The BMI-Glucose Connection: Investigating the Association between Body Weight and Blood Sugar Levels

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ABSTRACT

Background: *Obesity is the most important modifiable risk factor in the pathogenesis of type-2 diabetes reported in most cross-sectional studies. The aim of the study is to examine the association between Body Mass Index (BMI) and blood sugar levels in a population sample.*

Materials and methods: *An observational study was conducted on pregnant women with a positive family history of diabetes mellitus visiting in the Outpatient Department of Khulna City Medical Hospital from September 2022 to March 2023 to investigate the relationship between BMI and glucose level.*

Results: *The study categorized 67 pregnant women based on their BMI, with respondents having a BMI of over 30 kg/m2 have a higher risk of high blood glucose levels. The study found that higher BMI categories are associated with an increased risk of having elevated 2-hour post-glucose blood sugar levels, indicating a potential link between BMI and glucose metabolism. The results suggest that maternal obesity may increase the prevalence of Gestational Diabetes Mellitus (GDM) which is consistent with the global trend of increased GDM prevalence along with the rise in obesity.*

Conclusion: *The study concludes that BMI is a significant predictor of glucose metabolism in pregnant women with a positive family history of diabetes mellitus. Effective interventions to control maternal obesity may reduce the incidence of GDM.*

Key words: Body mass index; Obesity; Diabetes mellitus; Pregnancy.

Introduction

Over nutrition has been identified as a key risk factor for a variety of disorders, including diabetes, hypertension, heart disease and some types of cancer.[1,2,3] Excess weight is the potential reason for insulin resistance, which can increase blood sugar or glucose levels, resulting in diabetes.[4] In India, a link was discovered between BMI and FBG levels. They stated that a person with a BMI of over 30 kg/m^2 is likelier to have high blood glucose levels. As a result of their increased weight, their inner cells become more resistant to the important function of insulin.[5] In 2011, a group of Korean researchers showed strong connections between BMI and FBG levels in people aged 40 to 50 years.[6] Maternal obesity has increased significantly among women of reproductive age in both high and middle-income nations during the previous few decades. In 2014, the estimated percentage of overweight and obese pregnant women in India was 21.7 percent and 33 percent in the United States of America.[7] Similarly, the prevalence of GDM has increased in tandem with the rise in obesity.[8] Globally, the prevalence of GDM ranges from 1 to 50%, depending on maternal age, race/ethnicity, socioeconomic position, screening methods and diagnostic criteria.[9] The aim of the study is to examine the association between BMI and blood sugar levels in a population sample.

Materials and methods

The study included 67 pregnant women with a positive family history of Diabetes mellitus visiting in the outpatient department of Khulna City Medical Hospital from September 2022 to March 2023 to investigate the relationship between BMI and glucose level. Body Mass Index (BMI). Respondents were categorized into six groups based on their BMI, including those with BMI less than 18.5, those with BMI between 18.5

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and 24.9, those with BMI between 25 and 29.9, those with BMI between 30 and 34.9, those with BMI between 35 and 39.9, and those with BMI greater than 40. Fasting Blood Sugar Levels: This variable was measured for all respondents. 2-Hour Post-Glucose Blood Sugar Levels: This variable was also measured for all respondents. Descriptive statistics were used to calculate the range, mean, and standard deviation for both fasting and 2-hour post-glucose blood sugar levels. A paired T-Test was conducted to determine if there was a significant difference between the fasting and 2-hour post-glucose blood sugar levels. Odds ratios were calculated to determine the association between BMI categories and the risk of elevated 2-hour post-glucose blood sugar levels. Confidence intervals were also reported for each odds ratio.

