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Park Density Impacts Weight Change in a Behavioral Intervention for Overweight Rural Youth

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Abstract

Currently, over 30% of youth are overweight or obese. Limited access to parks and recreational facilities is related to physical inactivity and obesity. Environmental factors may also impact the effectiveness of pediatric weight management interventions. Most research concerning the built environment and child weight status has been conducted in urban settings, despite rural children being disproportionately overweight and obese compared to their urban peers. The current study examined the relationship between park density and weight change among 93 overweight rural youth (ages 8-14) participating in a randomized controlled trial examining the effectiveness of a behavioral family weight management intervention. Results revealed that increased park density was associated with decreases in BMI z-score over time for youth in the behavioral family weight management intervention, but not those in the wait-list control group. In rural communities it is important to consider the environmental context when designing prevention and treatment programs addressing childhood obesity.

Keywords

Built Environment; Parks; Obesity; Rural; Behavioral Intervention

Introduction

Pediatric obesity is a critical public health issue. Childhood and adolescent obesity are significant predictors of obese status in adulthood [1], which is associated with increased risk for type 2 diabetes, [2] coronary heart disease, [3] hypertension, [4] respiratory disease, [5] and premature death, [6]Current estimates suggest that approximately one in three children is overweight or obese in the U.S. [7]

Previous research has consistently demonstrated a relationship between environmental aspects, physical activity, and obesity. [8,9] Decreased physical activity is thought to play a role in obesity susceptibility and decreases in physical activity have been attributed to

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environmental influences .[10] High-intensity activity is particularly important for children. As little as 15 minutes of high-intensity activity a day has been associated with lower weight status in youth.[11] One of the best predictors of high-intensity activity for youth is time spent outdoors. [12] Children get 2-3 times more high-intensity activity outdoors compared to indoors, and it appears the majority of high-intensity activity takes place in parks and open spaces. [13] Additionally, a number of studies have shown that increased access to park spaces is related to increased physical activity among youth. [14-17] In a review by Davison, Lawson [10] proximity and availability of recreational infrastructure was consistently related to increased physical activity across a number of settings (e.g., urban and rural communities), ethnicities, and age groups (e.g., preschoolers to 17 year olds). Similarly, in a national sample Gordon-Larsen and colleagues found that a greater number of park locations within 8kms around families' homes were associated with lower odds of child obesity. [18] Despite these findings, little is known regarding how the built environment may influence the effectiveness of pediatric obesity treatments.

In an effort to address increases in childhood obesity over the last several decades, treatments to reduce or manage pediatric obesity have been explored. [19,20] Such interventions include behavioral interventions comprised of self-monitoring of diet and activity, stimulus control strategies, and contingency management. [21] Behavioral interventions incorporating parental involvement have the most empirical support to date for treating pediatric obesity. [19] However, there is virtually no research examining the influence of the environment on obesity treatment. Given the evidence of a relationship between the built environment and weight status, it is plausible that living in environments conducive to healthy behaviors may impact a child's ability to maintain better weight control. Concretely, access to parks may help a child maintain increased physical activity as part of a healthy lifestyle intervention program.

To our knowledge only one study exists which explores the relationship between pediatric obesity treatment and the built environment. Epstein et al. [22] found that aspects of the built environment were associated with poorer weight control among youth participating in family lifestyle interventions. Specifically, proximity to parkland was related to less weight regain over the course of an intervention and maintenance period. Further, findings indicated that type of behavioral treatment (e.g., interventions targeted at reducing sedentary activity versus interventions focused on increasing fruit and vegetable intake) did not interact with any aspects of the built environment over time, but rather that the built environment was a nonspecific predictor of treatment outcome across a number of behavioral treatment conditions. However, although Epstein et al.[22] demonstrated the non-specific influence of the built environment on behavioral interventions, this study examined proximity to parks as opposed to density of parks as other researchers have done [10,18] and did not include a wait-list comparison group. Lastly, the finding that the environment was a non-specific predictor of weight management has yet to be replicated in a rural sample or in community-based efficacy trials.

