

The Study of Association of Serum Ferritin Levels in Metabolic SyndromeAbhijeet¹, Ramya M R², Rangaswamy³¹Postgraduate, Department of General Medicine, Mysore Medical College and Research Institute²Senior Resident, Department of General Medicine, Mysore Medical College and Research Institute³Professor, Department of General Medicine, Mysore Medical College and Research Institute

Received: 01-05-2024 / Revised: 10-05-2024 / Accepted: 20-05-2024

Corresponding Author: Dr. Abhijeet

Conflict of interest: Nil

Abstract:

Background and Objectives: Metabolic syndrome is a collection of metabolic disorders that raises the risk of diabetes and cardiovascular disease. Obesity, especially abdominal obesity, is linked to resistance to insulin's effects on the use of fatty acids and peripheral glucose, frequently resulting in type 2 diabetes mellitus. In cardio metabolic disorders like hypertension, type 2 diabetes, and dyslipidemia, which are considered to be inflammatory diseases, evidence suggests an increase in serum ferritin. Since metabolic syndrome is thought to occur due to several causes, including chronic inflammation, numerous researches has been undertaken worldwide with mixed outcomes. Therefore, this study is conducted to assess the relationship between serum ferritin and components of metabolic syndrome.

Methodology: A cross-sectional study was conducted in a government tertiary care hospital in Mysuru city between November 2023 May 2024. The study population was patients with metabolic syndrome per the National Cholesterol Education Program, Adult Treatment Panel III criteria. The sample size was estimated to be 106. A predesigned, pretested and semi-structured proforma was used for data collection. Data were entered in a Microsoft excel spreadsheet. To describe the data frequencies, percentages and graphs were used. Pearson's correlation was used to address the second objective.

Results: The study on metabolic syndrome patients showed a significant correlation with serum ferritin levels. Of the five components of metabolic syndrome, FBS and waist circumference showed a significant positive correlation with serum ferritin levels.

Conclusion: Serum ferritin levels are elevated in patients with metabolic syndrome, suggesting that these patients exhibit a certain degree of inflammation which in future may increase the risk of developing cardiovascular disease.

Keywords: Metabolic Syndrome; Serum Ferritin; Inflammation.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Metabolic syndrome is a collection of metabolic disorders that raises the risk of diabetes and cardiovascular disease. The prevalence of metabolic syndrome in South Asians varies from 20% to 32%. Prevalence of the metabolic syndrome as defined by the National Cholesterol Education Program, Adult Treatment Panel III, and other criteria indicates ranges from ~11% to ~41% in India.[1] Obesity, especially abdominal obesity, is linked to a resistance to insulin's effects on the use of fatty acids and peripheral glucose, frequently resulting in type 2 diabetes mellitus. It was postulated that a metabolic syndrome existed when metabolic risk factors for type 2 diabetes and cardiovascular disease co-occurred. [2]

The prevalence of metabolic syndrome is rising. The prevalence of metabolic syndrome increased with increasing age, according to data from the

NHANES 2011 to 2016 database, with 34.7% of participants meeting the criteria. [3] The liver, spleen, bone marrow, and skeletal muscles contain the largest concentrations of ferritin, a protein-iron complex that is present throughout the body. [4]

A significant protein that stores iron, ferritin, is crucial for maintaining the balance of intracellular iron. All ferritin-producing cells secrete serum ferritin, which is typically used as a marker for iron overload or deficiency. Increasingly being recognized as inflammatory diseases, cardiometabolic disorders like hypertension, type 2 diabetes, and dyslipidemia have blood ferritin levels that are only slightly elevated. [5] Over the past few years, elevated blood ferritin levels without high transferrin saturation have become more prevalent in some patients with metabolic syndrome. According to studies using quantitative phlebotomy

on liver biopsies, hyperferritinemia seen in people with metabolic syndrome is linked to fatty liver and insulin resistance but not iron excess. [6] A significant risk factor for the later onset of type 2 diabetes and cardiovascular disease is metabolic syndrome. Therefore, a patient who needs severe lifestyle modification centered on weight loss and increased physical activity is identified through the diagnosis of metabolic syndrome. Targeting people for medical intervention to lower blood pressure and cholesterol can be done by determining a person's 10-year risk of CVD using a risk assessment algorithm like the Framingham risk score or the systemic coronary risk evaluation. Since metabolic syndrome is thought to occur due to several causes, including chronic inflammation, numerous researches has been undertaken worldwide with mixed outcomes. [7] The purpose of this study is to assess the relationship between serum ferritin and individual components of metabolic syndrome.

