PREVALENCE OF METABOLIC SYNDROME AMONG MIDDLE AGED WOMEN IN BABOL, IRAN

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Abstract. Metabolic syndrome is a cluster of interconnected cardiovascular risk factors. This research determined the prevalence of metabolic syndrome by body mass index, sociodemography, and lifestyle habits of women 30-50 years old in Babol Iran. A systematic random sampling was used to select 984 middle aged women from an urban area in Babol, Mazandaran, Iran. Screening was used to select eligible women who fulfilled selection criteria. The Adult Treatment Panel III (ATP III) criteria were used to classify participants as having metabolic syndrome. The overall prevalence of metabolic syndrome was 31.0%. Abdominal obesity was observed in about 76.6% (n = 273) of subjects. The prevalences of hypertension, high fasting blood glucose, high triglycerides and low HDL-cholesterol were 12.1, 12.1, 41.5 and 48.6%, respectively. Older age (OR=2.07; CI=1.56-2.75), higher waist circumference (OR=6.46; 95% CI=3.48-11.96), higher systolic (OR=3.84; 95% CI=2.37-6.22) and diastolic blood pressure (OR=1.89; 95% CI=1.17-3.05), low education level (OR=2.780; CI=1.80-4.31), housekeeping (OR=3.92; CI=1.24-12.44) and farming occupation (OR=20.54; 95% CI=3.54-119.06) were associated with increased risk for metabolic syndrome. The odds ratio (OR) showed no significant associations between metabolic syndrome and smoking or exposure to smoking. This study showed high prevalence of metabolic syndrome in Iranian middle aged women. A larger area and population study is needed to enable broader recommendations for the prevention of metabolic syndrome.

INTRODUCTION

Metabolic syndrome is a cluster of risk factors for cardiovascular disease. It includes hypertension, hypertriglyceridemia, low HDL-cholesterol, insulin resistance, and obesity (Ford *et al*, 2002). The prevalence of metabolic syndrome has increased. Existing data suggest that it has reached an alarming rate (Arslanian and Suprasongsin, 1996; Young-Hyman *et al*, 2001). It presents a major challenge to physicians and public health agencies (Poirier and Despres, 2003). Obesity plays a central role in metabolic syndrome and leads to the development of chronic diseases (Sinaiko, 2001). A recent study in Tehran showed an estimated prevalence of more than 30% in adults. It is more common in women than in men, and the prevalence is higher than in most developed countries (Azizi *et al*, 2003).

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Three health organizations, the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III), American Association of Clinical Endocrinologists (AACE) and the World Health Organization (WHO) have provided practical tools to identify individuals with metabolic syndrome. However, clinical criteria differ between organizations (WHO, 1999; Reaven, 2003). In the NCEP ATP III a clear demonstration of insulin resistance is not needed. Both the AACE and WHO state an oral glucose tolerance test to identify insulin resistance is necessary. However, an oral glucose tolerance test is beyond routine clinical assessment. Although insulin resistance measurements give additional information, they add time and cost to clinical practice. Therefore, the NCEP ATP III criteria are more suitable in clinical practice (Bjorntorp, 1997; Okosun *et al*, 2000), because they do not require glucose tolerance testing, insulin concentration measurements, and microalbuminuria testing (Grundy *et al*, 2005).

These health issues are widely discussed in developed countries, but little is reported regarding the Middle East. Lifestyles in developing countries often mimic those of the West, therefore, the problem has increased significantly. Consequently the population of these countries is at higher risk for obesity and metabolic syndrome than that of the west (Barker, 1997; Osmond and Barker, 2000). For example, in Iran the prevalence of overweight and obesity are 62.2% and 28.0%, respectively. The mean waist-to-hip ratio (WHR) among women is higher than those in other countries (Bahrami *et al*, 2006). Although Iranian women age 35-81 have low alcohol consumption (0.1%) and smoking (2.2%) rates a higher than normal BMI might be due to a genetic predisposition characteristics (Bahrami *et al*, 2006). This study determined the prevalence of metabolic syndrome and associated risk factors.

