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Overweight and obesity among maltreated young adolescents

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Abstract

Purpose—(1) To identify and compare rates of body mass index (BMI) 85% (overweight/obesity) and BMI 95% (obesity) in maltreated versus comparison young adolescents; (2) To determine whether demographic/psychological characteristics are related to high BMI; (3) To determine whether type of maltreatment is related to high BMI in maltreated young adolescents.

Methods—We compared a sample of maltreated young adolescents to a comparison sample of adolescents from the same neighborhood. The maltreated sample (N=303) of young adolescents (ages 9-12) came from referrals from the county child welfare department in Los Angeles, CA from new cases of maltreatment opened in specified zip codes. A comparison sample (N=151) was recruited from the same zip codes. The total sample (both maltreated and comparison) was 77% Black or Hispanic and 23% White or biracial with 53% males and 47% females. A stepwise logistic regression was used to examine predictors of high BMI with demographic/psychological covariates and maltreatment group. The maltreated young adolescents were selected and the logistic model included all covariates as well as an interaction between gender and each maltreatment type (neglect, sexual, and physical abuse).

Results—Maltreated young adolescents were similar to comparison adolescents in obesity prevalence (27.1% and 34.4%, respectively), although comparison young adolescents were 1.7 times more likely to have overweight/obesity than the maltreated young adolescents (95% CI = 1.13-2.76). No demographic variables predicted high BMI. For the comparison young adolescents, depression slightly increased the odds of overweight/obesity (OR = 1.08, 95% CI = 1.01-1.15). Being neglected reduced the odds of being in the overweight/obesity and obesity group when combining genders. For females, but not males, sexual and physical abuse slightly reduced the odds of obesity.

Conclusions—Both the maltreated and comparison young adolescents had a high prevalence of overweight and obesity, which puts them at risk for health problems. Maltreatment reduced the odds of having a high BMI for adolescents in this study, which is opposite to research in adults. Further exploration of the mechanism of how maltreatment is related to weight as adolescents age, with specific emphasis on differences between genders, is needed.

Introduction

Child maltreatment is a known risk factor for many negative outcomes including physical health problems, mental health problems, and educational difficulties (Chapman, Dube, &

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Anda, 2007; Hussey, Chang, & Kotch, 2006; Ringeisen, Casanueva, Urato, & Cross, 2008; Trickett & McBride Chan, 1995; Trickett, Negri, Ji, & Peckins, 2011; Trickett, Noll, & Putnam, 2011; Veltman & Brown, 2001; Watts-English, Fortson, Gibler, Hooper, & DeBellis, 2006). Although studies have linked a self-reported history of child maltreatment to weight problems in adults (Felitti et al., 1998), little is known about how child maltreatment relates to weight problems in young adolescents with maltreatment reported to child welfare. The purpose of this study was to investigate the problems of overweight and obesity in a sample of primarily urban minority youth identified as maltreated, and to compare the maltreated sample to nonmaltreated youth from the same neighborhoods.

The prevalence of obesity for US children and adolescents has increased threefold since the 1980s (Ogden et al., 2006). Unlike adults, where obesity is determined by an individual's body mass index (BMI) number, obesity in children is defined by BMI percentile. Obesity in children is defined as BMI for age/gender of $\geq 95^{\text{th}}$ percentile and overweight is defined as BMI for age/gender of $\geq 85^{\text{th}}$ percentile to $< 95^{\text{th}}$ percentile (Centers for Disease Control and Prevention, 2009). The term high BMI includes BMIs at both $\geq 85\%$ and $\geq 95\%$ levels (Ogden et al., 2006). Between 1999 and 2004, the percentage of children (ages 2-19) with BMI $\geq 85\%$ in the United States increased from 28.2% to 33.6%, whereas the percentage of adolescents (ages 12-19) with BMI $\geq 85\%$ increased from 30.0% to 34.3% (Ogden et al., 2006). Factors that are known to predict BMI in adolescents include demographics (age, ethnicity, and gender), development (puberty), and psychological functioning (anxiety and depression) (Storey, Forshee, Weaver, & Sansalone, 2003; Kaplowitz, 2008; Hillman, Dorn, & Huang, 2010; Dockray, Susman, & Dorn, 2009). An analysis examining studies of obesity in children found that gender differences are especially common in young adolescents, both before and during puberty, as males and females differ in patterns of weight gain, body composition, and the susceptibility to social and environmental factors (Wisniewski & Chernausk, 2009). High BMIs in youth is a serious concern, as adolescents who are overweight or obese are much more likely to become overweight adults and develop adult obesity-related morbidities (American Academy of Child & Adolescent Psychiatry, 2008).

