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# Combating Obesity in Head Start: Outdoor Play and Change in Children's BMI

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## Abstract

**Objective—**To determine whether increased outdoor play time at Head Start was associated with greater changes in BMI over the course of a preschool year.

**Study design—**We used data from 2,810 children from the Family and Child Experiences Survey 2006 cohort. With children's spring BMI as our outcome (both continuously measured and dichotomized to measure risk of obesity), we conducted weighted regression analyses, controlling for child-, family-, and school-level covariates, including preschool entry BMI.

**Results—**Children played outdoors at school for roughly 37 minutes per day, with little variation across half- and full-day programs. The more children played outdoors, the more their BMI decreased over the preschool year ($\beta = -.05$, 95% CI [−.08, −.01]) and the less likely they were to be obese (*OR* = .99, 95% CI [.98, .99]). The difference between high versus low levels of outdoor play corresponded to .18 BMI points and a 42% reduction in children's risk of obesity. Sixty minutes was the "tipping point" for the association between outdoor play time and improvements in children's BMI. These associations were also stronger among children who were obese at the start of the year, less active at home, and living in unsafe neighborhoods.

**Conclusions—**Outdoor play time at Head Start is associated with decreases in children's BMI scores and, thus, may serve as an important means of preventing obesity. Head Start programs should consider establishing clear guidelines encouraging more outdoor time.

### Keywords

Outdoor play; BMI; Obesity; Head Start

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Childhood obesity is a public health concern that has long-term implications for physical and mental health.[1–3] Early prevention is considered to be one of the most effective means of combating obesity. [4] Over 8% of all children between the ages of 2 to 5 are considered to be obese in the U.S.; however, this rate is even higher among low-income children (15%).[5,6]

One explanation for the wide prevalence of early childhood obesity has been the decline in children's outdoor activity.[7,8] Children who play outdoors are more likely to engage in physical play that improves their overall fitness.[9–12] Children from low-income families, however, face several barriers to outdoor play, including reduced access to safe neighborhoods or playgrounds.[13] By providing safe and supervised places and times to play, preschool programs can play an integral role in increasing children's time outdoors and, potentially, in reducing children's risk of obesity.[14,15] The American Academy of Pediatrics has iterated the importance of outdoor play at school for children generally and for low-income children in particular as a means of reducing obesity.[16] In fact, several child health organizations have recommended that for every hour children are in school, they be allowed 12 to 15 minutes of physical activity—the equivalent of approximately 20–25% of the school day. [17] Yet, children continue to experience an inadequate amount of physical activity and outdoor play during preschool hours.[14,15,18]

As the largest federally funded preschool program serving low-income children in the U.S., Head Start is a platform that can reach a large portion of the population who are at-risk for becoming overweight and obese and, thus, Head Start presents a unique opportunity to combat childhood obesity. Since its inception, the Head Start program has aimed to provide cognitively enriching environments to children while meeting their health and nutritional needs. Indeed, Head Start regulations require that teachers provide sufficient time outdoors for children but do not specify the amount or frequency of physical activity.[19]

Despite these regulations, no studies to date have examined whether additional outdoor play time at Head Start has any health benefits for children. To our knowledge, there has only been one other descriptive study that has examined children's physical activity in Head Start centers with nationally representative data; however, these authors did not examine whether additional outdoor play time at school had benefits for children's body mass index (BMI).[20] The current study will address this specific question and will thereby provide important insight into young children's physical activity during preschool hours. This study may be of practical significance as the results could point to a cost-effective method for addressing obesity during the early childhood years, an important period in shaping children's health trajectories.