MATERIALS AND METHODS

A systematic random sampling method was used to select 984 women age 30-50 years old from an urban area in Babol, Mazandaran, Iran. A list of households managed by Health Care Centers were used. The households were randomly selected, and stratified according to the number of households covered by each Health Care Center, to achieve a distribution similar to the original. We selected 1,905 households. In each household, all women between 30 and 50 years old were selected. The Ethics Committee of the Medical Faculty of Universiti Putra Malaysia and Babol University approved the study. Informed written consent was obtained from all subjects in the study. Inclusion criteria for the study were non-pregnant Babolian women, who were mentally sound. Exclusion criteria included individuals with a history of antilipidemic medication use or use of other drugs interfering with lipid metabolism, renal or thyroid dysfunction, significant hepatic disease, acute or chronic inflammatory diseases, immobilization, recent surgical operations, myocardial infarction, or a cerebrovascular accident within the previous three months.

Sociodemographic assessment

A sociodemographic questionnaire was used to obtain information regarding age, weight, height, blood pressure, education level, marital status, occupation, income, economic status, menstrual status, breast feeding, age of menopause, and smoking habits. Nine hundred eighty-four subjects were interviewed privately, face-to-face, using the questionnaire.

Date of menopause was defined as the date of the last menstrual period if greater than one year before the study began. For women who had undergone hysterectomy and oophorectomy, the age of menopause was the date of the surgical procedure. For women who were unsure of whether an oopherectomy was done at time of hysterectomy, the date of menopause was taken as the time of onset of hot flashes (Wamala *et al*, 1999).

Subjects were divided into three groups according to level of education: <6 years, 6 to 11 years, and ≥12 years. The women were divided into 3 economic groups by household income for the previous year: ≤150,000, 150,001 to 300,000, and >300,000 Tomans (Tomans=0.01 USD) per month.

Weight was recorded using digital scales to the nearest 100 grams with the subjects minimally clothed and without shoes. Height was measured without shoes, with a tape measure. Waist circumference was measured to the nearest 0.1 centimeter, using a tape measure at the level midway between the lower rib margin and iliac crest, (Jelliffe and Jelliffe 1989; Wamala *et al*, 1999). In order to minimize error, all measurements were taken by the same person.

The participants rested for 15 minutes before their blood pressures were obtained. The participants was questioned regarding drinking tea or coffee, physical activity, smoking. A physician measured the blood pressure twice using a standard mercury sphygmomanometer. An appropriate size cuff was used based on the subject's arm size. The cuff was inflated to 33 mmHg above the level the radial pulsed disappeared before the reading was taken. Two readings were taken 30 seconds apart. The mean blood pressure between the 2 reading was recorded. Participants were placed in the high-risk category for systolic and diastolic blood pressure if their values were at or above the levels defined as clinically hypertensive (JNC VI, 1997).

Metabolic syndrome assessment

The ATP III criteria were used to determine metabolic syndrome with the presence of any three or more of the following criteria: 1) waist circumference >88 cm, 2) serum triglycerides≥150 mg/dl, 3) blood pressure ≥130/85 mmHg, 4) HDL cholesterol < 50 mg/dl, and 5), serum glucose ≥110 mg/dl (NCEP, 2001).

Smoking history was categorized as current, past, or never smoked. Past smokers were those who reported that they had smoked at least 100 cigarettes during their lifetime, but were currently non-smokers.

Laboratory studies

Fasting blood samples for the measurement of glucose and lipid concentrations were drawn from the right arm of each subject, in the resting position, by antecubital vein puncture with a 1.4-mm Wasserman needle, after an overnight fast of 12 hours (Azizi *et al*, 2003). For lipid analyses the blood was drawn into a 10 ml pre-cooled sterile tube containing 0.12 ml of 0.34 mol/l tripotassium EDTA (ethylenediaminetetraacetic acid). After the samples sat for 1 hour, they were centrifuged (1,000*g* for 15 minutes at 30ºC). The recovered serum was divided into aliquots and stored at -80ºC. Blood glucose was measured on the day of blood collection by using an enzymatic colorimetric method with glucose oxidase (Trinder, 1969). Total cholesterol and triacylglycerols were determined using commercially available enzymatic reagents adapted to the Selectra autoanalyzer (Parsazmon). HDL-cholesterol was measured after precipitation of the apolipoprotein B–containing lipoproteins with phosphotungstic acid. LDL-cholesterol was estimated by the Friedewald equation. It was not calculated when the serum concentration of triacylglycerol was >400 mg/dl (Friedewald *et al*, 1972). Inter-assay and intra-assay coefficients of variation were 8.61% and 2.53% for total cholesterol and 7.92% and 1.6% for triglycerides, respectively.

