Cumulative Social Risk and Obesity in Early Childhood

**WHAT'S KNOWN ON THIS SUBJECT:** Cumulative social factors in childhood have been associated with obesity in adulthood. Little is known regarding the role of accumulation of social stressors and obesity in early life.

**WHAT THIS STUDY ADDS:** Cumulative social adversities were associated with increased odds of early-onset obesity among girls. In addition, those with a higher number of stressors at a single time period had elevated odds for obesity by 5 years of age.

**OBJECTIVES:** The goal of this study was to examine the relationship between cumulative social adversity and childhood obesity among preschool-aged children (N = 1605) in the Fragile Families and Child Wellbeing Study.

**METHODS:** Maternal reports of intimate partner violence, food insecurity, housing insecurity, maternal depressive symptoms, maternal substance use, and father’s incarceration were obtained when the child was 1 and 3 years of age. Two cumulative social risk scores were created by summing the 6 factors assessed at ages 1 and 3 years. Child height and weight were measured at 5 years of age. Logistic regression models stratified according to gender were used to estimate the association between cumulative social risk and obesity, adjusting for sociodemographic factors.

**RESULTS:** Seventeen percent of children were obese at age 5 years, and 57% had at least 1 social risk factor. Adjusting for sociodemographic factors, girls experiencing high cumulative social risk (≥2 factors) at age 1 year only (odds ratio [OR]: 2.1 [95% confidence interval [CI]: 1.1–4.1]) or at 3 years only (OR: 2.2 [95% CI: 1.2–4.2]) were at increased odds of being obese compared with girls with no risk factors at either time point. Those experiencing high cumulative risk at age 1 and 3 years were not at statistically significant odds of being obese (OR: 1.9 [95% CI: 0.9–4.0]). No significant associations were noted among boys.

**CONCLUSIONS:** There seems to be gender differences in the effects of cumulative social risk factors on the prevalence of obesity at 5 years of age. Understanding the social context of families could make for more effective preventive efforts to combat childhood obesity.

**AUTHORS:** Shakira F. Suglia, ScD, Cristiano S. Duarte, PhD; Earle C. Chambers, PhD; and Renée Boynton-Jarrett, MD, ScD

**KEY WORDS** cumulative risk, food insecurity, housing insecurity, obesity, social risk factors, social stress, violence

**ABBREVIATIONS**

CI—confidence interval
IPV—inimate partner violence
IPW—inverse probability weighting
OR—odds ratio
SES—socioeconomic status

**FINANCIAL DISCLOSURE:** The authors have indicated they have no financial relationships relevant to this article to disclose.

**FUNDING:** Dr Suglia was supported by grant 7K01HL103199-03 from the National Heart, Lung, and Blood Institute; Dr Duarte was supported by grant R21HD056170 from the National Institute of Child Health and Human Development; Dr Boynton-Jarrett was supported by the William T. Grant Foundation and by Boston University, Building Interdisciplinary Research Careers in Women’s Health, grant K12 HD043444 from the Office of Research on Women’s Health. The Fragile Families and Child Wellbeing Study was supported by grant R01HD36816 from the National Institute of Child Health and Human Development. Funded by the National Institutes of Health (NIH).
Childhood obesity is a major public health problem in the United States that disproportionately affects African American and Hispanic children as well as children of low socioeconomic status (SES). The high prevalence of obese children among minority populations is likely multifactorial, including genetic, environmental, and social factors. Minority children and children living in low-SES households are more likely to experience multiple environmental and social risk factors both simultaneously and chronically over a prolonged period of time. This accumulation of risk factors may be key for the development of chronic conditions.

Recently, a few studies have begun to explore associations between psychosocial stress and childhood obesity. Maternal intimate partner violence (IPV) and child maltreatment and neglect have both been associated with childhood obesity. Maternal depression, poor family functioning, lack of cognitive stimulation, and lack of emotional support, as well as single parenthood and maternal drug use, have all been associated with childhood obesity. Low-income households are likely to experience a disproportionate burden of these and other psychosocial stressors (ie, housing insecurity, food insecurity) that have also been independently related to childhood obesity.

