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Original Research Article

Relationship of Serum Ferritin Levels with Metabolic Syndrome: A Cross-Sectional Study

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Abstract

Background and Aim: Several studies have shown links between high ferritin levels and central obesity, hypertension, dyslipidemia, and elevated fasting insulin and blood glucose. Much less research has been done on the link between high serum ferritin and the metabolic syndrome. The purpose of the current study was to assess the connection between metabolic syndrome and serum ferritin.

Material and Methods: The current cross-sectional study was carried out over the course of a year at the Tertiary Care Institute of India's Department of General Medicine. Patients with metabolic syndrome who were enrolled in the Tertiary care teaching institute of India during the study period and who had been diagnosed according to the NCEP (National Cholesterol Education Program) ATP III (Adult Treatment Panel III) (2001) guidelines were included in the study. 200 patients in all were enrolled in the trial.

Results: In the current study, males composed 62% of the study populations while females composed 38%.) In the current study, 98% of participants had waist circumferences greater than 90 cm, while 94% of the female participants had waist circumferences greater than 85 cm. A statistically significant correlation between PPBS and the metabolic syndrome components was found in the current investigation. The mean blood ferritin levels in this study were 124.70 52.10 The p-value was calculated to be 0.05, indicating a statistically significant connection between serum ferritin levels and metabolic syndrome components.

Conclusion: The prevalence of the metabolic syndrome is positively correlated with elevated iron reserves as determined by serum ferritin levels. Serum ferritin levels were associated with an increasing number of metabolic syndrome factors.

Keywords: Cross-Sectional, Metabolic Syndrome, Serum Ferritin, Waist Circumference.

Introduction

A group of diseases known as metabolic syndrome (MS) affects 20–25% of adults worldwide and is characterised by central obesity, hypertriglyceridemia, low levels of high-density lipoprotein (HDL) cholesterol, hyperglycemia, and hypertension [1]. Insulin resistance syndrome (IRS), Reaven's syndrome, metabolic syndrome X, and CHAOS are further names for the condition (coronary heart disease, hypertension, adult-onset diabetes, obesity, and stroke) [2]. An increase in insulin secretion serves as a compensatory mechanism for a decrease in the tissue's sensitivity to the effects of insulin.

The WHO defines metabolic syndrome as a pathological condition marked by abdominal obesity, insulin resistance, hypertension, and hyperlipidemia. It is also referred to as X-Syndrome, insulin resistance, etc. Because contagious communicable diseases have been successfully eradicated worldwide, this new non-communicable disease (NCD) has emerged as the primary health threat of the modern era. While having its roots in the West, the spread of the Western way of life has made it a truly worldwide problem.

Urban populations in various developing countries frequently have higher rates of metabolic syndrome than their counterparts in the West. The growth in the consumption of high-calorie, low-fiber fast food and the loss in physical activity as a result of mechanical transportation and sedentary leisure activities are the two main factors spreading this disease. The syndrome feeds on disease spread such as type 2 diabetes, coronary disease, stroke and other impairments [3]. MetS has been linked to the development of kidney disease, diabetes mellitus, and cardiovascular disease (CVD) in a number of studies [4]. Studies have also shown a link between insulin resistance or MetS elements and high levels of acute phase reactant C-reactive protein (CRP), a sensitive marker of subclinical inflammation [5-8]. The regular physiological processes of the human body depend on iron. One of the essential proteins controlling iron homeostasis, ferritin, is a commonly used clinical biomarker to assess iron status and is particularly important for identifying an iron shortage.

In prospective trials involving men and women who appeared to be in good health, elevated serum ferritin levels independently predicted the occurrence of type 2 diabetes. Elevated fasting insulin, blood glucose, and central adiposity have all been linked in cross-sectional studies to elevated ferritin levels together with hypertension, dyslipidemia, and hypertension [9,10]. Much less research has been done on the link between high serum ferritin and the metabolic syndrome.

The purpose of the current study was to assess the connection between metabolic syndrome and serum ferritin.

Material and Methods

Present cross-sectional; study was conducted at the Department of General Medicine, Tertiary Care Institute of India for the duration of 1 year. Informed consent has been obtained from the patients before including them in the study.