Statistical analysis

This study hypothesized that some lifestyle habits (smoking, socioeconomic fac-

Table 1
Classification of laboratory data and blood pressures in the study participants (*N*=916).

Variables	*n* (%)
Total cholesterol (*N*=916)	
Desirable (<200 mg/dl)	563 (61.5)
Borderline high (200-239)	249 (27.2
High (≥240)	104 (11.4)
Triglyceride serum level (*N*=916)	
Normal (<150 mg/dl)	536 (58.5)
Borderline high (150-199 mg/dl)	158 (17.2)
High (200-499)	203 (22.2)
Very high (≥500)	19 (2.1)
HDL cholesterol (*N*=916)	
Low (<40 mg/dl)	156 (17.0)
High (>60)	226 (24.7)
LDL cholesterol (*N*=915)[a]	
Optimal (<100)	387 (42.3)
Near optimal/above optimal (100-129)	307 (33.6)
Borderline high (130-159)	152 (16.6)
High (160-189)	45 (4.9)
Very high (>190)	24 (2.6)
Blood pressure (*N*= 944)	
Normal (<130/<85)	780 (82.6)
High normal (130-139/85-89)	8 (0.8)
Hypertention	
Stage 1 (mild) (140-159/90-99)	90 (9.5)
Stage 2 (moderate) (160-179/100-109)	43 (4.6)
Stage 3 (severe) (180-209/110-119)	10 (1.1)
Stage 4 (very severe) (>210/>120)	13 (1.4)

[a]One case was not defined because the LDL was very high.

tors, and anthropomorphic behavior) are related in terms of risk to having metabolic syndrome. Using SPSS (version 15.0), all variables were tested for normality. Descriptive statistics were used to describe baseline demographic and anthropometric measures, and lipoprotein subclass levels. The data were not normally distributed; hence differences and associations between groups were done using the Mann-Whitney *U* test and chi-square tests. Multiple logistic regresion was used to determine the relationship between metabolic syndrome and demographic, socioeconomic, anthropometric, and lifestyle factors. The odds ratios (OR) were presented together with their 95% CI. Adjustments were made for independent variables: smoking, physical activity, nutrient and food groups. All analyses employed a two-tailed hypothesis with significance set at a p-value of ≤ 0.05.

RESULTS

A total of 984 women were selected with a mean age of 40.1 years (range 30 to 50 years). Forty women (4.1%) did not fast

Table 2
Metabolic syndrome-ATPIII definition (*N*=916).

Variable	*n* (%)
Abdominal obesity [a]	273 (76.6)
Blood pressure ≥130/85 mmHg	114 (12.1)
Fasting blood glucose ≥110 mg/dl	111 (12.1)
Triglycerides ≥150 mg/dl	380 (41.5)
Low HDL-cholesterol <50 mg/dl	445 (48.6)
1 component	282 (30.8)
2 components	265 (28.9)
3 components	207 (22.6)
4 components	70 (7.4)
5 components	7 (0.8)
ATPIII-defined metabolic syndrome[b]	284 (31.0)

[a]Abdominal obesity: waist circumference >88 cm for women.
[b]≥3 components

properly prior to the blood test and were excluded from these analyses. Complete data were obtained for the remaining 944 participants (95.9%). The mean ± standard deviation (SD) for the age of the participants was 40.2 (± 0.2) years and the median age was 40.0 years. Study participants had a mean (± SD) education level of 6.5 (± 0.1) years and a median education of 5.0 years. More than 75% (*n* = 713) of subjects had an educational level of elementary or lower. Eight hundred eighty-seven women (94.0%) were married and 854 women (90.5%) had no income (housewives). The mean (± SD) monthly household income was 243,000.4 (± 6.1) Tomans and the median household income was 220,000 Tomans. Almost half (44.5%) of women reported being in debt.

The mean (±SD) weight of the women was 72.0 (±12.4) kg and the median weight was 72.0. The mean (±SD) height was 156.0 (± 7.4) cm and the median height was 156.0. The mean BMI was 29.7 (±5.5) kg/m^2. The mean (±SD) waist circumference was 96.9 (±11.7) cm and the median waist circumference was 98.00 cm. Out of 944 women, 723 (76.6%) had a waist circumference >88 cm. The lipid results divided according to the classification system recommended according to National Cholesterol Education Program Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults and blood pressure (NCEP, 2001) are given in Table 1.

