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Investigate the Levels of Certain Adipokines in Patients with Diabetes in Kirkuk- Iraq

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ABSTRACT

Background: High blood sugar levels over an extended period are the primary sign of diabetes mellitus (DM), a metabolic disorder that falls under this class. It can be classified as one of the world's major diseases because it affects a large population and comes in two primary varieties: Type I and Type II. **Objectives:** The current study's goal is to assess many adipokines in patients with diabetes mellitus, including resistine, leptin, adiponectin and Apelin. **Material and Methods:** 50 patients (31 males and 19 females), age range (35-69) years (mean± SD) (49.7±13.1) years were enrolled in this study. All were consecutively admitted to the clinic at Azadi Teaching Hospital from January to March 2024. All patients had Type 2 Diabetes Mellitus (T2DM) as diagnosed by the physician. This study also included 25 healthy volunteers as a control group. **Results:** The current outcomes show that the concentration of Adiponectin demonstrated a significant ($P < 0.05$) reduction in Diabetes Mellitus patients compared with healthy subjects. Also, the findings showed that, compared to healthy people, the Apelin concentration in DM patients was significantly ($P < 0.05$) higher. Compared to healthy volunteers, the leptin levels in Diabetes Mellitus patients were significantly ($P < 0.05$) higher. Compared to healthy volunteers, the resistin concentration in DM patients showed a significant ($P < 0.05$) increase. **Conclusion:** In conclusion, the recent study found that leptin, resistin, and apelin levels were significantly increased in patients with DM compared to healthy people. However, adiponectin level was decreased.

INTRODUCTION

Diabetes Mellitus (DM) is a collection of metabolic disorders characterized by elevated blood glucose levels (hyperglycemia) due to insufficient or absent insulin secretion from the pancreatic β-cell, or weakness in both, or a genetically induced defect in insulin receptors (Hussein K. M 2020 and Kim BY.*et al.,*2021). Diabetes is a prevalent condition in which 44.3% of persons over 30 have prediabetes, defined as reduced fasting glucose or 5.7% to 6.4% glycosylated hemoglobin (HbA1c) values (Bae JH.*et al.,*2012 and Jong H.*et al.,* 2023). Hyperglycemia, a condition associated with altered insulin and glucose metabolism, is a feature of type 2 diabetes mellitus (T2D) (Punthakee.*et al.,* 2018).

It is the most common kind of diabetes, accounting for 85% of cases (Khan, *et al.,* 2019). Approximately 462 million people worldwide or nearly 6.3% of the total population struggle with T2D, and by 2025, that number could rise to 600 million (Lin *et al.,* 1990). Major complications of diabetes include microvascular complications like neuropathy and nephropathy. It has been suggested that vascular risk profiles, including anthropometric parameters, lipid profiles, and hormones derived from adipose tissue (specifically, adiponectin and leptin) all influence the development of these complications (Blüher M. .2013). Adiponectin is thought to have a role in the prevention of atherosclerosis and regulates glucose and lipid metabolism (Zhang P.*et al.,* 2009 and Li F. *et.al.,*2011). Synthesized by adipocytes, adiponectin is a novel protein that resembles collagen and acts as a hormone with anti-inflammatory and insulin-sensitizing properties. By inhibiting hepatic gluconeogenesis, promoting fatty acid oxidation in the liver, and boosting skeletal muscle glucose absorption, it lowers the risk of type 2 diabetes (Hassan A. J.2015). White adipose tissue produces the peptide hormone apelin, which is expressed in the kidney, liver, heart, lung, and adrenal glands (Humesh M. J.*et al.,.*2018). Apelin has been identified as a diabetic nephropathy biomarker by recent studies. Research has demonstrated apelin's importance as an adipokine in diabetes. It has a biomarker and a possible therapeutic target (Jwameer R. *et.al.,*2023). The human obesity (Ob) gene produces the 166 amino acid protein known as leptin. Adipose tissue is the primary producer of leptin (Arslan N.*et al.,*2010). There have been reports of leptin's effects on hematopoiesis, the immune system, reproduction, angiogenesis, bone formation, and wound healing, among other systems. Children who are obese have higher serum levels of leptin, and during the weight loss phase, leptin levels fall (Antunes H. *at al.,* 2008). Adipocytes release the cysteine-rich peptide resistin, which is circulated throughout the body (Maire E.*et al.,* 2003). It is a member of the resistin-like molecule protein family, which is likely implicated in the inflammatory process. However, research conducted in mouse models have demonstrated that resistin suppresses adipogenesis, reduces glucose tolerance, and interferes with insulin action (Rother KI.2007). The current study therefore sought to evaluate several adipokines (adiponectin, apelin, leptin, and resistin) in patients with diabetes mellitus.

