Neighborhood Context and Racial/Ethnic Differences in Young Children's Obesity: Structural Barriers to Interventions

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Numerous studies in the last ten years have investigated racial/ethnic disparities in obesity for young children. Increasing attention is paid to the influence of neighborhood environments – social and physical – on a variety of young children's health outcomes. This work identifies resource-based, community-based, and time-use-based arguments that impede on maintenance of healthy weights for young children in socioeconomically depressed areas, and shows consistently higher rates of obesity in more deprived areas. None of this work, however, has explored whether area deprivation contributes to racial/ethnic disparities in young children's obesity; and moreover, whether the influence of area deprivation varies by racial/ethnic group.

Previous work suffers from insufficient samples of racially and ethnically diverse young children clustered in geographic areas that would allow for the examination of area level effects on obesity risk. Utilizing restricted geo-coded data from the Early Childhood Longitudinal Study-Kindergarten (N=14,680), we utilize multilevel logistic regression models to show that living in a tract with higher poverty levels, as well as a higher proportion of residents with low education, and tracts with a higher proportion of people receiving public assistance, is associated with increased child obesity risk after considering a host of relevant individual level factors. There is limited evidence that neighborhood factors are more salient predictors of obesity for minority children compared to white children. However, preliminary results suggest that these neighborhood level measures do little to explain racial and ethnic differences in childhood obesity.

The results call into question many well-intentioned childhood obesity intervention programs undergoing clinical trials. Regardless of individual-level choices or changes in behaviors, significant structural barriers to preventing childhood obesity are likely to persist and to severely impact the effectiveness of any individual- or family-level interventions.

Introduction

Young children's increasing overweight and obesity in the United States has received considerable scholarly attention over the past decade. Despite 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 31.7% of children ages 2-19 overweight or obese (Ogden et al., 2010), and significant disparities by socioeconomic status (SES) (Singh, Siahpush, & Kogan, 2010) and race (Kimbro, McLanahan, & Brooks-Gunn 2007; Whitaker & Orzol, 2006). In addition to research documenting the increase in overweight and obesity for children, a large amount of medical research aims to develop and evaluate interventions for reducing children's overweight. In this paper, we argue that structural conditions in children's neighborhoods influence obesity above and beyond individual- and family-level factors – and this means that medically-based interventions, while well-intentioned, are unlikely to be effective, particularly for minority children living in neighborhoods with multiple structural barriers to good health. Using a unique restricted, geocoded dataset (the Early Childhood Longitudinal Study, Kindergarten wave) we take advantage of the clustering of children in neighborhoods and the large, ethnically diverse sample to test whether accounting for neighborhood characteristics reduces the observed race/ethnic differences in child obesity.

Background

The most recent estimates of overweight among young children in the United States indicate that 21.2% of children ages 2-5 are overweight (>=85th percentile on the CDC's sex-specific BMI-for-age growth charts), and 35.5% of children ages 6-11 are overweight. Considering children at or above the 95th percentile, 10.4% of young children ages 2-5 are obese, and 19.6% of children ages 6-11 are obese (Ogden et al., 2010). Although rates of overweight and obesity are high overall for U.S. children, large racial/ethnic differences exist, particularly between minority children and Non-Hispanic white children.

Among Hispanic children, 27.7% of children ages 2-5 are overweight, as are fully 42.6% ages 6-11; contrasted with 17.4% of Non-Hispanic white children ages 2-5, and 34.5% ages 6-11; and 26.0% of black children ages 2-5, and 37.6% ages 6-11 (Ogden et al., 2010). In terms of racial/ethnic differences in obesity (at or above the 95th percentile), differences are considerably smaller - 9.1% of non-Hispanic white children ages 2-5 are obese, compared to 8.7% of black children and 14.2% of Hispanic children.

Explanations for racial and ethnic disparities in young children's overweight status have centered on differences in socioeconomic status (SES), cultural differences between groups, and differences in parenting surrounding diet and physical activity. To our knowledge, no prior study has been able to satisfactorily explain these racial/ethnic disparities, particularly the elevated rates of overweight and obesity for Hispanic children compared to other groups. Scholars interested in the determinants of young children's weight status have recently focused on neighborhood environments as catalysts for healthy and unhealthy trajectories in weight.

