Prevalence of Overweight and Obesity in Adolescents With Severe Mental Illness: A Cross-Sectional Chart Review

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Objective: Pediatric obesity (body mass index [BMI] ≥ 95th percentile for sex and age) and overweight (BMI ≥ 85th percentile < 95% percentile) are priority public health targets for the prevention of diabetes and cardiovascular disease. We examined the prevalence and risk of overweight and obesity in adolescents with serious mental disorders.

Method: Height, weight, demographic, diagnostic, and treatment data were reviewed for 114 adolescents attending a partial hospitalization program over 18 consecutive months between January 2003 and July 2004. Sample data were compared to normative National Health and Nutrition Examination Survey data and regional county data for BMI. Unadjusted odds ratios and their 95% CIs were calculated for each categorical risk factor using the χ^2 test. A logistic regression model was conducted to detect the effects of these risk factors on the occurrence of overweight and obesity.

Results: The combined prevalence of overweight and obesity was 55.4% (n = 63); the prevalence for obesity alone was 30% (n = 34), approximately double the rate in national and county norms. Lack of private insurance, smoking, and antidepressant and antipsychotic treatment were associated with overweight and obese status.

Conclusions: Adolescents with severe mental illness are at increased risk for overweight and obesity. Identification of elevated BMI, associated risk factors, and efforts to prevent weight gain should begin at initiation of mental health treatment.

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Obesity is a global epidemic.[1,2] The prevalence and degree of obesity have significantly increased over the past 30 years within the United States.[3] The most recent National Health and Nutrition Examination Survey (NHANES 2003–2004) found almost 20% of children and adolescents aged 6–17 years were obese.[4,5] These rates represent a major public health concern, as overweight and obesity in childhood continue into adulthood, substantively contributing to the adult obesity epidemic.[4,6]

Expert panels of clinicians and public health officials, including the US Surgeon General's Call to Action (http://www.surgeongeneral.gov/topics/obesity/calltoaction/fact_adolescents.htm), have, for over the past decade, urged greater recognition, prevention, and treatment of childhood overweight and obesity to lessen rates of associated medical complications and psychological comorbidities, including cardiovascular disease, diabetes, fatty liver, social discrimination, poor self-esteem, and depression.[7,8] Causal factors include high-fat, energy-dense diets; sedentary lifestyles; economic growth; and urban globalization of food markets. Although genetics and in utero programming of adipose tissue may play a role, the rate at which obesity is increasing implies primarily environmental causes (http://www.who.int/dietphysicalactivity/publications/facts/obesity/en/).

Adult psychiatric populations at high risk for obesity include females and those with schizophrenia, depression, and bipolar disorder.[9–11] Individuals with bipolar disorder are more centrally obese than the general population; females with bipolar disorder are more likely to be overweight or obese than nonbipolar females.[12] Among adolescents, depressive symptoms are associated with overweight status and predictive of future obesity.[10,13,14]

Speculative mechanisms for the increased obesity rate in psychiatric patients include hypercortisolism,[15] exposure to certain psychotropic medications,[9,12,16,17] and adverse lifestyle habits, including poor diet, lack of exercise, and smoking.[11] Studies reporting increased weight in children undergoing treatment with certain antipsychotic, antidepressant, or mood-stabilizing medications have been summarized.[18] This study documents the prevalence of overweight and obesity among adolescents attending a partial hospitalization program for severe mental illness. We also examine relationships with pharmacologic agents and other potential contributory factors. To our knowledge, the rate of overweight in this high-risk subgroup of adolescents has not yet been examined in an outpatient setting.

METHOD

Participants

We conducted a chart review of 114 adolescents aged 12 to 18 years admitted to the Strong Behavioral Health Child and Adolescent Partial Hospitalization Program (PHP), Department of Psychiatry, University of Rochester,

New York, between January 2003 and July 2004. The study was approved by the University of Rochester Research Subjects Review Board. Adolescents meeting program admission requirements included those who required transition from an acute inpatient hospitalization, who were at risk for inpatient hospitalization and referred by a psychiatrist in an emergency room setting, or who were failing outpatient mental health treatment in the community. All of the patients had a Global Assessment of Functioning score of < 50, with the majority in the 31–40 range.