50 patients (31 males and 19 females), age range (35-69) years (mean± SD) (49.7±13.1) years were enrolled in this study. All were consecutively admitted to the clinic at Azadi teaching hospital at January to March 2024. All patients had Type 2 Diabetes Mellitus (T2DM) as diagnosed by the physician, in addition this study including 25 healthy volunteers as control group.

Blood Collection:

Five milliliters (ml) of venous blood were drawn, and after being separated by centrifugation at 300 rpm for fifteen minutes, the blood was removed using disposable plastic syringes. Before being analyzed, the separated sera were kept frozen at -20 C^0.

Measurements:

- **Adiponectin**: ELISA kits from United States Biological Company (My biosource, USA) were used to quantify adiponectin.
- **Apelin**: The enzyme linked immunosorbent test (My Biosource, USA) was utilized to quantify serum apelin.
- **Leptin**: using the Leptin (sandwich) Enzyme Immunoassay Kit to measure leptin in serum. The sole purpose of this assay is in vitro diagnostic usage. The sandwich principle serves as the foundation for this solid phase enzyme-linked immunosorbent test (ELISA).
- **Resistin**: By using an enzyme-linked immunosorbent test, serum resistin was quantified. (ELISA, Assay for Sandwich). The enzymatic colorimetric approach was utilized to quantitatively determine the amount of glucose.

Statistical Analysis:

Every date of information was sorted and totaled as a percentage and number. The student t-test was used to examine the significance of the difference between the mean values of any two groups that were selected; a *P*-value of less than 0.05 was deemed statistically significant. The link between the various parameters under study is described using the Pearson correlation coefficient (R) test, with a significance level of P<0.05 being statistically significant.

RESULTS AND DISCUSSION

Table (1), show the concentrations of some adipokines in T2DM patients and healthy subjects, where Adiponectin concentration in serum of T2DM patients demonstrated significant (P <0.05) decrease in (3.81 ± 0.37) compared with control group (9.57± 0.62) shows in Figure (1). Concentration of Apelin demonstrated significant (P <0.05) increase in T2DM patients (374.19 ± 42.26) compared with control group (86.05± 13.66) as shown in Figure (2). Figure (3) shows the concentration of Leptin demonstrated significant (P <0.05) increase in T2DM patients (24.43 ± 3.51) compared with control group (4.62 ± 0.35). Resistin concentration in serum of T2DM patients demonstrated significant (P <0.05) increase in (18.42 ± 2.93) compared with control group (6.71 ± 0.53) as shown in Figure (4).

Table 1: The concentrations of some Adipokines in studied groups.

Groups / Parameter	Control (25)	Patients (50)	P-Value
Adiponectin (µg/ml)	9.57± 0.62	3.81 ± 0.37*	0.0002
Apelin (pg/ml)	86.05± 13.66	374.19 ± 42.26*	0.032
Leptin (ng/ml)	4.62 ± 0.35	24.43 ± 3.51*	0.0001
Resistin (ng/dl)	6.71 ± 0.53	18.42 ± 2.93*	0.0001

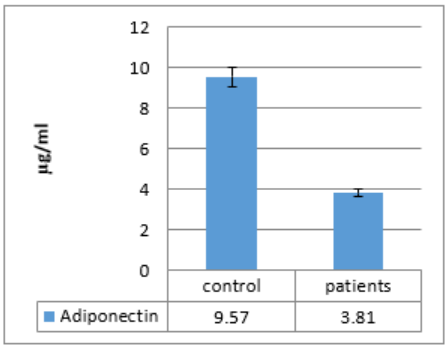

Fig.1: Adiponectin levels in patients and control.

