Egypt. J. Chem. **Vol.66,** No. 8, pp. 347 - 355 (2023)

Egyptian Journal of Chemistry

http://ejchem.journals.ekb.eg/

Biochemical study of Visfatin Hormone and Some Biochemical Parameters in The Serum of Obese Patients in Nineveh Governorate

Zubaida Khaddar Elias, Lelas Farhan Bdaiwi

Department of Chemistry, College of Education for Girls, University of Mosul, Iraq

Abstract:

In this study, there are 117 cases divided into 93 cases of obese patients and 24 healthy cases that collected from AL Salam Teaching Hospital in Mosul city. An estimation of some biochemical parameters such as Visfatin hormone, total cholesterol, triglycerides, high density lipoprotein (HDL), very low density lipoprotein (VLDL), low density lipoprotein (LDL), potassium, chloride, lactate dehydrogenase (LDH) and Aspartate Amino Transferase (AST), body mass index (BMI) in serum of all cases has been done. Cases are divided into 4 groups, Group 1: obesity without disease (n=64), group 2: obesity with blood pressure (n=19), group 3: obesity with diabetes mellitus (n=10), and group 4 served as the control included 24 healthy individuals (not obese). The results showed a significant increase in the levels of visfatin hormone, BMI, Total Cholesterol, Triglycerides, VLDL-C, LDL–C, Chloride, AST activity, LDH activity and a significant decrease in HDL-C, potassium levels in obese, obese with blood pressure, obese with diabetic mellitus patients a comparison with the healthy group has been done, and in female in comparison with male. The results also showed a positive correlation between visfatin hormone and (Total Cholesterol, Triglycerides, VLDL-C, LDL-C , BMI, AST, LDH, Chloride) and a negative correlation between visfatin and (Potassium, HDL-C).

Keywords: Obesity; Body mass index, Visfatin hormone ,Blood pressure, diabetes mellitus and lipid profile.

1. Introduction

Obesity is one of the most daunting health challenges of the 21st century. It linked to 100,000 to 400,000 deaths annually in the United States alone [1]. And in Iraq, according to a report by the Iraqi Ministry of Health issued in 2019, the number of people suffering from obesity and overweight reached nearly 29 million, 60% of whom have diabetes, and 9% of them suffer from high levels of cholesterol and fats in the blood [1].

Obesity become major global public health problem [2]. The increase in obesity in adults and children is a major public health concern and means that over a relatively short period of time. It has gone from being a rare condition to a relatively common condition [3]. The causes of obesity are complex and are caused by many factors including genetic, behavioral, environmental, physiological, social or cultural. It lead to an energy imbalance and promote excessive fat deposition in the body [4].

The World Health Organization (WHO) defines obesity as an abnormal or excessive accumulation of body fat that may harm a person's health and increase the risk of certain diseases [5].

Obesity is a pathological condition that results from excess body fat to an extent that becomes harmful to the health of individuals. It increases the risks of high blood pressure, dyslipidemia, type 2 diabetes, cardiovascular disease, sleep apnea, respiratory problems, osteoporosis, and cancer. It leads to a high death rate [6-9].

*Corresponding author e-mail: zobayda.20gep77@student.uomosul.edu.iq, Lelas.farhan@uomosul.edu.iq
Received date 28 July 2022; revised date 21 October 2022; accepted date 01 September 2022
DOI: 10.21608/ejchem.2022.153001.6628

Obesity in adults is defined as a Body mass index (BMI) of greater than or equal to 30 and severe obesity as a BMI of greater than or equal to 40 [**10**]A high . body-mass index (BMI, the weight in kilograms divided by the square of the height in meters) is associated with increased mortality from cardiovascular disease and certain cancers, but the precise relationship between BMI and all-cause mortality remains uncertain [11]

Visfatin has been discovered as an adipokine (Adipokines are biologically active mediators released from adipose tissue) that has insulin-mimetic effects produced predominantly by visceral adipose tissue [It's a 52 kDa protein composed of 473 amino acids [12] , secreted mainly by the visceral adipose tissue, macrophages and hepatocytes[[13-14]Visfatin is a . multifunctional molecule that can act both inside and outside cells as an adipokine, cytokine and enzyme. Besides its function as an insulin-mimetic adipokine. Visfatin is also effective as a cytokine B cell colony-promoting inflammatory factor (PBEF) and functions intracellularly as a rate-limiting enzyme in the biosynthesis of nicotinamide adenine. Dinucleotide (NAD) [15].

Visfatin is discovered as a growth factor for B lymphocyte precursors. It's encoded by the nicotinamide phosphoribosyl transferase (NAMPT) gene located on the long arm of chromosome. It's also secreted (in addition to the above) by skeletal muscles. It's also constitutively expressed in the myometrium, placenta, and all layers of human fetal membranes. Accumulating evidence has demonstrated that Visfatin is positively correlated with abdominal obesity and is negatively correlated with the plasma level of HDL-C. On the other hand, an independent study of 40 psoriatic patients showed that the plasma level of visfatin is higher than that in healthy control individuaals [16]. Visfatin, an adipokine, has been shown to be elevated in obesity, insulin resistance states, and type 2 diabetes [18].