Body Mass Index Definitions

Body mass index (BMI; weight in kg/height in m^2) is the recommended method to categorize weight status for pediatric and adult populations. In the pediatric group, age- and sex-specific percentiles are used to adjust for different patterns of growth and development to identify excess weight.[3] Large deviations in muscle mass or skeletal size may skew some values; thus, individual interpretation by a health practitioner is preferred for clinical use. For this study, however, standard definitions of overweight and obesity in pediatric practice were used: normal BMI is defined as 5th to less than 85th percentile; overweight is defined as BMI of 85th to less than 95th percentile for sex and age (2–19 years); and obesity is defined as BMI ≥ 95th percentile for age and sex. These 3 levels were used in categorical analyses. Our definitions are based on the following BMI ranges for adults, children, and adolescents[2]: normal is ≥ 19 but < 25 kg/m^2, overweight is ≥ 25 but < 30 kg/m^2, and obese ≥ 30 kg/m^2. The current terminology for the Centers for Disease Control and Prevention/American Medical Association/Health Resources and Services Administration Expert Committee Recommendations is to use the term *overweight* for BMI in the 85th to less than 95th percentile for age and sex, previously called "at risk for overweight," and to use the term *obese* for BMI ≥ 95th percentile for age and sex, previously called "overweight"; subsequent references to other published data will use these terms.

Study Design and Measures

Prevalence of overweight and obesity was compared to national norms and available county data. Potentially related factors such as race, age, sex, insurance status, geographic location (zip code), and medication exposure were documented. National norms were obtained from the 3rd NHANES 1988–1994 (NHANES III), a nationally representative survey of the noninstitutionalized civilian US population, which uses a multistage, stratified design.[19] Monroe County data, from Rochester and the surrounding suburbs, were used to determine whether the prevalence of overweight was related to a regional effect (P. Szilagyi, MD, 1999 Immunization and Primary Care Survey, Child Health Studies Group, Monroe County, New York State; personal written communication, February 2006). Racial and ethnic backgrounds were self-reported; the majority of referrals were from an outpatient setting. All regularly scheduled medication use for current and past exposure was recorded at admission to the program. All current and past medications prescribed for the cohort, including those for medical indications, such as asthma and hormonal contraception, were compared between those with normal BMI versus overweight and obese BMI by categories of exposure: stimulants, antidepressants, antipsychotics, anticonvulsants (including lithium and benzodiazepines), and other (such as oral contraceptives, asthma and allergy medications, and clonidine and benztropine). Weight and height were determined with a triple beam scale calibrated once a year.

Statistical Analyses

Various types of risk factors for development of overweight and obesity were considered in this study. Categorical risk factors included demographic risk factors, lifestyle risk factors, and clinical risk factors. Age is the only continuous risk factor.

Unadjusted odds ratios and their 95% CIs were calculated for each categorical risk factor using the χ^2 test. A logistic regression model was conducted to detect the effects of these risk factors on the occurrence of overweight and obesity. The response for the logistic regression is overweight or obese status, a binary variable defined for each subject with BMI ≥ 85th percentile, as opposed to a BMI < 85th percentile, as the reference level. Both continuous and categorical risk factors were included in the model as predictors. Adjusted odds ratios and their 95% CIs for each risk factor after controlling other factors were obtained from the logistic regression. All analyses were performed with SAS version 9.1 (SAS institute, Cary, North Carolina).

RESULTS

There were 84 females (74%) and 30 males, consistent with females being more likely to present for outpatient mental health services.[20] Racial breakdown was as follows: 84% white (n = 96), 8% African American (n = 9), 4% Hispanic (n = 4), 3% biracial (n = 3), and 1% Native American (n = 2). Mean (SD) demographic data were age = 15.2 (1.5) years, weight = 70 (20.9) kg, BMI = 25.9 (7.1) kg/m^2, BMI *z* score = 0.9 (1.2), and BMI percentile = 73.4 (28.4). There were no significant outliers for weight or BMI. There were no significant differences for race, age, sex, or primary Axis I diagnosis between groups. The percentage of PHP adolescents who were overweight or obese was significantly higher than national and county norms ($P < .001$ for both comparisons) (Table 1). The percentage of Monroe County adolescents who were overweight was slightly higher than that of NHANES adolescents ($P < .05$), but the percentage who were obese was similar ($P < .5$). Other statistically significant variables associated with overweight and obesity included Medicaid status; smoking; and stimulant, antidepressant, and antipsychotic exposure

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Table 1. Study Participant Body Mass Index (BMI) Comparison of Partial Hospital Program (PHP); National Health and Nutrition Examination Survey (NHANES); and Monroe County, New York

