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# A study on serum ferritin and its correlation with metabolic syndrome

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**Abstract**
**Aim and Objective:** To evaluate the relationship between serum ferritin and metabolic syndrome.
**Methods:** The patients attending Rajah Muthiah Medical College & Hospital inpatient department are being screened for metabolic syndrome on the basis of NCEP: ATP III 2001 and harmonizing definition criteria. Based on the inclusion and exclusion criteria the patients are being enrolled into this study. Informed consent will be obtained from the patients before including them in the study.
**Materials and Methods:**
Design : Hospital based observational study.
Place of Study : Department of General Medicine.
Study Population : Cases attending the RMMCH inpatient department during the study period.
Sample Size : 70.
Study Period : November 2019 to April 2021.
**Results:** In this study, we observed type 2 diabetes mellitus in 63 (90%) patients, systemic hypertension in 57 (81%) patients, elevated triglycerides in 28 (40%) patients, decreased HDL cholesterol in 13 (19%) patients and central adiposity was seen in all of the patients.
In this study we were able to observe that serum ferritin which was elevated above average levels can be used as a marker for metabolic syndrome since ferritin is an acute phase reactant and metabolic syndrome is a pro inflammatory condition.
**Conclusion:** There is a positive association between elevated serum ferritin (above average levels) and metabolic syndrome indicating it is a pro inflammatory condition.

**Keywords:** Metabolic Syndrome (MetS), NCEP ATPIII 2001 (National Cholesterol Education Program: Adult Treatment Panel III 2001)

## Introduction
Metabolic Syndrome (MetS) is cluster of physical conditions and metabolic abnormalities commonly found in association with increased risk for development of type-2 diabetes mellitus (T2DM), cardiovascular disease (CVD) and other medical conditions.; according to National Cholesterol Education Program: Adult Treatment Panel III 2001 and harmonizing definition criteria, a person is identified as having the MetS if he/she has central obesity plus any three of the following:

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.

## Harmonizing definition
Waist circumference (cm):

| Men | Women | Ethnicity |
|---|---|---|
| >94 | >80 | Europid, sub Saharan African, Eastern and Middle Eastern |
| >90 | >80 | South Asian, Chinese, ethinic South and Central America |
| >85 | >90 | Japanese |

Prevalence of the metabolic syndrome varies across the globe, in part reflecting the age and ethnicity of the population studied and the diagnostic criteria applied.

In general, the prevalence of metabolic syndrome increases with age. Other risk factors include overweight/obesity, sedentary lifestyle, aging, diabetes mellitus, coronary heart disease, lipodystrophy. Elevated serum ferritin levels independently predicted incident type 2 diabetes inprospective studies in apparently healthy men and women [1]. In cross-sectional studies, elevated ferritin levels have been associated with hypertension, dyslipidemia, elevated fasting insulin and blood glucose and central adiposity [2]. The association between elevated serum ferritin and metabolic syndrome, however, has been less well explored.

**Aim and objective**

To evaluate the relationship between serum ferritin and metabolic syndrome.

**Methods**

The patients attending Rajah Muthiah Medical College & Hospital inpatient department are being screened for Metabolic syndrome on the basis of NCEP: ATP III 2001 and harmonizing definition criteria. Based on the inclusion and exclusion criteria the patients are being enrolled into this study. 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.

**Harmonizing definition**

Waist circumference (cm)

| Men | Women | Ethnicity |
|---|---|---|
| >94 | >80 | Europid, sub Saharan African, Eastern and Middle Eastern |
| >90 | >80 | South Asian, Chinese, ethnic South and Central America |
| >85 | >90 | Japanese |

**Exclusion criteria**

1. Anemic individuals (Hemoglobin <10g/dL).
2. Patients who have received transfusion in the past 3 months.
3. Persons who has donated blood in the past 4 months.
4. Acute febrile illness.
5. Total Leucocyte count > 11,000/cu mm (or) < 3000/cu mm.
6. Chronic kidney disease of eGFR < 60ml/min/1.73m²

[By using MDRD formula (Modification of Disease in Renal Disease)]
eGFR (ml/min/1.73m$^2$) = 186.3×Pcr(e)$^{-1.154}$×age(e)$^{-0.203}$×0.742 (if female) ×1.212 (if black)

**If Male (black):** eGFR is calculated by below formula
eGFR (ml/min/1.73m$^2$) = 186.3×Pcr(e)$^{-1.154}$×age(e)$^{-0.203}$× 1.212(if black)

**If Male (non-black):** eGFR is calculated by below formula
eGFR (ml/min/1.73m$^2$) = 186.3×Pcr(e)$^{-1.154}$×age(e)$^{-0.203}$

**If Female (black):** eGFR is calculated by below formula
eGFR (ml/min/1.73m$^2$) = 186.3×Pcr(e)$^{-1.154}$×age(e)$^{-0.203}$× 0.742(if female) ×1.212(if black).