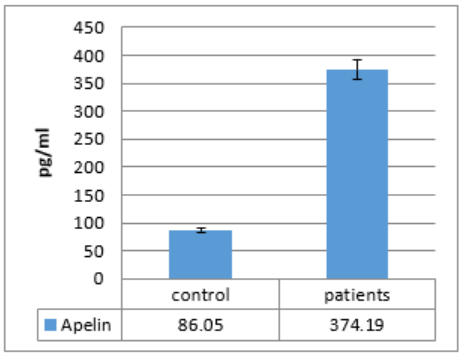

Fig.2: Apelin levels in patients and control.

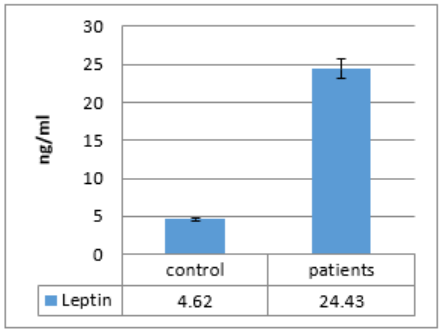

Fig.3: leptin levels in patients and control.

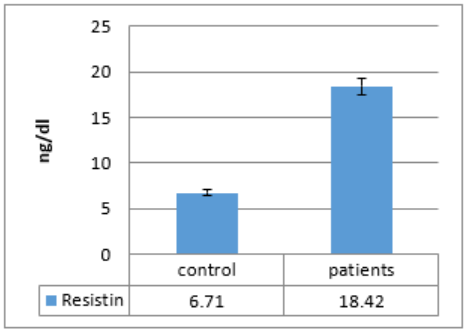

Fig.4: Resistin levels in patients and control.

