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Original Research Article

The Role of Anthropometric Indicators in Assessing Metabolic Health among Type-2 Diabetic Patients

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Abstract:

Introduction: Type-2 diabetes mellitus (T2DM) is a chronic metabolic disorder that significantly increases the risk of cardiovascular diseases (CVD) through insulin resistance, hyperglycemia, and dyslipidemia. Anthropometric indicators, such as body mass index (BMI), waist circumference, and blood pressure, are commonly used to assess metabolic health and obesity-related risks in patients with T2DM. Leptin, an adipokine linked to fat mass and energy regulation, plays a crucial role in metabolic dysfunction and obesity-related complications in T2DM patients. This study investigates the role of anthropometric indicators in assessing metabolic health among male and female T2DM patients, focusing on the gender differences in these indicators and their associations with metabolic outcomes.

Materials and Methods: A total of 140 T2DM patients (90 males, 50 females), aged 60-70 years, were recruited. Anthropometric measurements, including BMI, waist circumference, and blood pressure, were recorded. Blood samples were analyzed for metabolic parameters, including fasting plasma glucose (FPG), insulin, cholesterol, triglycerides, and leptin. Insulin resistance was assessed using the homeostasis model assessment (HOMA). Statistical analyses were performed using SPSS, with significance set at $p < 0.05$.

Results: Significant gender differences were found in anthropometric indicators, with females exhibiting higher BMI and waist circumference compared to males ($p < 0.01$). Elevated BMI and waist circumference were associated with adverse metabolic outcomes, including higher FPG and LDL cholesterol. Females also had significantly higher leptin levels than males, further correlating with greater adiposity. Additionally, while females had higher HDL cholesterol, they also showed elevated LDL cholesterol, highlighting their increased cardiovascular risk.

Discussion: The study's findings emphasize the importance of anthropometric indicators in assessing metabolic health in T2DM patients. Gender differences in BMI, waist circumference, and leptin levels suggest that females with T2DM may face a higher metabolic risk than males. Despite females' higher HDL cholesterol levels, their increased adiposity and leptin resistance could offset the protective effects, leading to worsened metabolic outcomes. These results underscore the need for gender-specific strategies in managing metabolic health in T2DM.

Conclusion: Anthropometric indicators, particularly BMI and waist circumference, play a critical role in assessing metabolic health among T2DM patients. Gender-specific differences in these indicators highlight the need for tailored approaches in managing metabolic health and reducing CVD risk in T2DM patients. Further research is warranted to explore the mechanisms underlying leptin resistance and its impact on metabolic outcomes in T2DM.

Keywords : Anthropometric indicators in diabetes, BMI and Type-2 diabetes, Waist circumference and metabolic health, Leptin resistance in T2DM, Gender differences in diabetes, Insulin resistance in diabetes, Obesity and cardiovascular risk, Adipokines and metabolic dysfunction, Fasting plasma glucose, HOMA in T2DM, Blood pressure and diabetes, Dyslipidemia in T2DM, Triglycerides and LDL cholesterol, Gender-specific diabetes strategies.

Introduction

Type-2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance, hyperglycemia, and dyslipidemia, all of which increase the risk of cardiovascular disease (CVD) and other complications [1,2]. Anthropometric indicators such as body mass index

(BMI), waist circumference, and blood pressure are widely used to assess obesity and its related risks in patients with T2DM. These measures provide important insights into metabolic health, with studies showing significant associations between these indicators and insulin resistance, dyslipidemia, and hypertension [3,4].

Leptin, an adipokine secreted by adipose tissue, regulates appetite and energy expenditure. In individuals with T2DM, leptin levels are typically elevated, reflecting increased fat mass and the development of leptin resistance, which can exacerbate metabolic dysfunction [5]. The relationship between leptin and anthropometric indicators such as BMI and waist circumference has been well-established, particularly in the context of metabolic syndrome and its associated risks [6,7]. This study aims to explore the role of anthropometric indicators in assessing metabolic health in T2DM patients and how these indicators differ between males and females.

Materials and Methods

A total of 140 Type-2 diabetic patients (90 males and 50 females), aged 60 to 70 years, were recruited from a diabetes care center. Anthropometric measurements, including height, weight, BMI, waist circumference, and blood pressure, were recorded for all participants [8]. Blood samples were collected after a 12-hour fast to assess metabolic parameters, including fasting plasma glucose (FPG), insulin, total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglycerides. Insulin resistance was calculated using the homeostasis model assessment (HOMA) [9].