Unfortunately, there are a limited number of weight management interventions that address childhood obesity in rural settings. [23,24] This is concerning given that rural children are more at risk for obesity than their urban counterparts. [25] Aspects of the rural environment, such as limited access to recreational facilities, gyms, and other safe places to engage in physical activity, may make adopting healthier lifestyles more challenging for families living in rural communities. [26,27] Therefore, understanding the impact of the environment on intervention effectiveness is paramount to maximize intervention cost-effectiveness with rural children and families, which are one of the largest medically underserved populations in the country. [28]

The majority of research regarding obesity and the built environment has been conducted with cross-sectional samples, and the limited longitudinal research that does exists examines this relationship in an urban context. [29] The purpose of the proposed study is to determine the impact of park and recreational facility location density on changes in weight status of rural overweight and obese children participating in a family-based behavioral lifestyle intervention. We hypothesize that increased park density will be associated with decreases in BMI z-score among children participating in the behavioral interventions, but will be unrelated to weight change among children in the wait-list control group. This study is the first to longitudinally investigate the impact of the built environment on the effectiveness of a behavioral weight management program in a sample of rural overweight and obese youth.

Methods

Participants

The protocol for the study was approved by the governing institutional review board. Participants were 93 children and their parent(s) from 4 rural counties in the southeastern United States. Criteria established by the Office of Management and Budget (OMB) were used to define rural areas in the study. These designations are based on population size and integration with large cities [30]. Eighty-nine participants completed two assessments and 71 completed all three assessment time points. Children were between the ages of 8 and 14 years, with a body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) above the 85th percentile for age and sex according to Centers for Disease Control and Prevention norms. [31] There were no inclusion criteria regarding parental weight. Children and adults were required to obtain physician approval to participate in the study. For families not able to access a physician, an appointment with a physician was arranged for them at no cost. Families were excluded if the child or parent had a medical condition that contraindicated mild energy restriction or moderate physical activity, were using prescription weight loss drugs, or were enrolled in another weight loss program.

Procedures

Families were recruited through direct mailings, distribution of brochures through local schools, and community presentations. The intervention was promoted as a healthy lifestyle program to help establish effective weight management strategies for children and families. Interested parents were invited to call the research office toll-free to learn about the study and complete a telephone screening. Those still eligible scheduled an in-person screening visit. At the in-person screening, children and their parent(s) completed consent forms and had their height and weight measured. Families were then scheduled for a baseline assessment, which consisted of height and weight measurements and completion of questionnaires. Upon completion of the baseline assessment, families were randomized to one of three conditions: a family-based behavioral intervention, a parent-only behavioral intervention, and wait-list control. The family-based and parent-only conditions consisted of 12 healthy lifestyle weight management group sessions over a 4 month period focusing on education regarding healthy dietary habits and increasing physical activity and incorporated a variety of behavioral strategies (e.g., monitoring, goal-setting, modeling, stimulus control, differential attention and positive reinforcement) to facilitate behavior change. Both children and parents were targeted for behavior change. Children and parents attended sessions in the family-based condition and only parents attended parent-only sessions. Substantial emphasis was placed on individualized family behavior plans aimed at utilizing available community resources, which in many cases included parks and recreational spaces. Families completed post intervention (Month 4) and 6 month follow-up (Month 10) assessments. Dyads in the wait-list condition were invited to participate in a 12 session healthy lifestyle intervention after completing the month 10 assessment. A more detailed description of the methods and intervention can be found elsewhere [24,32]. As there were no significant differences in weight outcomes between the behavioral treatment conditions, outcomes for children in the family-based and parent-only conditions were combined and compared to children in the wait-list control condition.

Anthropometrics—Height and weight were assessed for each child at the initial visit prior to the start of the program (baseline, Month 0), at the post intervention (Month 4), and six months post intervention (Month 10). All data were collected by trained research assistants. Height without shoes was measured to the nearest 0.1 cm using a Harpendon stadiometer (Holtain Ltd, Crosswell, United Kingdom). Weight was measured to the nearest 0.1 kg with one layer of clothing on and without shoes using a calibrated balance beam scale. Height and weight were measured three times and the average of each was used to calculate child BMI z-score, which was included in analysis.