Aim of The Research

The aims of this research are estimate Visfatin hormone levels in obese, obese with blood pressure , obese with diabetic mellitus patients. Also, a comparison with the healthy group is made. In addition, a study of its relationship with some biochemical parameters is discussed.

2. Materials and methods

This study is conducted during the period of September 2021 to February 2022 which is the period of case - control study.

Blood samples are collected from patients with varying obesity (93 samples) and compared with the control group (24 samples) in the Al-Salam teaching hospital in Mosul City. The information about age, height, weight, personal history is recorded and then laboratory evaluations (various biochemical parameters) are carried out. This study obtained the approval of the ethical research committee in the Nineveh Health Department in Mosul, about 10 ml of venous blood sample was withdrawn from patients and the control group, and then serum is separated by centrifugation at a rate of (3000 rpm) for 15 minutes. A sample of serum is collected of each patient and then stored at -20^{o}C. Now, to perform a homogeneous assessment of parameters for all patients, serum is separated and used to estimate the following parameters:

1. Visfatin hormone is measured by Enzyme-Linked Immunosorbent Assay (ELISA) technique using bioassay technology laboratory(BT Lab), china, with a detection range of 0.5-100 ng/ml Cat.No E0025Hu.
2. Electrolyte (K^{+},Cl^{-}): the measurement was performed automatically by auto analyzer device (Abbott ARCHITECT PLUS c4000, USA), lon-selective electrodes for potassium , and chloride utilize membranes selective to each of these ions. An electrical potential (voltage) is developed across the membranes between the reference and measuring electrodes in accordance with the Nernst equation. The voltage is compared to previously determined calibrator voltages and converted into ion concentration. Methodology: Ion-selective electrode diluted (Indirect) [14].
3. Aspartate Amino Transferase (AST): the measurement was performed automatically by auto analyzer device (Abbott ARCHITECT PLUS c4000, USA), The aspartate aminotransferase present in the sample catalyzes the transfer of the amino group from L-aspartate to α-ketoglutarate, forming oxaloacetate and L-glutamate. Oxaloacetate in the presence of NADH and malate dehydrogenase (MDH) is reduced to L-malate. In this reaction, NADH is oxidized to NAD. The reaction is monitored by measuring the rate of decrease in absorbance at 340 nm due to the oxidation of NADH to NAD [16].
4. Lactate Dehydrogenase (LDH): the measurement was performed automatically by auto analyzer device (Abbott ARCHITECT PLUS c4000, USA), The Lactate Dehydrogenase assay is an

automated clinical chemistry assay. Lactate dehydrogenase is a hydrogen transfer enzyme that catalyzes the oxidation of L-lactate to pyruvate with the mediation of NAD^+ as a hydrogen acceptor [16]The rate of the absorbance increase . at 340 nm is directly proportional to the LDH activity in the sample. Methodology: This method uses the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) recommended [16]

5. Total Cholesterol (T.C): is determined by enzymatic colorimetric method using BIOLABO Kit, LOT No.102058A (France).
6. Triglycerides (T.G): is estimated by enzymatic colorimetric method using BIOLABO Kit, LOT No.122033A (France).
7. High density lipoprotein-cholesterol (HDL-C): is estimated by precipitation method using BIOLABO kit, LOT No.081804A (France),
8. Very low density lipoprotein–cholesterol (VLDL-C): is calculated using the equation:
   VLDL-C (mmol/L) =TG/ 5 (mmol/L) [44].
9. Low density lipoprotein–cholesterol(LDL-C): is calculated using the Friedewaldequation:
   LDL conc.(mg/dL) = Conc. of cholesterol – Conc. HDL – TG/5
10. Body Mass Index (BMI): is calculated as weight in kilogram divided by square height in meters [19].

BMI (Kg/m^2) = Weight (Kg) / High(m^2)

3. Results and discussion

Table 1: Levels of Visfatin hormone and some biochemical parameters in the serum of obese patients for all groups compared to control group.

