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Objective and subjective residential context and urban children's weight status and physical and sedentary activities

Rachel Tolbert Kimbro
Rice University
Department of Sociology

Jeanne Brooks-Gunn
Columbia University
National Center for Children and Families

Sara McLanahan
Princeton University
Department of Sociology

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Author correspondence
Rachel Tolbert Kimbro, Rice University, Department of Sociology, Houston, TX, 77251.
E-mail: rtkimbro@rice.edu.

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Introduction

Despite trends indicating a recent stabilizing in the upward obesity trend for children and adolescents in the U.S., child overweight remains a significant public health issue, with approximately one-third of children overweight or obese and 16% obese (Ogden, Carroll and Flegal 2008). One prominent explanation for the increase is that children are spending too little time playing outdoors and too much time in front of the television. Some analysts also argue that lack of outdoor time is due in part to mothers' fears about neighborhood safety. Despite the interest in childhood obesity in general and the role of outdoor activities in particular, very little work has examined the associations between children's activities, neighborhood characteristics, and weight status, using nationally representative data. This paper fills this gap by addressing two research questions: first, we ask, are the activity patterns (outdoor play and television watching) of five-year-old children living in large cities associated with children's weight status? Second, we ask, is residential context, and neighborhood safety in particular, associated with children's activity patterns? Consistent with past research, we find that outdoor play is negatively associated with weight status, while television watching is positively associated with weight status. We also find, unexpectedly, that the poorest children are playing outdoors the most *and* watching the most television. Finally, we find that three measures of residential context: living in public housing, mothers' perceptions of neighborhood collective efficacy, and interviewer-assessed neighborhood physical disorder, are positively associated with children's physical activity, but that neighborhood

socioeconomic disadvantage is not. Thus, this paper answers calls both for more research into the determinants of child obesity as well as more work integrating objective and subjective neighborhood characteristics and physical activity (Foster and Giles-Corti 2008).

Children's Physical and Sedentary Activities and Obesity

Although the exact mechanisms of the link between physical and sedentary activities and the regulation of child obesity are not precisely understood, it is clear from experimental intervention studies that regular exercise is beneficial for children's weight status (Goran et al, 1999). Moreover, children who spend more time engaged in sedentary activities like watching television or playing video games are more likely to be overweight (Dennison, Erb and Jenkins 2002; Gortmaker et al. 1996), although at least one study did not find a link between three-year-olds' television viewing and BMI (Burdette and Whitaker 2005).

Most research on physical activity and overweight focuses on older children (ages 10-17), who may be more likely to gain physical activity through often-costly organized sports or after-school programs. Younger children, who typically have more unstructured time, are more likely to be physically active just through outdoor free play. As older children and adolescents are more likely to self-direct their leisure activities, and to engage in physical activities independently, it makes sense that researchers have focused on this age group. We argue, however, that understanding the determinants of young children's play is just as important, if not more so. Physical and sedentary activity patterns, like nutrition habits, may be set in early childhood (Pérez-Rodrigo and Aranceta 2001). Moreover, it is likely that, as for adults, links exist between individual and

neighborhood-level socioeconomic status, weight status, and the frequency of physical and sedentary activities.

Some of the studies cited above have examined the links between television viewing, physical activity, and BMI for young children, but most have homogenous samples or are from one geographic area, and most of this data does not allow for rigorous control measures. With our data, we are able to test for associations between physical and sedentary activities and BMI in young, urban children living in twenty U.S. cities, controlling for multiple determinants of obesity, including maternal weight status. Thus, in the first step of our analysis that follows, we document the associations between television watching, outdoor play, and children's BMI at age five. Then, we test whether the *ratio* of outdoor play to television time is a significant predictor of children's BMI percentiles, to see whether the potentially negative effects of television time may be counterbalanced by outdoor play.

Residential Context and Children's Physical Activity

Recently, scholarly attention has focused on neighborhood environments as determinants of weight status. Most of this work focuses on adults (e.g., Boardman et al. 2005). Generally, research shows that more disadvantaged neighborhoods (typically defined by percent of households in poverty) have lower levels of physical activity and higher rates of obesity (Fisher et al. 2004; Humpel, Owen and Leslie 2002; Moore et al. 2008). Hypotheses for the observed relationships center on safety concerns influencing leisure and exercise walking such as crime, but also include aspects of the built environment such as a lack of parks, playgrounds, nice walking trails, or walkable destinations such as churches, restaurants, and grocery stores (Bennett et al. 2007; Giles-

Corti and Donovan 2002; Gordon-Larsen, McMurray and Popkin 2000; Humpel, Owen and Leslie 2002; Huston et al. 2003). When focused on children or adolescents, results are mixed; with some studies showing strong correlations between neighborhood amenities and physical activity and others showing little to no effect (Burdette and Whitaker 2005; Carver, Timperio and Crawford 2008; Gómez et al. 2004; Molnar et al. 2004; Mota et al. 2005). The null findings may have to do with study design; some studies ask about overall physical activity, which could happen in or out of the neighborhood (Davison and Lawson 2006).

Adult residents of resource-deficient neighborhoods are at increased risk of poor health and low levels of physical activity, probably due to perceived hazardous or stressful conditions (Bennett et al. 2007; Geronimus 2000; Ross and Mirowsky 2001; Seefeldt, Malina and Clark 2002). There is conflicting evidence, however, about the specific correlation between perceptions of safety and physical activity (Foster and Giles-Corti 2008; Humpel, Owen and Leslie 2002). While most studies demonstrate that adults living in disadvantaged communities have lower levels of perceived safety and lower levels of physical activity, the size of the effect differs by gender and by race/ethnicity, and residents of some disadvantaged areas seem to walk more than those in more advantaged neighborhoods, perhaps due to greater density in urban environments as well as necessity (Brownson et al. 2001; Ross 2000).