Demographic information—A demographic questionnaire was administered to parents to obtain background information including child age and gender. Parents also provided their current home and mailing address during the initial screening. The home address was used to examine the built environment for the purposes of the current study.

Geographic environmental data—Each participant's home address was mapped using ArcGIS software (ESRI, ArcGIS Desktop: Release 10.) and the geographical coordinate system GCS WGS 1984. A circle with a 10 mile radius was created as a “buffer zone” around each address. Ten miles has been used to operationalize realistic access to aspects of the built environment in rural areas. [33,34]

Park and recreational space data were obtained through the Florida Geographic Data Library (FGDL). The FGDL is maintained by the University of Florida's GeoPlan Center and data is screened for quality by Geographic Information Systems (GIS) professionals and students. All data housed by the FGDL can be downloaded and used without cost. The number of park or recreation locations within each participant's buffer zone was used to calculate the combined density of parks and recreational spaces. GIS spatial data for point locations identifying park and recreation facilities were downloaded via the Florida Geographic Data

Library at (http://www.fgdl.org/metadataexplorer/explorer.jsp). This data were compiled from a combination of addresses provided for parks and recreational facilities from 43 different sources.

Statistical Analyses

In order to investigate trajectories of BMI z-scores over time, we used multilevel growth models, fitting BMI z-score as a repeated measure. First, change in BMI z-score over time was modeled accounting for treatment condition (e.g., Intervention [family-based and parent-only] vs. Control). In order to investigate the impact of park density on weight trajectory, park density was included in the model, stratified by treatment condition. Child gender and age were included as covariates. Unlike conventional regression methods, multilevel growth models have the ability to incorporate all participants who completed at least one assessment. [35]

Results

The sample was 57% female, with a mean age of 10.88 years (SD = 1.67). Youth had an average BMI z-score of 2.19 (SD = .41) at the baseline assessment. Fifty-eight percent of the sample had an annual family income between \$20,000 and \$60,000. The mean number of parks within a 10 mile radius was M = 16.63 (SD = 16.58) with 20% of the sample not having access to a single park within 10 miles. Demographic information, including a more detailed breakdown of income across the sample, is presented in Table 1. All model estimates are presented in Table 2. There were no significant differences between the wait-list condition and intervention condition on the dimensions of race χ^2 (5) = 3.39, p =.64, income χ^2 (4) = 3.34, p =.50, age t (91) = .274, p =.31, gender t (91) = -1.01, p =. 31, or BMI z-score at baseline t (91) = 1.14, p = .26, post-treatment t (79) = .75, p = .46 or follow-up t (70) = .09, p = .93. With regards to participants who were lost to follow-up, treatment completers were more likely to be older and have a lower baseline BMI z-score than drop-outs.

The multilevel model for change was applied to the sample for this study. Five models were tested, labelled A-E. These analyses were run using IBM SPSS (version 22). The models were tested with child BMI z-score as the dependent variable. Model A was the unconditional means model; Model B was the unconditional growth model. Models C-E were theoretical models in which the effects of the substantive predictor variables of interest in this study (intervention group and park density) were tested. Table 2 summarizes the results of the model tests for child BMI z-score.

Model A, the unconditional means model, consists of one level 1 equation and one level 2 equation. The model has an intercept but no slope and assumes that the change for all individuals in the sample is the same over time.

$$\begin{array}{l}\text{Level} \quad 1{:}Y_{ij}{=}\pi_{0i}{+}\varepsilon_{ij}\\ \text{Level} \quad 2{:}\pi_{0i}{=}\gamma_{00}{+}\zeta_{0i}\end{array}$$

Where π_{0i} is the mean of Y for person *i* (within-person mean), and γ_{00} is the mean of Y across all persons in the sample (grand mean) and ε_{ij} is the difference between person *i*'s score at time *j* and the within-person mean. The variance of this is the within-person variance. If there is a significant amount of within person variation in individual's scores over time around their mean, it will be useful to add time-varying predictors to the model. Finally, ζ_{0i} is the difference between a person's mean and the grand mean. The variance of this term is the between-person variance in initial status. If this is statistically significant, then there is variability due to individual differences (i.e., baseline BMI z-score may vary with group assignment).