Stress research suggests that individuals may be increasingly vulnerable to negative health outcomes when exposed to the cumulative effects of multiple stressors. Cumulative stressors may accelerate bodily wear and tear. Impoverished, urban communities, where exposure to multiple stressors is more prevalent, are particularly vulnerable.

In a recent study by Wells et al., cumulative risk exposure during childhood was noted as a mediator of the relation between early childhood poverty and adult obesity; however, it is unclear if the same process is also relevant for childhood obesity.

To date, studies examining social risk factors and childhood obesity have largely focused on school-aged children or adolescents, with few studies focusing on toddlers and preschool-aged children and even fewer assessing effects longitudinally. It is likely that the effects of social risk factors on childhood obesity may differ by developmental stage. Infants and preschool-aged children rely more heavily on their caregivers compared with their school-aged and adolescent years when they become increasingly more independent. Systematic assessment of social stressors early in life, when accumulation begins, is particularly informative about the relationship between accumulation of stressors and obesity.

In this study, we explored associations between cumulative social stressors and obesity among 5-year-old children. Social stressors included in these analyses were selected on the basis of previously documented literature on the negative effects of these stressors and chronic disease. We examined (1) whether cumulative social stressors experienced during early childhood are associated with obesity, and (2) whether exposure to cumulative social stressors experienced at specific points in time are associated with obesity. Because gender differences have been noted in the association between childhood psychosocial risk factors and adult obesity, as well as psychosocial stress and child obesity, we sought to determine whether associations between multiple social stressors and childhood obesity differed according to gender.

**METHODS**

**Study Population**

Analyses were conducted by using public-use data available from the Fragile Families and Child Wellbeing Study, a prospective birth cohort study that follows up a sample of mother–child pairs from 20 large cities in the United States. Nonmarital births were oversampled relative to marital births in a ratio of 3 to 1. The study is a joint effort by Princeton University’s Center for Research on Child Wellbeing and the Center for Health and Wellbeing, Columbia University’s Social Indicators Survey Center, and The National Center for Children and Families. Details on the study design can be found in Reichman et al. In brief, 4898 women were recruited from 75 hospitals during the birth of the child between 1998 and 2000 in 20 US cities with populations >200,000. Random samples of both married and unmarried births were selected until preset quotas were reached. On completion of screening and determination of eligibility, consent was obtained. Mothers completed a baseline interview at delivery and participated in follow-up interviews when the children were ~12, 36, and 60 months of age. All children who remained in follow-up were asked to participate in an in-home assessment at the 60-month follow-up; 2489 completed the assessment. The 1605 children included in final analyses had complete information on the social risk factors of interest and height and weight information at the 60-month follow-up. Those who did not participate in the 60-month in-home assessment differed significantly by race/ethnicity from those who participated (African American, 46% nonparticipants vs 50% participants, P < .0001; Hispanics, 28% nonparticipants vs 24% participants, P < .0001).

**Social Risk Factors**

Each of the 6 social risk factors was assessed at both the 12- and 36-month assessments.

**Maternal Mental Health**

Mothers answered the Composite International Diagnostic Interview Short
Form, a screening for depression that is based on 1 of the most widely used structured diagnostic interviews to assess adult psychiatric disorders in epidemiological studies. This tool was scored consistent with the developer’s guidelines, which generates probable diagnosis of psychiatric disorders consistent with the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (American Psychological Association, 1994). To ascertain probable depression, mothers were initially asked if they experienced dysphoria (depression) or anhedonia (lack of enjoyment of what is often experienced as pleasurable) in the past year for a specific duration (≥2 weeks, and if so, whether such symptoms lasted most of the day and occurred every day). If presence and persistence of symptoms were positive, mothers were asked about 7 other symptoms, such as losing interest, trouble sleeping, and thinking about death. A probable depression score resulted from adding up the answer to these 7 symptoms plus the first dysphoric symptom, if present, with scores therefore ranging from 0 to 8. A mother scoring ≥3 was considered as a probable case. Also, if a mother reported taking antidepressants, she was considered as a probable case.

