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Body Mass Index Dependent Metabolic Syndrome in Severe Mental Illness Patients

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ABSTRACT

The aim of this study was to evaluate the body mass index dependent metabolic syndrome in severe mental illness patients in Gorgan. A total of 267 severe mental illness patients took part in this study. The prevalence of metabolic syndrome in severe mental illness patients in different body mass index were 6.67, 24.09 and 53.06%. There were significant differences in the mean of waist circumference, HDL-cholesterol, triglyceride and fasting blood glucose in subjects with metabolic syndrome in different body mass index when compared with subjects without metabolic syndrome ($p<0.05$). The prevalence of high fasting glucose, low high density lipoprotein-cholesterol, high triglyceride levels, high waist circumference and high blood pressure were 14.23, 38.57, 41.57, 32.96 and 5.24%, respectively. It shows that high triglyceride levels (41.57%) and Low HDL-cholesterol levels (38.57%) were the most frequent characteristics in comparison to other metabolic components. Our results show that, 26.96, 31.08, 21.35, 15.35 and 5.25% of subjects had zero, one, two, three and four criteria for metabolic syndrome, respectively. These results show that the prevalence of metabolic syndrome in severe mental illness patients in Gorgan is increased with elevated body mass index. The results of this study suggest that mental illness patients are at risk of metabolic syndrome, when the rate of body mass index increases. Risk factors such as high triglyceride level and low HDL-cholesterol may play an important role in the occurrence of metabolic syndrome in severe mental illness patients.

Key words: Metabolic syndrome, severe mental illness, body mass index, Gorgan

INTRODUCTION

Metabolic Syndrome (MetS) is defined as a cluster of risk factors (glucose intolerance, obesity, raised blood pressure and dyslipidemia) that raises cardiovascular morbidity and mortality rate (Day, 2007). This syndrome is a global epidemic health problem (Yates *et al*., 2012). Overall prevalence of the metabolic syndrome in non-diabetic subjects using WHO criteria is 15.7% in men and 14.2% in women (Alberti *et al*., 2006). Also it has been reported that prevalence of this syndrome in the world is ranging among men from 8% in India to 24% in United States while it is ranging among women from 7% in France to 46% in India (Mattoo and Shubh, 2010). Several studies have shown that there are the relationship between metabolic syndrome and coronary artery diseases in different ethnic groups, gender, age, postmenopausal women and different

countries (Marjani *et al*., 2012a; Shahini *et al*., 2013; Marjani *et al*., 2012b; Marjani and Shahini, 2013; Marjani and Moghasemi, 2012; Takeuchi *et al*., 2005; Lakka *et al*., 2002). Pathogenesis of metabolic syndrome is complex but two features appear to be potential causative factors: Insulin resistance and abnormal fat distribution (central obesity). It is demonstrated that the prevalence of metabolic syndrome in populations with mental illness is higher than general population (Mattoo and Shubh, 2010). Some studies documented this for patients with schizophrenia and bipolar disorder. Similar findings were reported in psychiatric inpatients in USA, Brazil and India (Mattoo and Shubh, 2010). In a recent large study of outpatients with psychiatric illness, it was shown that prevalence of metabolic syndrome was 52% among them (Khatana *et al*., 2011). This high prevalence is more pronounced in patients with schizophrenia (John *et al*., 2009) and it has been attributed to the second generation antipsychotics used by psychiatric patients (Khatana *et al*., 2011). Prevalence of obesity and visceral fat distribution in schizophrenic patients is generally greater than individuals without this disorder (Toalson *et al*., 2004). Some studies suggest that a significant part of the metabolic syndrome risk is inherent in the psychiatric disease process itself (Mackin *et al*., 2005) but these studies are limited and more investigations are needed to reveal this association. Based on population studies, it has been shown that an increase in the risk of the metabolic syndrome is associated by a progressive increase in total adiposity that assessed by Body Mass Index (BMI) (Alberti *et al*., 2006). It has been suggested that increasing of BMI is an important factor in the presence of metabolic syndrome (Mattoo and Shubh, 2010). One study showed that BMI was higher in patients with bipolar disorder than control group without bipolar disorder (McElroy, 2009). In a study, BMI was significantly higher in patients with concurrent schizophrenia and bipolar disease than patients with schizophrenia or bipolar disorder alone (Khatana *et al*., 2011). It is suggested that metabolic syndrome should be evaluated in psychiatrically ill patients while they approach higher body mass index (Alberti *et al*., 2006). The aim of this study was to evaluate the body mass index dependent metabolic syndrome in severe mental illness patients in Gorgan.

