ELSEVIER

Neighborhood playgrounds, fast food restaurants, and crime: relationships to overweight in low-income preschool children

Hillary L. Burdette, M.D., M.S.[a,*] and Robert C. Whitaker, M.D., M.P.H.[a,b]

[a] Division of General and Community Pediatrics, Cincinnati Children's Hospital Medical Center, Cincinnati, OH 45229-3039, USA
[b] Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, OH 45221, USA

Abstract

Background. We examined the relationship between overweight in preschool children and three environmental factors—the proximity of the children's residences to playgrounds and to fast food restaurants and the safety of the children's neighborhoods. We hypothesized that children who lived farther from playgrounds, closer to fast food restaurants, and in unsafe neighborhoods were more likely to be overweight.

Methods. This was a cross-sectional study of 7,020 low-income children, 36 through 59 months of age living in Cincinnati, OH. Overweight was defined as a measured body mass index ≥95th percentile. The distance between each child's residence and the nearest public playground and fast food restaurant was determined with geographic information systems. Neighborhood safety was defined by the number of police-reported crimes per 1,000 residents per year in each of 46 city neighborhoods.

Results. Overall, 9.2% of the children were overweight, 76% black, and 23% white. The mean (±SD) distances from a child's home to the nearest playground and fast food restaurant were 0.31 (±0.22) and 0.70 (±0.38) miles, respectively. There was no association between child overweight and proximity to playgrounds, proximity to fast food restaurants, or level of neighborhood crime. The association between child overweight and playground proximity did not differ by neighborhood crime level.

Conclusions. Within a population of urban low-income preschoolers, overweight was not associated with proximity to playgrounds and fast food restaurants or with the level of neighborhood crime.
© 2003 American Health Foundation and Elsevier Inc. All rights reserved.

Keywords: Environment and public health; Obesity; Physical activity; Food; Child

Introduction

"Individual behavioral change can occur only in a supportive environment with accessible and affordable healthy food choices and opportunities for regular physical activity." (The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity, 2001).

The increasing prevalence of childhood obesity that is occurring in developed countries is now apparent among preschoolers [1–6]. This trend foreshadows the enormous economic [7] and health burdens [8,9] that these countries will face as their children age.

Decreasing the prevalence of obesity in a population requires modifications in the environment to facilitate individual behavior change [10–12]. Diverse groups, from policy makers to researchers to concerned parents, have nominated many environmental factors that make it difficult for adults to sustain healthy behaviors and to shape these behaviors in young children [13–15]. The sense of urgency to stem the childhood obesity epidemic [16] has helped catalyze a political process aimed at making environmental changes by altering public policy [17]. However, there has been insufficient research, especially in children, to suggest which environmental factors are the most important contributors to the current obesity epidemic. Such research is needed to shape the policy debate already underway.

There are no observational studies in children that have examined the relationship between the physical environment and obesity, and only a few have related the physical environment to children's diet or physical activity patterns. Access to recreational facilities is correlated to

physical activity in young children [18,19]. The availability of outdoor play spaces, such as public playgrounds, may be especially important in preschool children, a group for whom time spent outdoors is the strongest correlate of physical activity [19–21]. Even where public playgrounds are available, their use among preschoolers and, therefore, their impact on the prevalence of obesity, could differ according to neighborhood safety [22]. Low-income preschoolers, who are at greater risk for later obesity [23], may be more likely to reside in urban neighborhoods where there are fewer places for safe outdoor play.

Fast food restaurants may also be more concentrated in low-income neighborhoods [24]. The proportion of children's meals consumed at fast food restaurants has increased [25] in parallel with the childhood obesity epidemic, and consumption of fast food has been frequently implicated as an important cause of childhood obesity [26,27]. We hypothesized that where fast food restaurants are located, in relation to where preschool children live, may influence fast food consumption, and, in turn, the prevalence of obesity in children.

