# Exploring the Association Between Body Mass Index (BMI) and Fasting Blood Sugar: Implications for Early Intervention

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## Abstract

**Objective:** This study aims to investigate the correlation between body mass index (BMI) and fasting blood sugar (FBS) levels among individuals in Lahore, Pakistan.

**Material and Methods:** This prospective research study was carried out from May to June 2023, involving 150 participants aged 21 to 60. Height, weight, and fasting plasma glucose levels were recorded, and BMI was determined using the formula: weight (kg) / (height (m) X height (m)). The relationship between BMI and FBS was explored using statistical methods.

**Results:** Participants with a BMI over 25 showed a higher prevalence of FBS over 100 mg/dl compared to those with a BMI under 25. The study demonstrated a clear correlation between BMI and FBS levels ($p < 0.05$). Among individuals with a BMI under 25, 60 out of 75 had FBS levels below 100 mg/dl, highlighting the potential impact of a lower BMI on optimal blood sugar levels.

**Conclusion:** This study confirms a significant association between BMI and fasting blood sugar levels, highlighting the importance of weight management for optimal health and blood sugar regulation. Regular monitoring of BMI and FBS levels is essential for identifying potential risk factors and implementing preventive measures.


**Keywords:** BMI, FBS, Type 2 Diabetics Mellitus, Obesity, Pakistan

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## Introduction

Understanding the correlation between body mass index and fasting levels of blood sugar is crucial for assessing an individual's health and identifying potential health risks. By examining the relationship between these two indicators, we can gain valuable insights into the overall well-being and potential health conditions of an individual.[1] Numerous investigations have been carried out to find the connection between fasting blood sugar levels and body mass index.[1,2]

The body mass index (BMI) and fasting blood sugar (FBS) are two important health indicators that can provide valuable information about a person's overall health and potential risk for different health conditions. Basal metabolic rate (BMI), which divides an individual's weight in kilos by the square of their height in meters, is used to classify people into various weight categories. Studies have indicated a relationship between fasting blood sugar levels and body mass index.[3,4] It has been observed that individuals with higher BMI tend to have higher fasting blood sugar levels.[5] This relationship implies that being overweight, especially in the form of adipose tissue, may increase the risk of developing insulin resistance and having poor glucose metabolism, which raises blood sugar levels.[6] To completely comprehend the connection between BMI and fasting blood glucose (FBG) level more investigations are required.[5] Nonetheless, many studies have shown that obesity,

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which is frequently manifested by a high BMI, can raise the chance of insulin resistance and type 2 diabetes.[7] The finding that obese patients' insulin receptor numbers can return to normal if their insulin levels are lowered implies that insulin resistance plays a secondary role in the alterations in insulin receptor numbers rather than being the fundamental cause.[5] Individuals with higher BMI may have decreased insulin sensitivity, leading to elevated fasting blood sugar levels. In addition to the correlation between BMI and FBS levels, research has also highlighted the role of abdominal obesity in influencing blood glucose regulation.[7] Maintaining ideal blood sugar management requires maintaining a healthy body weight through a balanced diet and consistent exercise. Individuals with high BMI should focus on adopting modified lifestyle habits, including a balanced and nutritious diet, regular exercise, and weight management plans.[8] By managing body weight and reducing excess adipose tissue, individuals can potentially improve insulin sensitivity and blood sugar regulation[9]. Type 2 diabetes often develops gradually in obese adults due to poor glucose metabolism and insulin resistance. because of a confluence of lifestyle factors, including inactivity poor diet, and genetics. FBS less than 100 mg/dl is regarded as normal, while FBS between 100 and 125 mg/dl and Hb A1C 5.7%–6.4% are classified as impaired.[6] Fasting glucose during which the body becomes less responsive to insulin, leading to elevated blood sugar levels.[10] and the link between obesity and impaired glucose metabolism is well-established. Obesity, particularly abdominal obesity, contributes to an increase in insulin resistance and decreased insulin sensitivity, resulting in high fasting blood sugar levels and an increased risk of developing type 2 diabetes.[11] Obesity has a great impact on glycemic control and overall metabolic health. Adipose tissue, especially visceral fat, secretes many pro-inflammatory cytokines and adipokines, which contribute to chronic low-grade inflammation and insulin resistance.[12] This, in turn, disrupts glucose homeostasis and leads to elevated fasting blood sugar levels. Studies have also shown that dyslipidemia "a condition marked by increased triglycerides and lower levels of high-density lipoprotein cholesterol" is frequently present in obese persons. These lipid abnormalities further increase insulin resistance and the potential for the development of hyperglycemia.[13]