Although scholars are making progress in understanding how neighborhoods may influence residents' health, much remains to be understood. A neighborhood's level of collective efficacy, or the shared willingness to exert social control (Sampson 2003), is emerging as a potentially important factor for predicting the health of residents.

Collective efficacy (CE) is a flexible and nuanced measure that may not necessarily directly correlate with the socioeconomic status of residents; very poor neighborhoods may have high levels of collective efficacy and wealthier neighborhoods low levels of CE. The measure is flexible because it does not require that residents know each other very well at all; rather, it depends upon the shared understanding that they will intervene in social or civic situations and act in each other's shared interests (Sampson 2003; Sampson, Morenoff and Earls 1999; Sampson, Raudenbush and Earls 1997).

Collective efficacy and social cohesion have been shown to be associated with weight status among adults, net of neighborhood disadvantage characteristics (Cohen et al. 2006), and are positively associated with physical activity (Echeverría et al. 2008; Evenson et al. 2003). It is likely that collective efficacy influences weight status indirectly, through less stressful experiences for residents (Cohen et al. 2006), environs that are more friendly to exercise (Cohen, Inagami and Finch 2008; Cohen et al. 2007; Molnar et al. 2004) and through greater perceptions of safety (Molnar et al. 2004; Sampson, Raudenbush and Earls 1997). In neighborhoods where adults feel safer and more connected to their neighbors, they are likely to feel safer exercising outdoors and walking to neighborhood destinations for recreation or other purposes.

Parental concern about safety seems likely to be particularly relevant in determining children's outdoor activities. In higher socioeconomic areas, "stranger danger" and traffic safety concerns are most problematic; while in lower socioeconomic areas general physical safety concerns (e.g., violence) are prevalent (Carver, Timperio and Crawford 2008; Davison and Lawson 2006; Timperio et al. 2005). Perceptions of neighborhood safety are likely to be influenced by neighborhood collective efficacy,

perhaps particularly in poor communities. Small positive correlations between area crime rates and children's indoor sedentary activities have been noted (Brown et al. 2008), and the preschool-aged children of mothers who perceive their neighborhoods to have low collective efficacy have increased television viewing, but not decreased outdoor play (Burdette and Whitaker 2005). The odds of being overweight at age seven were linked to mothers' feelings about neighborhood safety (Lumeng et al. 2006). A recent study (Cradock et al. 2009), with rich and detailed neighborhood data, investigated whether social cohesion at the neighborhood level was linked to physical activity for adolescents, and found that adolescents in neighborhoods with high levels of cohesion had higher physical activity levels, which lends support to the idea that neighborhood social factors may also be linked to weight status for young children. There is some evidence, however, that children living in poor, dense neighborhoods may walk more for transport (such as to school) than other children, presumably because they lack alternate modes of transportation. In addition, children who perceive *more* neighborhood hazards evidence more physical activity (Romero et al 2001).

These findings are counterintuitive, if we expect disadvantaged neighborhoods to be more unsafe, and to have lower levels of collective efficacy, and thus to be associated with lower levels of children's physical activity. It is possible, however, that these children live in urban, densely populated areas with reasonable access to public transportation and walkable destinations, factors typically associated with more physical activity. In the second part of our analysis, we test multiple measures of residential context for their associations with children's physical activity – neighborhood socioeconomic disadvantage, type of living environment (building, number of residents

in the household, and public housing), maternal perceptions of social cohesion, as well as interviewer-assessed physical disorder of the immediate exterior of the home. We seek to understand whether associations between neighborhood and residential context and children's activities are primarily driven by the neighborhood socioeconomic context, or whether other factors – such as maternal perceptions of the neighborhood environment, type of housing, or physical disorder characteristics of the neighborhood – are more closely linked with children's outdoor time.

Research Methods

Data

Data are from the Fragile Families and Child Wellbeing Survey, wave IV (N=3,001), as well as the In-Home Longitudinal Study of Pre-School Aged Children, an in-depth survey administered when the children were five years old to a sub-sample of Fragile Families respondents who agreed to participate (about 76% of the Wave IV respondents). The Fragile Families Study is a national survey that follows a birth cohort of new (mostly) unwed parents and their children. The Wave I interviews, conducted between 1998 and 2000, contain information on 3,712 births to unmarried parents and 1,188 births to married parents, in 20 large U.S. cities. The survey over-sampled unmarried mothers and thus contains a large sample of minority and immigrant women. The data include information on the resources and relationships of new parents and their effects on children. Follow-up interviews were conducted at one, three, and five years. In addition to sociodemographic and attitudinal information for both mothers and fathers in the Wave IV survey, the In-Home Survey includes interview responses, parent and child activities, parent and child anthropometric measures, and an observation of both

parent-child interaction and the home environment (including the exterior of the home). The data for this project include the 2,210 Non-Hispanic white (20%), Non-Hispanic black (55%), and Hispanic (25%) mothers and children who completed all components of the In-Home Five-Year Survey and also completed the Five-Year Core Survey. For further information about the Fragile Families Study, please visit http://crcw.princeton.edu/ff.asp .

Variables

The first outcome of interest is the child's body mass index percentile (BMI) at age five. Children were weighed and measured during the in-home visit using standard procedures and digital scales (6% of children (N =148) are missing this outcome, primarily due to implausible measurements or refusals, and are omitted from the first set of analyses). Our three activity measures of interest, all mother-reported, are: 1) the child's average number of hours per weekday of outdoor play; 2) the child's average number of hours per weekday of television viewing; and 3) the average number of days per week the mother takes the child out to play at a park or playground. Less than 0.5% of cases are missing any of the activity measures, and those children are dropped from the sample for that particular analysis. In the first set of analyses, we also test whether the *ratio* of outdoor play time to television time is a meaningful predictor of BMI.

