

ORIGINAL RESEARCH

Correlates of Sedentary Time and Physical Activity Among Preschool-Aged Children

Diana H. Dolinsky, MD, MPH; Rebecca J. Namenek Brouwer, MS; Kelly R. Evenson, PhD;
Anna Maria Siega-Riz, PhD; Truls Østbye, MD, PhD

Suggested citation for this article: Dolinsky DH, Brouwer RJ, Evenson KR, Siega-Riz AM, Østbye T. Correlates of sedentary time and physical activity among preschool-aged children. *Prev Chronic Dis* 2011;8(6):A131. http://www.cdc.gov/pcd/issues/2011/nov/11_0006.htm. Accessed [date].

PEER REVIEWED

Abstract

Introduction

Few studies have examined the correlates of objectively measured amounts of sedentary time and physical activity in young children. We evaluated the demographic, biological, behavioral, social, and environmental correlates of the amount of sedentary time and moderate-to-vigorous physical activity (MVPA) as measured by accelerometry in preschool-aged children.

Methods

We obtained baseline measurements of physical activity by using an Actical accelerometer among 337 preschool-aged children (aged 2-5) of overweight or obese mothers. For children, we defined sedentary time as less than 12 counts per 15 seconds and MVPA as 715 or more counts per 15 seconds. Body mass index of the mother and child (calculated from measured height and weight) and maternal physical activity as measured by accelerometer were included as potential correlates. Mothers self-reported all other potential correlates. We used multivariable linear regression analyses to examine correlates of the amount of sedentary time and MVPA.

Results

Children had an average of 6.1 hours per day of sed-

entary time and 14.9 minutes per day of MVPA. In multivariable analysis, boys ($P < .001$) had fewer minutes per day of sedentary time, whereas older children ($P < .001$), boys ($P < .001$), children in high-income households ($> \$60,000/y$ [$P = .005$]), and children who spent more time outdoors ($P = .001$) had more MVPA.

Conclusion

Both modifiable and nonmodifiable factors were correlated with preschool children's amount of MVPA, which can be helpful when designing interventions for this age group. The lack of correlates for sedentary time indicates the need for further investigation into this behavior.

Introduction

Approximately one-fifth of preschool-aged children are overweight, and this prevalence increases as children age (1). Longitudinal studies indicate that children's amount of physical activity is inversely related to subsequent increases in adiposity, and the amount of sedentary time is directly related to increases in adiposity (2-4). Recent studies suggest that preschool-aged children are often inactive, spending less than 5% of their day in moderate-to-vigorous physical activity (MVPA) and more than three-fourths of their waking hours in sedentary pursuits (5,6).

Early interventions are necessary to alter these behaviors. However, even a basic understanding of the correlates of these behaviors is lacking. Although studies in older children have assessed the correlates of physical activity and of being sedentary (7,8), few studies examine this in preschool-aged children (9,10). The evidence examining correlates using objective measures is especially lacking (9,10). Reviews that have assessed correlates of physical activity and sedentary time in children have classified cor-



The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

relates into groups, such as demographic and biological; psychological, cognitive, and emotional; behavioral attributes and skills; social and cultural; and physical environment domains (8,11). Most of the studies in preschoolers assess correlates in only 1 or 2 of these domains, and few consider objectively measured maternal physical activity as a potential correlate (9,10). Further studies that use objective measures in preschool-aged children are needed to investigate the correlates of these behaviors more comprehensively across multiple domains. We used baseline data from the Kids and Adults Now! Defeat Obesity (KAN-DO) Study to examine potential demographic, biological, behavioral, social, and environmental correlates of objectively measured amounts of sedentary time and MVPA in a sample of children aged 2 to 5 years.

Methods

The KAN-DO Study participants

We used baseline data obtained from September 2007 through November 2009 from KAN-DO, a randomized, controlled intervention trial of 400 overweight postpartum mothers and their preschool-aged children. Details of the KAN-DO Study are published elsewhere (12). Briefly, inclusion criteria for the KAN-DO Study included a postpartum maternal body mass index (BMI) of at least 25 kg/m², delivery of an infant 1 to 7 months before randomization, and a child aged 2 to 5 years in the household. Exclusion criteria included mother less than 18 years old, mother unable to speak and read English, no regular access to a telephone, lack of a permanent mailing address, and presence of a health condition precluding daily physical activity in the mother or child. If multiple children in the home were aged 2 to 5 years, we chose the child born in the earliest month of the year for study participation.

We recruited study participants from 14 counties in the Triangle and Triad areas of North Carolina by using a combination of birth certificate records, publicly available mailing lists, and flyers posted in clinic and community locations. Of more than 40,000 women who received information about the KAN-DO Study, 4,445 were screened; and of those, 1,617 refused and 2,180 were ineligible, leaving 648 who were eligible and interested. Of those, 152 did not attend their first scheduled appointment, 80 refused or were deemed ineligible at their first study appointment, and 16 did not complete all components of the baseline assessment. This left 400 eligible mothers from whom we

obtained written informed consent. The participants were randomized based on 4 strata (child's age, mother's race, site, and days from birth of recent child). The institutional review boards of Duke University Medical Center and the University of North Carolina at Greensboro approved this study.