Research focused on neighborhood environments as determinants of adults' weight status tends to find that individuals in more disadvantaged neighborhoods have lower levels of physical activity and higher rates of obesity, controlling for individual-level SES (Boardman, Saint Onge, Rogers, & Denney, 2005; Fisher, Li, Michael, & Cleveland, 2004; Humpel, Owen, & Leslie, 2002). These links may be due to safety concerns (Fish, Ettner, Ang, & Brown 2010), the built environment (lack of parks, playgrounds, and walkable destinations) (Lovasi, Hutson, Guerra & Neckerman, 2009), access to and affordability of healthy foods (Lang & Caraher, 1998; Rose & Richards, 2007), or to differences in neighborhood social processes such as collective efficacy or social cohesion (e.g.Giles-Corti & Donovan, 2002; Humpel et al., 2002; Kawachi & Berkman, 2000; Moore, Diez Roux, Evenson, McGinn, & Brines, 2008). It is likely that these factors also are also responsible for the links between area deprivation and child obesity.

Beginning in the late 1990s, researchers started finding links between area deprivation measures and children's weight status (Jansen & Hazebroek-Kampschreur, 1997; Booth, Macaskill, Lazarus, & Baur, 1999; Kinra, Nelder, & Lewendon, 2000), although methodological considerations limited the conclusions that could be drawn from these studies. More recent work with new methods also finds links between area measures and child obesity, although the factors predicting obesity may vary by SES of the neighborhood (Edwards, Clarke, Ransley, & Cade 2010). Other work on adolescents also finds links between area measures -- including racial/ethnic composition, unemployment, education, and average family income – and obesity, above and beyond family-level SES (Janssen, Boyce, Simpson, & Pickett 2006; Nelson, Gordon-Larsen, Song, & Popkin 2006). Two recent studies documented a link between neighborhood SES and obesity in school-aged children (Grow et al., 2010; Singh, Siahpush, & Kogan, 2010). Grow et al. (2010) find, using a wide array of Census measures at the tract level in King County, WA, that for insured children aged 6-18, less social advantage is associated with higher rates of obesity. Utilizing parent-reported neighborhood data, Singh et al. (2010) find that overweight and obesity is higher among children aged 10-17 in neighborhoods that parents rate as unsafe or as having poor conditions. They also find stronger effects on overweight for these neighborhood measures on the youngest children and on girls.

Thus, in general in developed countries, children have higher risks of overweight and obesity in areas with higher levels of deprivation. Given that in the U.S. minority groups tend to be concentrated in under-resourced neighborhoods, and that higher area deprivation is linked to child obesity, it seems plausible that this residential segregation may contribute to an elevated risk of obesity for minority children. Potential mechanisms linking neighborhoods to obesity for children are similar to those for adults – linking the availability of and access to resources, as well as the social environment, to physical activity and diets. Poorer neighborhoods have less access to fresh foods and parks (Kipke, Iverson, Moore, Booker, Ruelas, Peters, & Kaufman 2007). They also, however, may have some factors beneficial

to physical activity – like density and more mixed-land use (Franzini et al., 2009), yet also may be perceived as less safe and have higher levels of physical disorder such as graffiti, litter, and abandoned homes and vehicles (Franzini, Taylor, Elliott, Cuccaro, Tortolero, Gilliland, Grunbaum, & Schuster 2010; Kimbro, Brooks-Gunn, & McLanahan 2011). In addition, more disadvantaged neighborhoods tend also to evidence social disorder – such as low levels of social cohesion, collective efficacy, and social capital (Sampson & Raudenbush, 2004; Ross & Mirowsky, 2001; Sampson, Raudenbush, & Earls, 1997). In fact, there is increasing evidence that the social characteristics of neighborhoods – including demographics and collective efficacy – may be more important predictors of physical activity and weight status for children and adolescents than physical characteristics of neighborhoods like the built environment (Duke, Borowsky, & Pettingell 2011; Franzini et al. 2010).

Given that social factors such as racial/ethnic composition and area poverty rates seem to be predictors of children's weight status, the question arises whether these "neighborhood effects" are truly contextual or whether they are compositional (Cummins, Curtis, Diez-Roux, & Macintyre, 2007). In other words, is it the neighborhood itself which exerts an influence on children's weight status, or rather the fact that the neighborhood may be comprised primarily of poor minorities who are more likely to be overweight? This can be tested empirically by assessing whether the "effects" of neighborhood characteristics vary for particular groups of people. The concentration of African-Americans and Hispanics into under-resourced neighborhoods, and the higher rates of obesity for children in minority groups, raises two complementary hypotheses. First, that the different neighborhood environments encountered by these groups may drive observed racial/ethnic disparities in child obesity – in other words, that accounting for neighborhood characteristics may mediate the associations between race/ethnicity and child obesity. And second, that the association between neighborhood deprivation and child obesity may vary for different groups – in other words, neighborhood characteristics may moderate the association between race/ethnicity and child obesity.

