

The Relation of Body Mass Index to Depressive Symptoms

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ABSTRACT

Objective: Data from the 1995 Nova Scotia Health Survey were analyzed to determine the relation between body mass index (BMI) and the risk of depression as measured by the Center for Epidemiological Studies Depression Scale (CES-D).

Methods: Clinical measures for height and weight and CES-D scores were available for 2,482 subjects from an initial sample of 5,578 Nova Scotians stratified probabilistically to be representative of age, gender and area of residence. BMIs were categorized according to the international standards (BMI 18.5-24.9 acceptable weight; 25-29.9 overweight; ≥ 30 obese).

Results: More men than women were classified as overweight (43.2% vs. 28.3%) but slightly more women than men were obese (25.6% vs. 23.4%). Based on the summary score of the CES-D, 14.2% were categorized as at risk for depression (≥ 16). Logistic regression indicated that lower education ($p < 0.001$) and income ($p < 0.001$), and BMI category ($p < 0.05$) were all significantly related to an increased risk of depression. The odds ratio for the association between obesity and depression, after controlling for education and income, was 1.41 [95% CI = 1.07-1.86].

Discussion: More studies are needed to ascertain the mechanism by which obesity and depression could be related and the significance of this relation for the prevention and treatment of both obesity and depression. Given the effects of depression, we suggest that health professionals should assess their obese patients for risk of depression before embarking on a weight management protocol.

La traduction du résumé se trouve à la fin de l'article.

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Increased body weight clearly is related to a host of chronic physical ailments;¹ less certain is whether it is also related to mental health. While early work had shown a correlation between obesity and depression in clinical populations,²⁻⁴ it has been more difficult to find this relation in community settings.⁵

An evaluation of Health Canada's population data failed to show a significant relation between weight and depression except among overweight and obese former smokers.⁶ In a large US study, different relations between body mass index (BMI) and depression were found for men and women. Increased BMI was associated with major depression in women while lower BMI was associated with major depression in men.⁷ In a prospective community-based study, obesity was associated with the development of depression one year later when obesity was defined as body weight above the 85th percentile. This relation was not significant, however, if obesity was defined as BMI ≥ 30 .⁸ Evaluation of subsequent prospective data from the same initial sample indicated that obesity, when defined as a BMI ≥ 30 , was predictive of the development of depression five years later, but the reverse was not true: depression did not predict obesity over the same time frame,^{9,10} suggesting that obesity is a causal antecedent for depression.

It is well accepted that the prevalence of depression, which is generally defined as a mental state characterized by feelings of sadness, loneliness, despair, low self-esteem and self-reproach, is greater among women than men.^{11,12} Although some investigators have suggested a convergence in the gender gap in depression at the time of menopause,¹³ a recent study using the Canadian National Population Health Survey (NPHS) showed gender differences persisted.¹⁴ The literature on the relation between depression and age is inconsistent, but Canadian data indicate that the prevalence of depression was higher in adolescents and young adults and declined sharply for both older men and women.¹⁴ Socio-economic status (SES) is also associated with depression. According to a recent meta-analysis, low-SES individuals have higher odds (OR = 1.81) of being depressed, with a dose-response relation observed for both education and income.¹⁵

TABLE I
Characteristics of Subjects Who Completed the CES-D and Were Measured for Height and Weight

	n	%
Sex		
Male	1211	49.8
Female	1220	50.2
Income		
< \$20,000	538	25.9
≥ \$20,000	1541	74.1
Education		
Up to Secondary	1169	48.2
Post-secondary	1256	51.8
BMI		
< 18.5*	51	2.1
18.5-24.9	935	37.7
25-29.9	886	35.7
≥ 30	610	24.6
Age Group		
18-34	758	31.2
35-64	1111	45.7
≥ 65	562	23.1
Smoking Status		
Current smokers	656	27.0
Non-smokers	1146	47.1
Unspecified	629	25.9

* Not included in the analysis

Atlantic Canadians have the highest rates of obesity in Canada.¹⁶ In Nova Scotia, body weights increased significantly over the nine-year period from 1986-1995.¹⁷ In the 1995 Nova Scotia Health Survey (NSHS), one in seven Nova Scotians also reported elevated symptoms of depression.¹⁸ Depression has also been associated with poor treatment outcomes and decreased compliance for other chronic conditions.^{19,20} The increasing incidence of obesity and its possible relation to depressive symptoms is of major public health significance. Understanding relations between depression and weight may help in the design of effective weight management programs and provide additional support for the importance of community endeavours in this area.