Table 2, under Model A, shows that for child BMI z-score, the grand mean is significantly different from zero, which was expected given that the sample selected was overweight. The random effects of model A show that there is significant within person (σ^2_e = .0126) and between person variation (σ^2_0 = .1590) to be accounted for in future models.

Model B is the unconditional growth model and adds time as a predictor of child BMI z-score, both fixed and random effects.

$$\begin{aligned}\text{Level } 1&: \mathrm{Y}_{ij}=\pi_{0i}+\pi_{1i}TIME+\varepsilon_{ij}\\ \text{Level } 2&: \pi_{0i}=\gamma_{00}+\zeta_{0i}\\ &\quad \pi_{1i}=\gamma_{10}+\zeta_{1i}\end{aligned}$$

In this model, Y is composed of an error term or residual (ε_{ij}) and the intercept (π_{0i}) and individual growth parameter (π_{1i}). In the level 2 model, there are two random effects (ζ_{0i} *and* ζ_{0i}) which have variances of σ^2_0 =.1616 and σ^2_1= .0055 (See Table 2). In model B the initial status or intercept (γ^{00} = 2.190) and the rate of change (slope) (γ^{10} = −.0322) were both significantly different from zero. The negative effect of time indicates that on average, children lost weight over the course of the study.

Model C was the theoretical model which tested the main effects of intervention group, as well as the interaction between group and linear change in child BMI z-score. The equation for model C is as follows:

$$\begin{aligned}\text{Level } 1 \text{ model}&: \mathrm{Y}_{ij}=\pi_{0i}+\pi_{1i}TIME+\varepsilon_{ij}\\ \text{Level } 2 \text{ model}&: \pi_{0i}=\gamma_{00}+\gamma_{01}\, I+\zeta_{0i}\\ &\quad \pi_{1i}=\gamma_{10}+\zeta_{1i}\end{aligned}$$

The intercept (γ^{00} = 2.060) is the average BMI z-score for all participants at baseline and when all other predictors are zero. The fixed effect of group was estimated and dummy coded in reference to the control group. The main effect of group was not significant on average for the intervention group (γ^{01} = .1958) compared to the control group. This indicates that the groups were not significantly different at baseline. However the interaction between group and time was significant for the intervention group (γ^{11} = −.0693) indicating that the average child in the behavioral interventions experienced decreases in BMI z-score over time. The variance of the random effect of time remained significant (σ^2_1 = .0055). The current model explained 10% of the within person variance in child BMI z-score.

Model D was the theoretical model which tested the main effects of park density on BMI z-score change. The model estimated the main effects of park density on initial child BMI z-score in addition to the effect of park density on BMI z-score change by condition. The equation for model D is as follows:

$$\begin{aligned}&\text{Level 1 model:} Y_{ij}=\pi_{0i}+\pi_{1i}TIME+\varepsilon_{ij}\\&\text{Level 2 model:} \pi_{0i}=\gamma_{00}+\gamma_{01}\ I+\gamma_{02}+\zeta_{0i}\\&\qquad\qquad\qquad \pi_{1i}=\gamma_{10}+\gamma_{11}+\gamma_{110}+\gamma_{111}+\zeta_{1i}\end{aligned}$$

The effect of parks on initial status was not significant ($\gamma^{02} = -.0034$) indicating that park density was not related to baseline BMI z-score. The effect of time X treatment condition was no longer significant after accounting for park density ($\gamma^{11} = -.0420$). However, the parks by condition interaction was a significant predictor of child BMI z-score slope for the intervention condition ($\gamma^{110} = -.002$) but not for the control condition ($\gamma^{111} = - .0006$). The current model explained 10% of within person variance in BMI z-score.

