1 Participant Characteristics

Variable	n* (%)
Maternal characteristics	
Waist circumference	
Low/normal	4 (4)
High	104 (96)
Smoking status	
Current smoker	33 (32)
Ex-smoker/nonsmoker	70 (68)
Alcohol consumption	
Never	72 (68)
Sometimes/regularly	34 (32)
Marital status	
Married/de-facto	83 (77)
Single	25 (23)
Employment status	
Full-/part-time employment	41 (38)
Student/caregiver	52 (48)
Unemployed/seeking work	15 (14)
Highest qualification	
No formal education	30 (28)
Secondary school qualification	24 (22)
Post-secondary school qualification	54 (50)
Household income	
Low (≤ $30,000 p.a.)	31 (30)
Medium ($30,001–$50,000 p.a.)	37 (36)
High (> $50,000 p.a.)	34 (33)
Child characteristics	
Sex	
Male	52 (41)
Female	74 (59)
Waist circumference	
Low/normal	53 (42)
High	73 (58)
Watch television every day	
No	42 (33)
Yes	84 (67)

* All participants meeting inclusion criteria were included in analyses (N = 126 children, 108 mothers); however, some data for other items (eg, smoking status) were missing.

Note. Data were collected in Auckland, New Zealand, in 2006.

Abbreviations: p.a., per annum.

Results

Of the 386 families (386 mothers, 393 children) invited, 254 mothers and 261 children consented to participate. Data were retained for 108 mothers and 126 children (52 boys); data loss was predominantly due to accelerometer failure (23% of children, 32% of mothers) and exclusion of participants due to insufficient data (ie, noncompliance with the research protocol; 22%). No systematic differences in demographic information, waist circumference, smoking (mothers only), or television watching (children only) were found between participants who were excluded or included in analyses. Mothers were aged between 20.8 and 48.5 years (mean 34.7 years), with waist circumference values ranging from 55.3 cm to 188.0 cm (mean 111.4 cm). Children were aged 5.9 years (range 5.8–6.7 years), with waist circumference values ranging from 48.2 to 95.4 cm (mean 59.4 cm). Table 1 shows further demographic and household characteristics.

The distribution of raw maternal and child waist circumference measurements were significantly different from normal (Shapiro-Wilk's $P = .003$ and $P < .001$, respectively). A square-root transformation of maternal measurements and a 1/cubic transformation of child measurements [using the transformation equation y = 1/(x^3)] resulted in an improved normal distribution (Shapiro Wilk's $P = .510$ and $P = .199$, respectively).

Descriptive information for the accelerometer-derived physical activity variables for mothers and children is provided in Table 2. On average, children exhibited greater frequency of breaks in sedentary time per hour (6.6 versus 3.1 breaks/hour), which were of shorter duration (4.2 minutes versus 8.2 minutes), and of more than twice the intensity (865 cpm versus 319 cpm) than mothers. All differences between mothers' and children's physical activity variables were significantly different (all Student's paired *t* tests, $P < .001$). As can be seen in the correlation matrix for children's and mothers' physical activity variables (Table 3), correlations were similar for children and mothers and with the exception of SED^b there was generally a high degree of correlation between variables.

Tables 4 and 5 show the results from the bivariable regression analyses and the final multivariable models for mothers and children, respectively. After backward elimination, SED^t and smoking status both remained significant predictors of maternal waist circumference. On average, current smokers had waist circumference values that were 7.8 cm less than ex- or nonsmokers (after accounting for SED^t at a median of 35.3 minutes; $P = .40$). Taking the effect of smoking status into account, SED^t was positively associated with maternal waist circumference, with mean differences of 3.5–4 cm found between quartiles. No serious multicollinearity was identified in the initial multivariable model for mothers (median VIF = 2.19, range 1.28–8.64) or children (median VIF = 1.03, range 1.01–1.03).

Table 2 Mother and Child Accelerometer-Derived Physical Activity Characteristics

	Mothers	Children
Physical activity variable	Mean (min, max)	Mean (min, max)
Hours	82.9 (30.6, 139.6)	84.8 (29.3, 140.4)
SED^t	34.6 (18.3, 53.2)	31.9 (23.1, 44.6)*
$MVPA^t$	9.0 (0.1, 21.4)	4.6 (0.7, 9.6)*
SED^b	3.1 (1.5, 4.2)	6.6 (5.0, 8.5)*
SED^{bi}	319 (145, 578)	865 (502, 1374)*
SED^{bd}	8.2 (4.1, 18.9)	4.2 (2.8, 6.2)*

* Significantly different to children ($P < .001$) in paired *t* tests (n = 80 mothers, 80 children).

Note. Data were collected in Auckland, New Zealand, in 2006.