Maltreated children have chronic, serious physical and mental health problems including attention-deficit hyperactivity disorder, irritable bowel syndrome, and depression, and these health problems are similar whether a maltreated child remains at home or enters foster care. (Schneiderman, Leslie, Arnold-Clark, McDaniel, & Xie, 2011; Palaszynski & Nemeroff, 2009; Ringeisen et al., 2008; Leslie et al., 2005). One of the primary medical problems identified in the past has been underweight (Halfon, Mendonca, & Berkowitz, 1995; Silver et al., 1999), although there is some recent evidence of overweight and obesity in children in child welfare. In Utah, overweight and obesity was the most frequent medical problem for children (ages 3-18) who entered foster care; 35% of the children had BMI $\geq 85\%$ and 18% had BMI $\geq 95\%$ (Steele & Buchi, 2008). Of children (from birth to 6 years old) in child welfare in Los Angeles (L.A.), 13% had BMI $\geq 95\%$, and the percentage of obese children between 2 and 5 years old was higher than National Health and Nutrition Examination Survey (NHANES) prevalence, although similar to NHANES prevalence in low-income children ages 2-5 (Schneiderman et al., 2011). There were no differences in high BMI prevalence for children in foster care compared to those who remained at home. Although overweight and obesity is increasingly prevalent in maltreated children, it is not known whether the prevalence is similar to comparable non-maltreated children in the same community.

A history of child maltreatment has been linked to obesity in adolescents (Task Force on Health Care for Children in Foster Care, 2005). Many retrospective studies have also found that adult obesity is linked to self-reported childhood maltreatment (Aaron & Hughes, 2007; Chartier, Walker, & Naimark, 2009; Dube, Cook, & Edwards, 2002; Midei, Matthews, &

Bromberger, 2010; Shaffer, Huston, & Egeland, 2008; Williamson, Thompson, Anda, Dietz, & Felitti, 2002). Yet, in the first prospective study using child welfare records of maltreatment, Bentley and Widom (2009) found that physical abuse was associated with high BMI in adulthood, while childhood sexual abuse and neglect were not significant predictors of adult BMI score. However, in another prospective longitudinal study using child welfare maltreatment records, sexually abused females had a steeper rate of BMI growth than a comparable group of nonabused females, although obesity rates between groups were not different until adulthood (Noll, Zeller, Trickett, & Putnam, 2007). Findings have also been inconsistent in terms of the relationship between childhood maltreatment and adolescent and early adult obesity. In Wave III of the National Longitudinal Study of Adolescent Health, which used self-reported history of maltreatment, adolescents with physical abuse had a greater tendency to be overweight in late adolescence or young adulthood than adolescents with sexual abuse and/or neglect (Hussey, Chang, & Kotch, 2006). In another study using self-reported histories of maltreatment, there was no association between BMI in early adulthood and a childhood history of sexual abuse or physical abuse (Clark, Thatcher, & Martin, 2010). Thus, there is some indication that specific types of maltreatment are associated with obesity, but more research is needed to determine which types of maltreatment are related to high BMI. Also, most previous research used retrospective reports of past abuse.

Due to the gaps in the extant research regarding the associations between maltreatment and high BMI in adolescence, the purpose of this study was to understand more about the weight problems of a sample of mainly minority urban youth identified by child welfare as maltreated. This study is unique because it uses child welfare records to identify maltreatment types, examines how demographics, psychological variables, and pubertal stage relate to overweight and obesity, and compares high BMI in maltreated young adolescents to young adolescents in the same community. The specific aims were:

1. To examine the prevalence of high BMI in both maltreated and comparison youth and to determine whether maltreated youth are more or less likely to have high BMIs than a sample of comparison youth from the same community.
2. To examine whether known correlates of overweight/obesity (depressive symptoms, anxiety, age, ethnicity, and pubertal stage) are similarly related to having high BMI for maltreated versus comparison youth.
3. To examine whether specific types of maltreatment are related to having high BMIs.