Lower levels of adiponectin and leptin are associated with obesity and type 2 diabetes, and they modulate the action of insulin by enhancing peripheral insulin sensitivity in an inverse relationship to insulin resistance (Blüher M.2013). The results of the present investigation demonstrated a substantial difference in the serum adiponectin levels between the patient and control group. Adiponectin is a hormone released by adipocytes that plays a role in the homeostatic regulation of lipid and glucose levels. Adiponectin levels are known decreased in people with type 2 diabetes (Manal F.E. *et al.,* 2012) Due to the antiatherogenic and anti-inflammatory qualities of adiponectin, hypo-adiponectenemia has numerous detrimental clinical effects (Dunajska K. *et al.,* 2004). According to (Al-Zubadi *et al.* 2013) adiponectin may play a significant role in the pathophysiology of CVD in people with T2DM of both genders (Al-Zubaidi.*et.al.,* 2013). Adiponectin's anti-inflammatory properties make it a preventative agent against atherogenic vascular change, which is linked to the development of atherosclerosis and low concentrations of the protein (Yuji M. *et al.,*2007 and Amir E. *et al.,*2010). On the other hand, Adiponectin levels in Type 2 DM patients appear to be more closely linked to obesity and less so to diabetes, according to a recent finding (Bahceci M. *et al.,*2007). The majority of Type 2 DM patients included in those investigations was on average, and obese. A recent study compares basal adipokines and inflammatory markers between obese and non-obese type 2 diabetes patients versus non-obese, normoglycemic controls in order to distinguish the effects of obesity and type 2 diabetes on the altered plasma adipokine and/or inflammatory profiles. The results of the study indicate that rather than the actual existence of type 2 diabetes, the observed changes in these parameters in obese type 2 diabetes patients, as opposed to non-obese Type 2 DM, are probably caused by their increased adipose tissue mass (Neuparth MJ. *et al.,* 2013 and Hansen D. *et al.,*2010). In comparison to healthy controls, T2DM patients had a considerably greater amount of apelin. Apart from its significant function in controlling glucose metabolism, apelin is also expressed in the kidney's glomeruli, tubules, and collecting ducts. It is believed to be involved in the control of glomerular filtration rate and renal blood flow, both of which are essential for preserving kidney function. Similar research revealed a considerably higher apelin level in type 2 diabetes complications (El-Kafrawy. *et al.,* 2018 and Helmy.*et al.,* 2021). Our findings are in line with earlier research, which found that while serum adiponectin levels were lower in diabetics than in non-diabetics (Zaletel J.*et al.,*2010), serum leptin levels were higher in diabetics (Hall JI. *et al.,*2011 and Baratta R.*et al.,*2004). These findings, combined with the rise in insulin resistance, imply that serum leptin can function as a measure of insulin resistance and, in clinical settings, is a useful metric for evaluating the efficacy of antidiabetic medication (Lilja M. *et al.,*2012). The data that suggests insulin may directly affect the expression of the genes encoding leptin and adiponectin as well as their concentrations in vitro (Tsai M. *et al.,*2012) explains the rise in leptin and fall in adiponectin levels in our T2DM patients. This is because an imbalance in the levels of these adipokines may result from a high insulin level combined with insulin resistance. In this study, we examined the plasma resistin levels in people with type 2 diabetes and healthy people. When compared to healthy persons, it revealed that diabetics had significantly higher plasma resistin levels. These results are consistent with another research (Gharibeh MY. *et al.,*2010 and Chanchay S. *et al.,*2006). That links resistin to diabetes and the degree of obesity. However, some researchers have not discovered this correlation (Mohammad.G. *et al.,* 2008 and Sinorita H. *et al.,*2010).

Conclusions

Finally, a recent study discovered that patients with diabetes had much higher levels of leptin, resistin, and apelin than

healthy people. However, adiponectin levels were reduced. Adiponectin is a hormone released by adipocytes that plays a role in the homeostatic regulation of lipid and glucose levels. Adiponectin levels are known decreased in people with type 2 diabetes.

Declarations:

Ethical Approval: The research was limited to in vitro laboratory studies, and informed consent was obtained from the laboratory department of Azadi Teaching Hospital, as well as verbal consent was obtained from each study participants.

Informed Consent: Not applicable.

Competing interests: The author declares no conflict of interest of any kind

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REFERENCES

Al-Zubaidi H. A., Abdul hussien M.K. Al-Jebory. (2013), "Serum level of adiponectin as a risk marker for cardiovascular and type 2 diabetes patients". *Medical Journal of Babylon,* 10 (2):517-529.

Amir E., Amira S., Tarek A.G., Marwan A. (2010), "Association between low adiponectin level and cardiovascular complications in diabetic and non-diabetic patients with end stage renal disease". *Arab Journal of Nephrology and Transplanation,* 3:15-21.

Antunes H., Santos .C, Carvalho S. 2008; Serum leptin levels in overweight children and adolescents. *British journal of nutrition*. 28:1-5.

Arslan N., Erdur B., and Aydin A (2010). Hormones and cytokines in childhood obesity. *Indian Pediatrics*. 47(17): 829-839.

Bae JH, Han KD, Ko SH, Yang YS, Choi JH, Choi KM, et al. Diabetes fact sheet in Korea 2021. *Diabetes Metabolism Journal,* 46: 417-26.

Bahceci M, Gokalp D, Bahceci S, Tuzcu A, Atmaca S, Arikan S: (2007).The correlation between adiposity and adiponectin, tumor necrosis factor alpha, interleukin-6 and high-sensitivity c-reactive protein levels. Is adipocyte size associated with inflammation in adults? *Journal Endocrinol Investigation,* 30:210–214.