Maternal and Child Background Characteristics

In our models, we control for a variety of background factors related to child weight status and to children's activities. We classify children into racial/ethnic/nativity categories based on mothers' status: Non-Hispanic White, Non-Hispanic Black, and Hispanic. We also control for the child's age in months at the time of the In-Home

interview, child's gender (1 = male), and, in the models predicting BMI, whether the child was normal birthweight (2500-5000 grams), low birthweight (<2500 grams), or high birthweight (5000+ grams), as the influence of birthweight on physical development reaches well into childhood (Hediger et al. 1999). We control for mothers' educational attainment (when the child was born) with a set of indicators for did not complete high school (reference group), completed high school, and some college or more, as well as mother's age. We include measures for mother's employment, with not employed outside the home as the reference category, compared to full-time and part-time work; as well as an indicator for whether the child is enrolled in any daycare, preschool, or kindergarten program. Because children with older siblings might be more likely to play outside, we include an older sibling indicator (1 = has older sibling). We also include a continuous measure of the income-to-poverty ratio for the household (also the income-to-poverty ratio squared as indicated below), as well as family structure indicators based on the mother's current relationship with a partner – married, cohabiting, or single. We also include an indicator for whether the mother is likely clinically depressed, which is an indicator based on the CIDI-SF (Kessler et al. 1998), as mothers who are depressed may be less likely to take their child out to play.

Residential Context Measures

The first set of residential context measures are an indicator for whether the family lives in public housing (1 = public housing), the number of residents in the household, and finally, a series of categories for the type of housing: Single-family home (reference), apartment, duplex/townhome/row house, or other housing type.

We also include a neighborhood socioeconomic disadvantage index to control for tract-level differences in neighborhood context. The measure consists of the sum of the percent of household in the tract who were below the poverty line, the percent of households headed by a single woman, the percent unemployment, and the percent of renter-occupied households (alpha = .83). Note that this data comes from the three-year survey. To account for the fact that nearly half the sample has moved since the three-year survey, we include an indicator for whether the family as moved in the last two years in all the models along with the disadvantage index. About 7% (N = 155) of respondents are missing geocoded information necessary to link them to census tract data. The missing cases, which are excluded from the models including the disadvantage measure, do not significantly differ on any of our independent measures from those cases with geocoded data. We feel confident in measuring neighborhood socioeconomic disadvantage this way because most of the Fragile Families respondents, as do most poor families, move to similar neighborhoods (Leventhal and Brooks-Gunn 2003). In using this index, we follow the example of Robert and Reithner (2004) and Ross and Mirowsky (2001), who have used similar measures for an overall assessment of community socioeconomic context.

To measure neighborhood collective efficacy, we created a modified version of the Neighborhood Environment for Children Rating Scale (Coulton, Korbin and Su 1996), using questions from the core five-year sample. Ten items assessing the mother's perception of neighborhood safety and cohesion were summed to create the scale (Chronbach's alpha = 0.86). There were two types of questions. The first set of five questions gauged how likely the mother thought neighbors would intervene in certain

situations, such as “If children were skipping school and hanging out on the street,” and “If a fight broke out in front of the house.” Mothers chose one of four responses; from “very likely” to “very unlikely.” The second set of five questions asked about how cohesive mothers felt their neighborhoods were, such as, “People around her are willing to help their neighbors,” and “Gangs are a problem in this neighborhood.” Mothers chose one of four responses, ranging from “strongly agree” to “strongly disagree.” If mothers chose “don’t know,” her score on that item was coded as in the middle of the range (e.g., 2.5). Items were coded with higher scores representing less neighborhood cohesion to be consistent with our other neighborhood context measures, and summed to create the full scale.

As part of the In-Home study, interviewers were instructed to complete a series of questions immediately after leaving the respondent’s home. The observations included, “Is there garbage, litter, or broken glass in the street or road, on the sidewalks, or in yards?” Responses were, “almost none,” “yes, but not a lot,” “yes, quite a bit,” and “yes, almost everywhere.” Next, “How would you rate the general condition of most of the buildings on the block?” Responses were, “well kept with good repair and exterior surface,” “fair condition,” “poor condition with peeling paint and in need of repair,” and “badly deteriorated.” Next, “Is there graffiti on the buildings or walls of the buildings on the block or within 100 yards of the respondent’s home?” Responses were, “none,” “yes, but not a lot,” “yes, quite a bit,” and “yes, almost everywhere.” Next, “Are there vacant, abandoned, or boarded-up buildings, on the block or within 100 yards of the respondent’s home?” Responses were, “No,” “yes, one building fits this description,” “yes, 2-3 buildings fit this description,” and “yes, 4 or more buildings fit this description.” And

finally, “Are there abandoned vehicles on the block or within 100 yards of the respondent’s home?” Responses were, “No,” “only one,” “2-3” and “4 or more.” This interviewer observation data was summed into a physical disorder index (alpha = 0.85), with higher values indicating more disorder. A substantial number of cases are missing these measures (N = 233, 10.5% of the total sample). Another 5% of cases are missing one or two of the physical disorder measures, and these cases are assigned the midpoint value (2.5) for the missing item(s), and then summed with the remaining measures. The cases missing all five measures are excluded from the models which contain the physical disorder scale (those missing are slightly more likely to be Hispanic, but are otherwise similar to those not missing the physical disorder measures). Most of the respondents missing on the physical disorder measures are also missing information on the type of home (N = 226).

Endogeneity

The causal direction for associations between maternal perceptions of neighborhoods and children’s physical activity is unclear – are mothers whose children spend more time outdoors more likely to more positively perceive their neighborhoods? Similarly, are mothers whose children watch lots of television less likely to perceive their neighborhoods positively, because they are indoors all the time? Or are mothers reacting to their perceptions of their neighborhoods by constraining or promoting their children’s physical and sedentary activities? One strategy to circumvent this problem, and the strategy we employ in this paper, is to test associations between subjective *and* objective measures of neighborhoods and children’s activities.