Methods

Setting and selection of participants

The data for our study are from Time 1 of a longitudinal study on the effects of child maltreatment on adolescent development. The maltreated sample ($n = 303$) was referred from the LA County Department of Children and Family Services (DCFS). Inclusion criteria were (1) a new case of maltreatment opened by DCFS within 60 days of referral; (2) the child was 9-12 years old; (3) the child was Latino, African American, or White; and (4) the child lived within specified zip codes in urban Los Angeles, California. We limited the ethnicities to Latino, African American, or White because those groups represent over 95% of children in DCFS. The maltreated sample included 152 males and 151 females; 77 % of the sample experienced neglect, 51% experienced emotional abuse, 51% experienced physical abuse, and 21% experienced sexual abuse (Table 1). The total percentages in Table 1 add up to more than 100% due to the fact that 76% of adolescents experienced more than 1 type of maltreatment. Adolescents in the maltreatment group had an average of 3.7

investigations for maltreatment by DCFS (Mennen, Kim, Sang, & Trickett, 2010; Trickett, Mennen, Kim, & Sang, 2009).

Comparison youth (n=151) from the same age group, race/ethnicity, and zip codes were recruited from lists generated by a direct marketing firm. Comparison families were asked about any previous experience with child welfare and none of the families identified any previous or ongoing involvement with child welfare. With the approval of DCFS, the juvenile court, and the institutional review board of the affiliated university, potential participants' caregivers were contacted via postcard followed by a phone call and asked to indicate their willingness to participate. Of the families referred by DCFS, 77% agreed to participate in the study, while 50% of the comparison families contacted agreed to participate.

Upon enrollment in the study, the maltreatment and comparison groups were compared on a number of demographic variables. The 2 groups were similar in age, ($M = 10.93$ years, $SD = 1.16$), gender (53% male), and neighborhood characteristics (based on census block information). Living arrangements between the 2 groups differed, as 93% of the comparison group and 52% of the maltreatment group lived with a biological parent. The remainder of the maltreatment group was living in foster care or kinship care. To check to see if the difference in living conditions portends important differences in homes and neighborhoods in which the adolescents reside, we compared the samples on variables in the year-2000 US Census (Trickett, Mennen, Negriff, & Horn, 2011). We used addresses of the homes in which the children were living (for the maltreated children, the address where they were living at the time of the referral to LACDCFS). Specifically, we compared these addresses in terms of the smallest geographic unit of the Census, namely, the Census Block Group. Comparisons were made on 9 census categories relevant to characterizing the social, educational, economic and demographic nature of neighborhoods and deemed important for child development (Duncan & Aber, 1997). Independent-samples t-tests were conducted for each category of each Census characteristic. For example, for the dimension, "Percent of People of Different Ages," 2-group t-tests were carried out for each of 10 age categories. For this set of comparisons, a statistically significant difference was found for 1 age category (percent 40- to 49-year-olds), where the average of 12% for the maltreated group differs statistically from the 13% for the comparison group. In 72 comparisons of this kind, 9 statistically significant differences were found. Like the difference reported above, none of these differences were at all large---not theoretically important and not likely to produce an effect through a relationship with other variables. The range of differences between the samples in percentages for the 72 comparisons of the 9 characteristics was from 1% to 4% (with a median of 2%). This indicates that, overall, for the dimensions examined, the neighborhoods of the maltreatment group and the comparison group are very similar.

Between 2002 and 2005, the children and their caretakers came to our office and completed an interview protocol that took approximately three to four hours. Caretakers gave consent and the youth gave assent to participate in the study. The measures used in the following analyses represent a subset of the questionnaires administered. There were both English and Spanish versions of the protocol, although all children preferred to be interviewed in English. Additional details of the procedure and sample are outlined elsewhere (Mennen & Trickett, 2007).

Measures

BMI—The youth were measured for weight and height in the second hour of the assessment. Trained graduate student assistants took weight measurements using a Healthometer scale and height measurements using a mounted stadiometer after asking the child to remove shoes and any large bulky outerwear. Weight was measured 3 times (to the nearest 0.5 lbs)

and height was measured twice (to the nearest 0.25 inch). Four weight groups were categorized by using the CDC gender-specific percentiles from the year 2000: (1) obese (> 95th); (2) overweight (> 85th to < 95th); (3) normal weight (> 5th to < 85th); and (4) underweight (< 5th) (CDC, 2009). We had very few subjects who were underweight, (five subjects, 2 in the maltreated groups and 3 in the comparison group) and therefore we focused on the primary weight problem in our sample, overweight and obesity. For the purpose of this study, three BMI level groups were used: normal, overweight/obesity (BMI > 85%), and obesity (Ogden et al., 2006).