Inclusion criteria

NCEP: ATPIII 2001 and harmonizing definition criteria (Three or more of the following): (National Cholesterol Education Program: Adult Treatment Panel)

1. Central obesity: waist circumference of > 102cm for males and >88cm for females
2. Hypertriglyceridemia: Triglyceride level ≥ 150mg/dL.
3. Low HDL cholesterol: < 40mg/dL for males and < 50mg/dL for females.
4. Hypertension: Blood pressure > 130mmHg systolic and/or > 85mmHg diastolic.
5. Fasting plasma glucose levels ≥ 100mg/dl.

Exclusion criteria

1. Those who are anaemic or have recently had anaemia treatment

2. Donors of blood in the previous four months
3. Hemochromatosis patients4. Positive inflammatory markers like (CRP> 1mg/dl, WBC> 11,000/cu mm or WBC

- 200 patients with metabolic syndrome who were enrolled in the Tertiary Care Teaching Institute of India during the study period and met the inclusion and exclusion requirements were included in the study. The following steps were completed:
- a thorough account of the patients' past
- the patients' clinical condition is examined
- The following tests have been performed on all of the patients:
- FBS
- PPBS
- Blood urea
- Serum creatinine
- Fasting Lipid Profile
- Baseline ECG
- CRP
- Urine routine
- Complete blood count
- Fasting serum ferritin levels (single-incubation two-site immunoradiometric assay)
- Serum ferritin was estimated by micro-ELISA using human ferritin enzyme immunoassay test with desirable levels in males are 30-300 ng/ml and females 15-200 ng/ml.

Statistical Analysis

Microsoft Excel 2007 was utilized to compile and input the collected data, which was then exported to the data editor page of SPSS version 15 for analysis (SPSS Inc., Chicago, Illinois, USA). The level of significance and confidence level for each test were set at 5% and 95%, respectively.

Results

The study population's mean age in the current study was 55.22 8.377. The age range of 51 to 60 years was the largest for research participants, followed by 61 to 70 years. In the current study, men made up 62% of the study populations while women made up 38%. (Table 1) Obesity rates in the current study were 42% overweight and 58% obese. (Table 2) In the current study, 98% of participants had waist circumferences greater than 90 cm, while 94% of the female participants had waist circumferences greater than 85 cm.

61% of participants in the current study had hypertension and were using regular medicines. (Table 3) Diabetics made up 76% of the study population. In the current study, diabetes had an average duration of 2.40 ± 0.35 years and 5.5 years for 19% of participants.

A statistically significant connection between the metabolic syndrome components and PPBS, Total cholesterol, Triglycerides, HDL, and LDL was found in the current study, with a p-value of 0.05 indicating statistical significance. The mean blood ferritin levels in this study were 124.70 ± 52.10 The p-value was calculated to be 0.05, indicating a statistically significant connection between the metabolic syndrome's components and blood ferritin levels. (Table 4)

Table 1: Gender distribution of study participants

Gender	Number	Percentage (%)
Male	124	62
Female	76	38

Table 2: BMI distribution of study participants

BMI	Number	Percentage (%)
25–29.9	84	42
>30	116	58

Table 3: HTN on treatment

HTN on treatment	Number	Percentage (%)
Yes	122	61
No	78	39

Table 4: Correlation of serum ferritin with each component in metabolic syndrome

Correlation	Variable	Correlation coefficient (r)	P value
SerumFerritin	BMI	0.14	0.12
	Waist circumference	0.32	0.001*
	SBP	0.16	0.09
	DBP	-0.04	0.10
	FBS	0.11	0.32
	PPBS	0.08	0.07
	Total Cholesterol	0.35	0.002*
	Triglycerides	0.136	0.35
	HDL	-0.14	0.47
	LDL	0.33	0.05*
	BUN	-0.045	0.98
	Serum Creatinine	0.016	0.48

