# The Relation Between Body Fat Distribution and Cardiovascular Risk Factors in Patients With Schizophrenia: A Cross-Sectional Pilot Study

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***Background:*** Obesity has recently become a concern for physicians treating schizophrenic patients. Obesity is associated with hypertension, dyslipidemia, and diabetes mellitus. In this pilot study, we investigate which anthropometric measurement, body mass index or waist circumference, is a better predictor of cardiovascular risk factors in patients with schizophrenia.

***Method:*** This cross-sectional study, conducted from January 2001 to January 2002, examined body fat distribution and its relation to cardiovascular risk factors in 62 patients with schizophrenia (DSM-IV) recruited from an outpatient psychiatric clinic.

***Results:*** Chi-square analysis revealed that an increased waist circumference was associated with dyslipidemia ($p < .01$), hypertension ($p < .05$), and abnormal serum glucose ($p < .05$), whereas an increased body mass index was only associated with dyslipidemia ($p < .05$). In logistic regression analysis, after controlling for age, gender, race, ethnicity, smoking, and body mass index, increased waist circumference remained significantly associated with dyslipidemia (odds ratio = 2.08, 95% CI = 1.01 to 1.15, $p < .05$) and hypertension (odds ratio = 2.05, 95% CI = 1.02 to 1.17, $p < .05$).

***Conclusions:*** Waist circumference revealed a stronger correlation than body mass index to cardiovascular risk factors in patients with schizophrenia. We propose the measurement of waist circumference as a screening tool for cardiovascular risk factors in this population. Waist circumference measurement can provide an opportunity for primary prevention of coronary heart disease and diabetes mellitus in patients with schizophrenia.

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Physicians need to be aware of the risks among schizophrenic patients of developing certain medical conditions in order to prevent and institute early and effective management of the comorbid medical illness. Weight gain has been associated with the use of both typical and atypical antipsychotic medications.[1–4] Many mechanisms have been postulated for the weight gain, but they remain speculative.

Hypertension, dyslipidemia, and diabetes mellitus are well-established cardiovascular risk factors. Obesity increases the risk for developing these medical conditions.[5] Body mass index (BMI), which is defined as weight (kg)/height ($m^2$), is the accepted measure to assess obesity.[6] Obesity is defined by a BMI value ≥ 30 $kg/m^2$.[6] BMI is an indicator of total body fat; however, it is not a good indicator of regional fat distribution. Studies suggest that fat distribution rather than total body fat is a better predictor for cardiovascular risk factors.[7,8] Waist-hip ratio (WHR) is an index of body fat distribution. As the WHR is difficult to interpret biologically and less sensitive to changes in total body fat and visceral fat,[9] waist circumference (WC) has been proposed to be a better predictor of cardiovascular risk factors.[6] Recent guidelines recommend WC over the WHR as a predictor of obesity-related diseases, due to its simplicity and its correlation with abdominal fat as measured by computed tomography.[6] Recent consensus guidelines for patients with schizophrenia recommend the measurement of both BMI and WC to monitor cardiovascular risk factors in this population.[10]

In this pilot cross-sectional study, we will investigate which anthropometric measurement, BMI or WC, is a

**Table 1. Clinical Identification of Cardiovascular Risk Factors[a]**

| Risk Factor | Defining Variable |
|---|---|
| Triglycerides | ≥ 150 mg/dL |
| High-density lipoprotein cholesterol | |
| Men | < 35 mg/dL |
| Women | < 45 mg/dL |
| Low-density lipoprotein cholesterol | ≥ 160 mg/dL |
| Blood pressure | |
| Systolic | ≥ 140 mm Hg |
| Diastolic | ≥ 90 mm Hg |
| Fasting serum glucose | ≥ 126 mg/dL |

[a]Based on *The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*[11] and the *Expert Panel on Detection and Treatment of High Blood Cholesterol in Adults*.[12]