Methods

For the first part of the analysis, testing the association between the activity measures and body mass index (BMI) percentile, ordinary least squares regression is used. We tested several specifications of SES, and found that the income-to-poverty ratio had a non-linear relationship with BMI percentile, so we also include a squared income-to-poverty ratio term. We also created categories for BMI percentile (underweight, normal weight, overweight, and obese), and tested whether the relationships between the activity measures and weight status varied depending upon the specification of the dependent variable, using ordered logit models. The relationships between the activity measures and a four-category weight outcome were uniformly weaker than for the linear model, but the effects were in the same direction. For the second part of the analysis, each of the three activity measures (average hours per day spent playing outdoors; average times per week mother takes the child to a playground; and average hours per day spent watching television) is a count measure and each is marked by over-dispersion. Thus, negative binomial regression models, which are increasingly common in physical activity research and which adjust standard errors for over-dispersion in the outcome measure, are conducted (Slymen et al. 2006). We also tested several SES specifications for these models, and found that the relationship between SES and hours of outdoor play had a non-linear relationship, so in this set of models we also include the squared income-to-poverty ratio term.

Results

Table 1 presents descriptive statistics for the sample. The mean BMI percentile in the sample is 66.2, and in categorical terms (not shown) approximately 19% of the

sample is overweight (between the 85th and 95th percentiles), and 16% are obese (>=95th percentile). On average, children are playing outside about two hours per day, and watching more than two and a half hours of television per day. Mothers are taking their children to the playground or the park nearly four times per week. The background characteristics show that the FFCWS sample is relatively disadvantaged, with more than one-third of mothers having not completed high school, and the mean income-to-poverty ratio is just 1.74. In addition, just 31% of mothers are married to the child's father (or a social father), and just 38% are working full-time. Fully 17% of mothers are likely depressed, and 68% are overweight or obese.

The mean collective efficacy (CE) score is 10.22 (range = 1-31), with higher values indicating *lower* collective efficacy. The neighborhood socioeconomic index and physical disordered measures are also coded with higher values indicating more disadvantage (mean = 1.10) and disorder (mean = 7.00). Nearly one in five families (18%) live in public housing, and 42% live in a single-family home, compared to 28% in apartments and 27% in a duplex, townhouse, or row house. The mean number of residents per household is 4.65.

Table 2 presents results of the OLS analysis designed to test our first research question: Whether and how children's physical and sedentary activities are associated with BMI percentile at age five. First we see that, as expected, hours of outdoor play are negatively associated with BMI, and hours of television are positively associated with BMI. So for each hour of outdoor play, children, on average, score half a percentile point lower on BMI. The corresponding increase for each hour of television is similar, about half a percentile point. Model 3 shows the results when the ratio of outdoor time to

television time is included in the model, and results indicate, as expected, that the higher the ratio of outdoor time to television time on an average weekday, the lower the child's BMI. In fact, for each additional hour – over and above television watching – that children play outside each day, they score 1.5 percentile points lower on BMI. Contrary to expectations, we find that the number of playground trips with the mother per week is associated with slightly elevated BMIs (though this result is just marginally significant). Across the models, we see that Hispanic children have substantially higher average BMI percentiles compared to white children. Interestingly, and contrary to our expectations, the income-to-poverty ratio is positively associated with BMI percentile– indicating that as this ratio increases, children have *higher* BMIs. We also see, however, that the ratio is associated in a nonlinear way with BMI percentile, such that it is lowest for the poorest and wealthiest children. In addition, children living with single mothers have higher average BMIs, and the mother's weight status is a strong positive predictor of a higher BMI percentile for children. This maternal weight status variable likely captures many of the unobserved factors that correlate with children's BMI percentiles, such as household dietary practices and genetic influences on weight status.

Table 3 presents results of the negative binomial regression models for hours of outdoor play. In the basic model (Model 1), we see that black children have an expected count of outdoor hours of play about 19% lower than white children, similar to the result for Hispanic children. We also see that the higher the income to poverty ratio, the fewer hours per day the child plays outside, contrary to expectations. We also see evidence of a curvilinear effect, however, such that children at the lowest and highest ends of the income-to-poverty ratio distribution are playing outside the most. Working mothers, and

those families interviewed in the winter, reported less time outside, as did mothers whose children were in fair or poor health. In Model 2, we control for residential context, specifically the household measures. Unexpectedly, we see that children living in public housing, holding all other variables constant, play outside about 16% more than other children. Neighborhood socioeconomic disadvantage is not significantly related to children's outdoor time, nor are the type of home or the number of residents in the household. Note that controlling for residential context explains some of the income-to-poverty ratio effect – indicating that part of the reason poor children play outside more is due to differences in residential context (perhaps living in public housing).

In Model 3, we see that lower levels of collective efficacy are associated with decreased outdoor play time for children, even after accounting for differences between neighborhoods in socioeconomic disadvantage and other residential context measures. The effect is significant but small; for a standard deviation increase in CE (which represents a worsening of CE), children's expected hours of play declines by 4%. In Model 4, we test the association between children's outdoor play and physical disorder in the immediate area around the home, and find that, counter-intuitively, higher physical disorder is associated with *more* time outdoors for children. This effect is a little stronger than the CE effect; a standard deviation increase in physical disorder is associated with an 7% increase in expected hours of play for children. Thus, some surprising results are reported in Table 3. Not only are poorer children and children who live in public housing playing outside more, but children living in areas of higher physical disrepair and disorder are playing outside longer as well.