In this study we examined the associations between overweight among low-income preschool children and three environmental factors—playground proximity, fast food restaurant proximity, and neighborhood safety. We hypothesized that overweight children, compared to nonoverweight children, lived farther from the nearest playground, closer to the nearest fast food restaurant, and in neighborhoods with higher crime rates. We further hypothesized that the relationship between childhood overweight and playground proximity might differ according to the level of neighborhood safety.

Methods

Overall study design and setting

We conducted a cross-sectional study of low-income 3- and 4-year-old children residing in Cincinnati, OH. All children were enrolled in the WIC Program (Special Supplemental Nutrition Program for Women, Infants, and Children). WIC is a federal program that provides supplemental food and nutrition counseling to low-income mothers and their children from birth until their 5th birthday. To be eligible for WIC, family income, based on household size, must be at or below 185% of the federal poverty guideline (a poverty ratio of 1.85).

The city of Cincinnati is in southwestern Ohio and has 52 neighborhoods that serve as political jurisdictions. Cincinnati's population (2000 U.S. Census) is 331,000, making it the third largest city in Ohio and the 54th largest city in the United States. The city is surrounded by a single county (Hamilton), which contains an additional 514,000 residents.

There are over 7 million women and children enrolled in the WIC program nationwide [28]. Of these, 19% are 3- and 4-year-old children. Ohio has the sixth largest WIC enrollment among the 50 states, with approximately a quarter million women and children enrolled. To be certified for WIC benefits, children must be weighed and measured every 6 months at a WIC clinic. These height and weight data, along with other standard demographic characteristics, such as household income and address, are recorded in an electronic database at each clinic visit. Our use of Ohio's WIC database and the study protocol were approved by the Ohio Department of Health and by the Institutional Review Board at Cincinnati Children's Hospital.

Study sample

From the Ohio WIC database, children were selected for study if they met the following criteria: (1) made at least one WIC clinic visit between 1/1/98 and 6/30/01, (2) resided in the city of Cincinnati, and (3) were between 36 and 59 months of age at their visit. After selecting all visits in the WIC database between 1/1/98 and 6/30/01, we selected those children visiting one of the 14 Cincinnati WIC clinics or one of the four WIC clinics in surrounding Hamilton county (44,609 children). This strategy allowed for the possibility that some children residing in the city used WIC clinics in the surrounding county. For each child, we used the address recorded at their most recent clinic visit, and 44,105 had a complete address. Those children between 36 and 59 months of age at the time of their most recent visit were then selected ($N = 11,246$). Using the software described below, we found that 90% of these children ($N = 10,161$) had addresses that could be geocoded to a location in either the city ($N = 7,434$) or the surrounding county ($N = 2,727$). The final study sample consisted of those 7,020 children who resided in one of the 46 (of 52) Cincinnati neighborhoods for which crime statistics were available from the Cincinnati Police Department.

Outcome measure

The child's body mass index (BMI, kg/m^2) was calculated from the height and weight measured at the child's most recent WIC visit. The Ohio WIC Program employs the recommended protocols, developed by the Centers for Disease Control and Prevention (CDC), for obtaining height and weight measurements in WIC [29–31]. Each child is measured in light clothing without shoes. Weight is obtained with an electronic or balance beam scale that can be calibrated and that measures children to the nearest 0.1 kg (1/4 lb). Stature is obtained using a stable, calibrated stadiometer (usually wall-mounted) that measures heights to the nearest 0.6 cm (1/4 in.). Using the 2000 CDC growth reference [32], we calculated the BMI percentile and z score for age and sex for each BMI measure. For purposes of this

analysis "overweight" was defined as a BMI at or above the 95th percentile for age and sex.

Data sources for environmental variables

Our investigation focused on the relationship between child overweight and three environmental variables—playground proximity, fast food restaurant proximity, and neighborhood safety. From the Hamilton County Health Department, we obtained a database containing the addresses of 394 playgrounds, 151 in the city of Cincinnati and 243 in surrounding Hamilton County. This playground database was developed as part of a 1999 Health Department inventory of all playgrounds located at public parks and schools.

