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# A National Study of Neighborhood Safety, Outdoor Play, Television Viewing, and Obesity in Preschool Children

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**ABSTRACT.** *Objective.* To test the hypothesis that preschool children have a higher prevalence of obesity, spend less time playing outdoors, and spend more time watching television (TV) when they live in neighborhoods that their mothers perceive as unsafe.

*Methods.* In a cross-sectional survey in 20 large US cities, mothers reported the average daily time of outdoor play and TV viewing for their 3-year-old children, and the children's BMI was measured. Maternal perception of neighborhood safety was assessed with the Neighborhood Environment for Children Rating Scales; the scale score was used to divide children into tertiles of neighborhood safety.

*Results.* Of the 3141 children studied, 35% lived in households with incomes below the US poverty threshold. After adjustment for sociodemographic factors (household income and mothers' education, race/ethnicity, age, and marital status), obesity prevalence (BMI  $\geq$ 95th percentile) did not differ in children from the least safe to the safest neighborhood safety tertile (18% vs 17% vs 20%) or in weekday (160 vs 151 vs 156 minutes/day) or weekend (233 vs 222 vs 222 minutes/day) outdoor play time. Children who lived in neighborhoods that were perceived by their mothers as the least safe watched more TV (201 vs 182 vs 185 minutes/day) and were more likely to watch >2 hours/day (66% vs 60% vs 62%). TV viewing and outdoor play minutes were not significantly correlated to each other or to BMI.

*Conclusions.* In a national sample of preschool children, mothers' perception of neighborhood safety was related to their children's TV viewing time but not to their outdoor play time or risk for obesity. *Pediatrics* 2005;116:657-662; safety, obesity, television, physical activity, preschool children.

ABBREVIATION. TV, television.

The childhood obesity epidemic is affecting even preschool children.<sup>1-3</sup> Although the causes of this epidemic are multifactorial, environmental factors have been the focus of increasing

attention in primary prevention efforts.<sup>4,5</sup> Unsafe neighborhoods are 1 factor that has been thought to increase obesity risk in younger children by limiting their outdoor play and increasing sedentary indoor activity, such as television (TV) viewing. National governments in the United States, United Kingdom, Australia, and Canada have proposed action plans to reduce obesity that include providing safe places for children to be physically active.<sup>4,6-8</sup>

Despite this interest in neighborhood safety and childhood obesity, few studies have examined the relationships between neighborhood safety, physical activity, and inactivity in children, and the studies have conflicting results.<sup>9-11</sup> The only study of preschool children found no relationship between the level of police-reported neighborhood crime and children's BMI or the distance from the child's home to the nearest playground.<sup>12</sup> However, in this study, there was no direct measure of physical activity, and neighborhood safety was based on police report of neighborhood crime rates rather than parental report of perceived safety. It may be the parent's perception of neighborhood safety that primarily determines whether a parent brings his or her young child outside to play. Because most physical activity in preschool children occurs outdoors,<sup>13-15</sup> the maternal perception that neighborhoods are unsafe for outdoor play might result in reduced physical activity levels in young children, increased TV viewing, and higher prevalence of obesity. Using data collected in 20 US cities, we tested the hypotheses that preschool children would have a higher prevalence of obesity (BMI  $\geq$ 95th percentile), spend less time playing outdoors, and spend more time watching TV when they lived in neighborhoods that their mothers perceived as unsafe.

## METHODS

The Fragile Families and Child Wellbeing Study is a birth cohort study that followed 4898 children, including 3712 whose parents were unmarried at the child's birth ("fragile families").<sup>16</sup> This sample was drawn from births in 1998-2000 in 20 large US cities in 15 states. A baseline interviewer-administered survey of mothers was conducted in the birth hospitals.

Families were ineligible (<5% of sampled births) if the child was being placed for adoption, if the mother did not speak either English or Spanish well enough to understand the survey, or if the mother was too ill after delivery to participate in an interview. Most hospitals did not allow mothers who were younger than 18 years to participate. Among eligible mothers, 82% of those who were married and 87% of those who were unmarried agreed to participate. The institutional review boards at all birth hospitals, as well as those at Princeton University and Columbia University, approved the data collection procedures. All participants gave informed written consent.

