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Association between Adverse Events in Childhood and BMI among People with Schizophrenia and Bipolar Disorder

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ASSOCIATION BETWEEN ADVERSE EVENTS IN CHILDHOOD AND BMI AMONG PEOPLE WITH SCHIZOPHRENIA AND BIPOLAR DISORDER

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University of Nebraska, 2015

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Background: People with schizophrenia and bipolar disorder die significantly earlier than members of the general public (16-18 years and 12-13 years, respectively). Diseases associated with obesity such as diabetes, heart disease, and stroke account for much of this discrepancy. People with mental illness often have difficulty losing weight despite intensive interventions. As a result, nurses caring for patients with mental illness need to monitor their weight diligently and implement individualized interventions to promote achieving or maintaining a healthy weight. Because intensive interventions come with some risk and expense, programs must target individuals with the most potential to develop obesity. In the general public, a history of adverse events in childhood such as abuse are associated with elevated body mass index (BMI). Objective: The purpose of this study is to examine if a history of adverse events in childhood is associated with BMI among people with schizophrenia or bipolar disorder. Methods: A secondary analysis of the Collaborative Psychiatric Epidemiology Surveys. BMI was calculated using self-reported height and weight. A history of a number of self-reported adverse events in childhood was used to form comparison groups. These relationships were examined both among people with schizophrenia (n=181) or bipolar disorder (n=299) and respondents with no psychiatric disorders (n=5,161). Results: Among subjects without mental illness, only a history of physical abuse by someone other than a parent was significantly associated with elevated BMI. Among individuals with schizophrenia or bipolar disorder, a history of physical abuse by a parent and emotional neglect from the subject's father were associated a higher BMI. In particular, among females the odds-risk (OR) for obesity associated with physical abuse from parents was 3.34 while the OR associated with paternal emotional

neglect was 2.44. Within both groups, no adverse events were significant related to BMI among males. Two types of adverse events were significantly linked with BMI in the psychiatric disorders group and one was significant in the control group. Discussion: This study indicates that practitioners should pay especially close attention to weight management among their female patients with a history of adverse events in childhood.

Key words: Child abuse, child neglect, schizophrenia, bipolar disorder, body mass index

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Individuals suffering from schizophrenia and bipolar disorder have significantly shorter life expectancies than members of the general public (16-18 years and 12-13 years, respectively) (Laursen, 2011). Early death rates have been falling in the population overall, but one analysis found that the mortality ratio due to natural causes in people with schizophrenia rose from 1.2 in 1999 to 1.7 in 2006 (Hoang, Stewart, & Goldacre, 2011).

Diseases related to obesity including diabetes, heart disease, and stroke have been found to account for a significant portion of the increased mortality rate seen in people with schizophrenia and bipolar disorder (Roshanaei-Moghaddam & Katon, 2009; Saha, Chant, & McGrath, 2007). Research has indicated that people with schizophrenia and bipolar disorder are 3.4 times and 1.7 times (respectively) more likely to have obesity relative to the general public (Gurpegui et al., 2012; Petry, Barry, Pietrzak, & Wagner, 2008). A history of adverse events in childhood has been found to be a risk factor for obesity in members of the general public (Midei & Matthews, 2011), but has not to our knowledge been examined among people with schizophrenia or bipolar disorder.

Studies have shown that people with schizophrenia and bipolar disorder have high rates of obesity due to antipsychotic medications (Limosin, Gasquet, Leguay, Azorin, & Rouillon, 2008; McIntyre, 2009), poor diets (Dipasquale et al., 2013; McElroy & Keck Jr, 2012), and physical inactivity (Daumit et al., 2005; Keck & McElroy, 2003). People with these conditions are also at greater risk for physical illnesses such as hypothyroidism (Leucht, Burkard, Henderson, Maj, & Sartorius, 2007) which may increase their risk for obesity. Lastly, physical problems among individuals with severe mental health challenges more often have physical conditions that are diagnosed late, elevating the risk for adverse outcomes including obesity (Nasrallah et al., 2006; Newcomer, 2006).

The above mechanisms help explain why people with schizophrenia or bipolar disorder are at an increased risk for obesity, but they do little to predict who is at greatest risk at the time of diagnosis so that this factor can be considered when making treatment decisions. The few risk factors that have been identified have included sex, non-psychiatric illnesses, and age. However, these risk factors lack

specificity and have been associated with small effect sizes (Gurpegui et al., 2012). More specific risk factors with greater effect sizes are needed to help distinguish individuals at high risk for obesity from individuals who have a lower risk for gaining weight. A history of childhood adversity holds promise in being a significant risk factor among people with schizophrenia or bipolar disorder given its impact among members of the general public. The purpose of this article is to examine if an association exists between adverse events in childhood and BMI among individuals with schizophrenia and bipolar disorder.

Review of Literature

Adverse events examined in the current study include traumatic loss (parental divorce or death of a parent), physical abuse, physical neglect, and emotional neglect. A fairly sizable amount of research has examined the link between adverse events of childhood and adult obesity in the general population. The majority of these studies have taken place in the United States with the others in Canada, Europe, and Australia (Aaron & Hughes, 2007; Afifi, Mota, MacMillan, & Sareen, 2013; Bentley & Widom, 2009; Boynton-Jarrett, Rosenberg, Palmer, Boggs, & Wise, 2012; Fuemmeler, Dedert, McClernon, & Beckham, 2009; Mamun et al., 2007; Midei, Matthews, & Bromberger, 2010; Rohde et al., 2008; Smith et al., 2010; Thomas, Hypponen, & Power, 2008; Vámosi, Heitmann, Thinggaard, & Kyvik, 2011) Approximately half of the articles examine at men and women while the other half focus on women exclusively. A few studies focus on selected portions of the population including lesbians and black women.

An extensive systematic review of the association between childhood violence and obesity in adulthood showed that 81% of studies found a positive relationship between childhood violence and obesity. In particular, they found that studies with more rigorous methods were more likely to report a significant relationship (Midei & Matthews, 2011).