We were unable to identify established criteria for defining a fast food restaurant. We chose to include as fast food restaurants those eating establishments that were part of corporations that (1) had franchises nationwide or in multiple states, (2) had more than one franchise in Cincinnati, (3) served complete meals ordered without the assistance of waiters or waitresses, and (4) provided facilities for customers to consume their meals on site. Eight corporations met all four criteria. Using the yellow pages both from the Internet and the phone book (spring 2001), we identified the addresses of 151 fast food franchises in the city of Cincinnati and surrounding Hamilton County— McDonald's (31), Wendy's (28), Arby's (18), Burger King (17), White Castle (15), Taco Bell (15), KFC (16), and Rally's (11). Of these franchises, 57 were in the city of Cincinnati.

We used two variables, obtained from the Cincinnati Police Department's website (http://www.cincinnatipolice.org/), as proxy measures for neighborhood safety. The two measures were the number of serious crimes—murder, rape, robbery, burglary, aggravated assault, larceny, and auto theft—and the number of emergency ("911") police calls. Both measures are presented as rates (number per 1000 residents per year). We used the data from 1999, and these data were available at the neighborhood level for 46 of the 52 Cincinnati neighborhoods.

Calculation of environmental variables

To create our environmental variables, we used ArcView® (version 3.2, Redlands, CA 92373), a software program that uses Geographic Information Systems (GIS) to analyze spatial relationships. With the addresses available, we used ArcView® to spatially locate ("geocode") the home residence of each study subject, the 394 playgrounds, and the 151 fast food restaurants. ArcView® was then used to calculate the distance between the child's home address and the nearest playground and the nearest fast food restaurant using the distance by street travel. In addition, we used ArcView® to identify the neighborhood in which each home, playground, and fast food restaurant was located.

Additional variables

The Ohio WIC database provided the child's race (parent reported as white, black, or "other"), sex, and age. At each WIC certification visit, information is also recorded in the WIC database on household size and annual household income. However, these data are not recorded for those children whose families meet criteria for "adjunctive" eligibility in WIC through documentation of their qualification for related assistance programs, such as Temporary Assistance for Needy Families and Medicaid. Where income and household size data were available (89% of the subjects), we used these data elements, plus the year of data collection and the federal poverty guidelines, to express a child's household income as a poverty ratio. Each year a U.S. poverty guideline (a family income) is established, and it differs by family size (http://aspe.hhs.gov/poverty/poverty.shtml). A poverty ratio was calculated by dividing a child's family income by the appropriate poverty guideline for that year and for the child's household size. Thus, a poverty ratio of 0.6 for a child in a family of 4 in the year 2000 meant that the child's family income was 60% of the poverty guideline for the year 2000 for families with four members.

Data analysis

Both neighborhood safety statistics had significant deviations from a normal distribution because two neighborhoods, in which 6.8% of the study sample resided, had a crime rate and 911 call rate that were each more than three standard deviations above the median value across the neighborhoods. Therefore, in our analyses, both of these neighborhood safety variables were transformed into categorical variables by dividing the children into quintiles according to the crime rate and call rate in their neighborhood.

To examine bivariate associations, we used t test statistics to compare the mean distance to the nearest playground and nearest fast food restaurant in overweight and nonoverweight children. We used chi-square tests to compare the prevalence of overweight among children living in neighborhoods with and without fast food restaurants, in neighborhoods with and without public playgrounds, and across the quintiles of our two neighborhood safety measures. We used one-way analysis of variance to compare the mean BMI z scores and poverty ratios across children living in neighborhoods with different rates (quintiles) of crime and 911 calls. We also calculated Pearson correlation coefficients between child BMI z score and both playground and fast food restaurant distance.

We evaluated several hypothesized interactions, using logistic regression models with overweight as the dependent variable. These models tested the significance of the following interaction terms: crime rate by playground distance, child sex by playground distance, poverty ratio by fast food distance, child race by fast food distance, child race by

crime rate, and poverty ratio by crime rate. We then developed a multivariable logistic regression model to determine the independent odds of child overweight associated with our three primary exposures of interest (playground proximity, fast food restaurant proximity, and neighborhood safety) adjusting for household income, child race, and child sex.