The overall prevalence of metabolic syndrome among Babolian urban women 30-50 years old was 31.0% by ATPIII definition. Abdominal obesity was observed in 76.6% (*n* = 273) (Table 2).

In order to explore the relationship between the parameters and metabolic syndrome, the subjects were divided into two groups: women with metabolic syndrome (*n* = 284) and women without metabolic syndrome (*n* = 632). Between group differences were analyzed using the Mann-Whitney *U* test. Women with metabolic syndrome had significantly lower HDL-cholesterol levels (p≤0.0001), higher total cholesterol levels (p≤0.0001), higher triglyceride levels (p≤ 0.0001), and higher glucose levels (p≤0.0001). These women also had significantly higher

Table 3
Characteristics of subjects according to occurrence of metabolic syndrome.

	Without metabolic syndrome (*N*=632)	With metabolic syndrome (*N*=284)	*p*-value
Variables	*n* (%)	*n* (%)	
Social economic status			
Education <6 years	282 (44.6)	181 (63.7)	0.0001
Low income< 200,000 Tomans[a]	266 (42.1)	130 (45.8)	0.332
Anthropometry			
BMI[b]≥25(kg/m²)	499 (79.0)	261 (91.9)	0.0001
Waist circumference >88 cm	43.3 (68.5)	269 (94.7)	0.0001
Blood pressure in mmHg			
Systolic BP ≥130 mmHg	51 (8.1)	103 (36.3)	0.0001
Diastolic BP≥85 mmHg	65 (10.3)	97 (34.2)	0.0001
Lipid profile and fasting glucose (mg/dl)			
Total cholesterol ≥200 mg/dl	221 (35.0)	132 (46.5)	0.001
LDL ≥130 mg/dl	148 (23.4)	73 (25.8)	0.488
HDL <50 mg/dl	206 (32.6)	239 (84.2)	0.0001
Triglycerides ≥150 mg/dl[a]	126 (19.9)	254 (89.4)	0.0001
Fasting glucose ≥110 mg/dl	21 (3.3)	90 (9.8)	0.0001

[a]Tomans=10 Rials=0.01 USD
[b]BMI; body mass index in weight/height^2 (kg/m^2)

body mass indexes (p≤0.0001), waist circumferences (p≤0.0001), systolic blood pressures (p≤0.0001), and diastolic blood pressures (p≤0.0001). However there was no statistically significant difference in mean LDL-cholesterol levels between women with and without metabolic syndrome.

Characteristics of women with and without metabolic syndrome were also analyzed with the chi-square test (Table 3). The BMI was significantly related to metabolic syndrome (p≤0.001). However, no significant associations were found between metabolic syndrome and BMI by odds ratio. Abdominal obesity (waist circumference >88 cm), fasting glucose (≥110 mg/dl), total cholesterol (≥ 200 mg/dl), HDL-cholesterol (<50 mg/dl), triglycerides (≥200 mg/dl), and education levels (<6 years) were all related to metabolic syndrome, but LDL-cholesterol, menopausal status and income (<200,000 Tomans) were not. There was a significant association between risk for metabolic syndrome and large waist circumference (OR=6.46; 95% CI=3.48-11.96), high systolic blood pressure (OR=3.84; 95% CI=2.37-6.22), and high diastolic blood pressure (OR=1.89; 95% CI=1.17-3.05) compared to subjects with low waist circumference, low systolic and diastolic blood pressures.

The adjusted odds ratios (with 95% CI) for associations between socioeconomic status and the risk for metabolic syndrome in women 30-50 years old were calculated. The risk for metabolic syndrome in women 41-50 years old was higher than in the 30-40 year old group (OR=2.07; CI=1.56-2.75) (Table 4). No significant associations were found between metabolic syndrome and marital status, income or economic status.

Table 4
Adjusted odds ratios (OR) for metabolic syndrome according to socioeconomic characteristics data of the subjects.