METHODS

Participant selection

The 1995 NSHS randomly selected 5,578 persons aged 18 and over, representative of the population by age, gender and area of residence from the provincial medical insurance registry. Of the 83% (4,649) of selected individuals who were located, 3% were screened out because they were pregnant or breastfeeding or they had serious mental or physical difficulties. Of those

TABLE II
Mean CES-D Scores ± SD Based on Age, Sex and Weight Status

	Females			Males		
	n	Mean CES-D score	SD	n	Mean CES-D score	SD
Age 18-34						
BMI:						
Acceptable	204	10.2	± 9.3	173	7.9	± 6.6
Overweight	88	7.8	± 7.6	134	6.5	± 6.2
Obese	81	9.6	± 9.1	78	8.3	± 7.2
Totals:	373	9.5	± 8.9	385	7.5	± 6.6
Age 35-64						
BMI:						
Acceptable	227	7.8	± 9.2	130	5.8	± 7.4
Overweight	166	7.0	± 7.8	258	6.5	± 7.6
Obese	171	9.6	± 9.2	159	7.5	± 8.4
Totals:	556	7.9	± 8.9	547	6.6	± 7.8
Age ≥ 65						
BMI:						
Acceptable	110	5.9	± 6.6	91	7.1	± 7.4
Overweight	103	8.0	± 8.3	137	4.3	± 5.3
Obese	70	7.7	± 6.5	51	6.8	± 6.6
Totals:	283	7.1	± 7.1	279	5.6	± 6.4
Overall mean		8.2			6.7	

TABLE III
Weight Status and CES-D Scores

	Non-obese BMI 18.5-29.9		Obese BMI ≥ 30	
	n	(%)	n	(%)
CES Score < 16	1588	(87.2)	498	(81.6)
CES Score ≥ 16	233	(12.8)	112	(18.4)*
Total	1821	(100)	610	(100)

* Pearson's $\chi^2= 11.62; p=0.001$

remaining, 71.8% (3,227) volunteered to complete the home interview. Of these, 3,135 completed the Center for Epidemiological Studies – Depression Scale (CES-D). Body weight and height were measured on 2,531 respondents who agreed to participate in a clinic visit. Of these, 2,482 had both CES-D and BMI scores. The final sample of 2,431 analyzed here includes all participants with a BMI ≥ 18.5 (98% of those from whom all data were available). This represents 44% of the original stratified sample. Complete information on the sample is reported elsewhere.¹⁷

Measures

The CES-D was developed for use in population-based epidemiological studies²¹ and measures current levels of depressive symptoms and emotional distress. The scale is comprised of 20 questions that assess the frequency or duration of depressive symptoms in the previous week. For the NSHS, a public health nurse read aloud the questions and recorded the answers. Scores of

0-60 are possible with higher scores representing a more depressed mood. A score of 16 or greater indicates that a person is at elevated risk for depression.

BMI was categorized according to the World Health Organization BMI cut-off values with 18.5-24.9 representing an acceptable weight, 25-29.9 as overweight and BMI ≥ 30 representing the obese. Age was grouped into three categories (18-34, 35-64 and ≥ 65 years). As indices of socioeconomic status, household income and years of education were dichotomized into < \$20,000 (approximately the 1995 Statistics Canada cut-off for a “low-income” family of four) and ≥ \$20,000, and less than post-secondary and post-secondary schooling. The relation of smoking status (current and non-smokers) to depression was also assessed.