Hormone and some parameters (Mean± Standard Deviation)	healthy cases (controls) (n=24)	cases Obesity without disease (n=64)	Obesity with Blood pressure (n=19)	Obesity with Diabetes mellitus (n=10)
BMI (kg/m2)	23.000±1.494	36.285±5.348*	37.031±5.131*	36.41±3.196*
Visfatin hormone (ng/ml)	7.246±3.425	14.70±5.865*	16.557±16.813*	43.360±35.957*
AST(U/L)	24.958±4.768	28.156±22.036*	31.210±14.972*	37.10±28.664*
LDH(U/L)	143.16±20.544	157.95±34.397*	173.00±32.625*	169.40±34.013*
Potassium K^+(mmol/L)	4.287±0.349	4.317±0.294*	4.268±0.362*	4.510±0.296*
Chloride Cl^-(mmol/L)	106.00±2.32	107.09±3.714*	104.57±3.716*	104.40±4.221*
Total Cholesterol(mg/dl)	165.241±28.982	223.26±40.90*	232.336±36.065*	241.968±49.01*
Triglycerides(mg/dl)	132.287±31.761	201.503±45.597*	230.668±54.715*	203.44±43.885*
HDL-C(mg/dl)	39.770±9.00	36.05±20.436*	36.100±11.331*	33.60±7.532*
VLDL-C(mg/dl)	26.457±6.352	40.303±9.118*	46.133±11.343*	40.688±8.777*
LDL-C(mg/dl)	98.984±26.201	146.89±40.715*	150.10±29.679*	167.68±32.73*

* significant difference at p≤0.05

The results in Table 1 indicated a significant increase in the levels of the hormone Visfatin in obese patients compared with healthy controls, and the highest rise is recorded in obese diabetic patients and that was in agreement with several studies which clarified that obesity causes increase the release of visfatin from adipocytes. In the year 2013, Mabrouk and his colleagues found that visfatin levels were significantly higher in obese diabetic compared to healthy normal weight group [20].

*The results in Table 1 indicated that the levels of (Body Mass Index (BMI), total Cholesterol (T.C), Triglycerides (T.G), Very low density lipoprotein–cholesterol (VLDL-C), Low density lipoprotein–

cholesterol (LDL-C)) were higher in obese patients compared with the healthy ones, and there was a significant decrease in high density lipoprotein-cholesterol (HDL-C) in the obese patients in comparison with healthy group that was in agreement with previous studies revealing similar results [21-23].

Table 2: Levels of visfatin hormone and some biochemical parameters in serum of patients with obesity for different age groups compared to the control group.

Hormones and some parameters	Age group (Mean± Standard Deviation)					
	Age group(20-35)year		Age group(36-50)year		Age group(51-65)year	
	Patients group (obese only) (n=24)	Control group (n=10)	Patients group (obese only) (n=38)	Control group (n=7)	Patients group (obese only) (n=2)	Control group (n=7)
Visfatin hormone (ng/ml)	26.28±30.71*	6.400±1.131	36.42±39.17*	7.063±3.315	60.16±32.77*	7.60±3.761
AST(U/L)	32.541±34.289*	24.5±4.81	25.891±8.548*	25.28±5.12	25.29±5.05*	18.50±2.121
LDH(U/L)	165.33±46.205*	140.5±25.08	153.184±25.002*	145.8±19.12	160.00±11.313*	144.28±16.92
K^+(mmol /L)	4.279±0.258*	4.16±0.201	4.347±0.308*	4.28±0.38	4.47 ±0.434*	4.200±0.565
Cl^- (mmol /L)	106.166±3.702*	106.6±2.36	107.631±3.744*	105.42±2.22	108.000±1.414*	105.7±2.49
Total Cholesterol(mg/dl)	211.020±27.961*	154.51±30.4	234.831±42.705*	176.12±22.93	168.6±30.76*	150.50±25.597
Triglycerides(mg/dl)	184.616±33.169*	12.51±38.48	215.247±47.432*	142.28±32.63	143.00±39.597*	134.82±18.09
HDL-C(mg/dl)	34.695±8.153*	40.01±8.03	36.815±25.580*	39.54±12.38	37.80±6.505*	39.65±7.77
VLDL-C(mg/dl)	36.923±6.633*	24.70±7.69	43.054±9.432*	28.45±6.52	28.60±7.919*	26.96±3.61
LDL-C(mg/dl)	139.39±26.00	89.72±28.33	154.934±45.459	108.12±15.91	103.06±30.23	84.10±27.011
BMI (kg/m2)	34.895±3.565	22.73±1.61	37.373±6.116	22.91±1.29	32.30±1.414	23.47±1.59

*significant difference at p≤0.05

Table 3: Levels of visfatin hormone and some biochemical parameters in serum of obese with Blood pressure patients for different age groups and compared to the control group.