Variables	OR	95% Confidence interval	*p*-value
Age (years)			
30- 40	1.00		
41-50	2.07	1.56-2.75	0.0001
Marital status			
Married	0.97	0.24-3.99	0.967
Single	0.47	0.06-4.12	0.499
Widowed	1.12	0.24-6.09	0.817
Divorced	1.00		
Education level (years)			
<6	2.78	1.80-4.31	0.0001
6-11	1.57	0.97-2.55	0.069
≥12	1.00		
Occupation			
Housewife	3.92	1.24-12.44	≤0.020
Factory worker	4.11	0.47-35.74	0.200
Employee	3.93	0.95-16.21	0.059
Technician	20.54	3.54-119.06	0.0001
Farmer	1.00		
Income (Toman/m)[a]			
<150,000	0.98	0.57-1.64	0.909
150,000-300,000	1.15	0.73-1.80	0.555
>300,000	1.00		
Menstruation			
Regular menstrual periods	1.11	0.72-1.72	0.636
Menopause	1.00		
Economic status			
With savings	0.73	0.33-1.61	0.439
With debts	1.24	0.91-1.69	0.177
No savings or debts	1.00		

[a]Toman: 10 Rials = 1 Toman= 0.01 USD

Low education (OR = 2.78; 95% CI=1.80-4.31) was a factor significantly associated with metabolic syndrome. The adjusted OR for metabolic syndrome in technicians (OR= 20.54; 95% CI=3.54-119.06) and house wives (OR=3.92; 95% CI=1.24-12.44) were significantly higher than in other subjects. Low education level (OR=2.78; 95% CI=1.80- 4.31) was a factor associated with metabolic syndrome. Since the CI for all these odds ratios did not include 1.00, the findings are considered significant. No significant associations were found between metabolic syndrome and marital status, income or menstrual status.

Of the 944 participants in whom we had complete data, only 2 (0.2%) reported being current smokers at baseline. Twenty-one (12.4%) women were exposed to cigarette smoke at their place of work and 289 (32.9%)

Table 5
Adjusted odds ratios (OR) for metabolic syndrome according to lifestyle habit data from subjects[a].

Variables	Categories	Adjusted OR	95% Confidence interval	p-value
Exposed to cigarette smoke at home	Yes	1.13	0.83-1.54	0.425
	No	1.00		
Exposed to cigarette smoke at work	Yes	0.92	0.35-2.43	0.864
	No	1.00		
Current cigarette smoking	Yes	2.23	1.39-35.77	0.571
	No			
Alcohol drinker	-	-	-	-

[a]Potential confounders used for analysis were total physical activity, total energy intake, years of school, income and body mass index.

were exposed to cigarette smoke. On comparing participants with metabolic syndrome (*n*=284) and without (*n*=632), a chi-square test revealed no significant differences between metabolic syndrome and current smoking, exposure to cigarette smoke at home and exposure to cigarette smoke at work. The adjusted odds ratio (OR) also showed no significant association between metabolic syndrome and smoking or exposure to cigarette smoke (Table 5).

DISCUSSION

The prevalence of the metabolic syndrome in this study was 31.0%. A number of surveys of Asian populations to estimate the prevalence of metabolic syndrome have been carried out (Onat *et al*, 2002; Al-Lawati *et al*, 2003; Gupta *et al*, 2003; Cameron *et al*, 2004; Hwang *et al*, 2006). The prevalence of metabolic syndrome in Asia is usually lower than in developed countries (Ford *et al*, 2002; Meigs *et al*, 2003; Park *et al*, 2003). The prevalence in our study was closer to the study in Tehran in 1999-2001 (Azizi *et al*, 2002). Azizi and colleagues (2002), in a study using the same definitions as ours, found an unadjusted prevalence of metabolic syndrome in 30.1% of the study population and an age-standardized prevalence of 33.7%. In women the prevalence was 24.3% in the 30-39 year age group, and 48.3% in the 40-49 year age group. Zabetian *et al* (2007) reported an age-adjusted prevalence of metabolic syndrome in urban Tehranian women equal to or greater than 20 years old of 40.5%. These findings suggest that metabolic syndrome is common among Babolian middle-aged women, and has become a serious public health challenge in Babol.