In model E, child age and gender were included to examine the influence of possible covariates on the model. The equation for model E is as follows.

$$\begin{aligned}&\text{Level 1 model:} Y_{ij}=\pi_{0i}+\pi_{1i}TIME+\varepsilon_{ij}\\&\text{Level 2 model:} \pi_{0i}=\gamma_{00}+\gamma_{01}\ I+\gamma_{02}+\gamma_{03}+\gamma_{04}+\zeta_{0i}\\&\qquad\qquad\qquad \pi_{1i}=\gamma_{10}+\gamma_{110}+\gamma_{111}+\zeta_{1i}\end{aligned}$$

Child gender was a non-significant predictor of initial status, however child age was significantly related to initial status, such that older children had higher BMI z-scores at the start of treatment ($\gamma^{04} = -.0593$).

In a final model (not shown) family income was added. Income was not a significant predictor of BMI-z score ($\gamma = -.0140$, $p = .72$) and did not substantially improve the fit of the model (AIC χ^2 (1) = .321, $p = .57$) or variance explained. Therefore, the more parsimonious model, which included only child age and gender, was retained as the final model.[36]

Discussion

The current study aimed to examine if park density moderated weight trajectories for rural children participating in a behavioral weight management lifestyle intervention to address obesity. Results indicated that increased park density was related to decreases in BMI z-score in the behavioral intervention group, but was unrelated to weight change in the control group.

The current study is one of the first to examine the longitudinal impact of park density on weight change in rural youth. Generally our findings are consistent with our hypotheses but are mixed when compared to previous research. Previous research examining the built environment in urban communities by Wolch et al. [29] found that children with increased park density within 500m of their home were less likely to experience significant increases in BMI over an eight year period. The current study found a similar relationship among youth receiving a behavioral lifestyle intervention in rural communities. These results are consistent with results regarding park proximity obtained by Epstein and colleagues [22] where increased access to park locations was related to improved weight trajectory among overweight and obese treatment seeking youth. The current study expands these findings by examining this effect in comparison to a no-treatment control group, for which park density did not predict weight change over time. Additionally, the current study extends previous research by examining the impact of the built environment on weight status outcomes associated with a behavior lifestyle intervention implemented in a real world community setting. Although our results did not indicate that increased weight status was related to park density cross-sectionally, as was found by Gordon-Larson and colleagues [18] this is likely due to the restricted range of child BMI z-scores, as the current study only included overweight and obese treatment-seeking youth.

There are important research and clinical implications regarding the findings from the current study. First, this study demonstrates the important role aspects of the built environment may play on the maintenance of weight improvements in pediatric obesity treatment. Previous research has demonstrated park proximity is associated with physical activity and weight status in adults and children. [10,14-17] This study extends those findings by demonstrating the number of available recreational areas to engage in physical activity (e.g., park density) may play a role in weight maintenance in pediatric obesity treatment for children living in rural communities. However, more research on the built environment, specifically park density and other environmental determinants of physical activity, as well as longitudinal associations with weight, are needed in youth, especially since findings were not significant for children in the wait-list group. Future research should consider whether park density differentially impacts long-term weight status by comparing children receiving behavioral family interventions to those receiving health education treatments. Perhaps park density augments healthy lifestyle interventions more generally, as opposed to just those that are behavioral in nature. Notably, the intervention in the current study did not specifically aim to increase park utilization, but rather targeted lifestyle changes in general, which often included utilization of specific community resources available to families (including parks and recreational spaces).