Sexual Abuse

The majority of studies examining childhood sexual abuse found that survivors are at an increased risk for obesity. Among women, the odds of obesity associated with sexual abuse ranged from 1.47 to 2.3 (Aaron & Hughes, 2007; Bentley & Widom, 2009; Boynton-Jarrett et al., 2012; Fuemmeler et al., 2009; Mamun et al., 2007; Midei et al., 2010; Rohde et al., 2008; Smith et al., 2010). Studies also found that lesbians (Aaron & Hughes, 2007) and black women (Boynton-Jarrett et al., 2012) who have a history of sexual abuse are also at a greater risk for obesity. Some research has indicated that the impact of the abuse may also vary according the relationship between the abuser and survivor. One study found that sexual abuse by a family member was associated with a higher risk for obesity than similar abuse by someone outside the family (OR = 1.94 v. OR = 1.46) (Smith et al., 2010). Additional research that distinguished the type of sexual abuse found a significant association between penetrative sexual abuse before the age of 16 and obesity, but failed to find the same relationship with non-penetrative abuse (Mamun et al., 2007).

Fewer studies have examined the relationship between sexual abuse and obesity among men. In addition, the results for men have been more variable. Interestingly, Fuemmeler et al. (2009) found that men with a history of childhood sexual abuse were at an increased risk for obesity, but did not find this association in women. The authors recognized that their findings were in contrast to previous research (e.g., Aaron & Hughes, 2007; Bentley & Widom, 2009; Mamun et al. 2007, etc). They hypothesized that this may have been due, in part, to a somewhat younger sample than previous studies of women.

Some studies failed to find a significant relationship between childhood sexual abuse and adult obesity. For example, in a prospective analysis, Thomas et al. (2008) found that men and women who had survived sexual abuse did not have higher rates of obesity. However, the authors suggested that the prospective methods used might have resulted in under reporting of abuse, leading to an insignificant association. Some children may have experienced abuse that went unreported at the time, but may reveal the past experiences years later as adults. Bentley and Widom (2009) found that a history of court-

substantiated sexual abuse was not related to adult BMI. They suggested that the small sample size and other methodological differences may have led to findings contrary to most previous studies.

Neglect

Few studies that have examined the effects of childhood neglect on adult obesity. Midei et al. (2010) found that physical and emotional neglect were not associated with obesity among women, but the authors hypothesized this may have been due to a small sample size. Bentley and Widom (2009) and Fuemmeler et al. (2009) also failed to find a significant relationship between childhood neglect and adult obesity. Vámosi et al. (2011) found that maternal antipathy and neglect were both associated with elevated body mass index (BMI), but did not find this association for paternal antipathy or neglect. Thomas et al. (2008) found that after adjustment, only a mother having little interest in a child's education was associated with elevated adult BMI.

Physical Abuse

Two studies have examined the relationship between childhood physical abuse and adult obesity among men and women in the US. Afifi et al. (2013) found that a history of harsh physical punishment was associated with elevated BMI with an OR of 1.2. Greenfield & Marks (2009) found that US men and women who experienced both physical and psychological abuse in childhood with at least one occurring frequently ("sometimes" or "often" according to participant) were also at risk for obesity. In a Canadian population, Fuller-Thomson, Sinclair, and Brennenstuhl (2013) found that physical abuse was associated with obesity among women (OR = 1.35).

Four studies focused exclusively on women in the US have found a significant relationship between physical abuse in childhood and obesity in adulthood. The populations have ranged from black women throughout the US (Boynton-Jarrett et al., 2012), women of different racial/ethnic groups in the Northeast (Midei et al., 2010), the Midwest (Bentley & Widom, 2009) and the Pacific Northwest (Rohde et al., 2008). Boynton-Jarrett et al. (2012) found that black women with a history of abuse had a relative

risk of obesity ranging from 1.05 to 1.08 depending on the intensity of the abuse. One of the strongest relationships was found by Rohde et al. (2008) with the effect sizes ranging from 1.96 to 2.21 depending on race. There are only a few studies that have failed to find a significant relationship between childhood physical abuse and adult obesity. For example, Fuemmeler et al. (2009) found that physical abuse was not related to obesity in either men or women. By contrast, Fuller-Thomson et al. (2013) found a significant relationship among women but not among men.

Conceptual Model

Three mechanisms have been proposed to elucidate the relationship between childhood violence and adult obesity in the general population. These mechanisms include negative affect, disordered eating, and physical inactivity. First, a number of studies have found that symptoms such as anger, stress, and depressed mood partially explain the connection between adverse childhood experiences and obesity later in life (Alvarez, Pavao, Baumrind, & Kimerling, 2007; Midei et al., 2010). Second, several studies have found evidence for a relationship between violence in childhood, disordered eating, and obesity. It has been suggested that survivors of violence may consume larger quantities of food and eat in response to stress (Greenfield & Marks, 2009; Rohde et al., 2008). Third, Walker et al. (1999) found that women with a history of childhood abuse and neglect had lower levels of physical activity. Although two studies found that physical activity did not significantly mediate the relationship between childhood abuse and adult obesity, the measurement of activity was taken only at the time of the survey or within the past year (Alvarez et al., 2007; Midei et al., 2010). It may be that physical activity earlier in adulthood explained a significant amount of this relationship. In addition, some of the effects of mental illness or its treatment may compound the effects of physical inactivity among people with a history of childhood abuse.