Hormones and some parameters	Age group (Mean± Standard Deviation)					
	Age group(20-35)year		Age group(36-50)year		Age group(51-65)year	
	Patients group (Obesity with Blood pressure) (n=24)	Control group (n=10)	Patients group (Obesity with Blood pressure) (n=38)	Control group (n=7)	Patients group (Obesity with Blood pressure) (n=2)	Control group (n=7)
Visfatin hormone (ng/ml)	26.28±30.71*	18.21±19.46	36.42±39.17*	13.188±7.161	26.28±30.71*	18.21±19.46
AST(U/L)	47.33±23.860*	24.5±4.81	30.55±13.88*	25.28±5.12	25.29 ±5.05*	25.14 ±7.22
LDH(U/L)	191.66±45.346*	140.5±25.08	170.66±32.442*	145.8±19.12	168.00±29.88*	144.28±16.92
K^+(mmol /L)	4.366±0.208*	4.16±0.201	4.18±0.190*	4.28±0.38	4.32±0.558*	4.47±0.434
Cl^-(mmol /L)	106.00±1.00*	106.6±2.36	106.44±3.609*	105.42±2.22	101.57±2.636*	105.7±2.49
Total Cholesterol(mg/dl)	229.83±33.767*	154.51±30.4	235.11±38.860*	176.12±22.93	229.842±38.55*	168.6±30.76
Triglycerides(mg/dl)	283.06±51.152*	12.51±38.48	237.34±36.396*	142.28±32.63	199.628±66.691*	134.82±18.09
HDL-C(mg/dl)	30.10±9.026*	40.01±8.03	32.98±8.178*	39.54±12.38	39.65±7.77*	42.671±13.636
VLDL-C(mg/dl)	56.613±10.23*	24.70±7.69	47.468±7.27*	28.45±6.52	39.925±13.338*	26.96±3.61
LDL-C(mg/dl)	143.12±28.847*	89.72±28.33	154.653±34.429*	108.12±15.91	147.245±26.828*	103.06±30.23
BMI (kg/m2)	35.90±5.534*	22.73±1.61	37.477±5.855*	22.91±1.29	36.94±4.703*	23.47±1.59

* significant difference at p≤0.05

Table 4: Levels of visfatin hormone and some biochemical parameters in serum of obese with diabetes mellitus patients for different age groups in compared to the control group.

Hormones and some parameters	Age group (Mean± Standard Deviation) Age group(20-35)year		Age group(36-50)year		Age group(51-65)year	
	Patients group (Obesity with Diabetes mellitus) (n=6)	Control group (n=10)	Patients group (Obesity with Diabetes mellitus) (n=6)	Control group (n=7)	Patients group (Obesity with Diabetes mellitus) (n=3)	Control group (n=7)
Visfatin hormone (ng/ml)	26.28±30.71*	18.21±19.46	36.42±39.17*	15.33±5.382	60.16±32.77*	19.0±4.32
AST(U/L)	46.0±11.23*	24.5±4.81	42.166±36.196*	25.28±5.12	25.29±5.05*	24.0±6.928
LDH(U/L)	188.5±13.5*	140.5±25.08	174.83±33.09*	145.8±19.12	159.33±47.173*	144.28±16.92
K^+(mmol /L)	4.70±0.40*	4.16±0.201	4.416±0.271*	4.28±0.38	4.633±0.378*	4.47±0.434
Cl^-(mmol /L)	103.2±4.60*	106.6±2.36	103.33±2.80*	105.42±2.22	105.33±7.023*	105.7±2.49
Total Cholesterol (mg/dl)	229.83±33.767*	154.51±30.4	242.35±34.02*	176.12±22.93	229.5±37.52*	168.6±30.76
Triglycerides (mg/dl)	231.0±51.152*	12.51±38.48	198.70±51.30*	142.28±32.63	193.0±8.38*	134.82±18.09
HDL-C(mg/dl)	34.5±5.67*	40.01±8.03	31.88±7.402*	39.54±12.38	39.65 ±7.77*	39.86 ±3.801
VLDL-C(mg/dl)	46.2±6.83*	24.70±7.69	39.74±10.26*	28.45±6.52	38.60±1.677*	26.96±3.61
LDL-C(mg/dl)	182.5±23.3*	89.72±28.33	170.72±30.41*	108.12±15.91	151.03±39.54*	103.06±30.23
BMI (kg/m2)	37.9±2.73*	22.73±1.61	37.73±3.12*	22.91±1.29	32.26±0.550*	23.47±1.59

* significant difference at p≤0.05

The results in Tables 2, 3 and 4 showed a significant increase in the levels of (Visfatin, Total Cholesterol(T.C),Triglycerides(T.G), Very low density lipoprotein–cholesterol (VLDL-C), Low density lipoprotein–cholesterol (LDL-C), Body Mass Index (BMI), Potassium, AST activity, LDH activity and a significant decrease in the level of High density lipoprotein-cholesterol (HDL-C) in obese, obese with blood pressure and obese with diabetic mellituspatients in comparison with healthy group for all different age groups. There are many reasons that contribute to the evolution of obesity such as genetic variation, individual and environmental factors. Moreover, the prevalence of obesity is often influenced by racial disparities such as sex, age and race [24-30]. The main source of fatty acids (FFA) in the fasting state is adipose tissue which is used for energy use and heat production [26]. Adipose tissue also recognized as large endocrine and paracrine organ in human body which is secretes hundreds of bioactive molecules called adipokines [31]. These molecules are proteins secreted mainly by adipocytes and have role in several function in the body including energy metabolism, glucose homeostasis, inflammation, insulin resistance, immunity, appetite and satiety [29]. Visfatin hormone, the subject of our current research, is one of the important adipokines secreted from adipose tissue, this hormone is predominantly found in visceral fat of obese mice and humans [28]. Visfatin has insulin mimic properties, its plays an important role in the homeostasis of energy, glucose metabolism and inflammation by regulation the production of some inflammatory cytokines including tumor necrosis factor-a (TNF-a) and interleukin-6 [30]. It's also implicated in the pathogenesis of multiple metabolic disorders such as obesity, diabetes mellitus (DM), blood pressure and insulin resistance (IR) [32].