Outcomes

The outcomes were measured objectively by using an accelerometer. Accelerometers are small instruments worn on the body that measure accelerations that can be converted to intensity of physical activity. The measurements are averaged over prespecified time periods called epochs (13). In the KAN-DO Study at baseline, children were instructed to wear an Actical omnidirectional accelerometer (Mini Mitter Co, Inc, Bend, Oregon) placed at the hip for 7 days. They were instructed to remove the monitor only for bathing and nighttime sleeping. The accelerometers were water-resistant, and children were instructed to also wear them for water-based activity. The accelerometers were set to record activity in 15-second epochs. The 2 outcomes of interest were child's minutes per day of sedentary time and child's minutes per day of MVPA. Sedentary time was defined by using a cutpoint of less than 12 counts per 15 seconds (14). MVPA was defined by using a cutpoint of 715 counts or more per 15 seconds (15). To be included in the analysis, children needed at least 3 valid days of wear (2 weekdays and 1 weekend day with at least 6 h/d of wear). Accelerometer data were available for 392 children; 55 of these children had fewer than 3 valid days of wear, resulting in 337 children available for analysis.

Potential correlates

The correlates (Table 1) were divided into demographic, biological, behavioral attributes and skills, social and cultural, and physical environment domains adapting a framework used by Sallis et al (8). The mothers were asked to wear the same type of accelerometer as the child, but set to 60-second epochs, at the hip for 7 days. They were instructed to remove them only for bathing or nighttime sleeping and to wear them for water-based activity. Maternal physical activity was examined as total counts per day. For the maternal accelerometer data to be included in the analysis, mothers also had to have at least 3 valid days (2 weekdays and 1 weekend day with at least 6 h/d) of wear. For both the mother and child, we measured height by using the Seca 214 portable stadiometer (Seca, Hamburg, Germany) and measured weight

by using the Tanita BWB-800s digital scale (Tanita Corp of America, Inc, Tokyo, Japan). We categorized children as underweight, healthy weight, overweight, or obese by using American Academy of Pediatrics recommendations (16). All other potential correlates were from the baseline questionnaires completed by the mother. To screen for postpartum depression, we used the Edinburgh Postnatal Depression Scale (EPDS), a 10-item questionnaire with a maximum score of 30, and we considered scores of 13 or higher as a positive screen for depression (17). To assess the presence of a chronic health problem among the mothers, we asked, "Do you have any longstanding illness, disability, or medical condition? That is, anything that affects your work or other regular daily activities such as type 2 diabetes, cancer, and heart disease?"

Statistical analysis

The outcomes were modeled by using a natural log transformation to meet the assumptions of linear regression. Since the study was conducted at 2 study sites (Durham and Greensboro), study site was included in all models to account for potential site difference. To account for differences in wear time, we also included mean hours per day of monitoring for the children in all models. We first conducted linear regression between each correlate and the transformed outcome to produce minimally adjusted β coefficients, adjusted only for site and wear time. We then conducted multivariable analysis to produce adjusted β coefficients. Because the outcome was log transformed, the β coefficients were retransformed ($[\text{exponentiated } \beta \text{ coefficient} - 1] \times 100$) to represent the percentage of change in the outcome per unit change in each independent variable. We explored collinearity between correlates using criteria of a condition index of 30 or higher to consider the presence of multicollinearity (18). Linearity with the outcome for each potential correlate was explored and, if necessary, correlates were either transformed or modeled by using indicator variables. Maternal physical activity was modeled by using quartiles, with the highest quartile representing the most total counts per day of maternal activity.

We created separate models for each of the domains of the potential correlates (demographic, biological, behavioral attributes and skills, social and cultural, and physical environment). For each of these models, we conducted a partial F test for the potential correlates only because site and wear time were kept in all models. If the P value was $<.20$, we used backward selection with partial F tests to remove

variables in the domain with P values of $\geq .20$. Variables retained in these separate models were combined in the full model. To create the final model, we removed each domain from the full model with partial F tests using a P value $\geq .20$ as the criteria for removal. We considered variables with a P value of $\leq .05$ to be significant. We ensured that the final models met the assumptions of linear regression. For the model examining the outcome of sedentary time, we removed 8 observations from the multivariable model because they led to violations of the assumptions of linear regression in the final model. For the model examining MVPA, we removed 1 observation from the multivariable model for the same reason. These observations were removed because they had studentized residuals of greater than 3 or less than -3 in the final models. For consistency, these observations were also removed from the unadjusted analyses. We performed all analyses with Stata 11.0 (StataCorp LP, College Station, Texas).

Results

Characteristics of the analysis sample

The 337 children in the analysis sample (Table 1) had a mean age of 3.5 years (standard deviation [SD], 1.1); 58% were boys. The children were monitored for a mean (SD) of 6.3 (1.4) days and had 6.1 (1.3) hours per day of sedentary time (Figure 1), and 14.9 (9.5) minutes per day of MVPA (Figure 2). Of the participants, 61% of children were seen at the Durham study site and 39% at the Greensboro study site. The variable with the most missing information was presence of a chronic health problem in the mother (12% missing). All other variables had less than 3% of observations missing.

The 337 children in the analysis sample were not different from the 63 children enrolled in the KAN-DO Study without sufficient accelerometry data for inclusion in our analysis with respect to maternal age, maternal marital status, maternal education, and maternal ethnicity. The 337 children in the analysis sample were on average 0.5 years older than the 63 children not included ($P < .001$), more likely to be boys (58% included vs 44% not included; $P < .05$), and more likely to have a household income greater than \$60,000 per year (59% included vs 45% not included, $P < .05$). Maternal race differed among the children in the analysis sample (77% white, 23% nonwhite), compared with those not included (63% white, 37% nonwhite; $P = .02$).

Comparison of potential correlates with child's amount of sedentary time

In minimally adjusted analyses (adjusting only for site and monitoring time), correlates of the child's amount of sedentary time were child's sex, child's time spent outdoors, and maternal activity (Table 2). In multivariable analyses, the final model contained only demographic, biological, and social and cultural variables. The only correlate of sedentary time in the final model was child's sex. Boys had less sedentary time than girls ($P < .001$).