The conceptual model in Appendix A has been created for use in this study to delineate the ways in which childhood adversity may have a greater impact on the development of adult obesity among people with schizophrenia or bipolar disorder than members of the general public. As discussed above, adverse events in childhood may increase the risk for adult obesity in the general population through

negative emotions, disorder eating, and reduced physical activity. These three factors are particularly relevant to people with severe mental health problems for a number of reasons. First, negative symptoms and depression are common (or even diagnostic) among people with schizophrenia and bipolar disorder possibly compounding the ramifications of child abuse (Rabinowitz et al., 2012). Second, disordered eating is a common response to stress among people with mental illness and many of the medications used to treat these conditions contribute to increased food intake (Inamura, 2012). Third, the sedentary lifestyle of many people with severe mental illness may amplify the effects of childhood adversity and increase the risk for obesity (Soundy, 2013). Fourth, a combination of dietary, activity, and healthcare behaviors often leads to a variety of untreated or undertreated physical conditions among people with mental illness such as hypothyroidism and diabetes which can lead to weight gain (Nasrallah et al., 2006; Newcomer, 2006). Although the proposed mediating variables such as medications, physical illnesses, and lifestyle factors are potentially useful in an analysis such as the one presented in this paper, the cross-sectional design does not allow for their examination over time leading to elevated BMI. In addition, most of these variables are not available in the dataset. As a result, the current analysis will only include the experience of childhood adversity, the presence of schizophrenia/bipolar disorder, and BMI (see bolded elements in Appendix A).

The study included three specific aims:

1. Determine if childhood adversity is associated with adult BMI in control and psychiatric disorder subjects in the Collaborative Psychiatric Epidemiology Surveys (CPES).

It is hypothesized that among subjects in both groups, those with a history of childhood adversity will have a higher BMI when compared with those who have no history of childhood adversity.

2. Compare the associations between childhood adversity and BMI among males and females separately.

It is hypothesized that a history of childhood adversity will show a greater association with elevated BMI among females than among males.

3. Compare the strength of association between childhood adversity and adult BMI in control subjects versus individuals with schizophrenia or bipolar disorder.

It is hypothesized that the association between a history of childhood adversity and BMI will have greater effect sizes among subjects in the psychiatric disorders group than the control group.

<div align="center">

Methods and Procedure

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A secondary analysis of the CPES was employed to complete this study through a descriptive case-control design. The CPES were completed through a series of three surveys conducted between 2001 and 2003 (Alegria, Jackson, Kessler, & Takeuchi, 2009). Structured in-home interviews were conducted by lay personnel using a computer program. The current study used the publically-available dataset that included no personal identifying information.

Sample

The CPES dataset includes data on 20,013 adults age 18 and older residing in the community. Subjects were selected using multi-stage randomized sampling in 252 areas across the United States (Alegria, Jackson, Kessler, & Takeuchi, 2009). The current study employed data from all individuals who reported symptoms consistent with schizophrenia (n=181) or bipolar disorder (n=299) laid out in the Diagnostic and Statistical Manual of Mental Disorders IV-TR (American Psychiatric Association, 2000). The control group consisted of subjects who did not report symptoms meeting criteria for any psychiatric disorder (n=5,161). The total sample size for the current study was 5,641.

Measures

Data on adverse events of childhood and psychiatric symptoms were collected in the CPES based on the Composite International Diagnostic interview (CIDI). The CIDI identifies individuals who likely have most major forms of mental illness based on their response to the presence of various psychiatric

symptoms. However, the tool does not identify individuals who likely meet criteria for schizophrenia. The current study included respondents who reported having ever been diagnosed with or disabled by schizophrenia or affirmed that they had at least two symptoms of hallucinations, delusions, and negative symptoms (i.e. lack of enjoyment, inability to take pleasure in daily activities). The psychiatric disorder group also included subjects identified by the CIDI as ever having met criteria for bipolar disorder. The control group included subjects who denied ever having symptoms that would meet criteria for any psychiatric disorder.

Adverse childhood data included variables of abuse, neglect, and other adverse events in childhood. Some of the variables were combined due to similarity of the survey questions. "Traumatic loss" was formed from three variables including of death of subject's mother or father or parents' divorce. Physical abuse by a non-parent and by a parent were examined separately. "Physical neglect" was formed from the four variables of being left unsupervised, not having needed things, having gone hungry, or having not have received needed medical treatment. Emotional neglect was formed from the variables of not being close to a parent, having received little love from a parent, or the parent having put little effort in the subjects' upbringing. Emotional neglect from the mother and father were analyzed separately. "Other traumatic event" included three variables of traumatic events not identified in other questions of the survey. A subject had to have been exposed to the adverse event before the age of 19 to be considered a childhood adverse event in this study.

Several of the variables elicited the age at which certain event occurred were translated into a dichotomous variable (e.g. "event occurred before the age of 19" or "event did not occur before the age of 19") for purposes of power and to reflect common clinical practices. Other questions asked the frequency of a certain event in childhood. These responses were formed into dichotomous variables with "often" or "sometimes" becoming "yes" and "rarely" or "never" becoming "no." Lastly, the emotional neglect questions asked for a subjective assessment of maternal and paternal love, effort, and closeness. "Very" and "somewhat" became "yes" while "not very" and "not at all" became "no."

Body mass index (BMI) was calculated using self-reported height and weight according to the standard formula: weight in kilograms / (height in meters) [2] (Alegria et al., 2009). Research has found that women may underestimate BMI more than men (Merrill & Richardson, 2009) but self-reported physiological measures have been shown to relate fairly well with clinical measurement (Taylor et al., 2006). Obesity was defined by the standard cutoff of a BMI of 30 or greater.

Instrumentation

The CIDI was developed for the Word Mental Health Survey Initiative and has been employed since the 1990s (Wittchen, 1994). This structured tool was established for use by lay individuals to produce diagnoses based on the American Psychiatric Association's Diagnostic and Statistical Manual and the World Health Organization's International Classification of Disease Criteria (Alegria et al., 2009). Studies have found a close relationship between diagnoses made by the CIDI when administered by laypersons and the semi-structured interviews of clinicians. Haro et al. (2006) found that the concordance between the CIDI and the Structured Clinical Interview for the DSM-IV was 0.76 for anxiety, mood, and substance disorders.

<center>**Statistical Analysis**</center>

All statistical analyses were completed using SPSS 23 (IBM Corp., 2015). Effect sizes were calculated with a widely-used online tool (Becker, 1999). Power calculations were completed using G-Power 3.0.10 (Faul, Erdfelder, Lang, & Buchner, 2007). Results were considered significant at p-value of less than 0.05 and an effect size of greater than 0.2. The data analyzed came from the Collaborative Psychiatric Epidemiology data set (Alegria, Jackson, Kessler, & Takeuchi, 2009).