In Table 4, we present results for our models examining children's television time. In Model 1, we see that Black and Hispanic children watch more weekday television, on average, than white children (27% and 13% more, respectively), and so do poorer children – each standard deviation increase in the income-to-poverty ratio results in about 8% less television time. Poorer children, then, are playing outside more *and* spending more time watching television, perhaps reflecting a greater amount of unstructured free time in lower-income homes. Children of mothers who work full-time watch less television, as do those children enrolled in kindergarten or a daycare program. Model 2 adds the residential context measures, and again we find a significant difference between children who live in public housing and those who do not – children living in public housing have a 12% increase in the expected number of hours of television per day. Children living in homes with more residents also have an elevated number of hours of television. In Model 3, we test the association between maternal perceptions of collective efficacy and children's television time, and find that the children of mothers who perceive worse collective efficacy in their neighborhoods (higher on the CE scale) watch more television, as expected. Each standard deviation increase in CE results in 4% more television time for children. In Model 4, the association between physical disorder and children's time works in the expected direction – children living in areas of higher physical disorder are spending more time watching television, about 6.5% more for each standard deviation increase in physical disorder.

Finally, Table 5 presents results of our negative binomial regression models of the number of times per week the mothers take the children to a park or playground. Single mothers, those who work full-time, those interviewed during the winter, and mothers who

are likely depressed, take their child to the park or playground significantly less often. Model 2 tests associations between residential context and maternal outings, and again we find a significant relationship between children's activities and public housing – mothers living in public housing take their children to the playground about 13% more frequently than mothers in other types of housing. In Model 3, we see that, similarly to the other outcomes, collective efficacy is significantly related to mothers' outings, such that mothers perceiving worse collective efficacy (higher on our CE scale) take their children on outings less often. This coefficient equates to an 8% decline in playground trips for each standard deviation increase in collective efficacy. In Model 4, we see that, unlike our other outcomes, physical disorder is not significantly associated with the number of trips per week to a park or playground.

Discussion

In sum, our analysis, which is the first to incorporate objective and subjective neighborhood characteristics' effects on young children's physical and sedentary activities, revealed some surprising findings. Despite most recent research documenting a negative relationship between SES and the likelihood of overweight for children (Danielzik et al. 2004; Haas et al. 2003; Mei et al. 1998), we find a nonlinear effect – the poorest and wealthiest children in our sample have the lowest BMIs, while the children in the middle of the SES distribution have the highest. Our findings may reflect the fact that younger children are more likely to be physically active than older children and adolescents (Sallis 2000), and suggest that the relationship between SES and physical activity (and overweight) may change during childhood.

In addition, children living in public housing, and those living in the neighborhoods with higher levels of physical disorder, are playing outdoors *more* often. These same characteristics are also, however, associated with more television viewing, indicating that these activities may not be substitutable, at least in this study population. Qualitative research on children's leisure activities provides a rich picture of children's time management differences by class. Children in lower class households have much more unstructured time than do those in middle-class households, reflecting class differences not just in resources but also in child-raising philosophies (Lareau 2003). The social environments surrounding families may also influence children's time regulation. Disadvantaged families, particularly African-Americans, often rely on in-home strategies for childrearing, given the uncertainties of the surrounding social environments (Furstenberg Jr, Cook and Eccles 2000). Thus, it seems likely that the poorest children in our sample have more unstructured time to fill with outdoor play and sedentary activities, such as television watching. These findings give rise to the idea that SES may differentially influence children's activities; which may have implications for interpretations of the associations between activities and weight status.

The negative influences of social and physical environments on children's physical activity are often construed as a result of mothers' decision to keep their children indoors for safety reasons. Instead, we argue that in poor communities, specific social conditions may give rise to higher rates of physical activity. In public housing projects where parents (especially mothers) are likely to be home during the day, and where a cohesive community may arise, children may have higher rates of outdoor physical activity. Moreover, these children of mostly non-working mothers may be less likely to

be enrolled in preschool or daycare programs, and thus may have more unstructured time at home in which to play outdoors. It also is likely that public housing projects provide relatively safe places to play, either courtyards or playgrounds, that other poor children who do not live in public housing may not have access to.

Our findings also dovetail with recent studies which find a positive effect of perceived collective efficacy on physical activity for adolescents and adults (Cradock et al. 2009; Echeverría et al. 2008). The children of mothers who perceive higher levels of collective efficacy in their neighborhoods are playing outside for longer periods each day, watching less television, and also visiting the park or playground more often each week. We also find that tract-level neighborhood socioeconomic disadvantage is not associated with any of our outcomes, lending support to the idea that maternal perceptions may matter more than objective measures of disadvantage in terms of neighborhood effects on children's outdoor play.

The agency of parents in selecting neighborhoods in which to raise their children must be considered in any investigation of the "effect" of neighborhood environments on children (Furstenburg, 1995, IRP). Typically, low-SES families have low agency in choosing where to live. There is some evidence, however, that families who have low socioeconomic resources may benefit from access to social and community resources (Small 2004). Moreover, residents of disadvantaged areas may have more at stake in terms of creating cohesive communities. They may also interact more frequently, particularly in dense, urban areas, and especially in communities where unemployment is high. These characteristics may have special salience for children's outdoor play. Mothers may be more comfortable sending their children outside, despite higher physical

and social disorder, because they know that adults are around (and possibly monitoring activity). It is also possible that mothers go out more often with their children, simply because they have more unstructured time and are not working. In this way, they can monitor their children's safety despite what may be higher physical and psychosocial hazards. With our data, we are unable to disaggregate between time children may be spending outside alone vs. time they are spending outdoors with their parents (or other adults). Ideally, future analyses of this sort would have more detailed measures of outdoor time (and sedentary activities). Despite these limitations, we believe our paper, which draws upon both subjective and objective neighborhood measures, adds to the literature on children's weight outcomes, physical activity levels, and residential context.

