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Research Article

The Levels of Serum Leptin in Type 2 Diabetes Mellitus Sudanese Link Obesity Indexes and Lipid Profile

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Abstract

Background: It is expected that there will be 366 million diabetics worldwide by 2030, up from 171 million in 2000. Regardless of their level of development, all nations need to do more to prevent and treat diabetes mellitus and its complications.

Aim: There was limited data of the adipocytokine leptin's (Lep) metabolic effects on diabetes patients in Sudan and its connection to the serum lipid profile (Cholesterol, Triglyceride, High density lipoprotein and low density lipoprotein). The purpose of this study is to determine how fasting plasma glucose, glycemic control, lipid profile, and leptin levels relate to each other in Sudanese people with and without diabetes.

Methods: Between April 2012 and March 2013, a case-control research involving 200 people was carried out to evaluate the levels of leptin, diabetic profile, and lipid profile. 100 people who were nondiabetic or in the control group were among the 100 participants with diabetes. Participants responded to questions about their personal and clinical characteristics on a questionnaire. We measured the participants' weight (kg), height (m), and BMI (Kg/m2), respectively. Blood was drawn from the veins following an overnight fast. The study population consisted of patients who visited the Abu A'gla Health Care Center from the Wad Madani city district and other nearby rural and urban areas. The participants represented many Sudanese tribes. Ages of the participants in this study ranged from 22 to 65, and none of them were currently infected or suffering from diabetes-related complications. The non-diabetic group consisted of healthy adults who consented to participate in the study.

Results: According to the study's findings, the mean WC increased between the diabetic and non-diabetic groups by a non-significant amount ($p=0.143$) and was significantly positively linked with the Lep level ($p<0.0001$). Between the diabetic and non-diabetic groups, the mean BMI significantly elevated ($p=0.037$), and the Lep level significantly positively correlated ($p<0.0001$). Between the diabetes and non-diabetic groups, the mean FPG and HbA1C significantly increased and showed a strong positive correlation with Lep level (all with $p<0.0001$). Between the diabetes and non-diabetic groups, the mean HDL-C decreased non-significantly ($p=0.581$), and it significantly positively correlated with Lep level (<0.0001). While 88 (88%) diabetics had normal mean Lep concentrations and 12 (12%) had low concentrations, 47 (58.02%), 33 (40.74), and 1 (1.23%) non-diabetics had normal, low, and high Lep concentrations, respectively, with a significant decline in its concentration of (<0.0001).

Conclusion: Both participants with diabetes and those without it in Sudan had lep concentrations within the accepted value. Between the groups with and without diabetes, the mean values of BMI, FPG, and HbA1C significantly increased. They also significantly positively correlated with Lep levels. Lep concentration and lipid profile had a strong negative correlation, and their mean concentration was non-significantly higher.

Keywords: Leptin; Type 2 Diabetes Mellitus; Sudan

Introduction

In the Sudan, diabetes is one of the most prevalent chronic diseases, with a prevalence of 447,000 in 2000 and a projected increase to 1,227,000 in 2030 [1]. According to Elbagir et al. [2] there is a potential for a catastrophic rise in the prevalence of kidney and cardiovascular disease due to the prevalence of T2DM in the Sudanese population, which is estimated to be 3.4%. T2DM also accounted for 75% of all diagnosed cases in the northern parts of Sudan in 1996 [3]. The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) defined metabolic syndrome as a group of metabolic diseases that include glucose intolerance, T2DM, atherogenic dyslipidemia, CVD, high blood pressure, HTN, and central obesity. These abnormalities occur in the same person and result in a number of risk factors that frequently co-occur [4].

In addition, one of those abnormalities frequently comes first [5]. The presence of three or more of the following metabolic disorders meets the criteria for metabolic syndrome: abdominal fat WC >102 cm in males and >88 cm in women, hypertriglyceridemia (TG 150 mg/dL), low HDL-C (40 mg/dL in men and 50 mg/dL in women), elevated blood pressure (SBP 130 mmHg, DBP 85 mmHg), and elevated FPG 110 mg/dL are all risk factors [6]. A disorder in lipid metabolism known as dyslipidemia causes variations in the serum levels of circulating lipids and lipoproteins [7]. This change can be seen in the elevated TG, LDL, and declining HDL cholesterol levels [8]. According to Assmann and Schute (1988) [9], metabolic abnormalities of lipoprotein quantity and quality are linked to an increased prevalence of cardiovascular problems and chronic heart disease in T2DM patients. Lipoprotein typically contains 60–70% LDL–C, 20–30% HDL–C, and 10-15% VLDL–C of the total serum cholesterol [10].