Data and Methods

This study uses restricted, geo-coded data from the fall kindergarten wave of the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K), which is a nationally-representative sample of 21,400 U.S. children who were in kindergarten in 1998-1999. The restricted version of the data provides Census tract numbers which may be linked with Census 2000 data to create neighborhood-level measures. Because children are sampled from within schools, there is also a good deal of neighborhood clustering within Census tracts; in addition, the sample is racially and ethnically diverse, making the data ideal for examining contextual-level influences on child obesity. We lose 3,160 cases where parents did not complete an interview in the fall kindergarten wave; and an additional 1,490 cases which were missing geocoded address data. Finally, due to data missing on our dependent and independent variables we lose an additional 12% of the sample (note – in time for PAA we will use multiple imputation to replace our missing data here). Our analytic sample size is thus 14,680 (note that in accordance with our restricted data agreement we must round all sample sizes to the nearest 10). Approximately 10% of children are the only respondent in their Census tract. Because we are interested more generally in the effects of aggregate characteristics on an individual outcome we keep these singleton neighborhood cases and conduct sensitivity analyses by comparing our results before and after dropping them and find no differences in results. The average number of children in each tract is 3.4 and there is a maximum of 41 children per Census tract.

Variables

Our outcome measure, whether a child is obese, is based on the CDC's gender-specific weight-for-age guidelines, and children were weighed and measured by trained ECLS-K interviewers. Children at or above the 95th percentile according to the CDC's guidelines are classified as obese. Data on children's weight and height was gathered at each data collection point. By utilizing data from the

spring kindergarten wave for children missing height and weight data at the baseline (fall) wave, we have an additional 1,795 cases with valid data. We decided to do this rather than impute missing data on our dependent variable. We ran models with and without a flag for whether the weight/height data came from the fall or spring waves; and results were very similar.

Independent variables for our study include the child's race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic asian, and non-Hispanic other), child's age in months, whether the child was low birthweight (<2500 grams), the child's gender (1=male), the mother's age and level of education (Less than high school, high school degree, or college degree or more), the mother's employment status (Works full-time, Works part-time, and Does not work) , the federal poverty threshold level of the household (under 100% of the Federal Poverty Line (FPL) in 1999, 100-200% FPL, 200-300% FPL, and 400%+ FPL), the number of siblings in the household, family structure (two-parent family, single-mother family, and other family type), and a mother-reported measure of the average number of weekday television hours the child watches (Less than two hours, 2-3 hours, and 4 or more hours).

Neighborhood-level measures include the percent of households in the Census tract living below the poverty line; the percent of the neighborhood's adult population with less than a high school degree, and the percent of households receiving public assistance. Neighborhood poverty is coded into terciles based on the full sample such that medium and high levels of poverty are compared to low levels of poverty. For the neighborhood education measure, we coded a dummy variable indicating the top 10% least educated neighborhoods. And for the public assistance measure, we coded a dummy variable indicating if the neighborhood had more than 10% of residents who were receiving public assistance.

Methods

To test the effects of neighborhood conditions on individual odds for obesity among children we use multi-level models for binary outcomes (Guo and Zhao 2000). We first estimate models with individual-level effects then add neighborhood-level measures to 1) evaluate the change in individual-level effects and 2) determine the importance of neighborhood considerations given individual-level differences.

Multilevel models treat level-1 individuals as nested within level-2 neighborhoods (census tracts). The maximum likelihood estimates of the model coefficients adjust for clustering by neighborhood, different sample sizes for level-1 and level-2 units, heteroscedastic error terms, and varying numbers of cases within level-2 units – all problems that otherwise downwardly bias estimated standard errors (Raudenbush and Bryk 2002). In a logistic regression model at level 1, the logged odds of obesity for child i in neighborhood j (Y_{ij}) is a function of mother's education (E_{ij}) and k control variables (X_{kij}):

$$\ln [\text{Prob}(Y = 1)/\text{Prob}(Y = 0)] = \beta_{0j} + \beta_{1j}*E_{ij} + \Sigma\, \beta_{kj}*X_{kij}. \quad (1)$$

With all determinants centered at their means, β_{0j} shows the mean adjusted logged odds of obesity, and β_{1j} and β_{kj} show the effects of mom's education (E_{ij}) and the control variables (X_{kij}) on the logged odds of obesity for each neighborhood j.

