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preschool, sedentary behavior, correlates, accelerometer

ABBREVIATION
PA—physical activity

All of the co-authors listed contributed to the development of this manuscript; Mr Byun contributed to the concept and design, drafting, revision, and interpretation of the data; Dr Dowda performed the statistical analysis and contributed to refining the data analyses, interpretation of the data, and drafting the manuscript; Dr Pate contributed to the study hypotheses, refining the data analyses, interpreting results, drafting the manuscript, and revising it through multiple drafts; and Drs Dowda and Pate contributed to supervision of study and the acquisition of the data.

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WHAT'S KNOWN ON THIS SUBJECT: A large proportion of preschool children spend significant amounts of time in sedentary behavior, but evidence regarding factors associated with objectively measured sedentary behavior in preschool children has been limited.

WHAT THIS STUDY ADDS: Objectively measured sedentary behavior in preschool children is influenced by multiple factors. Different correlates were identified for boys and girls. Such information will be helpful for future interventions to reduce sedentary behavior in preschool children.

abstract

OBJECTIVE: To identify correlates of objectively measured sedentary behavior in a diverse sample of preschool children.

METHODS: A total of 331 children (51% male, 51% black) from a wide range of ethnic and socioeconomic backgrounds in greater Columbia, South Carolina, were recruited for this study. Sedentary behavior (minutes/hour) was measured by using ActiGraph accelerometers (<37.5 counts per 15 seconds) over a 2-week period. All potential correlates except for anthropometric data of children were measured by a parent survey. Correlation and regression analyses were conducted to examine associations between 29 potential correlates across multiple domains (demographic, biological, psychosocial, behavioral, and physical environmental) and sedentary behavior measured by accelerometry in preschool children.

RESULTS: Girls spent more time in sedentary behavior than boys (33.2 vs 32.4 minutes/hour; $P = .05$). Six and 8 potential correlates were found to be significant in univariate analyses for boys and girls, respectively. In the gender-specific final model, for boys, a child's weekday TV/video games and physical activity equipment in the home were significant correlates of sedentary behavior ($R^2 = 0.091$). For girls, BMI *z* score and child's athletic coordination were significantly associated with sedentary behavior ($R^2 = 0.069$).

CONCLUSION: Several factors were identified as correlates of objectively measured sedentary behavior in American preschool children. However, there were no common correlates that influenced sedentary behavior for both boys and girls. Future interventions for reducing sedentary behavior could target correlates identified in this study. *Pediatrics* 2011;128:937–945

As a result of ubiquitous access to electronic media, low levels of physical activity (PA) and high levels of sedentary behavior are now major public health concerns. In addition, low PA and sedentary behavior are separate constructs, and both can affect health status. Sedentary behavior should be conceptualized not as the absence of moderate-to-vigorous PA, but as activities that do not increase energy expenditure substantially above the resting level, such as sitting, watching television, playing video games, using a computer, talking on the telephone, and listening to music.[1]

Recent data with representative samples of young American children revealed that a large proportion of preschool-aged children did not meet the sedentary behavior guideline of the American Academy of Pediatrics, which recommends limiting children's screen-based sedentary behavior to ≤2 hours/day.[2] The National Health and Nutrition Examination Survey, 2001 to 2006, found that more than one-third of children aged 2 to 5 years spent 2 or more hours per day watching TV and playing video games.[3] Findings from other cross-sectional[4] and longitudinal studies[5] also reported that >40% of preschool-aged children watched TV for >2 hours/day. Interestingly, children who watched more TV at an early age were more likely to watch TV in later childhood than those who did not.[5] Therefore, efforts to prevent excessive exposure to sedentary behavior in early childhood should be encouraged.

In studies it has been shown that excessive exposure to screen-based sedentary behavior in preschool children is associated with current[6,7] and future (from adolescent to adulthood) body fatness.[8–10] In addition, evidence is accumulating that objectively measured sedentary behavior is also associated with unfavorable metabolic risk profiles in children.[11,12]

As public health professionals become aware of the adverse health effects of excessive exposure to sedentary behavior, there are calls for developing and implementing effective interventions to reduce the prevalence of excessive sedentary behavior in US children. To accomplish this goal, researchers need to identify correlates of sedentary behavior, preferably modifiable factors, and develop interventions to target these correlates.