Data were analyzed using SPSS, with significance set at $p < 0.05$. Independent t-tests and one-way ANOVA were used to compare differences between groups.

Results

The anthropometric and metabolic characteristics of male and female Type-2 diabetic patients are presented in Tables 1 and 2. Females had significantly higher BMI and waist circumference compared to males, and these differences were associated with adverse metabolic outcomes. Serum leptin levels were elevated in both male and female Type-2 diabetic patients, with higher levels observed in females. The increase in leptin levels was correlated with increased BMI and waist circumference, further supporting the link between adiposity and metabolic dysregulation in these patients.

Table 1: Comparison of Anthropometric Parameters and Blood Pressure in Male and Female Type-2 Diabetic Patients

Parameter	Male Patients (n=90)	Female Patients (n=50)	p-value
BMI (kg/m²)	33.5 ± 4.47	39.4 ± 5.28	< 0.01
Waist Circumference (cm)	91.2 ± 9.11	98.4 ± 8.58	< 0.05
Systolic Blood Pressure (mmHg)	152.4 ± 2.33	158 ± 3.85	< 0.05
Diastolic Blood Pressure (mmHg)	118.2 ± 6.44	120 ± 4.29	0.21 (NS)

The results presented in **Table 1** indicate significant differences in anthropometric parameters and systolic blood pressure between male and female Type-2 diabetic patients. Females had a significantly higher **BMI** (39.4 ± 5.28 kg/m²) compared to males (33.5 ± 4.47 kg/m²), with a **p-value < 0.01**, highlighting a marked difference in body mass, likely contributing to greater adiposity in females. Additionally, females exhibited a larger **waist circumference** (98.4 ± 8.58 cm) compared to males (91.2 ± 9.11 cm), with a **p-value < 0.05**, suggesting a greater central fat distribution, which is associated with metabolic risk.

Regarding blood pressure, females had higher **systolic blood pressure** (158 ± 3.85 mmHg) compared to males (152.4 ± 2.33 mmHg), with a **p-value < 0.05**, indicating a significant difference in this cardiovascular risk factor between the two groups. However, the difference in **diastolic blood pressure** between females (120 ± 4.29 mmHg) and males (118.2 ± 6.44 mmHg) was not statistically significant, with a **p-value of 0.21 (NS)**, indicating that the observed difference in diastolic pressure is not meaningful.

Table 2: Comparison of Metabolic Parameters in Male and Female Type-2 Diabetic Patients

Parameter	Male Patients (n=90)	Female Patients (n=50)	p-value
FPG (mg/dL)	246.6 ± 63.0	257.4 ± 57.6	0.12
Cholesterol (mg/dL)	259.1 ± 46.4	262.0 ± 42.5	0.05
HDL (mg/dL)	23.2 ± 7.7	54.1 ± 11.6	< 0.01
Triglycerides (mg/dL)	257.0 ± 79.7	221.4 ± 70.9	0.15
LDL (mg/dL)	174.0 ± 38.7	185.6 ± 34.8	0.05

Insulin (µmol/L)	16.6 ± 4.3	14.3 ± 3.7	0.02
Leptin (ng/mL)	12.7 ± 3.1	13.5 ± 2.8	0.05