A set of level-2 equations treat the level-1 β coefficients as outcomes and neighborhoods, rather than individuals, become the units of analysis. With neighborhood measures (C_{mj}) as determinants of the β coefficients (such as percent in poverty), the level-2 equations take the following form:

$$\beta_{0j} = \gamma_{00} + \Sigma\, \gamma_{0m}*C_{mj} + u_{0j}\,, \quad (2a)$$

$$\beta_{kj} = \gamma_{k0}\,. \quad (2b)$$

The γ_{0m} coefficient represents the effects of the aggregate variables on the neighborhood-specific level of obesity. The model treats the intercept (β_{0j}) as random and the effects of the independent variables as fixed. The error term for equation 2a is assumed to be multivariate normally distributed, with a mean of zero and non-zero variances and covariances. The level-2 residual is a neighborhood specific error component, which remains constant, and the level-1 residual is a child-specific error component, which varies across kids and neighborhoods.

Results

Table 1 presents sample means for our dependent and independent variables as well as a race/ethnic comparison across our measures. Just over 11% of children in the full sample are classified as obese, with considerable differences across race/ethnicity. Black children are significantly more likely to be obese than white children, at 11.7% compared to 9.5%, but the largest difference is between white and Hispanic children (16.2% obese), which concurs with other work on childhood racial/ethnic differences in obesity. Asian children and those of other race/ethnic statuses have a similar obesity prevalence compared to white children.

On average, the children in the sample are about five and a half years old. Black children (14.8%), Hispanic children (7.9%), and Asian children (8.9%) are more likely than white children (6.1%) to have been born with a low birthweight. In general, Table 1 shows that non-Hispanic white children and Asian children are the most advantaged groups. Just 9% of white children live below the poverty line (<100% FPL) compared to fully 40.4% of black children, 35.9% of Hispanic children, 20.8% of Asian children, and 17.9% of children of other race/ethnicities. White and Asian mothers are most likely (34.5% and 40.6%, respectively) to have a college degree, compared to just 12.9% of black mothers and 11.8% of Hispanic mothers. All other racial/ethnic groups are more likely to watch four or more hours of

television on weekdays than are white children (4.4%) – 14.8% of black children, 9.6% of Hispanic children, 7.3% of Asian children, and 8.3% of children of other race/ethnic groups.

There are also large differences between neighborhood environments for the racial/ethnic groups in the sample. Although 44.5% of white children live in a low-poverty neighborhood, just 9.6% of black children, 13.9% of Hispanic children, 33.7% of Asian children, and 29.4% of children of other race/ethnic groups do. In contrast, 70.7% of black children live in high-poverty neighborhoods, as do 59.2% of Hispanic children. Similarly, just 1.3% of the white children in our sample live in a neighborhood ranked in the top ten percent for the number of adult residents without a high school degree, compared to 15.7% for black children, 31.5% for Hispanic children, 8.6% for Asian children, and 4.8% of children of other race/ethnicities. The figures are very similar for the public assistance neighborhood measure, except that the difference between Hispanic children and whites is not as large as for the neighborhood education measure; and the difference between whites and blacks is larger. To examine the effects of individual and neighborhood measures on obesity in a multivariate setting we turn to Table 2.

(Table 1 about here)

Table 2 provides odds ratios for child obesity risk from multi-level models incorporating individual and neighborhood measures. Model 1 includes only individual race/ethnicity and shows that both non-Hispanic blacks and Hispanics face increased risks of obesity compared to their non-Hispanic white counterparts. Further, blacks have 20% higher odds of obesity but Hispanics face 71% increased odds. Once additional individual level controls enter Model 2 the increased risk of obesity for blacks relative to whites is explained. Hispanics, however, still experience 55% increased risk of obesity compared to whites.