Analyses

Data were analyzed using SPSS version 10.0. Scores from the CES-D questionnaire underwent log transformation to normalize the data.²¹ Logistic regression mod-

TABLE IV
Odds Ratios and Confidence Intervals for the Relation of Sex, Age, Education, Income and Obesity to Risk of Depression

	Odds Ratio	CI 95%	p
Sex			
Male vs. female	1.48	1.18-1.87	<0.001
Age (years)			
18-34 vs. 35-64	0.77	0.60-0.99	<0.05
18-34 vs. 65+	0.57	0.41-0.79	<0.01
35-64 vs. 65+	0.74	0.54-1.02	ns
Education			
≥ Post-secondary vs. < post-secondary	0.76	0.58-0.99	<0.05
Income			
≥ \$20,000 vs. < \$20,000	0.58	0.44-0.77	<0.001
BMI (men and women)			
≥ 30 vs. 18.5-29.9	1.53	1.19-1.97	<0.01
BMI (men and women)			
Adjusted for education and income			
≥ 30 vs. 18.5-29.9	1.41	1.07-1.86	<0.05

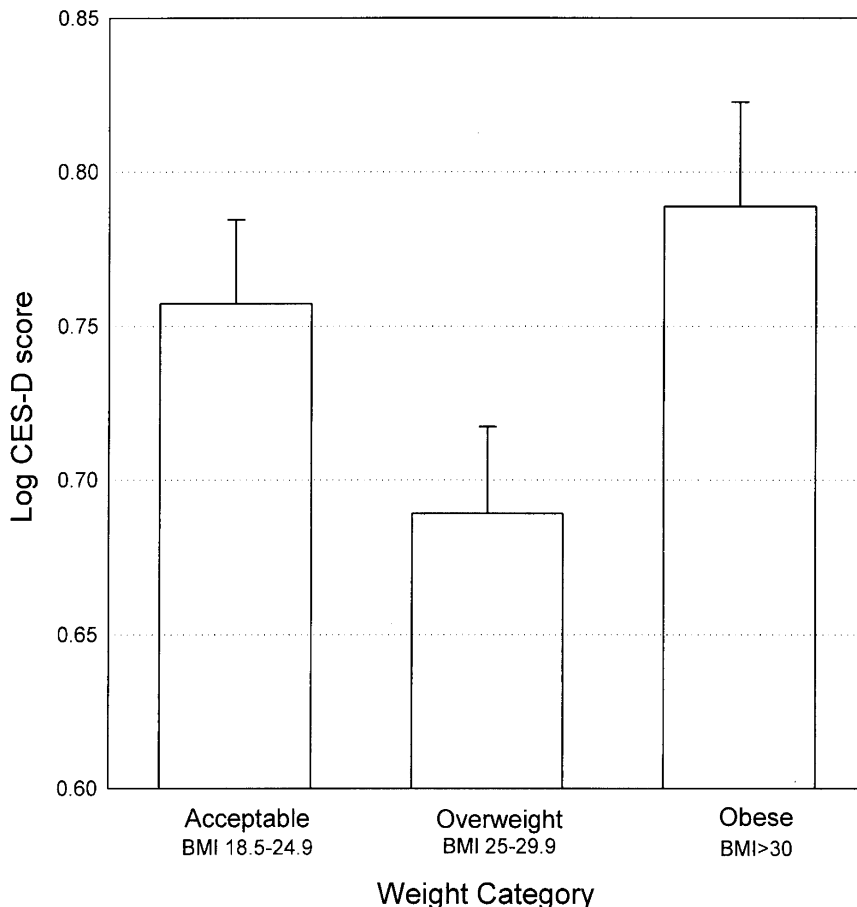


Figure 1. “U-shaped” relation between depressive symptomatology (mean log CES-D score) and weight (BMI category) for participants in the 1995 Nova Scotia Health Survey. (Error bars denote 95% CI.)

els were used to assess the relation among risk of depression and age, sex, income, smoking and BMI categories. Simple χ^2 statistics and multivariate analysis were used to generate odds ratios (OR).

