Original Contribution

Association of Body Mass Index, Blood Pressure with Fasting Serum Glucose in Female with Type-2 Diabetes Mellitus

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Type-2 diabetes mellitus is a global pandemic with immense social, health and financial consequences. The pathophysiology of type-2 diabetes is significantly influenced by overweight and obesity. Type-2 diabetes often goes hand-in-hand with high blood pressure. One way to check type-2 diabetes is by measuring fasting blood glucose. This cross-sectional analytical study looked at how blood pressure, body mass index (BMI) and fasting serum glucose relate to each other in women with type-2 diabetes in the Mymensingh locality. The research took place at the Physiology Department of Mymensingh Medical College, Bangladesh from July 2023 to June 2024. We included 200 participants: 100 apparently healthy women of 30-65 years without diabetes as the control group and 100 women with diabetes of same age group as the study group. The data was analyzed using SPSS software. Weight and height were measured anthropometrically in kilograms and meters, respectively. Blood pressure was checked with an aneroid sphygmomanometer for both systolic and diastolic values. To see if there were significant differences between groups, we used the unpaired Students 't' test and shared results as mean±SD. For relationships among fasting serum glucose, blood pressure and BMI, we used Pearson's correlation coefficient test. The average BMI for those in the control group was 24.19±1.22 kg/m². In contrast, the study group's average BMI was higher at 28.04±1.66 kg/m². The study group also had a greater average systolic blood pressure of 130.65±6.06 mm Hg compared to 115.30±5.07 mm Hg for controls. For diastolic blood pressure, values were also higher in the study group: 85.65±5.71 mm Hg compared to the control's 75.65±5.25 mm Hg. Fasting serum glucose levels showed a positive correlation with both BMI and blood pressure. We recommended from this study that routine evaluation of these parameters is important for preventing complications associated with type-2 diabetes mellitus.

[Mymensingh Med J 2024 Oct; 33 (4): 1064-1069]

Key words: Type-2 diabetes mellitus, Fasting serum glucose, Body mass index, Blood pressure

Introduction

Diabetes mellitus is a syndrome characterized by poor metabolism of proteins, fats, and carbohydrates that is brought on by a decrease in tissue sensitivity to insulin or a lack of insulin secretion[1]. These days, type-2 diabetes is one of the most common diseases in the world. The total number of diabetic persons globally is nearly 537 million with a prevalence of 10.5% in adult population. In Bangladesh, 13.81% of females have diabetes mellitus[2]. Impaired insulin production by pancreatic β-cells and the inability of insulin-sensitive tissues to react to insulin are responsible for its development[3]. The growing burden of type-2 diabetes mellitus is strongly related with rising incidence of obesity. Excess accumulation of adipose tissue to an extent that impairs both physical and psychosocial health and well-being is called obesity. Body mass index (BMI) is a straightforward weight-for-height metric that is frequently used to categorize persons who are overweight or obese[4].

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Diabetes and hypertension are interconnected conditions that significantly contribute to the development and progression of atherosclerotic cardiovascular disease. Hypertension is the leading cause of morbidity and mortality among type-2 diabetes globally. When both are combined, the chance of dying is increased by 7.2 times[5]. A fasting blood glucose level of ≥7 mmol/L is considered for diagnosis of diabetes according to ADA[6]. This study aimed to observe association of BMI, blood pressure with fasting serum glucose in female diabetic patients.

Methods

This study was carried out in the department of Physiology, Mymensingh Medical College, Mymensingh, Bangladesh from July 2023 to June 2024. This was cross-sectional analytical study with 200 participants in total, of which 100 were female type-2 diabetics (Group II) with ages ranging from 30 to 65 and 100 were healthy non-diabetic controls (Group I). With the appropriate approval from the relevant center's authorities, the subjects were collected from the department of Physiology, Medicine and Endocrine outpatient department, Mymensingh Medical College and Hospital. Written informed consent was obtained following appropriate counseling. The Mymensingh Medical College Institutional Review Board provided ethical approval (Memo no: MMC/IRB/2023/616). Data was gathered using a pre-made questionnaire. Following anthropometric measurements of height in meters and weight in kilograms, BMI was computed. Blood pressure measurement was done by using an aneroid sphygmomanometer. Using the enzymatic GOD-POD technique, fasting serum glucose was measured. The statistical significance of the difference between the groups was evaluated using the unpaired Students "t" test, and the data were expressed as mean±SD. A significant P value was defined as less than 0.05. To assess the association between the parameters, Pearson's correlation test was used. Symbolized by r, it extends from -1 to +1. The statistical product and service solution, version 26, was used for analyzing the data.