In addition to mediating the effects of race/ethnicity on obesity, Model 2 shows strong individual relationships between sociodemographic, socioeconomic, family type, and television viewing

measures and obesity. For example, child obesity risk decreases when mothers do not work and the further the family gets from poverty. In addition, when children have more siblings their obesity risk lessens and the more television they watch per day the higher their risk of being obese.

(Table 2 about here)

Model 3 adds the neighborhood poverty measure and shows strong relationships between area poverty and individual obesity risk after controlling for all relevant individual-level measures. Compared to the lowest poverty neighborhoods, children living in medium and high poverty areas experience 20 and 25% higher odds of obesity, respectively. Similar findings exist in Models 4 and 5 as living in the least educated neighborhoods and living in neighborhoods where a substantial portion of residents receive public assistance is associated with a 21% increased risk of obesity after accounting for individual-level effects.

Finally, comparing the race/ethnic differences in Model 2 to their differences after including the neighborhood measures shows that area poverty, education, and public assistance measures do little to explain race/ethnic differences in obesity. In fact, moving from Model 1 to Model 2 shows that individual level differences explain the difference between whites and blacks and reduces the difference between Hispanics and whites by 15% (1.71-1.55/1). This information suggests that while neighborhood measures matter for individual obesity risk, they do not explain racial and ethnic differences. Nevertheless, to further examine that possibility we ran separate models stratified by individual race and ethnic classifications (i.e. white, black, Hispanic) and for whites versus non-whites (these preliminary results not shown). The race-specific models show little difference in the ways neighborhoods impact obesity risk and suffer from small sample sizes. The white non-white models provide very limited evidence that neighborhood conditions matter more for minorities than for whites. For example, whites who live in neighborhoods with the least educated populations experience no increased risk of obesity while non-whites experience a moderately significant 20% increased risk.

Discussion (Draft)

Our findings indicate that unlike studies showing dramatic racial/ethnic differences for older children, we do not find striking race/ethnic differences in obesity for children in kindergarten with the exception of the difference between Hispanic children and all other racial/ethnic groups, similar to the national estimates from Ogden et al. (2010). Nearly one in five Hispanic five-year-olds in our sample are clinically obese, meaning at or above the 95th percentile according to the CDC's sex-specific weight for height guidelines. In our multivariate analysis, we sought to assess whether a set of individual- and neighborhood-level characteristics might explain the racial/ethnic differences in child obesity. We find that the individual characteristics explain the slight white/black difference in obesity, but not the white/Hispanic difference, which is only slightly attenuated by the inclusion of the individual-level controls. We also find little evidence that racial/ethnic differences in obesity for young children are explained by neighborhood-level factors. These factors, however, *are* important predictors of obesity for the full sample. In other words, living in a neighborhood with high poverty, low levels of education, and high levels of public assistance all increase the odds of child obesity by approximately 20%. The fact that minority children are more likely to live in these neighborhoods, however, does not explain their elevated risk of obesity.

We believe our findings, and the other recent work demonstrating associations between contextual factors and child weight problems, illustrate the difficulty of relying upon individual-level interventions to curb the child obesity epidemic. It is clear from our results, that, above and beyond individual-level factors like the poverty status of the household, family structure, maternal education, and behavioral factors such as sedentary television –watching – context matters for child obesity. And context matters in consistent ways across three different measures of deprivation – the percent of households in the neighborhood below the poverty line; and living in neighborhoods with high proportions of residents without high school degrees and those who are on public assistance. Interventions designed to reduce sedentary time and increase physical activity; and those designed to improve the diets of low-income families; are likely to fail in the absence of broad-scale social reforms targeting deprived neighborhoods.

Works Cited

Boardman, J. D., Saint Onge, J. M., Rogers, R. G., & Denney, J. T. (2005). Race differentials in obesity: The impact of place. *J Health Soc Behav,* 46, 229-243.

Booth, M., Macaskill, P., Lazarus, R., & Baur, L.A. (1999). Sociodemographic distribution of measures of body fatness among children and adolescents in New South Wales, Australia. *International Journal of Obesity*, 23, 456-72.

Burdette, H. L., & Whitaker, R. C. (2004). Neighborhood playgrounds, fast food restaurants, and crime: relationships to overweight in low-income preschool children. *Preventive Medicine,* 38, 57-63.

Burdette, H. L., & Whitaker, R. C. (2005). A national study of neighborhood safety, outdoor play, television viewing, and obesity in preschool children. *Pediatrics,* 116, 657-662.

