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Original article

The association between Metabolic Syndrome and serum levels of lipid peroxidation and interleukin-6 in Gorgan

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ABSTRACT

Background: There are limited studies on the relationship between inflammatory marker such as IL-6 and lipid peroxidation and metabolic syndrome.

Objective: The aim of present study was to assess IL-6 and lipid peroxidation in subjects with and without the metabolic syndrome and their association with metabolic syndrome components.

Methods: Age and gender matched 40 subjects with metabolic syndrome and 40 control groups took part in this study.

Results: The mean malondialdehyde level was significantly higher in overweight and obese subjects with metabolic syndrome than control groups ($P < 0.05$). The mean level of IL-6 in men and the mean level of malondialdehyde in women with metabolic syndrome was significantly higher than control groups ($p < 0.05$). There were significant positive correlation between malondialdehyde and fasting blood glucose, triglyceride and systolic blood pressure ($p < 0.05$).

Conclusions: Our results suggest that higher levels of IL-6 and malondialdehyde may cause insulin resistance and metabolic disorders in all subjects with metabolic syndrome. Malondialdehyde level shows strong association with some metabolic syndrome components. This means the greater risk of metabolic syndrome.

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1. Introduction

Metabolic syndrome (MS) is known as an important risk factor for cardiovascular disease and type II diabetes [1]. It is reported recently that the prevalence of the metabolic syndrome in U.S. adults above 20 years old was almost 23.7% [2,3]. Marjani et al. showed that metabolic syndrome and lipid peroxidation alter in different ethnic and age groups, postmenopausal women and different diseases [4–15]. Oxidative stress occurs when there is instability between tissue, free radicals, and reactive oxygen species and antioxidants system. This instability causes oxidative damage [16]. Oxidative stress shows an important role in the

pathogenesis of different diseases [17]. Studies have indicated that oxidative stress damage glucose uptake by muscle and fat cells [18,19]. It also reduces insulin secretion from pancreatic β cells [20]. Oxidative stress may be elevated by components of metabolic syndrome such as insulin resistance, type II diabetes, hypertension, dyslipidemia, visceral obesity [21–23], impaired vascular function, inflammation, thrombosis, and atherosclerosis and vascular disease [24]. These diseases may associate with metabolic syndrome. Studies have revealed that elevated oxidative stress and inflammatory stress play a significant role in beginning and development of atherosclerotic vascular disease [25,26]. It has reported that low density lipoprotein oxidation as a marker of oxidative stress increased in patients with coronary heart disease [25] and subclinical atherosclerosis [27]. It has shown that the metabolic syndrome reveals an association with elevated oxidative stress and inflammatory burden [28,29]. The risk of coronary heart disease was more seen in obese subjects with metabolic syndrome when compared to subjects without it [30]. IL-6 is a proinflammatory cytokine. Macrophages and smooth muscle cells secrete it in

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atherosclerotic lesions [31,32]. Plasma IL-6 is released from white blood cells (T cells and macrophages) and adipocytes [33–36]. It has associated with obesity and some components of the metabolic syndrome such as insulin resistance and dyslipidemia [37–39]. Studies have indicated that there is an association between elevated risk of coronary heart disease [40–43] and type 2 diabetes mellitus with IL-6. It has shown that IL-6 has principal role in the relationship among inflammation, obesity and cardiovascular disease [44]. Some other findings have shown that increased interleukin (IL)-6 used as a marker of systemic inflammation and diagnostic marker of future atherosclerotic events [45,46]. Clinical studies showed that the level of interleukin-6 (IL-6) is used as inflammatory marker for diagnosis of early stages of coronary artery disease [47]. It is recently reported that low-grade inflammation shows an important effect on the pathobiology of metabolic syndrome [47,48]. There are limited studies on the relationship between inflammatory marker such as IL-6 and lipid peroxidation and metabolic syndrome. The aim of present study was to assess IL-6 and lipid peroxidation in subjects with and without the metabolic syndrome and their association with metabolic syndrome components.

