Family Stressors and Childhood Obesity

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Abstract

The relatively high prevalence of obesity (1 in every 6 children in the United States) and associated adverse consequences (e.g., medical, psycho-social, and economic) make childhood obesity a public health priority. However, the causes of childhood obesity are more complex and multifactorial than previously thought. Of particular interest are the influences of individual, family, and community factors. This study focuses on a set of factors within the family, namely stressful and adverse experiences. Although some studies have shown that chronic stress is associated with childhood obesity, few have specifically examined relationships between multiple family-level and cumulative family-level stressors and child weight. This paper investigates these associations through analyses of data from the Panel Study of Income Dynamics (PSID) and its Child Development Supplement (CDS). Approximately 37 percent of the sample children were at risk of overweight (ARO, 16%) or overweight (OW, 21%). We estimate two multiple regression models: a probit using traditional weight categorizations and an approach whereby much less structure is imposed. Results from both analyses indicate that children in households with members who are experiencing higher mental and physical health problems and in households with greater financial difficulties were more likely to be ARO/OW in comparison to being normal weight. Likewise, experiencing greater cumulative stress was related to being more likely to be ARO/OW in comparison to normal weight. We find similar patterns when we regress child weight on these factors on weight, controlling for gender, height, and age. We discuss how public policies that reduce family stressors may, in turn, be reducing childhood obesity.

Family Stressors and Childhood Obesity

Evidence for the epidemic of childhood obesity in the United States (U.S.) is clearly shown by the three-fold increase in the prevalence of overweight for children over the last three decades (Anderson & Butcher, 2006; Kumanyika & Grier, 2006; Wang & Zhang, 2006) and current prevalence rates (17.1% overweight and another 16.5% at risk of overweight) (Ogden et al., 2006). These high prevalence rates, along with the adverse physical, psychological, and social consequences of being overweight on children that extend into adulthood (Gunnell et al., 1998; Mahoney et al., 1996; Nieto et al., 1992; Power et al., 1997; Schwimmer et al., 2003; Serdula et al., 1993; Smoak et al., 1987; Williams et al., 1992) which in turn may lead to a reduced life expectancy (Fontaine et al., 2003), make childhood obesity one of the most important medical issues among youth today (Hedley et al., 2004; Koplan et al., 2005).

The causes of childhood overweight include prenatal and postnatal origins consisting of genetic and environment factors (Eisenmann, 2006; Maffeis, 2000). One environmental factor that has received relatively limited attention is children's exposure to chronic family stress. Recent epidemiological studies have shown that occupational stress, anxiety and other personality disorders, perceived stress (Rosmond & Bjorntorp, 1999, 2000), and irregularities in the physiological stress response (Ljung et al., 2000) are associated with obesity in adults. If similar associations occur in children, the rates of overweight seen in children may be at least partly explained by the role of stress. For example, several studies indicate that family stressors, such as family disruption, may lead to eating disorders, poor eating habits, and obesity in children (e.g., Gibson et al., 2007; Johnson-Down et al., 1997; Menning & Stewart, forthcoming; Middlebrooks & Audage, 2008; Stewart & Menning, 2007).

In this paper, we examine a wide variety of stressors affecting children and families with a focus on family-level stressors using data from the Panel Study of Income Dynamics (PSID) and its Child Development Supplement (CDS). We also measure the cumulative effects of these stressors on children's risk of overweight. This study advances our understanding of child obesity in important ways by identifying new avenues to prevent childhood obesity in the area of family stress.

Background

The prevalence rates of overweight and obesity have increased for all children since the mid-1960s (Anderson & Butcher, 2006; Kumanyika & Grier, 2006; Wang & Zhang, 2006). Not only is the prevalence rate of overweight higher, but those who are overweight are heavier than in the past (Anderson & Butcher, 2006). To illustrate the changes in the body mass index (BMI) distribution of all children over time, Anderson and Butcher (2006) report that over the approximately 30 years between 1971-1974 and 1999-2002, a 4'6" child with the median BMI gained 4.6 pounds for a 6.3 percent increase (73.4 to 78.0 pounds). But a child at the 95th percentile gained about 19 pounds for a 17.5 percent weight gain (108.3 to 127.3 pounds).

Childhood overweight and obesity are associated with negative psychological, social, economic and physical health effects for children that carry into adulthood. For example, childhood obesity is associated with the clustering of risk factors for cardiovascular disease (e.g., high blood pressure, cholesterol, poor blood sugar control) during childhood (Smoak et al., 1987; Williams et al., 1992). Childhood obesity also increases the risk of adult obesity (Power et al., 1997; Serdula et al., 1993), coronary calcification (Mahoney et al., 1996), and cardiovascular disease mortality (Gunnell et al., 1998; Nieto et al., 1992). It is thought that these adverse health conditions experienced at an early age and by more individuals will reduce life expectancy in

contemporary generations (Fontaine et al., 2003). The increasing prevalence of obesity in children and its subsequent consequences led the Institute of Medicine to recommend making the prevention of child obesity a national priority (Koplan et al., 2005).

Beyond the medical implications, the economic cost of obesity among all Americans was estimated at $92 billion in 2004 (Feibelkorn, 2006), nearly 10 percent of all health care expenditures in the U.S. (Finkelstein et al., 2003). Among children in 2004, the national cost of obesity was approximately $11 billion for children with private insurance and $3 billion for those with Medicaid (Marder & Chang, 2006). Children treated for obesity are roughly three times more expensive for the health care system than the average insured child (Marder & Chang, 2006).