Lep and insulin interact to modify adipocytokine production. Lep is a positive regulator, and it boosts the expression of its genes to reduce appetite [11]. Adipocytokines, on the other hand, Adipocytokines, are believed to influence how insulin acts in other tissues and play a part in the obesity-related insulin resistance [12-14]. It was hypothesized that elevated plasma Lep levels were related to obesity, HTN, dyslipidemia, and metabolic syndrome in T2DM [15]. Studying adipocytokine levels in T2DM and their relationships to anthropometry, diabetic profile and lipid profile parameters may help to clarify the function of Lep in type 2 diabetes and the risk of cardiovascular complications that go along with it. It may also aid in the prevention and treatment of these complications in Sudanese diabetics.

Subjects, Materials and Methods

Study Design and Area

This study was a cross-sectional case-control investigation conducted at the Abu A'gla health center for diabetic care in Wad Madani, Gezira state, Sudan. Al Gezira state has 3,575,280 people living there as of the 2008 statistics, of which 1,723,488 were men and 1,851,792 were women. By 2016, the population is projected to reach 4,759,764 people (Central Bureau of Statistics). Each participant gave their verbal consent, and the study was given ethical approval by the Ethics Committee of the Faculty of Medicine at the University of Gezira.

Study Subjects

In the study, 200 adults of both sexes participated. 100 of them were type 2 diabetics who were not hypertensive (the diabetic group), and 100 others appeared to be in good health but were not diabetics or hypertensives (control group). Participants came from Wad Madani's rural and urban communities who use the Abu A'gla health center for medical care. The study took place between April 2012 and March 2013. Participants in this study had to be between the ages of 22 and 65 yrs., be free of any infections, and not have any complications from diabetes. A control group was comprised of voluntary participants who appeared to be in good health. If a subject does not fit any of the inclusion requirements, they were excluded.

Collection and Preparation of Blood Samples

Following an overnight fast, five milliliters of venous blood from each participant were taken using a conventional aseptic technique and separated into three parts: Blood samples were divided after centrifugation and used to measure the lipid profile and the adipocytokine concentration of Lep. One milliliter of blood was placed in an EDTA container to measure HbA1C, one milliliter in a fluoride container to measure plasma glucose, and three milliliters were placed in a lithium heparin container.

Data Collection

Each participant completed a structured questionnaire to provide information on their demographics, medical history, and personal and family history. All study participants had their weight and height measured in kilograms (kg) and meters (m), respectively. The body mass index (BMI) was then determined using the following formula:

$$BMI = (\text{weight in kg}) / (\text{height in m})^2.$$

Using the random-access analyzer A15, plasma samples were tested for several biochemical characteristics, as shown below.

Using glucose oxidase/peroxidase, plasma glucose was assessed (Code: 12503). Fasting blood sugar reference range: 110 mg/dl [16]. Hemoglobin A_{1C} turbidimetry was used to measure glycosylated hemoglobin (HbA1C), and the reference ranges are shown below (Source 1).

Cholesterol oxidase/peroxidase (Code: 12505), glycerol phosphate oxidase/peroxidase (Code: 12528), cholesterol HDL direct (Code: 12557), and cholesterol LDL direct (Code: 12558) were used to measure total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C (Code: 12585). The table below shows the lipid profile reference ranges (Source 2).

Source 1: Diabetes Multidisciplinary Team (2009).

Group	HbA1C Values
Excellent control	Less than 6.5%
Good control	6.5% - 7.5%
Moderate control	7.5% - 8.9%
Poor control	Greater than 9.0%

Source 2: Scott et al. (2001).

Lipid Profiles Values	
TC	< 200 mg/dl
LDL-C	<130 mg/dl
HDL-C	> 59 mg/dl
TG	< 150 mg/dl

Results

The results of the current study show that age significantly positively correlated with Lep level (p<0.0001) and that the mean difference between the diabetes and non- diabetic groups did not significantly differ (p=0.26). The mean WC increased non-significantly between the diabetes and non- diabetic groups by (p=0.143) and strongly positively correlated with the Lep level (p<0.0001). The mean BMI increased significantly between the diabetes and non- diabetic groups by (p=0.037) and had a significant positive correlation with Lep level (p<0.0001). The mean FPG and HbA_{1C} increased considerably between the diabetes and non-diabetic groups and had a strong positive association with Lep level (all with p<0.0001). The mean of TC increased non-significantly between the diabetes and non-diabetic groups by (p=0.371) and had a significant negative correlation with Lep level by (p=0.031).

