Stressful Life Events, Education, and Metabolic Syndrome in Women: Are They Related? A Study in First-Degree Relatives of Type 2 Diabetics

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Abstract

Background: Some reports show that the prevalence of metabolic syndrome is higher in poorly educated women. In our opinion, one probable reason for this is that these women experience more stressful events in their lives. We investigated the association between major stressful life events and the prevalence of metabolic syndrome and the effect of education on this relationship in women.

Methods: This cross-sectional study included 35- to 55-year-old women who were first-degree relatives of type 2 diabetics. They were questioned about stressful events in their lives, their physical activities, and basic characteristics. In addition waist circumference, blood pressure, fasting blood sugar, triglyceride, total and high-density lipoprotein cholesterol (HDL-C) were measured. Metabolic syndrome was defined according to Adult Treatment Panel III (ATP III) criteria, and the number of stresses was compared between two groups of participants with and without metabolic syndrome.

Results: Among the 351 study participants, the prevalence of metabolic syndrome was 28.9%. The mean number of stresses in the metabolic syndrome group was higher than in the nonmetabolic syndrome group at 3.82 ± 2.67 and 3.14 ± 2.35, respectively ($P = 0.036$). The prevalence of metabolic syndrome in subjects with eight or more stressful life events (46%) was greater compared to those who had experienced less than eight stresses (23.4%; $P = 0.017$). The relationship between stressful life events and the prevalence of metabolic syndrome was independent of the low level of education, but the prevalence of poorly educated women was associated with the number of stresses.

Conclusion: Considering the probable association between stress and prevalence of metabolic syndrome, which itself increases the risk of cardiovascular diseases, educating high-risk people to cope with stresses may be beneficial in reducing the incidence of cardiovascular diseases and preventing the onset of metabolic syndrome.

Introduction

METABOLIC SYNDROME IS A cluster of risk factors. Recent research has shown that people with metabolic syndrome are at increased risk for diabetes and cardiovascular diseases.[1–5] Unfortunately the prevalence of the syndrome is increasing worldwide,[6,7] and different causative factors have been cited for it. Some previous studies presented environmental stresses as predictors of metabolic syndrome.[8–10] For example, Chandola et al. showed that stress at work is a risk factor for metabolic syndrome.[11]

Bjorntorp believes that psychological stress resulting in a defeatist or helplessness reaction may stimulate the hypothalamo–pituitary–adrenal (HPA) axis, which leads to various endocrine abnormalities. These changes oppose the action of insulin, and insulin resistance is the key feature of metabolic syndrome.[12–14] Studies in this field are limited and usually discuss the association between work stresses and the prevalence of metabolic syndrome.[11,15] On the other hand, some reports show an association between low educational levels and metabolic syndrome in women.[16,17] We believed that women with a low level of education might have experienced more stressful events in their lives, so we decided to investigate the relationship between daily stressful life events (work and nonwork events) and the prevalence of metabolic syndrome and the effect of literacy on this

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relationship. Because components of metabolic syndrome and insulin resistance have been reported to be more prevalent in first-degree relatives of type 2 diabetics (FDR of type 2 diabetics).[18,19] Bjorntorp believes that the effect of stress is individually different and most likely based on genetic susceptibility,[14] so we decided to include FDR of type 2 diabetics as a genetically susceptible group.

Methods

In this cross-sectional study, women who were FDR of type 2 diabetics aged 35–55 years were enrolled via a consecutive sampling method through the Isfahan Diabetes prevention program at Isfahan, Endocrine and Metabolism Research Center (IEMRC), Isfahan, Iran, during 2005–2007. Subjects with a previous history of diabetes mellitus and those with known psychotic disorders were excluded.

FDRs were defined as siblings and offspring of known type 2 diabetics. The study protocol was approved by the ethics committee of the IEMRC. Written informed consent was obtained from each participant. The study complied with the current version of the Declaration of Helsinki.

Questionnaires relating to major stressful life events, physical activity, and basic characteristics were completed for all participants. Waist circumference and height were measured according to standard protocols.[20] Blood pressure was measured twice by a physician on the right upper arm in the seated position, once after at least 15 min of rest and for the second time after a 5-minute interval, using a standard mercury sphygmomanometer.

After an overnight fasting period of at least 10 h, a blood sample was taken from each participant for measuring fasting blood glucose, serum triglyceride, and total cholesterol (TC) and high-density lipoprotein-cholesterol (HDL-C) levels by enzymatic colorimetric techniques with Liasys auto analyzer (AMETS Srl, Italy). Metabolic syndrome was defined according to Adult Treatment Panel III (ATP III) criteria[21] as the presence of any three of the following five traits: Abdominal obesity (waist circumference >88 cm; serum triglyceride $\geq$150 mg/dL or drug treatment for elevated triglyceride; serum HDL-C <50 mg/dL or drug treatment for low HDL-C; blood pressure $\geq$130/85 mmHg or drug treatment for elevated blood pressure; fasting plasma glucose (FPG) $\geq$110 mg/dL.

