Metabolic Syndrome and Health-related Quality of Life in Obese Individuals Seeking Weight Reduction

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Background: No previous research has examined the association between metabolic syndrome (MetSyn) and health-related quality of life (HRQoL) using standard criteria for defining MetSyn. We hypothesized that MetSyn would be associated with lower HRQoL on measures of physical and mental health.
Methods and Procedures: Participants were 361 individuals in two randomized weight loss trials. MetSyn was defined by the National Cholesterol Education Panel criteria. The Medical Outcomes Study, Short Form-36 (SF-36) was used to assess HRQoL. Differences in HRQoL and in clinical and psychosocial characteristics were compared among participants with and without MetSyn. Multiple regression was used to determine predictors of HRQoL.
Results: MetSyn was associated with lower scores on the physical function and general health subscales of the SF-36 and on the physical component summary (PCS) score. This association remained after controlling for age or depression but was eliminated by controlling for BMI. MetSyn was not associated with lower mental quality of life, a higher depression score, tobacco or alcohol use, or a higher rate of psychosocial stressors.
Discussion: Individuals with MetSyn reported lower HRQoL. This appeared to be an effect of increased weight, rather than a unique effect of MetSyn. Larger studies are needed to assess whether MetSyn may have an independent effect on HRQoL.

INTRODUCTION

Metabolic syndrome (MetSyn) is associated with an increased risk for developing type 2 diabetes, as well as cardiovascular disease (1–3). Insulin resistance is thought to lie at the heart of the syndrome, which is diagnosed when patients meet at least three of the following five criteria: elevated waist circumference (>40 inches for men, >35 inches for women); high triglycerides (>150 mg/dl); reduced high-density lipoprotein cholesterol (<40 mg/dl for men, <50 mg/dl for women); high fasting glucose (>100 mg/dl); and elevated blood pressure (>130/85 mm Hg) (4).

Some investigators believe that metabolic syndrome is also associated with an increased risk for psychiatric comorbidity, stress, and impaired health-related quality of life (HRQoL) (5–8). For example, two previous studies have reported that individuals with metabolic syndrome had a reduced quality of life, principally in the area of physical function (7,9). In these two studies, however, unconventional criteria were used to define MetSyn, as compared to the criteria developed by the National Cholesterol Education Program (4) or by the World Health Organization (10,11). In addition, these studies did not examine whether differences in quality of life that were attributed to MetSyn may, in fact, have been attributable to the higher BMI of persons with the syndrome.

In the present study, we used the Medical Outcomes Study, Short Form-36 (SF-36) (12,13) to determine whether individuals with metabolic syndrome had lower scores on the physical health and mental health subscales of the instrument. The physical health subscales include those that measure physical function (i.e., degree of limitation in performing activities of daily living), physical role (i.e., limitations in daily activities due to physical health), bodily pain (i.e., limitations in daily activities due to pain), and general health (i.e., self-evaluation of overall health). The mental health subscales include those that measure vitality (i.e., energy and fatigue), social functioning (i.e., limitations in social activities due to physical or emotional health), emotional role (i.e., limitations in usual role activities due to emotional problems), and general mental health (i.e., psychological distress and well-being). We also examined whether the hypothesized

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association between MetSyn and lower HRQoL could be explained, in part, by a higher BMI or by a higher rate of psychosocial complications (e.g., depression, history of mental illness, alcohol and tobacco abuse, and stress) among those with the syndrome.

METHODS AND PROCEDURES

Participants

Participants were 404 overweight and obese individuals who took part in one of two randomized weight control trials that have been reported previously (14,15). Participants in both studies were required to have a BMI of 30–45 kg/m^2 and were excluded if they had significant medical or psychiatric comorbidities, described previously (15). These included uncontrolled hypertension (>140/90 mm Hg), types 1 or 2 diabetes, or the use of medications known to cause long-term changes in weight. The presence of MetSyn was assessed using the National Cholesterol Education Program criteria (4). Participants who took medications for hypertension or hypercholesterolemia were counted as meeting the blood pressure and triglyceride criteria for metabolic syndrome.

Outcomes measures

SF-36. The SF-36 was used to assess HRQoL. This measure includes eight subscales, all of which are used to derive a summary measure of physical health and a summary measure of mental health (12,13). Higher scores, both on the eight subscales and the two summary measures, indicate better functioning.