Table 5: Effect of gender on some biochemical parameters in obese patients.

Hormones and some parameters	(Mean± Standard Deviation) Obese Male	Obese Female	significance
Visfatin hormone (ng/ml)	7.109±3.184	7.491±3.881	0.871
AST(U/L)	31.487±26.816	22.217±5.053	0.006
LDH(U/L)	155.463±39.225	162.391±23.633	0.114
K^+(mmol /L)	4.378±0.274	4.208±0.304	0.012
Cl^-(mmol /L)	107±4.075	106.347±2.901	0.308
Total Cholesterol (mg/dl)	222.231 ±40.783	223.721±42.023	0.624
Triglycerides (mg/dl)	197.008±37.847	204.024±49.685	0.649

HDL-C (mg/dl)	36.469±4.739	35.817±25.401	0.000
VLDL-C (mg/dl)	39.401±7.569	40.809±9.935	0.639
LDL-C (mg/dl)	146.361±43.003	147.841±37.192	0.721
BMI (kg/m2)	36.073±5.321	36.665±5.493	0.580

* significant difference at p≤0.05

Table 6: Effect of gender on some biochemical parameters in obese with blood pressure patients.

Hormones and some parameters	(Mean± Standard Deviation) Obese Male with Blood pressure	Obese Female with Blood pressure	significance
Visfatin hormone (ng/ml)	7.491±3.881	18.855±17.295	0.362
AST(U/L)	22.217±5.053	35.444±16.233	0.188
LDH(U/L)	162.391±23.633	167.444±31.788	0.414
K^+(mmol /L)	4.322±0.334	4.208±0.301	0.566
Cl^-(mmol /L)	106.777±3.492	106.347±2.901	0.008
Total Cholesterol (mg/dl)	223.721±42.023	232.566±36.730	0.514
Triglycerides (mg/dl)	197.008±37.847	248.766±47.570	0.369
HDL-C (mg/dl)	36.496±4.739	30.411±5.849	0.041
VLDL-C (mg/dl)	39.401±7.596	49.753±9.514	0.369
LDL-C (mg/dl)	147.841±37.192	152.402±31.037	0.624
BMI (kg/m2)	36.877±3.764	37.13±6.344	0.838

* significant difference at p≤0.05

Table 7: Effect of gender on some biochemical parameters in obese with diabetes mellitus patients.

Hormones and some parameters	(Mean± Standard Deviation) Obese Male with Diabetes mellitus	Obese Female with Diabetes mellitus	significance
Visfatin hormone (ng/ml)	14.70±5.865	15.600±6.218	0.804
AST(U/L)	26.40±5.549	37.10±28.664	0.619
LDH(U/L)	164.20±45.543	169.40±34.013	0.758
K^+(mmol /L)	4.510±0.296	4.620±0.303	0.377
Cl^-(mmol /L)	104.400±4.221	103.40±5.813	0.619
Total Cholesterol (mg/dl)	239.79±32.152	249.896±23.211	0.951
Triglycerides (mg/dl)	192.56±56.40	203.44±43.885	0.499
HDL-C (mg/dl)	33.60±7.532	33.520±4.488	0.758
VLDL-C (mg/dl)	38.512±11.281	40.688±8.777	0.580
LDL-C (mg/dl)	167.682±32.734	175.688±24.194	0.758
BMI (kg/m2)	36.410±3.196	36.440±4.473	0.805

* significant difference at p≤0.05

The results in Tables 5, 6 and 7 showed a significant increase in the levels of Visfatin hormone, total Cholesterol (T.C), Triglycerides (T.G), very low density lipoprotein–cholesterol (VLDL-C), low density lipoprotein–cholesterol (LDL-C) and BMI and a significant decrease in high density lipoprotein-cholesterol (HDL-C) in obese, obese with blood pressure, obese with diabetic mellitus female in comparison with male patients for all groups. our results were in agreement with previous studies [33] and [25]. who recorded that obese women showed significantly higher lipid profile and lower high density lipoprotein-cholesterol (HDL-C) than lean women [25]Furthermore, another study illustrated that . serum level of visfatin was significantly higher in obese women when compared to controls [35].