The mean LDL-C increased non-significantly between the diabetes and non- diabetic groups by (p=0.175) and had a significant negative correlation with Lep level (<0.0001). The mean HDL-C decreased non-significantly between the diabetes and non- diabetic groups by (p=0.581) and had a significant positive correlation with Lep level (<0.0001). The mean TG increased non-significantly between the diabetes and non- diabetic groups by (p=0.203) and had a significant negative correlation with Lep level (<0.0001). In comparison, 47(58.02%), 33(40.74), 1(1.23%) non-diabetics had normal, low, and high Lep concentrations, with a significant drop in its concentration of (<0.0001), whereas 88(88%) diabetics had normal mean Lep concentration and 12(12%) had low concentrations (Table 1-3).

Table 1: General characteristic of study group and association analysis.

Variable	Number	Minimum	Maximum	Mean	Std. Deviation	Sig.
Age\yrs.	200	22	65	48.2	7.57	<0.0001a
Weight \kg	200	40	171	76.23	15.8	<0.0001a
Height \m	200	1.4	1.9	1.62	0.091	0.095b
WC\cm	200	52	127	98.42	11.1	<0.0001a
BMI\kg/m^2	200	17.31	55.2	28.95	5.83	<0.0001a
SBP\mmHg	200	80	170	116.45	11.11	<0.0001a
DBP\mmHg	200	30	130	79.34	14.9	<0.0001a
Duration of DM\yrs.	99	0.1	23	4.75	4.05	-
FPG\mg/dL	200	46	442	151.94	95.52	<0.0001a
HbA_{1C}%	200	3.1	15	6.83	2.56	<0.0001a
TC\mg/dL	200	75	312	196.28	42.89	0.031b
LDL-C\mg/dL	200	32	216	105.76	29.72	<0.0001b
HDL-C\mg/dL	200	15	100	54.29	16.47	<0.0001a

TG\mg/dL	195	38	533	159.61	81.5	<0.0001b
Serum Leptin\ug/L	181	0	9.81	1	0.99	-

a: Based on positive ranks; b: Based on negative ranks; FPG: Fasting Plasma Glucose; HbA1C: Glycosylated Hemoglobin; TC: Total Cholesterol; LDL-C: Low Density Lipoprotein Cholesterol; HDL-C: High Density Lipoprotein Cholesterol; TG: Tri-Glycerides; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; SBP: Systolic Blood Pressure; mmHg: millimeter of mercury; DM: Diabetes Mellitus; WC: Waist Circumferance; BMI: Body Mass Index; Cm: Centimeter; Kg: kilogram; m: Meter.

Table 2: Distribution of study population in groups according to variable characteristic.

Variable	Characteristics	Group		Sig.
		Diabetic n= 100	Control n= 100	
Gender	Male	26	31	0.26
	Female	74	69	
Age\yrs.	20-29	1	2	0.032
	30-39	3	5	
	40-49	40	58	
	50-59	49	27	
	60-69	7	8	
***WC\Cm**	Male<=102	14	25	0.143
	Male>102	12	6	
	Female<=88	9	7	
	Female>88	65	52	
***BMI \kg/m^2**	under weight (BMI < 18.50)	0	1	0.037
	Normal (BMI 18.50 - 24.99)	15	33	
	Overweight (BMI 25 - 29.99)	40	38	
	Obese class I (BMI 30 - 34.99)	27	17	
	Obese class II (BMI 35-39.99)	14	8	
	Obese class III (BMI =>40.00)	4	3	
HT Group	Normal (SBP\DBP less than 120\ 80)	28	52	0.002
	Pre-hypertension (SBP\DBP 120\80)	64	42	
	Stage 1 HT(SBP 140 -159 or DBP 90 -99)	8	4	
	Stage 2 HT (SBP\DBP 160\100 and above)	0	2	
FPG\mg/dl	Low < 75	2	22	<0.0001
	Normal 75 - 115	19	69	
	High > 115	79	9	
HbA_{1C}%	Excellent <6.5	30	94	<0.0001
	Good 6.5-7.5	6	6	
	Moderate 7.5-8.9	20	0	
	Poor >=9	44	0	
TC\ mg/dL	Desirable < 200	54	57	0.371
	Borderline high 200 - 239	32	24	
	High > 239	14	19	
LDL-C\ mg/dL	Optimal < 130	86	76	0.175
	Borderline high 130 - 159	12	19	
	Very high > 159	2	5	

HDL-C\ mg/dL	Low < 40	19	20	0.581
	Borderline high 40 - 59	51	44	
	Desirable > 59	30	36	
TG\ mg/dL	Normal < 150	47	56	0.203
	High 200 - 500	56	44	
	High =>10.4	21	0	
Serum LEP\ug/L	Low < 0.3	12	33	<0.0001
	Normal 0.3- 8	88	47	
	High >8	0	1	

Source: NHLBI Obesity Education Initiative (2000)*; FPG: Fasting Plasma Glucose; HbA1C: Glycosylated Hemoglobin; TC: Total Cholesterol; LDL-C: Low Density Lipoprotein Cholesterol; HDL-C: High Density Lipoprotein Cholesterol; TG: Tri-Glycerides; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; mmHg: millimeter of mercury; HT: Hypertension; DM: Diabetes Mellitus; WC: Waist Circumferance; BMI: Body Mass Index; Cm: Centimeter, Kg: kilogram, m: Meter.