MATERIALS AND METHODS

The 267 Severe Mental Illness (SMI) patients took part in this study which were referred to the psychiatric unit at 5th Azar Education Hospital of Gorgan, Faculty of Medicine, Golestan University of Medical Sciences in Gorgan, Iran in 2014. Schizophrenia, bipolar 1 mood disorder, major depressive disorder with psychotic features, psychotic or mood disorder defined as severe mental illness patients. Collection of ten milliliter blood samples were carried out after a 12 h overnight fast. Determination of biochemical parameters in serum (Fasting blood glucose, high density lipoprotein cholesterol (HDL-cholesterol), total cholesterol and triglyceride levels) were done with commercial kits by spectrophotometer techniques (Model JENWAY 6105 UV/VIS) in the Metabolic Disorders Research Center. Low density lipoprotein cholesterol (LDL-cholesterol) level was calculated by Friedewald equation. Weight of subjects was measured, when they were minimally clothed and without shoes using digital scales. Height was measured in standing position with the shoulder in a normal position using tape meter. Body mass index was determined, when weight (in kilograms) divided by height (in meters squared). Normal weight was defined as BMI = 18.5-24.9, Overweight as BMI = 25.0-29.9 kg m^{-2} and obese as BMI $\geq$30 kg m^{-2} (Altekin *et al*., 2005). Waist circumferences were measured at the point halfway between the lower border of ribs and the iliac crest in a horizontal plane (WHO., 1998). Systolic and diastolic blood pressure was measured in sitting position from the right hand. Metabolic syndrome defined if severe mental illness patients show any three or more of the criteria mentioned in Table 1, according to the ATP III (Adult Treatment Panel III) (2001).

Table 1: Metabolic syndrome components for the metabolic syndrome according to ATP III (adult treatment panel III)

Metabolic syndrome components	Clarifying level of parameters
Waist circumference	For males >102 cm and for females >88 cm
Triglyceride levels	≥150 mg dL^{-1}
High-density lipoprotein levels	For males <40 mg dL^{-1} and for females <50 mg dL^{-1}
Blood pressure	Systolic ≥130 mm Hg, Diastolic ≥85 mm Hg
Fasting glucose levels	≥110 mg dL^{-1}

Statistical analysis: The statistical data analysis was carried out by SPSS-16 version software. The data are showed as means and standard deviations and percentages. The data evaluation was done by using independent sample t and chi-squared tests. A p-value lowers than 0.05 considered statistically significant.

RESULTS

Table 2 shows biochemical characteristic of severe mental illness patients with and without metabolic syndrome with BMI = 18.5-24.9 kg m^{-2}. The mean fasting blood glucose level was significantly higher in the severe mental illness patients with metabolic syndrome ($p<0.05$). The prevalence of metabolic syndrome in these severe mental illness patients was 6.67%. Table 3 shows biochemical characteristic of severe mental illness patients with and without metabolic syndrome with BMI = 25-29.9 kg m^{-2}. There were significant differences in the mean of waist circumference, HDL-cholesterol and fasting blood glucose in subjects with metabolic syndrome, when compared with subjects without metabolic syndrome ($p<0.05$). The prevalence of metabolic syndrome in severe mental illness was 24.09%. Table 4 shows biochemical characteristic of severe mental illness patients with and without metabolic syndrome with BMI>30 kg m^{-2}. There were significant differences in the mean of triglyceride, HDL-cholesterol and fasting blood glucose in subjects with metabolic syndrome, when compared with subjects without metabolic syndrome ($p<0.05$). The prevalence of metabolic syndrome in severe mental illness was 53.06%. Table 5 shows prevalence of metabolic syndrome and the components of metabolic syndrome in severe mental illness patients. The prevalence of high fasting glucose, low high density lipoprotein-cholesterol, high triglyceride levels, high waist circumference and high blood pressure were shown to be 14.23, 38.57, 41.57, 32.96 and 5.24%, respectively. It shows that high triglyceride (41.57%) and Low HDL-cholesterol levels (38.57%) were the most frequent characteristics in comparison to other metabolic components. Table 6 shows number of subjects accomplishing the criteria of metabolic syndrome. Our results show that 26.96, 31.08, 21.35, 15.35 and 5.25% of subjects had zero, one, two, three and four criteria for metabolic syndrome, respectively.