To date, in only a few studies have correlates of sedentary behavior in preschool children been investigated.[13–15] However, these studies have used subjective measures of sedentary behavior (eg, self- or parent-reported watching TV and playing video games), which are susceptible to reporting bias, especially in young children. Although watching TV and playing video games are the most common sedentary behaviors in young children, they may not represent overall sedentary behaviors (ie, the total amount of time spent in sedentary behavior). In fact, low correlations among different types of sedentary behaviors and even negative correlations between TV viewing and other sedentary behaviors in children have been reported[16,17]; thus, it is possible that a low correlation also exists between watching TV or playing video games and objectively measured sedentary behavior. For instance, some children who do not excessively watch TV or play video games may accumulate large amounts of sedentary time by engaging in other types of sedentary behavior (eg, reading books, playing with toys, listening to the music). Therefore, to quantify overall sedentariness and examine correlates of sedentary behavior in preschool children, a measure of sedentary behavior that captures all sedentary activities should be used.

To our knowledge, no study has determined correlates of objectively measured sedentary behavior in preschool children. The purpose of this study, therefore, was to identify correlates of sedentary behavior measured by accelerometry, in a diverse sample of preschool children.

METHODS

Participants

Participants were enrolled in the Children's Activity and Movement in Preschool Study, or CHAMPS. All 3- to 5-year-old children from the 22 participating preschools (commercial [n = 11], religious [n = 7], and Head Start [n = 4]) were invited to participate in the study. The 22 preschools were recruited from the greater Columbia, South Carolina, region, an area that includes a wide range of ethnic and socioeconomic backgrounds. Sedentary behavior and parent survey data at each preschool were collected during 2 data collection waves across a 28-month period (August 2003–January 2006). For the analyses in the current study, data for a total of 331 children (51% male; 51% black) were available after exclusion of data with missing variables (n = 99). The distribution of gender, age, race, BMI, and parent education was not different between children who were included and excluded. Written informed consent was obtained from children's parents or guardians before collection of data. The study was approved by the University of South Carolina institutional review board.

Measures

Objectively Measured Sedentary Behavior

For the present study, sedentary behavior was measured by ActiGraph 7164 (Pensacola, FL) accelerometers during a 2-week period. The accelerometers were initialized to save data in

15-second epochs to capture the sporadic activity patterns that are characteristic of 3- to 5-year-old children. Participants wore the accelerometers on an elastic belt on the right hip (anterior to the iliac crest). Parents were instructed to remove the accelerometer only during water activities (bathing, swimming) and when the child went to bed at night. When data are collected in 15-second epochs, the ActiGraph 7164 cannot store 2 weeks of data because of limited memory size. Therefore, accelerometers were replaced before the weekend and again on the following Monday. Data were later linked according to child. Accelerometer data were reduced by using activity intensity cut-points developed specifically for 3- to 5-year-old children to categorize intervals as sedentary activity ($<$ 37.5 counts per 15 seconds).[18] Sixty minutes of consecutive zeros were considered as nonwear time. Minutes per hour of observation of sedentary behavior were then calculated, using each child's wear time as the divisor. Days that children were absent from preschool and on which total wear time was $\geq$18 or $<$5 hours were excluded from the analyses because they do not represent typical days.

Potential Correlates of Sedentary Behavior

In the present study, all potential correlates except for anthropometric data of children were measured by a parent survey, which is adapted without major modification from previous research.[19,20] One parent or guardian (94% mother) for each child completed a survey to assess demographic, biological, psychosocial, behavioral, and physical environmental characteristics that were considered potential correlates in this study. The names, definitions, variable types and scales, and psychometrics of potential correlates are described in Table 1.

Demographic Correlates

Parents reported their child's age, race (black, white, other) and number of siblings living at home. Parents also reported their own age, education (as an indicator of socioeconomic status), job status, and racial/ethnic background.

Biological Correlates

Children's height was measured to the nearest 0.1 cm using a portable stadiometer (Shorr Productions, Olney, MD). Weight was measured to the nearest 0.1 kg using an electronic scale (model 770 [Seca, Hamburg, Germany]). The average of 2 measurements was used for both height and weight, and BMI was calculated (kg/m^2) from the averages. For statistical analyses, the BMI *z* score was created by assessing the deviation of each participant's value from the mean values reported in Centers for Disease Control and Prevention growth charts.[21] Children's birth weight also was reported by parents who completed the survey. Adult BMI was calculated from the parent's self-reported height and weight.

