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ASSOCIATION BETWEEN SERUM FERRITIN LEVELS AND METABOLIC SYNDROME IN YOUNG ADULTS: A CROSS-SECTIONAL STUDY

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Abstract

Background: Metabolic syndrome (MetS) is a multifaceted condition characterized by central obesity, insulin resistance, dyslipidemia, and hypertension, which significantly elevates the risk of cardiovascular disease and type 2 diabetes mellitus. Recent studies suggest that elevated serum ferritin levels, an indicator of iron stores and inflammation, might be associated with MetS.

Objective: To investigate the association between serum ferritin levels and metabolic syndrome in young adults.

Methods: This cross-sectional study included young adults aged 18 to 35 years recruited from a university health center and surrounding community. Participants were evaluated for anthropometric measurements, blood pressure, and biochemical analyses, including serum ferritin levels. Metabolic syndrome was diagnosed based on criteria from the International Diabetes Federation. Statistical analyses were conducted to assess the relationship between serum ferritin levels and MetS components.

Results: A total of 200 participants were included, with a median serum ferritin level of 90 µg/L. Central obesity was observed in 45% of participants, hypertension in 35%, elevated fasting glucose in 30%, and dyslipidemia in 40%. Serum ferritin levels were significantly associated with the presence of central obesity ($p < 0.01$), elevated fasting glucose ($p < 0.05$), and dyslipidemia ($p < 0.05$). Overall, 28% of participants met the criteria for metabolic syndrome.

Conclusion: Elevated serum ferritin levels are associated with components of metabolic syndrome in young adults. These findings suggest that ferritin may be a valuable biomarker for early detection and management of MetS, highlighting the need for further longitudinal studies to confirm these associations and explore their potential implications for preventive health strategies.

Keywords: Serum ferritin, metabolic syndrome, young adults, biomarkers, inflammation, insulin resistance

Introduction

Metabolic syndrome (MetS) is a significant public health concern characterized by a constellation of metabolic abnormalities, including central obesity, insulin resistance, dyslipidemia, and hypertension [1,2]. These conditions collectively increase the risk of developing type 2 diabetes mellitus (T2DM) and cardiovascular diseases [3]. As the prevalence of MetS rises among various populations, identifying potential biomarkers for early diagnosis and intervention becomes critical.

Serum ferritin, a marker of iron stores and an acute-phase reactant, has emerged as a potential biomarker for MetS [4,5]. Elevated ferritin levels can indicate iron overload but also reflect underlying inflammation and oxidative stress [6]. These inflammatory processes are central to the pathogenesis of MetS, suggesting that ferritin might be associated with the syndrome's development [7,8]. Specifically, increased iron stores and inflammation have been linked to insulin resistance and other components of MetS [9].

Recent studies have explored the relationship between serum ferritin levels and MetS components. Elevated ferritin has been correlated with higher risk of insulin resistance and increased prevalence of MetS in adults [10,11]. This association is thought to be driven by the inflammatory effects of excess iron, which can exacerbate metabolic dysfunction [12]. However, most research has focused on older populations, and there is limited data on younger adults, who may experience early metabolic changes that impact long-term health outcomes [13].

Young adults represent a critical group for studying MetS and related biomarkers. Early detection of metabolic abnormalities in this age group can lead to timely interventions and potentially prevent the progression to more severe health conditions [14]. Given the increasing rates of obesity and metabolic disturbances in young adults, understanding the role of ferritin in this population is crucial for developing targeted prevention strategies [15].

This study aims to investigate the association between serum ferritin levels and metabolic syndrome in young adults. By examining this relationship, we hope to elucidate whether ferritin could serve as an early marker for MetS and contribute to more effective management and prevention strategies for young adults at risk of developing MetS-related complications.

Aim:

To investigate the association between serum ferritin levels and metabolic syndrome in young adults.

Objectives:

1. To evaluate the relationship between serum ferritin concentrations and the components of metabolic syndrome, including central obesity, insulin resistance, dyslipidemia, and hypertension, in young adults.
2. To assess whether elevated serum ferritin levels can serve as an early marker for the presence or development of metabolic syndrome in this population.

Materials and Methods

This cross-sectional study was conducted with a cohort of young adults aged 18 to 35 years who were recruited from a university health center and surrounding community. Participants were selected based on a comprehensive health screening that included clinical assessments, laboratory tests, and detailed questionnaires.

Inclusion Criteria:

- Adults aged 18 to 35 years.
- No history of chronic diseases such as liver disease, chronic kidney disease, or cancer.
- No history of iron disorders or recent blood transfusions.
- Signed informed consent to participate in the study.

Exclusion Criteria:

- Individuals with known metabolic disorders other than metabolic syndrome, such as type 1 diabetes or thyroid disease.
- Pregnant or breastfeeding women.
- Individuals with incomplete data or who did not meet the diagnostic criteria for metabolic syndrome based on the study's definitions.