Stressors and Overweight among Children

The concept of "stress" is complex and multifaceted. Its definition varies by discipline (Chrousos & Gold, 1992; Monat & Lazarus, 1991) and even within disciplines (Monat & Lazarus, 1991). Consistent with theoretical work on the "stress process" (Chrousos & Gold, 1992; Pearlin et al., 1981), we define *stress* as a negative physiological response and *stressors* as the external factors that may cause this negative response (Aneshensel, 1992; Chrousos & Gold, 1992; Pearlin et al., 2005).

There is a growing body of biological evidence describing how and why stress can lead to an individual being overweight (e.g., Bjorntorp, 2001; Raikkonen et al., 1996; Rosmond and Bjorntorp, 1999). One mechanism is that increased levels of cortisol (the chief hormone released during the stress response) and the chronic hypersecretion of cortisol lead to metabolic abnormalities directly or indirectly related to increased adiposity (or body fat) (Bjorntorp, 2001). The limited research on children suggests that higher levels of cortisol are associated with higher

measures of body fat (Dimitriou et al., 2003). In addition, stress may also contribute to poor

eating habits (Jenkins et al., 2005) and lower physical activity levels in children (Roemmich et

al., 2003), which are both associated with overweight and obesity (Ness et al., 2007).

In this paper, we use a family stress framework to examine the relationship between

stressors in the family and overweight in children. Family stress is defined as "pressure or

tension in the family system" (Boss, 1988, p. 12) and stressors and "stressor events" are

conditions and occurrences that provoke change in the family system (p. 36). Family stress and

stressors can arise from individuals, households, and contextual factors external to the family

such as neighborhoods and communities (Robert, 1999). We address family-level stressors via

five constructs: family disruption and conflict, mental and physical health problems, housing

issues, health care struggles, and financial difficulties. The literature associated with each of

these stressors is detailed below.

Family disruption and conflict. Family disruption such as parental divorce, cohabitation,

and stepfamily relationships may cause stress in children (Amato, 2000; Coleman et al., 2000;

Sobal et al., 2003) and affect child weight status. The effects of family disruption on children

manifest themselves in a variety of ways. For example, residing in a single parent family has

been shown to be positively associated with fat intake among children (Johnson-Down et al.,

1997), poor eating habits such as consuming fast food (Stewart & Menning, 2007), significantly

higher BMIs, and greater risk of obesity (Gibson et al., 2007; Strauss & Knight, 1999).

Although, Wolfe and colleagues (1994) found no effect of residing in a single parent family on

child obesity. Involvement with a nonresident father also has been positively associated with

adolescents' risk of obesity (Menning & Stewart, forthcoming). Aspects of family conflict that

have been associated with stress and/or a stress response in children include parental conflict

(Amato, 2000) and the lack of parental involvement (Booth & Crouter, 1998; Sandler et al., 1994). Authoritarian parenting as opposed to authoritative parenting is also associated with a five-fold increase in child overweight (Agras et al., 2004). Poor family functioning also has been linked to child overweight and obesity (Rhee, 2008). However, Gibson and colleagues (2007) examined family conflict and found no effect. Parental neglect during childhood has been linked to obesity in adulthood as well (Lissau & Sorensen, 1994).

Mental and physical health problems. Psychosocial characteristics of caregivers associated with stress in children include poor mental (Gutman et al., 2005; Jones et al., 2003) and physical health (Korneluk & Lee, 1998) Few studies, however, have examined the relationship between the mental or physical health of the child's parents and childhood obesity. One study by Gibson and colleagues (2007) did not find a relationship between maternal depression, anxiety, or parenting stress on child obesity.

Housing issues. Housing stressors disproportionately affect low-income children (Graham-Bermann et al., 1996) and have been associated with lower levels of child well-being. For example, poor housing, neighborhood, and living conditions (e.g., noise, crowding) are associated with behavioral and emotional problems in children (Jaffee et al., 2005) and increased deposition of body fat (Evans, 2003). The built environment may influence children's obesity as well by causing stress and /or affecting activity levels. Housing stressors such as the inability to make mortgage payments, multi-family housing, and crowding are associated with lower mental well-being among adults (Edwards et al., 1982; Regoeczi, 2003; Taylor et al., 2007) and could represent major stressors to children and families.

Health care struggles. The lack of health insurance significantly compromises one's ability to access medical care (Ayanian et al., 2000; Institute of Medicine, 2002) and has been

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associated with increased prevalence of overweight in children and adolescents (Haas et al., 2003). However, little research has examined the direct link between access to health care and overweight and obesity in children. It has been found that being uninsured is associated with greater difficulty in accessing primary or routine clinical services (Almeida et al., 2001; McWilliams et al., 2003) and a higher probability of choosing to delay or go without needed medical care (Schoen & DesRoches, 2000; Strunk & Cunningham, 2002). In addition, these health care access challenges contribute to more frequent reports of poor health among the uninsured (Ayanian et al., 2000; Institute of Medicine, 2001; McWilliams et al., 2003; Ross & Mirowsky, 2000). Perhaps the stress in children and families from being unable to access medical care as needed for illnesses and injuries contributes to poor health, overweight and obesity among family members.

