

Research Article

Estimation of some Biochemical Markers in Patients with Metabolic Syndrome

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Abstract

A collection of metabolic disorders, such as central obesity, insulin resistance, hypertension, and dyslipidemia, are known as metabolic syndrome. Together, these variables raise the risk of atherosclerosis, type II diabetes, and cardiovascular illnesses. The prevalence of MetS is rising globally, especially in populations undergoing lifestyle and dietary changes. This study aims to Analyze the relationship between MetS and various hematological and biochemical markers. Assess the role of Heat Shock Protein- 20 (HSP-20) as a potential biomarker for MetS. Compare metabolic indicators between MetS patients and a control group. The study was conducted at Al-Batul Hospital in Najaf Governorate and on 35 subjects, divided into two groups, 20 metabolic syndrome patients diagnosed based on obesity-related metabolic disorders and 15 healthy individuals as a control group. The ages of the participants ranged from 15 to 51years. However The results of the current study indicates a Participants were assessed based on the following parameters, Demographic characteristics: Age and Body Mass Index (BMI), Hematological markers: Hemoglobin (Hb), White Blood Cell count (WBC), and platelet count, Biochemical markers: Fasting Blood Sugar (FBS), cholesterol, triglycerides (TG), High-Density Lipoprotein (HDL), and Low-Density Lipoprotein (LDL), Blood pressure measurements: Systolic and diastolic pressures, HSP-20 levels, measured using ELISA techniques. The Current result show significant increase in mean level of age, BMI, FBS in patients with MetS compared with control group. The result also show there is no significant difference in mean level of blood pressure compared with control. The result also show significant increase in mean level of WBC, platelets, s. Cholesterol, TG, LDL of patients with MetS compared with control and there is no significant difference in Hb and HDL of patients compared with control. The result show there is significant increase in mean level of HSP-20 of patient with MetS compared with control group. Conclusions: Metabolic syndrome is a complex condition with various metabolic abnormalities. Obesity, insulin resistance, and inflammation are key factors in its development. Addressing modifiable risk factors can aid in the prevention of metabolic syndrome. The study supports significant differences in demographics and risk factors between individuals with metabolic syndrome and healthy individuals. Metabolic Syndrome is a growing health concern linked to obesity and metabolic dysregulation. HSP-20 may serve as a novel biomarker for (MetS), though further research is needed. Lifestyle modifications, including: diet and exercise, are crucial in managing and preventing metabolic Syndrome

1. Introduction

A set of risk factors for atherosclerotic cardiovascular disease (ASCVD) is known as the metabolic syndrome. These risk factors include prothrombotic and proinflammatory states, high blood pressure, raised plasma glucose, and atherogenic dyslipidemia [1]. The development of atherosclerotic cardiovascular diseases and type II diabetes mellitus is significantly increased by metabolic syndrome, which is characterized by a constellation of metabolic abnormalities, including central obesity, insulin resistance, hypertension, and dyslipidemia [2]. Pathogenesis Due to its high correlation with all metabolic risk variables, obesity has been identified as the primary cause of the metabolic syndrome. The majority of Asian nations are also seeing an increase in the high frequency of metabolic syndrome, which is not exclusive to the United States and Europe [3]. Compared to AP induced by other etiologies, HTG-AP is typically linked with more severe clinical consequences and prognosis. HTG-AP usually coexists with metabolic syndrome or its components and is intimately associated with metabolic dysfunction [4]. A higher risk of metabolic syndrome is linked to both short and lengthy sleep durations. The relationships between genetically determined sleep length and the five components of metabolic syndrome (central obesity, high blood pressure, dyslipidemia, hypertriglyceridemia, and hyperglycemia) among a group of elderly population [5]. Heat-shock proteins (Hsp) belong to three distinct families and are the only class of proteins that are frequently categorized based on their molecular weight. The first group comprises major Hsps Proteins with molecular weight of 60, 70, 90, 110 kDa. The minor Hsps is the second group that induced by glucose deprivation such as the glucose-related proteins. The last group included low molecular weight Hsps (20 kDa) [6]. However, Hsp20 is the only small heat shock protein that undergoes phosphorylated by PKA/PKG at Ser16 [7, 8]. Hsp20 is uttered in various tissues while is predominantly present in smooth, skeletal and cardiac muscle., This protein caused relaxation In smooth muscle, while its role in skeletal muscle is understood [9].