Results

Table I Distribution of respondents on the basis of BMI and Blood sugar levels

BMI	Number of respondents	Mean Blood glucose level (mg/dl)	
		Fasting	2 hours after 75g of glucose
<18.5	7 (10.45%)	88.7	138.4
18.5-24.9	35 (52.24%)	91.82	140.6
25-29.9	12 (17.91%)	96.42	154.6
30-34.9	8 (11.94%)	130.625	160.8
35-39.9	3 (4.48%)	160	180
>40	1 (1.49%)	155	195
Total	67 (100%)		

Table I illustrated BMI Categories and Respondents: <18.5: There are 7 respondents (10.45% of the total) classified as underweight. 18.5-24.9. The majority of respondents fall into this category, with 35 individuals (52.24% of the total) classified as having a normal weight. 25-29.9: There are 12 respondents (17.91% of the total) classified as overweight. 30-34.9: 8 respondents (11.94% of the total) fall into the obesity class I category. 35-39.9: There are 3 respondents (4.48% of the total) classified as obesity class II. >40: Only 1 respondent (1.49% of the total) falls into the obesity class III category. Mean Blood Glucose Levels: Fasting: The average blood glucose level after fasting ranges from 88.7 mg/dl for underweight individuals to 160 mg/dl for respondents in the obesity class II category, Mean fasting blood glucose level 108 mg/dl (SD±42). 2 hours after 75g of glucose. The average blood glucose level 2 hours after consuming 75 grams of glucose ranges from 138.4 mg/dl for underweight individuals to 195 mg/dl for respondents in the obesity class III category. Mean fasting blood glucose level 161 mg/dl (SD±22).

Discussion

Obesity is a worldwide problem increasing in both the developed and developing countries. It is a leading preventable cause of morbidity and mortality associated with non-communicable disease. In the present study, age (Mean, ±SD) of the pregnant mother was 18.99±0.75 (Years). Among 67 pregnant women with a positive family history of Diabetes mellitus 7 respondents with BMI less than 18.5, 35 respondents with BMI between 18.5 and 24.9, 12 respondents with BMI between 25 and 29.9, 8 respondents with BMI between 30 and 34.9, 3 respondents with BMI between 35 and 39.9, 1 respondent with BMI greater than 40. The fasting blood sugar levels range from 88.7 to 160, with a mean of 103.964 and a standard deviation of 26.983. The 2-hour post-glucose blood sugar levels range from 138.4 to 195, with a mean of 151.284 and a standard deviation of 21.797. A paired T-Test was conducted to determine if there was a significant difference between the fasting and 2-hour post-glucose blood sugar levels. The results showed a statistically significant difference ($t = -12.485$, $df = 66$, $p < 0.001$), indicating that the 2-hour post-glucose blood sugar levels were significantly higher than the fasting blood sugar levels. An odds ratio was calculated to determine the association between BMI categories and the risk of elevated 2-hour post-glucose blood sugar levels. The results showed that the odds of having elevated 2-hour post-glucose blood sugar levels were 3.92 times higher (95% CI: 1.19-12.89) for respondents with BMI between 25 and 29.9, 9.28 times higher (95% CI: 2.09-41.19) for respondents with BMI between 30 and 34.9, 25 times higher (95% CI: 3.07-204.61) for respondents with BMI between 35 and 39.9 and 45 times higher (95% CI: 1.48-1381.38) for the respondent with BMI greater than 40, compared to respondents with BMI between 18.5 and 24.9. In conclusion, the analysis shows that there is a significant difference between the fasting and 2-hour post-glucose blood sugar levels, with the latter being significantly higher. Study conducted by Rasul et al. found 27. 16% (Male 39% and female 22%) was overweight & obese, 58% of the respondents had positive family history of overweight/obesity and around 70% of them had positive family history of Type II Diabetes and Hypertension.[10] Similar type of study conducted by Gopalakrishnan et al. found 14.8% respondent were underweight (12.2% in male and 17.0% in female), 15.9% (18.3% in male and 13.8%) was overweight and 5.2% of study subjects were obese.[11] Additionally, higher BMI categories are associated with increased odds of having elevated 2-hour post-glucose blood sugar levels, indicating a potential link between BMI and glucose metabolism. Many studies including Gray et al and Sepp et al have estimated the relationship between over nutrition and NCDs for European countries.[12,13]

Conclusion

Research suggests that higher BMI categories are associated with an increased risk of elevated 2-hour post-glucose blood sugar levels. This link between BMI and glucose metabolism underscores the importance of maintaining a healthy weight through diet and exercise to reduce the risk of developing conditions such as diabetes and metabolic syndrome.

Recommendation

Early detection and intervention can also be crucial in managing these conditions and improving overall health outcomes. As always, consulting with a healthcare professional for personalized advice on managing weight and glucose levels is recommended.

Disclosure

All the authors declared no competing interest.

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