

Exploring the Complexities: Investigating the Relationship between BMI and Biomarkers of Obesity

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ABSTRACT

Introduction: A worldwide public health emergency known as the obesity pandemic has emerged, affecting both developed and developing nations with the greatest impact on the most vulnerable and socially vulnerable population groups (Aleksandrova *et al.*, 2020) (Al-Fatlawi *et al.*, 2023). Despite the increasing recognition of obesity, the number of obese individuals has nearly tripled since 1975. This affects billions of people worldwide (Jastreboff *et al.*, 2019). Over 650 million people, accounting for 13% of the world's population, were obese in 2016, with 40% of them being overweight, according to the WHO. Increasing rates of morbid obesity are becoming prevalent, especially among children where many biomarkers have similar functions, making univariate analysis ineffective (Nishihara *et al.*, 2017). Technological progress has enabled the analysis of multiple biomarkers, which is helping to overcome the limitations of biological complexity in understanding disease origins. Despite this, the vast amounts of data obtained through these techniques remain difficult to interpret and visualize. Recently, correlation-based network analysis has become a popular data-mining technique as it reduces the complexity of multidimensional data while keeping most information for interpretation intact (Patterson *et al.*, 2016) (Roy *et al.*, 2017). Through correlation study, it is possible to visualize molecular interactions that cause diseases and gain insight into the underlying mechanisms of these diseases (Williamson *et al.*, 2020) (Xie *et al.*, 2022). The representation of biomarkers in biological network analysis involves nodes and edges. Correlated networks can be interpreted using various network characteristics, such as the degree of connectivity between nodes with high correlations, the number and type of paths between intermediate and advanced connections in complex networks, and the density of existing edges compared to total possible areas.

Aims and Objective:

- To Examine the Correlation Between Obesity and Metabolic Biomarkers.
- To Identify Specific Biomarkers Associated with Obesity-Related Complications.
- To Investigate the Temporal Dynamics of Biomarker Changes in Obesity.

Methodology: A cross-sectional study was conducted involving a diverse sample of adults aged 18 to 65 years, recruited from primary care clinics and Jinnah University for Women. Participants were screened for eligibility based on their medical history and informed consent was obtained. A self-reported questionnaire was used to assess demographics, eating habits, physical activity, and family history. Normal, overweight, and obese biochemical parameters (BMI, WHR, WHtR, fasting glucose, insulin, HbA1c, TAG, cholesterol, leptin, and adiponectin) were measured. Data collection involved measuring height and weight to calculate BMI using the standard formula: $\text{weight (kg)} / \text{height (m)}^2$. Statistical analyses were conducted using Pearson and Spearman correlation coefficients to assess the relationships between BMI and the selected biomarkers. Multivariate regression analyses were also performed to control for potential confounding variables such as age, sex, and physical activity level.

Result: Higher BMI continuously correlated to increased insulin, and leptin levels as well as abnormalities in lipids like more total cholesterol and triglycerides. These correlations are indicative of systemic inflammation, insulin resistance, and metabolic dysfunction which are all characteristic traits for obesity.

Moreover, BMI negatively correlates with adiponectin, whose reduced levels are known to confer less protection against metabolic syndrome in individuals with high BMI. The ROC curve analysis corroborated that BMI is an accurate predictor for relevant shifts towards (or away from) these biomarkers, showing good discriminatory performance over a broad spectrum of metabolic deviations. Our findings highlight the need to assess multiple biomarkers when studying obesity-related health problems. This detailed analysis reveals the diverse biological mechanisms mediating obesity-related complications and highlights important implications for integrating approaches to help interpret the health consequences of obesity in research and clinical settings.

Conclusion: This study underscores the multifaceted nature of obesity and its physiological impact. The presence of insulin resistance, reflected in elevated insulin levels, indicates that BMI alone may not adequately represent an individual's metabolic risk. Additionally, the correlation between BMI and lipid profiles suggests that individuals with higher BMI are at increased risk for cardiovascular disease. These findings emphasize the importance of addressing not only weight management but also the underlying metabolic disturbances linked to obesity.

Keywords: Adiponectin, BMI, Biomarkers, Obesity, Leptin.

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