ORIGINAL ARTICLE

Association Between Obesity and Psychiatric Disorders in the US Adult Population

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Background: Epidemiologic data suggest an association between obesity and depression, but findings vary across studies and suggest a stronger relationship in women than men.

Objective: To evaluate the relationship between obesity and a range of mood, anxiety, and substance use disorders in the US general population.

Design: Cross-sectional epidemiologic survey.

Setting: Nationally representative sample of US adults.

Participants: A total of 9125 respondents who provided complete data on psychiatric disorder, height, and weight. Response rate was 70.9%.

Main Outcome Measures: Participants completed an in-person interview, including assessment of a range of mental disorders (assessed using the World Health Organization Composite International Diagnostic Interview) and height and weight (by self-report).

Results: Obesity (defined as body mass index [calculated as weight in kilograms divided by the square of height in meters] of ≥30) was associated with significant increases in lifetime diagnosis of major depression (odds ratio [OR], 1.21; 95% confidence interval [CI], 1.09-1.35), bipolar disorder (OR, 1.47; 95% CI, 1.12-1.93), and panic disorder or agoraphobia (OR, 1.27; 95% CI, 1.01-1.60). Obesity was associated with significantly lower lifetime risk of substance use disorder (OR, 0.78; 95% CI, 0.65-0.93). Subgroup analyses found no difference in these associations between men and women, but the association between obesity and mood disorder was strongest in non-Hispanic whites (OR, 1.38; 95% CI, 1.20-1.59) and college graduates (OR, 1.44; 95% CI, 1.14-1.81).

Conclusions: Obesity is associated with an approximately 25% increase in odds of mood and anxiety disorders and an approximately 25% decrease in odds of substance use disorders. Variation across demographic groups suggests that social or cultural factors may moderate or mediate the association between obesity and mood disorder.

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THE INCREASING PREVALENCE of overweight and obesity is a major public health concern. Among US adults, prevalence of obesity (defined as a body mass index [BMI, calculated as weight in kilograms divided by the square of height in meters] of ≥30) increased from approximately 23% in 1990 to 31% in 2000.[1] Similar increases were seen for men and women, across all age groups, and across all racial/ethnic groups.[1,2] More recent data indicate no decline in obesity rates between 2000 and 2002.[2] Given the expected increases in diabetes, cardiovascular disease, and other adverse consequences of obesity, increasing obesity rates are expected to produce an unprecedented decline in life expectancy in the United States.[3]

Regulation of weight is a complex phenomenon subject to a range of individual-level and community-level influences. In the United States, obesity prevalence is higher among middle-aged and older adults than younger adults.[1,2] Obesity is also more common among Hispanics and African Americans than other racial/ethnic groups,[1,2] with racial/ethnic differences greater among women than men.[2] In developed economies, obesity is inversely associated with income and other indicators of socioeconomic status,[4-6] but this relationship may be weakening over time.[5] At the community level, obesity is associated with greater access to inexpensive, calorie-dense foods[4,7,8] and with reduced opportunities for physical activity.[9,10]

Previous research suggests that obesity may be significantly associated with mood disorders.[11,12] Several community surveys in the United States and Canada have found associations between obesity and depressive symptoms,[13,14] history of depression,[15] and measures of psychological dis-

tress.[16] Several US surveys have observed sex differences in this relationship, with positive associations between obesity and depression among women and either negative or no associations among men.[17-20] One US survey[14] suggests a stronger association between obesity and depression among those younger than 65 years. Community survey data from the 1950s suggest a stronger association between obesity and depression among those with higher socioeconomic status.[21] The associations between depression and obesity observed in largely white sample populations in the United States and Canada, however, may not extend to other cultural or ethnic groups.[22,23] Longitudinal studies have found that depression predicts the subsequent onset of obesity,[24,25] that obesity predicts the subsequent onset of depression,[26] that successful weight loss is associated with decreased depression,[27] and that depression predicts poorer success in weight loss.[28,29]

Limited epidemiologic data address the relationship between obesity and anxiety or substance use disorders. Anxiety symptoms have shown moderate positive associations with obesity in community[30] and clinic[31,32] samples. Alcohol abuse has been associated with a lower risk of overweight and obesity.[33]

We used data from the National Comorbidity Survey Replication (NCS-R) to examine whether associations between depression and obesity continue to appear in the most recent survey of mental disorders in the United States and whether those associations extend to other mental disorders. We focus on the following questions: What are the current associations between obesity and a range of common mental disorders (mood, anxiety, and substance use disorders) in the US population? Do these associations vary according to sociodemographic characteristics: sex, age, race/ethnicity, and educational attainment (demographic characteristics consistently associated with obesity in the US population)?