Comparison of potential correlates with child's amount of MVPA

In minimally adjusted analyses, correlates of the child's amount of MVPA were child's age, child's sex, household income, maternal education, and mother's report of child's time spent outdoors. The final model contained only demographic and physical environment variables. Correlates of MVPA were child's sex, child's age, household income, and child's time spent outdoors. Both child's age and child's time spent outdoors were modeled with squared terms because they exhibited quadratic relationships with the outcome. Older children engaged in more MVPA than younger children ($P = <.001$), and boys had more MVPA than girls ($P < .001$). Children who spent more time outdoors had more MVPA ($P = .001$). Children in households with a household income of at least \$60,000 per year had more MVPA than children in households with a lower income ($P = .005$).

Discussion

In our sample, 1 demographic factor, sex, was a correlate of children's amount of sedentary time, and several demographic and physical environment factors were correlates of children's amount of MVPA. Variables in the biological, social and cultural, and behavioral attributes and skills domains were not correlates of either sedentary time or MVPA in our sample.

The small amount of MVPA and large amount of sedentary time in our sample of young children is of concern but is not uncommon. Taylor et al (who also used the Actical accelerometer) found similar results (19). Although 3-year-old children in that study had more MVPA than our sample, the mean minutes per day of MVPA in children aged 4 to 5 years was 16 minutes per day to 23 minutes per day, which is comparable to our findings (19). Other studies

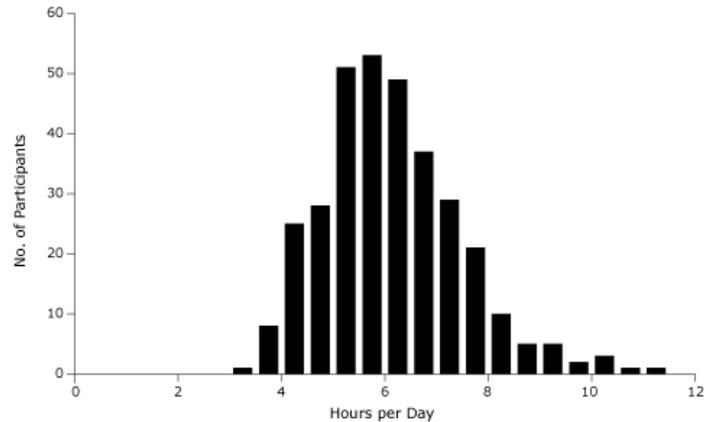


Figure 1. Child's amount of sedentary time, KAN-DO Study, North Carolina, 2007-2009 (n = 329). Children's mean (SD) amount of sedentary time was 6.1 (1.3) hours per day. Abbreviation: KAN-DO (Kids and Adults Now! Defeat Obesity).

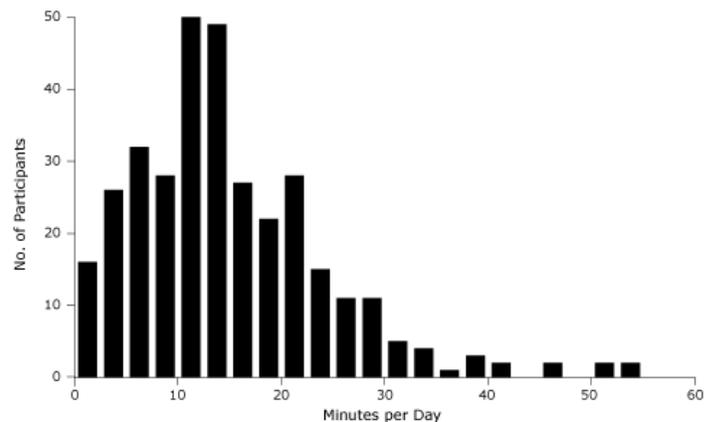


Figure 2. Child's amount of moderate-to-vigorous physical activity, KAN-DO Study, North Carolina, 2007-2009 (n = 336). Children's mean (SD) amount of moderate-to-vigorous physical activity was 14.9 (9.5) minutes per day. Abbreviation: KAN-DO, Kids and Adults Now! Defeat Obesity.

using different accelerometers for objective measurements have found that young children spend approximately three-fourths of their waking hours sedentary (5,6).

To our knowledge, ours is the first study to evaluate the relationship between overall sedentary time in preschool-aged children and maternal physical activity as measured by accelerometry. We found no relationship between maternal overall physical activity and children's sedentary time. We did identify an association between child's sex and child's amount of sedentary time. Other studies investigating the relationship between child's sex and sedentary time have found inconsistent results (20-22). We found no other correlates of sedentary time in preschool-aged children. Hinkley et al, in a review article, concluded

that there is a lack of consistent evidence of a relationship between amount of sedentary time and other potential correlates in preschool-aged children (10).

In comparison with studies investigating sedentary time, more studies have investigated correlates of the amount of MVPA as measured by accelerometry in this age group. Most studies have shown that boys engage in more MVPA than girls (20,23-26), which is in agreement with our findings. Children spending more time outdoors had more physical activity in our sample, which is in agreement with 1 other study (23). We found a positive association between household income and child's amount of MVPA. Our findings contrast with those of other studies in this age group that found no difference; however, these other studies were conducted outside the United States where the relationship between income and child's activity may differ (24,27). Perhaps the association between household income and MVPA represents differences in neighborhood physical activity options for families of different socioeconomic status. Studies in older children have found that lower socioeconomic status is associated with a lower availability of physical activity facilities and a lower subsequent physical activity level (28).