Table 1: Descriptive and Bivariate Statistics for Five-Year Core and In-Home Samples

	M (SD)
Activity/Outcome Measures	
Mean BMI Percentile	66.2 (28.64)
Weekday Hours of Outdoor Play	2.04 (1.87)
Weekday Hours of Television	2.60 (1.84)
Days Per Week Mother Takes Child Outside to Play	3.80 (2.19)
Mother Interviewed In Winter, Cold City	0.21
Child Background Characteristics	
Child's age in months (In-Home)	63.78 (3.01)
Child is male	0.52
Child enrolled in kindergarten or other program	0.76
(White)	0.20
Black	0.55
Hispanic	0.25
Child was low birthweight (<2500 grams)	0.11
Child was high birthweight (>5000 grams)	0.01
Mother's Background Characteristics	
(Mother did not complete high school)	0.35
Mother completed high school	0.32
Mother completed at least some college	0.33
Income/Poverty Ratio	1.74 (2.00)
Mother's age	30.0 (5.96)
Child Has Older Sibling	0.61
Mother is overweight/obese (BMI>=25.0)	0.68
Family Structure, Employment, and Mental Health	
(Mother married to child's father/social father)	0.31
Mother cohabiting with child's father/social father	0.27
Mother is single	0.42
(Mother does not work)	0.41
Mother works full-time	0.38
Mother works part-time	0.21
Mother is likely depressed	0.17
Residential Context	
Collective Efficacy (CE) Scale	10.22 (6.32)
Neighborhood SES Disadvantage Index (nindex)	1.10 (0.55)
Family moved since three-year survey	0.49
Physical disorder scale (outside home)	7.00 (2.54)
Family lives in public housing	0.18
(Family lives in house)	0.42
Apartment	0.28
Duplex/Townhouse/Row House	0.27
Other Housing Type	0.04
Number of Residents in Household	4.65 (1.73)
N	2,210

Table 2: OLS Regression of Child's BMI Percentile, Testing Association with Play Outcomes

	Model 1		Model 2		Model 3		Model 4	
	Coef.	*(Std. Err.)*	*Coef.*	*(Std. Err.)*	*Coef.*	*(Std. Err.)*	*Coef.*	*(Std. Err.)*
Number of Hours of Weekday Play	**-0.54***	**(0.25)**						
Number of Hours of Weekday TV			**0.50***	**(0.23)**				
Ratio of Play to Television Time					**-1.44***	**(0.72)**		
Days per Week Mother Takes Child Outside to Play							**0.60#**	**(0.31)**
Child Background Characteristics								
(White)								
Black	-0.81	(2.61)	-0.39	(2.61)	-1.02	(2.62)	0.10	(2.60)
Hispanic	7.03**	(2.28)	7.28**	(2.39)	6.78**	(2.32)	7.93**	(2.32)
Child's age in months (In-Home)	-0.17	(0.22)	-0.10	(0.22)	-0.16	(0.22)	-0.14	(0.21)
Child is male	-0.86	(1.55)	-0.74	(1.51)	-0.69	(1.56)	-0.67	(1.44)
Low Birthweight	-7.44**	(2.26)	-7.17**	(2.29)	-7.56**	(2.29)	-7.47**	(2.21)
High Birthweight	13.54***	(2.99)	13.28***	(2.80)	13.30***	(2.89)	13.34***	(2.92)
Child in fair or poor health	5.62	(4.80)	6.37	(4.72)	5.59	(4.83)	6.44	(4.86)
Mother's Background Characteristics								
(Mother did not complete high school)								
Mother completed high school	0.10	(1.75)	0.27	(1.78)	0.17	(1.75)	0.37	(1.86)
Mother completed at least some college	-1.40	(1.50)	-1.06	(1.51)	-1.22	(1.50)	-0.90	(1.52)
Household Income/Poverty Threshold	1.64**	(0.52)	1.74**	(0.54)	1.71**	(0.54)	1.63*	(0.58)
Household Income/Poverty Threshold^2	-0.08*	(0.03)	-0.08*	(0.03)	-0.07*	(0.03)	-0.07*	(0.03)
Mother's age	-0.07	(0.14)	-0.05	(0.14)	-0.07	(0.14)	-0.05	(0.13)
(Mother is married to father/social father)								
Mother is cohabiting with father/social father	1.29	(2.08)	1.15	(2.09)	1.24	(2.12)	1.09	(2.05)
Mother is no longer with father/social father	5.27*	(1.97)	4.85*	(1.92)	5.22*	(1.97)	5.20*	(1.95)
Child Has Older Sibling	1.01	(0.87)	0.83	(0.89)	1.10	(0.86)	1.18	(0.82)
(Mother does not work)								
Mother works full-time	1.53	(1.44)	1.70	(1.43)	1.52	(1.45)	1.91	(1.44)
Mother works part-time	1.01	(1.49)	0.96	(1.43)	0.79	(1.48)	1.28	(1.54)
Family lives in Public Housing	-0.01	(1.42)	-0.08	(1.38)	-0.06	(1.39)	-0.25	(1.32)
Mother is Overweight or Obese	9.86***	(1.47)	9.84***	(1.44)	10.01***	(1.45)	9.63***	(1.56)
Constant	67.4		59.2		66.8		60.5	
N	1,970		1,974		1,960		1,970	

Note: Standard errors were adjusted for clustering at the city-level.
#$p <$ .10; * $p <$ .05; ** $p <$ .01; *** $p <$ .001.