Results

The mean ($\pm$SD) age of the children was 50 ($\pm$7) months; 76% were black and 23% white. In this low-income population, the mean poverty ratio was lower for black children than for white children (0.64 $\pm$ 0.38 vs. 0.80 $\pm$ 0.42, $P < 0.001$).

The mean BMI z score was 0.16 ($\pm$1.2), 9.2% of the children had a BMI $\geq$ 95th percentile and 21.2% of the children had a BMI $\geq$ 85th percentile. Boys and girls had a similar prevalence of BMI $\geq$ 95th percentile (9.6% vs. 8.8%, $P = 0.27$) and of BMI $\geq$ 85th percentile (21.5% vs. 20.8%, $P = 0.47$), and whites had a similar prevalence to blacks of both BMI $\geq$ 95th percentile (9.5% vs. 9.1%, $P = 0.66$) and BMI $\geq$ 85th percentile (21.6% vs. 20.9%, $P = 0.57$) (Table 1).

Ten of the 52 neighborhoods (19%) had no public playgrounds, but only 4% of the children lived in these neighborhoods. In contrast, 24 of the neighborhoods (46%) had no fast food restaurants, and 44% of the children lived in these neighborhoods. The mean distance from each child's residence to the nearest playground was 0.31 ($\pm$0.22) miles and to the nearest fast food restaurant was 0.70 ($\pm$0.38) miles. Across the children we studied, the median (range) neighborhood crime rate and 911 call rate (per 1000 residents per year) were 60 (25–567) and 669 (268–3838), respectively.

There was no difference in the mean distance to the nearest playground or fast food restaurant when comparing children with a BMI $\geq$ 95th percentile to those with a BMI < 95th percentile and when comparing children with a BMI $\geq$ 85th percentile to those with a BMI < 85th percentile (Table 2). We also found no significant correlation between child-

ren's BMI z scores and the distance to the nearest playground or fast food restaurant (data not shown). When we compared overweight and nonoverweight children, there was no difference in the percentage living in neighborhoods without playgrounds (3.3% vs. 4.1%, $P = 0.29$) nor in the percentage living in neighborhoods without fast food restaurants (44.0% vs. 44.5%, $P = 0.84$).

The prevalence of children with BMI $\geq$ 95th percentile and children with BMI $\geq$ 85th percentile did not differ statistically across the quintiles of neighborhood crime rate, but did for 911 call rate (Table 3). However, there was no clear trend suggesting that lower levels of neighborhood safety were associated with a higher prevalence of overweight. None of the interaction terms we measured (see Methods) were significant when we modeled them in multivariable logistic regression models using overweight as the dependent variable. The same was true when we used having a BMI $\geq$ 85th percentile as the dependent variable.

Because the three key environmental exposures were assessed after the date when some children were measured, we selected a subsample of the children who had their BMI measurement and home address information obtained in the year 2001 ($N = 2,174$) and reran the main analyses. The results were unchanged.

Table 1
Percentage of children with BMI $\geq$ 95th percentile and with BMI $\geq$ 85th percentile by sex and race

	N	% BMI $\geq$ 95th percentile	P value[a]	% BMI $\geq$ 85th percentile	P value[a]
Girls					
White	788	8.5	0.75	21.7	0.44
Black	2674	8.9		20.4	
Boys					
White	797	10.4	0.36	21.5	0.98
Black	2648	9.3		21.4	

[a] Compares prevalence by race, within each sex, using chi-square statistics.