METHODS

The NCS-R was an in-person survey of a nationally representative sample of US residents conducted between February 5, 2001, through February 12, 2003. Respondents were selected from a multistage area probability sample of the noninstitutionalized civilian population in the 48 contiguous states. The response rate was 70.9%. More complete information on the methods of the NCS-R is presented elsewhere.[34,35]

Potential participants were mailed a letter and a study fact brochure. This was followed by an in-person interviewer visit. Interviewers explained the study procedures and obtained verbal informed consent before beginning the interview. Participants received $50 for participating. Recruitment and consent procedures were approved by the human subjects committees of Harvard Medical School, Boston, Mass, and the University of Michigan, Ann Arbor.

Professional nonclinician interviewers from the Institute for Social Research at the University of Michigan conducted all assessments. More than 300 interviewers participated in the study, each receiving 7 days of study-specific training and successfully completing 2 practice interviews before beginning field work. Interviews were administered using laptop computer-assisted software that included built-in skip logic, timing flags, and consistency checks. Regional supervisors recontacted a random 10% of respondents for quality control.

Table 1. Demographic Characteristics of Study Sample*

Characteristics	BMI <30 (n = 6795)	BMI ≥30 (n = 2330)	Total Sample (N = 9125)
Age, mean (SE), y	44.3 (0.5)	46.3 (0.3)	44.8 (0.4)
Female	51.1	52.3	51.4
>12 Years of education	53.6	45.9	51.7
Married or cohabiting	54.8	58.6	55.8
Race			
White	74.9	68.3	73.2
Hispanic	10.2	12.8	10.9
African American	10.2	15.7	11.6
Other race/ethnicity	4.7	3.2	4.3
Current smoker	26.2	21.9	25.1
Former smoker	23.9	26.3	24.5

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters).
*Data are presented as percentage of patients unless otherwise indicated.

Mental disorders were assessed using the World Mental Health version of the World Health Organization Composite International Diagnostic Interview (CIDI).[36] This fully structured diagnostic assessment was developed for use by trained nonclinician interviewers in diverse community populations. Mental disorder diagnoses are based on criteria of the *DSM-IV*. Diagnoses considered in this article include mood disorders (major depression, dysthymia, or bipolar disorder I or II), anxiety disorders (panic disorder, agoraphobia without panic, or generalized anxiety disorder), and substance use disorders (alcohol abuse and dependence or drug abuse and dependence). Previous research has documented good concordance between the NCS-R CIDI diagnoses and blind clinical diagnoses, with the CIDI generally having a higher diagnostic threshold in comparison with blind clinical diagnoses.[36]

Demographic characteristics (age, sex, and race/ethnicity), height, and weight were assessed by participants' self-reports. Previous methodological research suggests that self-reported height and weight are highly correlated with direct physical measurements,[37-39] but self-report tends to consistently underestimate weight and overestimate height,[38-41] leading to low estimates of overweight and obesity.

All analyses were based on weighted data and implemented using SUDAAN statistical software (Research Triangle Institute, Research Triangle Park, NC, 2002). The clustered sampling design of the NCS-R study could lead to overestimation of statistical significance (ie, design effect). Consequently, significance tests, standard errors, and 95% confidence intervals (CIs) were estimated using the Taylor Series method (delta method). All significance tests were made using 2-sided tests evaluated at the .05 level of statistical significance.

RESULTS

This article includes 9125 NCS-R respondents (of 9282 possible) who provided data on height and weight. **Table 1** compares respondents with BMIs less than 30 with those with BMIs of 30 or more. As expected, those with higher BMIs were more often African American or Hispanic and were less likely to have completed more than 12 years of education.