Cradock, A. L., Kawachi, I., Colditz, G. A., Gortmaker, S. L., & Buka, S. L. (2009). Neighborhood Social Cohesion and Youth Participation in Physical Activity in Chicago. *Social Science and Medicine,* 68, 427-435.

Cummins, S., Curtis, S., Diez-Roux, A., & Macintyre, S. (2007). Understanding and representing 'place' in health research: a relational approach. *Social Science & Medicine*, 65, 1825-1838.

Davison, K. K., & Lawson, C. T. (2006). Do attributes in the physical environment influence children's physical activity? A review of the literature. *Int J Behav Nutr Phys Act,* 3, 19.

Duke, N., Borowsky, I., Pettingell, S. (2011). Adult perceptions of neighborhood: links to youth engagement. *Youth & Society,* 43.

Edwards, K., Clarke, G., Ransley, J., & Cade, J. (2010). The neighborhood matters: studying exposures relevant to childhood obesity and the policy implications in Leeds, UK. *Journal of Epidemiology and Community Health*, 64, 194-201.

Fish, J.S., Ettner, S., Ang, A., & Brown, A.F. (2010). Association of perceived neighborhood safety on body mass index. *American Journal of Public Health, 100,* 2296-2303.

Fisher, K. J., Li, F., Michael, Y., & Cleveland, M. (2004). Neighborhood-level influences on physical activity among older adults: a multilevel analysis. *Journal of Aging and Physical Activity,* 12, 45-63.

Franzini, L., Elliott, M. N., Cuccaro, P., Schuster, M., Gilliland, M. J., Grunbaum, J. A., et al. (2009). Influences of physical and social neighborhood environments on children's physical activity and obesity. *American Journal of Public Health,* 99, 271.

Franzini, L., Taylor, W., Elliott, M., Cuccaro, P., Tortolero, S., Gilliland, M., Grunbaum, J., Schuster, M. (2010). Neighborhood characteristics favorable to outdoor physical activity: disparities by socioeconomic and racial/ethnic composition. *Health & Place*, 16, 267-274.

Giles-Corti, B., & Donovan, R. J. (2002). Socioeconomic status differences in recreational physical activity levels and real and perceived access to a supportive physical environment. *Preventive Medicine,* 35, 601-611.

Grow, H. M. G., Cook, A. J., Arterburn, D.E., Saelens, B.E., Drewnowski, A., & Lozano, P. (2010). Child obesity associated with social disadvantage of children's neighborhoods. *Social Science & Medicine*, In press.

Guo, Guang, and Hongxin Zhao. 2000. "Multilevel Modeling for Binary Data." *Annual Review of Sociology* 26:441-462.

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adults' participation in physical activity A review. *American Journal of Preventive Medicine,* 22, 188-199.

Jansen, W. and Hazebroek-Kampschreur, A.A.J.M. (1997). Differences in height and weight between children living in neighborhoods of different socioeconomic status. *Acta Paediatrica,* 86, 224-225.

Janssen, I., Boyce, W., Simpson, K., & Pickett, W. (2006). Influence of individual- and area-level measures of socioeconomic status on obesity, unhealthy eating, and physical inactivity in Canadian adolescents. *American Journal of Clinical Nutrition*, 83, 129-145.

Kawachi, I., & Berkman, L. (2000). Social Cohesion, Social Capital, and Health. In e. L. Berkman and I. Kawachi (Ed.), *Social Epidemiology* (pp 174-190). New York: Oxford University Press.

Kimbro, R.T., McLanahan, S. & Brooks-Gunn, J. (2007). Racial and ethnic differentials in overweight and obesity among 3-year-old children. *American Journal of Public Health*. *97,* 298-305.

Kimbro, R., Brooks-Gunn, J., & McLanahan, S. (2011). Young children in urban areas: links among neighborhood characteristics, weight status, outdoor play, and television watching. *Social Science and Medicine*, 72, 668-676.

Kinra, S., Nelder, R., & Lewendon, G. (2000). Deprivation and childhood obesity: a cross-sectional study of 20,973 children in Plymouth, United Kingdom. *Journal of Epidemiology and Community Health*, 54, 456-460.

Kipke, M., Iverson, E., Moore, D., Booker, C., Ruelas, V., Peters, A., & Kaufman, F. (2007). Food and park environments: neighborhood-level risks for childhood obesity in East Los Angeles. *Journal of Adolescent Health*, 40, 325-333.