Maltreatment classification—For the maltreatment classification, data were obtained from child welfare case records that described the children's maltreatment experiences. After permission was received from the juvenile court, these records were abstracted to classify the types of maltreatment the children experienced, as detailed in an earlier work (Mennen, Kim, Sang, & Trickett, 2010). Categories included physical abuse, sexual abuse, neglect, or emotional abuse (see Table 1). We excluded emotional abuse from our analysis as a reference variable because there was no research relating emotional abuse to adolescent obesity, emotional abuse is endemic to other types of maltreatment, and it is difficult to substantiate (Trickett et al., 2009). Subjects with emotional abuse were included when emotional abuse co-occurred with the reference maltreatment type (physical abuse, sexual abuse, and neglect). There were only 11 subjects with emotional abuse who did not have co-occurring physical abuse, sexual abuse, and/or neglect. Emotional abuse was also included as a covariate in the regression analysis. Four adolescents (1%) were retained in the maltreatment group but did not have a specific maltreatment type identified due to lack of evidence in the DCFS case record. We were unable to account for all types co-occurring maltreatment because of limitations of statistical power with the sample size. Therefore, we used the categorizations of sexual abuse, physical abuse, and neglect, with each indicating the presence or absence of that specific type of maltreatment. Since 76% of the maltreated subjects had more than 1 type of maltreatment, when a reference maltreatment type was chosen, subjects likely had other types of maltreatment as well as the reference type.

Covariates from the extant literature

Demographics—Child demographic characteristics included gender and race/ethnicity.

Pubertal stage—The adolescents self-reported on their stage of pubertal development using Tanner criteria (Marshall & Tanner, 1969; Marshall & Tanner 1970). Five stages of pubertal development are represented by sets of serial line drawings that depict the development of 2 different secondary sexual characteristics from prepubertal (stage = 1) to postpubertal (stage = 5) (Morris & Udry, 1980). Female drawings are of breast development and pubic hair growth; male drawings are of genital development and pubic hair growth. Scores on breast/genital development were used in analyses. Breast and genital development are indicators of activation of the gonadal axis, and are highly correlated to increased adiposity. Self-report on Tanner stages for boys and girls from age 9-15 is highly correlated with physician assessment and sufficient when approximate estimation of pubertal stage is adequate (Dorn, Susman, Nottelmann, Inoff-Germain, & Chrousos, 1990).

Psychological functioning—Depressive symptoms were measured using the 27-item Children's Depression Inventory (CDI) (Kovacs, 1992). This self-report measure contains 3 response options, such as "I am sad all the time" and "I feel like crying every day," indicating the highest level of depressive symptoms. The range of possible scores is 0 to 54. Test-retest for the CDI has been adequate in various samples, and the instrument has been shown to correlate strongly with other measures of childhood depressive symptoms (Kovacs, 1992). In the present sample, internal consistency was .86.

Anxiety was measured with the 39-item Multidimensional Anxiety Scale for Children (March, Parker, Sullivan, Stallings, & Connors, 1997). Each item contains 4 possible answers from 0 (never) to 3 (often true) on statements such as “I feel tense or uptight” or “I have trouble catching my breath.” Test-retest reliability ranged from .70-.93, and the measure has shown good discriminant validity (March et al., 1997). In the present sample, internal consistency was .91.

Data analysis

Descriptive statistics were examined for all variables. For continuous variables, the means, standard deviations, and ranges were computed, whereas for dichotomous variables, the frequencies were computed. Percentages of each weight category (normal, BMI $\leq 85\%$, and BMI $> 85\%$) were calculated for the maltreatment and comparison group. We identified 5 subjects (2 in maltreated group and 3 in comparison group) who were underweight. We included the underweight subjects in reporting the percentage of BMI $\leq 85\%$ and BMI $> 85\%$ in our sample, but did not include the underweight subjects in the regression analyses. Stepwise logistic regression was used to examine predictors of BMI $\leq 85\%$ and BMI $> 85\%$. A logistic regression was run with the covariates (age, gender [males were reference variable], ethnicity/race [African American was reference variable], pubertal stage, depressive symptoms, anxiety, emotional abuse, and maltreatment group [with the comparison group as the referent]). A gender-by-maltreatment-group interaction was included to determine if the effect of maltreatment status varied for males versus females. To determine if the covariates differed between the maltreatment and comparison groups, two-way interactions were tested for each covariate. Lastly, just the maltreated group was selected and the logistic model included all covariates as well as an interaction between gender and each maltreatment type (neglect, sexual, and physical abuse). For all analyses, the significance level was set at .05.

