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Original Research

Determination of Serum Adiponectin Levels in Type 2 Diabetes Patients of the Saudi Population in the Al-Jouf Region

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Abstract

Introduction: Type 2 diabetes mellitus (T2DM) is currently considered a worldwide and national health problem. Adiponectin is a hormone that is secreted by the adipose tissue and regulates glucose and lipid metabolism. This study aimed to determine the serum adiponectin levels in T2DM patients of the Al-Jouf region of Saudi Arabia. **Material and Methods:** We recruited 65 diabetes patients and 50 healthy control subjects. Serum levels of fasting blood glucose (FBG), total lipid profile levels, adiponectin, and insulin were measured in all subjects**. Results:** The comparison of biochemical parameters, including fasting glucose, insulin, T-cholesterol, and low-density lipoprotein (LDL), were significantly higher in patients than controls. The mean body mass index (BMI) and the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) index were significantly lower in controls compared to the T2DM cases. Considerably reduced serum adiponectin ($p < 0.01$) levels were observed in patients rather than controls. Further, a base comparison of the serum adiponectin demonstrated notably reduced adiponectin ($p < 0.01$) levels in females compared to males. **Conclusions:** Serum adiponectin levels were reduced in people with diabetes compared to controls. In comparison to males, females showed reduced adiponectin levels.

Keywords: Diabetes mellitus, insulin resistance, metabolic syndrome, adiponectin, Al-Jouf.

Introduction

Diabetes mellitus is a group of metabolic disorders characterized by hyperglycemia arising from insulin deficiency, insulin insufficiency, or both. Many factors contribute to the development of diabetes, ranging from autoimmune antibodies against the β cells of the pancreas, causing insulin deficiency to abnormalities related to defects that cause insulin resistance within cells [1]. Worldwide, diabetes mellitus is rapidly becoming more prevalent. Recent studies indicate that approximately 382 million people have diabetes, with an overall prevalence of 8.3%. Saudi Arabia has one of the highest levels of diabetes [2].

Insulin resistance, or type 2 diabetes, is not a single disease but rather a group of diseases; that is, it is a condition with different characteristics and pathophysiologies but identical symptoms and outcomes. Type 2 diabetes mellitus (T2DM) is a disorder with a combined etiology of insulin resistance and insulin deficiency [3]. Obesity is a common risk factor responsible for developing different metabolic syndromes, including T2DM [4, 5]. Obesity causes different metabolic abnormalities that result in an increased hepatic glucose output and decreased skeletal muscle, liver, and adipose tissue sensitivity to insulin - the main processes closely related to the pathogenesis of T2DM [6].

Adiponectin is a hormone similar to glycoprotein that is mainly produced by adipose tissues [7, 8]. This molecule is secreted into circulation in three main isoforms: low-molecular-weight (LMW), middle-molecular-weight (MMW), and high-molecular-weight (HMW) [7]. The most biologically active molecule of adiponectin in humans is the high-molecular-weight isoform.

Lower levels of this isoform mostly correlate with the occurrence of T2DM [9–11]. Adiponectin operates through three receptors: AdipoR1, AdipoR2, and T-cadherin. AdipoR1 is expressed at higher levels in muscular tissue, but AdipoR2 is expressed in the hepatocytes. Several studies mentioned the presence of AdipoR1 in different organs, including endothelial cells, cardiac muscle [12, 13], and pancreatic beta cells [14]. Obesity decreases adiponectin levels, resulting in insulin action resistance [15]. Various studies have observed a decrease in adiponectin levels in T2DM [16–18].

The objective of the present study was to determine the serum adiponectin levels in T2DM patients of the Al-Jouf region of Saudi Arabia.

Material and Methods

Ethical declaration

Ethical approval was received from the Local Committee of Bioethics (LCBE), Jouf University (Sakaka, Saudi Arabia). Informed consent to participate in the study was obtained from all patients and control subjects.

Study design and patients

A total of 65 unrelated Saudi diabetic patients in the Al-Jouf region participated in this research. Patients were selected from the King Abdul Aziz Specialist Hospital, Sakaka, Al-Jouf. The World Health Organization (WHO) criteria were used to diagnose all diabetic patients. Demographic data were collected for all participants using a questionnaire that included questions about weight, height, family history of diabetes, and insulin intake. Body mass index (BMI) was calculated by dividing the body weight by height squared (kg/m2). BMI values of 25–30 kg/m2 were considered overweight, and values above 30 kg/m2 were considered obese [19]. For control subjects, 50 healthy individuals participated in this research. All control subjects had no diabetic family history, no history of taking insulin, and healthy BMIs.

Collection of samples

Venous blood was collected from all subjects after an overnight fast of at least ten hours in an aseptic environment using a sterile yellow cap tube containing gel for serum separation. Serum was separated through centrifugation of clotted blood at 4,000 rpm for 10 minutes within three hours of blood collection and used for the estimation of adiponectin and insulin levels, as well as other research requirements.