Lang, T., & Caraher, M. (1998). Access to healthy foods: part II. Food poverty and shopping deserts: what are the implications for health promotion policy and practice? *Health Education Journal,* 57, 202.

Lovasi, G.S., Hutson, M.A., Guerra, M., & Neckerman, K.M. (2009). Built environments and obesity in disadvantaged populations. *Epidemiologic Reviews, 31,* 7-20.

Molnar, B. E., Gortmaker, S. L., Bull, F. C., & Buka, S. L. (2004). Unsafe to Play? Neighborhood Disorder and Lack of Safety Predict Reduced Physical Activity Among Urban Children and Adolescents. *American Journal of Health Promotion,* 18, 378-386.

Moore, L. V., Diez Roux, A. V., Evenson, K. R., McGinn, A. P., & Brines, S. J. (2008). Availability of recreational resources in minority and low socioeconomic status areas. *American Journal of Preventive Medicine,* 34, 16-22.

Nelson, M., Gordon-Larsen, P., Song, Y., & Popkin, B. (2006). Built and social environments: associations with adolescent overweight and activity. *American Journal of Preventive Medicine*, 31, 109-117.

Ogden, C.L., Carroll, M.D., Curtin, L.R., Lamb, M.M., & Flegal, K.M. (2010). Prevalence of high body mass index in U.S. children and adolescents, 2007-2008. *Journal of the American Medical Association, 303,* 242-249.

Raudenbush, Stephen W., and Anthony S. Bryk. 2002. *Hierarchical Linear Models*. Thousand Oaks, CA: Sage Publications.Rose, D., & Richards, R. (2007). Food store access and household fruit and vegetable use among participants in the US Food Stamp Program. *Public Health Nutrition,* 7, 1081-1088.

Ross, C., and Mirowsky, J. (2001). Neighborhood disadvantage, disorder, and health. *Journal of Health and Social Behavior*, 42, 258-276.Sampson, R., & Raudenbush, S. (2004). Seeing disorder: neighborhood stigma and the social construction of 'broken windows.' *Social Psychological Quarterly*, 67, 319-342.

Sampson, R., Raudenbush, S., & Earls, F. (1997). Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science*, 277, 918-924.

Singh, G.K., Siahpush, M., & Kogan, M.D. (2010). Neighborhood socioeconomic conditions, built environments, and childhood obesity. *Health Affairs*. 29, 503-512.

Table 1. Descriptive Statistics for the ECLS-K Fall Kindergarten Sample

	Full Sample	Whites	Blacks	Hispanics	Asians	Others
	% or Mean (SD)	% or Mean (SD)	% or Mean (SD)	% or Mean (SD)	% or Mean (SD)	% or Mean (SD)
Dependent Measure						
Child is obese (>=95th BMI percentile)	11.2	9.5	11.7**	16.2***	11.1	10.9
Independent Measures						
Individual-level measures						
Race / ethnicity (non-Hispanic white, ref)	58.6					
Non-Hispanic Black	13.9					
Hispanic	17.8					
Non-Hispanic Asian	6.3					
Other race	3.4					
Child's age in months	68.4 (4.3)	68.8 (4.3)	68.1 (4.3)***	67.7 (4.2)***	67.3 (4.1)***	68.2 (4.2)**
Low birth weight	7.8	6.1	14.8***	7.9**	8.9**	7.7
Gender (female, ref)	49.4	49.2	50.5	49.7	49.4	47.7
male	50.6	50.8	49.5	50.3	50.6	52.3
Mother's age	33.4 (6.5)	34.1 (5.9)	32.1 (8.1)***	31.9 (6.6)***	34.7 (6.1)**	32.7 (7.3)***
Mother's education (less than high school, ref)	9.4					
high school or some college	63.1	62.8	73.5***	59.2**	49.7***	71.4***
college degree	27.5	34.5	12.9***	11.8***	40.6***	23.3***
Mother's employment status (Full-time Work , ref)	45.5	42.5	60.7***	42.1	49.9***	45.3
Part-Time Work	22.3	26.9	12.7***	17.8***	14.7***	21.9*
Unemployed	32.2	30.6	26.6***	40.3***	35.4**	32.8
Poverty thresholds (<100% FPL ,ref)	19.2	9.0	40.4***	35.9***	20.8***	17.9***
100%-200% FPL	22.5	18.9	28.3***	29.7***	21.2#	24.8**
200-300% FPL	19.4	21.8	15.0***	14.7***	18.3*	21.1
300%+ FPL	38.9	50.2	16.3***	19.6***	39.7***	36.2***
Number of siblings	1.5 (1.2)	1.4 (1.0)	1.5 (1.3)***	1.5 (1.2)***	1.7 (1.7)***	1.4 (1.1)
Family Structure (Two parents, married or cohabiting, ref)	77.4	85.7	41.8***	75.4***	87.7	70.8***
Single mother family	19.5	12.4	49.6***	22.1***	8.8**	23.5***
Other family type	3.1	1.9	8.6***	2.5*	3.5**	5.6***
Daily television viewing (less than 2 hours, ref)	45.9	51.4	31.5	38.7	48.6	42.4
2 to 3 hours	47.0	44.2	53.7***	51.7***	44.1	49.3*
4 or more hours	7.1	4.4	14.8***	9.6***	7.3***	8.3***
Neighborhood measures						
Poverty terciles (low poverty, ref)	33.0	44.5	9.6	13.9	33.7	29.4
medium poverty	33.0	37.8	19.7***	26.9***	33.4**	35.6
high poverty	34.0	17.7	70.7***	59.2***	32.9***	35.0***
Education (% of population with less than high school)						
top 10% least educated neighborhoods	9.3	1.3	15.7***	31.5***	8.6***	4.8***
Public assistance (% of households receiving public assistance)						
>10% on public assistance	8.7	1.9	22.1***	19.1***	13.6***	7.4***
N	14680	8600	2050	2610	920	500