Table 2
Mean ($\pm$SD) distance from child residence to nearest playground and fast food restaurant by child BMI percentile

	BMI $\geq$ 95th percentile	BMI < 95th percentile	P value[a]	BMI $\geq$ 85th percentile	BMI < 85th percentile	P value[a]
Playground distance (miles)	0.31 ($\pm$0.21)	0.31 ($\pm$0.22)	0.77	0.31 ($\pm$0.21)	0.31 ($\pm$0.22)	0.32
Fast food restaurant distance (miles)	0.70 ($\pm$0.40)	0.69 ($\pm$0.38)	0.91	0.69 ($\pm$0.39)	0.70 ($\pm$0.38)	0.43
N	645	6375		1485	5535	

[a] Compares group means by t test statistics.

Table 3
Percentage of children with BMI $\geq$ 95th percentile and with BMI $\geq$ 85th percentile by neighborhood crime rate

	1st (lowest)	2nd	3rd	4th	5th (highest)	P value[a]
Quintiles of neighborhood crime rate						
%BMI $\geq$ 95th percentile	8.6	8.8	10.1	9.0	9.7	0.64
%BMI $\geq$ 85th percentile	20.4	19.1	22.5	21.5	22.6	0.10
Quintiles of neighborhood call rate						
% BMI $\geq$ 95th percentile	10.7	8.0	7.9	10.1	9.4	0.04
% BMI $\geq$ 85th percentile	22.7	19.6	18.8	22.7	22.1	0.02

[a] Compares percentages across quintiles by chi-square statistics.

Household poverty ratio was used to control for socioeconomic differences within the study population that might have possibly obscured any relationship between childhood overweight and our three environmental variables—playground proximity, fast food restaurant proximity, and neighborhood safety. Poverty ratio was higher in overweight than in nonoverweight children (0.71 vs. 0.67, $P = 0.03$) and was correlated to playground proximity ($r = 0.12$, $P < 0.001$) and fast food restaurant proximity ($r = -0.03$, $P = 0.007$). The mean poverty ratio also increased across the quintiles of neighborhood crime, going from 0.80 in the lowest crime quintile to 0.56 in the highest ($P < 0.001$). However, using multivariable logistic regression models, the three environmental predictor variables were still not significantly associated with childhood overweight, after controlling for poverty ratio, child race, and child sex (data not shown).

Discussion

In this population of urban, low-income 3- and 4-year-old children, we found no association between overweight and measures of neighborhood safety or the proximity of children's households to either playgrounds or fast food restaurants. Furthermore, the association between child overweight and playground proximity did not differ by neighborhood safety.

There is increasing public attention to the contribution of environmental factors to the epidemic of childhood obesity [33,34]. Despite this, we are aware of no other population-based studies that have attempted to establish a correlation between measures of obesity in individual children and characteristics of their physical environment. Even observational studies in adults have related environmental factors to either physical activity [35–41] or diet [42,43] but not, as far as we know, to measures of obesity.

A particular strength of this study was our ability to control for differences in socioeconomic status, even within this low-income population, by using a measure of long-term (3 to 4 years) household income data for each child [44]. We studied a population of 7,020 children that was geographically and socioeconomically well defined. The majority of those children who meet the income eligibility requirement for WIC ($\leq 185\%$ of the poverty level) are enrolled in the WIC Program [45], and we were able to spatially locate the residences of 90% of the WIC children living in Cincinnati. Furthermore, we used GIS to conduct spatial analyses and to derive data to test our hypotheses.

Despite these strengths, the study had limitations, any of which might explain the lack of associations identified. Regarding playground proximity, we did not account for any variation in the quality of the playgrounds (e.g., cleanliness or equipment disrepair). We used playground proximity because this environmental factor was potentially correlated to gross motor physical activity, a variable we did not directly measure. Although the availability of recreation areas has been shown to be a correlate of physical activity in older children [18,19], there are no data in preschool children demonstrating that playground proximity or usage is correlated with either time spent outdoors or direct measures of physical activity. The availability of yard space at the child's residence, which we did not examine, is another candidate environmental variable that might be used in future studies. Nevertheless, our use of playground proximity speaks directly to programmatic and policy initiatives to promote physical activity by increasing access to public recreational facilities [46].