DISCUSSION

The results of this study showed that prevalence of metabolic syndrome increased with elevation of body mass index in severe mental illness patients (Table 2-4). It was revealed that prevalence of metabolic syndrome reported 37, 60 and 75% among schizophrenic and mood disorder patients, respectively (Heiskanen *et al*., 2003; Kato *et al*., 2003). Studies on different populations showed that metabolic syndrome changes in populations of Hong Kong (35%), USA (28.7-60%), Australia (54%), Canada (44.7%) and Finland (37.1%) (Heiskanen *et al*., 2003; Bressington *et al*., 2013; Straker *et al*., 2003; Kato *et al*., 2004; John *et al*., 2009; Cohn *et al*., 2004). Studies on Asian populations like Taiwan and Thailand showed that prevalence of metabolic syndrome in schizophrenia patients were 22 and 20%, respectively (Littrell *et al*., 2003; Srisurapanont *et al*., 2007) which was lower than western populations. Results of this study show that the prevalence

Table 2: Biochemical characteristic of severe mental illness patients with and without metabolic syndrome with BMI=18.5-24.9 kg m^{-2}

Parameters	All severe mental illness patients	Severe mental illness patients without metabolic syndrome	Severe mental illness patients with metabolic syndrome	p-value
BMI (kg m^{-2}) <25				
Number of patients (%)	135.0 (100)	126.0 (93.33)	9 (6.67)	
Age (years)	38.77±11.18	38.98±11.25	41.8±8.92	0.58
Waist circumference (cm)	81.73±8.57	81.41±8.67	84.4±4.15	0.44
Systolic blood pressure (mm Hg)	103.96±11.62	103.85±11.35	104.0±15.16	0.97
Diastolic blood pressure (mm Hg)	66.14±9.16	65.75±8.9	69.0±12.44	0.43
Triglyceride (mg dL^{-1})	134.10±70.07	132.87±70.62	189.4±41.52	0.08
Total cholesterol (mg dL^{-1})	160.81±47.25	161.13±47.79	164.0±48.74	0.89
HDL-cholesterol (mg dL^{-1})	51.30±15.18	51.29±14.96	49.4±23.41	0.78
LDL-cholesterol (mg dL^{-1})	82.21±41.31	82.76±41.85	76.8±46.01	0.75
Glucose (mg dL^{-1})	80.14±18.06	78.48±11.98	126.4±57.21	0.001

HDL: High density lipoprotein, LDL: Low density lipoprotein

Table 3: Biochemical characteristic of severe mental illness patients with and without metabolic syndrome with BMI= 25-29.9 kg m^{-2}

Parameters	All severe mental illness patients	Severe mental illness patients without metabolic syndrome	Severe mental illness patients with metabolic syndrome	p-value
BMI (kg m^{-2}) = 25-29.9				
Number of patients (%)	83.0 (100)	63.0 (75.90)	20.0 (24.09)	
Age (years)	38.90±10.78	38.0±10.77	41.5789±10.86	0.2
Waist circumference (cm)	95.92±7.09	94.81±7.23	99.42±5.47	0.01
Systolic blood pressure (mm Hg)	107.26±12.10	106.02±10.08	110.79±17.09	0.13
Diastolic blood pressure (mm Hg)	68.80±10.34	67.5±9.51	72.63±12.17	0.057
Triglyceride (mg dL^{-1})	173.86±92.82	166.0±93.47	203.16±88.66	0.13
Total cholesterol (mg dL^{-1})	172.46±48.5	175.38±49.56	162.74±46.02	0.32
HDL-cholesterol (mg dL^{-1})	49.5738±15.15	51.4±15.73	43.57±11.77	0.047
LDL-cholesterol (mg dL^{-1})	87.33±41.11	89.7±39.15	78.42±48.02	0.2
Glucose (mg dL^{-1})	83.09±19.55	78.56±12.22	98.1±30.44	0.001

HDL: High density lipoprotein, LDL: Low density lipoprotein

Table 4: Biochemical characteristic of severe mental illness patients with and without metabolic syndrome with BMI >30 kg m^{-2}

Parameters	All severe mental illness patients	Severe mental illness patients without metabolic syndrome	Severe mental illness patients with metabolic syndrome	p-value
BMI (kg m^{-2})>30				
Number of patients (%)	49.0 (100)	23.0 (46.94)	26.0 (53.06)	
Age (years)	39.333±10.16	38.75±11.06	42.59±8.23	0.08
Waist circumference (cm)	105.72±8.51	104.20±8.06	107.04±8.85	0.28
Systolic blood pressure (mm Hg)	109.88±12.55	107.00±9.23	112.39±14.6	0.16
Diastolic blood pressure (mm Hg)	72.32±10.19	70.50±9.16	73.91±10.97	0.28
Triglyceride (mg dL^{-1})	96.23±88.19	144.15±82.81	212.61±81.52	0.009
Total cholesterol (mg dL^{-1})	186.33±44.69	176.75±30.81	194.65±53.26	0.19
HDL-cholesterol (mg dL^{-1})	47.41±16.09	56.75±15.75	39.30±11.5	0.001
LDL-cholesterol (mg dL^{-1})	102.54±46.85	90.77±40.25	112.78±50.55	0.12
Glucose (mg dL^{-1})	180.77±39.03	82.35±10.72	108.30±49.82	0.028