In addition, we found that older preschool-age children engaged in more MVPA than younger ones. Other studies using accelerometry have found varied results regarding the association between the child's age and amount of MVPA in preschoolers. Some have found no association (20), but others found that MVPA is higher in older children (25,26,29), and in contrast, others have found that MVPA is lower in older children (19). In our study, maternal physical activity was not a correlate of child's MVPA. Another study using accelerometry found that parental physical activity as measured by accelerometry was related to the child's, but in that study, parental activity included the activity of mothers or fathers, or both (29).

The main strengths of our study are that we obtained information on a relatively large number of children and evaluated various potential correlates over numerous domains, including measurements of maternal physical activity. In addition, we used objective measures of our outcomes. Specifically, the Actical accelerometer is omnidirectional; it assesses activity in many unspecified dimensions, whereas most previous studies used other accelerometers that assess activity in only 1 to 3 prespecified axes and, theoretically, may not capture preschooler activity as well (13).

Limitations to our study include not obtaining measures of other potential influences on the child's behavior, such as paternal physical activity and the neighborhood environment. Also, we measured total sedentary time, and the correlates of different types of sedentary behaviors (television viewing vs reading) may be different for these activities. Inclusion criteria for the study included that the mother must be overweight or obese, and the correlates of children's behavior may differ if they have a normal weight or underweight mother. In addition, participants in our study were more educated and had a higher household income than the North Carolina population, as described using 2000 US Census information (30). Our results may have limited generalizability because of these issues.

In summary, only 1 nonmodifiable (sex) correlate was identified for sedentary time, and both nonmodifiable (child's age, sex) and modifiable (household income, child's time spent outdoors) correlates were identified for MVPA in preschool-aged children. Knowledge of these correlates may be helpful in designing and targeting interventions to decrease the amount of sedentary time and increase the amount of MVPA in young children.

Acknowledgments

The KAN-DO Study was funded by National Institute of Diabetes and Digestive and Kidney Diseases grant no. 75439. Dr Dolinsky is supported by the Snyderman Foundation. The authors thank Bercedis Peterson, PhD, MS, and Katrina Krause, MA, for their assistance with the manuscript.

Author Information

Corresponding Author: Diana H. Dolinsky, MD, MPH, 4020 N Roxboro St, Durham, NC 27710. Telephone: 919-308-3301. E-mail: dolin004@mc.duke.edu.

Author Affiliations: Rebecca J. Namenek Brouwer, Truls Østbye, Duke University Medical Center, Durham, North Carolina; Kelly R. Evenson, Gillings School of Global Public Health, University of North Carolina at Chapel Hill; Anna Maria Siega-Riz, Gillings School of Global Public Health and Carolina Population Center, University of North Carolina at Chapel Hill. Dr Dolinsky is affiliated with the Duke University Medical Center, Durham, North Carolina.

References

1. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA* 2010;303(3):242-9.
2. Moore LL, Nguyen US, Rothman KJ, Cupples LA, Ellison RC. Preschool physical activity level and change in body fatness in young children. The Framingham Children's Study. *Am J Epidemiol* 1995;142(9):982-8.
3. Proctor MH, Moore LL, Gao D, Cupples LA, Bradley ML, Hood MY, Ellison RC. Television viewing and change in body fat from preschool to early adolescence: The Framingham Children's Study. *Int J Obes Relat Metab Disord* 2003;27(7):827-33.
4. Janz KF, Burns TL, Levy SM; Iowa Bone Development Study. Tracking of activity and sedentary behaviors in childhood: the Iowa Bone Development Study. *Am J Prev Med* 2005;29(3):171-8.
5. Kelly LA, Reilly JJ, Jackson DM, Montgomery C, Grant S, Paton JY. Tracking physical activity and sedentary behavior in young children. *Pediatr Exerc Sci* 2007;19(1):51-60.
6. Reilly JJ, Jackson DM, Montgomery C, Kelly LA, Slater C, Grant S, Paton JY. Total energy expenditure and physical activity in young Scottish children: mixed longitudinal study. *Lancet* 2004;363(9404):211-2.
7. Van Der Horst K, Paw MJ, Twisk JW, Van Mechelen W. A brief review on correlates of physical activity and sedentariness in youth. *Med Sci Sports Exerc* 2007;39(8):1241-50.
8. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc* 2000;32(5):963-75.
9. Hinkley T, Crawford D, Salmon J, Okely AD, Hesketh K. Preschool children and physical activity: a review of correlates. *Am J Prev Med* 2008;34(5):435-41.
10. Hinkley T, Salmon J, Okely AD, Trost SG. Correlates of sedentary behaviours in preschool children: a review. *Int J Behav Nutr Phys Act* 2010;7:66.
11. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q* 1988;15(4):351-77.
12. Ostbye T, Zucker NL, Krause KM, Lovelady CA, Evenson KR, Peterson BL, et al. Kids and adults now! Defeat obesity (KAN-DO): rationale, design and baseline characteristics. *Contemp Clin Trials* 2011;32(3):461-9.
13. Cliff DP, Reilly JJ, Okely AD. Methodological considerations in using accelerometers to assess habitual physical activity in children aged 0-5 years. *J Sci Med Sport* 2009;12(5):557-67.
14. Evenson KR, Catellier DJ, Gill K, Ondrak KS, McMurray RG. Calibration of two objective measures of physical activity for children. *J Sports Sci* 2008;26(14):1557-65.
15. Pfeiffer KA, McIver KL, Dowda M, Almeida MJ, Pate RR. Validation and calibration of the Actical accelerometer in preschool children. *Med Sci Sports Exerc* 2006;38(1):152-7.
16. Barlow SE. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics* 2007;120 Suppl 4:S164-92.
17. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry* 1987;150:782-6.
18. Belsley DA, Kuh E, Welsch RE. Regression diagnostics: identifying influential data and sources of collinearity. New York (NY): Wiley; 1980.
19. Taylor RW, Murdoch L, Carter P, Gerrard DF, Williams SM, Taylor BJ. Longitudinal study of physical activity and inactivity in preschoolers: the FLAME study. *Med Sci Sports Exerc* 2009;41(1):96-102.
20. Pate RR, Pfeiffer KA, Trost SG, Ziegler P, Dowda M. Physical activity among children attending preschools. *Pediatrics* 2004;114(5):1258-63.
21. Hannon JC, Brown BB. Increasing preschoolers' physical activity intensities: an activity-friendly preschool playground intervention. *Prev Med* 2008;46(6):532-6.
22. Montgomery C, Reilly JJ, Jackson DM, Kelly LA, Slater C, Paton JY, et al. Relation between physical activity and energy expenditure in a representative sample of young children. *Am J Clin Nutr* 2004;80(3):591-6.
23. Burdette HL, Whitaker RC, Daniels SR. Parental report of outdoor playtime as a measure of physical activity in preschool-aged children. *Arch Pediatr Adolesc Med* 2004;158(4):353-7.
24. Jackson DM, Reilly JJ, Kelly LA, Montgomery C, Grant S, Paton JY. Objectively measured physical activity in a representative sample of 3- to 4-year-old children. *Obes Res* 2003;11(3):420-5.
25. Pfeiffer KA, Dowda M, McIver KL, Pate RR. Factors related to objectively measured physical activity in preschool children. *Pediatr Exerc Sci* 2009;21(2):196-208.
26. Grontved A, Pedersen GS, Andersen LB, Kristensen PL, Moller NC, Froberg K. Personal characteristics and demographic factors associated with objectively