Results

Sample characteristics and percentage of sample with high BMI

There were no differences between the maltreated and comparison youth on age, gender, pubertal stage, or level of depressive symptoms (see Table 2). The comparison group had more Latinos. The maltreated group scored higher on anxiety than the comparison group.

A higher percentage of the comparison group than the maltreated group had BMI $\leq 85\%$ [60.9% vs. 46.2%, respectively; $\chi^2 = 9.33 (1), p < .01$]. The obesity percentages were similar for the maltreated and comparison group (27.1% and 34.4% respectively). Analyses first compared the normal weight group (BMI $< 85\%$) to the BMI $\leq 85\%$ group, then the normal weight/overweight group to the BMI $> 85\%$ group. To examine whether maltreatment predicted normal versus BMI $\leq 85\%$ group, a maltreatment-by-gender interaction was entered into the logistic regression model after the covariates. The results showed no maltreatment by gender interaction. However, without the interaction and including gender as a covariate, the main effect of maltreatment group was significant. Comparison adolescents were 1.7 times more likely to have BMI $\leq 85\%$ than the maltreated adolescents (95% CI = 1.13-2.76). For analyses examining the normal weight/overweight versus obese groups, there was no main effect of maltreatment status on BMI group, nor was there an interaction between maltreatment group and gender.

Predictors of BMI group

To examine whether the predictors of normal weight versus BMI $\leq 85\%$ groups differed for maltreated versus comparison adolescents, 2-way interactions with maltreatment and each covariate were entered into the logistic regression. However, none of interactions were

significant. Although the interaction between maltreatment group and depressive symptoms was not significant, depressive symptoms increased the odds of being overweight/obese in the comparison group (OR = 1.08; 95% CI = 1.01-1.15). For the analyses examining normal/overweight to obese BMI group, there were no significant interactions between maltreatment group and any of the covariates

Maltreatment type and BMI group

To examine whether the type of maltreatment (physical, sexual, neglect) predicted BMI group, only the maltreated group was selected and maltreatment type by gender interactions were included in the logistic regression model after the covariates. There was a significant interaction between physical abuse and gender ($p = .03$) when comparing normal-weight youth to the BMI 85% group (Table 3). This interaction effect indicated that, for females, being physically abused reduced the odds of having a BMI 85% (OR = .29; 95% CI = .10-.87) compared to maltreated adolescents without physical abuse. Although the interaction term was not significant, there was a main effect of neglect on BMI group when combining the genders ($p = .01$). This result showed that being neglected reduced the odds of being in the BMI 85% group (OR = .45; 95% CI = .25-.82) compared to maltreated adolescents without neglect.

For the analyses comparing normal/overweight to obese BMI groups, there was a physical-abuse-by-gender interaction effect ($p = .002$; Table 3). Similar to the analysis with normal weight versus BMI 85%, being physically abused reduced the odds among females of being in the obese group (OR = .14; 95% CI = .04-.49) compared to maltreated adolescents without physical abuse. In addition, there was a significant interaction between sexual abuse and gender ($p < .05$), indicating that being sexually abused reduced the odds among females of being obese (OR = .24; 95% CI = .06-.996) compared to maltreated adolescents without sexual abuse. There was also a main effect of neglect when combining genders ($p = .02$), indicating that being neglected reduced the odds of being obese (OR = .46; 95% CI = .25-.86) compared to maltreated adolescents without neglect.