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A follow-up survey of the mothers was conducted when the children were ~36 months of age. Of the 3326 mothers who completed the follow-up survey, 2620 did so as an in-home interview during which the child's height and weight were measured. The remaining 706 mothers completed the survey by telephone, and no height or weight measurements were obtained on the children. There were no significant differences in baseline income, marital status, maternal age, or education between mothers who were followed up at 3 years and those who were not. However, among the mothers who were followed up, fewer were of Hispanic origin (26% vs 31%,  $P = .001$ ).

### Outcome Measures

Parents were asked to recall the number of hours their child "typically" spends playing outdoors each day: 1 question about weekdays and the other about weekend days. This parent recall measure has been shown to correlate with physical activity levels in preschoolers as measured by accelerometer.<sup>17</sup>

Mothers were asked the amount of time the child spends "watching television or watching videos on TV" on a typical weekday and on a typical weekend day. The hours of TV viewing were reported in whole numbers, and <1 hour was considered as watching no TV.

Interviewers were trained to measure height and weight in young children using a protocol modeled after the one established by the Centers for Disease Control and Prevention.<sup>18</sup> Children were measured while wearing light clothing and no shoes. Weight was obtained with an electronic scale (SECA 840 Bella Digital Scale, Hanover, MD). Stature was obtained with a portable stadiometer (SECA 214 Road Rod Stadiometer). Measurements were taken once and recorded to the nearest pound and to the nearest 0.1 cm.

### Neighborhood Safety Measure

Maternal perception of neighborhood safety was assessed using the Neighborhood Environment for Children Rating Scales.<sup>19</sup> This 8-item scale asked the mother how often she saw certain things happening in her neighborhood, such as loitering adults, gang activity, drunks or drug dealers "hanging around," and disorderly or misbehaving groups of youths or adults. The response options were "never," "rarely," "sometimes," and "frequently."

### Sociodemographic Variables

Sociodemographic variables were obtained from the survey at birth and included the mothers' education, race/ethnicity, age, and marital status. Income was calculated as a ratio of the household income divided by the income at the US poverty threshold for a given household size in the child's birth year (available at [aspe.hhs.gov/poverty/poverty.shtml](http://aspe.hhs.gov/poverty/poverty.shtml)).

### Computing Variables for Analysis

The outdoor play time questions and the TV viewing time questions were analyzed as continuous variables (converted to minutes). TV viewing time was also analyzed as a dichotomous variable on the basis of the American Academy of Pediatrics' recommendation for 3-year-old children (no more than 2 hours of TV a day).<sup>20</sup> We computed BMI  $z$  score and percentiles for age and gender using the Centers for Disease Control and Prevention 2000 growth reference<sup>21</sup> and classified all children with a BMI  $\geq 95$ th percentile as obese.

The 4 responses on the 8 neighborhood safety questions, ranging from "never" to "frequently," were assigned the values 1 through 4, respectively. The scale score for each mother was computed as the mean value of her responses and was computed for all mothers who completed at least 6 of the 8 items. Because the scale scores were not normally distributed, they were divided into tertiles. The safest tertile included all mothers with a score equal to 1.0 (ie, answering "never" to all items). The medium safety tertile score ranged from 1.0 to 2.0, and the least safe tertile scores were >2.0. The final sample consisted of the 3141 children with complete data on this neighborhood safety measure.

### Data Analysis

We used 1-way analysis of variance to compare outdoor play time and TV viewing time across the 3 tertiles of neighborhood

safety, and we used  $\chi^2$  tests to compare the prevalence of obesity and percentage of children who met the American Academy of Pediatrics' TV recommendations across the tertiles. We then used general linear models to compare outdoor play time and TV viewing time by safety tertile after adjusting for household socio-demographic factors.