**Table 2. Demographics and Characteristics of Schizophrenic Patients[a]**

| Variable | Women (N = 30) | Men (N = 32) |
|---|---|---|
| Age, y | 42.53 ± 12.76 | 41.53 ± 12.72 |
| Weight, kg | 86.35 ± 18.45 | 92.93 ± 20.45 |
| Height, m | 1.59 ± 0.11 | 1.72 ± 0.09 |
| BMI, kg/m$^2$ | 34.34 ± 7.43 | 30.33 ± 4.55 |
| WC, cm | 102.79 ± 16.53 | 104.26 ± 13.34 |
| Blood pressure, mm Hg | | |
| Systolic | 122.65 ± 17.40 | 126.14 ± 15.85 |
| Diastolic | 78.92 ± 10.11 | 82.13 ± 10.24 |
| HDL-cholesterol, mg/dL | 48.77 ± 12.84 | 41.60 ± 9.79 |
| LDL-cholesterol, mg/dL | 114.24 ± 35.83 | 116.79 ± 32.07 |
| Triglycerides, mg/dL | 194.10 ± 149.22 | 203.05 ± 105.31 |
| Fasting glucose, mg/dL | 113.63 ± 92.91 | 96.16 ± 23.01 |

[a]Data are mean ± SD.
Abbreviations: BMI = body mass index, HDL = high-density lipoprotein, LDL = low-density lipoprotein, WC = waist circumference.

better predictor of cardiovascular risk factors in patients with schizophrenia. The comparison of BMI and WC as predictor of cardiovascular risk factors has not been reported in patients with schizophrenia to our knowledge. The pattern of body fat distribution may be used by the treating physician to predict which patients are prone to develop cardiovascular risk factors, so that early preventive measurements can be taken.

## METHOD

Patients with schizophrenia were recruited from an outpatient psychiatric clinic. All subjects, aged 20 through 73 years, met the DSM-IV criteria for schizophrenia. These patients had no history of chronic medical illnesses. Other exclusion criteria included patients who were pregnant, suicidal, active substance abusers, and those who in the investigators' opinion lacked capacity to give consent. This study was approved by the Subcommittee for the Protection of Human Subjects at the University of Miami. Informed consent was obtained from each subject. This study was conducted from January 2001 to January 2002.

Participants were seen after a 12-hour fast. All historical information was obtained by interview and from chart review. Sitting blood pressure was measured twice, and the mean reading was used. WC taken at the level of the umbilicus was measured twice, and the mean measurement was used. Fasting blood glucose and lipids were obtained. Height and weight were measured after the removal of shoes and with the patients wearing light clothing. BMI was calculated as weight (kg)/height (m$^2$).

Cardiovascular risk factors shown in Table 1 are defined according to *The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*[11]: low-density lipoprotein (LDL)-cholesterol ≥ 160 mg/dL, high-density lipoprotein (HDL)-cholesterol < 35 mg/dL in men and < 45 mg/dL in women, systolic blood pressure (SBP) ≥ 140 mm Hg, diastolic blood pressure (DBP) ≥ 90 mm Hg, and fasting serum glucose ≥ 126 mg/dL. Also, according to *The Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults*[12]: serum triglycerides level ≥ 150 mg/dL. Subjects with 1 or more of the above conditions were considered as having cardiovascular risk factors. Obesity was defined as a BMI value ≥ 30 kg/m$^2$ or WC > 102 cm in men and > 88 cm in women.[6]

All data were analyzed using the Statistical Program for Social Sciences 10.0 software program (SPSS Inc., Chicago, Ill.). Pearson's correlation coefficients were used to assess associations between adiposity measures and cardiovascular risk factors in women and men. The $\chi^2$ test was used to compare the prevalence of the cardiovascular risk factors with WC and BMI as indices of obesity. The Fisher exact test was used if the expected cell size was < 5. Logistic regression analysis was utilized to allow for covariates. Triglyceride and glucose values were transformed to the natural logarithm to normalize skewed distribution for statistical testing; however, actual values are displayed. The p values were 2-sided, and the term *statistically significant* implies a p value < .05.

## RESULTS

Sixty-two schizophrenic patients were enrolled in the study. The sample consisted of 30 women and 32 men, with a mean ± SD age of 41.98 ± 12.60 years. The ethnic background of the group included 40 Hispanics and 22 non-Hispanics. Seventy-nine percent (49/62) were white and 32% (20/62) were smokers. Sixty-nine percent (43/62) of the patients were taking atypical antipsychotics. The demographics and characteristics of the study patients are shown in Table 2.