2. Materials and Methods

2.1. Study subject

The study was conducted at Al-Batul Hospital in Najaf Governorate and on 35 subjects, divided into two groups, 20 metabolic syndrome patients diagnosed based on obesity-related metabolic disorders and 15 healthy individuals as a control group. The ages of the participants ranged from 15 to 51 years.

2.2. Participants

Twenty Iraqi individuals undergoing health assessments between January and June 2024 were included in the research. Additionally, fifteen healthy adults without metabolic syndrome symptoms served as controls. The patients suffering from obesity- related with metabolic syndrome and receiving drug treatment.

2.3. Inclusion and Exclusion Criteria

Contributors involved in research underwent health assessments and met the following criteria: they were between 15 and 51 years of age and undergoing metabolic syndrome examinations for medical reasons. Those Patients with renal disease or hepatic disorders and other disease are excluded. Participants were excluded if they were pregnant or lactating, and some patients are smokers.

2.4. Assessment criteria

Members suffered wide-ranging health assessments, including blood chemistry (TG, Cholestrol, HDL, LDL), fasting blood sugar, Hb concentration, Leukocytes count, platelets and Biomarker HSP-20.

2.5. BMI Calculation

Body mass index (BMI) was calculated by dividing the individual's self-reported body weight (kg) by their height squared (m). Body mass index (BMI) was classified based on the WHO physical status classification 17: underweight (BMI <18.5 kg/m²), normal weight (BMI 18.5-25 kg/m²), overweight (BMI 25-30 kg/m²), or obese (BMI > 30 kg/m²) [10].

2.6. Laboratory Analyses

Blood samples were composed via venipuncture using sterile syringes of 5 mL. Each sample was directly transported into selected tubes. The blood was permissible to clot at room temperature for 10 minutes, then centrifugation at 6000 rpm for 15 minutes. The resulting serum was then stored frozen at -80°C for subsequent laboratory analysis.

Measurements of hematological parameters: The hematological parameters were performed on EDTA blood using ABX Micros ES 60 (Horiba Medical, France) in Laboratory. This device is a completely automated hematology analyzer estimated complete blood count (CBC) on EDTA anticoagulated blood.

Measurements of blood pressure: Blood pressure measured by using a sphygmomanometer.

Biochemical parameters

Measurements of serum lipid profile concentration: The assessment of serum lipid profile (s.cholesterol, triglyceride, HDL,LDL) concentration were provided by using lipid analyzer.

Biomarker: The assessment of serum heat shock protein-20 concentration is provided by (sunlong- china) sandwich immunoassay technique (enzyme linked immunosorbent assay-automated microtiter plate), ELISA reader (Bio kit SL0826Hu).

Determination Fasting Blood Sugar: A colorimetric response was used to measure the satisfied of fasting blood sugar in serum. Biolabo SA of France offered the fasting blood sugar level in serum.

2.7. Statistical Analysis

The data were abounding by exploiting Statistical Package for Social Sciences (SPSS) software version 26.0. Significance testing involved calculating descriptive statistics such as means and standard deviations for comparisons between patient and control subgroups. Data visualizations were created using Microsoft Office 2016 Excel. All statistical tested were conducted with a significance level set at $P < 0.05$.

3. Results

3.1. Demographic Characteristics of study subject

In This study a total of 35 cases consisting of 20 patients with metabolic syndrome and 15 control were examined. As shown in Table 1 the patients had ages ranging between 15 to 51 and there is significant increase in mean level of age of patients with metabolic syndrome (34.25 ± 2.868) compared with control group (23.5 ± 1.5). As illustrated in the same table, there is significant increase in mean level of BMI of patients with metabolic syndrome (43.39 ± 1.82) compared with control group (20.25 ± 2.25). The table also show there is no significant difference between the two groups in mean of diastolic and systolic blood pressure. The result also show there is significant increase in mean level of FBS of patients with metabolic syndrome (137.45 ± 11.61) as compared with control group (83.5 ± 6.5).