First, the demographic variables were analyzed using an independent samples t-test for subject age and Chi-square analyses for categorical variables (sex, marital status, education, and race). Next, Chi-square analyses were used to compare the rate of exposure to each adverse event between the psychiatric disorder and control groups. Each type of adverse event was analyzed separately throughout this study.

The statistical analyses for aim one examined the link between adverse events and BMI among control and psychiatric disorder subjects. The BMI of all subjects exposed to each adverse event in childhood was compared to that of subjects not exposed to the particular event using independent samples t-tests. The effect size of each relationship was calculated using the means and standard deviations. This allowed for the comparison effect sizes between the control and psychiatric disorder groups. Spearman Rho correlations were used to see if the number of forms of adverse events experienced was associated with BMI. Then, t-tests were used to compare the BMI of subjects who had experienced two or more forms of adverse events was different from those who had experienced one or fewer, etc. In addition, Chi-square analyses were run on the same variables that were significant in the t-tests to compare the rates of obesity among exposed individuals to those who were unexposed.

For aim two, t-tests were used to examine associations between adverse events and BMI among males and females separately within both the control and psychiatric disorders group. For aim three the strengths of the relationships between adverse events and BMI were analyzed. The number of significant relationships and the effect sizes were compared between the control group and the psychiatric disorders group.

Results

Sample Description

The current study used a total potential sample of 20,013 survey respondents. The analysis found that 181 subjects (0.9%) of subjects reported symptoms consistent with a diagnosis of schizophrenia, 299 (1.5%) for bipolar disorder, and 5,161 (25.8%) for no psychiatric disorder. Subjects in the psychiatric disorders group were older (38 years v. 47.2 years, $t(668) = 14.05$, $p < 0.001$) (see Appendix B). A greater proportion of psychiatric disorder subjects were female (61.9% v. 53.1%, $\chi^2(1, N = 5,641) = 13.576$, $p < 0.001$). More of the control subjects were married (59.7% v. 40.4%, $\chi^2(1, N = 5,641) = 67.045$, $p < 0.001$) and had studied beyond high school (55.1% v. 45.1%, $\chi^2(1, N = 5,610) = 17.66$, p

<0.001). A greater number of psychiatric disorders subjects identified themselves as non-white (63.3% v. 29.1%, ^{2}(1, N = 5,641) $=$ 236.077, p <0.001). The BMI of the psychiatric disorders group was significantly higher than the control group (28.3 v. 26.9, t(516) = 4.216, $p < 0.001$)

Subjects in the psychiatric disorders group were more likely than control subjects to report having experienced every form of adverse event examined in this study. Subjects with schizophrenia/bipolar disorder more often reported experiencing a traumatic loss (χ^2(1, N $=$ 2,878) $=$ 12.74, $p = 0.001$), physical abuse by a non-parent (χ^2(1, N = 2,864) $=$ 166.16, p <0.001), physical abuse by a parent (χ^2(1, N = 2,844) $=$ 156.5, p <0.001), physical neglect (χ^2(1, N = 2,871) $=$ 110.31, p <0.001), emotional neglect from mother (χ^2(1, N = 2,875) $=$ 60.27, p <0.001), emotional neglect from father (χ^2(1, N = 2,688) $=$ 50.6, p <0.001), and an "other traumatic event" (χ^2(1, N = 1,744) $=$ 298.18, p <0.001). A greater proportion of subjects in the control group reported being exposed to no forms of adverse events in childhood (χ^2(1, N= 1,458) = 156.979, p < 0.001) while psychiatric disorder subjects were more likely to report having experienced every other number of forms of adverse events (one through seven).

BMI Results

Aim 1: Childhood adversity and BMI

Limited sample sizes produced inconclusive results in most analyses. Among control subjects, only experiencing physical abuse from someone other than a parent was associated with elevated BMI, but the effect size was small (t(2,325) = 2.188, p = 0.029, d = 0.13) (see Appendix C). Many analyses were also limited by small sample sizes within the psychiatric group. Physical abuse by parents was associated with elevated BMI (t(43) = 3.554, p = 0.012, d = 0.54). In addition, subjects who received little love from their fathers had higher BMIs (t(42) = 2.775, p = 0.008, d = 0.56).

Chi-square analyses were then run on the variables that were significant in the t-tests for the psychiatric disorders group comparing rates of obesity among individuals who had experienced adverse events in childhood to those who had not. Variables included physical abuse by a parent and emotional

neglect by the subject's father. Psychiatric disorders subjects who had experienced physical abuse from a parent had a higher risk for obesity than those who did not ($\chi^2(1, N = 232) = 8.562, p = 0.003$, OR = 2.77). In addition, subjects in the psychiatric disorders group who experienced emotional neglect from their fathers had a higher risk of obesity ($\chi^2(1, N = 215) = 6.703, p < 0.01$, OR = 2.59).

Spearman Rho correlations revealed no correlation between the number of forms of adverse events experienced by control subjects and BMI ($r_s = 0.001, p = 0.975$). A significant but weak correlation was found among subjects in the psychiatric disorders group ($r_s = 0.191, p=0.007$). Within the control group, none of the t-tests were significant. For example, the BMI of subjects exposed to two or more forms of adverse events did not differ from those who were exposed to one form, etc. However, within the psychiatric disorders group every increase in the number of forms of adverse events was associated with elevated BMI through five or more (see Appendix D). The BMI of subjects who had experienced six or more and seven forms of adverse events did not differ from those who had been exposed to fewer forms.

Aim 2: Sex differences in BMI associations

No variables were significantly associated with BMI among males alone in the control group. Among control group females, having experienced physical abuse from someone other than parents was associated with a greater effect size than in the combined analysis ($t(1,292) = 2.327, p = 0.02$, d = 0.32). Among males, analyses found that emotional neglect from the subject's father was not associated with BMI despite having a relatively high level of power (0.81). All other variables lacked sufficient power to determine if a relationship existed.