Financial difficulties. It is well-documented that children from low socio-economic status (SES) families exhibit higher levels of stress (Finkelstein et al., 2006). These stressors include high expense levels relative to income, limited assets, and an inability to pay bills or make needed purchases (e.g., Drentea & Lavrakas, 2000; Gutman et al., 2005; Haas et al., 2003; Lorenz et al., 1991; Parke et al., 2004; Wadsworth & Compas, 2002; Xiao et al., 2006). Experiencing these stressors, therefore, may raise children's risk of overweight and obesity (Garasky et al., 2007).

Cumulative stress. Beyond the impact of these stressors, families may experience "stress pile-up" as a result of dealing with multiple stressors at once (White & Klein, 2002) with effects on overweight being cumulative. For example, the number of risk factors was positively associated with internalizing problems in a sample of African American children from single mother households (Jones et al., 2002). Rural children who experience multiple housing and

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psychosocial stressors have greater psychological distress, lower perceptions of self-worth, and increased deposition of body fat (Evans, 2003). Thus, in addition to examining the independent effects of specific types of the aforementioned stressors, we also create a cumulative risk index which totals the number of stressors experienced in each of the five stressor categories.

In summary, children face numerous stressors that may be associated with the risk of being overweight. In this article, we investigate both the independent and cumulative associations of these stressors on a child's propensity to be at-risk for overweight or overweight. Previous studies have not systematically examined the potential relationships of these factors. The present analysis addresses this gap in knowledge.

Methods

Our interest is in the associations between family stressors and childhood overweight. We first consider categorical measures of overweight and estimate the following probit models:

$CWC_{ij} = 1$ if $CWC_{ij}* > 0$; $CWC_{ij} = 0$ otherwise

$$CWC_{ij}* = \alpha + \beta_{FDC}FDC_i + \beta_{MPHP}MPHP_i + \beta_{HI}HI_i + \beta_{HCS}HCS_i + \beta_{FD}FD_i + \lambda \mathbf{X}_i + \varepsilon_i \quad (1)$$

where i denotes a child; j denotes the child weight category (i.e., at-risk of overweight or overweight versus normal weight, and overweight versus not overweight); FDC is a family disruption and conflict stressor index; MPHP is an index of mental and physical health problems; HI is a housing issues stressor index; HCS is an index of health care struggles; FD is a financial difficulties stressor index; $\mathbf{X}$ is a vector of standard covariates and characteristics of the household and child; and ε is an error term. Estimations of (1) allow us to assess via β_{FDC}, β_{MPHP}, β_{HI}, β_{HCS}, and β_{FD} the independent relationships between these family-level stressors and child overweight.

We also estimate a model with a cumulative stressor (CS) index with the probit estimation as follows:

$$CWC_{ij} = 1 \text{ if } CWC_{ij}^* > 0; \ CWC_{ij} = 0 \text{ otherwise}$$

$$CWC_{ij}^* = \alpha + \beta_{CS}CS_i + \lambda\mathbf{X}_i + \varepsilon_i \tag{2}$$

Equations (1) and (2) impose a particular structure on the construction of childhood obesity. Namely, the child weight classifications entail defining a child's body size in a particular way with respect to weight, height, age and gender. In addition, the age- and sex-specific percentiles derived from the BMI measure rely on the BMIs established for other children with cutoffs based on particular cutpoints which constitute childhood weight status classifications (e.g., 85th and 95th percentiles).

While all of these model structure assumptions are acceptable, we also pursue an analytic approach whereby much less structure is imposed. A key advantage of using a less structured approach is that we avoid some problems inherent in using ratios (e.g., BMI, percentiles derived from BMIs) in analyses. (See Kronmal (1993) for a general treatment of problems using ratios and Bhargava and colleagues (forthcoming), Zakeri (2006), and Poehlman and Toth (1995) for problems with using ratios akin to BMI in analyses of obesity.) Our second approach is to estimate the following equation:

$$WT_i = \alpha + \beta'_{FDC}FDC_i + \beta'_{MPHP}MPHP_i + \beta'_{HI}HI_i + \beta'_{HCS}HCS_i + \beta'_{FD}FD_i +$$

$$\beta'_{HT}HT_i + \beta'_{AGE}AGE_i + \beta'_{GEN}GEN_i + \lambda\mathbf{X}_i + \varepsilon_i \tag{3}$$

where WT denotes a child's weight, HT denotes a child's height, AGE denotes a child's age, and GEN denotes the gender of a child.

Akin to equation (2), we also estimate an equation that includes a total stressor index:

$$WT_i = \alpha + \beta'_{CS}CS_i + \beta'_{HT}HT_i + \beta'_{AGE}AGE_i + \beta'_{GEN}GEN_i + \lambda\mathbf{X}_i + \varepsilon_i \tag{4}$$

Data

Our analyses are conducted with data from the Panel Study of Income Dynamics (PSID) and its Child Development Supplement (CDS). The PSID, begun in 1968, is a longitudinal study of a representative sample of individuals and the family units which reside in the United States. While emphasizing the dynamic aspects of economic and demographic behavior, the content of the PSID is broad and includes a range of measures relevant to this research. In 1997, a refresher sample of post-1968 immigrant families and their adult children was introduced to keep the study representative of the U.S. population. A major content expansion -- Child Development Supplement -- was introduced in 1997 as well. The CDS focuses on the human capital development of children age 0-12 in PSID families (PSID, 2005). A second round of the CDS (CDS-II) was conducted in 2002.