Depression. Symptoms of depression were assessed using the Beck Depression Inventory (BDI-II), the standard measure for depression in mental health (16). Scores range from 0 to 63, with higher values indicative of greater symptoms of depression. Scores of 0–13 are considered minimal (i.e., in the normal range). Participants also reported whether they had a history of mental health problems, as assessed by the Weight and Lifestyle Inventory (17).

Lifestyle habits. Lifestyle habits, including smoking and alcohol intake, were also assessed with the Weight and Lifestyle Inventory (17). This questionnaire has good reliability for these items (18). The Weight and Lifestyle Inventory was also used to identify ongoing sources of stress, including those related to work, intimate relationships, and legal/financial troubles. Participants responded yes or no to the presence of each of eight psychosocial stressors, as described previously (17).

Statistical analysis

Full data concerning MetSyn and quality of life were available for 361 of the original 404 participants. Individuals who were not included in the analysis data set did not differ in age, weight, BMI, education, or ethnicity from the 361 persons for whom full data were available. If a participant had missing data on one or more components of MetSyn but met at least three criteria, the individual was designated as having the syndrome.

Differences in weight and in other characteristics between participants with and without MetSyn were compared using *t*-tests for continuous variables and chi-square tests for categorical variables. Similar analyses were used to compare individuals with and without MetSyn on: (i) the eight subscales of the SF-36; (ii) symptoms of depression; (iii) lifestyle habits; and (iv) psychosocial stressors.

Zero-order correlations were used to estimate the strength of association between HRQoL and single variables of interest. Multivariable regression was then used to assess the total variance in HRQoL explained by all predictor variables. All analyses were conducted using Stata software, version 9.2 (Stata Corporation, College Station, TX). A *P* value <0.05 was considered significant for all analyses.

RESULTS

Metabolic syndrome

Participants with MetSyn had a significantly greater age (P = 0.002), height (P < 0.001), weight (P < 0.001), and BMI (P < 0.001) than those without the syndrome (**Table 1**). A higher percentage of individuals with MetSyn were white (P = 0.02) and male (P < 0.001). As expected, participants with MetSyn also had significantly higher blood pressure, higher fasting glucose and insulin, higher triglycerides, and lower high-density lipoprotein cholesterol than did those without MetSyn (P < 0.001 for all comparisons). Low-density lipoprotein cholesterol levels did not differ significantly between the two groups (**Table 1**).

Quality of life

Comparisons of HRQoL between participants with and without MetSyn are shown in **Table 2**. Individuals with MetSyn had significantly lower scores on two of the eight subscales of the

Table 1 Baseline characteristics of participants with and without metabolic syndrome, among individuals seeking weight reduction[a]

	No metabolic syndrome (*n* = 226)	Metabolic syndrome (*n* = 135)	*P* value
Gender, number (%)			
Female	190 (84.1%)	82 (60.7%)	<0.001
Male	36 (15.9%)	53 (39.3%)	
Ethnicity			
White	167 (73.9%)	113 (83.7%)	0.02
African American	56 (24.8%)	20 (14.8%)	
Other[b]	3 (1.3%)	2 (1.5%)	
Age (year)	44.9 ± 10.0	48.2 ± 9.5	0.002
Education (year)	15.6 ± 2.3	15.7 ± 2.3	0.67
Weight (kg)	96.7 ± 18.4	109.0 ± 18.6	<0.001
Height (cm)	166.6 ± 7.7	170.4 ± 10.1	<0.001
BMI (kg/m^2)	34.7 ± 5.6	37.4 ± 4.2	<0.001
Waist (cm)	41.5 ± 5.4	45.0 ± 5.1	<0.001
Low-density lipoprotein (mg/dl)	123.2 ± 30.7	121.5 ± 33.6	0.61
High-density lipoprotein (mg/dl)	61.2 ± 13.7	46.8 ± 11.0	<0.001
Triglycerides (mg/dl)	104.3 ± 48.0	184.6 ± 123.0	<0.001
Systolic blood pressure (mm Hg)	123.1 ± 14.6	137.3 ± 14.5	<0.001
Diastolic blood pressure (mm Hg)	68.7 ± 9.8	74.2 ± 10.0	<0.001
Glucose (mg/dl)	91.4 ± 9.1	101.2 ± 15.0	<0.001
Insulin (μU/ml)	12.9 ± 8.1	21.3 ± 15.8	<0.001
Insulin resistance[c]	2.9 ± 2.0	5.5 ± 4.9	<0.001