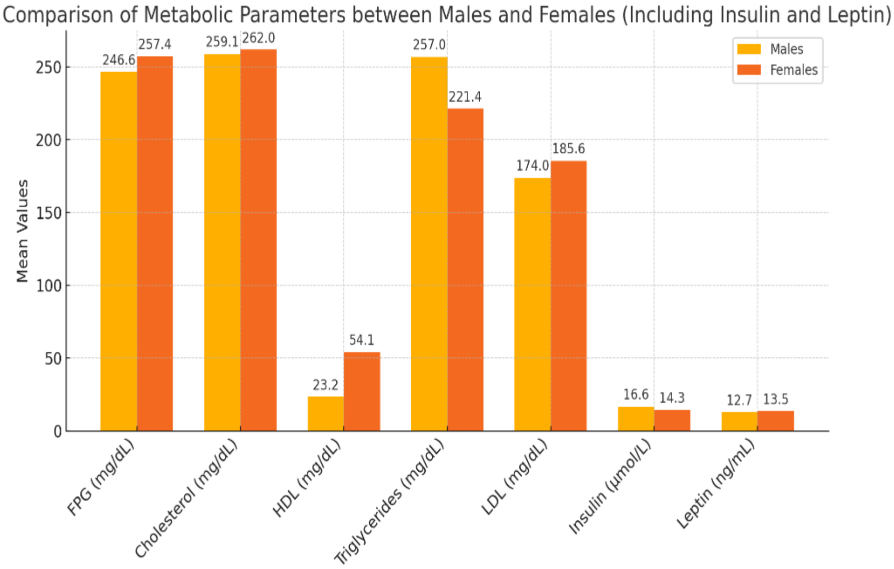

Figure 1 : Comparison of Metabolic Parameters between Males and Females

The metabolic parameters comparison shown in Table 2 and **Figure 1** reveals significant differences between male and female Type-2 diabetic patients. Females demonstrated elevated HDL cholesterol levels compared to males, which is typically associated with a protective effect against cardiovascular diseases, though this benefit might be diminished by their higher LDL cholesterol levels. Additionally, males had higher insulin levels, reflecting greater insulin resistance, which is a hallmark of Type-2 diabetes. Females also exhibited slightly higher leptin levels, reinforcing the link between increased adiposity and metabolic dysregulation. These findings, along with differences in triglycerides and fasting plasma glucose (FPG), highlight the importance of gender-specific considerations when assessing metabolic health in Type-2 diabetic patients.

Discussion

The results of this study demonstrate significant differences in the anthropometric and metabolic profiles of male and female Type-2 diabetic patients. Females exhibited significantly higher BMI and waist circumference, which were associated with adverse metabolic outcomes such as elevated fasting plasma glucose and LDL cholesterol. These findings align with previous research indicating that women with T2DM tend to have higher adiposity compared to men, which may contribute to their increased risk of cardiovascular complications [10,11].

The observed gender differences in HDL cholesterol levels were particularly notable, with females having higher HDL levels than males.

The graph in figure 1 highlights significant gender differences in metabolic parameters among Type-2 diabetic patients. Notably, females have higher HDL levels but lower triglycerides compared to males, suggesting a potential protective effect, although this is offset by higher LDL and overall cholesterol levels. Males exhibit higher insulin levels, reflecting greater insulin resistance, while females show slightly elevated leptin levels, which are associated with higher body fat mass. These differences emphasize the need for gender-specific strategies in managing metabolic health and addressing cardiovascular risk in Type-2 diabetes.

Leptin, a key regulator of energy balance and fat storage, was significantly elevated in female patients compared to males. This aligns with previous studies suggesting that leptin levels are strongly associated with body fat mass, especially in females, and play a role in the development of insulin resistance and metabolic syndrome [5,10,12]. Leptin resistance, common in patients with Type-2 diabetes, may further exacerbate metabolic dysfunction, particularly in those with higher BMI and waist circumference. This is consistent with other studies that suggest women typically have higher HDL cholesterol, which may offer some protective effect against cardiovascular disease [12,13]. However, despite higher HDL levels, the increased adiposity in females, as indicated by BMI and waist circumference, likely negates this protective effect and contributes to their overall metabolic risk.

Leptin plays a central role in regulating energy balance and body weight, and its levels are directly proportional to fat mass. Elevated leptin levels, particularly in females, have been associated with increased risk of metabolic syndrome and cardiovascular disease [14]. However, in patients with T2DM, leptin resistance may develop, diminishing its effectiveness in regulating appetite and energy expenditure [15]. The strong association between leptin levels, BMI, and waist circumference further underscores the importance of managing adiposity in T2DM patients to mitigate metabolic risk [16].

Conclusion

This study highlights the significant role of anthropometric indicators, particularly BMI and waist circumference, in assessing metabolic health among Type-2 diabetic patients. The gender differences observed in these indicators suggest that tailored strategies may be necessary for managing metabolic health in males and females with T2DM. Further research is needed to explore the underlying mechanisms linking anthropometric measures to metabolic outcomes, with a focus on the role of leptin resistance and its impact on metabolic health in T2DM patients.

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