- measured physical activity in children attending pre-school. *Pediatr Exerc Sci* 2009;21(2):209-19.
27. Kelly LA, Reilly JJ, Fisher A, Montgomery C, Williamson A, McColl JH, et al. Effect of socioeconomic status on objectively measured physical activity. *Arch Dis Child* 2006;91(1):35-8.
 28. Gordon-Larsen P, Nelson MC, Page P, Popkin BM. Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics* 2006;117(2):417-24.
 29. Oliver M, Schofield GM, Schluter PJ. Parent influences on preschoolers' objectively assessed physical activity. *J Sci Med Sport* 2010;13(4):403-9.
 30. US Census Bureau. Census 2000 data for the state of North Carolina. <http://www.census.gov/census2000/states/nc.html>. Accessed Aug 25, 2011.

Tables

Table 1. Descriptive Characteristics of Analysis Sample, KAN-DO Study, North Carolina, 2007-2009 (n = 337)

Characteristic	n ^a	Mean (SD) or %
Demographic		
Child's age, y	337	3.5 (1.1)
Maternal age, y	337	32.7 (4.9)
Maternal race/ethnicity		
White non-Hispanic	246	73%
White Hispanic	15	4%
Nonwhite	76	23%
Child's sex		
Boy	195	58%
Girl	142	42%
Maternal marital status		
Married	295	88%
Single/divorced/separated	29	9%
Living with partner	13	4%
Annual household income, \$		
≤60,000	137	41%
>60,000	195	59%
Maternal education		
High school or less	41	12%
Some post-high school training or college	63	19%
College graduate or greater	233	69%

Abbreviations: KAN-DO, Kids and Adults Now! Defeat Obesity; SD, standard deviation.

^a Numbers may not sum to totals because of missing numbers, and percentages may not sum to 100% because of rounding.

^b Defined by using current American Academy of Pediatrics recommendations (16).

^c Categorized by using the Edinburgh Postnatal Depression Scale, considering scores of 13 or greater as a positive screen for depression (17).

^d Maternal physical activity is described in counts per day because cutoffs for MVPA and sedentary time were not available.

(Continued on next page)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Table 1. (continued) Descriptive Characteristics of Analysis Sample, KAN-DO Study, North Carolina, 2007-2009 (n = 337)

Characteristic	n ^a	Mean (SD) or %
Biological		
Child's body mass index category^b		
<5th percentile (underweight)	10	3%
≥5th to <85th percentile (healthy weight)	242	72%
≥85th to <95th percentile (overweight)	55	16%
≥95th percentile (obese)	30	9%
Maternal body mass index, kg/m²		
25 to <30	132	39%
30 to <35	111	33%
35 to <40	57	17%
≥40	37	11%
Maternal depression screen^c		
Negative	278	82%
Positive	59	18%
Maternal chronic health problem		
Yes	29	10%
No	268	90%
Behavioral attributes and skills		
Child's history of being breastfed in first 12 months		
No breastfeeding	51	15%
Breast and formula fed	227	67%
Breastfed exclusively until 12 mo	59	18%
Child's television watching, h/d		
<2	187	55%
≥2	150	45%
Child's sweetened beverage and soda consumption per day		
None	157	47%
Some	180	53%
Child sleeps too little		
Usually or sometimes	81	24%
Rarely	253	76%

Abbreviations: KAN-DO, Kids and Adults Now! Defeat Obesity; SD, standard deviation.

^a Numbers may not sum to totals because of missing numbers, and percentages may not sum to 100% because of rounding.

^b Defined by using current American Academy of Pediatrics recommendations (16).

^c Categorized by using the Edinburgh Postnatal Depression Scale, considering scores of 13 or greater as a positive screen for depression (17).

^d Maternal physical activity is described in counts per day because cutoffs for MVPA and sedentary time were not available.