**Maternal Substance Use**

Mothers were asked whether in the past month, they had drank ≥5 alcoholic beverages in 1 day, had smoked pot or marijuana, or if they had used cocaine, crack, lysergic acid diethylamide, speed, heroin, or other hard drugs. In addition, mothers were asked whether alcohol/drugs had interfered with their daily life, personal relationships, or whether they had sought help or treatment of a drug or alcohol problem since the child’s birth. Mothers affirming any of these questions were classified as using drugs/alcohol.

**Intimate Partner Violence**

Maternal IPV was assessed at the 12- and 36-month follow-up assessments by using previously validated questions.

Mothers were asked to think about their relationship with the infant’s father or current partner and were then asked: (1) “How often does he slap or kick you?”; (2) “How often does he hit you with a fist or object that could hurt you?”; (3) “How often does he try to make you have sex or do sexual things you don’t want to?”; and (4) “Were you ever cut or bruised or seriously hurt in a fight with the baby’s father or current partner?” Mothers who responded “often” or “sometimes” as opposed to “never” to either of the first 3 questions or who responded “yes” to the last question were categorized as experiencing IPV for the relevant time period.

**Housing Insecurity**

Mothers were asked whether they had been evicted from their home in the past 12 months, stayed in a shelter/car or abandoned vehicle, did not pay full rent or mortgage, or if they had moved in with other people because of financial problems. These questions were derived from the Survey of Income and Program Participation and the New York City Social Indicators Survey. Mothers affirming ≥1 of these questions were categorized as experiencing housing insecurity.

**Food Insecurity**

Mothers were asked whether in the past 12 months they were ever hungry but could not afford to buy more food or whether their children were hungry but they could not afford to buy more food. Mothers endorsing either question were characterized as experiencing food insecurity.

**Paternal Incarceration**

Mothers were asked whether the father of the child was currently incarcerated.

**Cumulative Social Index**

Because we were interested in both timing and chronicity of these social risk factors, 2 cumulative scores were created. Dichotomous variables were created for each of the 6 social factors (probable maternal depression, IPV, maternal drug/alcohol use, housing insecurity, food insecurity, and paternal incarceration) obtained at the 12- and 36-month assessments. A score of 1 was assigned for each item endorsed for each of the 6 measures for each year. The cumulative score was created by summing the dichotomous variables for both assessments, with a possible score ranging from 0 to 12. Higher scores indicated a higher level of cumulative social risk, resulting in the total cumulative social risk score (mean ± SD: 1.3 ± 1.5). Lastly, to allow for the examination of the role of timing of exposure, cumulative risk scores at each assessment were dichotomized; children were classified as having high cumulative risk for a particular year if they endorsed ≥2 social risk factors for a particular year and 0 if not. A 4-level chronicity of cumulative social risk variable was then created, characterized as: (1) no cumulative risk during years 1 and 3, (2) low cumulative risk during years 1 and 3 (total cumulative risk score <2 in both assessments), (3) high cumulative risk in year 1 only (early cumulative risk), (4) high cumulative risk in year 3 only (late cumulative risk), or (5) high cumulative risk in years 1 and 3 (chronic cumulative risk).

**Child Obesity**

Trained interviewers measured height and weight with participants wearing light clothing and no shoes during the 36- and 60-month assessments (child ages 3 and 5 years). A portable stadiometer (Seca 214 Road Rod Stadiometer, SecaCorporation, Hanover, MD) was used to measure height, and an electronic scale (Seca 840 Bella Digital
Scale) was used to measure weight. BMI was calculated from measured height and weight (kilograms per meters squared) measured at the 36-month follow-up. The Centers for Disease Control and Prevention BMI growth reference chart was used to determine age- and gender-specific BMI percentiles. Obesity at age 5 years was defined as BMI $\geq 95$th percentile at the 5-year assessment.

**Sociodemographic Factors**

Data on child gender, child race/ethnicity (based on the mother’s information about her own race/ethnicity), and birth weight were collected on the baseline survey. Marital status of the parents (married/cohabitating or not married at child’s birth), maternal education (some college, high school graduate, or less than high school) and receipt of public assistance were also considered. The 36-month assessment collected data on child bottle use and hours of daily television viewing. Maternal BMI was based on anthropometric factors collected at the 36-month in-home assessment.