As reported in **Table 2**, lifetime prevalence estimates for mood and anxiety disorders are all higher among those with BMIs of 30 or more than among those with BMIs less

than 30. Odds ratios (ORs) comparing rates of specific mood and anxiety disorders in the obese and nonobese groups range from approximately 1.2 to 1.5. A similar pattern was seen for prevalence of mood or anxiety disorders in the last 12 months, with ORs in the range of 1.1 to 1.6. In contrast, lifetime and past-year prevalence estimates for substance use disorders are significantly lower in those with BMIs of 30 or more. Some relationships (eg, major depression or any mood disorder) are statistically significant for lifetime diagnosis and not so for past-year diagnosis. This discrepancy, however, reflects wider CIs (due to lower prevalence rate and fewer cases) rather than clinically or statistically significant differences in ORs.

Table 2. Lifetime Prevalence of Selected Mental Disorders by BMI

Variable	Prevalence If BMI <30, %	Prevalence If BMI ≥30, %	OR (95% CI)
Lifetime			
Mood disorder	18.3	22.0	1.27 (1.15-1.41)
Major depression	16.0	18.6	1.21 (1.09-1.35)
Bipolar disorder	1.9	2.8	1.47 (1.12-1.93)
Anxiety disorder	9.8	12.3	1.28 (1.05-1.57)
Generalized anxiety	5.4	6.5	1.20 (0.99-1.47)
Panic or agoraphobia	5.6	7.1	1.27 (1.01-1.60)
Substance use disorder	15.6	12.8	0.78 (0.65-0.93)
Last 12 months			
Mood disorder	8.1	9.5	1.19 (1.00-1.42)
Major depression	6.6	7.2	1.09 (0.89-1.34)
Bipolar disorder	1.3	2.0	1.61 (1.07-2.43)
Anxiety disorder	5.3	7.0	1.34 (1.07-1.66)
Generalized anxiety	2.6	2.9	1.12 (0.77-1.64)
Panic or agoraphobia	3.1	4.6	1.50 (1.20-1.87)
Substance use disorder	4.3	2.9	0.65 (0.40-1.06)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); CI, confidence interval; OR, odds ratio.

Subgroup analyses examined the relationship between obesity and mood disorders across different sociodemographic groups (**Table 3**). This association did not vary significantly between men and women ($P=.65$ for interaction). Although the association between obesity and mood disorder appears stronger among younger respondents, a formal test for interaction finds no significant variation with age ($P=.40$ for interaction with years of age as continuous measure). The association between obesity and mood disorder is only statistically significant among respondents with more than 12 years of education, and a formal test for interaction finds significant variation by years of educational attainment ($P=.007$ for interaction with years of education as continuous measure). The association between obesity and mood disorder is statistically significant only among non-Hispanic whites. A formal test for interaction finds a borderline significant difference in ORs between non-Hispanic whites and other racial/ethnic groups ($P=.06$ for interaction with non-Hispanic whites vs other racial/ethnic groups). Columns 2 and 3 of Table 3 give the variation in mood disorder prevalence and obesity prevalence by age, educational attainment, and race/ethnicity. The sociodemographic groups that showed the strongest association between obesity and depression (age ≤29 years, college education or higher, non-Hispanic whites) are also among the groups with the lowest prevalence of obesity.

Parallel subgroup analyses examined the association between obesity and anxiety disorders across demographic groups (**Table 4**). This association does not vary significantly according to sex ($P=.52$), age ($P=.13$), or race/ethnicity ($P=.21$). The association is strongest in those with the highest educational attainment, and a formal test for interaction is marginally significant ($P=.06$ for interaction with years of education as a continuous measure).