Table 3: Negative Binomial Regression Models for Hours of Weekday Outdoor Play

	Model 1	Model 2	Model 3	Model 4
Residential Context	*Coef. (Exp. Coef.)*	*Coef. (Exp. Coef.)*	*Coef. (Exp. Coef.)*	*Coef. (Exp. Coef.)*
Family lives in public housing		0.15** (1.16)	0.15** (1.16)	0.16** (1.17)
Neighborhood SES Disadvantage Index		0.01 (1.01)	0.01 (1.02)	-0.02 (0.98)
Family moved since three-year survey		-0.02 (0.98)	-0.02 (0.98)	-0.02 (0.98)
(Family Lives in House)				
Apartment		-0.14# (0.87)	-0.13# (0.88)	-0.13# (0.88)
Duplex/Townhome/Row House		-0.07 (0.93)	-0.07 (0.94)	-0.10* (0.91)
Other Housing Type		0.02 (1.01)	0.01 (1.01)	-0.01 (0.99)
Number of Residents in Household		0.02 (1.02)	0.02 (1.02)	0.02 (1.02)
Collective Efficacy (CE) Scale			**-0.01* (0.99)**	
Physical disorder scale (outside home)				**0.02* (1.02)**
Child Background Characteristics				
(White)				
Black	-0.21***(0.81)	-0.21** (0.81)	-0.20** (0.82)	-0.22** (0.80)
Hispanic	-0.18# (0.83)	-0.18# (0.84)	-0.17# (0.84)	-0.19# (0.83)
Child's age in months (In-Home)	-0.01 (0.99)	-0.01 (0.99)	-0.01 (0.99)	-0.01 (0.99)
Child is male	0.01 (1.01)	0.04 (1.04)	0.04 (1.04)	0.03 (1.03)
Child in fair or poor health	-0.30* (0.74)	-0.34# (0.71)	-0.33# (0.72)	-0.37* (0.69)
Mother's Background Characteristics				
(Mother did not complete high school)				
Mother completed high school	0.01 (1.01)	0.01 (1.01)	0.01 (1.01)	0.01 (1.01)
Mother completed at least some college	-0.06 (0.95)	-0.03 (0.97)	-0.04 (0.96)	-0.01 (0.99)
Household Income/Poverty Threshold	-0.05*** (0.95)	-0.04* (0.96)	-0.05* (0.95)	-0.04# (0.97)
Household Income/Poverty Threshold^2	0.01*** (1.01)	0.01# (1.01)	0.01* (1.01)	0.01 (1.01)
Mother's age	-0.01 (0.99)	-0.01 (0.99)	-0.01 (0.99)	-0.01 (0.99)
(Mother is married to father/social father)				
Mother is cohabiting with father/social father	0.05 (1.05)	0.06 (1.06)	0.06 (1.06)	0.04 (1.04)
Mother is no longer with father/social father	0.04 (1.04)	0.08 (1.08)	0.07 (1.07)	0.08 (1.08)
Child Has Older Siblings	0.03 (1.03)	0.01 (1.01)	-0.01 (0.99)	0.01 (1.01)
(Mother does not work)				
Mother works full-time	-0.11** (0.90)	-0.08* (0.93)	-0.08# (0.93)	-0.08* (0.93)
Mother works part-time	-0.11** (0.90)	-0.11** (0.89)	-0.11* (0.89)	-0.12* (0.89)
Mother interviewed in cold winter	-0.81***(0.44)	-0.77*** (0.46)	-0.77***(0.46)	-0.76***(0.47)
Child enrolled in kindergarten/program	-0.06 (0.94)	-0.09 (0.92)	-0.08 (0.92)	-0.09 (0.91)
Mother likely depressed	-0.08 (0.93)	-0.09* (0.91)	-0.08# (0.92)	-0.09* (0.91)
Constant	2.23	1.86	1.95	1.83
N	2,192	1,822	1,822	1,800

Note: Standard errors were adjusted for clustering at the city-level.
#$p <$ .10; * $p <$ .05; ** $p <$ .01; *** $p <$ .001.

Table 4: Negative Binomial Regression Models for Hours of Weekday Television

	Model 1		Model 2		Model 3		Model 4	
	Coef.	*(Exp. Coef.)*	*Coef.*	*(Exp. Coef.)*	*Coef.*	*(Exp. Coef.)*	*Coef.*	*(Exp. Coef.)*
Residential Context								
Family lives in public housing			0.11***	(1.12)	0.11***	(1.12)	0.12***	(1.13)
Neighborhood SES Disadvantage Index			-0.01	(0.99)	-0.02	(0.98)	-0.04	(0.96)
Family moved since three-year survey (Family Lives in House)			-0.01	(0.99)	-0.01	(0.99)	-0.01	(0.99)
Apartment			0.01	(1.01)	-0.01	(0.99)	0.01	(1.01)
Duplex/Townhome/Row House			-0.07	(0.93)	-0.08	(0.92)	-0.10#	(0.91)
Other Housing Type			-0.10	(0.91)	-0.10	(0.90)	-0.09	(0.91)
Number of Residents in Household			0.02*	(1.02)	0.01#	(1.01)	0.01	(1.01)
Collective Efficacy (CE) Scale					**0.01****	**(1.01)**		
Physical disorder scale (outside home)							**0.02*****	**(1.02)**
Child Background Characteristics								
(White)								
Black	0.24***	(1.27)	0.24***	(1.27)	0.23***	(1.26)	0.23***	(1.26)
Hispanic	0.13*	(1.13)	0.13*	(1.14)	0.13*	(1.13)	0.14**	(1.15)
Child's age in months (In-Home)	-0.03**	(0.97)	-0.03**	(0.97)	-0.03**	(0.97)	-0.03**	(0.97)
Child is male	0.03	(1.03)	0.03	(1.03)	0.03	(1.03)	0.03	(1.03)
Child in fair or poor health	-0.08	(0.92)	-0.11	(0.90)	-0.11	(0.89)	-0.12	(0.88)
Mother's Background Characteristics								
(Mother did not complete high school)								
Mother completed high school	-0.02	(0.98)	0.01	(1.01)	0.01	(1.01)	0.01	(1.01)
Mother completed at least some college	-0.07	(0.93)	-0.08#	(0.93)	-0.07	(0.93)	-0.06	(0.94)
Household Income/Poverty Threshold	-0.04***	(0.96)	-0.03*	(0.97)	-0.03*	(0.97)	-0.03*	(0.97)
Mother's age	-0.01*	(0.99)	-0.01*	(0.99)	-0.01*	(0.99)	-0.01*	(0.99)
(Mother is married to father/social father)								
Mother is cohabiting with father/social father	0.05	(1.05)	0.05	(1.05)	0.05	(1.05)	0.03	(1.03)
Mother is no longer with father/social father	0.06	(1.06)	0.08	(1.09)	0.09	(1.09)	0.07	(1.08)
Child Has Older Siblings	0.07*	(1.07)	0.07*	(1.07)	0.07*	(1.07)	0.07#	(1.07)
(Mother does not work)								
Mother works full-time	-0.06*	(0.94)	-0.05	(0.95)	-0.05	(0.95)	-0.05	(0.95)
Mother works part-time	-0.01	(0.99)	-0.03	(0.97)	-0.03	(0.97)	-0.03	(0.97)
Mother interviewed in cold winter	-0.04	(0.96)	-0.04	(0.96)	-0.04	(0.96)	-0.04	(0.96)
Child enrolled in kindergarten/program	-0.15**	(0.86)	-0.19***	(0.83)	-0.19***	(0.83)	-0.20***	(0.82)
Mother likely depressed	-0.07	(0.93)	-0.07	(0.93)	-0.07	(0.93)	-0.07	(0.93)
Constant	2.81		2.72		2.64		2.66	
N	2,197		1,826		1,826		1,804	