The American Diabetes Association stated that obesity, especially abdominal obesity as demonstrated by a high BMI and waist circumference, is one of the risk factors for diabetes. Significant risk factors for the development of type 2 diabetes also include poor glucose metabolism, insulin resistance, and decreased insulin sensitivity due to increased body weight.[14,15]

Individuals with higher BMI need to prioritize weight management through the adaptation of a healthy lifestyle, including a complete and balanced diet and regular exercise. They may be able to lower their chance of getting diabetes, control blood sugar levels, and enhance their sensitivity to insulin by doing this.[16] Regular monitoring of BMI and fasting blood sugar levels can help in identifying potential risk factors early and taking proactive steps to maintain optimal health.

It's crucial to remember that the correlation between BMI and FBG levels underscores the significance of maintaining a healthy BMI for optimal blood sugar regulation.[11] By making informed decisions and taking necessary measures, individuals can work towards improving their overall well-being and reducing their chance of developing type 2 diabetes.

## Material and Methods

This prospective study was carried out from May to June 2023 at different medical college Hospitals in Lahore, Pakistan. Regularly visiting healthy patients of the hospital for check-ups were selected to be a part of this study with authorization from the Institutional Ethics Committee No 684/ERC/CMH/LMC dated 27-05-2023. Psychiatric, diabetic, pediatric, and pregnant participants. Those receiving treatment for cardiovascular disorders and diabetes mellitus were not included in the study group. There were one hundred and fifty people in the study group, ages 21 to 60. The subjects' height, weight, sex, and age were noted after they gave their informed consent. 50 guys in the study group had a BMI of 25–29 kg/m$^2$, while the control group had a BMI of 18–24 kg/m$^2$. Both height and weight were reported to be the closest 0.5 cm and 0.5 kg, respectively. Fasting (8–12 hours, followed by an overnight fast).

Venipunctures of the median cubital vein were used to obtain venous blood samples, which were then centrifuged to separate the plasma. The Glucose Oxidase technique was used to estimate the fasting plasma glucose levels using an ERBA-Transasia fully automated analyzer[17]. Body mass index can serve as a predictor of fasting blood sugar levels. Higher BMI values are

associated with an increased risk of elevated fasting blood sugar levels.

BMI was determined by using the following formula:

BMI = weight (kg) / (height (m) X height (m))

Once we have calculated BMI, we can interpret the results using the following categories:

- Underweight: BMI less than 18.5
- Normal weight: BMI 18.5–24.9
- Overweight: BMI 25–29.9
- Obesity: BMI 30 or higher

It is a statistical measurement of an individual's weight scaled by height. It serves as a straightforward method of dividing sedentary people with average body composition into groups based on the percentage of body fat they contain.

## Results

The study had 150 participants who met the inclusion and exclusion criteria were included in the study. They appeared to be in good health. forty of the individuals were not allowed to participate in the trial because their fasting blood glucose levels fell within the range of diabetes. Out of the total 150 members, 81 (54%) were women and 69 (46%) were men. Participants in the study ranged in age from twenty-one to sixty years. The average age of the males and females was 37.98 ± 10.51 and 36.4 ± 10.11 years, respectively.