Abbreviations: Hours, hours of valid data; max, maximum; min, minimum; $MVPA^t$, average minutes/hour spent in moderate-to-vigorous physical activity; SED^b, average frequency of breaks from being sedentary per hour; SED^{bd}, average duration (minutes) of sedentary breaks; SED^{bi}, average accelerometer counts per minute when being nonsedentary; SED^t, average minutes/hour spent sedentary.

Table 3 Correlation Matrix for Accelerometer-Derived Physical Activity Characteristics for Mothers and Children

	SED^t	$MVPA^t$	SED^b	SED^{bi}	SED^{bd}
Variable	Mo., Child	Mo., Child	Mo., Child	Mo., Child	Mo., Child
SED^t	1.00, 1.00				
$MVPA^t$	–0.86, –0.64	1.00, 1.00			
SED^b	–0.30, –0.14	–0.00, –0.16	1.00, 1.00		
SED^{bi}	–0.56, –0.40	0.77, 0.93	–0.09, –0.23	1.00, 1.00	
SED^{bd}	–0.86, –0.86	0.87, 0.68	–0.20, –0.38	0.60, 0.49	1.00, 1.00

Note. Data were collected in Auckland, New Zealand, in 2006.

Abbreviations: Mo., mothers; Child, children; $MVPA^t$, average minutes/hour spent in moderate-to-vigorous physical activity; SED^b, average frequency of breaks from being sedentary per hour; SED^{bd}, average duration (minutes) of sedentary breaks; SED^{bi}, average accelerometer counts per minute when being nonsedentary; SED^t, average minutes/hour spent sedentary.

Table 4 Results of Bivariable and Multivariable Regression Between Maternal Waist Circumference and Potential Predictor Factors

Variable	n	Mean† (95% CI†)	*P*-value
Bivariable analyses			
Smoking status	103		0.084*
Ex-smoker/nonsmoker		113.0 (108.6, 117.5)	
Current smoker		106.1 (99.9, 112.6)	
Alcohol consumption	106		0.077*
Never		112.5 (107.9, 117.1)	
Sometimes/regularly		105.3 (98.9, 111.9)	
Marital status	108		0.269
Married/de-facto		111.6 (107.4, 116.0)	
Single		106.7 (99.1, 114.5)	
Employment status	108		0.165*
Full-/part-time employment		108.3 (102.4, 114.4)	
Student/caregiver		114.0 (108.6, 119.6)	
Unemployed/seeking work		104.3 (94.8, 114.3)	
Highest qualification	108		0.648
No formal education		110.6 (103.5, 117.9)	
Secondary school qualification		107.3 (99.5, 115.4)	
Post-secondary school qualification		111.9 (106.5, 117.3)	
Household income	102		0.825
Low (≤ $30,000 p.a.)		108.9 (102.2, 115.8)	
Medium ($30,001–$50,000 p.a.)		111.7 (105.5, 118.1)	
High (> $50,000 p.a.)		109.6 (103.2, 116.2)	
Age	108		0.748
Quartile 1 (29.6 years)		110.0 (105.3, 114.8)	
Median (33.8 years)		110.4 (106.6, 114.2)	
Quartile 3 (40.7 years)		111.0 (106.0, 116.2)	
Physical activity			
SED^t	108		<0.001*
Quartile 1 (30.6 min)		106.4 (102.4, 110.6)	
Median (35.3 min)		111.1 (107.6, 114.8)	
Quartile 3 (39.2 min)		115.1 (110.7, 119.7)	
$MVPA^t$	108		0.006*
Quartile 1 (6.0 min)		114.2 (109.7, 118.8)	
Median (8.2 min)		111.5 (107.8, 115.3)	
Quartile 3 (11.3 min)		107.8 (103.8, 111.9)	
SED^b	108		0.849
Quartile 1 (2.8)		110.2 (105.6, 114.9)	
Median (3.1)		110.5 (106.7, 114.3)	
Quartile 3 (3.3)		110.7 (106.4, 115.1)	
SED^{bi}	108		0.051*
Quartile 1 (244.6)		113.2 (108.6, 117.9)	
Median (289.2)		111.6 (107.7, 115.5)	
Quartile 3 (368.5)		108.7 (104.6, 112.8)	
SED^{bd}	108		<0.001*
Quartile 1 (6.6 min)		115.1 (110.7, 119.5)	
Median (7.8 min)		111.7 (108.1, 115.3)	
Quartile 3 (9.3 min)		107.3 (103.4, 111.2)	
Final multivariable model‡	103		
Smoking status			0.040
Ex-smoker/nonsmoker (reference)		113.8 (109.5, 118.2)	
Current smoker		106.0 (100.0, 112.1)	
Physical activity			0.002
SED^t			
Quartile 1 (30.6 min)		109.8 (105.1, 114.5)	
Median (35.3 min)		113.8 (109.5, 118.2)	
Quartile 3 (39.2 min)		117.3 (112.2, 122.5)	

* *P*-value < 0.20 and included in multivariable regression analyses.