The results in table 8 showed that Visfatin hormone had a positive correlation with BMI, total cholesterol, triglyceride, VLDL-C, LDL-C, AST, LDH, Chloride and a negative correlation with HDL-C, Potassium

Table 8: Correlation of visfatin hormone with the other biochemical parameters.

Positive +	correlation	Negative -	correlation
BMI (kg/m2)	+	Potassium(mmol /L)	-
Chloride(mmol /L)	+	HDL (mg/dl)	-
Total Cholesterol (mg/dl)	+		
Triglycerides (mg/dl)	+		
VLDL (mg/dl)	+		
LDL (mg/dl)	+		
AST(U/L)	+		
LDH(U/L)	+		

4. Conclusions

Through this study, a significant increase in the levels of visfatin hormone, BMI, total Cholesterol, Triglycerides, VLDL-C, LDL–C, Chloride, AST activity, LDH activity and a significant decrease in HDL-C, potassium levels in obese without disease, obese with blood pressure, obese with diabetes mellitus patients in comparison with healthy group, and was visfatin higher in diabetic patients. and in women in comparison with men are noticed. A positive correlation is found between visfatin hormone with all of the biochemical parameters except with potassium, HDL-C where the correlation was negative and visfatin was higher in diabetic patients.

5. Benefits

We learned about the role of the hormone visfatinin obese male and female in different age groups and its relationship to the rest of the biochemical parameters, and this gives us an idea of the metabolism of this hormone and its mechanism and action in obese female and male .

6. Acknowledgments

First, thanks to god for giving me the insistence,the power to complete this work and get this degree. Second, I would like to express my deepest thanks and appreciation to my supervisor Dr. Lelas Farhan Bdaiwi, and to chemistry department in College of Education for Girls / University of Mosul, Iraq.

7. References

1. G. L. Blackburn and W. A. Walker, (2005). Science-based solutions to obesity: what are the roles of academia, government, industry, and health care?, Am J ClinNutr, 82,(1), 207-210. doi: 10.1093/ajcn/82.1.207S.
2. S. Vandevijvere, C. C Chow, K. D Hall, E. Umalia& B. A Swinburn, Increased food energy supply as a major driver of the obesity epidemic: a global analysis, Bull World Health Organ, 2015;93:446–456 .doi:http://dx.doi.org/10.2471/BLT.14.150565
3. M. Oldham, Perceptions of Weight Status in Overweight and Obesity, 2017, University of Liverpool for the degree of Doctor of Philosophy.p.15.
4. S. B. Racette, S. S. Deusinger, and R. H. Deusinger, (2003) "Obesity: overview of prevalence, etiology, and treatment", *PhysTher*, 83: 276–288.
5. World Health Organization(WHO). 9 June 2021.Obesity and Overweight, https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.
6. American Society for Reproductive Medicine,(2015). Obesity and Reproduction: A committee Opinion,Fertility and Sterility,104(5):1116–1126.
7. Maria P. and S. Evagelia, (2009) "Obesity disease", *Health Science Journal.* 3: 132-138.
8. N. Sattar , I. B. McInnes, J. J.V. McMurray, 2020, Obesity Is a Risk Factor forSevereCOVID-19Infection,Circulation;142(1):4–6. DOI:10.1161/CIRCULATIONAHA.120.047659
9. Javaid F., Mehmood M.H. and Shaukat B., (2021), Hydroethanolic Extract of A. officinarumHance Ameliorates Hypertension and Causes Diuresis in Obesogenic Feed-Fed Rat Model, Front. Pharmacol., 12:1-15. doi: 10.3389/fphar.2021.670433
10. Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2020). Prevalence of obesity and severe obesity among adults: United States, 2017–2018.NCHS Data Brief,)3607-1:(.
11. A. B. de Gonzalez, P. Hartge, J. R. Cerhan, A. J. Flint, L. Hannan, R. J. MacInnis, S. C. Moore, G. S. Tobias, H. Anton-Culver, L. B. Freeman, W. L. Beeson,S.L. Clipp, D. R. English, et al., Body-Mass Index and Mortality among 1.46 Million White Adults, N Engl J Med. 2010; 363(23): 2211–2219.doi: 10.1056/NEJMoa1000367