Psychosocial Correlates

Parents or guardians were asked to report their participation in moderate and vigorous PA, enjoyment of PA, and family support for children's PA. Family support was assessed by an average of responses to frequency of a number of habits. These included frequency of family encouraged PA, participated in PA with the child, provided transportation to PA facilities, watched the child in/activities, and told the child that PA is good. Parents also reported their perceptions regarding their child's enjoyment of PA, child's level of PA compared with other children, child's amount of PA, and importance of child participating in PA.

Behavioral Correlates

Parents or guardians reported their perception of child's athletic coordination compared with other children of the same age and gender, child's participation in organized sports and outdoor play, and child's choice of activity during his or her free time. Parents also were asked to report child's average time spent watching TV or playing video games during weekday and weekend days.

Physical Environmental Correlates

Parents or guardians reported the distance from their home to the nearest park where their child could be physically active or play sports, how often they took their child to the park, and their perception of the reputation of the closest park. PA equipment in the home and outdoor play area were assessed using a checklist of items that can be used by child. Parents also reported type of current residence where their child lives.

Statistical Analyses

Descriptive statistics (mean, SD, and percent) were calculated for the total group and by gender. Simple *t* test and 1-way analysis of variance were used to examine differences in sedentary behavior (minutes/hour) by gender, race, parent education, parent job status, and residence type. Pearson correlation coefficients were calculated between potential correlates and objectively measured sedentary behavior. All variables with *P* values of less than .10 were included as predictors of sedentary behavior in the final model-building process. To build the final model, a manual backward elimination model building process was performed. The PROC MIXED procedure in SAS (SAS Institute, Inc, Cary, NC) (linear mixed model) including preschool as a random variable was used to take into account the clustering effect of preschool on children's sedentary behavior. Because there were significant gender differences in sedentary behavior, the final mod-

TABLE 1 Potential Correlates of Objectively Measured Sedentary Behavior

Variable	Definition	Variable Type	Psychometric, ICC
Demographic			
Adult age	Current age of parent/guardian	Ordinal (1–7) [1: ≤25 y; 7: ≥75 y]	NA
Child age	Current age of child	Continuous: 2.8–5.7 y	NA
Siblings	No. of siblings living in the home	Nominal: 0, 1, or more	$R = 0.93$[a]
Race	Child's race/ethnicity	Nominal: black, white, other	$R = 1.00$[a]
Adult education	Parent/guardian education	Nominal: ≤high school, >high school	$R = 0.77$[a]
Adult job (yes/no)	Current parent/guardian employment	Nominal: yes or no	NA
Biological			
Adult BMI	Parent/guardian BMI	Continuous: 17.0–53.0	NA
Child BMI-*z*	Child BMI *z* score	Continuous: −6.2–6.7	NA
Birth weight	Weight when child was born (lb)	Continuous: 2.1–10.1	NA
Psychosocial			
Adult VPA	No. of days in the previous 7 d that he or she participated in vigorous exercise and/or sports for at least 20 min	Ordinal (1–8) [1: 0 d; 8: 7 d]	$R = 0.78$[b]
Adult MPA	No. of days in the previous 7 d that he or she participated in moderate exercise and/or sports for at least 30 min	Ordinal (1–8) [1: 0 d; 8: 7 d]	$R = 0.71$[b]
Adult enjoy PA	Adult enjoyment of PA	Ordinal (1–5) [1: not enjoyable; 5: very enjoyable]	$R = 0.76$[b]
Family support for PA	Average of responses to 5 items regarding parent/guardian and sibling's frequency of encouragement of PA, participation in PA with the child, provision of transportation to PA facilities, watching child's PA, and telling PA is good	Ordinal (1–5) [1: never; 5: daily]	$R = 0.81$[a]
Perceived enjoyment of PA	Child's enjoyment of PA	Ordinal (1–5) [1: not enjoyable; 5: very enjoyable]	$R = 0.87$[a]
Perceived enough PA	Child's amount of PA	Ordinal (1–3) [1: more than enough; 3: not enough]	NA
Perceived level of PA	Child's level of PA compared with others'	Ordinal (1–5) [1: much less; 5: much more]	NA
Perceived importance of PA	Importance of child's participating in PA	Ordinal (1–5) [1: very unimportant; 5: very important]	$R = 0.67$[b]
Behavioral			
Athletic coordination	Child's athletic coordination compared with others	Ordinal (1–5) [1: much less; 5: much more]	$R = 0.81$[a]
Choice of activity	Child's choice of activity in free time	Ordinal (1–5) [1: always sedentary activities; 5: always PA]	$R = 0.88$[a]
Participate in organized sports	Child's participation in organized sports (No. of sports)	Ordinal (1–5) [1: 0; 4: 4 or more]	NA
Outdoor play	Child's use of outdoor play area (number of days per week)	Ordinal (1–8) [1: 0 d; 8: 7 d]	NA
Weekday TV/video game	Child's watching TV or playing video games	Ordinal (1–6) [1: <1 h/d; 6: >5 h/d]	NA
Weekend TV/video game	Child's watching TV or playing video games	Ordinal (1–6) [1: <1 h/d; 6 = >5 h/d]	NA
Physical environmental			
Residence type	Child's current residence	Nominal: house, apartment, duplex, condominium/townhouse, mobile home/trailer	NA
Distance to park	Distance to nearest park	Ordinal (1–6) [1: 1–2 blocks; 6: >5 mi]	$R = 0.70$[a]
Safety of park	Reputation of nearest park	Ordinal (1–5) [1: very unsafe; 5: very safe]	$R = 0.68$[a]
Usage of park	Taking child to the park	Ordinal (1–5) [1: never, 5: ≥14 times per mo]	$R = 0.68$[a]
PA equipments	No. items at home or play area	Continuous: number of items in 18 choices (plus, "other" choice) check list	NA