2. Methods

Age and gender matched 40 subjects with metabolic syndrome and 40 control groups took part in this study. Blood samples were collected after overnight fasting from all subjects who were referred to the Jelleyin health center in Golestan University of Medical Sciences, 2014. Commercial kit (With the use of photometer techniques, Model CLINIC II-Photometer) were used for determination of serum fasting glucose, triglycerides, LDL-cholesterol and HDL-cholesterol levels in the Metabolic Disorders Research Center, Gorgan Faculty of Medicine. Weight measurement of all subjects was done, while subjects were minimally clothed without shoes, using digital scales. Height measurement of all subjects was carried out in standing position using tape meter while the shoulder was in a normal position. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Subjects with BMI = 25.0–29.9 kg/m² and BMI ≥30 kg/m² were indicated as overweight and obese subjects, respectively [38]. Waist circumferences were determined at the point halfway between the lower border of ribs and the iliac crest in a horizontal plane [49]. Systolic and diastolic blood pressure was measured in sitting position from the right hand. Subjects with 3 or more of the below mentioned criteria were considered as a metabolic syndrome subjects according to Adult Treatment Panel III definition [50]:

- Waist circumference >102 cm in men and >88 cm in women.
- Serum triglycerides level ≥150 mg/dl.
- Low HDL-cholesterol: <40 mg/dl in men and <50 mg/dl in women.
- Systolic blood pressure (SBP) ≥130 mmHg and/or diastolic blood pressure (DBP) ≥85 mmHg or on treatment for hypertension.
- Serum glucose level ≥110 mg/dl or on treatment for diabetes.

Serum IL-6 (Picogram/ml) and malondialdehyde (Nano mol/l) were determined by Immunoassay (LOT: IL6041453, REF: EIL06001, Germany) and Kei Satoh (using spectrophotometer technique, JENWAY6305) [51] methods, respectively ((the level of lipid peroxidation expressed as Malondialdehyde (MDA)). Collected data was analyzed using SPSS–16 version software. Statistical analysis of data expressed as percentage and means and standard deviations. Chi squared, independent sample *t* and Pearson's

Table 1

Characteristic of subjects with metabolic syndrome and control groups.

Parameter	Subject with metabolic syndrome	Control groups	P-value
Age (years)	48.50 ± 7.80	46.20 ± 9.70	0.227
BMI (kg/m ²)	29.95 ± 3.82	26.35 ± 4.14	0.0001
Overweight			
IL-6 (pg/ml)	3.74 ± 0.24	3.50 ± 0.01	0.342
Malondialdehyde (nmol/l)	3.40 ± 0.20	1.90 ± 0.19	0.02
Obese			
IL-6 (pg/ml)	6.85 ± 2.07	4.40 ± 0.93	0.063
Malondialdehyde (nmol/l)	3.58 ± 0.50	1.89 ± 0.15	0.01

The *p*-value of tables is in bold.

correlation tests were used to evaluate data. Statistical differences were considered significant if *p* < 0.05.

3. Results

The clinical and biochemical data of the subjects with metabolic syndrome and control group were shown in Table 1. The mean malondialdehyde level was significantly higher in overweight and obese subjects with metabolic syndrome than control groups (*P* < 0.05). Table 2 shows characteristic of the men and women with metabolic syndrome and control groups. The mean level of IL-6 in men and the mean level of malondialdehyde in women with metabolic syndrome was significantly higher than control groups (*p* < 0.05). Correlation between metabolic syndrome components and IL-6 and malondialdehyde are shown in Table 3. There were significant positive correlation between malondialdehyde and fasting blood glucose, triglyceride and systolic blood pressure (*p* < 0.05). There were no significant correlation between IL-6 and metabolic syndrome components. There were no significant correlation between IL-6 and malondialdehyde (*P* = 0.917, not shown in result section).

4. Discussion

In present study, we observed that the levels of IL-6 were significantly higher in subjects with the metabolic syndrome (Table 1). Studies have shown that there is an association between the participation of IL-6 and systemic inflammatory responses that causes to metabolic syndrome [52,53]. Higher levels of IL-6 in men than in women show that abdominal obesity, which is more prevalent in men, causes more proatherogenic cytokines production. This may show that men are more in higher risk for

Table 2

Characteristic of subjects with metabolic syndrome and control groups in men and women.