Results

The mean value of BMI of control group (Group I - non-diabetic healthy female, age 30-65 years) and study group (Group II- female with type-2 diabetes mellitus with same age group) were 24.19±1.22 and 28.04±1.66 kg/m^2 respectively. The study group possessed a greater BMI than the control group. The outcome is statistically highly significant.

Table I: Comparison of BMI, blood pressure, fasting serum glucose in both groups

Parameters	Control group (n=100) (Group I)	Study group (n=100) (Group II)	p value
	Mean±SD	Mean±SD	
BMI (kg/m^2)	24.19±1.22	28.04±1.66	<0.001
Systolic BP (mm of Hg)	115.30±5.07	130.65±6.06	<0.001
Diastolic BP (mm of Hg)	75.65±5.25	85.65±5.71	<0.001
Fasting serum glucose (mmol/L)	4.94±0.24	8.40±0.91	<0.001

The mean value of systolic blood pressure in control group was 115.30±5.07 and in study group was 130.65±6.06 mm of Hg. The mean value of diastolic blood pressure in control group and study group were 115.30±5.07 and 130.65±6.06 mm of Hg respectively. Systolic and diastolic blood pressure in the study group was higher than in the control group. The outcome has statistical significance. The study group's mean fasting serum glucose value was 8.40±0.91 mmol/L, while the control groups was 4.94±0.24 mmol/L. Fasting serum glucose levels in the research group was higher than in the control group. The result is statistically significant. In this study we have found significant positive correlation of Fasting serum glucose with body mass index, systolic and diastolic blood pressure.

Table II: Correlation of fasting serum glucose with BMI, blood pressure

Parameters	r value	p value
Body mass index	0.516	<0.001
Systolic blood pressure	0.518	<0.001
Diastolic blood pressure	0.491	<0.001

r = Pearson's correlation co-efficient

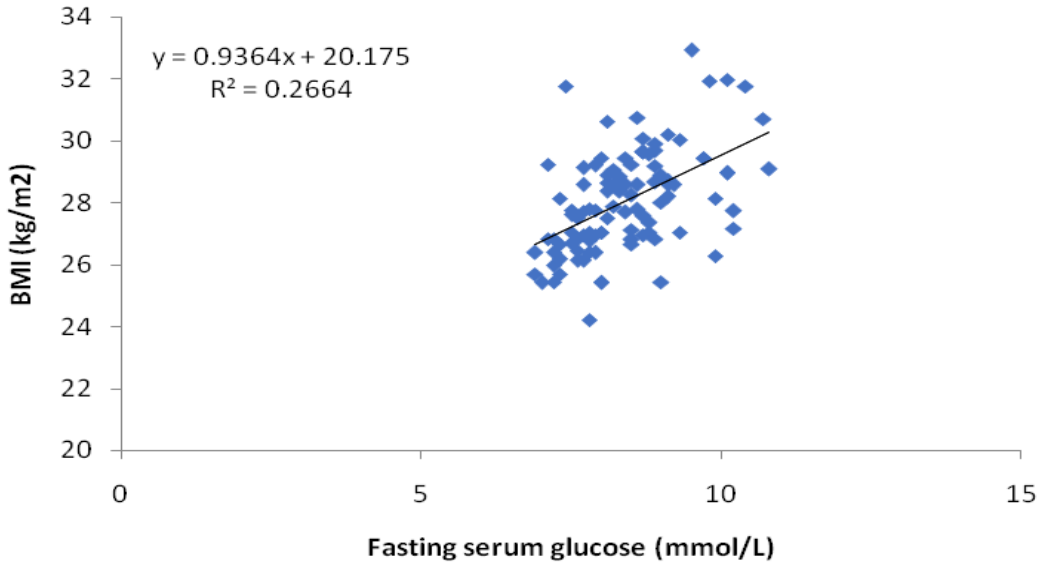

Figure 1: Scatter diagram showing positive correlation between fasting serum glucose and BMI