Table 3. Lifetime Prevalence of Mood Disorder by BMI Stratified by Age, Educational Attainment, and Race/Ethnicity

Variable	Overall Prevalence of BMI ≥30, %	Overall Prevalence of Mood Disorder, %	Mood Disorder Prevalence If BMI <30, %	Mood Disorder Prevalence If BMI ≥30, %	OR (95% CI)
Sex					
Male	24.8	14.9	14.3	16.9	1.21 (0.99-1.46)
Female	25.7	23.1	22.1	26.6	1.29 (1.11-1.50)
Age, y					
≤29	17.8	18.6	17.5	23.8	1.49 (1.06-2.08)
30-44	26.5	22.2	21.2	24.9	1.23 (0.96-1.58)
45-59	30.6	22.7	22.3	23.8	1.11 (0.90-1.35)
≥60	25.0	11.4	10.8	13.3	1.27 (0.94-1.72)
Educational attainment, y					
<12	29.3	17.3	17.3	17.3	1.01 (0.82-1.24)
12	27.8	18.4	17.7	20.3	1.20 (0.97-1.49)
13-15	25.5	21.5	19.9	26.0	1.42 (1.16-1.75)
≥16	18.9	19.0	17.9	23.8	1.44 (1.14-1.81)
Race/ethnicity					
Black	34.3	14.6	14.6	14.5	1.01 (0.75-1.36)
Hispanic	29.8	17.0	16.8	18.0	1.11 (0.63-1.94)
White (not Hispanic)	23.5	20.2	18.9	24.4	1.38 (1.20-1.59)
Other	18.6	19.8	19.0	22.7	1.15 (0.63-2.11)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); CI, confidence interval; OR, odds ratio.

Table 4. Lifetime Prevalence of Anxiety Disorder by BMI Stratified by Age, Educational Attainment, and Race/Ethnicity

Variable	Overall Prevalence of BMI ≥30, %	Overall Prevalence of Anxiety Disorder, %	Anxiety Disorder Prevalence If BMI <30, %	Anxiety Disorder Prevalence If BMI ≥30, %	OR (95% CI)
Sex					
Male	24.8	7.5	7.2	8.4	1.17 (0.82-1.67)
Female	25.7	13.2	12.4	15.8	1.34 (1.09-1.64)
Age, y					
≤29	17.8	8.8	8.5	10.2	1.22 (0.83-1.79)
30-44	26.5	12.3	12.2	12.6	1.04 (0.76-1.41)
45-59	30.6	13.2	12.2	15.4	1.31 (0.99-1.74)
≥60	25.0	6.4	5.5	8.8	1.64 (1.02-2.64)
Educational attainment, y					
<12	29.3	10.0	7.5	16.2	2.42 (1.69-3.47)
12	27.8	10.2	10.3	9.9	0.96 (0.71-1.31)
13-15	25.5	11.9	11.2	14.0	1.29 (0.98-1.69)
≥16	18.9	9.4	9.2	10.1	1.10 (0.71-1.72)
Race/ethnicity					
Black	34.3	8.3	8.1	8.7	1.06 (0.66-1.70)
Hispanic	29.8	9.7	7.6	14.7	2.11 (1.24-3.59)
White (not Hispanic)	23.5	10.9	10.5	12.4	1.20 (0.96-1.51)
Other	18.6	10.0	8.2	17.9	2.49 (0.97-6.37)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); CI, confidence interval; OR, odds ratio.

A third set of subgroup analyses examined variation in the association between obesity and substance use disorders (**Table 5**). This negative association does not vary significantly by sex ($P=.46$), age ($P=.22$), race/ethnicity ($P=.43$), or educational attainment ($P=.36$).

The final set of analyses considered potential confounders that might magnify or obscure associations between obesity and psychiatric disorders. Adjustment for age and sex has no effect on the observed associations (third column of **Table 6**). Although smoking is positively associated with psychiatric disorder and negatively associated with obesity, adjustment for smoking status has no meaningful effect on associations between obesity and mood disorder, anxiety disorder, or substance use disorder (fourth column of Table 6). Finally, adjustment for comorbid psychiatric disorder (eg, effect of substance use disorder adjusted for mood and anxiety disorders) also had no meaningful effect on observed associations (fifth column of Table 6).

COMMENT

We observed significant positive associations between obesity and a range of mood and anxiety disorders in a nationally representative sample of the US household population. In contrast, substance use disorders were associated with significantly lower risk of obesity. These associations were not explained by confounding due to age, sex, smoking, or comorbid psychiatric disorders. Mood and anxiety disorders each made independent contributions to obesity risk.