This study examined the associations between outdoor play time at Head Start centers and children's BMI, by conducting secondary data analysis of the FACES 2006 study. We hypothesized that children who played outdoors for longer periods at school would demonstrate improvements in BMI from fall to spring of the school year. Considering that the benefits of outdoor play are likely to vary among children from different circumstances, we examined whether these associations varied by children's initial BMI, physical activity at home, and television watching at home. We also considered parents' beliefs about neighborhood safety, which has been shown to be associated with children's time spent

outdoors at home. [11] The indicators of household and neighborhood characteristics are particularly important given that they tap into children's physical activity and the potential barriers to outdoor play at home (either perceived or objective). That is, for children who face these barriers, outdoor time during school hours may compensate for a lack of physical activity after school hours. Additionally, although all children are likely to benefit from outdoor time, the benefits might be greater for children who are already overweight or obese. We also considered the possibility that increased outdoor time may have unintended negative side effects on children's academic achievement due to the possibility that outdoor time takes away from children's time spent in other academic activities, which has become a growing concern in preschool programs.[8]

## Method

Data were drawn from the FACES 2006 cohort, a nationally representative sample of 3,315 3- and 4-year-old children in 125 Head Start centers across the country (for information on sampling, refer to the FACES 2006 users guide).[21] Children and families were assessed at the beginning (fall 2006) and end of the Head Start year (spring 2007). For the purposes of this study, we restricted our sample to children who had a valid longitudinal weight and were enrolled in a non-home-based Head Start program, resulting in a final sample of 2,810 children and families. On average, children (49% female) in our final sample were 45 months of age and the majority of mothers identified their children as Hispanic (35%) or Black (34%) with a smaller portion identifying their children as White (22%) or Asian/other (9%). Seven in ten (69%) children had mothers' with a high school education or less and 47% of children had mothers who were unemployed. Although these are sample averages, it is important to note that these data are nationally representative and there is considerably heterogeneity from center-to-center (for more sample demographics, see Table 1).

### Measures

**Outdoor play at school—**During the spring of 2007, teachers were asked to, "think for a moment about a typical day in your program during the last month. On a typical day, about how many minutes per day do the children in your class play outside?" Teachers' responses were provided in 5- to 10-minute intervals (e.g., 15, 20, 25 minutes) and ranged from 0–180 minutes. To determine the validity and stability of our measure, we conducted two fidelity checks. First, of the 1,642 3-year-old children who were in our original sample, 1,047 remained in the same Head Start program for a second year. For these children, we found that the bivariate correlation between outdoor play time in the spring of 2007 (the focus of this study) and following year was modest ($r$ = .45). Further, roughly 33% ($n$ = 358) of the 3-year-old children who experienced two years of Head Start had the same teacher across both years. The correlation between outdoor play time for these children was stronger ($r$ = .59). Thus, these bivariate estimates reveal that our focal independent variable of time spent outdoors demonstrated moderate stability across time. Second, given concerns regarding the accuracy of teachers' reports of outdoor time for every 5–10 minute interval, we conducted threshold analyses by grouping teachers' reports into three meaningful groups: (a) less than 30 minutes, (b) 30–59 minutes, and (c) 60 minutes or greater, which allow for the estimation of non-linear relationships. We also tested different thresholds, and all findings were similar

to those reported below. These threshold models, however, are treated as robustness check because dichotomization leads to a loss of statistical power.

**Children's body-mass index and obesity status—**Data on children's height and weight were directly assessed twice at each wave and any discrepancies in measurement were handled in the following ways. [21] If at the fall 2006, measures of children's height differed by less than two inches or their weight differed by less than five pounds, then the average was taken, which is similar to other nationally representative data collection efforts (e.g., the Early Childhood Longitudinal Study Birth Cohort).[22] However, if the difference between the two assessments was beyond these bounds, then for the fall 2006 assessment, the value that was closest to the average height and weight of the child's same aged peers, based on growth charts from the Center for Disease Control, was used.[21,23] For the spring 2007, a third measurement was taken, and if this matched either of the first two measurements, then that value was used; if no two of the three measurements were equal, then an average of the two closest measurements was used. [21] Once the final values for height and weight were determined, these data were then coupled with children's gender and age to create measures of children's BMI. Based on these scores, children were also classified as underweight (BMI percentile < 5), normal weight (BMI percentile 5–84), overweight (BMI percentile 85–94.9), or obese (BMI percentile ≥95; for more information on this conversion, see the FACES 2006 users guide).[21] Thus, both of our outcome measures were based on children's BMI; in one we examined the continuous measure of BMI and in the second analyses we used the BMI cutoffs for obesity. Although there has been some debate about whether to measure children's BMI as z-scores, percentiles, or raw scores, there is emerging evidence that using raw BMI or BMI percentiles to measure change in adiposity is preferable over BMI z-scores.[24] This is because z-scores are highly skewed at the upper distribution of BMI, which results in a smaller z-score change when there are large changes in BMI.[24] Thus, in this study, we use children's raw BMI scores.