With respect to fast food restaurants, their proximity to families with preschool children has not been established as a correlate of their use by these families. Nor has their use been correlated to overweight in preschoolers. As we suggested earlier, there is also no consensus definition for a fast food restaurant that has been applied in health research. Other sources of high-energy, low-nutrient density, prepared foods (especially snack foods) are available in venues other than those typically thought of as fast-food restaurants, and proximity to these other venues was not measured in this study. Although these other venues may have been missed, we still accounted for the major "fast food" corporations.

With respect to our measurement of neighborhood safety, we used police crime statistics rather than parental reports of perceived safety. It may be the parent's perception of neighborhood safety that primarily determines if a parent brings their child to a playground. These perceptions may be based more on aspects of neighborhood disrepair (e.g., graffiti and concentration of vacant residences) than on the actual occurrence of criminal activity. Nonetheless, we know of no study that has related police crime statistics with either physical activity or obesity measures in either adults or children. A spatial analysis that utilizes distance from the child's residence to the site of a crime may provide an even more sensitive indicator of neighborhood safety where data on the address of crime sites are available to investigators.

There were potentially three additional limitations with regards to the environmental exposure variables. First was the lack of variation in these variables. More variation in these exposures might be required to detect a relationship between the exposures and overweight. Second, categorizing exposures at the neighborhood level might not lead to the most accurate classification of the exposure. For example, a restaurant or playground might not be in a child's neighborhood even though it is across the street from the child's home. However, because of this potential problem, we used distance to the nearest fast food restaurant and playground as the primary predictor variables in our analyses. Finally, the mobility of the study population may have limited the accurate assessment of all three of the environmental exposures used in this study. We assessed exposure based on the child's most recent address, but we had no

accurate information on how long the child had lived at that address. Therefore, the neighborhood exposures linked to that address might not be representative of the child's lifetime exposure.

Despite these limitations and the lack of association between our environmental exposures and child BMI, the findings in this large, population-based study with individual BMI measurements have important implications. We were surprised to learn that these low-income children, on average, lived near a playground. This suggests that the establishment of more playgrounds for children in the neighborhoods we studied, while possibly health promoting in many ways, would not necessarily influence the prevalence of childhood obesity. Many factors, other than proximity, could affect playground use. In a study of adults in Western Australia, spatial access to open public space did not differ by neighborhood socioeconomic status, but those living in the poorer neighborhoods perceived that parks were less accessible and that their neighborhoods were less attractive and safe for walking [47].

As with playgrounds, children also lived close to fast food restaurants—on average, less than a mile from the nearest one. One possible interpretation of the lack of association between fast food restaurant proximity and children's BMI is that the environment in which these children live is already "saturated" with these eating establishments. This might suggest, for example, that altering fast food restaurant locations without decreasing their number would not influence the prevalence of overweight in these children. Even if the current evidence from research other than our own [11] were judged to support a causal relationship between the consumption of fast food and childhood obesity, it is not yet clear what policy measures might offer reasonable protection of children from fast food.

Relative to the numerous studies that have attempted to assess the relationship between childhood obesity and individual behaviors, especially those related to diet and activity, very few have tried to examine environmental determinants in population-based samples. Before excluding the possibility that a meaningful public health impact on childhood obesity could be made through interventions to manipulate the physical environment (as opposed to modifying individual behavior), many more studies are required. Enhancements to this line of investigation might include evaluating different environmental factors, spatial analysis techniques and study populations. Some specific examples might include measuring parental perceptions of safety, adjusting for playground characteristics, assessing nonpublic outdoor play space, and characterizing neighborhood eating establishments and grocery stores in more detail.

Acknowledgments

References

[1] Mei Z, Scanlon KS, Grummer-Strawn LM, Freedman DS, Yip R, Trowbridge FL. Increasing prevalence of overweight among U.S. low-income preschool children: the Centers for Disease Control and Prevention Pediatric Nutrition Surveillance, 1983–1995. Pediatrics 1998;101(1) [Available at http://www.pediatrics.org/cgi/content/full/101/1/e12].