## RESULTS

The children had a mean ( $\pm$ SD) age of 39 ( $\pm 3$ ) months. Fifty-three percent were boys, and 35% lived in households that reported income below the federal poverty threshold (income-to-poverty ratio <1.00; Table 1). At the time of the child's birth, the mean age of the mothers was 26 ( $\pm 6$ ) years, 26% were married to the child's father, and 64% reported no education beyond high school. The racial/ethnic composition of the mothers was approximately one half non-Hispanic black, one fourth non-Hispanic white, and one fourth Hispanic (any race).

Eighteen percent of the children were obese. The children spent more time playing outdoors on weekends than on weekdays ( $P < .001$ ) but watched similar amounts of TV on weekends and weekdays ( $P = .43$ ; Table 2). Therefore, outdoor play time was analyzed separately for weekday and weekend days. For TV viewing time, the weekend and weekday times were averaged to produce a variable for mean daily TV viewing time (mean  $\pm$  SD = 190  $\pm$  128 minutes/day). Almost two thirds of the children watched >2 hours of TV a day. TV viewing and outdoor play time were not significantly correlated to each other or to BMI (data not shown).

Mothers who were more educated, married, non-Hispanic white, older, and had higher household income were more likely to rate their neighborhoods as being safer (Table 1). Compared to children with BMI data, those without BMI data were also more likely to live in neighborhoods in the safest tertile (44% vs 30%;  $P < .001$ ).

In bivariate analysis, mean BMI  $z$  scores and obesity prevalence did not differ in children from the least safe to the safest tertile of neighborhood safety (Table 3), and children did not differ in weekend or weekday outdoor play time across the neighborhood safety tertiles (Table 4). Children in the least safe neighborhoods watched more TV and were more likely to watch >2 hours of TV per day in unadjusted analysis.

Adjusting for sociodemographic factors (all the categorical variables listed in Table 1), the relationship between TV viewing and neighborhood safety remained significant, with children in the least safe tertile watching TV ~20 minutes more (~10% more) per day than children in the other 2 tertiles of neighborhood safety. The fully adjusted models explained the following percentage of variance in each outcome: BMI  $z$  score, 2.2%; weekday outdoor play, 2.3%; weekend outdoor play, 2.9%; and TV time, 9.3%.

## DISCUSSION

We hypothesized that if mothers perceived that their neighborhoods were unsafe, then they would tend to keep their children indoors and that these children would have increased TV viewing time and

**TABLE 1.** Sociodemographic Characteristics of Mothers (*N* = 3141) and the Number (%) of Children in Each Neighborhood Safety Tertile by Level of Sociodemographic Indicator

	<i>N</i> (%)	Neighborhood Safety Tertile*		
		Low (Least Safe)	Medium	High (Safest)
<b>Household income-to-poverty ratio</b>				
<0.50	559 (18)	285 (51)	139 (25)	135 (24)
0.5–0.9	529 (17)	245 (46)	138 (26)	146 (28)
1.0–1.9	848 (27)	318 (37)	269 (32)	261 (31)
2.0–2.9	485 (15)	154 (32)	165 (34)	166 (34)
≥3.0	720 (23)	123 (17)	237 (33)	360 (50)
<b>Education†</b>				
Less than high school	1057 (34)	459 (43)	278 (26)	320 (30)
High school degree or equivalent	935 (30)	390 (42)	291 (31)	254 (27)
Some college	802 (25)	242 (30)	262 (33)	298 (37)
College graduate or more	343 (11)	31 (9)	117 (34)	195 (57)
<b>Race/ethnicity†</b>				
White, non-Hispanic	704 (22)	122 (17)	262 (37)	320 (46)
Black, non-Hispanic	1492 (48)	709 (48)	399 (27)	384 (26)
Hispanic (any race)	828 (26)	262 (32)	254 (31)	312 (38)
Other race, non-Hispanic	110 (4)	30 (27)	32 (29)	48 (44)
<b>Age y†</b>				
<20	565 (18)	259 (46)	158 (28)	148 (26)
20–24	1115 (36)	436 (39)	354 (32)	325 (29)
25–29	737 (23)	251 (34)	214 (29)	272 (37)
≥30	723 (23)	178 (25)	222 (31)	323 (45)
<b>Relationship status</b>				
Married	802 (26)	147 (18)	267 (33)	388 (48)
Cohabiting	1136 (36)	429 (38)	344 (30)	363 (32)
Single	1203 (38)	549 (46)	337 (28)	317 (26)