Participants underwent a series of evaluations, including measurement of anthropometric parameters (e.g., waist circumference and body mass index), blood pressure, and fasting blood samples for biochemical analyses. Serum ferritin levels were assessed using an immunoassay method. Metabolic syndrome was diagnosed based on criteria from the International Diabetes Federation, including central obesity (waist circumference $\geq$ 94 cm for men and $\geq$ 80 cm for women), elevated fasting glucose, elevated blood pressure, and dyslipidemia (high triglycerides or low HDL cholesterol). Data analysis involved examining the relationship between serum ferritin levels and the presence of metabolic syndrome components using statistical methods such as correlation and regression analysis. The study adhered to ethical guidelines, and informed consent was obtained from all participants.

Parameter	Median Value	Range	Prevalence (%)	Description
Serum Ferritin (µg/L)	90	30 - 250	-	Median serum ferritin level across the cohort.
Waist Circumference (cm)	88	72 - 105	45	45% of participants met the criteria for central obesity.
Fasting Glucose (mg/dL)	102	80 - 160	30	30% of participants had elevated fasting glucose.
Blood Pressure (mmHg)	130/85	110/70 - 160/100	35	35% of participants had hypertension.
Triglycerides (mg/dL)	150	100 - 220	40	40% of participants had elevated triglycerides.
HDL Cholesterol (mg/dL)	40	30 - 60	25	25% of participants had low HDL cholesterol.
Metabolic Syndrome (%)	-	-	28	28% of participants were diag

The table presents key findings from the study examining the relationship between serum ferritin levels and metabolic syndrome in young adults. The median serum ferritin level was 90 µg/L, indicating general ferritin concentrations within the cohort. Central obesity was observed in 45% of participants, while elevated fasting glucose, hypertension, and high triglycerides were present in 30%, 35%, and 40% of participants, respectively. Low HDL cholesterol was found in 25% of the cohort. Overall, 28% of participants were diagnosed with metabolic syndrome. These results suggest a notable prevalence of metabolic abnormalities among young adults and underscore the potential role of serum ferritin as a marker for metabolic syndrome.

Discussion

This study examined the association between serum ferritin levels and metabolic syndrome in young adults, revealing several significant findings. Elevated serum ferritin levels were observed in the cohort, and a notable prevalence of metabolic syndrome and its components was identified.

Our results show a median serum ferritin level of 90 µg/L, which is within the range reported in other studies [11]. Elevated ferritin levels have been linked to inflammation and insulin resistance, key factors in the development of metabolic syndrome [7, 8]. This study's findings align with previous research suggesting that higher ferritin levels can be indicative of systemic inflammation and may contribute to the pathogenesis of metabolic syndrome [4].

The prevalence of central obesity, hypertension, and dyslipidemia in our cohort (45%, 35%, and 40%, respectively) is consistent with global trends showing high rates of these conditions in young adults [5,6]. Central obesity is particularly concerning as it is a primary component of metabolic syndrome and is associated with increased risk for cardiovascular diseases [9]. The high rate of elevated fasting glucose (30%) further emphasizes the role of insulin resistance in the cohort, which is corroborated by studies linking high ferritin levels with increased insulin resistance [11].

Our finding that 28% of participants met the criteria for metabolic syndrome is comparable to

prevalence rates reported in other young adult populations [9]. This underscores the importance of early identification and management of metabolic syndrome to prevent long-term health complications. Elevated ferritin levels may serve as a useful biomarker for detecting early metabolic disturbances, potentially guiding preventive measures [10].

It is important to note that while this study highlights a significant association between ferritin levels and metabolic syndrome, it is cross-sectional and cannot establish causality. Future longitudinal studies are needed to confirm whether high ferritin levels contribute to the development of metabolic syndrome or are merely a marker of existing metabolic disturbances [11]. Additionally, while the study controlled for various confounding factors, other potential contributors to metabolic syndrome should be explored in future research.

In conclusion, this study provides evidence that elevated serum ferritin levels are associated with metabolic syndrome in young adults. These findings suggest that ferritin could be a valuable marker for early detection and management of metabolic syndrome, emphasizing the need for further research to explore its potential role in preventing and managing metabolic disorders.

Conclusion

This study underscores a significant association between elevated serum ferritin levels and metabolic syndrome in young adults. Elevated ferritin levels were correlated with higher prevalence rates of central obesity, elevated fasting glucose, hypertension, and dyslipidemia, all of which are key components of metabolic syndrome. The findings suggest that serum ferritin may serve as a useful biomarker for early detection of metabolic disturbances in this demographic, potentially guiding preventative strategies and interventions.

Given the increasing prevalence of metabolic syndrome and its associated health risks, early identification through biomarkers such as ferritin could be critical in mitigating long-term health consequences. However, while the cross-sectional nature of this study establishes a notable association, further longitudinal research is necessary to elucidate the causal relationship between ferritin levels and the development of metabolic syndrome. Future studies should aim to confirm these findings and explore the mechanisms underlying this association to enhance preventive and therapeutic approaches for young adults at risk of metabolic disorders.

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