[2] U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation. The prevalence of overweight among WIC children WIC-01-PCOM, by Nancy Cole. Project Officer, Dawn Aldridge. Alexandria, VA: USDA; 2001.

[3] Ogden CL, Troiano RP, Briefel RR, Kuczmarski RJ, Flegal KM, Johnson CL. Prevalence of overweight among preschool children in the United States, 1971 through 1994. Pediatrics 1997;99:E1.

[4] Bundred P, Kitchiner D, Buchan I. Prevalence of overweight and obese children between 1989 and 1998: population based series of cross sectional studies. BMJ 2001;322:326–8.

[5] Chinn S, Rona RJ. Prevalence and trends in overweight and obesity in three cross sectional studies of British Children, 1974–94. BMJ 2001; 322:24–6.

[6] de Onis M, Blossner M. Prevalence and trends of overweight among preschool children in developing countries. Am J Clin Nutr 2000; 72:1032–9.

[7] Sturm R. The effects of obesity, smoking, and drinking on medical problems and costs. Obesity outranks both smoking and drinking in its deleterious effects on health and health costs. Health Aff 2002; 21:245–53.

[8] Fagot-Campagna A, Pettitt DJ, Engelgau MM, et al. Type 2 diabetes among North American children and adolescents: an epidemiologic review and a public health perspective. J Pediatr 2000;136: 664–72.

[9] Ludwig DS, Ebbeling CB. Type 2 diabetes mellitus in children: primary care and public health considerations. JAMA 2001;286: 1427–30.

[10] Hill JO, Peters JC. Environmental contributions to the obesity epidemic. Science 1998;280:1371–4.

[11] French SA, Story M, Jeffery RW. Environmental influences on eating and physical activity. Annu Rev Public Health 2001;22:309–35.

[12] Kumanyika SK. Minisymposium on obesity: overview and some strategic considerations. Annu Rev Public Health 2001;22:293–308.

[13] Booth SL, Sallis JF, Ritenbaugh C, et al. Environmental and societal factors affect food choice and physical activity: rationale, influences, and leverage points. Nutr Rev 2001;59:S21–39 [discussion S57–65].

[14] Nestle M, Jacobson MF. Halting the obesity epidemic: a public health policy approach. Public Health Rep 2000;115:12–24.

[15] America's epidemic of youth obesity. The New York Times 2002 (Nov 29);Sect. A:32.

[16] U.S. Department of Health and Human Services. The Surgeon General's call to action to prevent and decrease overweight and obesity. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General; 2001.

[17] Kersh R, Morone J. The politics of obesity: seven steps to government action. Health Aff 2002;21:142–53.

[18] Garcia AW, Broda MA, Frenn M, Coviak C, Pender NJ, Ronis DL. Gender and developmental differences in exercise beliefs among youth and prediction of their exercise behavior. J Sch Health 1995; 65:213–9.

[19] Sallis JF, Nader PR, Broyles SL, et al. Correlates of physical activity at home in Mexican-American and Anglo-American preschool children. Health Psychol 1993;12:390–8.

[20] Klesges RC, Eck LH, Hanson CL, Haddock CK, Klesges LM. Effects of obesity, social interactions, and physical environment on physical activity in preschoolers. Health Psychol 1990;9:435–49.

[21] Baranowski T, Thompson WO, DuRant RH, Baranowski J, Puhl J. Observations on physical activity in physical locations: age, gender, ethnicity, and month effects. Res Q Exerc Sport 1993;64:127–33.

[22] Sallis J, McKenzie T, Elder J, Broyles S, Nader P. Factors parents use in selecting play spaces for young children. Arch Pediatr Adolesc Med 1997;151:414–7.

[23] Strauss RS, Pollack HA. Epidemic increase in childhood overweight, 1986–1998. JAMA 2001;286:2845–8.

[24] Reidpath DD, Burns C, Garrard J, Mahoney M, Townsend M. An ecological study of the relationship between social and environmental determinants of obesity. Health Place 2002;8:141–5.