Within the psychiatric disorders group, no associations between childhood adversity and BMI were significant among males. Among females, physical abuse by a parent ($t(70) = 2.791, p = 0.007$, d = 0.51) and emotional neglect from father $t(36) = 2.562, p = 0.015$, d=0.58) were associated with elevated BMI. The effect sizes were similar to the analyses of males and females combined.

Chi-square analyses were run on the two variables that were significantly associated with BMI among females in the psychiatric disorders group. Among psychiatric disorders females, those who had been physically abused by a parent were at a higher risk for obesity (χ^2(1, N = 147) = 9.011, p =0.003, OR = 3.34). In addition, psychiatric disorders females who reported emotional neglect from their fathers also had a higher risk of obesity (χ^2(1, N = 136) = 4.153, p <0.042, OR = 2.44).

Aim 3: Comparison of relationships between control and psychiatric disorder subjects

Only one adverse event variable was significantly associated with elevated BMI among control subjects. By contrast, two variables were significant among psychiatric disorder subjects. In addition, the relationships had smaller effect sizes among control subjects when compared to psychiatric disorder subjects (d = 0.13 and d = 0.32 v. d = 0.51-0.58). As a result, although direct statistical comparison was limited by small sample sizes for many of the variables, it can be inferred that exposure to adverse events in childhood is more strongly associated with elevated BMI among psychiatric disorder subjects than a similar exposure among control subjects.

Discussion and Conclusions

Obesity is one of the most common comorbid health problems among individuals with mental illness. Although the causes of weight gain in this population has not been fully explored, practitioners do not need to wait for further research to help their patients maintain a healthy weight. Studies such as the current one can help medical professionals start to identify individuals with the greatest risk for obesity and offer interventions to help prevent weight gain.

The current study had a number of limitations. Most centrally, the small sample sizes resulted in inconclusive results for most analyses. In fact, only one analysis that had a power of 0.8 or greater failed to meet significance. A study with a larger sample size (particularly of individuals with schizophrenia or bipolar disorder) would likely find more numerous significant associations. Another limitation was that the data were cross-sectional. This does not allow for the examination of the risk factors preceding the

development of obesity over time. In addition, the data were collected by self-report and were retrospective. Subjects may have under-reported exposure to adverse events, biasing the results towards the null hypothesis.

Despite limitations of sample size, this study makes a number of contributions to the body of knowledge on the risk factors for elevated BMI among people with mental illness. In the control group with males and females combined, physical abuse was found to be associated with elevated BMI, but had a small effect size (d = 0.13). Among control group females alone physical abuse was linked with a larger effect size (0.32). Most other variables lacked the sample size for a reliable analysis. The significant analyses within the psychiatric disorders group were somewhat more numerous. The study found that subjects who were physically abused by a parent or emotionally neglected from their fathers had a higher mean BMI. The effect sizes were medium (d = 0.54-0.56).

The process of breaking down the analyses by sex revealed that the same variables were significant among females but no adverse events were significantly associated with BMI among males. However, this does not necessarily mean that child adversity is less impactful among males as many of the sample sizes did not allow the researchers to determine if a significant relationship exists. Females who suffered abuse from their parents or were emotionally neglected from their fathers had higher mean BMIs. In addition, the effect sizes were medium, ranging from d = 0.51 to d = 0.58.

Further research is needed in this area, but practitioners would be justified in concluding that they need to pay especially close attention to the weight management of their patients with schizophrenia or bipolar disorder who survived adverse events in childhood. In particular, physical abuse from parents was associated with a 3.34 times risk of obesity among females relative to those who did not suffer physical abuse from their parents. Females who reported emotional neglect from their fathers were at a 2.44 times greater risk for obesity relative to subjects who did not report this neglect.

Additional analyses revealed that the number of forms of adverse events experienced by subjects was associated with BMI in the psychiatric disorders group, but not the control group. This indicates that

individuals with mental health problems may be more vulnerable to developing obesity when they have experienced multiple forms of adverse events. In clinical practice, healthcare professionals should be alerted to an increased risk of obesity when a patient has experienced multiple forms of abuse, neglect, or loss during childhood.

The current study indicates that practitioners would be justified in implementing increased monitoring for females with mental illness who were abused by their parents or had a poor relationship with their fathers. Current guidelines recommend that weight be monitored weekly for the first six weeks, at week 12, and then annually (National Collaborating Centre for Mental Health, 2014). However, high-risk individuals may warrant more frequent monitoring of weight.

This study does not support relaxed monitoring for males as the sample sizes were too small to conclude if significant relationships exist. Further research should examine a larger number of risk factors simultaneously to determine the relative contribution of these factors and identify the strongest predictors of elevated BMI among people with mental illness. Additional exploratory research may use observational analysis of cross-sectional data to examine variables such as age, sex, smoking status, and intensity of disease. Subsequent studies could use a prospective design to measure all identified variables simultaneously over time.

References

Aaron, D. J., & Hughes, T. L. (2007). Association of childhood sexual abuse with obesity in a community sample of lesbians. *Obesity, 15*(4), 1023-1028.

Afifi, T. O., Mota, N., MacMillan, H. L., & Sareen, J. (2013). Harsh physical punishment in childhood and adult physical health. *Pediatrics, 132*(2), e333-40.

Alegria, M., Jackson, J., Kessler, R., & Takeuchi, D. (2009). Collaborative psychiatric epidemiology surveys (CPES), 2001–2003. *Institute for Social Research, Survey Research Center and Inter-University Consortium for Political and Social Research, Ann Arbor, MI.Http://Www.Icpsr.Umich.Edu/CPES/.*

Alvarez, J., Pavao, J., Baumrind, N., & Kimerling, R. (2007). The relationship between child abuse and adult obesity among california women. *American Journal of Preventive Medicine, 33*(1), 28-33.

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders: DSM-5. Washington, D.C: American Psychiatric Association.