Table 1: Comparison of clinical characteristics between patients with MetS disease and control group

Clinical characteristics	Group	N	Mean $\pm$ SE
Age	Patients	20	$34.25^* \pm 2.868$
	Control	15	23.5 ± 1.5
BMI	Patients	20	$43.39^* \pm 1.828961$
	Control	15	20.25 ± 2.25
Diastolic blood pressure	Patients	20	80.9 ± 1.571
	Control	15	79.5 ± 2.5
Systolic blood pressure	Patients	20	126.5 ± 1.303
	Control	15	122.5 ± 2.5
FBS	Patients	20	$137.45^* \pm 11.61$
	Control	15	83.5 ± 6.5

$p < 0.05$ statistically significant

3.2. Hematological and biochemical Characteristics of study subject

Table 2: Hematological and biochemical Characteristics of study subject

Characteristics	Group	N	Mean $\pm$ SE
Hb	Patients	20	13.155 ± 0.2194
	Control	15	12.15 ± 0.15
WBC	Patients	20	$9.965^* \pm 0.45041$
	Control	15	5.305 ± 1.305
Platelets	Patients	20	$284.95^* \pm 8.066$
	Control	15	185.03 ± 10.02
s.chol	Patients	20	$229.2^* \pm 12.935$
	Control	15	126.78 ± 4.33
S.TG	Patients	20	$377.35^* \pm 26.859$
	Control	15	120.5 ± 2.75
HDL	Patients	20	55.95 ± 3.812
	Control	15	59.5 ± 0.5
LDL	Patients	20	$161.3^* \pm 11.539$
	Control	15	69.04 ± 5.20

As shown in Table 2, there is no significant difference in mean level of Hb between patients with MetS (13.155 ± 0.2194) and control group (12.15 ± 0.15). Also there is significant increase in mean level of White Blood Cells (WBC) of patients with metabolic syndrome ($9.965^* \pm 0.45041$) as compared with control group (5.305 ± 1.305). The table also show there is significant increase in mean level of platelets of patients with MetS ($284.95^* \pm 8.066$) as compared with control group (185.03 ± 10.02). The result also show there is significant increase in

mean level of s.cholesterol of patients with MetS ($229.2^* \pm 12.935$) as compared with control group (126.78 ± 4.33). The table also illustrated there is significant increase in mean level of Triglycerides of patients with MS ($377.35^* \pm 26.859$) as compared with control group (120.5 ± 2.75). There is no significant difference in mean level of High-Density Lipoprotein (HDL) between patients with MetS (55.95 ± 3.812) and control group (59.5 ± 0.5). The result also show there is significant increase in mean level of low-density lipoprotein (LDL) of patients with MS ($161.3^* \pm 11.539$) as compared with control group (69.04 ± 5.20).

3.3. Concentration of Heat Shock Protein-20 (HSP-20) in metabolic Syndrome patients and control

As shown in the Figure 1 significant increase in mean level of heat shock protein-20 of patients with MetS (13.90885 ± 2.316808) as compared with control group (0.7550 ± 0.36562), as shown in Table 3.

Table 3: Concentration of Heat Shock Protein-20 (HSP-20) in metabolic syndrome patients and control

	Group	N	Mean $\pm$ SE	SD
HSP-20	Patients	20	$13^*.90885 \pm 2.316808$	10.361080
	Control	15	0.7550 ± 0.36562	0.73123