Objectives

- To study serum ferritin levels in patients with metabolic syndrome
- To study the association of serum ferritin with components of metabolic syndrome

Study Design: Cross Sectional study

Study Setting: A Government Tertiary care hospital in Mysuru city.

Population Element: Metabolic syndrome patients

Sampling Element: Metabolic syndrome patients at the study setting.

Study Period: November 2023 to May 2024.

Sample Size Estimation: Assuming that random sampling and conditions warranting approximate normality of the distribution of p, sample size determination when a population proportion is to be estimated, leads to the following formula for n, given by = where,

n = Sample size

z = Standard Normal Deviate [z value] for a given level of confidence

p = prevalence or proportion q = 1-p d = absolute allowable error

Here by taking, Prevalence of metabolic syndrome in India, p = 7.35 % [3], 95% level of confidence, z = 1.96 for α = 5% and d = 5%, = . (.) = 106

Results

Table 1: Distribution of subjects according to age group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<40yrs	4	3.7	3.7	3.7
	41-50yrs	24	22.4	22.4	26.2
	51-60yrs	66	61.7	61.7	87.9
	>70yrs	13	12.1	12.1	100.0
	Total	107	100.0	100.0	

Majority of the study subjects 61.7% were in the 51-60 years age group, followed by 41-50yrs age group which was 22.4 %, 12.1% of the subjects were >70yrs age group and only 3.7% of the subjects were below 40yrs.