VPA indicates vigorous PA; MPA, moderate PA; ICC, intraclass correlation.

[a] Values reported by Sallis et al[19] (2002).

[b] Values reported by Trost et al[20] (2003).

els were built separately for the total sample, boys and girls. To obtain the proportion of variance explained by the final models (R^2), pseudo-R^2 values were calculated by using suggested formula,[22] which is based on residuals from the final and null model. For all regression analyses, the α level of .05 was considered as statistical significance.

RESULTS

Demographic and physical characteristics of parents and children who participated in this study are presented in

TABLE 2 General Characteristics of Preschool Children According to Gender

	Total ($N = 331$)	Boys ($n = 168$)	Girls ($n = 163$)	P[a]
Age, mean (SD)	4.3 (0.6)	4.3 (0.7)	4.2 (0.6)	.11
BMI *z* score, mean (SD)	0.5 (1.2)	0.6 (1.3)	0.5 (1.1)	.43
Birth weight, mean (SD), lb	7.2 (1.3)	7.5 (1.2)	7.0 (1.3)	<.05
Sedentary behavior, mean (SD), min/h	32.8 (3.9)	32.4 (4.0)	33.2 (3.8)	.05
Race, %				.74
Black	51.4	50.0	52.8	
White	40.1	40.5	39.9	
Other	8.5	9.5	7.3	
Parent education: higher than a high school education, %	57.7	55.4	60.1	.38
Adult respondent: mother, %	94.0	94.0	93.9	.61
Adult job: yes, %	83.38	86.31	80.37	.14
Residence type: house, %	78.5	78.6	78.4	.92

[a] *P* for difference between boys and girls.

Table 2. Overall, the majority of adult respondents were mothers, employed, and with greater than high school education. The amount of time that children engaged in sedentary behavior differed by gender. Girls were more sedentary than boys (33.2 vs 32.4 minutes/hour; $P = .05$). No other characteristic differences were observed between boys and girls.

The univariate analyses showed no significant difference in sedentary behavior (minutes/hour) according to race, parent education, parent job status, and residence type among boys and girls. The results of the correlation analyses are presented in Table 3. For the total sample, child's BMI *z* score ($P < .05$), birth weight ($P < .05$), perceived level of PA ($P < .05$), athletic coordination ($P < .001$), outdoor play area ($P < .05$), and PA equipment ($P < .05$) were significantly associated with sedentary behavior. Associations between family support for PA ($P < .10$), parent perceived enough PA ($P < .10$), and weekday TV/video games ($P < .10$) and sedentary behavior approached significance.