(Continued on next page)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Table 1. (continued) Descriptive Characteristics of Analysis Sample, KAN-DO Study, North Carolina, 2007-2009 (n = 337)

Characteristic	n ^a	Mean (SD) or %
Social and cultural		
Maternal physical activity, counts/d ^d	330	113,037 (46,550)
Maternal television watching, h/d		
<2	145	43%
≥2	192	57%
Maternal computer use, h/d		
<2	261	77%
≥2	76	23%
Physical environment		
Child's time spent outdoors, h/d	330	2.0 (1.6)
Childcare arrangement		
Stay-at-home mother	176	52%
Some combination of child care that includes mother	79	23%
Full-time child care with someone other than mother	82	24%
No. of children born to the mother		
2	208	62%
3	82	24%
≥4	47	14%
Opportunities indoors for gross motor play		
Yes	297	88%
No	40	12%
Opportunities outdoors for gross motor play		
Yes	305	91%
No	32	10%
Television in the child's bedroom		
Yes	83	25%
No	254	75%

Abbreviations: KAN-DO, Kids and Adults Now! Defeat Obesity; SD, standard deviation.

^a Numbers may not sum to totals because of missing numbers, and percentages may not sum to 100% because of rounding.

^b Defined by using current American Academy of Pediatrics recommendations (16).

^c Categorized by using the Edinburgh Postnatal Depression Scale, considering scores of 13 or greater as a positive screen for depression (17).

^d Maternal physical activity is described in counts per day because cutoffs for MVPA and sedentary time were not available.

Table 2. Association of Potential Correlates With Child's Sedentary Time and Moderate-to-Vigorous Physical Activity (MVPA), KAN-DO Study, North Carolina, 2007-2009

Characteristic	Sedentary Time (n = 329)				MVPA (n = 336)			
	Minimally Adjusted ^a		Adjusted ^b		Minimally Adjusted ^a		Adjusted ^b	
	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value
Demographic								
Child's age^d								
Linear term, y	-0.2 (-1.5 to 1.0)	.70	NA ^e	NC	218.1 (102.4 to 399.9)	<.001	187.1 (83.6 to 349.1)	<.001
Squared term, y ²	NA	NC	NA	NC	-10.6 (-15.8 to -5.1)	<.001	-9.7 (-14.9 to -4.2)	.001
Maternal age, y								
<30	1 [Reference]	0.79	NA	NC	1 [Reference]	0.24	NA	NC
≥30	-0.4 (-3.4 to 2.7)		NA	NC	11.6 (-7.1 to 33.9)		NA	NC
Maternal race/ethnicity								
White non-Hispanic	1 [Reference]	0.23	NA	NC	1 [Reference]	0.35	NA	NC
White Hispanic	4.7 (-2.1 to 11.9)		NA	NC	-24.7 (-48.9 to 11.0)		NA	NC
Nonwhite	2.0 (-1.2 to 5.2)		NA	NC	-2.8 (-19.4 to 17.2)		NA	NC
Child's sex								
Boy	1 [Reference]	<.001						
Girl	5.4 (2.8 to 8.2)		5.2 (2.3 to 8.2)		-25.6 (-36.2 to -13.4)		-24.0 (-33.5 to -13.0)	
Maternal marital status								
Married	1 [Reference]	.77	NA	NC	1 [Reference]	.51	NA	NC
Single/divorced/ separated	-0.9 (-5.4 to 3.8)		NA	NC	-7.3 (-29.8 to 22.6)		NA	NC
Living with partner	-2.1 (-8.4 to 4.6)		NA	NC	-19.6 (-46.1 to 19.9)		NA	NC
Annual household income, \$								
≤60,000	1 [Reference]	.52	NA	NC	1 [Reference]	.02	1 [Reference]	.005
>60,000	0.9 (-1.8 to 3.7)		NA	NC	21.0 (3.2 to 41.9)		23.1 (6.4 to 42.3)	

Abbreviations: MVPA, moderate-to-vigorous physical activity; KAN-DO, Kids and Adults Now! Defeat Obesity; CI, confidence interval; NA, not applicable; NC, not calculated.

^a All estimates are adjusted for site and child's mean hours per day of monitoring.

^b Includes estimates for potential correlates remaining in the final model only.

^c Because the outcome was log transformed, the estimate ($[\text{exponentiated } \beta \text{ coefficient} - 1] \times 100$) represents the percentage change in the outcome per unit change in each independent variable.

^d Linearity with each potential correlate and the outcomes were examined. For age and both outcomes and child's time spent outdoors and MVPA, the potential correlates were most appropriately modeled by using transformation (including both linear and squared terms).

^e NA indicates that the variable in the specified form was not evaluated in the model.

^f Defined by using current American Academy of Pediatrics recommendations (16).

^g Categorized by using the Edinburgh Postnatal Depression Scale, considering scores of 13 or higher as a positive screen for depression (17).

(Continued on next page)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Table 2. (continued) Association of Potential Correlates With Child's Sedentary Time and Moderate-to-Vigorous Physical Activity (MVPA), KAN-DO Study, North Carolina, 2007-2009