Information from interviews from the CDS-II constitutes the basis of the current analysis. We supplement the CDS-II data with contemporaneous data from the 2003 PSID interview wave. The CDS-II and 2003 PSID are well-suited for this analysis as both have a large sample of households and detailed information on child characteristics, family stressors and relevant covariates. These data sets have other strengths as well. In particular, children who participated in the CDS-II were measured for height and weight by trained personnel (e.g., nurses or field interviewers). The use of directly measured height and weight strengthens this study as other large, national studies (e.g., Youth Risk Behavior Survey) tend to rely on less reliable self-report or parental-report methods.

As seen in Table 1, the analytic sample consists of 2,260 children and adolescents ages 5 through 19 years (average 12 years) interviewed for the CDS-II who are not classified as underweight (i.e., BMI <5th percentile of age- and sex-specific values as described below) and

have complete information for the regression analyses. About two-thirds (63%, n=1,419) of the analytic sample is classified as normal weight, 16 percent (n=356) are at-risk of overweight and 21 percent (n=485) are overweight. They weigh on average 112 pounds and are 59 inches. The sample is evenly split between males and females.

[Table 1 about here]

Variables

Childhood weight status. The measures used to delineate childhood overweight begin with the calculation of a child's BMI (kg/m^2) from their height and weight. The BMI for each child is then mapped into a percentile using the Centers for Disease Control and Prevention (CDC) growth charts for the United States (Ogden et al., 2002). Under this measure, a child is classified using age- and sex-specific percentiles as follows: Normal weight, BMI $\geq 5^{th}$ percentile and $< 85^{th}$ percentile; at-risk of overweight, BMI $\geq 85^{th}$ percentile and $< 95^{th}$ percentile; and overweight, BMI $\geq 95^{th}$ percentile. Underweight children (BMI $< 5^{th}$ percentile) (n=76) are not included in this study since underweight children should not be included in the referent group (e.g., normal weight) and we are not interested in examining the association between underweight and stressors given the focus of this article.

Family-level stressors. We examine five categories of stressors. These are family disruption and conflict, mental and physical health problems, housing issues, health care struggles, and financial difficulties. Each element in each index is operationalized as a dichotomous variable and each category is combined into a cumulative index (see below).

Family disruption and conflict was measured via three variables. First, aggravation in parenting was assessed through a scale comprised of seven questions related to parenting stress. Respondents were read seven statements about raising children and asked to indicate on a scale

from 1 to 5 the number that best described how true each statement was ranging from 1 (not at all true) to 5 (completely true). The statements were: (1) There are some things that (child) does that really bother me a lot. (2) I find myself giving up more of my life to meet (child)'s needs than I ever expected. (3) I often feel angry with (child). (4) Being a parent is harder than I thought it would be. (5) I feel trapped by my responsibilities as a parent. (6) I find that taking care of my child(ren) is much more work than pleasure. (7) I often feel tired, worn out, or exhausted from raising a family. The scale value was the mean score of the seven items. If the respondent's aggravation in parenting scale value was above the 75th percentile for the study sample, we considered this to be an indicator of stress. Second, respondents were asked if the alcohol consumption of anyone in the household negatively affected their child(ren). A 'yes' response was considered an indicator of stress. Third, if the primary caregiver of the child was not married or cohabiting, we considered this to be an indicator of stress.

Mental and physical health problems were measured via five variables. Respondents were asked if a household member's mental disability affected their child(ren). Similarly, they were asked if a household member's physical disability affected their child(ren). For each question, a 'yes' response was considered an indicator of stress. The third measure related to psychological distress. The K-6 Non-Specific Psychological Distress Scale (Kessler et al., 2003) was administered to respondents. The K-6 was designed to discriminate cases of serious mental illness in a general population survey (Mainieri, 2006). It included six items that queried primary caregivers about how they felt during the prior four weeks. Specifically, they were asked if they felt (1) so sad that nothing could cheer them up; (2) nervous; (3) restless or fidgety; (4) hopeless; (5) everything was an effort; and (6) worthless. Likert-type responses were recoded such that 'all of the time' = 4; 'most of the time' =3; 'some of the time' =2; 'a little of the time' =1; and 'none

of the time' = 0. A score of 13 or higher indicated a potential for nonspecific distress (Mainieri, 2006). As such, we defined a score of 13 or higher as an indicator of stress. Fourth, the Pearlin Self-Efficacy Scale was administered to assess the extent to which people see themselves as having control over aspects of their lives (Mainieri, 2006). Four items were answered on a 4-point response scale ('strongly agree', 'agree', 'disagree', and 'strongly disagree'). Specifically, respondents were asked about their level of agreement with the following statements: (1) There is really no way I can solve some of the problems I have. (2) Sometimes I feel that I'm being pushed around in life. (3) I have little control over the things that happen to me. (4) I often feel helpless in dealing with the problems of life. Item responses were reverse coded for these analyses so that higher scores reflected lower self-efficacy. Utilizing the same cut-off point from the aggravation in parenting scale above, if the respondent's reverse coded scale value was above the 75th percentile for the study sample, we considered this to be an indicator of stress. Fifth, the Rosenberg Self-Esteem Scale was administered to assess the degree of approval or disapproval toward oneself (Mainieri, 2006). Primary caregivers reported on a series of 10 items using a response scale of 1 to 4. For this study, responses were coded such that a higher score designated lower self-esteem. The ten items related to (1) feeling like a failure; (2) having good qualities; (3) having a positive attitude; (4) feeling useless at times; (5) thinking I'm no good; (6) feeling like a person of worth; (7) being satisfied with self; (8) having not much to be proud of; (9) wanting more respect; and (10) doing things well. Once again, if the respondent's scale value was above the 75th percentile for the study sample, we considered this to be an indicator of stress.