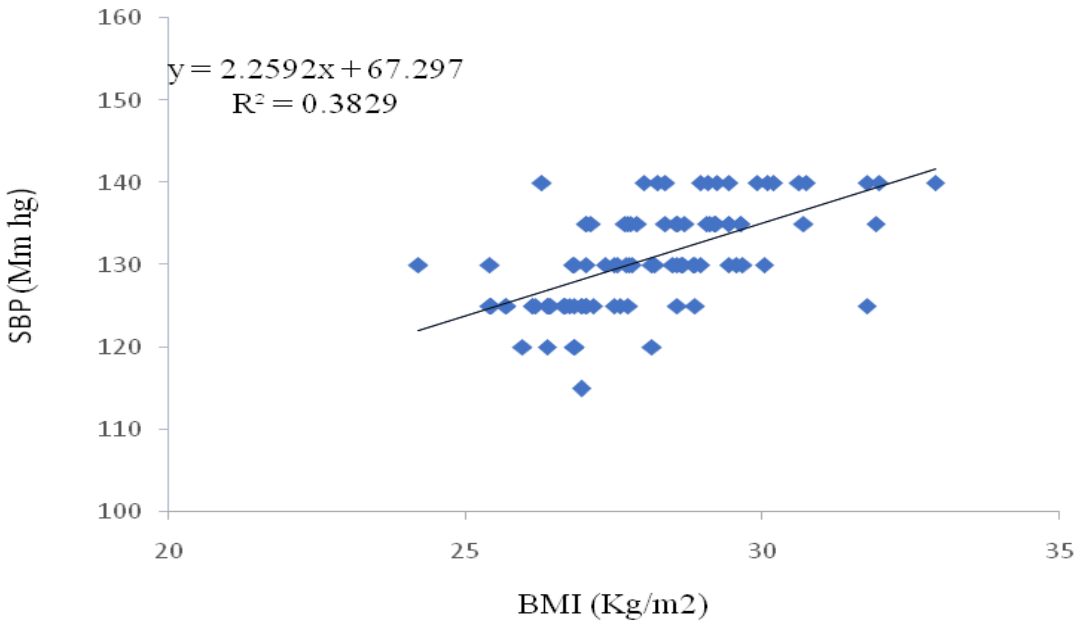

Figure 2: Scatter diagram showing positive correlation between fasting serum glucose and systolic blood pressure