**Children's academic skills—**Literacy skills were measured through three direct assessments that tapped into children's letter word identification, spelling skills (as measured by the Woodcock Johnson), and receptive vocabulary (Peabody Picture Vocabulary Test).[25,26] Math skills were also directly assessed using the Woodcock Johnson Applied Problems subscale. [25]

**Stratification variables—**We considered children's initial BMI classification (3%, underweight; 61%, normal weight; 19%, overweight; 17%, obese) as a potential stratification variable that may qualify any associations between outdoor play and children's BMI. Additionally, three parent-reported environmental indicators of household and neighborhood characteristics were also used as potential stratification variables: amount of outdoor play at home (20%, 0 minutes; 80%, 30 minutes or more), hours spent watching television at home, (32%, one hour or less; 48%, one to two hours; 20%, two hours or more), and neighborhood safety (4 items; $\alpha = .73$; 68%, witnessed no violent crimes; 16%, witnessed violent/non-violent crimes; 16%, experienced/knew victims of a violent crime). Specifically, parents were asked to report "About how much time does [child] spend (watching TV/playing outside) on a typical weekday?" with a scale ranging from 0 (*less*

*than one hour*) to 2 (*more than two hours*). Based on the past year, parents also reported whether they "saw non-violent crimes take place in [their] neighborhood", "heard or saw violent crime take place in [their] neighborhood", "know someone who was a victim of a violent crime in [their] neighborhood", or "was a victim of violent crime in [their] neighborhood." These questions were also based on a 3-point Likert scale (0 = *never*, 1 = *once*, 2 = *more than once*).

**Covariates—**In order to minimize the risk of confounding factors due to non-random assignment, all models controlled for children's school entry BMI, which allowed us to examine whether outdoor play was associated with changes in children's BMI from the start to the end of the school year. We also controlled for a robust, but theoretically relevant, set of child-, family-, and school-level covariates that could be linked with both amount of activity during outside time and BMI (see Table 1). The parent-reported child covariates included: gender, race/ethnicity, age, birth weight, overall health, unhealthy food habits (frequency of: salty snacks, soda, fast food, sweets), and days per week the child attended Head Start. We also controlled for teachers' reports of children's school behavior (e.g., behavior problems, attention/persistence, and social skills). Maternal and household covariates were: marital status, employment status, education, depressive symptoms, age, health, household size, household income, and neighborhood violence. Classroom covariates included: program type, classroom quality, teachers' education, and a composite variable reflecting classroom sedentary behavior (time spent: playing on computers, watching television, playing video games).

**Analysis plan—**All analyses were conducted in *Mplus* version 7.[27] We began by regressing children's spring BMI scores on their minutes of outdoor play at school, their fall BMI score, and the covariates. Then, these same models were re-estimated in a group modeling framework comparing these same parameters (outdoor play → BMI) across different subsamples of children. Wald's tests formally examined whether the coefficients across groups were significantly different from one another. Multilevel models were conducted to adjust standard errors for shared variance as a result of the sampling strata and sampling units while also using: 1) longitudinal weights, ensuring that our sample was representative of Head Start children and families across the nation; and 2) full information maximum likelihood estimation to address missing data, which fits the covariance structure model to the data for each individual participant by using all available data.