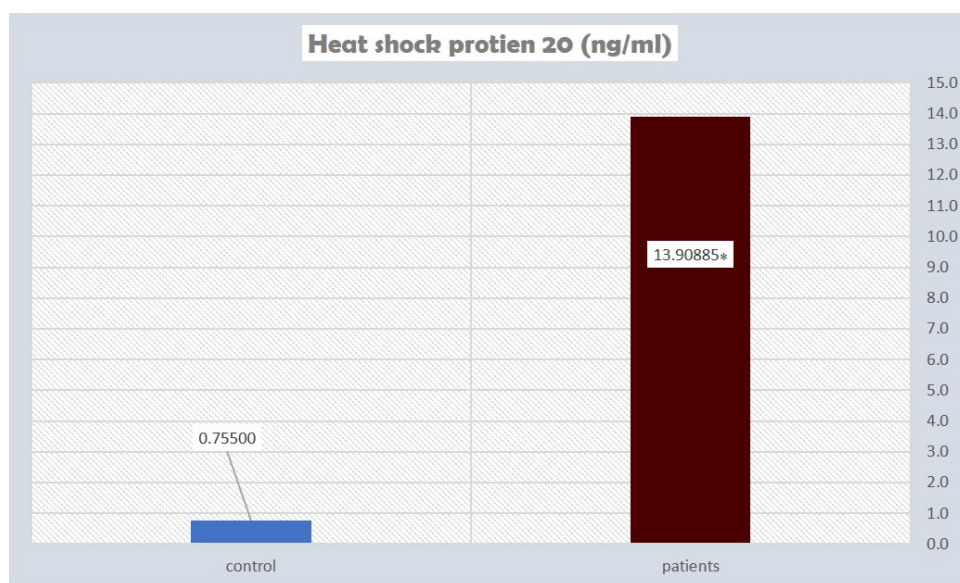


Figure 1: Heat Shock Protein -20 ng/ml level in patients with metabolic syndrome and control group

*refer to significant differences(p-value<0.05)

Patients n = 20, Control n=15

Mean $\pm$ SE.

4. Discussion

The significant difference in mean age between patients with metabolic syndrome and the control group may indicate the correlation between age and the prevalence of metabolic syndrome. This finding is consistent across various studies, indicating that older age groups are at a higher risk for developing metabolic syndrome due to factors such as lifestyle changes and increased prevalence of obesity and hypertension. Studies show that metabolic syndrome prevalence rises with age, with individuals aged 51 years or older having a higher odds ratio (OR) of 5.91 for developing the syndrome [10]. The mean age of participants in studies often exceeds 40 years, indicating a trend where older populations are more affected by metabolic syndrome [11]. The significant difference in mean BMI levels between patients with metabolic syndrome (43.39 ± 1.82) and the control group (20.25 ± 2.25) may indicate the critical association between obesity and metabolic syndrome. This disparity underscores the need for targeted interventions to address obesity as a primary risk factor for metabolic syndrome. Studies indicate that obesity is a major contributor to metabolic syndrome, with a prevalence of 70.5% in obese individuals compared to 19.7% in non-obese individuals [12].

Research shows a strong correlation between BMI and metabolic syndrome components, including waist circumference and lipid profiles [13]. Low physical activity is a significant contributor to the development of MetS, with sedentary lifestyles correlating with higher BMI and increased metabolic risk [14]. The observation that there is no significant difference in mean diastolic and systolic blood pressure between two groups of patients with metabolic syndrome suggests a complex relationship between hypertension and metabolic syndrome. This finding may indicate that while hypertension is a common feature of metabolic syndrome, its manifestation can vary significantly among individuals, influenced by other factors such as lifestyle and treatment interventions. Research shows that lifestyle interventions and multi-interventional therapies can lead to significant reductions in blood pressure among women with metabolic syndrome, highlighting the potential for effective management strategies [15]. The significant increase in fasting blood sugar (FBS) levels in patients with metabolic syndrome compared to the control group may indicate the critical link between metabolic syndrome and glucose dysregulation. This elevation in FBS is indicative of insulin resistance, a hallmark of metabolic syndrome, which predisposes individuals to type 2 diabetes and cardiovascular diseases. Patients