Second, if the findings from this study are replicated the recommendations for pediatric obesity treatments are important to consider. Specifically, the results from this study indicate that behavioral interventions should be tailored to highlight the importance of park utilization in child weight maintenance and encourage families to take advantage of existing community infrastructures.[37] For example, incorporating food field trips into behavioral family weight management interventions has been suggested as one way to address barriers families experience when identifying healthier foods to purchase in rural communities. [27] Similar field trips could be conducted to parks and recreational spaces so parents and children become more aware of resources available in their rural community. However, parental involvement is essential to utilize parks spaces outside a safe walking distance from families' homes. Research on the built environment also indicates that multi-level interventions may be needed to combat the obesity epidemic and have a greater influence on changing healthy lifestyle behaviors. Ecological models provide a framework for such interventions as they suggest child health behaviors are influenced by interactions between a child and their environment, specifically their genetic/biological, intrapersonal, social, cultural, and physical environments. [38] Avenues for intervention include family, peer, school, community, mass media, and public policy to help children and parents modify multiple environments to support healthy behaviors. [38]In rural communities examples may include modifying the physical environment by creating more parks and safe child play areas, installing sidewalks along rural roads, and creating family and community programs that provide education about and emphasize health behaviors. [27] Given 20% of children participating in this study did not have access to a park or recreational facility within 10 miles of their home, there is a need for additional community infrastructure promoting physical activity in rural communities. Unfortunately, research findings are rarely included in state legislative policy efforts to support environments conducive to physical activity and to address obesity related concerns. [39] However, as the body of research regarding the built environment becomes richer and consistently identifies environmental risk and protective factors for weight status and weight maintenance, researchers and clinicians will have a larger evidence base to rely on when advocating for policy level changes to promote healthy lifestyles in communities.

It is worth noting that previous research has implicated socioeconomic differences in health disparities associated with the built environment. [18] Although income was not a significant predictor of child weight in the current study, park density and income were significantly correlated ($r = .26$, $p = .02$). Indeed, it is appears likely that both rurality and economic disparities underlie key differences in park density in rural areas. [40] Future studies should continue to delineate the complicated relationship between the rural built environment and socioeconomic status, especially in the context of healthy-lifestyle interventions.

Several limitations should be considered when interpreting the results of the current study. Small sample size precluded our ability to examine more complicated models, due to limited power. Potential models, such as including four-way interaction models, may not have converged due to limited sample size. Future studies may consider estimating the quadratic trends of weight management, subsequent interactions with conditions, and further explore more diverse error structures. Small samples are often adequate to examine longitudinal effects of intervention programs. However, larger samples may be needed to explore more complex relationships in future studies. The generalizability of the study findings are also limited by the sample being treatment-seeking overweight and obese children from rural communities. In addition, although the current study did not include a measure of physical activity, previous literature has made a consistent connection between park locations and physical activity, [12] as well as between physical activity and weight status. [11] The current study demonstrates a relationship between park locations and weight trajectory; however, future research should explicitly test the mediating effect of physical activity on the relationship between park locations and weight status over time in overweight youth. Further, it is possible that participants utilized personal recreation equipment, and future studies should aim to assess the impact of utilizing personal versus public play equipment. Lastly, the current study did not explicitly measure park utilization, and as such park density was utilized as a proxy measure. This limitation should be interpreted in the context of the lack of published literature on the relationship between the built environment and weight intervention outcomes, particularly in rural settings. To this end, future research should aim to explicitly measure park utilization as a predictor of physical activity and ultimately weight change in light of current results indicating a relationship between these factors. Additionally, it should be noted that the upper limit and average number of parks in the current study may be inflated compared to other rural areas due to the classification of beaches and nature reserves as park areas, which were somewhat common in the rural communities this study was conducted. Indeed, GIS technology has shown to have a degree of inaccuracy in rural areas. [41] Although not feasible in the current study, future research should make use of rigorous methods of facility evaluation including “ground-truthing” of park facilities, ideally working with community based organizations, to achieve this goal. [42]