*p<.05; **p<.01; ***p<.001 Chi squares or t-tests for significant differences between Non-Hispanic Whites and other racial/ethnic groups

Table 2. Multilevel logistic regression odds ratios for individual and neighborhood determinants of child obesity.[a]

	Model 1		Model 2		Model 3		Model 4		Model 5	
Individual measures										
Race / ethnicity (non-Hispanic white, ref)										
non-Hispanic black	1.20	*	1.04		1.00		1.03		1.02	
Hispanic	1.71	**	1.55	**	1.50	**	1.49	**	1.53	**
non-Hispanic Asian	1.11		1.10		1.08		1.09		1.09	
Other race	1.10		1.03		1.02		1.03		1.03	
Child's age in months			1.00		1.00		1.00		1.00	
Low birth weight			0.59	**	0.59	**	0.59	**	0.59	**
Gender (female, ref)										
male			1.18	**	1.18	**	1.18	**	1.18	**
Mother's age			1.02	**	1.02	**	1.02	**	1.02	**
Mother's education (less than high school, ref)										
high school			1.14	+	1.15	+	1.16	+	1.15	+
greater than high school			0.99		1.02		1.01		1.00	
Mother's employment status (works full-time , ref)										
works part-time			0.82	**	0.83	**	0.82	**	0.82	**
does not work			0.78	**	0.79	**	0.78	**	0.78	**
Poverty thresholds (under 100% ,ref)										
100 to 200%			0.94		0.95		0.95		0.95	
200 to 300%			0.80	*	0.83	*	0.81	*	0.82	*
400% and over			0.63	**	0.67	**	0.64	**	0.64	**
Number of siblings			0.85	**	0.85	**	0.85	**	0.84	**
Family (two-parent family , ref)										
single-mother family			0.99		0.99		0.99		0.98	
other family type			0.74	+	0.73	+	0.74	+	0.73	+
Television viewing (less than 2 hours, ref)										
2 to 3 hours			1.14	*	1.14	*	1.14	*	1.14	*
4 or more hours			1.36	**	1.36	**	1.35	**	1.35	**
Neighborhood measures										
Poverty terciles (low poverty, ref)										
medium poverty					1.20	*				
high poverty					1.25	**				
Education (% of population with less than high school)										
top 10% least educated neighborhoods							1.21	*		
Public assistance (% of households receiving public assistance)										
> 10% on public assistance									1.21	*
Log likelihood	-5083.08		-5011.54		-5007.2		-5009.52		-5009.48	

Source: ECLS-K 1998-1999.

+ p < 0.10 ; * p < 0.05 ; ** p < 0.01

[a] All models control for population density in the neighborhood.