The T-test is done in pairs. Figer 2 indicates that 40/50 participants with a BMI less than 25 kg/m2 had an FBS of less than 100 mg/dl. 38/50 Subjects with a BMI greater than 25 kg/m$^2$ had an FBS greater than 100 mg/dl. (Figer-3) There is a significant p-value. The study demonstrates a clear correlation between BMI and FBS.

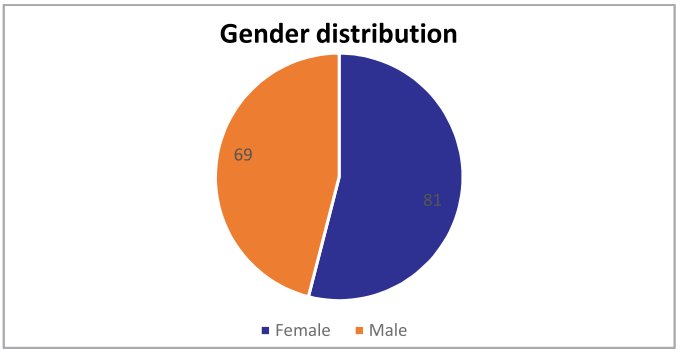


**Figure 1:** *Gender distribution of the study population*

**Table 1:** *Age-specific FBS and BMI*

| Age group | Mean BMI | Mean FBS (mg/dl) |
|---|---|---|
| 21-30 years | 20.25 | 78.37 |
| 31-40 years | 24.57 | 92.05 |
| 41-50 years | 24.22 | 93.02 |
| 51-60 years | 27.15 | 89.73 |

**Table 2:** *Comparing of BMI and FBS*

| BMI Kg/m$^2$ | FBS<100 mg/dl | FBS>100 mg/dl | Total |
|---|---|---|---|
| BMI<25 | 60 | 15 | 75 |
| BMI>25 | 18 | 57 | 75 |
| Total | 78 | 72 | 150 |

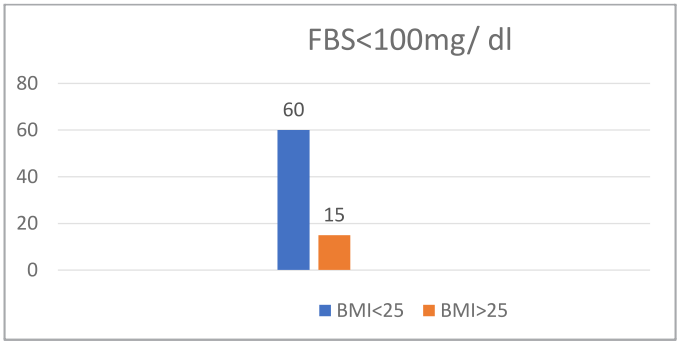


**Figure-2:** *BMI versus FBS*

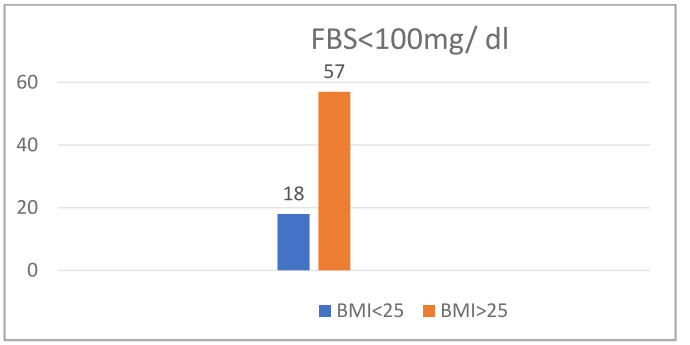


**Figure-3:** *BMI versus FBS*

## Discussion

After recognizing the substantial impact of BMI on fasting blood sugar levels, it is crucial to explore the specific relationship between BMI categories and fasting blood sugar levels 2. According to the data provided, there is a clear connection between BMI and fasting blood sugar levels. The data indicates that individuals with a BMI over 25 have a higher prevalence of FBS over 100 mg/dl compared to those with a BMI under 25. The data implies that maintaining a healthy BMI under 25 could contribute to better blood sugar management. 60 out of 75 individuals with a BMI under 25 have FBS levels below 100 mg/dl, highlighting the potential