* indicates statistically significance at $p \leq 0.05$

Discussion

Metabolic syndrome frequently has an association with chronic inflammation. The inflammatory markers hs-CRP, TNF-, fibrinogen, and IL-6 have been linked to metabolic syndrome [11]. When a subclinical inflammatory process is present, the blood level of these proteins is raised. Acute-phase reactant serum ferritin may increase in the presence of inflammation. Serum ferritin has been demonstrated to be an early indicator of cardiovascular risk in a study by Liu JR *et al* [12]. However, it was noteworthy to note that the sex differences in the prevalence of the various metabolic syndrome factor combinations were mostly erased in older persons. The majority of the metabolic syndrome risk factors were more common in older adults than in younger adults. In their study, Cohen *et al* [13]. observed that, with the exception of low HDL cholesterol, which was found to be more prevalent in women, a cross-sectional sample of patients with a healthy BMI revealed that male gender was a self-sufficient risk factor for all components of the MetS.

Traditional risk factors that are clearly linked to the metabolic syndrome include elevated levels of oxidised LDL-C, adiponectin, and CRP. As a result, the diagnosis of the MetS acts as a marker for many of the non-classic risk factors, identifying patients at high risk of cardiovascular disease. The average blood ferritin levels in our study were 124.70±52.10. As the p-value between serum ferritin and waist circumference was assessed, a statistically significant connection between elements of metabolic syndrome and serum ferritin levels was found. According to the current cross-sectional study's findings, those with MetS have considerably higher blood ferritin levels. Moreover, we discovered a favourable relationship between serum ferritin and the MetS subtypes of hypertriglyceridemia, BMI, waist-hip ratio, and HOMA-IR. The correlation between serum ferritin and MetS, stratified by gender, has been examined in a number of investigations. In a Chinese population, after controlling for other factors, elevated serum ferritin was substantially related with risk of

MetS among the male gender, but not among the females [14]. A comparable study conducted in Korea indicated that men and women with elevated serum ferritin had a higher chance of developing MetS [10]. Similar findings were seen in a Chinese cohort, where hypertriglyceridemia and high blood sugar levels were linked to men's serum ferritin levels [15].

Several investigations revealed varying degrees of consistency in the relationship between serum ferritin and the MetS constituents. A prospective study carried out in Finland came to the conclusion that a drop in blood ferritin levels was indicative of the resolution of both hypertriglyceridemia and hyperglycemia [16]. Among the numerous MetS components, hyperglycemia and high triglyceride levels were two that were more strongly related with serum ferritin levels, according to a recent meta-analysis [17].

In their investigation, Biqiang Li, Wein Lin, and colleagues came to the same conclusion that serum ferritin raises the risk of metabolic syndrome components. They claimed that greater blood ferritin levels were associated with more severe metabolic disorders and more frequent cases of the metabolic syndrome. Because serum ferritin concentration and iron levels in the body are inversely connected, measuring serum ferritin levels is utilised as a major diagnostic marker for disorders linked to iron excess. Nevertheless, metabolic diseases, chronic renal insufficiency, and inflammation can all affect ferritin levels. For this reason, transferrin saturation is used routinely as a complement in the iron overload diagnosis [18]. Using a meta-analysis, the connection between serum ferritin levels and the MetS was investigated. According to the study, people who had metabolic syndrome had serum ferritin levels that were higher than those of participants who did not have the condition. As is well known, serum iron played a crucial part in the body's metabolism, particularly in the portion that produces adenosine triphosphate (ATP) in the chondrocyte's oxidative respiratory system. The various enzymes' activities were impaired. This effect would be amplified based on illnesses including type 2 diabetes mellitus, neoplasms, and degenerative brain disorders. Although earlier research has established a link between elevated iron levels and pathological statuary, the actual evidence is unclear to us. Perhaps the real causes of the statistical analysis's apparent variability are regional variations, gender gaps, and the contrast between a woman's premenstrual and menstrual phases [19]. Our study's primary weakness is that it is an observational cross-sectional study in which we were unable to identify any data supporting a temporal association between exposure and results.

Conclusion

The prevalence of the metabolic syndrome is positively correlated with elevated iron reserves as determined by serum ferritin levels. Serum ferritin levels were associated with an increasing number of metabolic syndrome factors. To ascertain if elevated blood ferritin precedes the development of MetS and insulin resistance and contributes to the increased related risks, prospective trials with lengthy follow-up are required.

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