Discussion

The primary aims of the paper were to identify and compare high BMI prevalence in the maltreated and comparison populations, identify whether any demographic/psychological variables predicted high BMI, and to examine whether specific types of maltreatment predicted high BMI. The maltreated young adolescents had similar rates of obesity to the comparison group, but they were actually less likely to have a BMI 85% than their nonmaltreated peers. Depressive symptoms slightly increased the odds of having a BMI 85% for the comparison group, but not the maltreated group. The analysis on the relationship of types of maltreatment to high BMI found that neglect reduced the odds of being obese compared to maltreated adolescents without neglect. Sexual abuse reduced the odds of being obese compared maltreated adolescents without sexual abuse for females and not for males. Similarly, physical abuse reduced the odds of being obese compared to maltreated adolescents without physical abuse for females and not for males. However, both the maltreated and comparison adolescents had a high prevalence of overweight and obesity, which put them at risk for poor health outcomes. The high BMIs in our study population are consistent with the weight trends in LA, California. In 2001, obesity prevalence in students in the fifth, seventh, and ninth grade in LA County was highest for children in the south-central region of the county, where the present study took place (Los Angeles County Department of Health Services, 2003). Also, a higher percentage of LA high school students were obese (14%) than US high school students (12%) in the 2009 national Youth Risk Behavior Survey (US Department of Health and Human Services, 2009a, 2009b). Thus, these findings reflect the severity of the obesity epidemic in LA, which is even greater than

other parts of the United States. Ethnic disparities in high BMI may have also played a part in the high BMI percentages seen in our sample. Black females and Hispanic males are more likely to be obese than their White counterparts (Lamb, Carroll, & Ogden, 2009), and African American, Hispanic, and Biracial adolescents made up 88% of the present study population.

None of the demographic variables were predictive of high BMIs, and only 1 psychological variable, depressive symptoms, was related to high BMIs. In the comparison group, a higher level of depressive symptoms slightly increased the risk of having a BMI $\geq 85\%$. Data for our study were collected when the subjects were in early adolescence and therefore less likely to have the increase in depression associated with midpuberty (Angold & Costello, 2006). Surprisingly, ethnicity/race did not predict high BMI in either the maltreatment or comparison group. Although minority status is related to obesity in adolescents, the influence of community poverty on adolescent obesity is stronger for Whites than minorities (Wickrama, Wickrama, & Bryant, 2006). The maltreated and comparison samples in this study lived in low-income census tracts; thus, poverty may have reduced the differential influence of ethnicity/race on obesity status. White adolescents in this study did not have lower obesity rates, which may have been due to the fact that they were living in similar low income neighborhoods as the Hispanic and African American adolescents. Low variance in Tanner stages may have contributed to the lack of a relationship between puberty and BMI.

When controlling for gender, neglected young adolescents in our study were less likely to have high BMIs than young adolescents with other types of maltreatment. Research on the relationship of neglect and BMI is inconsistent in children. Similar to our study, chronic neglect was related to lower BMIs in children 4 to 9 years old, beginning at age 8 (Bennett, Sullivan, Thompson, & Lewis, 2010). In a different study of children 3 to 9 years old, high BMI was related to care neglect in younger children but not older children, and supervisory neglect was related to high BMI in older but not younger children (Knutson, Taber, Murray, Valles, & Koepl, 2010). Similar to neglect, physical and sexual abuse reduced the odds of obesity. In our study, female young adolescents (but not males) who experienced physical or sexual abuse were less likely to be obese than young adolescents with other types of maltreatment. Gender differences in the relationship of childhood maltreatment to obesity have been found in adults, although the direction of the relationship to obesity is opposite to our findings in young adolescents. Adult females, but not adult males, with self-reported histories of childhood physical abuse and penetrative sexual abuse were more likely to have higher BMIs (Mamun et al., 2007). Females may react to their maltreatment differently over time, and this could possibly require gender-specific interventions for maltreated individuals to prevent and treat obesity in adolescence and adulthood.

Maltreatment reduced the odds of having a high BMI for young adolescents in our study—a counterintuitive finding given research in adults has consistently found that maltreatment is related to obesity. The mechanisms linking child maltreatment to adult obesity are not completely understood, although possible explanations of adult obesity include: (1) maltreatment affects endocrine system activation, including cortisol production, which is linked to abdominal obesity; (2) eating is used as a coping mechanism; and (3) increased weight is viewed as physically protective (Bentley & Widom, 2009). These explanations may not have utility for understanding the phenomena in young adolescents, since negative outcomes of maltreatment may be cumulative and occur over a longer timeframe. For example, in a prospective, longitudinal study by Noll et al. (2007), there were no significant differences in BMI between sexually abused children and the comparison group in adolescence, although the sexually abused group had higher BMIs than the comparison group in early adulthood.