Correlation coefficients for association among the adiposity measures revealed a strong and positive correlation between BMI and WC in both women (p < .01) and men

**Table 3. Pearson's Correlation Coefficients for Association of Cardiovascular Risk Factors and Adiposity Measures**

| Variable | HDL | LDL | Log-Triglyceride | SBP | DBP | Log-Glucose |
|---|---|---|---|---|---|---|
| Women (N = 30) | | | | | | |
| WC | –0.43* | 0.27 | 0.16 | 0.37* | 0.59** | 0.25 |
| BMI | –0.20 | –0.21 | 0.28 | 0.35 | 0.31 | 0.32 |
| Men (N = 32) | | | | | | |
| WC | –0.12 | 0.35 | 0.44* | 0.34 | 0.29 | 0.18 |
| BMI | –0.06 | 0.39* | 0.36* | 0.12 | 0.16 | 0.20 |

*p < .05.
**p < .01.
Abbreviations: BMI = body mass index, DBP = diastolic blood pressure, HDL = high-density lipoprotein cholesterol, LDL = low-density lipoprotein cholesterol, SBP = systolic blood pressure, WC = waist circumference.

**Table 4. Prevalence of Cardiovascular Risk Factors and Obesity in Patients With Schizophrenia (N = 62)**

| Variable | N | % |
|---|---|---|
| Dyslipidemia | 36 | 58 |
| Hypertension | 28 | 45 |
| Abnormal fasting glucose | 9 | 15 |
| Obesity | | |
| WC | 42 | 68 |
| BMI | 39 | 63 |

Abbreviations: BMI = body mass index, WC = waist circumference.

**Table 5. Prevalence of Cardiovascular Risk Factors in Patients With Schizophrenia According to Body Mass Index (BMI)[a]**

| Variable | Abnormal BMI (N = 39) | Normal BMI (N = 23) | p |
|---|---|---|---|
| Dyslipidemia | 26 (67) | 8 (35) | < .05 |
| Normal lipids | 13 (33) | 15 (65) | |
| Abnormal glucose | 8 (20) | 1 (4) | .08 |
| Normal glucose | 31 (80) | 22 (96) | |
| Hypertension | 19 (49) | 9 (39) | .46 |
| Normal blood pressure | 20 (51) | 14 (61) | |

[a]Data are N (%).

**Table 6. Prevalence of Cardiovascular Risk Factors in Patients With Schizophrenia According to Waist Circumference (WC)[a]**

| Variable | Abnormal WC (N = 42) | Normal WC (N = 20) | p |
|---|---|---|---|
| Dyslipidemia | 28 (67) | 6 (30) | < .01 |
| Normal lipids | 14 (33) | 14 (70) | |
| Abnormal glucose | 9 (21) | 0 (0) | < .05 |
| Normal glucose | 33 (79) | 20 (100) | |
| Hypertension | 23 (55) | 5 (25) | < .05 |
| Normal blood pressure | 19 (45) | 15 (75) | |

[a]Data are N (%).

(p < .001). Table 3 displays Pearson's correlation coefficients for associations of cardiovascular risk factors and adipose measures in women and men. In women, there was an inverse association between HDL-cholesterol and WC, and a positive association was found between WC and both SBP and DBP. No association was found between BMI and cardiovascular risk factors in this group. In men, log-triglyceride positively correlated with both WC and BMI, and a significant association was also found between LDL-cholesterol and BMI.

The prevalence of cardiovascular risk factors and obesity defined by BMI and WC in patients with schizophrenia is shown in Table 4. Tables 5 and 6 show the prevalence of cardiovascular risk factors according to BMI and WC, respectively, in this population. In schizophrenic patients, an increased WC was significantly associated with all 3 risk factors: dyslipidemia, hypertension, and abnormal serum glucose, whereas an increased BMI was only significantly associated with dyslipidemia. In logistic regression analysis, after controlling for age, gender, race, ethnicity, smoking, and BMI, an increased WC remained significantly associated with dyslipidemia (odds ratio = 2.08, 95% CI = 1.01 to 1.15, p < .05) and hypertension (odds ratio = 2.05, 95% CI = 1.02 to 1.17, p < .05).

## DISCUSSION

In this pilot study, data suggest that WC is a stronger predictor of cardiovascular risk factors than BMI in patients with schizophrenia. Our findings in schizophrenic patients are comparable to those reported in the general population.[13,14] Waist circumference, a surrogate measurement for intra-abdominal fat, has been associated with metabolic disturbances including insulin resistance.[7] Insulin resistance is believed to be the underlying reason for the association between WC and cardiovascular risk factors.[13]