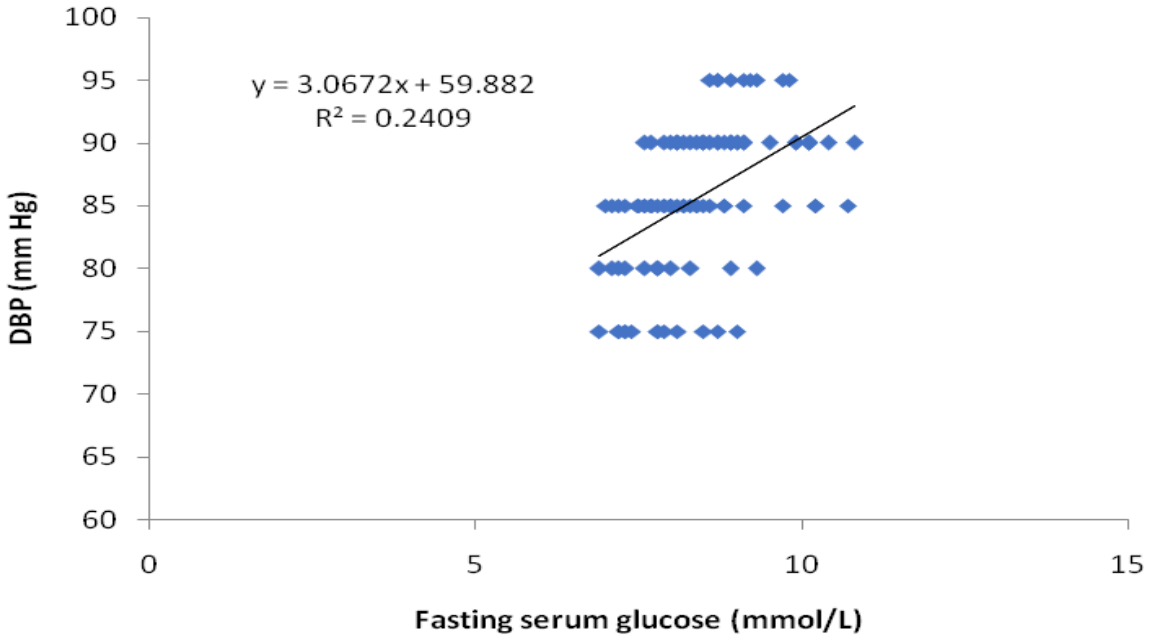

Figure 3: Scatter diagram showing positive correlation between fasting serum glucose and diastolic blood pressure

Discussion

The present study was carried out to assess the changes of body mass index, blood pressure, fasting serum glucose in female with type-2 diabetes and correlate them. In this study, the mean value of BMI was significantly increased in study group (Group II) in comparison to control group (Group I). A nationwide cohort study was conducted in Sweden to explore the association between BMI and type-2 diabetes mellitus. They claimed that a higher risk of type-2 diabetes in adolescents was linked to an increase in BMI[7]. In the United States, an extensive population was the subject of another case control study. They asserted a strong relationship between type-2 diabetes and BMI[8]. Adipose tissue hypertrophy is seen in obese individuals. Certain metabolites are released by adipose tissue, together with an excess of inflammatory cytokines. This results in cellular dysfunction and systemic inflammation. Damage to physiological and metabolic regulation, impaired insulin signaling and locally caused loss of β-cell function all take place. These ultimately lead to the occurrence of diabetes mellitus and hyperglycemia. Diabetes is also facilitated by hypoxia, fibrosis, and mitochondrial dysfunction in obese individuals[9]. There was significant increase in systolic and diastolic blood pressure in study group (Group II) in comparison to control group (Group I). Data from six Bangladeshi hospitals that specialize in diabetic care were gathered for a cross-sectional study. 67.2% of patients with type-2 diabetes mellitus among 1252 adults also had hypertension[10]. A prospective cohort study that included 318664 participants from the UK Biobank revealed a strong correlation between type-2 diabetes and hypertension[11]. Hyperglycemia, hyperinsulinemia, inflammation and oxidative stress development, along with dyslipidemia associated with type-2 diabetes, play a role in vascular remodeling.This ultimately results in peripheral vascular resistance and arterial stiffness, which impair blood pressure autoregulation[12]. Insulin resistance generates an improper activation of the Renin-Angiotensin-Aldosterone System.Renal salt and water retention results in hypertension[13].There was significant increase in fasting serum glucose in study group (Group II) in comparison to control group (Group I). In a study including 100 participants, Patel et al. discovered that the mean fasting blood glucose level in the group of diabetes patients was greater (167.06 ± 57.24 mg/dl) than in the group of healthy patients (78.94±16.70 mg/dl)[14]. In this study, significant positive correlation (r = 0.516) found between fasting serum glucose with BMI. A cross-sectional study with 210 participants who had type-2 diabetes mellitus was carried out by

Ridwanto et al. A favorable connection between BMI and fasting serum glucose has been observed (r = 0.141, P = 0.04)[15]. It is consistent with our study. Significant positive correlation was (r = 0.518) observed between fasting serum glucose with systolic blood pressure (r = 0.518) and diastolic blood pressure (r = 0.491). There was positive correlation between fasting serum glucose and blood pressure found in a report published by Kuwabara and Hisatome[16]. There was positive correlation between fasting serum glucose and blood pressure (systolic and diastolic) in a study by Ohara et al.[17].

Conclusion

This study shows that glycemic control, blood pressure, and BMI all significantly and adversely change when a person has insulin resistance in type-2 diabetes mellitus. Regular examination of these variables can aid in early diagnosis and prevention. Different steps like regular physical exercise, controlling body weight and blood pressure may help diabetic people to prevent serious health problems. This study is helpful for raising awareness about diabetes mellitus and its complications among the peoples.

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