   Housing difficulties were measured via four variables. To identify housing problems in the last 12 months, CDS-II participants were asked three questions about housing experiences. (1) Did they move to cheaper living quarters? (2) Did they move in with other people? (3) Did

they send one or more of the children to live with someone else? A 'yes' response to any item was considered an indicator of stress. The last housing-related measure regarded mortgage and rent expenditures. Respondents were queried about monthly first mortgage, second mortgage and rent payments. An indicator of housing stress was calculated by summing these payments and multiplying by 12 to arrive at an annual housing expenditure. The annual housing expenditure was divided by annual family income to determine the share of annual income spent on housing. If the share of income spent on housing was greater than 30 percent, an amount commonly considered to represent a household that is housing cost burdened (HUD, 2007), we considered this to be an indicator of stress.

 Health care struggles were measured via two variables. The first measure related to health insurance coverage. Respondents were asked "In 2001 or 2002, was anyone in the family covered by health insurance or some other kind of health care plan?" Respondents who answered that no one in their family was covered by health insurance over the two-year period were considered to be experiencing this aspect of stress. Regarding health care expenditures, respondents were asked a series of questions about health care expenditures. Specifically, they were queried about how much their family spent in the last 12 months on the focal child for dental care and on medical insurance. They also were asked how much they spent in 2001 and 2002 on nursing home and hospital bills combined, and how much they paid out-of-pocket for doctor, outpatient surgery and dental bills combined. We divided these amounts by two to arrive at average annual expenditures. Our indicator of stress was calculated by dividing the sum of these annual expenditure amounts by the annual income of the family to determine the share of annual income spent on health care. If the share of income spent on health care was greater than 7.5 percent, an amount that must be exceeded before medical and dental expenditures can be

deducted by someone itemizing deductions for federal income taxes (IRS, 2006), we considered this to be an indicator of stress.

Financial difficulties were measured via ten questions. CDS-II respondents were asked a series of questions regarding possible financial problems experienced in the past 12 months. Responses to ten of these questions comprised our indicators of stress. Specifically, respondents were asked if they had experienced any of the following in the last 12 months happened as a result of economic problems: (1) sold possessions or cashed in life insurance; (2) postponed major purchases; (3) postponed medical care; (4) borrowed money from friends or relatives; (5) filed for or taken bankruptcy; (6) fallen behind in paying bills; (7) had a creditor call or visit to demand payment; (8) had wages attached or garnished by a creditor; (9) had a lien filed against property because of nonpayment of a bill; and (10) had home, car or other property repossessed. For each question, a 'yes' response was considered an indicator of stress.

Cumulative stress indices. We created indices for each stressor category by summing the dichotomous response values for each variable in a given category. Specifically, the family disruption and conflict index was the sum of responses to the three items in this category, the mental and physical health problems index was the sum of five stress measures, the housing issues index was the sum of responses to the four items in this category, the health care struggles index was the sum of the two health care measures, and the financial difficulties index was based on the ten financial variables. The cumulative stressor index was then the sum of these five indices and ranged from zero to 24.

Other covariates. Several other covariates included in these analyses are reported in Table 1. These were as follows: the age of the child (mean=12.13 years); the gender of child with 'female' equaling 1 (mean=0.50); age of the primary caregiver (mean=39.93 years); whether the

primary caregiver was the child's mother (mean=0.90); whether religion was very important to the primary caregiver (mean=0.76); whether spirituality/faith was very important to the primary caregiver (mean=0.82); the number of persons in the family unit (mean=4.15); and total family income (mean=62.05, measured in $1000).

Results

We begin with a discussion of differences in stressor indices by child weight categories. In Table 2, results are displayed for the full sample (column (1)) and by child weight status categories - normal weight (column (2)), at-risk of overweight or overweight (column (3)), at-risk of overweight (column (4)), and overweight (column (5)). We concentrate on the differences between columns (2) and (3). Mean values for two of the stressor indices, mental and physical health problems and financial distress, were about 20 percent higher among children at-risk of overweight or overweight compared to normal weight children with the differences being statistically significant. Indeed, these comparative differences held when assessing the cumulative stressor index, which is 15 percent higher in at-risk of overweight or overweight children compared to normal weight children. Similar results are found when comparing at-risk of overweight children (column (4)) to normal weight children and when comparing overweight children (column (5)) to normal weight children.