BMI Group	Age, y	< 85th Percentile, %	≥ 85th Percentile, %	85th to < 95th Percentile, %	≥ 95th Percentile, %
PHP 2003–2004	12–18	44.6	55.4	25.4	30
NHANES 1999–2002	12–19	69.1	30.9	14.8	16.1
Monroe County 2001–2002	11–14	65.8	34.2	17.2	17
PHP versus NHANES		χ^2_1=31.387, P<.001		χ^2_1=9.907, P<.001	χ^2_1=15.860, P<.001
PHP versus Monroe County		χ^2_1=21.024, P<.001		χ^2_1=4.938, P<.05	χ^2_1=12.327, P<.001
NHANES versus Monroe County		χ^2_1=5.465, P<.02		χ^2_1=4.803, P<.05	χ^2_1=0.645, P<.5

Table 2. Demographics and Exposure Risk by Body Mass Index (BMI) for Partial Hospitalization Program Adolescents

Variable	BMI ≥ 85th Percentile (N = 59), n (%)	BMI < 85th Percentile (N = 55), n (%)	Unadjusted Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Demographic risk factor						
Sex						
Male	12 (20.3)	17 (30.9)	0.57	0.24–1.34	1.48	0.49–4.41
Female	47 (79.7)	38 (69.1)				
Race						
White	50 (84.8)	46 (83.6)	1.08	0.40–2.98	1.31	0.34–5.05
Other	9 (15.2)	9 (16.4)				
Lifestyle risk factor						
Medicaid status						
No insurance/Medicaid, Managed Medicaid	26 (44.1)	14 (25.5)	2.31*	1.04–5.11	3.30*	1.07–10.19
Private	33 (55.9)	41 (74.6)				
Residence						
Urban	10 (17.0)	9 (16.4)	1.04	0.39–2.80	0.86	0.24–3.18
Rural/suburban	49 (83.0)	46 (83.6)				
Smoking status						
Smoking	19 (32.2)	8 (14.6)	2.79*	1.10–7.05	4.84*	1.27–18.41
Nonsmoking	40 (67.8)	47 (85.4)				
Clinical risk factor						
Diagnosis			Bipolar vs unipolar = 0.51	0.22–1.19	0.48	0.16–1.43
Bipolar	14 (23.7)	19 (34.5)	Bipolar vs other = 1.11	0.32–3.83	0.84	0.20–3.55
Unipolar	39 (66.1)	27 (49.1)				
Other	6 (10.2)	9 (16.4)	Unipolar vs other = 2.17	0.69–6.80	1.74	0.47–6.40
Antidepressant use						
Used	30 (50.9)	20 (36.4)	1.81	0.86–3.83	2.83*	1.02–7.88
Did not use	29 (49.1)	35 (63.6)				
Stimulant use						
Used	4 (6.8)	14 (25.4)	0.21*	0.07–0.69	0.07**	0.01–0.32
Did not use	55 (93.2)	41 (74.6)				
Antipsychotic use						
Used	13 (22.0)	5 (9.1)	2.83	0.93–8.54	4.33*	1.00–18.7
Did not use	46 (78.0)	50 (90.9)	2.83	0.93–8.54	4.33*	1.00–18.7

*P value < .05.
**P value < .001.

(all P < .05), compared to those with BMI < 85th percentile within the PHP group (Table 2). Odds ratios for these variables are depicted in Figure 1.

Compared with those with private insurance, those without insurance or with Medicaid had a 3.3-fold increased likelihood of being overweight. Forty-four percent of those who were overweight or obese were without private insurance, as compared to 25% of those who were not overweight or obese (P < .04, df = 1). Compared with the nonsmokers, the smoking group had a 4.8-fold increased likelihood of being overweight or obese. Over 30% of those who were overweight or obese were smokers, as compared to 15% who were not overweight or obese (P < .02, df = 1).

For past medication exposure, specific medications prescribed for more than 5% of subjects in either the BMI ≥ 85th percentile or < 85th percentile groups were generally comparable, with only methylphenidate (5% versus 14%), fluoxetine (10% versus 12%), sertraline (15% versus 16%), paroxetine (11.8% versus 19.3%), citalopram (11.9% versus 3.5%), and risperidone (10.2% versus 7%) prescribed for more than 10% of subjects. Current medication exposures > 10% (at time of admission) included citalopram (22% versus 25%), venlafaxine (13.6% versus 0%), escitalopram (6.8% versus 10.9%), trazodone (13.6% versus 5.45%), sertraline (16.9% versus 10.9%), risperidone (20.3% versus 20%), divalproex (10.2% versus 7.3%), and lithium (13.6% versus 12.7). Only citalopram and risperidone were prescribed for 20% or more of subjects in both groups. The odds of overweight or obesity were similar between categories of past and current medication use. Compared with subjects who did not use antidepressants, current antidepressant users had 2.8-fold odds of overweight or obesity. Sixty percent