Table 3: Mean of anthropometric and biochemical measurements.

Variables	Male				Female				Sig.
	Number	Minimum	Maximum	Mean	Number	Minimum	Maximum	Mean	
Age\yrs.	57	28	62	49.37	143	22	65	47.74	0.001
WC\Cm	57	73	116	94.93	143	52	127	99.81	<0.0001
BMI\kg/m²	57	19.14	55.2	26.41	143	17.31	49.98	29.96	0.001
SBP\mmHg	57	80	150	115.79	143	80	170	116.71	0.38
DBP\mmHg	57	50	130	78.05	143	30	130	79.85	0.72
FPG\mg/dL	57	60	442	147.56	143	46	409	153.69	0.55
HbA_{1C}%	57	3.1	15	6.61	143	3.2	15	6.92	0.17
TC\mg/dL	57	122	273	189.89	143	75	312	198.83	0.07
LDL-C\mg/dL	57	56	167	103.89	143	32	216	106.5	0.3
HDL-C\mg/dL	57	22	100	51.91	143	15	97	55.23	0.45
TG\mg/dL	56	40	350	154.5	139	38	533	161.67	0.41
Serum LEP\ug/L	53	1	2	1.72	128	1	3	1.77	0.65

FPG: Fasting Plasma Glucose; HbA1C: Glycosylated Hemoglobin; TC: Total Cholesterol; LDL-C: Low Density Lipoprotein Cholesterol; HDL-C: High Density Lipoprotein Cholesterol; TG: Tri-Glycerides; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; mmHg: millimeter of mercury; WC: Waist Circumference; BMI: Body Mass Index; Cm: Centimeter; Kg: kilogram; m: Meter.

Discussion

There were 200 participants in the current study, of which 57 were men and 143 were women. They range in age from 22 to 65. There was a significant increase in FPG in the study group, which indicates the little care about controlling blood glucose among study participants, this finding undoubtedly led to alteration in all cellular reactions, especially in metabolic pathways of micronutrients including glucose, fatty acid, and amino acid [17]. According to Watson et al 2011 .'s research, obesity is linked to a worsened response to insulin, which is demonstrated by greater HbA1C levels and lower accomplishment of the target value. These BMI measurements revealed that the development of insulin resistance and T2DM is associated to the distribution of body fat and visceral adiposity in diabetic and non-diabetic individuals [18]. Our data on HbA1C shows that diabetic groups had significantly higher levels of HbA1C, which suggests poor blood glucose control. The international diabetes federation (IDF) reported in 2015 that a 1% decrease in HbA1C will significantly lower the probability of dying from diabetes to 21%. In both microvascular and macrovascular

consequences of DM, the likelihood of glycemic control was dramatically reduced [19].

First, this study discusses how BMI affects individuals with diabetes compared to participants without diabetes, and it shows that 73 participants were obese, 78 participants were overweight, 48 participants were in the normal range, and only one participant was underweighted. The peptide leptin, which is the ob gene's product, has a high correlation with adiposity and may play a role in determining obesity and its problems. According to the results of the current investigation, lep concentration is also correlated with BMI, body fat, and patients with Type 2 diabetes mellitus as well as non-obese and obese participants as reported by Haffner SM et al. [20]. Other research have revealed the relationship of spontaneous or forced weight changes and serum leptin levels, which is consistent with our findings regarding the existence of a positive correlation between the circulating leptin levels and the body weight [21]. Both obese and normal weight humans who lost weight through dietary restriction were shown to have lower serum leptin levels, regardless of the baseline concentration [22-26].

Conclusion

Both participants with diabetes and those without it in Sudan had lep concentrations within the accepted value. Between the groups with and without diabetes, the mean values of BMI, FPG, and HbA1C significantly increased. They also significantly positively correlated with Lep levels. Lep concentration and lipid profile had a strong negative correlation, and their mean concentration was non-significantly higher.

Recommendations

More research is needed and measuring the insulin resistance will provides accurate and precise data.

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Conflict of Interest

None.

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