[a]Values are mean ± s.d. with the exception of gender and ethnicity, which are shown as *n* (%). [b]Other = Asian–American or Latino. [c]Insulin resistance was determined using the homeostasis model of insulin resistance (26). Scores range from 0 to 15, with higher scores indicating greater insulin resistance, and are calculated as the product of the fasting plasma insulin level (in microunits per milliliter) and the fasting plasma glucose level (in millimoles/liter), divided by 22.5.

SF-36. These were, physical functioning ($P = 0.021$) and general health ($P = 0.007$). Participants with MetSyn also scored significantly lower on the physical component summary (PCS) score ($P = 0.013$). No differences were observed between those with and without MetSyn on any of the four subscales of the SF-36 that assessed dimensions of mental health or in the mental component summary score (**Table 2**).

Psychosocial status and lifestyle habits

The psychosocial characteristics of participants with and without MetSyn are shown in **Table 3**. No significant differences were observed between the two groups in Beck Depression Inventory scores or in the percentage of patients who reported a history of mental health problems or of alcohol or tobacco use. There also were no significant differences between groups in the number of psychosocial stressors (**Table 3**).

Table 2 Baseline SF-36 scores for participants with and without metabolic syndrome among individuals seeking weight reduction[a]

	No metabolic syndrome (*n* = 226)	Metabolic syndrome (*n* = 135)	*P* value
Physical functioning	80.6 ± 18.1	75.9 ± 19.5	0.021
Role physical	82.2 ± 30.7	77.6 ± 34.2	0.19
Bodily pain	72.8 ± 21.8	72.7 ± 20.6	0.99
General health	71.3 ± 16.9	66.3 ± 17.7	0.007
Vitality	49.6 ± 18.4	50.5 ± 18.7	0.68
Social function	85.4 ± 19.0	83.5 ± 20.5	0.38
Role emotional	75.5 ± 36.1	80.0 ± 34.6	0.25
Mental health	74.7 ± 15.3	75.1 ± 14.6	0.80
Physical component summary	49.1 ± 8.4	46.8 ± 8.4	0.013
Mental component summary	48.6 ± 9.7	49.9 ± 9.2	0.23

SF-36, Medical Outcomes Study, Short Form-36.
[a]Values are mean ± s.d.

Table 3 Psychosocial characteristics and lifestyle habits of participants with and without metabolic syndrome among individuals seeking weight reduction[a]

	No metabolic syndrome[b]	Metabolic syndrome[c]	*P* value
Beck Depression Inventory	7.7 ± 6.8	7.7 ± 7.2	0.96
History of mental health problems, number (%)	58 (26.0%)	33 (24.8%)	0.80
Psychosocial stressors, total number	1.6 ± 1.4	1.4 ± 1.3	0.21
Work, number (%)	116 (51.8%)	65 (48.9%)	0.59
Health, number (%)	57 (25.4%)	32 (24.1%)	0.77
Intimate relationships, number (%)	49 (21.9%)	20 (15.0%)	0.11
Legal/financial, number (%)	53 (23.7%)	25 (18.8%)	0.28
Current smoker, number (%)	9 (4.0%)	4 (3.0%)	0.77
Ever smoker, number (%)	106 (47.3%)	69 (51.9%)	0.41
Alcoholic drinks per week, number	2.3 ± 3.9	3.0 ± 4.7	0.11

[a]Values are mean ± s.d. for depression score, number of stressors, and drinks per week; and *n* (%) for other variables. [b]*n* ranges from 219 to 224. [c]*n* ranges from 131 to 133.

Correlations and regression analyses

Correlation and regression analyses are shown in **Tables 4** and **5** for the PCS score of the SF-36. In univariable analyses, lower values on the PCS score were associated with the presence of MetSyn, higher BMI values and depression scores, and with higher age. By contrast, there was no association between the PCS score and years of education, gender, ethnicity, alcohol intake, smoking status, or psychosocial stressors (**Table 4**).