The positive associations between obesity and mood or anxiety disorders were generally modest, with ORs in the range of 1.2 to 1.5. Even these modest associations carry public health significance, though, given the high overall prevalence of obesity (approximately 25%) and mood or anxiety disorders (approximately 25%). The estimated prevalence of lifetime mood disorder in those with BMIs below 30 and in those with BMIs 30 or higher translate to a population attributable risk of 24%, which indicates that nearly one quarter of the cases of obesity in the general population are attributable to the association with mood disorder. This calculation illustrates the public health importance of the association but does not indicate a direction for the causal relationship. It is equally correct to state that more than one fifth of cases of mood disorder in the general population are attributable to the association with obesity (population attributable risk of 21%). We have no way of distinguishing the direction of the causal relationship between obesity and psychiatric disorders or the possibility that unmeasured common causes induce an association between them.

The NCS-R offers several advantages over previous community surveys used to examine associations between psychiatric disorders and obesity. First, the sample was designed to be an accurate representation of the noninstitutionalized population of the 48 contiguous United States. Results can be generalized to this population. Second, the survey assessed a full range of psychiatric and substance use disorders, allowing us to examine associations with anxiety disorders, bipolar disorder, and substance use disorders. Third, mental disorders were assessed using a well-validated structured diagnostic interview, which allowed the association of obesity with these disorders to be assessed with accuracy. Fourth, the assessment considered lifetime diagnoses and current state. Assessment of lifetime diagnosis is preferable because an association between weight and psychiatric disorder would be expected to reflect long-term behavioral and/or biological mechanisms.

The associations between obesity and psychiatric disorders in this sample did not vary between men and

Table 5. Lifetime Prevalence of Substance Use Disorder by BMI Stratified by Age, Educational Attainment, and Race/Ethnicity

Variable	Overall Prevalence of BMI ≥30, %	Overall Prevalence of Substance Use Disorder, %	Substance Use Disorder Prevalence If BMI <30, %	Substance Use Disorder Prevalence If BMI ≥30, %	OR (95% CI)
Sex					
Male	24.8	21.3	22.4	18.1	0.75 (0.60-0.93)
Female	25.7	8.9	9.2	8.1	0.88 (0.65-1.18)
Age, y					
≤29	17.8	17.2	16.8	19.0	1.13 (0.65-1.97)
30-44	26.5	18.1	19.2	15.6	0.75 (0.56-1.02)
45-59	30.6	15.7	18.0	11.1	0.57 (0.38-0.84)
≥60	25.0	6.5	6.7	5.7	NE
Educational attainment, y					
<12	29.3	18.7	20.6	13.9	0.59 (0.39-0.90)
12	27.8	15.0	15.3	14.2	0.90 (0.66-1.21)
13-15	25.5	15.7	17.2	11.6	0.63 (0.50-0.78)
≥16	18.9	10.7	10.6	10.8	1.04 (0.71-1.53)
Race/ethnicity					
Black	34.3	11.0	13.4	7.0	0.49 (0.29-0.84)
Hispanic	29.8	16.5	16.7	15.8	0.94 (0.55-1.62)
White (not Hispanic)	23.5	15.0	15.5	13.4	0.83 (0.67-1.03)
Other	18.6	19.0	18.3	22.4	1.11 (0.38-3.21)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); CI, confidence interval; NE, not estimable because of the small number of cases; OR, odds ratio.

Table 6. Adjusted ORs (With 95% CIs) for Association Between Obesity and 3 Categories of Psychiatric Disorder

Disorder	Unadjusted OR	OR Adjusted for Age and Sex	OR Adjusted for Age, Sex, and Smoking	OR Adjusted for Age, Sex, Smoking, and Other Psychiatric Disorders*
Mood	1.27 (1.15-1.41)	1.24 (1.11-1.39)	1.27 (1.13-1.42)	1.25 (1.11-1.42)
Anxiety	1.28 (1.05-1.57)	1.23 (1.01-1.50)	1.25 (1.02-1.54)	1.21 (0.96-1.52)
Substance use	0.78 (0.65-0.93)	0.76 (0.63-0.92)	0.82 (0.68-0.98)	0.79 (0.67-0.95)