12. Kaminski, T. Kiezun, M. Zaobidna, E. Dobrzyn, K. Wasilewska, B. Mlyczynska, E. Rytelewska, E. Kisielewska, K. Gudelska, M. Bors, K. Kopij, G. Szymanska, K. Kaminska, B. Rak A. &Smolinska, N.(2021). Plasma level and expression of visfatin in the porcine hypothalamus during the estrous cycle and early pregnancy. Sci Rep. 11(1):8698. doi: 10.1038/s41598-021-88103-z.
13. S. L. Vasilache, C. O. Mărginean, A. Boaghi, RM. Pop, C. Banescu, V. G. Moldovan, A. Hutanu, C. Duicu, I. M. Pascanu, 2020, Implications of visfatin genetic variants in the metabolic profile of the Romanian pediatric population, Romanian Journal of Laboratory Medicine Vol. 28, Nr.2., 2020, 163-174.
14. S. Mazaki-Tovi, R. Romero, J. P. Kusanovic, O. Erez, F. Gotsch, P. Mittal, N. G. Than, C.L. Nhan-Chang, N. Hamill, E. Vaisbuch, T. Chaiworapongsa, S. Edwin, J. K. Nien, R. Gomez, J. Espinoza, C. Kendal-Wright, S. Hassan and G. Bryant-Greenwood, (2008), Visfatin/Pre-B cell colony-enhancing factor in amniotic fluid in normal pregnancy, spontaneous labor at term, preterm labor and prelabor rupture of membranes: an association with subclinical intrauterine infection in preterm parturition, J. Perinat. Med., 36,485–496.
15. P. Svoboda, E. Krizova, K. Čenkova, K. Vapenkova, J. Zidkova, V. Zidek and V. Škop, 2017, Visfatin Is Actively Secreted In Vitro From U-937 Macrophages, but Only Passively Released From 3T3-L1 Adipocytes and HepG2 Hepatocytes, Physiol. Res. 66: 709-714.
16. Y. Kong, S. Zhang, R. Wu, X. Su, D. Peng, M. Zhao and Y. Su, (2019) New insights into different adipokines in linking the pathophysiology of obesity and psoriasis, Lipids in Health and Disease, 18:171,1-12.
17. Chyl-Surdacka KM, Bartosińska J, Kowal M, Przepiórka-Kosińska J, Krasowska D, Chodorowska G., Assessment of visfatin concentrations in the serum of male psoriatic patients in relation to metabolic abnormalities. *AdvClinExp Med*., 2020;29(1):79–84. doi:10.17219/acem/111820
18. R. Adya, B. K. Tan, J. Chen, H. S. Randeva, (2008), Nuclear Factor-αB Induction by Visfatin in Human Vascular Endothelial Cells, *Diabetes Care*, 31(4):758–760.
19. F. Q. Nuttall, "Body mass index: Obesity, BMI, and health: A critical review," *Nutr. Today*, vol. 50, no. 3, pp. 117–128, 2015, doi: 10.1097/NT.0000000000000092.
20. Mabrouk, R., Ghareeb, H., Shehab, A., Omar, K., El-Kabarity, R. H., Soliman, D. A., & Mohamed, N. A. (2013). Serum visfatin, resistin and IL-18 in a group of Egyptian obese diabetic and non diabetic individuals. Egypt J Immunol, 20(1), 1-11.
21. Ayman, S. S., Mohamed, T., Amira, M. J., Wafaa, I. R., &Abd-Elreheem, M. D. (2019). The Association between Resistin, Leptin and Adiponectin with Obesity and Type 2 Diabetes Mellitus. The Medical Journal of Cairo University, 87(December), 4227-4237.
22. Baltacı, D. Tunce, M. C. Cetinkaya, M. Gunduz, M. T. Ozbey, Z. Admis, O. Kara, I. H. and Ankarali, H., (2016). Evaluation of Visfatin in Patients with Obesity, Metabolic Syndrome, Insulin Resistance and Impaired Glucose Tolerance; Case-Control Study, Acta Med Anatol;4(2):61-67. doi: 10.5505/actamedica.2016.00710.
23. Li, R. Z., Ma, X. Y., Hu, X. F., Kang, S. X., Chen, S. K., Cianflone, K., & Lu, H. L. (2013). Elevated visfatin levels in obese children are related to proinflammatory factors. Journal of Pediatric Endocrinology and Metabolism, 26(1-2), 111-118
24. Alqarni,S.S.M. (2016). A review of prevalence of obesity in Saudi Arabia. J Obes Eat Disord, 2(2), 25.
25. Alnowihi, S. M., Al Doghaither, H. A., & Osman, N. N. (2020). Serum visfatin concentration and its relationship with sex hormones in obese Saudi women. International Journal of Health Sciences, 14(3), 9.
26. Balistreri, C. R., Caruso, C., &Candore, G. (2010). The role of adipose tissue and adipokines in obesity-related inflammatory diseases. Mediators of inflammation, 2010.
27. Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2020). Prevalence of obesity and severe obesity among adults: United States, 2017–2018.
28. Makhdoumi, P., Zarif-Yeganeh, M., &Hedayati, M. (2014). Physical Activity and Obesity Related Hormones.
29. Unamuno, X., Gómez-Ambrosi, J., Rodríguez, A., Becerril, S., Frühbeck, G., &Catalán, V. (2018). Adipokinedysregulation and adipose tissue inflammation in human obesity. European journal of clinical investigation, 48(9), e12997
30. Yu, F., Li, J., Huang, Q., &Cai, H. (2018). Increased peripheral blood visfatin concentrations may be a risk marker of coronary artery disease: a meta-analysis of observational studies. Angiology, 69(9), 825-834.
31. Zhang, H., &Sairam, M. R. (2014). Sex hormone imbalances and adipose tissue dysfunction impacting on metabolic syndrome; a paradigm for the discovery of novel adipokines. Hormone molecular biology and clinical investigation, 17(2), 89-97.
32. Zhang, Y., Huo, Y., He, W., Liu, S., Li, H., & Li, L. (2019). Visfatin is regulated by interleukin-6

and affected by the PPAR-γ pathway in BeWo cells. Molecular medicine reports, 19(1), 400-40