impact of a lower BMI on optimal blood sugar levels. Individuals who are overweight or obese are categorized at a higher risk for elevated fasting blood sugar levels, indicating impaired glycemic control.[14] Regular monitoring of BMI and fasting blood sugar levels is crucial for identifying potential risk factors and taking necessary steps to maintain optimal health.[18] Additionally, the relationship between BMI and fasting blood sugar levels highlights the importance of weight management and maintaining a healthy BMI to improve glycemic control. In conclusion, there is a significant association in BMI and fasting levels of blood sugar.[15]

Pregnancy-related high blood glucose levels have been regularly linked to BMI, suggesting a connection between BMI and fasting blood sugar.[18] In this study, we find, a positive correlation was found between BMI and fasting blood glucose levels 1. A different longitudinal study discovered a substantial correlation between early adulthood BMI trajectories and diabetes later in life, indicating that young adulthood is a critical time for the onset of diabetes.[12] An additional cross-sectional study conducted on adult Chinese participants revealed a correlation between diabetes and impaired glucose metabolism and BMI and waist circumference, with central obesity being more significant[2]. Additionally, a descriptive study found that fasting serum glucose was significantly increased in obese individuals, indicating a potential risk for cardiovascular and metabolic diseases[13]. These findings suggest that there is an association between BMI and FBS, highlighting the importance of early intervention and prevention strategies for individuals with high BMI to control glucose levels and lower the risk of developing diabetes.

Conversely, some participants with a BMI over 25, 57 out of 75 have FBS levels above 100 mg/dl. This demonstrates a higher prevalence of elevated fasting blood sugar levels in this BMI category. These findings emphasize the significance of weight management and sustaining a healthy BMI for better blood sugar control. Individuals with a BMI over 25 may benefit from lifestyle adjustments aimed at reducing excess body weight to enhance glycemic control and decrease the risk of developing conditions such as type 2 diabetes.[19]

Current research suggests adipose tissue and monocytes release the adipokine resistin. It gets its name from its capacity to obstruct or hinder the action of insulin. It was suggested as a connection between diabetes and obesity. Obese individuals' adipose tissue secretes more pro-inflammatory cytokines, glycerol, hormones, non-esterified fatty acids, and other chemicals that aid in the emergence of resistance to insulin.[11]

The purpose of our research is to confirm that elevated body weight and fasting levels of blood sugar are positively correlated. In the BMI <25 control group, most individuals displayed less than 100 mg/dl of fasting blood sugar (Graph 1). Most participants in the study group with BMIs had FBS levels above 100 mg/dl (Graph 2). Since patients with diabetes mellitus and cardiovascular disorders were not included in our study, other factors, such as the impact of stress in everyday life, should be taken into account as potential causes of the elevated FBS that results in prediabetes. It is well known that stress hormones raise blood sugar levels. Stress, both mental and physical, raises these hormones, which raises blood sugar levels.[12]

## Conclusion

The correlation between BMI and fasting blood sugar levels is substantial and underscores the importance of individuals being mindful of their BMI and taking proactive measures to attain and sustain a healthy weight for optimal health and blood sugar regulation. Regular physical activity is also crucial for enhancing insulin sensitivity and glucose uptake, thereby assisting in combating insulin resistance, which can lead to long-term health complications.[7]

**Conflict of interests:** *None*

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## Authors Contribution

**HNL:** Conceptualization of Project
**AF:** Data Collection
**SI:** Literature Search
**MI:** Statistical Analysis
**RA:** Drafting, Revision
**MR:** Writing of Manuscript