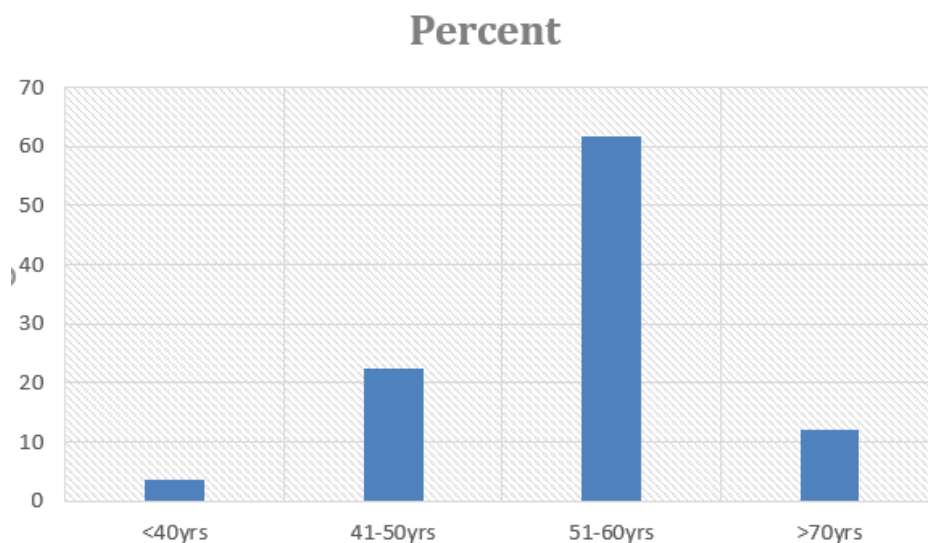


Figure 1: Graph showing Distribution of subjects according to age group

Table 2: Sex Percent

Sex	Percent
Male	51.4
Female	48.6

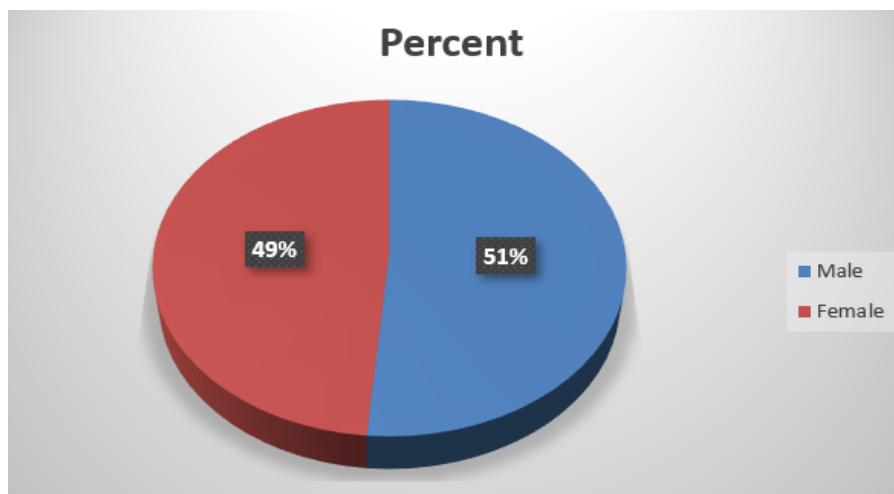


Figure 2: Graph showing Distribution of subjects according to sex

Table 3: Distribution of subjects according to BMI

Range	Frequency	Percent
Normal	3	2.8
25-29.9	66	61.7
>30	38	35.5
Total	107	100

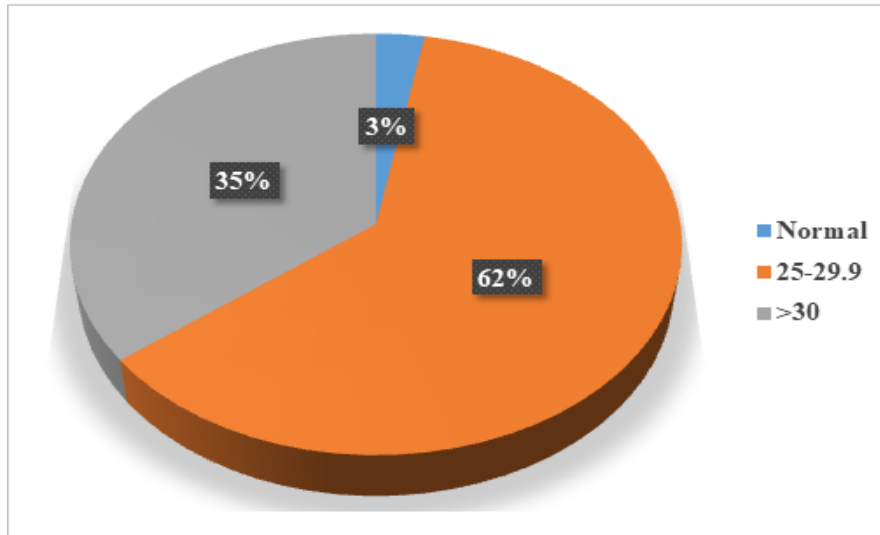


Figure 3:

61.7% of the subjects had BMI between 25 - 29.9 and 35.5% of the subjects had BMI more than 30 and only 2.8% of the subjects had Normal BMI

Table 4: Distribution of subjects according to number of component present

	Frequency	Percentage
Two	1	0.9
Three	9	8.4
Four	37	34.6
Five	60	56.1
Total	107	100

56.1% of the subjects had five components, 34.6% of the subjects had four components and 8.4% of the subjects had three components and only 0.9% of the subjects had two components