RESULTS

For our sample, age ranged from 18 to 98 years, 52% had post-secondary education, 74% had an annual income of \$20,000 or

over and 27% were current smokers (Table I). Using the International Standards for the categorization of body weight, 60.2% were classified as either overweight or obese. More men than women were classified as overweight (43.2% vs. 28.3%; $p<0.001$) but slightly more women than men were obese (25.6% vs. 23.4%; $p=0.13$). Based on the summary scores of the CES-D, 14.2% were categorized as at risk. Women scored higher on the depression scale than men (mean score 8.2 vs. 6.7; $p<0.01$) and women and men aged 18 to 34 scored higher than women and men aged ≥ 65 (Table II).

Logistic regression indicated that years of education ($p<0.001$), income ($p<0.001$) and BMI category ($p<0.05$) were all significantly related to risk of depression. When weight was categorized as obese or not (using a BMI cut-off of 30) and depressive symptoms as indicating at risk or not (using a CES-D cut-off of 16), obese subjects were significantly more likely to be at risk for depression (Table III). Participants who had no post-secondary education or had incomes below \$20,000 were also more likely to be depressed. After controlling for income and education, participants who were obese were 41% more likely to be depressed than participants who were non-obese (Table IV). Smoking was confounded with age and did not show a clear relation with depression.

To further explore the key relation of interest between weight and depression, an ANOVA comparing the mean normalized CES-D scores across the three weight categories was conducted. Differences were significant ($F(2,2428) = 11.16, p<0.001$) as illustrated in Figure 1. Probing of the U-shaped curve revealed that respondents who were either an acceptable weight ($t(1819) = 3.42, p=0.001$) or obese ($t(1494) = 4.47, p<0.001$) scored significantly higher on the CES-D scale than those who were overweight. The difference between the obese and acceptable weight participants was not significant ($t(1543) = 1.43, p=0.153$).

DISCUSSION

It is not surprising that a higher level of education and higher total household income are related to a decreased risk of depression. This supports the findings of

numerous other studies,²¹⁻²³ including a study completed in Calgary²³ that confirmed a strong association between income and depression with individuals in the lowest income brackets having the highest prevalence of depression.

The finding that women are more depressed than men is also consistent with the literature.^{11,12} Although some investigators report a higher prevalence of depression among older adults compared with younger adults,^{24,25} our results agree with the Canadian NPHS in that younger respondents had higher levels of depression than older individuals.¹⁴

Palinkas and co-workers studied subjects over 50 years of age and found no association between obesity and depression among women.²⁶ In their study, however, height and weight were self-reported and depression was measured by the Beck Depression Inventory (BDI). They found that overweight (BMI 25-29.9) and obese (BMI \geq 30) men were less depressed when compared to acceptable weight men, thereby supporting the "jolly fat" hypothesis. Our data, however, showed a U-shaped relation between weight and depression.

A large US sample (> 50 years of age) was assessed prospectively for clinical depression using the standardized nomenclature from the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*.⁷ Again, weight and height were self-reported and BMIs were classified as "underweight" BMI of 20.77 or less, "average weight" BMI between 20.78 and 29.99, and "obese" BMI of 30 or more. Obese women had increased odds of past-year major depressive episode (MDE) compared to average weight women, while obese men had decreased odds of MDE compared to average weight men. The method of classifying weight in that study does not allow for an identification of an overweight group.

One possible explanation for the disparate results among studies is the use of self-reported height and weight for calculating BMI. Although several studies^{27,28} have suggested that there is a strong correlation between self-reported and actual weight, a comparison of the numbers of obese and overweight from this study with those reported by Statistics Canada for Nova Scotia for the same year using self-reported data shows strikingly different

results.¹⁴ For example, using clinical measures of height and weight we are reporting for men and women respectively 43.2% and 28.3% overweight and 23.4% and 25.6% obese, while Statistics Canada, using self-reported height and weight, report 47.9% and 32.0% overweight and only 16.8% and 14.7% obese. Sampling methods are similar for both studies and cannot reasonably account for these differences. This misclassification of individuals using the self-reported weights may be sufficient to account for many of the inconsistencies in the literature. Using data derived from the NHANES II study, underestimation of weight occurred most frequently among individuals from higher BMI categories.²⁹ The NHANES study concluded that biases associated with self-reported weight limit its usefulness in epidemiology studies. Other studies support this conclusion.³⁰⁻³² Approximately 35% of women underestimate their weight. Certain subgroups such as the obese elderly may also have significant underestimating biases.²⁹