\* Overall  $\chi^2$  test for association between each sociodemographic indicator and level of neighborhood safety; *P* < .001 for all 5 variables.

† *N* < 3141 as a result of missing data for this variable.

**TABLE 2.** Descriptive Statistics of Outcome Variables

	Mean ± SD
<b>Outdoor play time</b>	
Weekday outdoor time, min	156 ± 120
Weekend outdoor time, min	226 ± 149
<b>TV viewing time</b>	
Weekday TV viewing, min	190 ± 136
Weekend TV viewing, min	191 ± 152
BMI z score	0.56 ± 1.3

less outdoor play time. In turn, these behavioral mechanisms might cause children, over time, to have positive energy balance and an increased risk for obesity. What we found in this sample of preschool children from 20 large US cities was that mothers' perception of neighborhood safety was related to their children's TV viewing time but not to their children's outdoor play time, BMI, or obesity risk. After adjusting for a variety of sociodemographic factors, TV viewing time was ~10% greater (>2 additional hours per week) among children who lived in the least safe neighborhoods. However, TV viewing was not significantly associated with either outdoor play time or BMI.

#### Comparisons With Previous Studies

Although it has been proposed that low levels of neighborhood safety may cause increased TV viewing,<sup>22</sup> we are aware of only 1 study that tested this hypothesis. In the National Longitudinal Study of Adolescent Health, reports from >17 000 adolescents about the combined time that they spent watching TV/videos and playing computer/video games was

not associated with the level of police-reported crime in their neighborhoods.<sup>9</sup>

We found no relationship between BMI or obesity status and neighborhood safety in this study or in our earlier study of >6000 low-income preschool children in which neighborhood safety was measured by police-reported crime.<sup>12</sup> A recent study of 11- to 16-year-olds in Chicago also found no relationship between neighborhood safety perception and BMI.<sup>11</sup> These authors did find that the level of perceived neighborhood safety was inversely related to parental report of children's "recreational" activity. However, the association was of uncertain clinical significance, with children in the highest quartile of safety having 7 minutes/day more of recreational activity than those in the lowest quartile. In the National Longitudinal Study of Adolescent Health, teens who lived in neighborhoods with higher crime levels were least likely to be in the highest category of moderate to vigorous physical activity.<sup>9</sup> However, a study that surveyed 9-year-old children found that children who indicated more neighborhood hazards reported more physical activity and tended to have lower BMI.<sup>10</sup> We also found similar, although not significant, trends in our study with children in the least safe neighborhoods spending more time playing outdoors and having lower BMI.

The lack of relationship in our study between TV viewing time and either BMI or outdoor play time is consistent with a previous study in an ethnically diverse sample of preschoolers that used direct observations of both TV viewing time and physical activity (including outdoor time).<sup>23</sup> Although a

**TABLE 3.** BMI z Score and Obesity Status of Children by Neighborhood Safety Tertile

	BMI z Score, Mean ± SE		Obese, %*	
	Unadjusted	Adjusted†	Unadjusted	Adjusted†
Neighborhood safety tertile				
Low (least safe)	0.53 ± 0.04	0.54 ± 0.04	18	18
Medium	0.55 ± 0.05	0.55 ± 0.05	17	17
High (safest)	0.60 ± 0.05	0.59 ± 0.05	20	20
<i>P</i>	.50‡	.75	.31§	.36

\* BMI ≥95th percentile.

† Adjusted for household income and mothers' education, race/ethnicity, age, and marital status.