## Results

As can be seen in Table 2, children in Head Start were engaged in an average of 37 minutes of outdoor play per day ($M$= 36.69, $SD$ = 18.78, 95% CI [35.92, 37.46]). Approximately 10–13% of children spent less than 15 minutes outdoors per day, whereas 11–25% spent more than 45 minutes playing outside. Most children (40–50%), regardless of whether they attended part- or full-day programs, spent between 16–30 minutes outdoors. Although teachers in full-day programs reported significantly more minutes in outdoor play ($M$ = 39.19, $SD$ = 21.44, 95% CI [36.64, 41.74]) than teachers in half-day programs ($M$ = 34.32, $SD$ = 15.49, 95% CI [33.32, 35.32]), the difference only corresponded to 5 minutes of additional outdoor play time ($F$ = 47.91, $p$ < .001), despite the fact that full-day programs

are typically 2.5 hours longer than part-day programs. Thus, children in full-day programs spent an average of 11% of their time at Head Start outside, whereas children in part-day programs spent 16% of the school day outdoors, both of which fall short of recommendations from public health organizations (recommended: 20–25%).[17] In this sample of low-income children, BMI was also found to be highly stable across the school year ($\beta$ = .76, 95% CI [.73, .79]), with over 72% remaining in the same weight classification. Roughly 17% of children were considered obese (see Table 3), which is higher than national averages for their same aged peers during this same time frame (8–15%).[4,5]

Despite the general stability of BMI from fall to spring, children who experienced greater outdoor play time at preschool experienced a significant reduction in their overall BMI ($\beta$ = −.05, 95% CI [−.09, −.01]). To give a sense of the meaning of this observed association, the difference in children's BMI between children who experienced low (−1 *SD*) and high (+1 *SD*) outdoor play time corresponded to .18 BMI points. In addition to the continuous BMI scale, we also used the BMI cutoff of obesity as an additional outcome. Results from these analyses revealed that the more children experienced outdoor time, the lower their chance of being obese at the spring wave (*OR* = .99, 95% CI [.98, .99]; see Table 4). Because the odds ratios in these analyses correspond to the effect of a one-unit change in the predictor (i.e., one minute of outdoor time), these results suggest that for every minute children spent outdoors, children were approximately 1% less likely to be obese. [28] To give a meaningful comparison across different levels of outdoor time, we calculated children's likelihood of obesity for those who experienced high (+1 *SD*) versus low (−1*SD*) levels of outdoor play (obesity risk = *OR* X 2 *SD*s of outdoor play). Thus, children who experienced high levels of outdoor time were 42% less likely to be obese at the end of the Head Start year as compared with children who experienced low-levels of outdoor time.

The next step was to consider variation in the links between outdoor play and children's BMI and obesity status across different subgroups of children. The first set of variables examined children's own BMI classification at the start of the school year. Results from these analyses revealed that the extent to which outdoor play was linked with changes in BMI depended on children's weight classification upon preschool entry (see Table 4, Model 2). Specifically, outdoor play was associated with gains in children's BMI for those children who entered the Head Start program as underweight ($\beta$ = .18, 95% CI [.01, .35]) and the difference between high and low outdoor time corresponded to .42 BMI points for underweight children. In contrast, children who were classified as obese at the beginning of the year benefited most both in terms of their overall BMI ($\beta$ = −.10, 95% CI [−.18, −.01]) and their likelihood of being considered obese (*OR* = .98, 95% [CI = .97, .99]). The difference between obese children who experienced high and low levels of outdoor time corresponded to .34 BMI points and a 62% reduction in risk of obesity. Wald's tests confirmed that the regression coefficients for outdoor play were significantly different across subgroups of children's initial BMI.