Parameter	Subject with metabolic syndrome	Control groups	P-value
Men			
Number of subjects (%)	18 (100%)	18 (100%)	
Age (years)	49.11 ± 8.74	45.72 ± 11.40	0.324
BMI (kg/m ²)	30.88 ± 3.53	25.98 ± 2.34	0.0001
IL-6 (pg/ml)	7.14 ± 0.24	3.50 ± 0.01	0.0001
Malondialdehyde (nmol/l)	3.36 ± 0.23	2.01 ± 0.11	0.262
Women			
Number of subjects (%)	22 (55%)	22 (55%)	
Age (years)	48 ± 7.11	46.59 ± 6.86	0.507
BMI (kg/m ²)	29.18 ± 3.96	26.65 ± 5.01	0.071
IL-6 (pg/ml)	3.77 ± 0.21	3.92 ± 0.42	0.351
Malondialdehyde (nmol/l)	3.65 ± 0.45	1.75 ± 0.14	0.001

The *p*-value of tables is in bold.

Table 3

Correlation between metabolic syndrome components and IL-6 and Malondialdehyde.

Parameters	Malondialdehyde (nmol/l)		IL-6 (pg/l)	
	R	P-value	r	P-value
Glucose (mg/dl)	0.474	0.0001	-0.007	0.948
Triglyceride (mg/dl)	0.224	0.003	0.065	0.565
HDL-C (mg/dl)	0.064	0.573	-0.131	0.247
Waist circumference (cm)	0.388	0.0001	0.193	0.256
Systolic blood pressure	0.232	0.038	0.126	0.256
Diastolic blood pressure	0.151	0.183	0.054	0.637

The p-value of tables is in bold.

cardiovascular diseases than women [39,54]. Men had higher IL-6 levels than women which is not in agreement with some other studies [52,55]. IL-6, as a pro-inflammatory cytokine was higher in obese subjects than overweight subjects with metabolic syndrome. This may show a relationship between obesity and IL-6 levels [56]. Some studies have indicated that serum IL-6 were not associated with metabolic syndrome [57,58]. It revealed that IL-6 has an important role in development of insulin resistance [44,59] while some other studies reported IL-6 prevents insulin resistance [60]. Our results showed that there were no significant correlation between IL-6 and metabolic syndrome components. Thus, in contrast to some other studies, it may suggest that IL6 could not be used as a biomarker for the diagnosis of metabolic syndrome [57]. Oxidative stress may play a significant role in the development of metabolic syndrome [23]. In the present study malondialdehyde level was statistically significant in subjects with metabolic syndrome which was not in agreement with some studies [61,62] while it was in agreement with some other findings [16]. The results of this study show that the metabolic syndrome intensifies oxidative stress in subjects with metabolic syndrome. The present study also shows that oxidative stress was significantly higher in overweight and obese subjects with metabolic syndrome in comparison with subjects without metabolic syndrome which is in agreement with the findings of other studies that they have shown independent association of obesity and metabolic syndrome with elevated oxidative stress and inflammatory burden [28,29,45,46]. In the present study, we also determined the correlations between oxidative stress and metabolic syndrome components. Our findings showed that the oxidative stress was significantly positive correlated with triglyceride, glucose, systolic blood pressure and waist circumference in our study subjects (Table 3). It can be suggest that subjects with metabolic syndrome may have a higher level of oxidative stress. In general, abdominal obesity has seen in subjects with metabolic syndrome. Obesity makes happen oxidative stress that may cause to the decrease of antioxidant enzymes activities [63]. This may influence on inflammation which plays a pathogenic role in the development and progression of metabolic syndrome [64].

5. Conclusion

Our results suggest that higher levels of IL-6 and malondialdehyde may cause insulin resistance and metabolic disorders in all subjects with metabolic syndrome. Malondialdehyde level shows strong association with some metabolic syndrome components. This means the greater risk of metabolic syndrome.

Conflict of interest

None.

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