‡ Overall *P* value for 1-way analysis of variance (ANOVA).§ *P* value for  $\chi^2$  test.**TABLE 4.** Outdoor Play and TV Viewing Time by Neighborhood Safety Tertile

	Weekday Outdoor Time, min, Mean ± SE		Weekend Outdoor Time, min, Mean ± SE		Daily TV Viewing Time, min, Mean ± SE		>2 Hours TV per Day, %	
	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*
Neighborhood safety tertile								
Low (least safe)	162 ± 4	160 ± 4	232 ± 5	233 ± 5	216 ± 4	201 ± 4	71	66
Medium	151 ± 4	151 ± 4	223 ± 5	222 ± 5	178 ± 4	182 ± 4	59	60
High (safest)	154 ± 4	156 ± 4	221 ± 4	222 ± 5	173 ± 4	185 ± 4	58	62
<i>P</i>	.13‡	.24	.22‡	.16	<.001†	.001	<.001‡	.02

\* Adjusted for household income and mothers' education, race/ethnicity, age, and marital status.

† Overall *P* value for 1-way ANOVA.‡ *P* value for  $\chi^2$  test.

cross-sectional analysis of low-income preschool children in New York state found that TV viewing time was related to overweight (BMI ≥85th percentile), the authors did not report on the relationship to BMI or obesity (BMI ≥95th percentile).<sup>24</sup>

#### Potential Explanations for Our Findings and Study Limitations

Our study focused on 3 factors—neighborhood safety, TV viewing, and outdoor play time—that are often mentioned as potential targets for childhood obesity prevention efforts at both the population and the individual levels. The impact on child BMI of any of the potential mechanisms that we studied may not appear until school age or later, after these behaviors, and the small average daily energy imbalance that they cause, have been sustained for several years. However, in addition to the risk factors that we studied, there are many others, such as dietary ones, that we did not measure and that contribute to obesity risk. All known risk factors for childhood obesity, including those assessed in this study, are difficult to measure, and any 1 of them, even when measured well, is likely to interact with other factors and to explain only a small portion of the variability in children's obesity risk.

Our measure of safety perception was based primarily on the construct of social disorder, which is thought to underlie the perception of safety.<sup>25</sup> This measure showed a strong expected relationship to a number of sociodemographic variables, such as income. However, it is possible that another dimension of safety that was not measured in this study, such as street traffic, is a more important influence on children's outdoor play.<sup>26</sup>

Physical activity in preschoolers is especially difficult to measure, and large epidemiologic studies,

like this one, must rely on surrogate measures such as parent report of outdoor play time.<sup>17</sup> Outdoor play time, like any recall measure by a proxy reporter, is prone to error, which could reduce the likelihood of finding an association between outdoor play time and neighborhood safety. It is also possible that outdoor play occurred in settings other than the child's neighborhood, such as in preschool or day-care. One reason that outdoor play may not have been related to BMI was that outdoor play was not a direct measure of physical activity. For example, some children can be physically active while indoors.

TV viewing, although greater among children who lived in neighborhoods that were perceived as less safe, was not related to BMI. TV viewing may increase obesity risk by decreasing energy expenditure or increasing energy intake. TV is only 1 form of sedentary behavior, and it is not necessarily correlated with physical activity levels in children.<sup>27</sup> Although there is some experimental evidence that TV viewing is causally related to increases in children's BMI,<sup>28</sup> this may be true only in older children, for whom the average daily TV viewing time is greater.

In interpreting our findings, 3 additional factors should be considered. First, BMI was measured on a subsample of the children, and these children were more likely to have lived in unsafe neighborhoods. However, the direction of a selection bias, if any, on our analyses involving BMI is unclear. Second, the study involved only children who lived in large cities and oversampled children who were born to unwed mothers. Finally, even in the case of our findings regarding TV viewing and neighborhood safety, it is still possible that this association is explained by factors related to both neighborhood selection and TV viewing that were not measured.