Research investigations

1. The GOD–PAP method was used for the estimation of fasting blood glucose (FBG).
2. Fasting insulin was measured by enzyme-linked immunosorbent assay (ELISA) using a Bioassay Technology Laboratory kit (Shanghai, China).
3. Insulin resistance was calculated by the Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) using the following formula: HOMA index = (fasting insulin (μU/ml) x fasting plasma glucose (mg/dl)/405 [20].
4. Plasma adiponectin levels were measured by ELISA using a Bioassay Technology Laboratory kit (Shanghai, China).
5. Total lipid profile levels:
   a. Total cholesterol and triglycerides levels were estimated using the CHOD–PAP and GPO–PAP methods, respectively.

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b. High-density lipoprotein (HDL) was measured using the direct homogenous enzymatic colorimetric method, whereas low-density lipoprotein (LDL) was determined by the Friedewald formula [21].

6. LDL = total cholesterol – (HDL + TG/5)

Statistical analysis

Results were entered and analyzed statistically using the GraphPad Prism software. An independent t-test was conducted to compare the mean ± SEM of the control and patient groups; a p-value ≤ 0.05 was considered statistically significant.

Results

A total of 115 subjects, including 65 diabetic patients and 50 healthy controls, was investigated in this study. Of the total participants, 47.8% were female, and 52.2% were male (Table 1). The mean age for T2DM cases was 50.83 ± 1.16, while the mean age for the controls was 42.73 ± 0.5354.

Different anthropometric and biochemical parameters were compared between the groups (Table 2). The mean BMI was lower in the controls (23.82 ± 0.6385) than in the T2DM cases (31 ± 0.8469), which was statistically significant (p < 0.01). The HOMA-IR was observed to be significantly higher in T2FM patients than in the controls (p < 0.0001).

Biochemical parameters, including fasting glucose, insulin, and lipid profiles, were significantly higher in the T2DM cases compared to the controls. The means for fasting glucose in patients and controls were 189.9 ± 7.694 and 89.9 ± 1.871, respectively (p < 0.0001). The mean insulin levels were found to be greater in T2DM patients (19.8 ± 2.343) compared to the control groups (10.23 ± 0.937). However, serum triglyceride and serum HDL-cholesterol were not significantly different between the two groups (p > 0.05).

The adiponectin serum levels had a mean of 4.837 ± 0.321 and 7.336 ± 1.081 in T2DM cases and controls, respectively. Significantly reduced serum adiponectin (p < 0.01) was observed in T2DM patients as opposed to controls (Figure 1). Further, a base comparison of serum adiponectin demonstrated that adiponectin (p < 0.01) was significantly reduced in females rather than males.

Table 1: Distribution of study groups according to gender.

Gender	Groups		Total N (%)
	Controls N (%)	T2DM cases N (%)	
Males	30 (60)	30 (46)	60 (52.2)
Females	20 (40)	35 (54)	55 (47.8)
Total	50 (100)	65 (100)	115 (100)

Table 2: Comparison of descriptive variables between T2DM cases and healthy controls.

Parameters (mg/dl)	Controls	T2DM patients	P-value
Age (years)	42.73 ± 0.5354	50.83 ± 1.16	< 0. 01*
BMI (kg/m²)	23.82 ± 0.6385	31 ± 0.8469	0.0024**
FBG (mg/dl)	89.9 ± 1.871	189.9 ± 7.694	< 0.0001 ****
Insulin (µIU/ml)	10.23 ± 0.937	19.8 ± 2.343	< 0.0001****
HOMA-IR index	2.408 ± 0.246	8.534 ± 1.083	< 0.0001 ****
TG (mg/dl)	139 ± 7.603	180.9 ± 13.59	0.0768
T-cholesterol (mg/dl)	145.5 ± 3.904	179.7 ± 9.272	0.0319*
HDL (mg/dl)	45.13 ± 1.158	46.04 ± 2.141	0.7980
LDL (mg/dl)	72.53 ± 4.287	115.6 ± 7.458	0.0004***

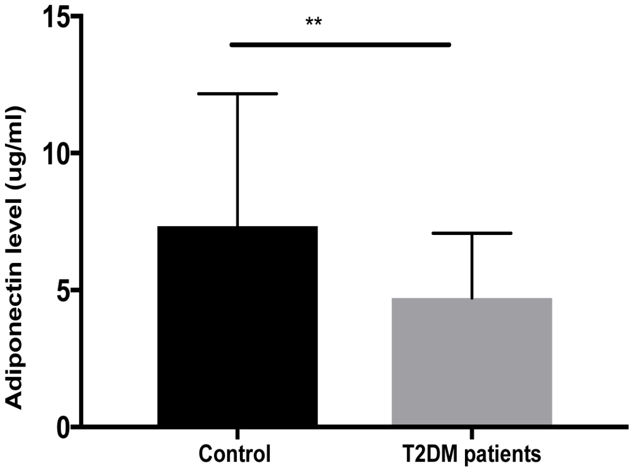

Figure 1: Serum adiponectin levels in T2DM cases and controls.