HDL: High density lipoprotein, LDL: Low density lipoprotein

Table 5: Prevalence of the components of metabolic syndrome in severe mental illness patients (N = 267)

Parameters	No.	%
Fasting blood sugar ≥110 mg dL^{-1}	38	14.23
High density lipoprotein-cholesterol for males <40 mg dL^{-1} and for females <50 mg dL^{-1}	103	38.57
Triglyceride ≥150 mg dL^{-1}	111	41.57
Waist circumference for males >102 cm and for females >88 cm	88	32.96
Systolic blood pressure >130 mm Hg/diastolic blood pressure >85 mm Hg	14	5.24

Table 6: Number of subjects accomplishing the criteria of metabolic syndrome

Criteria (%)	Subjects (n = 267)
0	72 (26.96)
1	83 (31.08)
2	57 (21.35)
3	41 (15.35)
4	14 (5.25)

of metabolic syndrome in patients with normal and overweight body mass index is to be lower than western populations (Heiskanen *et al*., 2003; Straker *et al*., 2003; Kato *et al*., 2004; John *et al*., 2009; Cohn *et al*., 2004) and North American (McEvoy *et al*., 2005). Etiology of metabolic syndrome in severe mental illness patients may depend on socioeconomic, nutritional status, different ethnic groups, cultural differences, medical care and kind of life style (Hennekens, 2007; Robson and Gray, 2007). These factors may reduce susceptibility for metabolic syndrome in our area when it compares to other populations. A study showed that central obesity, hypertension, dyslipidemia and hyperglycemia as risk factors of cardiovascular disease were higher in severe mental illness patients than general population (Keenan *et al*., 2013). Elevated fasting blood sugar and reduced HDL-cholesterol were common with increase of body mass index in our study. High waist circumference and high triglyceride levels were seen in overweight and obese patients when body mass index increases. Thus, high waist circumference gives its place to high triglyceride levels with increase of body mass index. In this study, 41.57, 38.57 and 32.96% of subjects had high triglyceride level, low HDL-cholesterol level and high waist circumference, respectively. Some studies have shown that there are an association between serum triglyceride and low HDL-cholesterol levels and coronary heart disease and cardiovascular disease prevalence (Kannel *et al*., 1991; Assmann *et al*., 1998; Vega and Grundy, 1996). Some other studies have indicated that a low HDL-cholesterol level is associated with increased levels of serum triglycerides and high LDL-cholesterol (Austin *et al*., 2000). It was reported that waist circumference is associated with increase of portal free fatty acid levels (Zabetian *et al*., 2007). A study has shown that body mass index was not significantly different between schizophrenic patients and their healthy controls (Oresic *et al*., 2011). A lot of guidelines have recommended that body mass index should be assessed regularly in patients with psychotic disorders and it is more important in patients who receive antipsychotics (McEvoy *et al*., 2005). At the first 6 months after initiating treatment, body mass index was showed to be stable (McEvoy *et al*., 2005). In an Australian study it was shown that in patients with bipolar disease or schizophrenia or both together, body mass index elevated after 18 months from baseline with receiving antipsychotic therapy in control group, but it was decreased in intervention group who underwent exercise, changing diet and physical activity program in this period (McEvoy *et al*., 2005). Body mass index was not significantly different between psychiatric outpatients who underwent typical and atypical antipsychotic therapy (Mackin *et al*., 2005). There is some evidence of ischemic damage in adult brains that had metabolic syndrome (Yates *et al*., 2012). Studies have shown that individuals with metabolic syndrome have increased prevalence of intracranial arteriosclerosis and white matter lesions. Brain's White matter abnormalities were associated with elevating in presence of metabolic syndrome components that could be derived by vascular risk factors in people with metabolic syndrome (Yates *et al*., 2012). It is suggested that metabolic syndrome could affect on brain integrity that is partly caused by abnormality in vascular reactivity as it increase carotid stiffness and intima-media thickness 2. Schizoaffective, bipolar and depressive disorders patients show elevated mortality (Lawrence *et al*., 2001; Taylor and MacQueen, 2006; Harris and Barraclough, 1998). Psychiatric illness must consider as a risk factor for metabolic syndrome to prevent occurrence of some diseases in the future. People with mental disorders, cardiovascular disease may consider as an important risk factors. Thus, the screening of this disease should be taken into consideration by health care service centers.

CONCLUSION

These results show that the prevalence of metabolic syndrome in severe mental illness patients in Gorgan is increased with elevated body mass index. The results of this study suggest that

mental illness patients are at risk of metabolic syndrome when the rate of body mass index increases. Risk factors such as high triglyceride level and low HDL-cholesterol are the most prevalent of metabolic syndrome components. These risk factors may play an important role in the occurrence of metabolic syndrome in severe mental illness patients.

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