**If Female (non-black):**eGFR is calculated by below formula
eGFR (ml/min/1.73m$^2$) = 186.3×Pcr(e)$^{-1.154}$×age(e)$^{-0.203}$× 0.742(if female).
Patient were investigated with, Blood Urea, Serum creatinine, Fasting lipid profile, Complete blood count, Fasting blood sugar, Serum Ferritin.
Metabolic syndrome was diagnosed using NCEP: ATPIII 2001 and harmonizing definition criteria.

**Results**

Gender distribution of the patients studied:

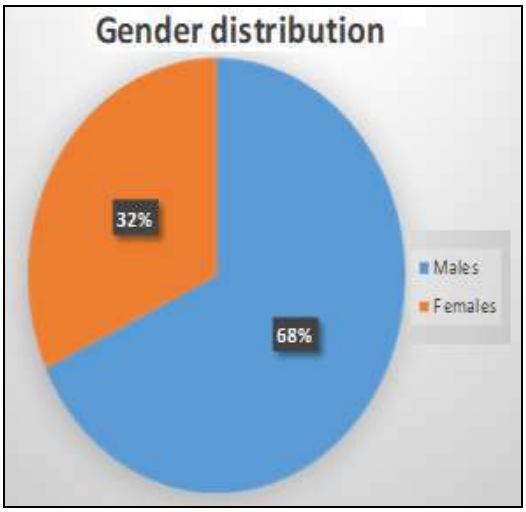


**Fig 1:** Gender distribution of the patients studied

**Table 1:** Gender distribution of the patients studied

| S. No | Sex | No. of patients | Percentage |
|---|---|---|---|
| 1. | Males | 48 | 68% |
| 2. | Females | 22 | 32% |

In this present study out of the 70 patients enrolled 48 were male and 32 were female.

**Serum ferritin values of the patients studied**


**Fig 2:** Serum Ferritin values of the patients

**Table 2:** Serum Ferritin values of the patients

| S. No | S.Ferritin (ng/ml) | Males | Females | Total |
|---|---|---|---|---|
| 1. | 0 – 50 | 1 | 0 | 1 |
| 2. | 51 – 100 | 10 | 12 | 22 |
| 3. | 101 – 150 | 11 | 5 | 16 |
| 4. | 151 – 200 | 13 | 2 | 15 |
| 5. | 201 – 250 | 7 | 3 | 10 |
| 6. | 251 – 300 | 2 | 0 | 2 |
| 7. | >300 | 4 | 0 | 4 |
| Total | | | | 70 |

- In this present study out of the 70 patients enrolled 48 (68%) were male and 22 (32%) were female.
- In this study, we observed type 2 diabetes mellitus in 63 (90%) patients, systemic hypertension in 57 (81%) patients, elevated triglycerides in 28 (40%) patients, decreased HDL cholesterol in 13 (19%) patients and central adiposity was seen in all of the patients.
- The present study revealed that serum ferritin was elevated significantly in metabolic syndrome with p=0.000001 for females and p=0.0000001 for males.
- This has showed that elevated serum ferritin (above average levels) had a significant correlation with metabolic syndrome.

## Discussion

In this study it is seen that moderately elevated serum ferritin levels would be more common in those with metabolic syndrome.

Patients were evaluated with detailed history, meticulous examination and laboratory investigations. Laboratory investigations included fasting lipid profile, fasting blood sugar, complete blood count, renal function test, serum ferritin.

Since serum ferritin is an acute-phase reactant and may be elevated in the presence of inflammation, we have attempted to minimize this potential source of confounding by adjusting for CRP and by excluding those individuals with suspected inflammation, infection, since metabolic syndrome is a pro inflammatory condition [3, 4].

Most of our patients were selected when they had come for treatment of diabetes and hypertension.

Biqiang Li, Wein Lin *et al*. also concluded in their study that serum ferritin increases the risk of metabolic syndrome factors. They stated that higher the serum ferritin levels, higher the metabolic disorder severity and more frequent the metabolic syndrome incidence rate [5].

## Conclusion

There is a positive association between elevated serum ferritin (above average levels) and metabolic syndrome indicating it is a pro inflammatory condition.

## References

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