## Future Research Directions

There are several ways in which future research efforts might help to clarify the role, if any, that the perception of neighborhood safety plays in the childhood obesity epidemic and which policies or practices should be implemented. Perceived safety is a complex psychological construct, and before additional cohort or experimental studies are conducted, smaller qualitative research efforts are needed to determine which dimensions of safety, such as motor vehicle traffic, physical hazards, or threats of interpersonal violence, limit children's outdoor play.

Once we understand which aspects of safety might influence children's energy balance, an experiment is the theoretically strongest design to test whether low levels of perceived neighborhood safety contribute to childhood obesity. In such a study, neighborhoods might be randomly assigned to an intervention that improves safety and/or the perception of safety, and variables, such as outdoor play and TV viewing, would also be measured.

In 1 housing experiment, Moving to Opportunity, low-income families were randomly assigned to receive housing vouchers that could be used in neighborhoods that differed in their average poverty level.<sup>29</sup> Although no impacts were seen on children's BMI, mothers who received vouchers to obtain housing in higher income neighborhoods had a significantly lower prevalence of obesity at follow-up. However, the higher income neighborhoods were likely different in many other dimensions, aside from safety, that could influence obesity risk. Other quasi-experiments of neighborhood mobility have been implemented, but they have not examined health outcomes.<sup>30,31</sup> Adding refined measures of safety perception, along with measures of child TV viewing, physical activity, and BMI, to such quasi-experiments might be the best research approach to increase our understanding in this area. However, even in these studies, it may be necessary to conduct long-term follow-up because it is usually small but ongoing daily energy imbalance that produces obesity.

## Study Implications

This is the first study to examine, in a national sample, the relationship between parental perception of neighborhood safety and obesity, physical activity, and TV viewing in preschool children. The finding that perception of neighborhood safety is associated with TV viewing is important because TV viewing is associated with aggression<sup>32-34</sup> and poorer school performance<sup>35</sup> in school-aged children. TV viewing patterns are established early in life,<sup>36</sup> and mothers play a large role in determining how preschool children spend their time. Although we found no cross-sectional association between TV viewing and obesity in preschoolers, it may be that a sustained pattern of TV viewing, established in the preschool years, leads to childhood obesity over time.

Although we found no association between outdoor play and neighborhood safety, we maintain

that increasing children's outdoor play time and making neighborhoods safer for children are 2 objectives that, if achieved, may still have beneficial impacts on children's well-being even if the 2 objectives are unrelated and even if neither improves fitness or reduces fatness.<sup>37</sup> In the face of the obesity epidemic, it is intuitive to provide a prescription for parents to turn off the TV and to encourage their children to play outdoors. It is equally intuitive, however, that parents will not act on this prescription if they believe that their children are not safe outdoors. Nonetheless, research findings so far have not supported these intuitions about how perceived safety, physical activity, and obesity are related in children.

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## PRESCHOOLERS' PREP: TODDLER TUTORING

“As the academic pressure grows on the littlest learners—to recognize their letters in preschool, to read in kindergarten—so does the idea of toddler tutoring. . . . Being kindergarten-ready means more than it did even a decade ago. In the 1990s, states began drafting ‘learning standards’ setting out expectations for their schools, including prekindergarten classes. At the same time, new brain research linked children’s early exposure to language, books and music to their late success in school. And by levying embarrassing sanctions on schools failing to produce fluent readers by third grade, President Bush’s No Child Left Behind program pushed districts to require more from younger pupils. As a result, in many districts, skills one thought appropriate for first or second graders are being taught in kindergarten, while kindergarten skills have been bumped down to preschool. . . . But most researchers maintain that preschoolers aren’t learning enough. About 70% of 4-year-olds are in group care, says a University of North Carolina child-development expert. ‘It’s a wasted opportunity not to teach them,’ she adds.”

Kronholz J. *Wall Street Journal.* July 2, 2005

Noted by JFL, MD

## A National Study of Neighborhood Safety, Outdoor Play, Television Viewing, and Obesity in Preschool Children

Hillary L. Burdette and Robert C. Whitaker

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