Note: Standard errors were adjusted for clustering at the city-level.
#$p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 5: Negative Binomial Regression Models for Number of Playground Trips (with Mother) Per Week

	Model 1		Model 2		Model 3		Model 4	
	Coef.	*(Exp. Coef.)*	*Coef.*	*(Exp. Coef.)*	*Coef.*	*(Exp. Coef.)*	*Coef.*	*(Exp. Coef.)*
Residential Context								
Family lives in public housing			0.12**	(1.13)	0.13***	(1.14)	0.12**	(1.13)
Neighborhood SES Disadvantage Index			-0.02	(0.98)	-0.01	(0.99)	-0.02	(0.98)
Family moved since three-year survey (Family Lives in House)			-0.03	(0.97)	-0.03	(0.97)	-0.03	(0.97)
Apartment			-0.12*	(0.88)	-0.10#	(0.90)	-0.13*	(0.88)
Duplex/Townhome/Row House			-0.08	(0.93)	-0.06	(0.94)	-0.08	(0.93)
Other Housing Type			-0.04	(0.96)	-0.03	(0.97)	-0.05	(0.95)
Number of Residents in Household			0.01	(1.01)	0.01	(1.01)	0.01	(1.01)
Collective Efficacy (CE) Scale					**-0.01*** **	**(1.01)**		
Physical disorder scale (outside home)							**0.01**	**(1.01)**
Child Background Characteristics								
(White)								
Black	-0.09	(0.92)	-0.05	(0.95)	-0.03	(0.97)	-0.04	(0.96)
Hispanic	-0.17#	(0.84)	-0.14#	(0.87)	-0.13#	(0.88)	-0.14#	(0.87)
Child's age in months (In-Home)	0.01	(1.01)	0.01	(1.01)	0.01	(1.01)	0.01	(1.01)
Child is male	0.01	(1.01)	0.02	(1.02)	0.01	(1.01)	0.01	(1.02)
Child in fair or poor health	0.05	(1.05)	0.09	(1.09)	0.11	(1.11)	0.09	(1.09)
Mother's Background Characteristics								
(Mother did not complete high school)								
Mother completed high school	-0.03	(0.97)	-0.04	(0.96)	-0.04	(0.96)	-0.03	(0.97)
Mother completed at least some college	-0.04	(0.96)	-0.04	(0.96)	-0.05	(0.95)	-0.04	(0.96)
Household Income/Poverty Threshold	-0.01	(0.99)	-0.01	(0.99)	-0.01	(0.99)	-0.01	(0.99)
Mother's age	-0.01	(0.99)	-0.01	(0.99)	-0.01	(0.99)	-0.01	(0.99)
(Mother is married to father/social father)								
Mother is cohabiting with father/social father	-0.03	(0.97)	-0.01	(0.99)	-0.01	(0.99)	-0.02	(0.98)
Mother is no longer with father/social father	-0.08*	(0.93)	-0.06#	(0.94)	-0.06#	(0.94)	-0.06#	(0.94)
Child Has Older Siblings	-0.01	(0.99)	-0.03	(0.97)	-0.04#	(0.96)	-0.03	(0.97)
(Mother does not work)								
Mother works full-time	-0.11***	(0.89)	-0.09**	(0.91)	-0.09**	(0.91)	-0.09**	(0.91)
Mother works part-time	-0.08#	(0.93)	-0.05	(0.95)	-0.05	(0.95)	-0.06	(0.95)
Mother interviewed in cold winter	-0.14**	(0.86)	-0.13**	(0.88)	-0.14**	(0.86)	-0.13**	(0.87)
Child enrolled in kindergarten/program	0.02	(1.03)	0.02	(1.02)	0.02	(1.03)	0.02	(1.02)
Mother likely depressed	-0.11**	(0.89)	-0.14**	(0.87)	-0.12**	(0.88)	-0.14***	(0.87)
Constant	0.99		1.04		1.23		1.00	
N	2,191		1,826		1,826		1,804	

Note: Standard errors were adjusted for clustering at the city-level.
#$p <$ .10; * $p <$ .05; ** $p <$ .01; *** $p <$ .001.

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