A strong correlation was found between BMI and WC, as has been shown in other studies. This points to WC as an indicator of both intra-abdominal fat and total body fat.[15] The prevalence of obesity in patients with schizophrenia was high at 63% when defined by an abnormal BMI and 68% when defined by an abnormal WC. Patients with abnormal BMI or WC were found to have a higher prevalence of dyslipidemia, hypertension, and abnormal serum glucose than non-obese patients. A statistically significant association was found between increased WC and all 3 of the cardiovascular risk factors. In schizophrenic patients with increased BMI, a significant association was only found with dyslipidemia; but in logistic regression when age and WC were added as covariates, the association was no longer significant. The most common cardiovascular risk factor found in schizophrenic patients was dyslipidemia followed by hypertension. Notably, dyslipidemia and hypertension were the 2 measures that significantly correlated with an abnormal WC in logistic regressions. Elevated fasting glucose was the least frequent abnormality. Logistic regression revealed that the association between increased WC and both dyslipidemia and

hypertension was independent of BMI. Thus, WC, a measure of both general and central obesity, is a better anthropometric measure in patients with schizophrenia than BMI, which reflects only general obesity.

We propose the measurement of WC as a screening tool for cardiovascular risk factors. The standard weight and height measurements reflect body mass or obesity, whereas cardiovascular risk lies in the distribution of fat or namely central obesity. Waist circumference measurement provides an opportunity for primary prevention of coronary heart disease and diabetes mellitus in patients with schizophrenia. This screening tool is an objective measure that is easily obtained in any health care setting. Patients with increased WC (> 102 cm in men and > 88 cm in women) should be encouraged to lose weight and increase their physical activity.

Limitations in our study include lack of a control group and the small sample size. The power to identify further relationship between obesity measures and cardiovascular risk factors is reduced due to the small sample size. Another limitation is the cross-sectional relationship between predictors and cardiovascular risk factors used here. Further longitudinal studies are needed to corroborate our findings.

## REFERENCES


1. Ganguli R. Weight gain associated with antipsychotic drugs. J Clin Psychiatry 1999;60(suppl 21):20–24
2. Allison DB, Mentore JL, Heo M, et al. Antipsychotic-induced weight gain: a comprehensive research synthesis. Am J Psychiatry 1999;156: 1686–1696
3. Wirshing DA, Wirshing WC, Kysar L, et al. Novel antipsychotics: comparison of weight gain liabilities. J Clin Psychiatry 1999;60: 358–363
4. Wetterling T, Mubigbrodt HE. Weight gain: side effect of atypical neuroleptics? J Clin Psychopharmacol 1999;19:316–321
5. Kuczmarski RJ, Flegal KM, Troiano RP. Varying body mass index cutoff points to describe overweight prevalence among US adults: NHANES III (1988–1994). Obes Res 1997;5:542–548
6. Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. Arch Intern Med 1998;158:1855–1867
7. Larsson B, Svardsudd K, Welin L, et al. Abdominal adipose tissue distribution**,** obesity, and risk of cardiovascular disease and death: 13 year follow up of participants in the study of men born in 1913. Br Med J (Clin Res Ed) 1984;288:1401–1404
8. Lapidus L, Bengtsson C, Larsson B, et al. Distribution of adipose tissue and risk of cardiovascular disease and death: a 12 year follow up of participants in the population study of women in Gothenburg, Sweden. Br Med J (Clin Res Ed) 1984;289:1257–1261
9. Bouchard C, Bray GA, Hubbard VS. Basic and clinical aspects of regional fat distribution. Am J Clin Nutr 1990;52:946–950
10. American Diabetes Association, American Psychiatric Association, American Association of Clinical Endocrinologists, et al. Consensus development conference on antipsychotic drugs and obesity and diabetes. J Clin Psychiatry 2004;65:267–272
11. The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults**.** US Dept Health Human Services publication 00-4084. Bethesda, Md: National Institutes of Health; 2000
12. Expert Panel on Detection and Treatment of High Blood Cholesterol in Adults. Executive summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA 2001;285:2486–2497
13. Schmidt MI, Watson RL, Duncan BB, et al. Clustering of dyslipidemia, hyperuricemia, diabetes, and hypertension and its association with fasting insulin and central and overall obesity in a general population. Atherosclerosis Risk in Communities Study Investigators. Metabolism 1996; 45:699–706
14. Zhu SK, Wang Z, Heshka S, et al. Waist circumference and obesity-associated risk factors among whites in the Third National Health and Nutrition Examination Survey: clinical action thresholds. Am J Clin Nutr 2002;76:743–749
15. Han TS, Van Leer EM, Seidell JC, et al. Waist circumference action levels in the identification of cardiovascular risk factors: prevalence study in a random sample. BMJ 1995;31:1401–1405


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