† Transformed mean values and associated (95% CI) presented.

‡ R^2 for final multivariable model = 0.12.

Note. Data were collected in Auckland, New Zealand, in 2006. For ease of exposition, results for all continuous variables have been presented using the quartile 1, median, and quartile 3 values associated with each variable.

Abbreviations: $MVPA^t$, average minutes/hour spent in moderate-to-vigorous physical activity; SED^b, average frequency of breaks from being sedentary per hour; SED^{bd}, average duration (minutes) of sedentary breaks; SED^{bi}, average accelerometer counts per minute when being nonsedentary; SED^t, average minutes/hour spent sedentary; p.a., per annum.

Table 5 Results of Bivariable and Multivariable Regression Between Child Waist Circumference and Potential Predictor Factors

Variable	n	Mean† (95% CI†)	*P*-value
Bivariable analyses			
Sex			0.035*
Male	52	59.2 (57.6, 61.1)	
Female	74	57.0 (55.9, 58.3)	
Watch television every day			0.113*
No	42	56.8 (55.3, 58.5)	
Yes	84	58.5 (57.3, 59.8)	
Maternal waist circumference‡	117		0.047*
Quartile 1 (–12.5 cm)		57.5 (56.4, 58.8)	
Median (–3.0 cm)		58.0 (57.0, 59.1)	
Quartile 3 (10.0 cm)		58.7 (57.5, 60.0)	
Physical activity			
SED^t	126		0.766
Quartile 1 (28.9 min)		57.8 (56.6, 59.1)	
Median (32.1 min)		57.9 (56.9, 59.0)	
Quartile 3 (34.8 min)		58.0 (56.8, 59.3)	
$MVPA^t$	126		0.553
Quartile 1 (3.2 min)		58.1 (56.9, 59.5)	
Median (4.0 min		58.0 (57.0, 59.1)	
Quartile 3 (5.8 min)		57.7 (56.6, 59.0)	
SED^b	126		0.906
Quartile 1 (6.2)		57.9 (56.6, 59.2)	
Median (6.7)		57.9 (56.9, 59.0)	
Quartile 3 (7.0)		58.0 (56.8, 59.2)	
SED^{bi}	126		0.353
Quartile 1 (750.8)		58.2 (57.0, 59.5)	
Median (838.6)		58.0 (57.0, 59.0)	
Quartile 3 (944.9)		57.7 (56.6, 58.8)	
SED^{bd}	126		0.813
Quartile 1 (3.7 min)		58.0 (56.8, 59.4)	
Median (4.2 min)		57.9 (56.9, 59.0)	
Quartile 3 (4.8 min)		57.8 (56.6, 59.1)	
Final multivariable model§	117		
Watch television every day			0.042
No (reference)		56.7 (55.2, 58.4)	
Yes		59.0 (57.6, 60.4)	
Maternal waist circumference‡			0.022
Quartile 1 (–12.5 cm)		56.1 (54.5, 57.9)	
Median (–3.0 cm)		58.8 (57.5, 60.2)	
Quartile 3 (10.0 cm)		59.6 (58.1, 61.2)	

* *P*-value < 0.20 and included in multivariable regression analyses.

† Transformed mean values and associated (95% CI) presented.

‡ Values centered on 111.96 cm.

§ R^2 for final multivariable model = 0.07.

Note. Data were collected in Auckland, New Zealand, in 2006. For ease of exposition, results for all continuous variables have been presented using the quartile 1, median, and quartile 3 values associated with each variable.

Abbreviations: $MVPA^t$, average minutes/hour spent in moderate-to-vigorous physical activity; SED^b, average frequency of breaks from being sedentary per hour; SED^{bd}, average duration (minutes) of sedentary breaks; SED^{bi}, average accelerometer counts per minute when being nonsedentary; SED^t, average minutes/hour spent sedentary.

After backward elimination of nonsignificant factors, the most parsimonious model to explain child waist circumference was watching television every day and having a mother with a high waist circumference. Accounting for maternal waist circumference (at the centered median of –3.0 cm), watching television every day was associated with a mean increase in child waist circumference of 2.3 cm (P = .042). Allowing for television watching, maternal waist circumference was positively associated with that of their child, with a mean increase of 3.5 cm in children's waist circumference values found between the quartile 1 and quartile 3 values for centered maternal waist circumference (P = .022).

No significant 2-factor interaction terms existed for either the child or maternal multivariable models. Residual checks showed no significant divergence from a normal distribution for the final models for mothers or children (Shapiro-Wilk's P = .253 and P = .262, respectively).