**Data Analysis**

We used inverse probability weighting (IPW) to adjust for potential selection bias. The weights are the inverse of the probability of follow-up versus loss to follow-up given baseline covariates, obtained with the use of binary logistic regression. Weights were assigned to each child ($N = 1605$) to represent the full study sample.

Logistic regression analyses were conducted to estimate the association between obesity at age 5 years and total cumulative social risk (dependent variable), adjusting for sociodemographic factors (race/ethnicity, maternal education, maternal marital status, and receipt of public assistance) stratified according to gender. Next, a second regression model examined the relationship between chronic cumulative social risk experienced at either age 1 year, age 3 years, or at both time periods, and obesity, while adjusting for sociodemographic factors. To verify if the relation between obesity and cumulative social risk could be attributable to maternal obesity–related influences, health behaviors, or be influenced by a child’s low birth weight status, a sensitivity analysis was conducted adjusting the final model for maternal BMI, low birth weight status, television viewing time, and taking a bottle to bed at 36 months.

All analyses were weighted by using IPW and conducted in SAS version 9.0 (SAS Institute, Cary, NC).

**RESULTS**

Table 1 shows the distribution of demographic characteristics, childhood obesity, and study covariates. In the sample of 1605 children, 51% were boys, 51% African American, and 27% Hispanic. Seventeen percent of children were obese at 5 years of age. Housing insecurity (22%), maternal depression (12%), and IPV (10%) occurred frequently in children’s home environments during their first year of age. No gender differences were noted in the distribution of social risk factors, obesity, or study covariates.

In analyses adjusted for sociodemographic factors, girls who experienced $>$ 1 social risk factor at 1 or 3 years of age were at significantly increased odds of being obese by age 5 years (Table 2). No significant associations were noted among boys.

When examining cumulative risk according to age of exposure, girls were at increased odds of being obese if they experienced high cumulative risk ($= 2$ risk factors) at age 1 year only (odds ratio [OR]: 2.1 [95% confidence interval [CI]: 1.4–4.1]) or at age 3 years only (OR: 2.2 [95% CI: 1.2–4.2]) compared with...
children who experienced no risk factors at either age (Table 3). Girls who experienced high cumulative risk at both 1 and 3 years of age were at increased odds of being obese (OR: 1.9 [95% CI: 0.9–4.0]), albeit this association was not statistically significant. No significant associations were noted between cumulative social risk and obesity among boys.

On further adjustment for maternal BMI, child’s low birth weight status, television viewing hours, and taking a bottle to bed at 36 months, an association between high cumulative risk and obesity was still noted: girls who experienced high cumulative risk at both age 1 year only (OR: 1.8 [95% CI: 0.9–3.5]), age 3 years only (OR: 2.1 [95% CI: 1.1–4.0]), or chronically at ages 1 and 3 years (OR: 1.9 [95% CI: 0.9–4.2]). The ORs for high cumulative risk at age 1 year only and chronically narrowly eluded statistical significance.

**DISCUSSION**

In this study, we examined the relationship between multiple social risk factors and childhood obesity in a longitudinal study of urban 5-year-old children of mostly low SES. Among girls, those who experienced ≥1 social stressor at either age 1 or 3 years were at increased odds of being obese by 5 years of age. Experiencing ≥2 stressors during the same time period was associated with higher odds of being obese by age 5 years. No significant associations were noted among boys.

These results in preschool-aged children are similar to a recent study by Wells et al., in which cumulative risk in the preadolescent and adolescent periods (ages 9, 13, and 17 years) was associated with a higher BMI trajectory. Similarly, the Adverse Childhood Experiences studies also documented an association between childhood cumulative stress and adult obesity.

The association between early childhood stressors and early obesity possibly reflects parenting behaviors such as providing the child with poor nutrition foods and not engaging in physical activity. In a stressful home environment, parental availability for caretaking needs of the child may be limited. Food may be used in excess as a tool for consoling or pacifying emotional needs of the child by the parent or to self-soothe by the child. Alternatively, the noted associations may represent more direct biological mechanisms. Repeated stimulation of the hypothalamic-pituitary axis by environmental stressors may elevate cortisol levels, dysregulate neuroendocrine mediators of the reward pathway, and influence compulsive feeding practices as well as visceral fat accumulation.