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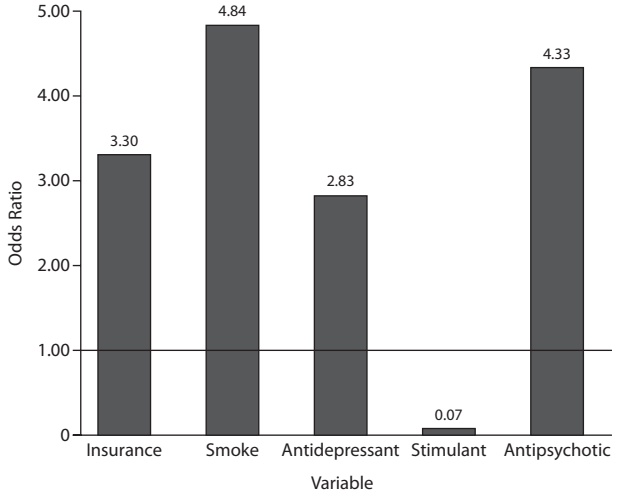
Figure 1. Variables Associated With Overweight and Obesity in the Study Participants



of current antidepressant users were overweight or obese versus 45% of those who did not use antidepressants ($P < .05$, $df = 1$). A significant difference for specific antidepressant type between those with overweight or obesity and those of normal BMI was present only for venlafaxine; however, no teen of normal BMI had been prescribed venlafaxine. Compared with those not treated with antipsychotics, current antipsychotic users had 4.3-fold odds of overweight. Seventy-two percent of antipsychotic users were overweight or obese versus 48% of those who did not use antipsychotics ($P < .04$, $df = 1$). Past or current stimulant use was associated with a decreased risk for overweight or obesity; odds of overweight decreased 93% (odds ratio = 0.07) for subjects using stimulants in the past. Fewer stimulant users were obese, (22% versus 57% of those not using stimulants; $P < .001$, $df = 1$).

DISCUSSION

Significantly more adolescents in our sample with severe mental illness were overweight or obese compared to community and national peer groups, placing the sample at increased risk for the development of obesity-related comorbid physical diseases. This study is one of the first to identify adolescents with severe mental illness as a specific subpopulation at increased risk for overweight and obesity. The youth of the sample and corresponding onset of illness underscore a much lower lifetime exposure to both medication and illness to date, making the findings of elevated BMI particularly concerning. Our study may indicate that increased weight among adolescents with severe mental illness may occur prior to treatment with psychotropic medications, as prevalence and duration of psychotropic medication exposure among this sample were relatively low. A study of 300 psychiatrically hospitalized children and adolescents also found twice the rate of obesity (28.7%) as compared to the prevalence in NHANES III, with 14.3% overweight. In the subgroup exposed, atypical antipsychotic use was associated with BMI z score as well (2-tailed $P = .006$).[20] Our population had a very similar percentage of obesity (30%), but higher overweight (25.4%). The similar time points for data collection (2002–2003) and different (Southeast) location also provide indirect support for a cohort effect. The study, likewise, did not find any significant associations with sex or race.

A follow-up study by this group found a 51.1% prevalence of overweight and obesity in adolescent inpatients treated at a public-sector hospital receiving statewide referrals; the majority had mood and psychotic disorders.[21] The association between overweight and obesity and Medicaid status may vary regionally. In the North Carolina Nutrition and Physical Activity Surveillance System,[22] 17.5% of adolescents aged 12–18 years enrolled in Medicaid were at risk for overweight, and 28.9% were overweight in 2004. A subanalysis from the 2003 National Survey of Children's Health examined state-level overweight and obesity prevalence rates for children aged 10–17 years as well as across-state variation.[23] Disparity ratios assessed within-state equity according to children's insurance type, income, race, and ethnicity. Prevalence of within-state and across-state childhood overweight and obesity varied significantly, with higher and lower rates of overweight and obesity as well as more and less disparity than national averages. No correlations were found between disparities of insurance, income, and race and state overweight and obesity prevalence rates. Non-Hispanic black and Hispanic children were, however, more likely to be overweight and obese independent of income. New York was 1 of the 5 states with the lowest disparity rate for ethnicity, supporting our finding of race and ethnicity as not associated with elevated BMI for our sample. Both North Carolina and New York prevalences of overweight and obesity were insignificantly higher than the mean.