Baratta R., Amato S., Degano C., Farina MG., Patane G., Vigneri R., Frittitta L (2004). Adiponectin Relationship with Lipid Metabolism Is Independent of Body Fat Mass: Evidence from Both Cross-Sectional and Intervention Studies. *Journal Clinical Endocrinol Metabolism.* 89(6): 2665– 2671.

Blüher M (2013). Importance of adipokines in glucose homeostasis. *Diabetes Management,*3: 389- 400.

Chanchay S, Tungtrongchitr R, Hamroongroj T, Phonrat B, Rungseesakorn O, Paksanont S, *et al.* (2006); Plasma resistin, insulin concentration in non-diabetic and diabetic, overweight/ obese Thai. *International journal for vitamin and nutrition research,* 76(3):125–31.

Dunajska K., Milewicz A., Jedzejuk D., Szymczak J. *et al.* (2004), "Plasma adiponectin concentration in relation to severity of coronary atherosclerosis and cardiovascular risk factors in middle-aged men". *Endocrine,* 25:215-221.

El-Kafrawy, N.A.; Abo El-Hassan, M.H.; Nouh, M.Z.; Korany, M.A.; (2018). "Evaluation of Apelin Level in Type 2 Diabetic Patients with Peripheral Neuropathy and Nephropathy"; *Medical Journal Cairo University,* 86 (9): 2303–2309,

Gharibeh MY, Al Tawallbeh GM, Abboud

MM, Radaideh A, Alhader AA, Khabour OF. (2010). Correlation of plasma resistin with obesity and insulin resistance in type 2 diabetic patients. *Diabetes Metabolism,* 36:443–9.

Hall JI., Vora N., Langworthy R., Stock S., Momin A., Sherwood RA., le Roux CW., Alaghband-Zadeh J. 2011; Leptin/adiponectin ratio in patients with coronary heart disease: comparing subjects with and without metabolic syndrome. *Annals Clinical Biochemstry.* 48(4): 327–331.

Hansen D, Dendale P, Beelen M, Jonkers RAM, Mullens A, Corluy L, Meeusen R, van Loon LJC: 2010, Plasma adipokine and inflammatory marker concentrations are altered in obese, as opposed to nonobese, type 2 diabetes patients. *Europian Journal Apply Physiology,* 109:397–404.

Hassan A. J. 2015, Study the Relationship of IL-33 with Adiponectin in Postmenopausal Female with and without Type 2 Diabetes Mellitus. *Medical Journal of Babylon,* 12(3): 618-624.

Helmy, M.; Hamdy, N.; El-Ghaffar, N.; 2021. "Connection Between the Plasma Level of Apelin and Diabetic Nephropathy in Type 2 Diabetic Patients. A Case Control Study". *Indian Journal Endocrinol Metabolism,* 25 (5): 418–426,

Humesh M. J., AbduL-Monaim H.M., Zainab A.L. 2018, Apelin Levels and its Relationship with a Number of Electrolytes in Patients with Myocardial Infarction. *Tikrit Journal of Pure Science.,* 23(3): 16-22.

Hussein K. M. 2020, CLEC4E is A New Biochemical Tool for Evaluation the Progression of Nephropathy Complications of Type 2 Diabetes Mellitus. *Journal KUFA FOR Chemical Science,* 2(6): 166-171.

Jong H. C, Kyung A., Joon H., *et al.* 2023. Clinical Practice Guidelines for Diabetes Mellitus of the Korean Diabetes Association. *Diabetes Metabolism Journal,* 47:575-594.

Jwameer R., Alaa H. J., Amamer R., Salam M. 2023, Assessment of Serum Apelin Level in Iraqi Type 2 Diabetic Nephropathy Patients. *Al-Nahrain Journal Science.,* 26(3): 18-23

Khan, M.A.B.; Hashim, M.J.; King, J.K.; Govender, R.D.; Mustafa, H.; Al Kaabi, J. 2019, Epidemiology of Type 2 Diabetes Global Burden of Disease and Forecasted Trends. *Journal of Epidemiology and Global Health,* 10(1):107-111.