The next set of stratification variables examined whether the benefits of outdoor play varied according to children's household and neighborhood characteristics. Results from these analyses revealed that children who did not spend any time outside at home benefited most, both in terms of their overall BMI ($\beta$ = −.12, 95% CI [−.18, −.05]), and their weight

classification (*OR* = .97, 95% CI [.95, .99]; see Model 3). This effect size translated to a reduction of .42 BMI points and these children were 106% less likely to be considered obese. We found similar patterns for children's television viewing (see Model 4). Specifically, the benefits of outdoor play were strongest for those children who exceeded the American Academy of Pediatrics recommendation of no more than two hours of television time per day ($\beta = -.10$, 95% CI [−.16, −.04]), which translates to .34 BMI points across low and high levels of outdoor play. [29] Similar patterns did not emerge, however, when examining children's likelihood of obesity. The final stratification variable considered was parents' perceptions of neighborhood safety (see Model 5). Results from these analyses revealed that, for the most part, the benefits of outdoor play were concentrated among children whose parents' perceived their neighborhoods as unsafe (continuous BMI score: $\beta = -.10$, 95% CI [−.16, −.04]; weight classification: *OR* = .97, 95% CI [.95, .99]). This difference corresponded to a .34 difference in BMI and a 116% reduction in children's likelihood of being considered obese at high versus low levels of outdoor play. Wald's test confirmed that these regression coefficients were also significantly different across children's household and neighborhood characteristics.

We also examined whether additional time spent outdoors had implications for children's literacy and math skills. Results from these analyses revealed that minutes of outdoor play were not associated with changes in children's math ($\beta = .02$, 95% CI [−.03, .07]) or literacy skills ($\beta$'s = .01−.03, 95% CI's [−.05, .07]). Additional minutes of outdoor play, therefore, had benefits for children's weight and risk of obesity but did not detract from children's academic learning.

### Robustness check

As a supplementary exploration, we examined whether there was a threshold above which the associations between outdoor time and children's BMI were stronger in magnitude by comparing those who spent 60 minutes or more outside with children who spent less than 30 minutes outside and with children who spent less than 60 minutes outside (but more than 30 minutes). These analyses revealed that outdoor time was associated with a greater change in children's BMI when children engaged in 60 minutes or more of outside play as compared with children who experienced less than 30 minutes ($\beta = -.07$, 95% CI's [−.14, −.02], .14 BMI points) and children who experienced 30–59 minutes of outdoor time ($\beta = -.07$, 95% CI's [−.14, −.03], .14 BMI points). Thus, children who spent at least 60 minutes outdoors at school were more likely to display improvements in their weight status. These same associations also emerged for children's risk of obesity, such that children who spent at least an hour a day outdoors at school were 48–57% less likely to be classified as obese at the end of the year (versus < 30 minutes: *OR* = .43, 95% CI [.26, .69]; versus 30–59 minutes: *OR* = .52, 95% CI [.36, .77]).

## Discussion

Children who have weight problems in preschool often continue to have weight difficulties over time, making early childhood an important time for intervention.[1, 2, 30] Although outdoor time can improve children's physical, socio-emotional, and cognitive development,

preschool-age children are spending less time outdoors as a result of increased pressure on teachers to prioritize classroom learning over physical activity.[8] In this study, we shift the attention from elementary school to preschool, which has received less empirical attention, and specifically, to Head Start, which has a long history of promoting healthy child development among at-risk populations.[14,31, 32] In doing so, this study is one of the first to show that additional outdoor play time in Head Start may be associated with improvements in children's BMI.

Our results are consistent with the broader literature on outdoor play showing that children who spend more time outdoors have a higher likelihood of being at an optimal weight.[9–12] These studies, however, have often been restricted to the home context, and so, it was unknown, up till now, what preschool programs like Head Start can do to shape young children's weight trajectories. Our findings demonstrate that additional outdoor play during preschool was associated with significant reductions in children's BMI and likelihood of obesity, and this was especially true for children who experienced 60 minutes or more each school day. These associations were also stronger among children who were deemed most "at-risk", namely children who were obese at the beginning of the school year, living in unsafe neighborhoods, and who experienced less physical activity at home. Thus, future research on these "at-risk" children would be of great interest and might help elucidate other means of promoting healthy weight.