The American Psychiatric Association, in conjunction with the American Diabetes Association, has recognized the potential for second-generation antipsychotics to induce weight gain. A jointly issued practice statement has, for adults, recommended baseline screening for diabetes and lipid disorders, as well as close monitoring for weight gain and changes in other cardiovascular risk factors on initiation of psychotropic medications.[24] The identification of the metabolic syndrome in overweight adolescents,[1] in the context of children and adolescents beginning potential weight gain–inducing psychotropic medications, has led to the proposal for such monitoring in pediatric patients as well.[19,25]

Our study may also be one of the first to identify smoking as one of several significant variables associated with overweight and obesity in adolescents with severe mental illness. Smoking is an independent risk factor for diabetes and cardiovascular disease. Known risk factors for adolescent smoking include psychosocial stressors (childhood abuse and low socioeconomic status), presence of smokers in the

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environment (family members or friends), and depression.[26] Smoking initiation is more frequent in overweight females.[27] In addition, the prevalence of metabolic syndrome increases with tobacco exposure, rising from 1.2% in teens not exposed to environmental tobacco smoke to 5.4% in those exposed to environmental tobacco smoke and 8.7% in those who smoked.[27] Young adults aged 18–24 years had a 4.5% prevalence of obesity and smoking. Although there is no information for adolescents, the combination of obesity and smoking in adulthood, including young adults 18–24 years old, is associated with lower socioeconomic status.[28] Overweight or obesity and light and heavy smoking respectively beginning in adolescence are independent predictors for increased mortality.[29] Our association adds to previous findings that smoking is a contributing risk factor for the metabolic syndrome in adolescents.[30]

The risk factors found to be significant in our work highlight potential target areas for further investigation into the causes for overweight and obesity in adolescents with severe mental illness and also suggest areas for prevention and intervention. The psychosocial factor of financial status may represent proxy variables for unsafe neighborhoods, lack of access to exercise, and unavailability of healthy food choices. Supportive evidence for limited access to fresh fruits and vegetables was recently demonstrated in our population's urban demographic area (C. Arivizo, BS, URMC Urban Fellow report, personal written communication, August 2007). Evidence for psychotropic medication contributions to weight gain are being delineated in recent and ongoing clinical trials for atypical antipsychotics[31] and mood stabilizers in adolescents; potential lifestyle and pharmacologic interventions have been outlined[18,32] but require prospective evaluation. Potentially relevant biologic factors include individual and family genetic risk for increased weight as well as illness-related factors such as elevated cortisol, a potential contributor to insulin resistance and central obesity. The role of smoking and effects of smoking cessation in adolescents with severe mental illness on weight warrant further investigation as well, as preventive strategies and interventions currently exist.

Limitations of this work include its cross-sectional nature, local patterns in referral and prescribing practices, lack of baseline BMI data at time of initial onset of illness, and relatively small sample size with lack of a nonpsychiatric control group. Strengths include its diverse population, local normative data, and fairly comprehensive risk factor assessment, including biologic and psychosocial variables.

Future assessments of teens with severe mental illness involving a larger subject pool are needed to confirm our findings. Prospective work to determine relative contributions of social and lifestyle, iatrogenic, and biologic factors specific to overweight and obesity in mentally ill adolescents will aid development of specifically targeted, individualized, effective, and comprehensive prevention and intervention strategies. End goals of preventing physical, emotional, and economic consequences of obesity include improving overall health and quality of life and decreasing future illness burden. Expert recommendations regarding prevention, assessment, and treatment of child and adolescent overweight and obesity[33–37] are now available and contain prudent steps to help initiate risk factor identification, education, monitoring, and intervention at the time an adolescent presents to the mental health system until more specific information about this important subgroup is known.

Drug names: benztropine (Cogentin), citalopram (Celexa and others), clonidine (Catapres, Duraclon, and others), divalproex (Depakote and others), escitalopram (Lexapro and others), fluoxetine (Prozac and others), lithium (Eskalith, Lithobid, and others), methylphenidate (Ritalin and others), paroxetine (Paxil, Pexeva, and others), risperidone (Risperdal and others), sertraline (Zoloft and others), venlafaxine (Effexor and others).

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Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Childhood and Adolescent Mental Health section. Please contact Karen D. Wagner, MD, PhD, at kwagner@psychiatrist.com.

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