All of the same correlates with the exception of family support for PA were either significantly or nearly significantly related to sedentary behavior in boys. For girls, child's BMI *z* score ($P < .05$), adult VPA ($P < .05$), adult enjoyment of PA ($P < .05$), family support for PA ($P < .05$), athletic coordination ($P < .001$), participation in organized sports ($P < .05$), and PA equipment ($P < .05$) were associated with sedentary behavior. Parent-perceived enjoyment of PA ($P < .10$) and participation in organized sports ($P < .10$) approached a significant association with sedentary behavior.

All significant and nearly significant variables ($P < .10$) from the univariate analysis were included in linear mixed model analysis (Table 4). The final

TABLE 3 Univariate Analysis Between Potential Correlates and Sedentary Behavior

Correlate	Sedentary Behavior, min/h		
	Total	Boys	Girls
Demographic			
Adult age	0.01	−0.07	0.10
Child age	−0.06	−0.02	−0.10
Siblings	−0.06	−0.07	−0.07
Biological			
Adult BMI	0.01	0.03	−0.03
Child BMI (*z* score)	−0.16[b]	−0.14[a]	−0.18[b]
Birth weight	−0.13[b]	−0.16[b]	−0.06
Psychosocial			
Adult VPA	−0.01	0.10	−0.15[b]
Adult MPA	−0.05	−0.06	−0.05
Adult enjoy PA	−0.08	0.03	−0.19[b]
Family support for PA	−0.10[a]	−0.03	−0.15[b]
Perceived enjoyment of PA	−0.05	0.07	−0.14[a]
Perceived enough PA	0.11[a]	0.09	0.09
Perceived level of PA	−0.13[b]	−0.14[a]	−0.11
Perceived importance of PA	0.01	0.10	−0.06
Behavioral			
Athletic coordination	−0.19[c]	−0.13[a]	−0.26[c]
Choice of activity	0.04	0.08	−0.01
Participation in organized sports	−0.04	0.04	−0.14[a]
Weekday TV/video games	0.10[a]	0.16[b]	0.03
Weekend TV/video games	0.08	0.11	0.06
Physical environment			
Distance to park	0.05	0.05	0.03
Safety of park	−0.06	−0.10	−0.02
Usage of park	−0.04	0.03	−0.12
PA equipment	−0.17[b]	−0.17[b]	−0.16[b]

VPA indicates vigorous PA; MPA, moderate PA.
[a] $P \leq .10$.
[b] $P \leq .05$.
[c] $P \leq .001$.

TABLE 4 Mixed Model Regression Analysis for Associations Between Correlates and Sedentary Behavior

Correlates	Sedentary Behavior, min/h		
	Total β (SE)	Boys β (SE)	Girls β (SE)
Full model[a]			
Gender (boys)	−0.69 (0.4)[c]	—	—
Adult job	0.43 (0.5)	—	—
Child BMI (*z* score)	−0.30 (0.1)[c]	−0.29 (0.2)	−0.55 (0.2)
Birth weight	−0.22 (0.1)	−0.35 (0.2)	—
Adult VPA	—	—	−0.02 (0.1)
Adult enjoy PA	—	—	−0.32 (0.3)
Family support for PA	0.18 (0.3)	—	−0.45 (0.4)
Perceived enjoyment of PA	—	—	−0.13 (0.5)
Perceived enough PA	0.26 (0.3)	—	—
Perceived level of PA	−0.35 (0.3)	−0.58 (0.4)	—
Athletic coordination	−0.64 (0.3)[d]	−0.17 (0.3)	−1.05 (0.4)[d]
Participate in organized sports	—	—	−0.19 (0.2)
Weekday TV/video game	0.49 (0.2)[d]	0.68 (0.2)[d]	—
PA equipments	−0.14 (0.1)	−0.18 (0.1)	−0.14 (0.1)
R^2 (MCCC), %		7.7	7.6
Final model[b]			
Gender (boys)	0.82 (0.4)[d]	—	—
Child BMI (*z* score)	−0.40 (0.1)[d]	—	−0.58 (0.2)[d]
Athletic coordination	−0.74 (0.2)[d]	—	−1.24 (0.39)[d]
Weekday TV/video game	0.47 (0.2)[d]	0.70 (0.3)[d]	—
PA equipment	−0.15 (0.1)[c]	−0.27 (0.13)[d]	—
R^2 (MCCC), %		6.9	9.1