[Table 2 about here]

The results of estimating equations (1) and (2) are found in Table 3. Specifically, columns (1) and (2) are regression results for models that include the five separate stressor indices. Columns (3) and (4) report results for the models with the cumulative stressor index. In the odd columns, the comparisons are between children who at-risk of overweight or overweight with children who are normal weight. In the even columns, the comparisons are between children

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who are overweight with children who are at-risk of overweight or normal weight. Consistent with the results from the bivariate analysis presented in Table 2, when we examine the results in column (1), children in households experiencing higher mental and physical health problems and higher financial difficulties were more likely to be at-risk of overweight or overweight in comparison to their normal weight peers. When we examine the results for overweight (column (2)), the association with financial difficulties is still statistically significant, but the association with mental and physical health problems is not. To assess the magnitudes of these relationships, we estimate marginal effects (the increased likelihood of being at-risk of overweight or overweight resulting from a one unit increase in an index value when the values of all indices and covariates are set at the sample mean) (Baum, 2006). From column (1), the marginal effect of the mental and physical health problems index is a 2.4 percentage point increase in the likelihood of the child being at-risk of overweight or overweight. The marginal effect is similar for the financial difficulties index, a 2.0 percentage point increase. The marginal effect for the financial difficulties index is about half as large (1.3 percentage points) when we focus on only the increased likelihood of being overweight (column (2)).

[Table 3 about here]

In the models with the cumulative stressor index, the association is statistically significant in the case of comparisons between overweight or at-risk of overweight versus normal weight (column (3)). Assessing the marginal effect of this relationship, we find that one unit increase in this index is associated with a 1.2 percentage point increase in the likelihood of the child being at-risk of overweight or overweight. In other words, experiencing any additional stressor is associated with an increased likelihood of a child being at-risk of overweight or

overweight, even those stressors for which the relationship between the specific stressor index and child weight was statistically insignificant.

Regarding the covariates, only in the models that compared normal weight and at-risk of overweight to overweight (columns (2) and (4)) were any of the covariates statistically significant. A positive association was found between residing with a primary caregiver who indicated that religion was very important having a greater likelihood of being overweight. A child was less likely to be overweight if she or he resided with more household members or if their household had more income.

We conclude in Table 4 with our estimations of equations (3) and (4). In column (1) we include each of the stressor indices and in column (2) the cumulative stressor index. The financial difficulties index is statistically significant and positively associated with higher child weight, independent of the child's age, sex, and height. Unlike in Table 3, when we employ standard CDC weight classifications, the association of the family disruption and conflict index with child weight is negative and statistically significant. (In contrast, this variable was negative, but insignificant in Table 3.) In addition, the mental and physical problems index is not significantly related to child weight whereas it was positively related to being at-risk of overweight or overweight in Table 3. Turning to the cumulative stressor index, the association with child weight is positive and significant. Child height and age are positively related to child weight with the relationships being statistically significant. The relationship with child gender is insignificant. Of the other covariates, residing with a primary caregiver for whom religion is very important continues to be associated with higher child weight. Household size and income are negatively related to child weight, but the relationship is weak, at the $p < 0.10$ level in only one model specification.

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Conclusions

This study extends our knowledge of the association between adverse childhood

experiences (e.g., stressors) and overweight in a large representative sample of 5-19 year old

children and adolescents. Most of the literature examining relationships between the child's

shared environment and weight status has addressed eating and physical activity behaviors (e.g.,

Jenkins et al., 2005; Ness et al., 2007; Roemmich et al., 2003). Our analysis adds to this body of

work by examining associations between family stress and childhood obesity. A major strength

of this investigation was the thorough examination of several aspects of family stress. We

examined five specific domains of stressors in the family and their association with child

overweight. These domains were family disruption and conflict, mental and physical health

problems, housing issues, health care struggles, and financial difficulties. In addition, we

investigated associations between family stressors and child overweight from a cumulative stress

perspective.

A second highlight of this research is the two empirical models that were estimated. First,

models were estimated to identify associations between family stressors and a child's weight

classification. A child was classified into three weight categories using their BMI which was

mapped into a percentile using the CDC growth charts for the United States (Ogden et al., 2002).

A child was classified as either normal weight (BMI $\geq$ 5th percentile and < 85th percentile), at-

risk of overweight (BMI $\geq$ 85th percentile and < 95th percentile), or overweight (BMI $\geq$ 95th

percentile). Underweight children (BMI < 5th percentile) (n=76) were not included in this study.

Second, models were estimated to identify associations between family stressors and the child's

weight, after controlling for the child's height, age and gender. This approach imposes much less

structure such that it avoids problems inherent in using ratios or classifications including lost variance across the dependent variable (e.g., children with a wide range of BMIs will all receive the same weight classification) and 'cliff effects' related to a small change in an underlying variable generating a reclassification (e.g., a one pound difference between two children of the same height, age and gender may result in them being classified differently) (Kronmal, 1993; Poehlman & Toth, 1995; Zakeri, 2006).

In general, the results indicate positive associations between child overweight and two domains of family stressors: mental and physical health problems, and financial difficulties. These findings are consistent with others (e.g., Garasky et al., 2007), but in opposition to those who did not find significant associations (e.g., Gibson et al, 2007). The marginal effects of these stressors are between 1.3 to 2.4 percentage point increases in the likelihood of the child being at-risk of overweight or overweight. The relationships between the other three stressor indices – family disruption and conflict, housing issues, and health care struggles – are child overweight were statistically insignificant. As such, this research does not support studies that have identified relationships between these stressors and child overweight including Gibson and colleagues (2007) and Strauss and Knight (1999) who found that residing in a single parent family is positively associated with a greater risk of obesity. However, this research is consistent with Gibson and colleagues (2007) who examined family conflict and found no effect. Wolfe and colleagues (1994) also did not find a relationship between residing in a single parent family and obesity. Similarly, by not finding an association between housing issues and child overweight, this research does not support studies that have linked the family's built environment and adult well-being (e.g., Edwards et al., 1982; Regoeczi, 2003; Taylor et al., 2007). Likewise,

this research is in contract to studies that have linked health care struggles and child obesity (e.g., Haas et al., 2003).