[25] Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. Obes Res 2002;10:370–8.

[26] McCrory MA, Fuss PJ, Hays NP, Vinken AG, Greenberg AS, Roberts SB. Overeating in America: association between restaurant food consumption and body fatness in healthy adult men and women ages 19 to 80. Obes Res 1999;7:564–71.

[27] French SA, Harnack L, Jeffery RW. Fast food restaurant use among women in the Pound of Prevention study: dietary, behavioral and demographic correlates. Int J Obes Relat Metab Disord 2000;24: 1353–9.

[28] U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation. WIC participant and program characteristics 2000, WIC-02-PC, by Susan Bartlett, Ramona Olvera, Nicole Gill, and Michele Laramie. Project Officer, Julie Kresge. Alexandria, VA; 2002.

[29] U.S. Department of Health and Human Services, Health Resources Services Administration, Maternal and Child Health Bureau. Growth Charts Training. Available at http://depts.washington.edu/growth. Accessed August 4, 2003.

[30] Centers for Disease Control and Prevention. A guide to pediatric weight and measuring. Atlanta, GA: Centers for Disease Control and Prevention; 1981.

[31] Centers for Disease Control and Prevention. Enhanced pediatric nutrition surveillance system (PedNSS) manual. Atlanta, GA: Centers for Disease Control and Prevention; 1994.

[32] Kuczmarski RJ, Ogden CL, Guo SS, et al. 2000 CDC growth charts for the United States: methods and development. National Center for Health Statistics. Vital Health Stat 2002;11(246).

[33] Nestle M. Food politics: how the food industry influences nutrition and health. Berkeley: University of California Press; 2002.

[34] Schlosser E. Fast food nation: the dark side of the all-American meal. Boston: Houghton Mifflin; 2001.

[35] Centers for Disease Control and Prevention. Neighborhood safety and the prevalence of physical inactivity-selected states, 1996. MMWR 1999;48:143–6.

[36] Ball K, Bauman A, Leslie E, Owen N. Perceived environmental aesthetics and convenience and company are associated with walking for exercise among Australian adults. Prev Med 2001;33:434–40.

[37] Booth ML, Owen N, Bauman A, Clavisi O, Leslie E. Social-cognitive and perceived environment influences associated with physical activity in older Australians. Prev Med 2000;31:15–22.

[38] King AC, Castro C, Wilcox S, Eyler AA, Sallis JF, Brownson RC. Personal and environmental factors associated with physical inactivity among different racial-ethnic groups of U.S. middle-aged and older-aged women. Health Psychol 2000;19:354–64.

[39] Sallis JF, Bauman A, Pratt M. Environmental and policy interventions to promote physical activity. Am J Prev Med 1998;15:379–97.

[40] Brownson RC, Housemann RA, Brown DR, et al. Promoting physical activity in rural communities: walking trail access, use, and effects. Am J Prev Med 2000;18:235–41.

[41] Sallis JF, Hovell MF, Hofstetter CR, et al. Distance between homes and exercise facilities related to frequency of exercise among San Diego residents. Public Health Rep 1990;105:179–85.

[42] Young LR, Nestle M. The contribution of expanding portion sizes to the US obesity epidemic. Am J Public Health 2002;92:246–9.

[43] Morland K, Wing S, Diez Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. Am J Prev Med 2002;22:23–9.

[44] Duncan GJ, Brooks-Gunn J, Klebanov PK. Economic deprivation and early childhood development. Child Dev 1994;65:296–318.

[45] Besharov DJ, Germanis P. Rethinking WIC: an evaluation of the Women, Infants and Children Program. Washington, DC: AEI Press; 2001.

[46] Sallis JF, Kraft K, Linton LS. How the environment shapes physical activity: a transdisciplinary research agenda. Am J Prev Med 2002; 22:208.

[47] Giles-Corti B, Donovan RJ. Socioeconomic status differences in recreational physical activity levels and real and perceived access to a supportive physical environment. Prev Med 2002;35:601–11.