Given current rates of childhood obesity, there has been increased interest in policies that may facilitate healthy child development at school, especially for children living in poverty.[18,30] Even though child health organizations have recommend that preschoolers be allowed 12 to 15 minutes of physical activity for every hour at school, Head Start regulations fail to provide sufficient or concrete recommendations for children's outdoor activity.[17] As a result, outdoor time is fairly limited at an average of 37 minutes per day. Full-day programs in particular, which are only spending 11% of the program day outdoors, should be able to increase the amount of time spent outdoors. Given the documented associations between outdoor play and children's BMI, Head Start programs should consider establishing clear guidelines for outdoor time, such as increasing time outside to an hour per day, as a cost effective means of combating obesity.

Despite recent trends in reducing outdoor play time for children in favor of more instructional time in preschool classrooms, the results from this study reveal that increased outdoor time does not detract from children's academic learning. This is an encouraging finding for efforts aimed at increasing children's physical activity in preschool settings.

Finally, with the recent research and clinical emphasis on obesity, less attention has been paid to underweight children and the best practices of helping them achieve optimal weight. The results from this study suggest that physical activity at school can be one important means of helping these children gain weight, perhaps by stimulating children's appetites and strengthening their bones and muscles. However, these possibilities require further research.

An important strength of this study is the inclusion of an extensive set of covariates, thereby accounting for potential confounds. That is, the relations between outdoor play time at

school and improvements in children's BMI and rates of obesity were robust to several child-, family-, and school-level covariates, including BMI upon preschool entry. The findings from this observational study, however, will need to be interpreted with caution as outdoor play in school can be a marker of total physical activity, or also, of other environmental factors that contribute to both outdoor play and changes in children's BMI. The results from the current investigation, therefore, do not permit causal inference. For these reasons, randomized evaluations of outdoor activity at Head Start centers could provide important insight in determining whether outdoor play time causes reductions in children's BMI and whether 60 minutes is the "tipping point". This study was also limited by the fact that observed measures of physical activity were not available, which would be needed for truly accurate estimates of the amount and intensity of physical activity. Accordingly, future studies should consider how much time Head Start children spend in moderate to vigorous physical activity during outdoor times.

Furthermore, FACES 2006 did not collect data on region of country and, therefore, we could not explicitly examine (or account for) such variation. A caveat to this limitation is that our models accounted for sampling units, which were based on census region (Northeast, West, South, Midwest), urbanicity (metro or non-metro), and proportion of children who were of minority origin; thus, our models adjusted for the shared variances across the different regions of the country. [21] Even so, future studies in Head Start centers should examine the role of regional and seasonal variation in the documented associations, which were not possible with these data. For example, indoor physical activity might compensate for reduced outdoor times in areas of the country where it is sometimes prohibitively cold for children to play outdoors. Finally, considering that there is no standardized curriculum used in Head Start programs, future research should also consider whether the implementation of different curricula explain the variability in outdoor time across Head Start centers and, in turn, promote healthy child development.

## Conclusion

The early childhood years serve as an important juncture in lifelong trajectories of mental and physical health.[1–3] Results from this study revealed that outdoor play at preschool may serve as an important means of combating obesity, especially among children at risk. Considering the heterogeneity in amount of outdoor time across centers in this national sample of Head Start centers, federal regulations that set a minimum for outside time in Head Start centers would be an important means for increasing outdoor time in Head Start nationally. The results from this study also raise questions for future research. Ideally, future studies will have more detailed measures of outdoor time at school that can untangle the mechanisms that underlie these benefits. Given the clear health and nutritional components of the Head Start program, future studies should also consider other aspects of the school environment—both in Head Start and other early care and education programs—that can facilitate young children's health, such as screen time, classroom nutrition, and the provision of health referrals and services. In addressing such questions, these studies can further identify potential mediating and moderating variables that may influence the association between preschool children's physical activity and their weight status. With these future directions and associated limitations in mind, the current study provides promising new

evidence suggesting that outdoor play time at Head Start may serve as a cost effective means of combating obesity during the early childhood years.