Characteristic	Sedentary Time (n = 329)				MVPA (n = 336)			
	Minimally Adjusted ^a		Adjusted ^b		Minimally Adjusted ^a		Adjusted ^b	
	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value
Maternal education								
High school or less	1 [Reference]	.33	NA	NC	1 [Reference]	.04	NA	NC
Some post-high school training or college	3.6 (-1.2 to 8.6)		NA	NC	-11.2 (-33.1 to 17.9)		NA	NC
College graduate or greater	2.7 (-1.4 to 7.0)		NA	NC	14.5 (-10.1 to 45.8)		NA	NC
Biological								
Child's body mass index category^f								
<5th percentile (underweight)	1 [Reference]	.32	NA	NC	1 [Reference]	.84	NA	NC
≥5th to <85th percentile (healthy weight)	0.9 (-6.5 to 8.9)		NA	NC	18.1 (-25.5 to 87.2)		NA	NC
≥85th to <95th percentile (overweight)	-2.4 (-10.1 to 5.9)		NA	NC	20.4 (-26.2 to 96.6)		NA	NC
≥95th percentile (obese)	0.2 (-8.1 to 9.2)		NA	NC	9.7 (-34.7 to 84.1)		NA	NC
Maternal body mass index (kg/m²)								
25 to <30	1 [Reference]	.13	1 [Reference]	.18	1 [Reference]	.37	NA	NC
30 to <35	-1.8 (-4.7 to 1.3)		-2.5 (-5.6 to 0.7)		-3.9 (-19.9 to 15.4)		NA	NC
35 to <40	2.9 (-0.9 to 6.8)		1.9 (-2.1 to 6.0)		-15.5 (-32.4 to 5.7)		NA	NC
≥40	0.6 (-3.7 to 5.2)		-1.1 (-5.8 to 3.8)		-15.5 (-35.0 to 9.8)		NA	NC
Maternal depression screen^g								
Negative	1 [Reference]	.45	NA	NC	1 [Reference]	.22	NA	NC
Positive	-1.3 (-4.6 to 2.1)		NA	NC	-11.9 (-28.0 to 7.8)		NA	NC

Abbreviations: MVPA, moderate-to-vigorous physical activity; KAN-DO, Kids and Adults Now! Defeat Obesity; CI, confidence interval; NA, not applicable; NC, not calculated.

^a All estimates are adjusted for site and child's mean hours per day of monitoring.

^b Includes estimates for potential correlates remaining in the final model only.

^c Because the outcome was log transformed, the estimate ($[\text{exponentiated } \beta \text{ coefficient} - 1] \times 100$) represents the percentage change in the outcome per unit change in each independent variable.

^d Linearity with each potential correlate and the outcomes were examined. For age and both outcomes and child's time spent outdoors and MVPA, the potential correlates were most appropriately modeled by using transformation (including both linear and squared terms).

^e NA indicates that the variable in the specified form was not evaluated in the model.

^f Defined by using current American Academy of Pediatrics recommendations (16).

^g Categorized by using the Edinburgh Postnatal Depression Scale, considering scores of 13 or higher as a positive screen for depression (17).

(Continued on next page)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Table 2. (continued) Association of Potential Correlates With Child's Sedentary Time and Moderate-to-Vigorous Physical Activity (MVPA), KAN-DO Study, North Carolina, 2007-2009

Characteristic	Sedentary Time (n = 329)				MVPA (n = 336)			
	Minimally Adjusted ^a		Adjusted ^b		Minimally Adjusted ^a		Adjusted ^b	
	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value
Maternal chronic health problem								
Yes	1 [Reference]	.20	1 [Reference]	.15	1 [Reference]	.60	NA	NC
No	3.1 (-1.6 to 8.0)		3.5 (-1.2 to 8.5)		-6.9 (-28.8 to 21.9)		NA	NC
Behavioral attributes and skills								
Child's history of being breastfed in first 12 months								
No breastfeeding	1 [Reference]	.09	NA	NC	1 [Reference]	.36	NA	NC
Breast and formula fed	2.8 (-0.9 to 6.6)		NA	NC	-6.7 (-25.1 to 16.3)		NA	NC
Breastfed exclusively until 12 months	5.3 (0.6 to 10.2)		NA	NC	-17.4 (-37.1 to 8.5)		NA	NC
Child's television watching (h/d)								
<2	1 [Reference]	.20	NA	NC	1 [Reference]	.51	NA	NC
≥2	1.7 (-0.9 to 4.4)		NA	NC	5.4 (-9.8 to 23.3)		NA	NC
Child's sweetened beverage and soda consumption per day								
None	1 [Reference]	.69	NA	NC	1 [Reference]	.15	NA	NC
Some	-0.5 (-3.1 to 2.1)		NA	NC	12.3 (-4.0 to 31.4)		NA	NC
Child sleeps too little								
Usually or sometimes	1 [Reference]	.44	NA	NC	1 [Reference]	.28	NA	NC
Rarely	1.2 (-1.8 to 4.3)		NA	NC	-9.5 (-24.4 to 8.4)		NA	NC
Social and cultural								
Maternal physical activity quartile								
Lowest	1 [Reference]	.02	1 [Reference]	.13	1 [Reference]	.34	NA	NC
Second	5.3 (1.5 to 9.2)		3.7 (-0.3 to 7.9)		-14.7 (-31.7 to 6.5)		NA	NC
Third	0.7 (-3.0 to 4.5)		-0.4 (-4.2 to 3.6)		-15.4 (-32.3 to 5.6)		NA	NC
Highest	0.7 (-3.0 to 4.5)		-0.3 (-4.2 to 3.7)		-4.0 (-23.2 to 20.1)		NA	NC

Abbreviations: MVPA, moderate-to-vigorous physical activity; KAN-DO, Kids and Adults Now! Defeat Obesity; CI, confidence interval; NA, not applicable; NC, not calculated.

^a All estimates are adjusted for site and child's mean hours per day of monitoring.

^b Includes estimates for potential correlates remaining in the final model only.

^c Because the outcome was log transformed, the estimate ($[\text{exponentiated } \beta \text{ coefficient} - 1] \times 100$) represents the percentage change in the outcome per unit change in each independent variable.

^d Linearity with each potential correlate and the outcomes were examined. For age and both outcomes and child's time spent outdoors and MVPA, the potential correlates were most appropriately modeled by using transformation (including both linear and squared terms).

^e NA indicates that the variable in the specified form was not evaluated in the model.

^f Defined by using current American Academy of Pediatrics recommendations (16).