The basic characteristic questionnaire consisted of questions about age, history of smoking (yes, no), and low level of education (illiterate or end of primary school). The physical activity questionnaire fielded questions about the subject's daily activities (during work and leisure time) to calculate daily energy consumption per body weight.[22]

Stressful life events questionnaire

The Holmes and Rahe social readjustment scale is an instrument frequently used to evaluate the association between stress and disease.[23] We made some changes to the questionnaire after performing a pilot study. First, in accordance with our belief in the Bjorntorp theory, we focused on major negative stressful events that could cause a feeling of helplessness in almost every individual and omitted those questions relating to positive ones. Second, the questions about educational stresses were deleted because they were considered to be irrelevant, in view of the fact that subjects questioned were mostly illiterate. In any case, we took into consideration that the age group (35–55) would not have under normal circumstances attended school within the 2 years prior to the study. This left us with the top 23 items in the Holmes and Rahe social readjustment scale with the highest scores to use in our study. To these questions, we added others that we felt were relevant to the study due to the fact that identical life events were found to cause stress in both our own pilot study and in two other studies carried out in Iran[24,25] prior to our study. These events included death of a child, a child's chronic disease, having problem with a child, spouse addiction to opioids, occupational failure, inadequate income, and spouse disloyalty. The reliability of the questionnaire was assessed by performing a pretest and a posttest at an interval of 21 days using the α Krumbach test ($\alpha = 0.78$). Because many of our subjects were illiterate, we had no choice other than to ask a second person to help with the questionnaire. And because our people trust physicians, we decided to ask a female physician to communicate with the participants. The trained physician assisted all participants with the questionnaire.

The number of major stresses during the past 2 years was compared between two groups of participants with and without metabolic syndrome.

Statistical analyses

We used a *t*-test to compare continuous variables and the chi-squared test or the Fisher exact test to compare categorical variables, basic characteristics, and mean number of stresses in subjects with metabolic syndrome and those without metabolic syndrome. The analysis of variance (ANOVA) test was used to compare basic characteristics according to different number of stresses. The relationship between stressful events and the prevalence of metabolic syndrome was adjusted for low level of education and other factors, including age, sex, waist circumference, and smoking using univariate analysis. *P* values $\leq$0.05 were considered significant. All analyses were done using the SPSS version 13 (Chicago, IL).

Results

In this study 351 women who were FDR of type 2 diabetics were evaluated. The mean age (year) and mean waist circumference (cm) were 42.78 ± 5.99 and 88.37 ± 8.72, respectively. The number and percentage of subjects having 0 to 5 components of metabolic syndrome are presented in

TABLE 1. NUMBER AND PERCENTAGE OF SUBJECTS WITH 0 TO 5 COMPONENTS OF METABOLIC SYNDROME

Number of components of metabolic syndrome	0	1	2	3	4	5	Total
Number	41	97	111	58	35	9	351
(%)	(11.7)	(27.6)	(31.6)	(16.5)	(10)	(2.6)	(100%)

TABLE 2. BASIC CHARACTERISTICS OF SUBJECTS WITH AND WITHOUT METABOLIC SYNDROME

	With metabolic syndrome	Without metabolic syndrome	P value
Age[a] (year)	44.02 ± 5.59	42.28 ± 6.09	0.015
Waist circumference[a] (cm)	95.56 ± 6.63	85.42 ± 7.70	0.000
Physical activity[a] (kcal/kg)	27.75 ± 5.74	33.62 ± 6.19	0.000
Low educational level[b]	57 (77.0)	122 (61.3)	0.01
Smoking[b]	1 (1.0)	2 (0.8)	0.5

[a]Mean ± standard deviation (SD).
[b]n (%).

Table 1. According to these data, the prevalence of metabolic syndrome (having three or more components) was 28.9%.

Table 2 shows basic characteristics of subjects with and without metabolic syndrome. This table shows that mean age and waist circumference in women with metabolic syndrome were significantly higher than those without metabolic syndrome. The mean level of physical activity was significantly higher in women without metabolic syndrome than those with metabolic syndrome.

The prevalence of subjects with a low level of education was higher in women with metabolic syndrome than in those without metabolic syndrome. The prevalence of metabolic syndrome increased by experiencing more than eight stresses and 50% of subjects with more than eight stressful events had metabolic syndrome.

Table 3 shows that there was no significant association between the number of stressful life events and the mean level of physical activity or smoking, but the waist circumference increased by increasing the number of stresses. This difference is only significant when comparing women with no stressful event with those who had more than eight stresses (P = 0.043).