## Abbreviations

| | |
|---|---|
| **BMI** | body mass index |
| **CI** | confidence interval |
| **FACES-2006** | Family and Child Experiences Survey, 2006 Cohort |
| **OR** | odds ratio |
| **SD** | standard deviation |

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## Table 1

Weighted demographic characteristics used as covariates in the current study

| | M (SD) or % |
|---|---|
| Child gender (female) | 48.7 |
| Child race/ethnicity | |
| White | 22.4 |
| Black | 33.5 |
| Hispanic | 35.4 |
| Asian/other | 8.7 |
| Child age | 45.45 (6.61) |
| Child health | |
| Excellent | 47.8 |
| Very good | 30.0 |
| Good | 16.4 |
| Poor/fair | 5.8 |
| Child behavior | |
| Behavior difficulty | 6.96 (6.08) |
| Social skills | 15.60 (4.73) |
| Attention/persistence | 50.30 (9.91) |
| Low birth weight | 11.5 |
| Child health behaviors | |
| Unhealthy food habits | 18.14 (16.14) |
| No outdoor play at home | 19.9 |
| Television exposure | |
| One hour or less | 31.7 |
| One to two hours | 47.8 |
| More than two hours | 20.5 |
| Days a week attending Head Start | 4.64 (0.54) |
| Program type (full day) | 48.7 |
| Household size | 4.62 (1.58) |
| Income-to-needs ratio | 2.74 (1.44) |
| Mothers' depressive symptoms | 5.32 (6.09) |
| Mothers' age | 28.66 (5.87) |
| Mothers' marital status | |
| Married | 33.0 |
| Single | 17.1 |
| Not two parent household | 49.9 |
| Mothers' employment status | |
| Full-time | 32.4 |
| Part-time | 20.9 |
| Unemployed | 46.7 |
| Mothers' education | |

| | M (SD) or % |
|---|---|
| Less than high school | 37.2 |
| High school diploma | 31.9 |
| Some college | 24.7 |
| Bachelors | 6.2 |
| Mothers' health | |
| Excellent | 21.3 |
| Very good | 29.6 |
| Good | 32.4 |
| Poor/fair | 16.8 |
| Neighborhood violence | |
| No violence | 68.0 |
| Witnessed violence | 15.6 |
| Experienced violence | 16.4 |
| Classroom sedentary behavior | 6.23 (1.52) |
| Classroom quality | 3.58 (0.59) |
| Teachers education | |
| High school or less | 3.2 |
| Some college | 14.2 |
| Associates degree | 41.3 |
| Bachelor's degree | 33.7 |
| Graduate school | 7.6 |

*Note*. For categorical variables, the largest category was used as the referent in the regression models.

**Table 2**

Data on Outdoor Play at School.

| | *M* (*SD*) or % | | |
|---|---|---|---|
| | **Overall** | **Full day** | **Half day** |
| Average outdoor play (minutes) | 36.69 (18.78) | 39.19 (21.44) [a] | 34.32 (15.49) [b] |
| Percent of children with each amount of outdoor play time | | | |
| Do not have outdoor time | 1.0 | 1.3 [a] | 0.6 [a] |
| 1–15 minutes per day | 10.6 | 8.9 [a] | 12.3 [a] |
| 16–30 minutes per day | 44.9 | 40.0 [a] | 49.7 [b] |
| 31–45 minutes per day | 25.2 | 24.5 [a] | 26.0 [a] |
| 46–60 minutes per day | 14.3 | 17.2 [a] | 11.3 [a] |
| More than 60 minutes per day | 4.1 | 8.1 [a] | 0.1 [b] |

*Note*. Different superscripts indicate significant differences.

## Table 3

Head Start Children's BMI Scores and Weight Status at Both Waves

| | ***M* (*SD*) or *%*** |
|---|---|
| Fall 2006 | |
| BMI continuous score | 16.53 (1.70) |
| Under weight | 2.8 |
| Normal weight | 61.7 |
| Overweight | 18.6 |
| Obese | 17.0 |
| Spring 2007 | |
| BMI continuous score | 16.50 (1.75) |
| Under weight | 3.2 |
| Normal weight | 61.9 |
| Overweight | 18.1 |
| Obese | 16.8 |