We also found that the cumulative stressor index is positively related to a child being at-risk of overweight or overweight, which is consistent with a cumulative stress perspective (White & Klein, 2002). Children's well-being, in this case child weight status, is related to not only different *types* of family-level stressors, but also an accumulation of stressors. The marginal effect is a 1.2 percentage point increase in the likelihood of the child being at-risk of overweight or overweight. The magnitude of this effect is about half that of experiencing a specific mental and physical health problems stressor.

There are several potential mechanisms for the relationship between family stressors and childhood obesity. From a biological perspective, increased levels of cortisol and the chronic hypersecretion of cortisol lead to metabolic abnormalities and overweight (Bjorntorp, 2001). Among children, some evidence suggests that higher levels of cortisol are associated with higher measures of body fat (Dimitriou et al., 2003). For a behavioral perspective, stress may contribute to poor eating habits (Jenkins et al., 2005) and lower physical activity levels in children (Roemmich et al., 2003), which are both associated with overweight (Ness et al., 2007).

Two unexpected results warrant mentioning. While the second empirical approach that introduced less structure to the conceptualization of child weight status generally yielded similar results to that of the first approach, the family disruption and conflict index was found to be negatively associated with child weight in the second model. This association was statistically insignificant in the first model. Second, in both empirical models, a child having a primary caregiver who perceives religion to be very important is associated with the child having a higher

likelihood of being overweight and with the child weighing more. Additional research is needed to understand both of these findings.

In summary, a clear public health implication from this research is that assisting families by reducing family-level stressors may have the further benefit of reducing childhood overweight. One in every six children in the United States is obese, making it one of the most prevalent medical problems among youth today. It is imperative that policy makers attend to this issue. We discuss two examples of how public policies and programs can reduce family-level stressors. First, programs such as the Temporary Assistance for Needy Families (TANF) program and the Earned Income Tax Credit (EITC) that help families establish economic security through finding well-paying jobs, supplementing earnings, providing in-kind supports and/or helping families in other ways meet their financial obligations may reduce family stress and contribute to the enhancement of the health of the children in these households by reducing their likelihood of being overweight. Also, reductions in childhood obesity may occur as programs work to reduce family disruption, family conflict and mental and physical problems in the household. By providing families with comprehensive counseling and medical care, these stressors may be alleviated with the further indirect benefit of reducing childhood overweight.

Based on the results of this study and the paucity of studies examining the relationship between stressors and childhood obesity, we conclude with four suggestions for future research. First, future studies should include a wide set of other indicators of stress. We included five indices of family-level stressors. However, other stressors including child-level (e.g., mental health problems, delinquency) or community-level stressors (e.g., neighborhood problems, low collective efficacy) may yield different results. Indeed, prior work has related these constructs to children's health and well-being (e.g., Cleveland, 2003; Farrell, et al., 2005; Fauth et al., 2007).

This approach would allow for a multi-systematic examination of the relationships between stressors and overweight/obesity. Second, we were unable to examine the biological pathways for how these family-level stressors are influencing childhood weight status. Future work that includes biomarker data (e.g., stress hormones, heart rate responses, etc.) in children would help identify the biological mechanisms involved when children face family stressors such as those examined here. In addition, future work should also address the longitudinal nature of these relationships. For example, we do not know the exact frequency and/or duration of these stressors which may contribute to the allostatic load. Chronic stress has been shown to have long-term health implications for individuals (Compas, 2004; Evans & Pilyoung, 2007). Similarly, future research may wish to understand how shifts, changes, or stability in stressors over time may influence childhood weight status.

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Table 1. Summary Statistics.

Variable	Mean	Standard Deviation	Minimum	Maximum
Child characteristics				
Weight status: Normal	0.63		0	1
Weight status: At-risk of overweight	0.16		0	1
Weight status: Overweight	0.21		0	1
Weight (pounds)	112.31	50.03	37	328
Height (inches)	59.07	7.83	27	77
Age	12.13	3.72	5.52	19.25
Gender (female=1)	0.50		0	1
Family-level stressors				
Family disruption & conflict index	0.69	0.74	0	3
Mental & physical health problems index	0.74	0.94	0	5
Housing issues index	0.23	0.51	0	3
Health care struggles index	0.23	0.44	0	2
Financial distress index	1.25	1.52	0	8
Cumulative stress index	3.15	2.47	0	16
Covariates				
Age of primary caregiver	39.93	7.75	21	77
Primary caregiver is child's mother	0.90		0	1
Primary caregiver: religion is very important	0.76		0	1
Primary caregiver: spirituality/faith is very important	0.82		0	1
Number in household	4.15	1.25	1	11
Income (1000$)	62.05	85.73	-99.27	2068.70

Notes: Results are unweighted. Number of observations is 2,260.