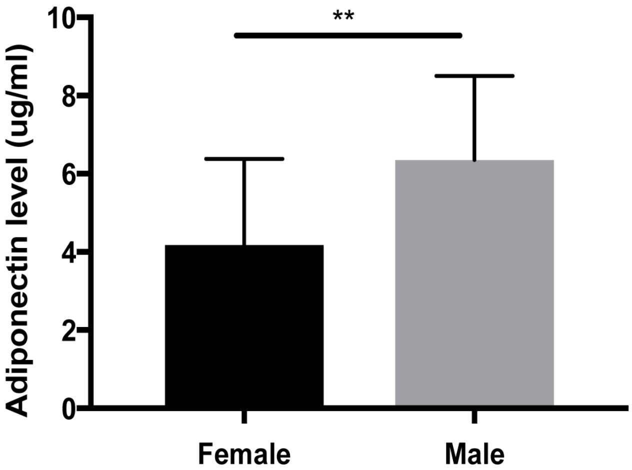

Figure 2: Comparison of serum adiponectin levels in females and males with T2DM.

The mean serum adiponectin was 6.355 ± 0.595 in males and 4.179 ± 0.343 in females (Figure 2).

Discussion

T2DM is the most prevalent form of diabetes mellitus and causes enormous health and economic consequences [22]. Reliable diagnostic tests for T2DM include the FBG test, the oral glucose tolerance test, and the glycated hemoglobin. However, there remain limitations in the use of these tools for the diagnosis of T2DM. Therefore, additional diagnostic biomarkers of T2DM are being explored. Adipocytokines regulate the sensitivity of peripheral tissues to insulin, glucose, and lipid metabolism; they modulate appetite, angiogenesis, blood pressure, energy expenditure, homeostasis, the axis of endocrine, and the reproductive systems [23]. Some studies documented the role of adiponectin in the pathophysiology of T2DM and metabolic syndrome [24].

In the present study, the levels of serum adiponectin were lower in the T2DM cases than in the healthy controls. The results of our study are comparable to those of previous studies in which reduced adiponectin levels were demonstrated to be independent of age, gender and BMI in T2DM patients [25–28]. Conversely, some studies describe high adiponectin concentrations in T2DM participants [29]. The major factor contributing to this difference is the underlying insulin resistance in type 2 diabetic patients [28, 30]. Insulin is the hormone that mediates the secretion of proteins, including adiponectin, from the adipose tissue and this adiponectin provokes the sensitivity of insulin [31].

In our study, BMI and HOMA-IR were determined and differed significantly between the controls and the T2DM cases. The HOMA-IR was higher in people with diabetes, establishing the development of insulin resistance. Previous studies have reported low adiponectin concentrations to be associated with the risk of obesity [28]. A negative correlation between BMI and adiponectin levels has also been established [25, 32, 33]. The essential role of adiponectin is to act as a hypoglycemic and antidiabetic agent [31]. Therefore, the reduced adiponectin levels in T2DM might enhance the development of insulin resistance and pancreatic dysfunctions [28]. However, the relationship between decreased adiponectin concentration and the effect of insulin resistance remains unclear.

Our results showed that the mean adiponectin levels were significantly lower in diabetic females than males. These results are comparable to those of previous studies reporting reduced adiponectin levels in diabetic females as opposed to males [34]. However, some studies documented no change in adiponectin concentrations in diabetic subjects [28].

In the present study, lipid profile tests, including total cholesterol and LDL cholesterol, were significantly higher in people with diabetes than in non-diabetics, while the presence of

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serum triglyceride and serum HDL-cholesterol was found to be non-significant between the groups. Previous research supports the results of the current study [28]. The association between T2DM and dyslipidemia has been well documented [35]. However, the previous research has presented variable correlations between serum adiponectin and lipid profiles. Mostly, there is an inverse relationship between triglyceride and adiponectin [36, 37]. Some studies have demonstrated the correlation of reduced adiponectin with lower HDL and raised LDL cholesterol [37, 38]. Recently, a study from India revealed that a low adiponectin level is correlated with dyslipidemia [25].

Conclusion

Anthropometric and biochemical profiles are significantly associated with the risk of T2DM. Serum adiponectin levels were reduced in diabetics as opposed to controls. In females, rather than males, reduced adiponectin was associated. It is suggested that variable concentrations of adiponectin can lead to an increased risk of obesity, T2DM, insulin resistance, and metabolic syndrome. Further, the development of adipocytokines as biomarkers may be helpful in managing the risks of metabolic syndrome complications.

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Conflict of Interest

The authors declare no conflict of interest.

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