A possible explanation for the higher prevalence of metabolic syndrome is abdominal obesity. The waist circumference directly reflects abdominal fat and has been suggested as an index of abdominal obesity (Reeder *et al*, 1992), which is an independent predictor for cardiovascular disease (Kannel *et al*, 1991). In our study of Babolian women age 30-50 years, 76.6% had a high waist circumference. The mean waist circumference was 96.9 cm which is more than what had previously been reported in a WHO project where the age-adjusted mean waist circumference from nineteen population studies was 78 to 91 cm in women (Molarius *et al*, 1999). This was also more than that previously reported from Iran (the age adjusted mean waist circumference in women was 89.6 cm) (Janghorbani *et al*, 2007). The waist circumference in our study is closer to that found in Northeast Iran in Golestan Province (mean waist circumference in women was 98.0 cm) (Bahrami *et al*, 2006). Variation in the location of measurement of the waist circumference may account for the differences in the different studies. The WHO Expert Committee on Physical Status (1995) recommends measurement at a point midway between the lower rib and the iliac crest. The National Health and Nutrition Examination Survey guidelines recommend a point just above the right ileum (Chumlea and Kuczmarski, 1995), and the North American Association for the Study of Obesity and the National Heart, Lung and Blood Institute (1998) recommend the right iliac crest. Finally, in clinical practice, measurement at the narrowest point is practical because of easy interpretation, easy measurement, and higher acceptance in caucasian populations (Larsson *et al*, 2007). In this study, we measured waist circumference based on the WHO Expert Committee on Physical Status definition. The mean waist circumference was higher than those in other studies. Abdominal obesity and overweight are associated with metabolic syndrome.

Abdominal obesity is associated with an increase in portal free fatty acid concentrations, which leads to hyperinsulinemia (Foucan *et al*, 2002; Zabetian *et al*, 2007). This hyperinsulinemia is linked to cardiovascular disease risk factors (Schmidt *et al*, 1996). Lifestyle factors such as smoking, unhealthy diet and decreased physical activity might play an important role in abdominal obesity (Molarius and Seidell, 1998), the effect varies by race (Gallagher *et al*, 1996). In this survey, we found healthy diet, dairy products and vigorous physical activity to be inversely associated with waist circumference. We also found healthy diet, dairy products and vigorous physical activity to be inversely associated with waist circumference.

The WHO has estimated that the mean BMI in Africa and Asia to be about 22-23 kg/m^2 (http://www.who.int/dietphysicalactivity/publications/facts/obesity/en,2008). In this study the mean BMI was 29.7 kg/m^2, which is similar to that of women age 35-81 years old in northeastern Iran, Golestan Provience (28.6 kg/m^2) (Bahrami *et al*, 2006). The mean BMI in Babolian middle aged women was even greater than in America, Europe, and some Latin American, North African and Pacific Island countries as reported by the WHO (2008) (25-27 kg/m^2). The overall prevalence of obesity (BMI ≥30 kg/m^2) was 45.0%, similar to the women in the Kingdom of Saudi Arabia (age-adjusted prevalence of obesity of 44%) (Al-Nozha *et al*, 2005), but higher than that reported for Tehran (30.1%) (Malekzadeh *et al*, 2005).

Obesity increases the risk of dyslipidemia, type 2 diabetes, and hypertension, and is a strong predictor of coronary heart disease. Abdominal obesity is associated with an increased risk for cardiovascular disease (National Institutes of Health, National Heart, Lung, and Blood Institute, 1998). Therefore, health professionals and policy makers should focus on prevention of metabolic syndrome (Reeder *et al*, 1992), since the prevalence of abdominal obesity is increasing and there is a strong relationship between metabolic syndrome and abdominal obesity. Strategies must focus on decreasing abdominal obesity. A metabolic syndrome clinic could be established in Primary Health Care Centers with the cooperation of the Non-communicable Diseases Center of the Iran Ministry of Health. The Iranian health authorities have developed an electronic database containing information on mothers' ages, number of children, occupation, and family planning history in Primary Health Centers. It is proposed that this database be expanded to include health status information, including blood pressure, fasting plasma glucose, lipid profiles, BMI, dietary history, and physical activity of all women registered at the Primary Health Centers. This should enhance the monitoring of health, especially among middle aged women in the prevention of metabolic syndrome by health staff such as dietician, general practitioners and midwives at the Primary Health Center.

Applying simple and systematic screening programs like measurement of waist circumference, blood pressure, and determining of lipids and plasma glucose would be useful in the prevention of metabolic syndrome. Personnel at these clinics should do their best to improve unhealthy habits of middle aged women.

Iranian health policy-makers should develop an appropriate intervention plan to decrease the incidence of metabolic syndrome and cardiovascular disease.