Limitations

Generalizability is limited due to the dense urban sample population, and results cannot be extended to nonurban populations. We were unable to control for parental weight status, a predictor of child and adolescent obesity (Krahnstoever Davison, Francis, & Birch, 2005). The study is cross-sectional and causation cannot be inferred. We only looked at the limited age group of 9-12 years old, so results cannot be expanded to other age groups. The use of official child welfare reports of maltreatment captured only what the worker noted in investigations and official reports and thus may not capture the totality of the child's experience (Shaffer et al., 2008). Also, none of the comparison group identified involvement in DCFS during the Wave 1 interview, although it is not known if any of the comparison adolescents experienced maltreatment that was not reported to DCFS. The inability to investigate co-occurring types of maltreatment due to limitations of statistical power decreased our ability to fully explore the relationship between maltreatment and obesity.

Conclusion

Obesity prevalence in the maltreated young adolescents was similar to comparison young adolescents. While the maltreated group was less likely to have BMI $\geq 85\%$ than the comparison youth, the prevalence of overweight and obesity in the maltreated group is high. However, over 46% of the maltreated group was overweight or obese as well as maltreated. Both maltreatment and obesity are independently related to physical and mental health problems (Hagele, 2005; Varness et al., 2008), and combining maltreatment and obesity may make these young adolescents more vulnerable to poorer health outcomes. Pediatricians need to identify maltreated children who have co-morbid conditions as a result of obesity for lifestyle interventions. Comorbid conditions from obesity have a continuum of harm, from hyper-insulinism to type 2 diabetes requiring insulin, snoring to pulmonary hypertension, and elevated transaminases to cirrhosis (Varness et al., 2008). All of these conditions can lead to premature death of the obese child, therefore treatment is important. Child welfare needs to be part of a community effort to address obesity in maltreated adolescents. Pediatric clinicians can work with child welfare workers to explore weight concerns with overweight youth in their care and support appropriate lifestyle changes such as healthy eating and physical activity (Neumark-Sztainer, 2009). Further exploration of the mechanism of how maltreatment is related to weight as adolescents age, with specific emphasis on differences between genders, will help us better understand whether our findings relate to this particular age period or continue as the youth move into adulthood.

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Table 1

Presence of maltreatment types by gender

	Male	Female
N	149	150
Emotional abuse	49% 73	55% 83
Physical abuse	60% 89	45% 67
Sexual abuse	15% 23	27% 41
Neglect	81% 121	74% 111

Note: Total percentages add up to more than 100% because 76% of adolescents experienced more than one type of maltreatment. Four subjects (1%; 3 males and 1 female) in the maltreatment group did not have a type of maltreatment noted.

Table 2

Characteristics of maltreated and comparison adolescents

	% or Mean (SD)	
	Maltreated	Comparison
N	303	151
Age (SD)	10.84 (1.15)	11.11 (1.15)
Gender, %		
Male	50	60
Female	50	40
Ethnicity, %		
African American	40	32
Latino	35*	47*
White	12	10
Mixed Biracial	13	11
Tanner breast/genital stage	2.06 (.89)	2.09 (.84)
Depressive symptoms	9.78 (7.66)	8.44 (6.27)
Anxiety	49.80 (21.31)*	45.84 (18.54)*

* Significant group difference at $p < .05$

Table 3

Logistic regression: Maltreatment type as a predictor of BMI group

	Overweight/Obese			Obese		
	B	95% CI	P	B	95% CI	P
Main effects						
Sexual abuse vs. not	0.92	.50-1.70	0.79	0.97	.49-1.91	0.92
Physical abuse vs. not	0.78	.47-1.31	0.35	0.65	0.37-1.16	0.15
Neglect vs. not	0.45	.25-.82	0.01	0.46	.25-.86	0.02
Interaction effects						
Sexual abuse × gender (male ref)	0.32	.09-1.19	0.09	0.24	.06-.996	0.05
Physical abuse × gender (male ref)	0.29	.10-.87	0.03	0.14	.04-.49	0.002
Neglect × gender (male ref)	1.22	.36-4.09	0.75	0.74	.20-2.70	0.65

Note: maltreatment type indicates presence of that type of maltreatment versus other maltreated participants without that specific type; the maltreated group without the specific type of maltreatment was always used as the reference variable.

Overweight/Obese is BMI 85 percentile

Obese is BMI 95 percentile