

Exploring The Importance of Hematological and Metabolic Biomarkers in Metabolic Syndrome: A Thorough Method for Evaluating Risk

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ABSTRACT

Introduction: Metabolic syndrome is a collection of metabolic abnormalities, including obesity, insulin resistance, dyslipidemia, and hypertension, that significantly increase the risk of diabetes and cardiovascular disease (Swarup, *et al.*, 2024). The global prevalence of metabolic syndrome varies widely, ranging from less than 10% to as high as 84% (Kaur, *et al.*, 2019). Metabolic syndrome has a complex origin involving genetic factors, environmental influences, and lifestyle choices such as obesity, lack of physical activity, and unhealthy eating habits. Aging, stress, medications, gut bacteria, sleep patterns, and hormonal changes also contribute to the development of metabolic syndrome (Neeland *et al.*, 2019). Important markers used to evaluate metabolic syndrome include adiponectin, leptin, ghrelin, HOMA IR (Fahed *et al.*, 2022), uric acid, interleukin-6, interleukin-10, tumor necrosis factor-alpha (TNF- α) (Mohammadi *et al.*, 2017), hs-CRP, as well as various blood cell counts and ratios. Precautionary measures primarily focus on lifestyle changes like weight management, dietary adjustments, and increased physical activity. Clinical management of metabolic syndrome is challenging due to the absence of a standardized approach for prevention or treatment, with insulin resistance being a major issue (Ambroselli *et al.*, 2023).

Aims and Objective: The aims and objectives of this research are outlined as follows:

- To analyze the concentrations of specific metabolic and inflammatory biomarkers, along with hematological parameters, in individuals diagnosed with metabolic syndrome.
- To explore the correlations among the selected biomarkers in the context of metabolic syndrome.
- To evaluate the effectiveness of utilizing a comprehensive strategy that incorporates hematological, metabolic, and inflammatory biomarkers in predicting the likelihood of developing metabolic syndrome.

Methodology: In this observational study, a total of 100 female participants aged between 20 and 60 years were included. Blood samples were obtained from both a general hospital and Jinnah University for Women following informed consent procedures. Data collection was carried out through a self-administered questionnaire covering demographic information, lifestyle habits, physical activity levels, and family history relevant to metabolic syndrome (MetS). The study was divided into two groups: n=50 for individuals diagnosed with MetS and n=50 individuals without MetS. Various metabolic, inflammatory & hematological biomarkers including lipid profile, adiponectin, leptin, HOMA-IR, uric acid, high sensitivity C-reactive protein (hs-CRP) were utilized for diagnosing MetS. Pearson and Spearman correlation coefficients were utilized for statistical analysis to investigate the associations between MetS and the specified biomarkers.

Result: The study revealed a strong link between metabolic syndrome (MetS) and multiple biomarkers. Key diagnostic markers for MetS include glucose levels, HbA1c, and lipid profile parameters like cholesterol, triglycerides, LDL, and HDL. Individuals with MetS exhibited higher levels of serum uric acid and creatinine compared to control subjects. It was found that MetS was associated with elevated levels of insulin, HOMA-IR, leptin, and the leptin/adiponectin ratio, suggesting insulin resistance. Red Blood Cell

indices did not show significant relationships with MetS, parameters like Hematocrit (HCT), MCHC, and RDW did. Leukocyte indices such as WBCs, %GRA, %MON, and #GRA were significantly correlated with MetS severity. Platelet indices including Platelet count (PLT), MPV, and PDW were positively correlated with MetS severity. Inflammatory markers like hs-CRP were notably elevated in the MetS group, highlighting the link between inflammation and MetS.

Conclusion: In conclusion, the provenance of this study revealed the considerable correlation between metabolic and the inflammatory markers in alliance with hematological indices with the components of MetS. These results highlight the importance of handling the metabolic instabilities that are related with MetS.

Keywords: Metabolic Syndrome, Inflammatory Markers, HOMA-IR, T2DM, MHR, NHR.

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