Relations between depression and obesity will depend not only on the measures used to assess obesity (e.g., self-report or clinical measures) and depression (CES-D, BDI, or clinical diagnoses), but also on the number of categories and their cut-offs chosen for statistical analyses. For example, Roberts et al. found that using a BMI > 85th percentile as the cut-off point for obesity resulted in a significant relation with depression, whereas using BMI \geq 30 did not.⁸ Later data from the same cohort showed the relation to be verified with the BMI \geq 30 criterion.^{9,10} With obesity defined as a BMI \geq 30, our results showed that obese participants had significantly higher self-reported levels of depressive symptoms than overweight individuals, but not significantly higher than those of acceptable weight (Figure 1). When our two non-obese groups were combined, obesity was found to be associated with a significant 53% (unadjusted) increased risk of being classified as at risk for depression, as defined as a CES-D score \geq 16. Despite differences between our study and that of Roberts et al.,⁸ both studies show an association between obesity and depression.

Our finding that overweight individuals were less depressed than either the obese or acceptable weight groups may in part reflect the increasingly normative nature of

being overweight, but this needs further exploration. Although various explanations have been suggested for the relation between obesity and psychological health, we have limited understanding of its etiology.^{26,33,34} More studies are also needed to ascertain the mechanism by which obesity and depression are related and the significance of this relation for the prevention and treatment of *both* obesity and depression. Given the public health implications of obesity, the association with depression is important. Depression can involve changes in appetite, decreased energy and psychomotor changes, as well as loss of interest in activities and cognitive impairments.³⁵ A patient presenting with such symptoms would be unlikely to comply well with recommended lifestyle changes aimed at controlling weight. Health professionals should be suspicious of depression with their obese clients, and in some cases treating this mental illness might be the first step in treating the obese patient.

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RÉSUMÉ

Objectif : Nous avons analysé les données de l'enquête sur la santé en Nouvelle-Écosse (1995) pour déterminer la relation entre l'indice de masse corporelle (IMC) et le risque de dépression mesuré selon l'échelle de dépression du Center for Epidemiological Studies (CES-D).

Méthode : Les mesures cliniques de la taille et du poids et les scores du CES-D étaient disponibles pour 2 482 sujets d'un échantillon initial de 5 578 Néo-Écossais, stratifié selon la technique du calcul probabiliste pour être représentatif de l'âge, du sexe et de la région de résidence. Les IMC ont été catégorisés selon les normes internationales (IMC 18,5-24,9 = poids acceptable; 25-29,9 = embonpoint; ≥ 30 obésité).

Résultats : Plus d'hommes que de femmes ont été classés comme faisant de l'embonpoint (43,2 % c. 28,3 %), mais les femmes étaient un peu plus nombreuses que les hommes dans la catégorie des obèses (25,6 % c. 23,4 %). Selon le score sommaire du CES-D, 14,2 % des sujets étaient vulnérables à la dépression (≥ 16). Par régression logistique, nous avons déterminé que de faibles niveaux d'instruction ($p < 0,001$) et de revenu ($p < 0,001$) et la catégorie d'IMC ($p < 0,05$) étaient trois facteurs liés de façon significative à un risque de dépression accru. Le rapport de cotes de l'association obésité-dépression, compte tenu du niveau d'instruction et du revenu, était de 1,41 (IC de 95 % = 1,07-1,86).

Discussion : Il faudrait davantage d'études pour établir avec précision le mécanisme qui relierait l'obésité à la dépression et la signification de ce lien pour la prévention et le traitement de l'obésité et de la dépression. Étant donné les effets de la dépression, nous suggérons aux professionnels de la santé d'évaluer le risque de dépression de leurs patients obèses avant d'amorcer un protocole de gestion du poids.