As 38.5% of women 30-50 years old had hypercholesterolemia. In Tehran, adult women had a prevalence of hypercholesterolemia of 55% (Azizi *et al*, 2005). The mean LDL- cholesterol was 107.4 mg/dl. Stamler *et al* (1986) observed a broad range of LDL-cholesterol levels; the higher the level the higher the risk of coronary heart disease. Low levels of cholesterol (total cholesterol <150 mg/dl or LDL-cholesterol <100 mg/dl) throughout life are associated with no clinical coronary heart disease (Law *et al*, 1994; Law, 1999). In people with genetic forms of hypercholesterolemia, elevated LDL-cholesterol is associated with coronary heart disease (Brown and Goldstein, 1986). Since LDL-cholesterol levels <100 mg/dl throughout life are associated with low risk for coronary heart disease, these levels can be considered optimal (NCEP, 2001).

In this study, 33.6% of sujects had a LDL-cholesterol (between 100 and 129 mg/dl). However, it has been shown when LDL-cholesterol concentrations are near optimal, atherogenesis still occurs (Law *et al*, 1994; Law, 1999). Sixteen point six percent of women had LDL levels between 130 and 159 mg/dl. At these levels atherogenesis proceeds at a significant rate (Law *et al*, 1994; Law, 1999). Four point nine percent and 2.6% of our subjects had an LDL level of 160-189 mg/dl and≥190 mg/dl, respectively. High (160-189 mg/dl) and very high (≥190 mg/dl) levels are associated with frequent coronary heart disease (Stamler *et al*, 1986; Law *et al*, 1994; Law, 1999; NCEP, 2001). If we use ≥130 mg/dl as a cut-off for high levels then 21.1% of women age 30-50 years old had high LDL cholesterol levels in our study; which is similar to Turkish women over 30 years old (28.35%) (Sanisoglu *et al*, 2006). Adult women had a higher percentage (42%) with high LDL levels in Tehran (Azizi *et al*, 2005). When we compared levels of LDL-cholesterol between women with metabolic syndrome and those without metabolic syndrome we observed no significant difference.

Many prospective epidemiological studies have reported a positive relationship between serum triglyceride levels and incidence of coronary heart disease. Thus, elevated serum triglycerides help to identify persons who are at risk (Assmann *et al*, 1998; Austin *et al*, 1998). In this study, 24.3% had triglyceride levels ≥200 mg/dl. Some reports suggest when triglyceride levels are ≥200 mg/dl, increased quantities of atherogenic remnant lipoproteins lead to coronary heart disease. This condition can be predicted by LDL-cholesterol alone (Steiner *et al*, 1987; Tornvall *et al*, 1993).

Usually a low HDL-cholesterol level is linked with elevated levels of serum triglycerides and remnant lipoproteins (Phillips *et al*, 1981; Schaefer *et al*, 1994). A low HDL-cholesterol level is commonly associated with high LDL-cholesterol (Austin *et al*, 2000). A low HDL-cholesterol level can be a sign of insulin resistance and is associated with metabolic risk factors (Wilson *et al*, 1998). Our findings shows the prevalence of low HDL cholesterol in Babol middle aged women is lower than in adult women from Tehran (17% *vs* 36%) (Azizi *et al*, 2005). A high HDL cholesterol is associated with reduced risk for coronary heart disease (Vega and Grundy, 1996). The Adult ATP II classification of HDL cholesterol defined two categories: low (<40 mg/dl) and high (>60 mg/dl) (National Cholesterol Education Program, 1993). The prevalence of high HDL cholesterol was 24.7% in our sample.

The total cholesterol/HDL cholesterol ratio is a powerful predictor of coronary heart disease risk. Some investigators suggest that this "cholesterol ratio" is a simple approach for lipid risk assessment. This ratio reflects two powerful components of risk. High total cholesterol is a marker for atherogenic lipoproteins, whereas low HDL cholesterol is linked with multiple risk factors of metabolic syndrome and probably imparts some independent risk for coronary artery disease (Castelli *et al*, 1992; Kinosian *et al*, 1995). A total cholesterol/HDL-cholesterol ratio ≥4 is also associated with an adverse serum lipid profile (Morar *et al*, 1998). The mean total cholesterol/HDL-cholesterol ratio in our sample was 3.90, and the prevalence of dyslipidemia in our study was 51.8%. This is in contrast to the mean levels of total cholesterol/HDL cholesterol ratio in 35-64 year old women of Switzerland in two Swiss regions and the prevalences of dyslipidemia of 4.2, 22.4% and 4.4, 25.9%, respectively (Wietlisbach *et al*, 1997). In our study, we found a higher prevalence of dyslipidemia compared to Turkey (Sanisoglu *et al*, 2006), Switzerland (Wietlisbach *et al*, 1997), and Canada (MacLean *et al*, 1999). Therefore, dyslipidemia along with abdominal obesity, which correlate with adverse serum lipids and lipoproteins (Pouliot *et al*, 1994; Dobbelsteyn *et al*, 2001) are a problem among middle aged Babol women, which may be attributed to their lifestyles.