Abbreviations: CI, confidence interval; OR, odds ratio.
*The OR for mood disorders was adjusted for anxiety and substance use disorders, the OR for anxiety disorders was adjusted for mood and substance use disorders, and the OR for substance use disorders was adjusted for mood and anxiety disorders.

women. This contrasts with findings in other US national surveys[17-20] that indicate that positive associations between obesity and depression exist among women, whereas negative or absent associations exist among men. We are unable to identify any consistent differences in methods between our study and previous studies that would explain why earlier studies found no association between obesity and depression in men, whereas such an association was observed in the NCS-R sample. In one earlier study,[20] the magnitude of the OR between obesity and depression in men was similar to that in women, but the lower prevalence of depression in men led to a wider CI and a statistically insignificant result. A similar phenomenon is seen in this sample for both mood and anxiety disorders. Because we observe no statistically significant interaction with sex, we conclude that this discrepancy (significant association in women but not in men) probably reflects differences in statistical power rather than differences in magnitude of the association.

Most previous research has focused on the association between obesity and depression, and various mechanisms have been proposed to explain this relationship.[11,12,42] Some of those mechanisms propose a causal pathway that leads from depression to obesity. Increased appetite and weight gain are common symptoms of depression,[43,44] and tendency to gain weight remains stable across depressive episodes.[43] Depression may lead to reduced physical activity,[45] increasing the risk of obesity. Depression may increase risk of weight gain through its effect on binge eating,[46,47] especially among women.[28,48] Medications used to manage mood or anxiety disorders may also lead to weight gain.[49] Alternatively, some proposed mechanisms suggest a causal relationship that leads from obesity to depression. The stigma attached to obesity (especially for women) may contribute to depression.[50,51] Activity limitations due to obesity or obesity-related chronic illnesses may increase risk of depression by reducing involvement in rewarding or pleasurable activities.[30] Finally, depression and obesity may be linked through some common cause or third factor, either environmental (eg, childhood abuse[52]) or biological.

We observed an interesting variation in the relationship between obesity and mood disorder across socio-

demographic groups. The association appeared stronger in younger than older respondents, in non-Hispanic whites than other racial/ethnic groups, and in respondents with higher educational attainment. Only the interaction with educational attainment, however, was significant at the .05 level. Approximately 40 years ago, The Midtown Manhattan Study[21] also observed that, among women, the association between obesity and depression was confined to those with higher socioeconomic status. In the NCS-R sample, the groups that showed the strongest association between obesity and mood disorder were also the groups with the lowest overall rates of obesity. A similar phenomenon has been observed regarding the association between depression and tobacco use; as rates of tobacco use decline, the association between tobacco use and depression grows stronger.[53]

Our findings are consistent with either direction of causal relationship between obesity and mood or anxiety disorders. If stigmatization of overweight and obesity causes or contributes to mood and anxiety disorders, the effects of stigma might be more powerful in sociodemographic groups with lower obesity rates. Some previous research suggests that self-perception of overweight[54,55] and the perceived stigma associated with obesity[56-59] may both be greater in white populations and those with higher income or educational attainment. Alternatively, if mood or anxiety disorders contribute to obesity through an effect on health behaviors (reduced physical activity, increased caloric intake), then this effect could be more easily expressed in sociodemographic groups with lower obesity rates. This cross-sectional study does not allow us to distinguish between causal mechanisms or examine how they might differ across sociodemographic groups.

Our findings also do not indicate a specific mechanism or causal direction for the observed negative association between obesity and substance use disorders. Although alcohol or other substances may have a direct effect on appetite or caloric intake, a negative association was also observed in those with histories of substance abuse (ie, lifetime substance use disorder not active in the last 12 months).

We conclude that obesity is meaningfully associated with a range of common mood and anxiety disorders in the general US population. Obesity is associated with a moderately lower risk of substance use disorder. Variation in the obesity-depression relationship by educational level and race/ethnicity suggests an important role of social or cultural factors in mediating or moderating the relationship between obesity and mood disorders. Clarifying the social and cultural influences on the relationship between obesity and mood or anxiety disorders will require additional research in populations with a broader range of race/ethnicity, educational attainment, and income. Clarifying the direction of causal relationships will require alternative research designs, including longitudinal and experimental studies.

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