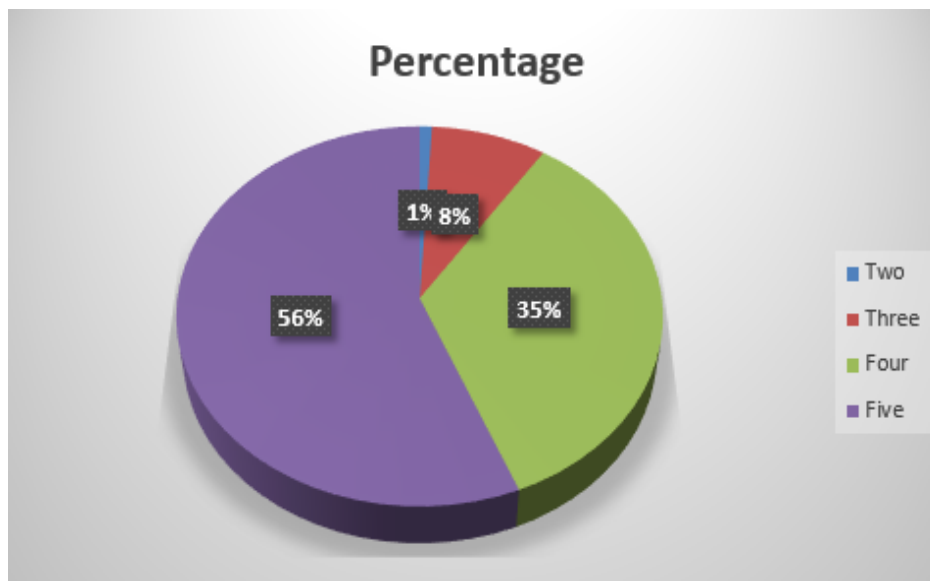


Figure 4: Percentage

Table 5: Frequency Distribution of various metabolic syndrome

	Frequency	Percent
Central Obesity	101	94.4
Hypertriglyceridemia	79	73.8
Low HDL cholesterol	103	96.2
Hyperglycemia	97	90.7
Hypertension	97	90.7

96.2% of the subjects had Low HDL cholesterol, 90.7% of the subjects had Hyperglycemia, 90.7% of the subjects had Hypertension, 94.4% of the subjects had Central Obesity and 73.8% of the subjects had Hypertriglyceridemia.

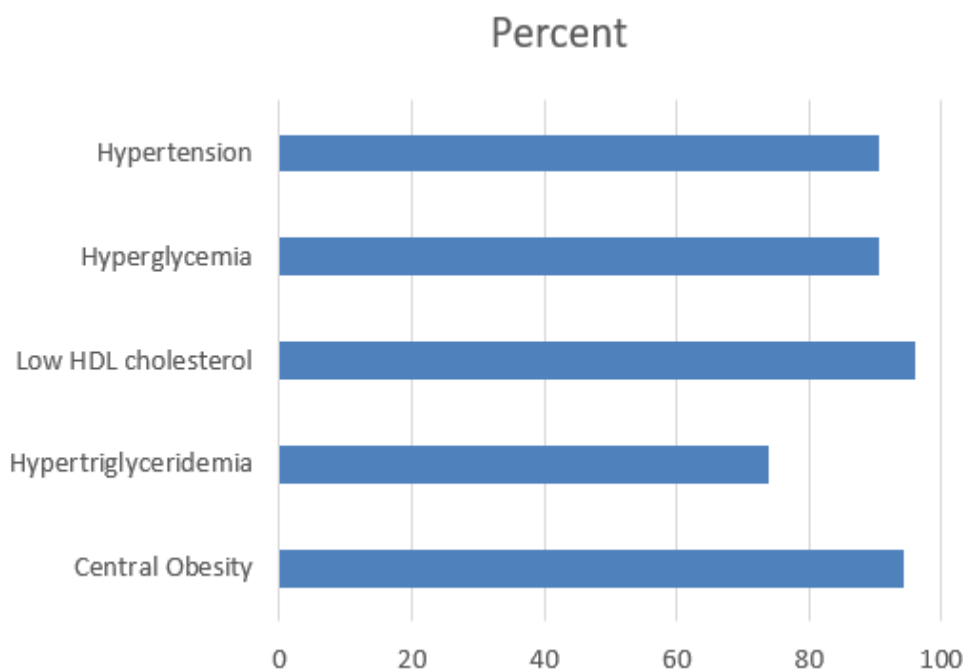


Figure 5: Graph showing Frequency Distribution of various components

Table 6: Descriptive statistics of various parameters

	N	Minimum	Maximum	Mean	Std. Deviation
Age	107	28	90	55.4019	10.08909
Height	107	150	176	159.3738	4.98398
Weight	107	8	94	77.8318	9.61768
Waist Circumference	107	82	120	91.5981	4.79162
Hemoglobin	107	12	15.9	13.3	0.9958868
HbA1c	107	5.1	19	8.779	2.394
Fasting blood sugar	107	60	420	216.0579	68.06152
TriGlyceride	107	68	431.8	158.5729	43.8853
Total Cholesterol	107	71.7	252	198.85	51.382
HDL	107	8.2	64	32.786	7.02476
LDL	107	61	160	116.35	29.406
Serum ferritin	107	40.58	802	381.197	196.421

Table 7: Correlation of various parameters with Serum Ferritin

	Pearson Correlation coefficient (r value)	P value
Waist circumference	0.237	0.014
BMI	0.061	0.53
Hemoglobin	-0.113	0.246
HbA1c	0.142	0.144
FBS	0.323	0.001
Triglyceride	-0.127	0.191
Total cholesterol	-0.102	0.297
HDL	-0.092	0.349
LDL	-0.012	0.898