A forward step-wise regression analysis was conducted using the four variables that had the strongest association with the PCS score derived from univariable analysis. They

Table 4 Univariable correlation of the physical component summary (PCS) score of the SF-36 with demographic and psychosocial variables

Variable	Correlation coefficient	*P* value
BMI	−0.27	<0.001
Depression score[a]	−0.23	<0.001
Metabolic syndrome	−0.15	0.004
Age	−0.15	0.005
Years of education	0.1	0.07
Ever smoker	−0.08	0.11
Drinks per week	−0.07	0.21
Number of stressors	0.03	0.52
Ethnicity	0.04	0.53
Gender	0.02	0.69

SF-36, Medical Outcomes Study, Short Form-36.
[a]Beck Depression Inventory.

Table 5 Variance in the physical component summary (PCS) score accounted for by BMI, depression score, age, and the metabolic syndrome, as determined by forward step-wise regression

Variable	Cumulative R^2	*P* value
Full model		
BMI	0.07	<0.001
Depression score[a]	0.11	<0.001
Age	0.15	<0.001
Metabolic syndrome	0.15	0.63
Partial model #1		
BMI	0.07	<0.001
Age	0.10	0.001
Metabolic syndrome	0.10	0.52
Partial model #2		
BMI	0.07	<0.001
Metabolic syndrome	0.07	0.19

[a]Beck Depression Inventory.

were entered into the regression according to the strength of their association—BMI, depression score, age, and MetSyn. As shown in **Table 5**, three variables—BMI, depression score, and age—explained 15% of the variance in the PCS score. MetSyn did not contribute significantly to the variance explained after accounting for these three variables. Secondary analyses showed that the effect of MetSyn was eliminated by controlling for BMI alone (**Table 5**).

DISCUSSION

This study found that MetSyn was associated with lower HRQoL on two of the physical subscales of the SF-36. These were physical function (i.e., limitations in daily activities due to physical health) and general health (i.e, self-reported overall health status). In addition, participants with MetSyn scored significantly lower on the PCS score than did persons without the syndrome. By contrast, no association was observed between MetSyn and the mental component summary score or any of the SF-36 subscales related to mental health. There also was no association between MetSyn and symptoms of depression, alcohol or tobacco use, or psychosocial stressors.

Participants in the present study who had MetSyn had a significantly higher BMI than those without the syndrome (37.4 kg/m^2 vs. 34.7 kg/m^2, respectively). Correlation analyses showed that both BMI and MetSyn were associated with a lower PCS score. Results of multiple regression analysis, however, showed that MetSyn did not account for a significant amount of the variance in PCS scores after controlling for BMI. Thus, the reduced HRQoL in participants with MetSyn appeared to be related to their greater BMI, rather than to MetSyn *per se*. Numerous studies have shown that a higher BMI is associated with lower HRQoL (19–25).

Two previous studies reported that MetSyn was associated with reduced HRQoL (7,9). However, neither of these investigations controlled for the effect of BMI. In addition, neither of these studies used standardized criteria to define MetSyn, such as the criteria used by the National Cholesterol Education Panel (4) or World Health Organization (10,11). A third study found lower SF-36 scores at baseline for all eight domains among a population of surgically treated obese patients, but no association of lower quality of life with insulin resistance (19). The other criteria for MetSyn were not examined.

The present study had several limitations. First, patients with type 2 diabetes were excluded from both of the clinical trials used for the analysis. Obese individuals with type 2 diabetes are likely to meet the criteria for MetSyn and may experience lower HRQoL than persons with the syndrome who do not have diabetes. Second, our sample consisted principally of persons from middle- to upper-middle socioeconomic backgrounds (mean education of 15.6 years in the present analysis). Higher socioeconomic status may protect obese individuals from the potential adverse health and psychosocial consequences of MetSyn. Third, we failed to observe the expected relationship between psychosocial stress and MetSyn. This may have been attributable to our use of a suboptimal measure to detect stress. Future studies should correct this limitation.

In summary, the present study found that excess weight appeared to explain the decrease in HRQoL observed in participants with MetSyn. Larger studies of more diverse samples are needed to confirm this finding.

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