with metabolic syndrome exhibit markedly higher FBS levels, suggesting impaired glucose metabolism [16]. High-calorie consumption and lack of physical activity are prevalent among individuals with metabolic syndrome, contributing to elevated FBS levels [17]. Some studies suggest that not all individuals with metabolic syndrome will develop diabetes, indicating variability in metabolic responses and the potential for effective interventions through lifestyle changes and medical management [18]. The observation that there is no significant difference in mean hemoglobin (Hb) levels between patients with Metabolic Syndrome (MetS) and a control group aligns with some findings in the literature, although it contrasts with others. While some studies have reported elevated Hb levels in MetS patients, the lack of significant difference in this particular study could be attributed to various factors, including sample size, population characteristics, or methodological differences. This result suggests that Hb levels alone may not be a reliable marker for MetS in all populations. The relationship between Hb and MetS may also be influenced by other metabolic components, such as inflammation markers like white blood cells and neutrophils, which have shown significant correlations with MetS [19]. The significant increase in mean levels of White Blood Cells (WBC) in patients with metabolic syndrome (MetS) compared to the control group highlights the inflammatory nature of this condition. The findings align with multiple studies indicating that elevated WBC counts are associated with MetS, suggesting a potential biomarker for early detection and management of the syndrome. The relationship between WBC and MetS is independent of insulin resistance, suggesting that WBC counts could be a reliable indicator for assessing metabolic health [20]. The significant increase in mean platelet levels in patients with metabolic syndrome (MetS) compared to the control group highlights the association between platelet activation and MetS. This elevation in platelet count is indicative of a pro-inflammatory state, which is a hallmark of MetS and its related complications. Increased platelet aggregation in MetS patients has been documented, suggesting heightened thrombotic risk, which is less effectively managed by aspirin therapy [21]. The significant increase in mean serum cholesterol levels in patients with Metabolic Syndrome (MetS) compared to the control group highlights the critical role of lipid metabolism in this condition. The mean serum cholesterol level MetS patients starkly contrasts with controls, indicating a substantial dysregulation of lipid profiles in MetS. Patients with MetS exhibit elevated total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides, alongside reduced high-density lipoprotein cholesterol (HDL-C) levels [22]. Patients with metabolic syndrome exhibit significantly elevated triglyceride levels (377.35 ± 26.859) compared to controls (120.5 ± 2.75), emphasizing the condition's role as a risk factor for cardiovascular diseases and the importance of lifestyle modifications for management. Research indicates that MetS patients exhibit not only high triglycerides but also altered levels of other lipids, such as low HDL and high LDL, contributing to increased cardiovascular risk [23]. The increase of Heat Shock Protein - 20 ng/ml (HSP) levels, in patients with metabolic syndrome compared to a control group highlights the role of HSPs in metabolic dysregulation. This elevation suggests a response to the chronic inflammation and oxidative stress associated with metabolic syndrome, indicating potential therapeutic avenues. Increased oxidative stress in metabolic syndrome activates pathways that inhibit insulin signaling. HSPs can counteract these effects by inhibiting stress kinases like JNK and IKK β , which are involved in insulin resistance [24]. The highly preserved Heat Shock Proteins (HSPs) continue to show essential roles in the protection of cell reliability. Meanwhile, in the center of an obesity widespread, research demonstrates a key contribution of low grade infection, and mitochondrial dysfunction amongst other mechanisms, in the pathology of insulin resistance and type 2 diabetes mellitus (T2DM) [25]. several studies sustenance these findings by importance the elevated expression of HSP-20 in metabolic and cardiovascular conditions. HSP-20 is a small heat shock protein known for its cytoprotective properties, including anti-apoptotic, anti-inflammatory, and vasodilatory effects [26]. For instance, other investigation established that overexpression of HSP-20 in cardiomyocytes diminished ischemia-reperfusion injury and improved myocardial function, suggesting its cardioprotective role [27]. In the situation of metabolic syndrome, increased HSP-20 levels could return a compensatory reaction to systemic inflammation, oxidative stress, and insulin resistance—seals of the syndrome [28]. HSP-20 develops endothelial nitric oxide synthase (eNOS) activity, encouraging vascular relaxation and defending against endothelial dysfunction, which is regularly experimental in metabolic syndrome and early phases of atherosclerosis [29]. HSP-20 modifies autophagy and tenderness in diabetic cardiomyopathy models, further connecting its upregulation to defensive machines against both metabolic and cardiovascular impairments [30].

5. Conclusion

The study concluded that Heat Shock Protein-20 (HSP20) levels were raised up in patients with metabolic syndrome (MetS) and were accompanying with higher BMI, fasting blood glucose, leukocyte and platelet counts, and abnormal lipid profiles. The link between prominent HSP20 and inflammatory and metabolic irregularities recommends that HSP20 may play a probable role in MetS and its related problems and may serve as a useful biomarker associated with metabolic syndrome.

Article Information

Ethical Approval: The study was approved by the Ethical Committee of the University of Kufa, Iraq. All procedures involving human participants were performed in accordance with the ethical standards of the institutional research committee and the Helsinki Declaration.

Informed Consent: Written informed consent was obtained from all participants before their inclusion in the study.

Consent for Publication: Not applicable.

Data Availability: The data supporting the findings of this study are available from the corresponding author.

Clinical Trial Registration: Not applicable.

Conflict of Interest: The author declare that they have no conflict of interest.

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