In the first 3 years of life, the ability to regulate one’s responses to stress (ie, self-regulation) emerges in the context of the caregiver–child relationship. Stressful environments can hamper the development of self-regulation. In a recent study, Graziano et al demonstrated that low self-regulation among toddlers, as well as low inhibitory control skills/higher reward sensitivity, is associated with obesity at age 5 years. Children with higher reward sensitivity may engage in impulsive eating and may request foods that are sweet and high in fat, which are reportedly tastier than healthier/bland foods. Among adults, emotional dysregulation has been associated with overeating; it is thus plausible that children exhibiting poor self-regulation have difficulty assessing satiety. Studies by Evans et al demonstrated that cumulative risk is associated with stress dysregulation among children and postulated that the accumulation of psychosocial and environmental risk factors, as a consequence of living in poverty, explains the physical, psychological, and developmental health disparities noted among low-SES children. We sought to determine whether a cumulative effect was more detrimental than experiencing a single stressor, irrespective of when the stressors were experienced. When exploring the effect of cumulative stressors irrespective of when they were experienced, we noted significant associations among children who experienced ≥1 stressor. However, when exploring the effect of timing, a higher odds of being obese at
age 5 years was noted among children experiencing ≥2 stressors at the same time. This finding suggests that while the accumulation of stressors over time is associated with obesity at a young age, being exposed to multiple factors at the same time is more important to the development of obesity. Lower odds of obesity at 5 years of age were noted among children exposed to a high number of stressors chronically. These results are potentially due to the fact that few children experienced a high number of stressors across the 2 time points (52 girls and 44 boys).

In this study, significant effects were observed in girls but not in boys. Two studies have documented associations between adolescent depression and adult obesity among girls but not boys. It has been proposed that these differential effects could be the result of differences in coping mechanisms; girls may be more likely to respond to stress with emotional and binge eating.

Our study has a number of strengths. The analyses were based on a national sample of mainly children of low SES, with objectively measured height and weight. We explored a variety of home social factors not previously considered for their cumulative effects, which were measured repeatedly throughout follow-up. However, there are limitations worth noting. A number of participants were lost to follow-up. Although those who completed the 60-month assessment and those who did not differed by race/ethnicity, there were no differences based on sociodemographic characteristics or social risk factors at the 12-month follow-up. Furthermore, we implemented IPW to correct for potential selection bias. Our measure of food insecurity and maternal drug and alcohol use was based on a small number of questions and not a fully standardized instrument. Social desirability may have influenced reported drug and alcohol use; however, we do not believe such bias would be differential with respect to childhood obesity.

**CONCLUSIONS**

In these analyses, we noted associations between the accumulation of early exposure to social risk factors and obesity among 5-year-old girls. Identifying modifiable mediators of these associations can better inform intervention and prevention efforts to curb childhood obesity. Future studies should explore mechanisms that could help explain gender-related differences among young children.


### Cumulative Social Risk and Obesity in Early Childhood

Shakira F. Suglia, Cristiane S. Duarte, Earle C. Chambers and Renée Boynton-Jarrett

*Pediatrics*; originally published online April 16, 2012;

DOI: 10.1542/peds.2011-2456

<table>
<thead>
<tr>
<th>Updated Information &amp; Services</th>
<th>including high resolution figures, can be found at: /content/early/2012/04/11/peds.2011-2456</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citations</td>
<td>This article has been cited by 6 HighWire-hosted articles: /content/early/2012/04/11/peds.2011-2456#related-urls</td>
</tr>
<tr>
<td>Permissions &amp; Licensing</td>
<td>Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: /site/misc/Permissions.xhtml</td>
</tr>
<tr>
<td>Reprints</td>
<td>Information about ordering reprints can be found online: /site/misc/reprints.xhtml</td>
</tr>
</tbody>
</table>
Cumulative Social Risk and Obesity in Early Childhood
Shakira F. Suglia, Cristiane S. Duarte, Earle C. Chambers and Renée Boynton-Jarrett
*Pediatrics*; originally published online April 16, 2012;
DOI: 10.1542/peds.2011-2456

The online version of this article, along with updated information and services, is located on the World Wide Web at:
/content/early/2012/04/11/peds.2011-2456