Becker, L. (1999). Effect size calculators. Retrieved from http://www.uccs.edu/~lbecker/

Bentley, T., & Widom, C. S. (2009). A 30-year follow-up of the effects of child abuse and neglect on obesity in adulthood. *Obesity, 17*(10), 1900-1905.

Boynton-Jarrett, R., Rosenberg, L., Palmer, J. R., Boggs, D. A., & Wise, L. A. (2012). Child and adolescent abuse in relation to obesity in adulthood: The black women's health study. *Pediatrics, 130*(2), 245-253.

Daumit, G. L., Goldberg, R. W., Anthony, C., Dickerson, F., Brown, C. H., Kreyenbuhl, J., . . . Dixon, L. B. (2005). Physical activity patterns in adults with severe mental illness. *The Journal of Nervous and Mental Disease, 193*(10), 641-646.

Dipasquale, S., Pariante, C. M., Dazzan, P., Aguglia, E., McGuire, P., & Mondelli, V. (2013). The dietary pattern of patients with schizophrenia: A systematic review. *Journal of Psychiatric Research, 47*(2), 197-207.

Fuemmeler, B. F., Dedert, E., McClernon, F. J., & Beckham, J. C. (2009). Adverse childhood events are associated with obesity and disordered eating: Results from a US population-based survey of young adults. *Journal of Traumatic Stress, 22*(4), 329-333.

Fuller-Thomson, E., Sinclair, D. A., & Brennenstuhl, S. (2013). Carrying the pain of abuse: Gender-specific findings on the relationship between childhood physical abuse and obesity in adulthood. *Obesity Facts, 6*(4), 325-336.

Greenfield, E. A., & Marks, N. F. (2009). Violence from parents in childhood and obesity in adulthood: Using food in response to stress as a mediator of risk. *Social Science & Medicine, 68*(5), 791-798.

Gurpegui, M., Martínez-Ortega, J. M., Gutiérrez-Rojas, L., Rivero, J., Rojas, C., & Jurado, D. (2012). Overweight and obesity in patients with bipolar disorder or schizophrenia compared with a non-psychiatric sample. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 37*(1), 169-175.

Haro, J. M., Arbabzadeh-Bouchez, S., Brugha, T. S., De Girolamo, G., Guyer, M. E., Jin, R., ... & Kessler, R. C. (2006). Concordance of the Composite International Diagnostic Interview Version 3.0 (CIDI 3.0) with standardized clinical assessments in the WHO World Mental Health surveys. *International Journal of Methods in Psychiatric Research*, *15*(4), 167-180.

Hoang, U., Stewart, R., & Goldacre, M. J. (2011). Mortality after hospital discharge for people with schizophrenia or bipolar disorder: Retrospective study of linked English hospital episode statistics, 1999-2006. *British Medical Journal, 343*

IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

Inamura, Y., Izumi, T., Sakurai, K., Katsui, T., and Murayama, N. (2012). Dietary factors associated with obesity in patients with schizophrenia living at home. *Food and Nutrition Sciences, 3*(10), 1387-1396.

Keck, P. E., & McElroy, S. L. (2003). Bipolar disorder, obesity, and pharmacotherapy-associated weight gain. *The Journal of Clinical Psychiatry, 64*(12), 1426-1435.

Laursen, T. M. (2011). Life expectancy among persons with schizophrenia or bipolar affective disorder. *Schizophrenia Research, 131*(1-3), 101-104.

Leucht, S., Burkard, T., Henderson, J., Maj, M., & Sartorius, N. (2007). Physical illness and schizophrenia: A review of the literature. *Acta Psychiatrica Scandinavica, 116*(5), 317-333.

Limosin, F., Gasquet, I., Leguay, D., Azorin, J., & Rouillon, F. (2008). Body mass index and prevalence of obesity in a french cohort of patients with schizophrenia. *Acta Psychiatrica Scandinavica, 118*(1), 19-25.

Mamun, A. A., Lawlor, D. A., O'Callaghan, M. J., Bor, W., Williams, G. M., & Najman, J. M. (2007). Does childhood sexual abuse predict young adult's BMI? A birth cohort study. *Obesity, 15*(8), 2103-2110.

McElroy, S. L., & Keck Jr, P. E. (2012). Obesity in bipolar disorder: An overview. *Current Psychiatry Reports, 14*(6), 650-658.

McIntyre, R. S. (2009). Managing weight gain in patients with severe mental illness. *The Journal of Clinical Psychiatry, 70*(7), e23-e23.

Merrill, R. M., & Richardson, J. S. (2009). Validity of self-reported height, weight, and body mass index: Findings from the national health and nutrition examination survey, 2001–2006. *Prev Chronic Dis, 6*(4), A121.

Midei, A., & Matthews, K. (2011). Interpersonal violence in childhood as a risk factor for obesity: A systematic review of the literature and proposed pathways. *Obesity Reviews, 12*(5), e159-e172.

Midei, A. J., Matthews, K. A., & Bromberger, J. T. (2010). Childhood abuse is associated with adiposity in midlife women: Possible pathways through trait anger and reproductive hormones. *Psychosomatic Medicine, 72*(2), 215-223.

Nasrallah, H. A., Meyer, J. M., Goff, D. C., McEvoy, J. P., Davis, S. M., Stroup, T. S., & Lieberman, J. A. (2006). Low rates of treatment for hypertension, dyslipidemia and diabetes in schizophrenia: Data from the CATIE schizophrenia trial sample at baseline. *Schizophrenia Research, 86*(1), 15-22.

Newcomer, J. W. (2006). Medical risk in patients with bipolar disorder and schizophrenia. *The Journal of Clinical Psychiatry, 67 Suppl 9*, 25-30; discussion 36-42.

National Collaborating Centre for Mental Health (UK). (2014). Psychosis and Schizophrenia in Adults: Treatment and Management.

Newcomer, J. W. (2006). Medical risk in patients with bipolar disorder and schizophrenia. *The Journal of Clinical Psychiatry, 67 Suppl 9*, 25-30; discussion 36-42.