It should be acknowledged that parks only constitute one aspect of a complicated interplay of the environment and health behaviors. [12] Indeed, aspects of the natural environment (i.e., climate [43]) or socioeconomic environment [18] have been shown to account for variability in weight status. However, continued attention should be paid to investigating the influence of the rural *built* environment over time. For example, additional research could help identify other important factors that may help increase the amount of variance in weight change explained by built environment factors. In general, longitudinal research should continue to examine factors in the built environment that are both risk and protective factors associated with weight status in children in both rural and urban settings. In line with the current study, additional research is needed to determine what aspects of the built environment may impact response to behavioral pediatric obesity treatments and associated maintenance of improvements in weight status. This research is important to inform the development and evaluation of pediatric obesity prevention and treatment efforts. For example, availability of fast food restaurants have been identified as impacting weight status [44] but to our knowledge has not been examined as impacting weight management interventions or weight maintenance in youth. Though behavioral family weight management interventions are efficacious at improving weight status, [19] the generalizability of these findings to community-based and rural settings are limited. In addition, not all children who participate in these treatments experience a decrease in weight status. Thus, additional modifications are needed to current interventions to improve feasibility to community and underserved settings, as well as improve treatment outcomes to prevent the development of secondary medical problems and poor long-term physical and mental health in overweight and obese youth. Research findings regarding the built environment may provide novel avenues for intervention modification and refinement and inform the development of community-wide and national policies related to obesity prevention efforts.

As the prevalence of childhood obesity increases, the translation and dissemination of effective health interventions to diverse community settings are critical. This is especially relevant for populations at increased risk for obesity, such as residents of rural communities. [25] By identifying environmental factors associated with improved outcomes in intervention studies, the effectiveness of treatments can be maximized by integrating positive influences of existing environmental infrastructures and modify future infrastructure to promote improved health in youth.

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Table 1

Means (SD) and percentages of Child demographic and weight status variables

	Overall (N = 93)
Child Age (years)	10.88 (1.67)
Child Gender (% female)	57 %
Child Baseline BMI z-score (Month 0) (n = 93)	2.19 (.406)
Child Post-Treatment BMI z-score (Month 4) (n = 89)	2.07 (.482)
Child 6 Month Follow-up BMI z-score (Month 10) (n = 71)	2.04 (.476)
Race	
Caucasian	76.3 %
Hispanic	9.7 %
African American	7.5 %
Other/unknown	6.5 %
Yearly Household Income	
Below $10,000	5.5 %
$10,000- $20,000	11 %
$20,000- $40,000	34.1 %
$40,000-$60,000	24.2 %
$60,000- $80,000	8.8 %
Over $80,000	16.5 %

Table 2

Results of model tests for BMI z-score change

	Parameter	Model A	Model B	Model C	Model D	Model E
Fixed Effects						
Initial Status						
Intercept	γ^{00}	**2.177* (.047)**	**2.190* (.050)**	**2.060* (.090)**	**2.11* (.100)**	**2.750* (.338)**
Group						
Intervention	γ^{01}			.1958 (.108)	.0243(.107)	.1831(.106)
Control				.0	.0	.0
Park Density	γ^{02}				−.0034(.003)	−.0047(.003)
Child Gender	γ^{03}					.0709(.096)
Child Age	γ^{04}					**−.0593* (.029)**
Rate of Change						
Time (linear)	γ^{10}		**−.0322* (.014)**	.0152 (.024)	.0243(.031)	.0253(.031)
X condition						
Intervention	γ^{11}			**−.0693* (.029)**	−.0420(.038)	−.0434(.039)
Control				.0	.0	.0
X Parks						
Intervention	γ^{110}				**−.0020* (.001)**	**.0020(.001)**
Control	γ^{111}				−.0006(.001)	−.0006(.001)
Random Effects						
Level 1						
Within-person	σ^2_e	.0126* (.002)	.0127* (.002)	.0123* (.002)	.0126* (.002)	.0126* (.002)
Level 2						
In initial Status	σ^2_0	.1590* (.028)	.1616* (.029)	.1621* (.029)	.1571* (.029)	.1496* (.029)
In Rate of Change	σ^2_1		.0055* (.002)	.0052* (.002)	.0043* (.002)	.0043* (.002)

Note.

* $p<.05$. Standard errors are between parentheses.