Age and low level of education were associated with the number of stressful life events. As the number of stressful life events increased, the prevalence of women with a low level of education increased correspondingly. By using the post hoc test, it was revealed that the main difference was between those who had more than eight stresses and other groups.

The prevalence of metabolic syndrome was 46% in 25 subjects with eight or more stressful events and 23.4% in those with less than eight stressful events (P = 0.017). After adjustment for low level of education, age, physical activity, and smoking, this difference remained significant (P = 0.013).

The mean number of stressful events was significantly higher in subjects with metabolic syndrome (3.82 ± 2.67) than in those without metabolic syndrome (3.14 ± 2.35) (P = 0.036). Despite adjustment for age, waist circumference, physical activity, low educational level, and smoking, this difference was significant once more (P = 0.044).

Discussion

This study shows that women with metabolic syndrome have experienced a greater number of stressful life events than those without metabolic syndrome. In addition, experiencing eight or more stressful events can increase the prevalence of metabolic syndrome, which suggests a dose–response relationship between stressful events and metabolic syndrome. These results are very similar to those of the Chandola study,[11] which showed a dose–response association between exposure to work stressors and the risk of metabolic syndrome. They also found that employees who were exposed to three or more work stresses were more than two times likely to have metabolic syndrome than those without work stress. Today, it is virtually impossible to have a stress-free life. These stresses when occurring repeatedly or protractedly may lead to organic problems.[14] Bjorntorp believes that psychological stress leads to hyperactivity of the HPA axis, which leads to a hormonal imbalance, and this imbalance causes visceral adiposity and insulin resistance and contributes to the development of the entire spectrum of metabolic syndrome.[12,14]

TABLE 3. BASIC CHARACTERISTICS OF SUBJECTS BY NUMBER OF EXPERIENCED STRESSES DURING LAST 2 YEARS

Number of experienced stresses during last 2 years	None	1–3	4–7	≥8	P value
Prevalence of metabolic syndrome	9 (26.5)	41 (25.2)	39 (30)	12 (54.5)	0.04
Age[a] (year)	43.18 (5.21)	42.44 (5.83)	42.47 (5.94)	46.43 (7.71)	0.027
Waist Circumference[a] (cm)	86.82 (8.94)	87.59 (8.83)	89.23 (8.55)	91.53 (7.83)	0.089
Physical activity[a] (kcal/kg)	31.38 (6.27)	32.19 (6.63)	31.85 (6.89)	31.18 (5.55)	0.85
Low educational level[b]	15 (51.7)	81 (61.8)	66 (70.2)	17 (89.5)	0.03
Smoking[b]	1 (3.1)	0 (0)	1 (0.8)	1 (4.5)	0.07

[a]Mean (standard deviation, SD).
[b]n (%).

In this study, even though we found that physical inactivity and low educational level were more prevalent in women who had experienced eight or more stresses, thus supporting findings in other trials that low educational level is associated with metabolic syndrome in women,[16,17] we discovered that the effect of stressful events on the prevalence of metabolic syndrome was independent of the level of education and behavioral factors, but the prevalence of poorly educated women was associated directly with the number of stressful life events. So we can conclude that stressful events that are more prevalent in women with lower socioeconomic positions (indicated by low educational level) can increase the risk of metabolic syndrome.

In our study, there was a significant difference between the prevalence of metabolic syndrome and the mean waist circumference in women with more than eight stresses and those with no stress. Bjorntorp cites evidence indicating a potentially causal relationship between stress and abdominal obesity,[3,14] but an unfortunate limitation of our study is lack of access to data pertaining to HPA axis.

Limitations

This study is the first of its kind undertaken in our country. However, it is not without limitations. Among the limitations of our study is that we did not have a relevant scoring scale on which to base our cultural values. Nevertheless, it is obvious that the perception of stress and its scoring is highly varied among different individuals; hence, we tried to find major stressful events in our society. Consequently, we added them to the first 23 negative stressful events mentioned in the Holmes and Rahe questionnaire, which had the highest scores. It is to be expected that when patients with different coping abilities suffer from such serious stressful events, they feel helpless. As mentioned before, the other limitation of this study is that we have no data to address HPA axis function to support our theory. This should be considered in the future studies.

Conclusions

It would seem that major stressful life events may contribute to the development of metabolic syndrome, at least in individuals already at risk for metabolic syndrome. Because metabolic syndrome is a predictor of cardiovascular diseases, it is very important to discover risk factors related to this syndrome in order to decrease the prevalence of both metabolic syndrome and cardiovascular diseases. Considering the possible effect of stressful life events on a daily basis on the prevalence of metabolic syndrome, it makes sense to educate high-risk groups in how to cope with them.

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