Petry, N. M., Barry, D., Pietrzak, R. H., & Wagner, J. A. (2008). Overweight and obesity are associated with psychiatric disorders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Psychosomatic Medicine, 70*(3), 288-297.

Rabinowitz, J., Levine, S. Z., Garibaldi, G., Bugarski-Kirola, D., Berardo, C. G., & Kapur, S. (2012). Negative symptoms have greater impact on functioning than positive symptoms in schizophrenia: analysis of CATIE data. *Schizophrenia research*, *137*(1), 147-150.

Rohde, P., Ichikawa, L., Simon, G. E., Ludman, E. J., Linde, J. A., Jeffery, R. W., & Operskalski, B. H. (2008). Associations of child sexual and physical abuse with obesity and depression in middle-aged women. *Child Abuse & Neglect, 32*(9), 878-887.

Roshanaei-Moghaddam, B., & Katon, W. (2009). Premature mortality from general medical illnesses among persons with bipolar disorder: A review. *Psychiatric Services, 60*(2), 147-156.

Saha, S., Chant, D., & McGrath, J. (2007). A systematic review of mortality in schizophrenia: Is the differential mortality gap worsening over time? *Archives of General Psychiatry, 64*(10), 1123.

Smith, H. A., Markovic, N., Danielson, M. E., Matthews, A., Youk, A., Talbott, E. O., . . . Hughes, T. (2010). Sexual abuse, sexual orientation, and obesity in women. *Journal of Women's Health, 19*(8), 1525-1532.

Soundy, A., Wampers, M., Probst, M., De Hert, M., Stubbs, B., & Vancampfort, D. (2013). Physical activity and sedentary behaviour in outpatients with schizophrenia: A systematic review and meta-analysis. *International Journal of Therapy and Rehabilitation*, *20*(12), 588-596.

Taylor, A. W., Grande, E. D., Gill, T. K., Chittleborough, C. R., Wilson, D. H., Adams, R. J., . . . Ruffin, R. E. (2006). How valid are self-reported height and weight? A comparison between CATI self-report and clinic measurements using a large cohort study. *Australian and New Zealand Journal of Public Health, 30*(3), 238-246.

Thomas, C., Hypponen, E., & Power, C. (2008). Obesity and type 2 diabetes risk in midadult life: The role of childhood adversity. *Pediatrics, 121*(5), e1240-9.

Vámosi, M. E., Heitmann, B. L., Thinggaard, M., & Kyvik, K. O. (2011). Parental care in childhood and obesity in adulthood: A study among twins. *Obesity, 19*(7), 1445-1450.

Walker, E. A., Gelfand, A., Katon, W. J., Koss, M. P., Von Korff, M., Bernstein, D., & Russo, J. (1999). Adult health status of women with histories of childhood abuse and neglect. *The American Journal of Medicine, 107*(4), 332-339.

Wittchen, H. U. (1994). Reliability and validity studies of the WHO-Composite International Diagnostic Interview (CIDI): A critical review. *Journal of psychiatric research*, *28*(1), 57-84.

Appendix A
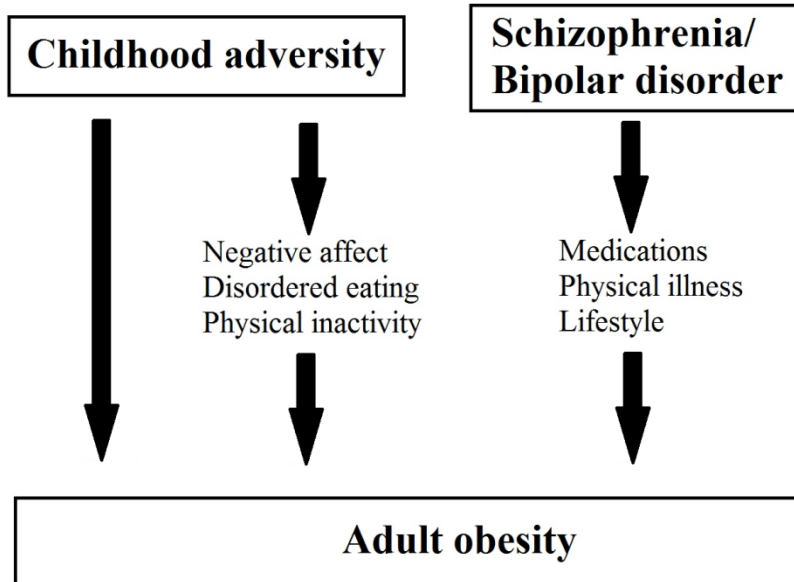
Proposed conceptual framework of childhood adversity, schizophrenia/bipolar disorder, and adult obesity.