Kim BY, Kang SM, Kang JH, Kang SY, Kim KK, Kim KB, *et al.* 2020. Korean Society for the Study of Obesity guidelines for the management of obesity in Korea. *Journal of Obesity & Metabolic Syndrome,*; 30(2):81–92.

Li F, Zhao T, Wen X (2011). Changes in serum adiponectin concentrations and endothelial function after intensive insulin treatment in people with newly diagnosed type 2 diabetes: A pilot study. *Diabetes research and clinical practice*,94:186-92.

Lilja M., Rolandsson O., Norberg M., Soderberg S. 2012; The impact of leptin and adiponectin on incident type 2 diabetes is modified by sex and insulin resistance. *Metabolic syndrome and related disorders,* 10(2):143–151.

Lin, X.; Xu, Y.; Pan, X.; Xu, J.; Ding, Y.; Sun, X.; Song, X.; Ren, Y.; Shan, P.-F. 2020, Global, Regional, and National Burden and Trend of Diabetes in 195 Countries and Territories: An Analysis from 1990 to 2025. *Science report.* 10(1):14790. doi: 10.1038/ s41598-020-71908-9.

Maire E. And Josephine M.: 2003; Pharmacological Agents that Directly Modulate Insulin Secretion. *Pharmacological reviews,* 55: 105-131.

Manal F.E., Samar M.S., Marwa M. E., Nahed E. 2012, "Adiponectin: an

adipocytesderived hormone and its gene encoding in children with chronic kidney disease". *BMC Research Notes,* 5 article number,174.

Mohammad zadeh G, Zarghami N, Mobaseri M. (2008); Serum resistin concentration in obese diabetic patients: Any possible relation to insulin resistin indices? *International Journal of Endocrinol Metabolism*, 6(4):183–93.

Neuparth MJ, Proença JB, Santos-Silva A, Coimbra S: 2013, Adipokines, oxidized low- density lipoprotein, and C-reactive protein levels in lean, overweight, and obese Portuguese patients with type 2 diabetes. *Obesity,* 2013, Article ID 142097.

Punthakee, Z.; Goldenberg, R.; Katz, P. 2018, Definition, Classification and Diagnosis of Diabetes, Prediabetes and Metabolic Syndrome. *Canadian Journal of Diabetes,* 42 Suppl 1: S10-S15.doi: 10.1016/j.jcjd.2017.10.003.

Rother KI: 2007: Diabetes treatment-bridging the divide. *New England journal of medicine*, 356(15): 1499-501.doi: 10.1056/NEJMp078030.

Sinorita H, Asdie RH, Pramono RB, Purnama LB, Asdie AH. (2010). Leptin, Adiponectin and Resistin Concentration in Obesity Class 1 and 2 at Sardjito Hospital Yogyakarta. *Acta Medica Indonesiana*,42(2):74–7.

Tsai M., Asakawa A., Amitani H., Inui A. 2012; Stimulation of leptin secretion by insulin. *Indian Journal of Endocrinology and Metabolism.* 16(3): S543- S548.

Yuji M., Tohtu F., Shinji K., Iichiro S. , (2007), "Adiponectin and metabolic syndrome". *Arteriosclerosis, thrombosis, and vascular biology,* 27:1267-82.

Zaletel J., Barlovic DP., Prezelj J. 2010; Adiponectin-leptin ratio: A useful estimate of insulin resistance in patients with Type 2 diabetes. *Journal of Endocrinol Investigation*. 33(8): 514-851.

Zhang P, Wang Y, Fan Y, Tang Z, Wang N (2009). Overexpression of adiponectin receptors potentiates the antiinflammatory action of sub effective dose of globular adiponectin in vascular endothelial cells. *Arteriosclerosis, thrombosis, and vascular biology,* 29(1): 67-74.

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