Table 2. Mean (standard error) stressor indices for the total sample and by Child weight classifications.

Variable	All	Normal weight	At-risk of overweight or overweight	At-risk of overweight	Overweight
	(1)	(2)	(3)	(4)	(5)
Family disruption and conflict index (0-3)[a]					
	0.556	0.543	0.591	0.599	0.585
	(0.019)	(0.022)	(0.033)	(0.052)	(0.042)
Mental and physical health problems index (0-5)[a]					
	0.783	0.731	0.877***	0.870*	0.882**
	(0.026)	(0.031)	(0.046)	(0.072)	(0.058)
Housing issues index (0-3)[a]					
	0.205	0.200	0.214	0.240	0.192
	(0.013)	(0.015)	(0.024)	(0.036)	(0.031)
Health care struggles index (0-2)[a]					
	0.245	0.239	0.257	0.281	0.237
	(0.012)	(0.015)	(0.021)	(0.033)	(0.027)
Financial distress index (0-8)[a]					
	1.127	1.041	1.284***	1.214	1.341***
	(0.040)	(0.047)	(0.075)	(0.111)	(0.101)
Cumulative stressor index (0-16)[a]					
	2.919	2.753	3.222***	3.204**	3.237***
	(0.067)	(0.079)	(0.118)	(0.190)	(0.148)
Unweighted sample (N)	2260	1419	841	356	485

Notes: Normal weight (BMI $\geq 5^{th}$ and $< 85^{th}$ percentiles); at risk of overweight (BMI $\geq 85^{th}$ and $<95^{th}$ percentiles); overweight (BMI $\geq 95^{th}$ percentile). Results are weighted using child-level weights. Superscripts of *, **, and *** are used if the p-value of the adjusted Wald test (Baum, 2006) of the difference in means when compared to normal weight children (column 2) is less than .10, .05, or .01 respectively.

[a] Minimum and maximum values.

Table 3. The Effect of Various Factors on the Probability of At-Risk of Overweight (ARO) or Overweight (OW) and Overweight, Including Indices of Stressors

Variable	ARO or OW	OW	ARO or OW	OW
	(1)	(2)	(3)	(4)
Family-Level Stressors				
Family disruption & conflict index	-0.031	-0.045	-	-
	(0.041)	(0.046)		
Mental & physical health problems index	0.063**	0.053	-	-
	(0.030)	(0.033)		
Housing issues index	-0.060	-0.096	-	-
	(0.055)	(0.061)		
Health care struggles index	0.011	-0.045	-	-
	(0.062)	(0.069)		
Financial difficulties index	0.053***	0.044**	-	-
	(0.019)	(0.020)		
Cumulative stressor index	-	-	0.031***	0.019
			(0.011)	(0.013)
Covariates				
Age of primary caregiver	-0.004	0.002	-0.003	0.002
	(0.004)	(0.004)	(0.004)	(0.004)
Primary caregiver is child's mother	-0.050	0.020	-0.048	0.019
	(0.093)	(0.103)	(0.093)	(0.103)
Primary caregiver: religion is very important	0.096	0.226**	0.097	0.228**
	(0.079)	(0.091)	(0.079)	(0.090)
Primary caregiver: spirituality/faith is very important	-0.032	-0.034	-0.035	-0.040
	(0.087)	(0.099)	(0.087)	(0.098)
Number in household	-0.017	-0.052**	-0.008	-0.043*
	(0.022)	(0.025)	(0.022)	(0.104)
Income	-0.0002	-0.002**	-0.00007	-0.0013**
	(0.0003)	(0.001)	(0.0003)	(0.0006)
Constant	-0.176	-0.759***	-0.270	-0.853***
	(0.230)	(0.256)	(0.225)	(0.250)

Notes: Standard errors in parentheses. * significant at 10% level; ** significant at 5% level; *** significant at 1% level. Number of observations is 2,260.

Table 4. The Effect of Various Factors on the Child's Weight (WT), Including Indices of Stressors

Variable	WT (1)	WT (2)
Family-Level Stressors		
Family disruption & conflict index	-1.896**	-
	(0.935)	
Mental & physical health problems index	1.069	-
	(0.685)	
Housing issues index	-0.955	-
	(1.256)	
Health care struggles index	-0.042	-
	(1.416)	
Financial difficulties index	1.777***	-
	(0.429)	
Cumulative stressor index	-	0.734***
		(0.258)
Covariates		
Child's height	3.700***	3.696***
	(0.163)	(0.164)
Age of child	3.459***	3.443***
	(0.356)	(0.356)
Child is female	-1.099	-1.215
	(1.265)	(1.265)
Age of primary caregiver	-0.036	-0.022
	(0.098)	(0.097)
Primary caregiver is child's mother	0.777	1.142
	(2.157)	(2.154)
Primary caregiver: religion is very important	4.968***	4.953***
	(1.785)	(1.789)
Primary caregiver: spirituality/faith is very important	-2.162	-2.128
	(1.979)	(1.978)
Number in household	-0.976*	-0.619
	(0.511)	(0.499)
Income	-0.014*	-0.010
	(0.008)	(0.007)
Constant	-145.501***	-148.463***
	(8.147)	(8.100)

Notes: Standard errors in parentheses. * significant at 10% level; ** significant at 5% level; *** significant at 1% level. Number of observations is 2,260.