Appendix B

	Psychiatric disorder		Control
n	480		5,161
Mean age (SD)	38 (13.2)	*$t(668) = 14.05$, $p <0.001$	57.2 (18.6)
Female	297 (61.9%)	*$\chi^2(1, N = 5,641) = 13.576$, $p <0.001$	2,741 (53.1%)
Married	194 (40.4%)	*$\chi^2(1, N = 5,641) = 67.045$, $p <0.001$	3,081 (59.7%)
Studied beyond high school	216 (45.1%)	*$\chi^2(1, N = 5,610) = 17.66$, $p <0.001$	2,827 (55.1%)
Non-white	304 (63.3)	*$\chi^2(1, N = 5,641) = 236.077$, $p <0.001$	1,503 (29.1%)
Mean BMI (SD)	28.3 (7)	*$t(516) = 4.216$, $p < 0.001$	26.9 (5.5)
Normal BMI	178 (38.1%)	$\chi^2(1, N = 5,528) = 0.029$, $p = 0.881$	1,909 (37.7%)
Overweight	131 (28.1%)	*$\chi^2(1, N = 5,528) = 8.542$, $p = 0.004$	1,759 (34.8%)
Obese	150 (32.1%)	*$\chi^2(1, N = 5,528) = 16.126$, $p < 0.001$	1,203 (23.8%)
Number of forms of adverse events			
0	92 (44.2%)	*$\chi^2(1, N= 1,458) = 156.979$, $p < 0.001$	1,041 (83.3%)
1	39 (18.8%)	*$\chi^2(1, N= 1,458) = 156.978$, $p < 0.001$	126 (10.1%)
2	21 (10.1%)	*$\chi^2(1, N= 1,458) = 168.457$, $p < 0.001$	42 (3.4%)
3	20 (9.6%)	*$\chi^2(1, N= 1,458) = 160.513$, $p < 0.001$	26 (2.1%)
4	19 (9.1%)	*$\chi^2(1, N= 1,458) = 137.067$, $p < 0.001$	6 (0.5%)
5	10 (4.8%)	*$\chi^2(1, N= 1,458) = 56.557$, $p < 0.001$	5 (0.4%)
6	5 (2.4%)	*$\chi^2(1, N= 1,458) = 22.088$, $p < 0.001$	4 (0.3%)
7	2 (1%)	*$\chi^2(1, N= 1,458) = 12.036$, $p = 0.02$	0
Traumatic loss	72 (29.4%)	*$\chi^2(1, N = 2,878) = 12.74$, $p = 0.001$	520 (19.7%)
Physical abuse by non-parent	54 (22.2%)	*$\chi^2(1, N = 2,864) = 166.16$, $p <0.001$	89(3.4%)
Physical abuse by parent	42 (17.6%)	*$\chi^2(1, N = 2,844) = 156.5$, $p <0.001$	56 (2.1%)
Physical neglect	40 (16.3%)	*$\chi^2(1, N = 2,871) = 110.31$, $p <0.001$	72 (2.7%)

Emotional neglect from mother	24 (9.9%)	*χ^2(1, N = 2,875) = 60.27, p <0.001	47 (1.8%)
Emotional neglect from father	38 (17.1%)	*χ^2(1, N = 2,688) = 50.6, p <0.001	127 (5.2%)
Other trauma	146 (40.7%)	*χ^2(1, N = 1,744) = 298.18, p <0.001	84 (6.1%

* = statistically significant at $p < 0.05$

Sample description

Appendix C

	Psychiatric disorder	Psychiatric disorder male	Psychiatric disorder female	Controls	Controls male	Controls female
Physical abuse by non-parent	27.6 (6.7) (no) v. 29.1 (7.9) (yes) d = 0.2 t(209) = 1.48, *p* = 0.141 power = 0.35	27.2 (5) (no) v. 28.0 (5.4) (yes) d = 0.15 t(77) = 0.653, *p* = 0.516 power = 0.12	28 (7.7) (no) v. 29.6 (8.7) (yes) d = 0.2 t(146) = 1.188, *p* = 0.237 power = 0.29	* 27 (5.6) (no) v. 27.7 (5.5) (yes) d = 0.13 t(2,325) = 2.188, *p* = 0.029 power = 0.31	27.8 (5.1)(no) v. 28.9 (3.7) (yes) d = 0.25 t(1,031) = 1.235, *p* = 0.217 power = 0.42	* 26.5 (6) (no) v. 28.6 (7) (yes) d = 0.32 t(1,292) = 2.327, *p* = 0.02 power = 0.68
Physical abuse by parent	* 27.5 (6.3) (no) v. 32.1 (10.3) (yes) d = 0.54 t(43) = 3.554, *p* = 0.012 power = 0.92	27.7 (4.9) (no) v. 27 (6)(yes) d = 0.13 t(77) = 0.554, *p* = 0.581 power = 0.1	* 27.4 (7.1) (no) v. 31.8 (9.8) (yes) d = 0.51 t(70) = 2.791, *p* = 0.007 power = 0.8	27.1 (5.6) (no) v. 27.9 (6) (yes) d = 0.14 t(2,313) = 1.697, *p* = 0.09 power = 0.26	27.8 (5) (no) v. 28.3 (4.9) (yes) d = 0.1 t(1,028) = 0.79, *p* = 0.194 power = 0.09	26.5 (6) (no) v. 28 (6.8) (yes) d = 0.23 t(1,283) = 1.559, *p* = 0.119 power = 0.42
Emotional neglect from father	* 27.4 (6.6) (no) v. 31.9 (9.3) (yes) *p* = 0.008, d = 0.56 t(42) = 2.775, *p* = 0.008 power = 0.92	27.2 (4.5) (no) v. 29.3 (6.7) (yes) d = 0.37 t(7) = 0.863, *p* = 0.414 power = 0.25	* 27.5 (7.6) (no) v. 32.6 (9.8) (yes) d = 0.58 t(36) = 2.562, *p* = 0.015 power = 0.86	27.1 (5.6) (no) v. 28.1 (5.9) (yes) d = 0.17 t(125) = 1.718, *p* = 0.088 power = 0.55	27.8 (5) (no) v. 29.8 (5.5) (yes) d = 0.38 t(1,028) = 1.299, *p* = 0.194 power = 0.81	26.5 (6) (no) v. 27.6 (6.4) (yes) d = 0.18 t(1,213) = 1.441, *p* = 0.15 power = 0.42

* = statistically significant at p < 0.05

BMI Differences for Adverse Childhood Events among Psychiatric and Control Groups

Appendix D

Number of traumas	Psychiatric disorders
One or more v. fewer	*29.7 v. 26.6 $t(189) = 2.98$, $p=0.002$ d=0.44
Two or more v. fewer	*30 v. 27.4 $t(106) = 2.37$, $p=0.035$ d=0.33
Three or more v. fewer	*31.2 v. 27.2 $t(69) = 2.855$, $p=0.006$ d=0.5
Four or more v. fewer	*33.2 v. 27.3 $t(39) = 3.308$, $p=0.002$ d=0.7
Five or more v. fewer	*34.6 v. 27.7 $t(17) = 2.537$, $p=0.021$ d=0.76

* = statistically significant at $p < 0.05$

Association between Number of Types of Adverse Events and BMI