VPA indicates vigorous PA; MCCC, maximum cross-correlation coefficient.
[a] Linear mixed-model including all significant variables in univariate analyses.
[b] Linear mixed-model after manual backward elimination process.
[c] $P \leq .10$.
[d] $P \leq .05$.

models for the total sample, boys, and girls were constructed separately. For the total sample, gender (girls) ($P < .05$) and weekday TV/video games ($P < .05$) were positively associated with sedentary behavior, but child's BMI *z* score ($P < .05$), athletic coordination ($P < .05$), and PA equipment ($P < .10$) were negatively associated. For boys, weekday TV/video games ($P < .05$) was positively associated with objectively measured sedentary behavior ($R^2 = 0.091$), but PA equipment ($P < .05$) was negatively associated. For girls, child's BMI *z* score ($P < .05$) and athletic coordination ($P < .05$) were negatively associated with objectively measured sedentary behavior ($R^2 = 0.069$).

DISCUSSION

In the current study we aimed to address a unique research question: what factors are associated with objectively measured sedentary behavior in preschool children? We hypothesized that objectively measured sedentary behavior in preschool children is influenced by multiple factors operating in different domains, such as demographic, biological, psychosocial, behavioral, and physical environment. We found that gender, BMI *z* score, athletic coordination, weekday TV/video games, and PA equipment were significant correlates of objectively measured sedentary behavior in the overall sample. However, the results from gender-specific analyses revealed no common correlates that influenced both girls and boys. This finding suggests that interventions to reduce sedentary behavior in preschool children may need to include different intervention components for girls and boys.

For girls, we found that BMI *z* score and child's athletic coordination were significantly associated with sedentary behavior. Regarding BMI *z* score, although a positive association between objectively measured sedentary behavior and adiposity in older girls has been suggested,[23] in a number of studies null association has been shown.[24–27] It is possible that our unexpected discovery of a direct association between sedentary behavior and adiposity is confounded by children's developmental status (eg, adiposity rebound) because preschool age is a period of rapid change in body composition.[28,29] In addition, the nature of the cross-sectional data prevents us from drawing causality for this finding. Therefore, longitudinal studies with complete information on children's developmental stage will be necessary to confirm the observed association in this study. Another significant factor for girls' sedentary behavior was athletic coordination. We found an inverse association between athletic coordination and sedentary behavior in preschool girls. Although several studies showed that perceived athletic competence is a significant factor influencing PA in preschool children[30] and youth,[31–34] in no studies has it been examined whether parent perception of athletic coordination influences a child's sedentary behavior. However, because the locomotion motor skills are not fully developed in preschool age children, it is possible that parents who perceived that their child's athletic coordination is low may withhold opportunities for outdoor play and sports activity. In other words, those parents may provide more opportunities for sedentary behavior (ie, reading, watching TV, or playing video games) than for PA (ie, outdoor play or sports) because they fear their child might be injured. Unfortunately, there are no data on parent perceptions regarding injury and safety while a child participates in PA; thus, future re-

search needs to address this potential relationship.

For boys, a child's weekday TV/video games and PA equipment in the home were significant correlates of objectively measured sedentary behavior. We found that time spent with weekday TV/video games was directly associated with overall sedentariness in preschool boys. Unlike older children, who have more options for sedentary behavior (using a computer, texting, talking on the telephone, reading books, and listening to music), screen-based sedentary behavior for preschool boys (watching TV/DVD and playing video games) is the major mode of sedentary behavior. Therefore, future interventions to reduce overall sedentariness in preschool boys should include components to reduce watching TV and playing video games. Our study also found that preschool boys who had more PA equipment spent less time sedentary. No previous studies have investigated this association, although some have examined relationships between active toys and PA equipment and PA.[30,35] These studies did not show a significant association with moderate-to-vigorous PA, but 1 study showed a positive association with nonsedentary (light-to-vigorous) activity. On the basis of the findings of the current and previous studies, it is possible that playing with active toys or PA equipment may not be intense enough to be considered moderate-to-vigorous PA, but it may be enough to reduce sedentary behavior.