Discussion

This is the first study to investigate breaks in sedentary time in children, and the first to simultaneously consider this factor in mothers and their children. We considered this variable in Pacific peoples, a high risk population group for poor health outcomes that may be ameliorated by changes in the patterning of sedentary behaviors. The investigation of factors related to health outcomes in this population is thus especially important for providing direction for public health interventions.

Taking the effect of smoking status into account, time spent being sedentary was associated increased maternal waist circumference. Healy et al[16] also observed a detrimental association between sedentary time and waist circumference in the nationally representative 2003–04 and 2005–06 US National Health and Nutrition Examination Surveys (NHANES). Their study also identified ethnic differences in associations between sedentary time and waist circumference, further exemplifying the importance of investigating these relationships in specific ethnic groups. In contrast, a small study of United Kingdom adults with a family history of diabetes reported no relationship between sedentary time and waist circumference.[31] The different diabetic status of target participants between studies is likely to explain this difference.

Accounting for maternal SED^t, current smokers had waist circumference values that were, on average, 7.8 cm less than ex/non smokers. Inconsistent relationships between body size and smoking have been previously reported, with positive[32] and negative[33] associations in Scottish women and US men, respectively. A recent study of over 6000 Swiss adults revealed that while current smokers had lower waist circumference values than nonsmokers, a dose response relationship existed for cigarettes smoked per day and central fat accumulation among smokers, particularly females.[34] It is recommended that smoking cessation initiatives consider the inclusion of weight control strategies for optimal health outcomes in this population.

No variables related to the frequency, intensity, or duration of breaks in sedentary behavior were related to maternal body size. This finding is in contrast with Healy et al,[15] who reported a negative relationship between breaks in sedentary time with waist circumference in a sample of 168 Australian adults and later found a negative relationship with waist in adults participating in recent NHANES surveys.[16] For both studies, associations were independent of potential confounders and time spent sedentary. Although Healy et al also employed 1 minute epochs in both studies, it is possible that the use of a 1 minute epoch was not sufficiently sensitive to capture meaningful variations in breaks in sedentary behavior (or MVPA) in this sample. It is also plausible that the different methodologies employed in the current study (eg, shorter data inclusion criteria, manual extraction of non wear time) may explain our nonsignificant findings. Although nonsignificant, both the intensity and duration of sedentary breaks were negatively associated with maternal waist circumference in the current study. It is possible that the small sample size limited the capacity to detect any significant relationships between sedentary breaks and body size. It is also likely that the relative homogeneity in high maternal waist circumference values further reduced our ability to detect any meaningful effects.

For children, waist circumference was associated with watching television every day, and having a mother with a high waist circumference. No significant associations were found with any of the objective physical activity measures, including breaks in sedentary time, the duration of sedentary breaks, or frequency of these breaks. Previous examination of associations of objectively assessed physical activity variables and percentage body fat in Pacific children have shown strikingly similar findings.[18] As noted above, it is possible that the choice of a 1-minute epoch may have hindered our ability to sensitively capture activity variations, potentially obscuring any relationship between the objective activity measures and body size. This may be especially important when considering that children participate in more sporadic, intermittent activity behaviors than their adult counterparts.[35,36]

Strengths and Limitations

While the use of accelerometry enabled the objective and detailed quantification of sedentary patterns, a substantial amount of data were lost due to accelerometer failure. Further, over a fifth of children and mothers were excluded due to noncompliance, limiting the overall sample size and producing potential bias. Given the lack of significant differences in factors found between those included and excluded, this potential bias is likely to be small. Accelerometry enables the objective and highly detailed quantification of physical activity over time and so remains the method of choice for gaining sensitive measures of physical activity intensity across the lifespan.[37–39] Future research may thus benefit from considering acceptability of objective activity monitoring with this population and developing strategies to encourage participation.

Waist circumference was chosen as the most appropriate measure of relative body size for the purposes of this study. Compared with other proxy measures of body size for age (eg, body mass index, skinfold thicknesses), waist circumference has been shown to have stronger associations with cardiovascular disease risk factors in adults.[40] Moreover, waist circumference was found to best predict total/high density lipoprotein ratio in both Pacific and non-Pacific children in the National New Zealand Children's Nutrition Survey.[41] The use of waist circumference for both mothers and their children also enabled age-related comparisons to be made. Nutritional practices were not assessed in the current study; it would be worthwhile considering this in future investigations of body size and activity patterns in this population.

Summary

Efficacious interventions are urgently required to improve body size outcomes in Pacific children and their mothers. Interventions that aim to reduce sedentary time in Pacific mothers and to promote television free days in young Pacific children are recommended.

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