The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI, 1997) defined hypertension as a systolic blood pressure ≥140 mmHg a diastolic blood pressure ≥90 mmHg or the current use of antihypertensive medication. Numerous observational studies have demonstrated a strong association between high blood pressure and risk for coronary heart disease (Franklin *et al*, 1999; van den Hoogen *et al*, 2000). Even below these values, high-normal blood pressure of 130-139 mmHg systolic and/or 85-89 mmHg diastolic is associated with increased risk for coronary heart disease, compared with optimal blood pressure values (Rodgers and MacMahon, 1999; Vasan *et al*, 1999). Reaven *et al* (1996) determined about half of patients with hypertension may have insulin resistance and hyperinsulinemia. A meta-analysis review demonstrated a significant correlation between fasting serum insulin level and systolic/diastolic blood pressure (Denker and Pollock, 1992). The prevalence of hypertension in the present study (≥140/90 mmHg) was 16.5%. In some studies in the Islamic Republic of Iran, the prevalence of hypertension in adult women is different from our study. In Tehran, the age-adjusted prevalence of hypertension in women was 23.3% (Sarraf-Zadegan *et al*, 1999), in Isfahan it was 19.4% in 1999 (Sarraf-Zadegan *et al*, 1999) and 18.8% in 2004 (Sadeghi *et al*, 2004). The prevalence of hypertension in our study was lower than that reported in adult women from some countries, such as France (22.2%) (Asmar *et al*, 2001) and Korea (25.9%) (Choi *et al*, 2006). This may be due to differences in sample size, age of subjects, environmental or cultural conditions. Many factors, such as heredity, insulin resistance, environmental factors, and intake of ions, such as sodium and calcium may affect the genesis of hypertension (Krummel, 2004).

Interestingly, 3.5% of our subjects had a history of hypertension but only 2.4% were using the antihypertensive prescribed medicine. Therefore, nearly 78.8% of hypertensive patients had not been diagnosed. These results place great emphasis on the urgent need for a public health program to improve the detection, prevention and treatment of hypertension. This may be attributable to recent socioeconomic changes in Iran. Some findings indicate waist circumference is related to hypertension (Janssen *et al*, 2002; Wang *et al*, 2002). Further studies evaluating the possible role of waist circumference in the pathogenesis of hypertension are needed.

There may have been recall bias regarding lifestyle habit assessment because of the prohibition of alcohol consumption and smoking in women in Iran.

In conclusion, this study showed a high prevalence of metabolic syndrome in middle aged women in Babol, Iran. It would be more fruitful to conduct a study involving a larger population and to make recommendations for the primary and secondary prevention of metabolic syndrome.

Despite the limitations, this study has important implications for future research and programs. The findings of this study may be used as a basis for developing health education and health promotion programs regarding metabolic syndrome prevention and control.

Having a greater knowledge regarding the lifestyles of women is helpful for health care personnel to give useful advice. Similarly, it is useful to understand the body ideals of Babolian women obesity in woman and children is attractive to some people. The health examination produces a health profile which may be used as a basis for individual counselling.

This suggestion raises the question of whether general population screening should be performed, or if it is more cost-effective to focus on screening those at high risk for developing metabolic syndrome.

Schools can educate regarding food and physical activity. They can stimulate adult students to improve their habits regarding food and drink intake. Giving education in schools regarding food and physical activity is recommended. Walking, swimming and cycling programs would be of benefit to women and men.

Local health care staff, civic employees (these employed in schools, leisure time activities, social services supplied by the government private organizations, stadium exercise for women), local adult education institutes, and voluntary organizations should be able to reach most socio-economic groups.

Local health care staff and local women organizations should work together. Local women associations can help to organize health seminars for their members with input from local health care staff and health oriented family magazines.

Emphasis should be placed on practical education to raise women's knowledge about unhealthy lifestyles and ways of improving their lifestyles.

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