Waist circumference has a Positive correlation with serum ferritin which is statistically significant. BMI have a Positive Weak correlation with serum ferritin which was not statistically significant. HbA1c Positive Weak correlation with serum ferritin which was statistically significant FBS have a Positive correlation with serum ferritin which was statistically significant Triglyceride Negative Weak

correlation with serum ferritin which was not statistically significant. HDL had Negative Moderate Correlation with serum ferritin which was statistically significant. Total cholesterol had Negative Moderate Correlation with serum ferritin which was statistically significant. LDL had Negative Moderate Correlation with serum ferritin which was statistically significant.

Table 8: Comparison of serum ferritin with components of metabolic syndrome

	Mean	Std. Deviation
Three	307.7	285.591
Four	355.944	182.431
Five	406.698	184.715
Total	381.197	196.421

Mean Serum ferritin was 307.7 in subjects who had three component, Mean Serum ferritin was 355.94 in subjects who had four component, Mean Serum ferritin was 406.69 in subjects who had five component and Overall Mean Serum ferritin was 389.19

Discussion

A total of 107 patients visiting K R Hospital OPD or admitted in our hospital were studied, of the people studied, 61.7.1% of them were aged between 51-60 years, with male being 51.4% and female 48.6%. Out of 107, 56.1% had all five components of metabolic syndrome in them Patients with metabolic syndrome had mean

HbA1c of 8.779, mean FBS 216, mean triglyceride of 158.57, mean HDL of 32.786, mean LDL of 116, mean total cholesterol of 198, mean serum ferritin of 381, Mean waist circumference of 91.5 cm. This study contained 51.4% of male, and 48.5% of female which is almost similar to study conducted by Young Suk Shim et al among Korean population representing equal proportion of males and females getting affected by metabolic syndrome and there is no gender preponderance.

Conclusion

The study found that there was significant correlation between serum ferritin and metabolic syndrome hence the disease tend to exhibit certain

degree of inflammation which in future may increase the risk of developing cardiovascular disease, thus determining serum ferritin concentration aids in evaluation of metabolic syndrome candidate for aggressive intervention against cardiovascular risk factor

References

1. Munjal YP, Sharm SK. API Textbook of Medicine, Two Volume Set. JP Medical Ltd; 2012 May 18.9th ed. Chapter 18. 12 Pg No. 1279.
2. Ferrannini E, Haffner SM, Mitchell BD, Stern MP. Hyperinsulinemia: the key features of a cardiovascular and metabolic syndrome. *Diabetologia*. 1991; 34:416.
3. Hirode G, Wong RJ. Trends in the prevalence of metabolic syndrome in the United states, 2011-2016. *JAMA* 2020; 323:2526
4. Kumar V, Abbas AK, Fausto N, Aster JC. Robbins and Cotran pathologic basis of disease, professional edition e-book. Elsevier health sciences; 2014 Aug 27. 10th ed. Chapter 14 Pg No.655.
5. Cho MR, Park JK, Choi WJ, Cho AR, Lee YJ. Serum ferritin level is positively associated with insulin resistance and metabolic syndrome in postmenopausal women: a nationwide population-based study. *Maturitas*. 2017 Sep 1; 103: 3-7.
6. Brudevold R, Hole T, Hammerstrom J. Hyperferritinemia is associated with insulin resistance and fatty liver in patients without iron overload. 2008;3.
7. Wang M, Zhao A, Szeto IM, Wu W, Ren Z, Li T, Feng H, Wang P, Wang Y, Zhang Y. Association of serum ferritin with metabolic syndrome in eight cities in China. *Food science & nutrition*. 2020 Mar; 8(3):1406-14.
8. Jameson JL. Harrison's principles of internal medicine. McGraw-Hill Education, 2018. 20th ed. Vol 2. Chapter 401 Pg No. 2903.
9. Executive summary of the third report of the national cholesterol education programme (NCEP) expert panel on detection, evaluation and treatment of high blood cholesterol in adults (adult treatment panel III), *JAMA*. 2001; 285(19): 2846-2497.
10. Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, et al; Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation*. 2009; 120(16):1640-1645.