**Table 4**

Children's BMI and Obesity Status at Spring 2007 Regressed on Outdoor Play and Stratified by Child and Neighborhood Characteristics.

| | Child's BMI score [a] | | | Child is obese [a] | | |
|---|---|---|---|---|---|---|
| | β | 95% CI | BMI diff. [b] Low vs. high | OR | 95% CI | Obesity likelihood [c] Low vs. high |
| Full sample | | | | | | |
| Model 1: Minutes of outdoor play | −0.05 * | [−0.09, −0.01] | ↓ 0.18 | 0.99 * | [0.98, 0.99] | ↓ 42% |
| Associations between minutes of outdoor play and child outcomes by moderator subcategories | | | | | | |
| Model 2: Stratification by initial BMI status | | | | | | |
| Child is underweight | 0.18 * *d* | [ 0.01, 0.35] | ↑ 0.42 | N/A | N/A | N/A |
| Child is normal weight | −0.05 † *e* | [−0.10, 0.00] | ↓ 0.12 | 0.98 * *d* | [0.95, 1.00] | ↓ 90% |
| Child is overweight | −0.04 *e* | [−0.13, 0.05] | ↓ 0.10 | 1.00 *e* | [0.99, 1.01] | ↑ 4% |
| Child is obese | −0.10 * *f* | [−0.18, −0.01] | ↓ 0.34 | 0.98 * *d* | [0.97, 0.99] | ↓ 62% |
| Model 3: Stratification by outdoor play at home | | | | | | |
| No outdoor play at home | −0.12 *** *d* | [−0.18, −0.05] | ↓ 0.42 | 0.97 ** *d* | [0.95, 0.99] | ↓ 106% |
| Any outdoor play at home | −0.02 *e* | [−0.06, 0.01] | ↓ 0.08 | 0.99 *e* | [0.99, 1.00] | ↓ 18% |
| Model 4: Stratification by children's television exposure | | | | | | |
| One hour or less | −0.01 *d, e* | [−0.06, 0.03] | ↓ 0.04 | 0.99 *d* | [0.98, 1.01] | ↓ 32% |
| One to two hours | −0.05† *e, f* | [−0.11, 0.01] | ↓ 0.18 | 0.99 *d* | [0.98, 1.01] | ↓ 24% |
| More than two hours | −0.10 *** *f* | [−0.16, −0.04] | ↓ 0.34 | 0.99 *d* | [0.97, 1.01] | ↓ 52% |
| Model 5: Stratification by mothers' violence exposure | | | | | | |
| Never witnessed/experienced violence | −0.03 *d* | [−0.07, 0.01] | ↓ 0.10 | 0.99 *d* | [0.98, 1.00] | ↓ 26% |
| Witnessed violence | −0.02 *d* | [−0.08, 0.05] | ↓ 0.08 | 0.99 *d* | [0.98, 1.01] | ↓ 36% |
| Experienced violence | −0.10 *** *e* | [−0.16, −0.04] | ↓ 0.34 | 0.97 *** *e* | [0.95, 0.99] | ↓ 116% |

*Note.* Low = low outdoor play time (−1 SD). High = high outdoor play time (+1 SD). N/A = there were no children who were underweight at baseline who were classified as obese at the end of the year.

[a] Models control for all covariates listed in Table 1.

[b] Differences in end of year BMI were calculated by multiplying the standardized coefficient by 2 SDs of BMI to get the range of 1 SD above and below the mean, representing differences in children's BMI at low versus high levels of outdoor play.

[c] Because odds ratios correspond to the percent likelihood an outcome will occur given a one unit increase in the predictor (i.e., one minute of outdoor play), we calculated the overall likelihood of obesity by multiplying the odds ratio by 2 SDs of outdoor play, representing children's likelihood of obesity at low versus high levels of outdoor play. For each set of subgroup analyses, the SDs for outdoor play were pulled from each respective group (e.g., male, female).

[d, e, f] Different superscripts within each model indicate that the outdoor play time coefficients were significantly different across groups.

*** $p < .001$.

** $p < .01$.

* $p < .05$.

† $p < .10$.