^g Categorized by using the Edinburgh Postnatal Depression Scale, considering scores of 13 or higher as a positive screen for depression (17).

(Continued on next page)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Table 2. (continued) Association of Potential Correlates With Child's Sedentary Time and Moderate-to-Vigorous Physical Activity (MVPA), KAN-DO Study, North Carolina, 2007-2009

Characteristic	Sedentary Time (n = 329)				MVPA (n = 336)			
	Minimally Adjusted ^a		Adjusted ^b		Minimally Adjusted ^a		Adjusted ^b	
	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value
Maternal television watching (h/d)								
<2	1 [Reference]	.53	NA	NC	1 [Reference]	.76	NA	NC
≥2	0.9 (-1.8 to 3.5)		NA	NC	-2.4 (-16.4 to 14.0)		NA	NC
Maternal computer use (h/d)								
<2	1 [Reference]	.68	NA	NC	1 [Reference]	.31	NA	NC
≥2	0.7 (-2.4 to 3.9)		NA	NC	-9.1 (-24.4 to 9.2)		NA	NC
Physical environment								
Child's time spent outdoors (h/d)								
Categorical								
<1	1 [Reference]	.005	NA	NC	NA	NC	NA	NC
≥1	-4.4 (-7.3 to -1.4)		NA	NC	NA	NC	NA	NC
Continuous								
Linear term (h/d) ^e	NA	NC	NA	NC	33.8 (18.7 to 50.7)	<.001	22.2 (9.6 to 36.2)	<.001
Squared term (h/d) ^{2e}	NA	NC	NA	NC	-3.3 (-4.6 to -1.9)	<.001	-2.3 (-3.5 to -1.1)	<.001
Child care arrangement								
Stay-at-home mother	1 [Reference]	.43	NA	NC	1 [Reference]	.05	1 [Reference]	.98
Some combination of child care that includes mother	0.03 (-3.1 to 3.3)		NA	NC	22.7 (1.4 to 48.4)		-0.6 (-16.3 to 18.1)	
Full-time child care with someone other than mother	2.0 (-1.2 to 5.3)		NA	NC	19.4 (-1.1 to 44.1)		1.5 (-14.3 to 20.2)	

Abbreviations: MVPA, moderate-to-vigorous physical activity; KAN-DO, Kids and Adults Now! Defeat Obesity; CI, confidence interval; NA, not applicable; NC, not calculated.

^a All estimates are adjusted for site and child's mean hours per day of monitoring.

^b Includes estimates for potential correlates remaining in the final model only.

^c Because the outcome was log transformed, the estimate ($[\text{exponentiated } \beta \text{ coefficient} - 1] \times 100$) represents the percentage change in the outcome per unit change in each independent variable.

^d Linearity with each potential correlate and the outcomes were examined. For age and both outcomes and child's time spent outdoors and MVPA, the potential correlates were most appropriately modeled by using transformation (including both linear and squared terms).

^e NA indicates that the variable in the specified form was not evaluated in the model.

^f Defined by using current American Academy of Pediatrics recommendations (16).

^g Categorized by using the Edinburgh Postnatal Depression Scale, considering scores of 13 or higher as a positive screen for depression (17).

(Continued on next page)

Table 2. (continued) Association of Potential Correlates With Child's Sedentary Time and Moderate-to-Vigorous Physical Activity (MVPA), KAN-DO Study, North Carolina, 2007-2009

Characteristic	Sedentary Time (n = 329)				MVPA (n = 336)			
	Minimally Adjusted ^a		Adjusted ^b		Minimally Adjusted ^a		Adjusted ^b	
	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value	% Difference (95% CI) ^c	P Value
No. of children born to the mother								
2	1 [Reference]	.51	NA	NC	1 [Reference]	.55	NA	NC
3	1.8 (-1.3 to 5.0)		NA	NC	2.9 (-14.5 to 23.9)		NA	NC
≥4	0.2 (-3.7 to 4.2)		NA	NC	-10.6 (-29.0 to 12.7)		NA	NC
Opportunities indoors for gross motor play								
Yes	1 [Reference]	.11	NA	NC	1 [Reference]	.14	NA	NC
No	3.3 (-0.7 to 7.6)		NA	NC	-16.8 (-34.5 to 5.8)		NA	NC
Opportunities outdoors for gross motor play								
Yes	1 [Reference]	.34	NA	NC	1 [Reference]	.76	NA	NC
No	-2.1 (-6.3 to 2.3)		NA	NC	4.2 (-19.8 to 35.5)		NA	NC
Television in the child's bedroom								
Yes	1 [Reference]	.68	NA	NC	1 [Reference]	.60	NA	NC
No	-0.7 (-3.7 to 2.5)		NA	NC	-4.8 (-21.0 to 14.6)		NA	NC

Abbreviations: MVPA, moderate-to-vigorous physical activity; KAN-DO, Kids and Adults Now! Defeat Obesity; CI, confidence interval; NA, not applicable; NC, not calculated.

^a All estimates are adjusted for site and child's mean hours per day of monitoring.

^b Includes estimates for potential correlates remaining in the final model only.

^c Because the outcome was log transformed, the estimate ($[\text{exponentiated } \beta \text{ coefficient} - 1] \times 100$) represents the percentage change in the outcome per unit change in each independent variable.

^d Linearity with each potential correlate and the outcomes were examined. For age and both outcomes and child's time spent outdoors and MVPA, the potential correlates were most appropriately modeled by using transformation (including both linear and squared terms).

^e NA indicates that the variable in the specified form was not evaluated in the model.

^f Defined by using current American Academy of Pediatrics recommendations (16).

^g Categorized by using the Edinburgh Postnatal Depression Scale, considering scores of 13 or higher as a positive screen for depression (17).

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.