33. Ayman, S. S., Mohamed, T., Amira, M. J., Wafaa, I. R., &Abd-Elreheem, M. D. (2019). The Association between Resistin, Leptin and Adiponectin with Obesity and Type 2 Diabetes Mellitus. The Medical Journal of Cairo University, 87(December), 4227-4237.
34. Alnowihi, S. M., Al Doghaither, H. A., & Osman, N. N. (2020). Serum visfatin concentration and its relationship with sex hormones in obese Saudi women. International Journal of Health Sciences, 14(3), 9.
35. Zahorska-Markiewicz, B., Olszanecka-Glinianowicz, M., Janowska, J., Kocełak, P., Semik- Grabarczyk, E., Holecki, M., ... &Skorupa, A. (2007). Serum concentration of visfatin in obese women. Metabolism, 56(8), 1131-1134.
36. Tietz NW, Pruden EL, Siggaard-Anderson O. Electrolytes . In : Burtis CA , Ashwood ER , editors . Tietz Textbook of Clinical Chemistry , 2nd ed . Philadelphia, PA: WB Saunders; 1994 : 1354-1374.
37. US Department of Health and Human Services. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. Washington, DC: US Government Printing Office; December 2009.
38. Clinical and Laboratory Standards Institute (CLSI). Protection of Laboratory Workers From Occupationally Acquired Infections ; Approved Guideline-Fourth Edition. CLS Document M29-A4. Wayne, PA: CLSI; 2014.
39. Huang, X. J. Choi, Y.-K. Im, H.-S. Yarimaga, O. Yoon, E. and Kim H. S. (2006). Aspartate Aminotransferase (AST/GOT) and Alanine Aminotransferase (ALT/GPT) Detection Techniques. Sensors (Basel). 6(7): 756–782.
40. Burtis CA, Ashwood ER, Bruns DE, editors. Tietz Fundamentals of Clinical Chemistry, 6th ed. St Louis, MO: Saunders; 2008:321-322.
41. Bais R, Philcox M. Approved recommendation on IFCC methods for the measurement of catalytic concentration of enzymes. Part 8 IFCC method for lactate dehydrogenase. Eur J Clin Chem Biochem,1994;32:639-655.
42. Schumann G, Bonora R, Ceriotti F, et al. IFCC primary reference procedures for the measurement of catalytic activity concentrations of enzymes at 37°C. Part 3 reference procedure for the measurement of catalytic concentration of lactate dehydrogenase. Clin Chem Lab Med, 2002;40(6):643-648.
43. Rosler E, Klauke R, Kasal C, et al. Traceability of the new, optimized ARCHITECT LDH Assay to IFCC reference method. 7th Annual Conference of the German Society for Clinical Chemistry & Laboratory Medicine, 2010. Clin Chem Lab Med 2010;49(9):A142.
44. Friedewald WT, Levy RI, Fredrickson DS.(1972). Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem;18(6):499-502.
45. ALhaboo, A., & Bdaiwi, L. (2021). Evaluation the Role of Hepcidin in Women with Osteoporosis. *Egyptian Journal of Chemistry*, 64(12), 7283-7290. doi: 10.21608/ejchem.2021.79681.3916
46. Zaki, M., Abdallah, H., El-Bassyouni, H., Tawfeek, H., Hanna, H., Ashour, M., & Youness, E. (2022). Circulating Irisin In Relation To Obesity and Anorexia Nervosa in Patients with Type 2 Diabetes. *Egyptian Journal of Chemistry*, 65(12), -. doi: 10.21608/ejchem.2022.112977.5143
47. Rasheed, W., Elias, T., Ashour, M., Agaibyi, M., Al Wassif, M., Youness, E., Abdel Latif, Y., & Nazih, N. (2022). Irisin, an exercise stimulated hormone as a metabolic regulator in metabolic syndrome in obese rats. *Egyptian Journal of Chemistry*, 65(12), doi: 10.21608/ejchem.2022.113904.5247.
48. Alramadhany, R., & Ali, H. (2021). Study The Arginase Activity And Its Correlation With Liver And Kidney Functions For Patients With Type-2 Diabetes Mellitus In Nineveh Governorate. *Egyptian Journal of Chemistry*, 64(12),7075-082.doi:10.21608/ejchem.2021.80046.3942.II49.
49. Iraqi Ministry of Health.