We did not observe significant associations between PA-related psychosocial variables (parent's and child's) and sedentary behavior in boys or girls. In a limited number of studies the association has been examined between PA-related psychosocial variables and objectively measured sedentary behavior in older children[36,37] but not in preschool children. These studies did not find consistent evidence for relationships between PA-related psychosocial variables and sedentary behavior. However, consistent significant associations between sedentary behavior-related psychosocial factors (parental sedentary behavior and family support for reducing sedentary behavior) and children's sedentary behavior have been reported.[14,38–40] These findings, including the null associations reported in this study, support the idea that the construct of sedentary behavior is different from that of PA, and that high levels of sedentary behavior is distinct from low levels of PA. Therefore, future research should include measures of psychosocial variables that are theoretically linked to objectively measured sedentary behavior in preschool children.

This study had several strengths and limitations. Strengths include the use of accelerometers to measure sedentary behavior and the inclusion of a wide range of potential correlates across different levels of the social ecological model. This study also included a large sample of preschool children from diverse sociodemographic backgrounds. The cross-sectional study design and limited geographic area may limit temporality and generalizability of the findings. Another limitation includes the reliance on parent-reported information regarding child's athletic coordination, because only reliability (intraclass correlation coefficient, $R = 0.81$) was determined for this survey item.[19] Therefore, future studies that use a prospective study design, samples from diverse locations, and a validated measure of child's athletic coordination are warranted.

The findings of this study may deliver an important clinical message to pediatricians and other pediatric health care providers. Pediatricians and other health care providers should inform parents about the adverse effects of excessive exposure to sedentary behavior. They should encourage parents to reduce sedentary behavior by setting limits on watching TV and playing video games and providing more PA equipment and more opportunities for PA, regardless of the child's level of athletic coordination level.

CONCLUSIONS

Correlates of objectively measured sedentary behavior were investigated in a racially and socioeconomically diverse sample of American preschool children. For girls, BMI *z* score and child's athletic coordination were significantly associated with sedentary behavior. For boys, sedentary behavior was associated with child's weekday TV/video games and PA equipment in the home. No common factor was found to be a significant correlate of sedentary behavior for both boys and girls. These findings should inform researchers and other public health professionals who design and implement interventions to reduce sedentary behavior in preschool children.

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ANOTHER C FOR DIAMONDS: *Most of us have heard of at least three of the four Cs associated with diamonds: cut, clarity, color, and cost. Now there may be another, carbon cycle. While not as glamorous as the first three, scientists are excited in regards to what they can learn about the carbon cycle and the earth's mantle from impurities found in diamonds. Most diamonds are formed miles beneath the rock under continents. However, some diamonds are made much farther below the earth's surface and are associated with enormous slabs of rock that were initially part of the ocean floor. According to an article in* The New York Times *(Science: September 15, 2011), scientists could detect these slabs, which are approximately 435 miles beneath the surface, in seismic images but could not directly study them as no drill could penetrate to that depth. However, by examining impurities found in diamonds mined in Brazil, they gleaned information about these slabs. The data suggests that a very large and deep conveyer belt exists that recycles carbon between the ocean and the earth's mantle. As the rock slabs beneath the oceans descended into the earth's mantle, basalt and traces of organic material on the ocean floor descended with it. When the diamonds formed within these slabs, impurities, originally on the ocean floor became trapped in some of them. Once formed, diamonds eventually reached the surface floating in a plume of molten rock. Researchers scanned hundreds of non-gem quality diamonds before finding a few that suggested formation at great depths. Using a jeweler's polishing wheel and spectroscopic tests, the researchers were able to measure the mineral composition of the diamond impurities. They were able to infer the existence of two minerals that can only form under conditions found more than 400 miles below the earth's surface. Moreover, they could measure the amount of Carbon 13, a signature of organic carbon. The findings change the way we think about plate tectonics. There is more vertical movement than previously thought. Understanding how carbon is cycled within the mantle could give us a better understanding of our environment. While diamonds with impurities may not be a girl's best friend, they may be scientists'.*

Noted by WVR, MD

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