Research Square

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Effect of Weight Reduction on Serum Vaspin, Metabolic Parameters, and Body Composition in Obese Females Participating Low-Energy Diet and Aerobic Exercise: A Prospective Observational Study

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Abstract

Objective

This study aimed to evaluate serum Omentin Levels and its Association with Glycemic Control, Lipid Profile, and Obesity in Palestinian Females with Type 2 Diabetes Mellitus.

Methods

This observational case–control study was recruited 200 participants aged (30–60 years) divided into a control group and diabetic patients categorized according to their BMI as normal weight group (BMI < 25 kg/m^2), overweight group (BMI 25 -29.9 kg/m^2), and obese group (BMI ≥ 30 kg/m^2) with 50 participants in each study groups. Sociodemographic data, clinical history, anthropometric measurements, blood pressure, and pulse rate were collected from all subjects. The levels of biochemical parameters; omentin, insulin, glycated hemoglobin, fasting glucose, and lipid profile were measured and statistically analyzed using one-way ANOVA and correlation analysis.

Results

Compared with controls, diabetic participants showed significantly increased body weight, waist circumference, BMI, and both systolic and diastolic blood pressure ($P < 0.05$). Serum omentin level was significantly increased in overweight diabetic and obese diabetic patients compared to control ($P < 0.05$). HbA1c and fasting glucose levels were significantly higher across all diabetic groups ($P < 0.001$). All diabetic patients had increased cholesterol and triglyceride levels with decreased HDL values indicating dyslipidemia. Persons Correlation analysis showed significant correlations between BMI and anthropometric measures. Omentin levels were significantly correlated with lipid markers.

Conclusions

The findings suggest that serum omentin is associated with metabolic disturbances in T2DM patients. It can be used as a promising biomarker for T2DM patients and has relation with obesity and dyslipidaemia.

Introduction

Type 2 diabetes mellitus (T2DM) is one of the most common chronic metabolic diseases worldwide [1]. The global prevalence of T2DM has increased dramatically in recent decades, largely due to changes in lifestyle, increasing obesity rates, and population aging [2]. Persistent hyperglycemia is associated with severe microvascular and macrovascular complications, including nephropathy, neuropathy, retinopathy, and cardiovascular diseases [3]. Obesity is widely recognized as one of the most significant risk factors

that lead to type 2 diabetes and cardiovascular disease [4]. The accumulation of excess adipose tissue, particularly visceral fat, plays a major role in the pathogenesis of insulin resistance [5]. In recent years, adipose tissue has been identified not only as a site for energy storage but also as an active endocrine organ that secretes a variety of biologically active molecules known as adipokines [6]. These molecules participate in the regulation of glucose metabolism, lipid homeostasis, inflammatory processes, and vascular function [7].

Omentin is a relatively recently identified adipokine that is predominantly produced by visceral adipose tissue [8]. It has been reported that omentin enhances insulin-mediated glucose uptake in adipocytes and may therefore contribute to improved insulin sensitivity [9]. In addition, omentin has been suggested to exert anti-inflammatory and vasoprotective effects, which may have implications for cardiovascular health [10]. Metabolic control in individuals with diabetes is commonly evaluated using biochemical markers such as fasting plasma glucose and glycated hemoglobin (HbA1c). HbA1c reflects the average blood glucose concentration over the preceding two to three months and is widely used for both diagnosis and monitoring of diabetes [11]. Elevated HbA1c levels are associated with an increased risk of chronic diabetic complications [12].

Dyslipidemia is another metabolic abnormality frequently observed in patients with T2DM and is characterized by elevated triglycerides, increased concentrations of low-density lipoprotein (LDL), and reduced levels of high-density lipoprotein (HDL). These lipid alterations contribute significantly to the development of atherosclerosis and cardiovascular disease, which represent the leading causes of mortality among diabetic individuals [13]. Anthropometric measurements such as body mass index (BMI) and waist circumference are commonly used indicators of obesity and central fat accumulation. Numerous epidemiological studies have demonstrated a strong association between increased BMI, abdominal obesity, and the risk of developing T2DM [14]. Despite increasing interest in the role of adipokines in metabolic disorders, the relationship between circulating omentin levels and metabolic parameters in patients with type 2 diabetes remains unclear. Therefore, the present study was designed to evaluate serum Omentin Levels and its Association with Glycemic Control, Lipid Profile, and Obesity in Palestinian Females with Type 2 Diabetes Mellitus.

Methods

Study Design and Participants

This observational case–control study included 200 participants aged between (30–60) years in Gaza strip. Cases comprised 150 type 2 diabetic females divided into three subgroups based on body mass index; normal weight diabetes group (BMI < 25 kg/m^2), overweight diabetes group (BMI 25-29.9 kg/m^2), and obese diabetes group (BMI ≥ 30 kg/m2) with fasting glucose level > 150 mg/dl, and receiving hypoglycemic drug daily all over the study period. In addition to ffifty healthy individuals without diabetes, with normal weight (BMI < 25 kg/m^2) and fasting glucose level < 90.0 mg/dl as a control group.

Study variables

Diagnosis of type 2 diabetes was established according to the criteria of the World Health Organization which include a fasting plasma glucose level ≥ 126 mg/dl, 2-hr plasma glucose level ≥ 200 mg/dl and HbA1c value between 5.7%-6.4% [15]. The study was conducted under physician supervision at private centers in Gaza strip. Exclusion criteria included patients with T1DM, severe kidney or liver diseases, severe cardiovascular diseases, chronic viral or bacterial infection, asthma, tumors, connective tissue diseases and pregnant females were excluded.

Ethical consideration

The informed consent form was signed by all the participants before joining the study. Helsinki committee in Gaza strip gave their ethical approval to the study under approval number PHRC/HC/899/15 and the study procedures were therefore done in accordance to the accepted ethical standards of research involving human subjects.

Clinical trial number

not applicable

Anthropometric Measurements

Body weight, height, waist circumference and body mass index (BMI) were anthropometric measures. BMI was determined as weight (kg)/height (m^2). The pulse rate and blood pressure were measured by means of standard clinical measurements.

Blood pressure and pulse monitors: Blood pressure was measured with mercury sphygmomanometer. The pulse rate was determined by counting the pulses at the wrist region at least 15 seconds and then multiplying the result by four to obtain the number of beats per minute.

Specimen collection and processing

Fasting Blood samples were collected from all participants after overnight fasting. Serum was separated by centrifugation for 10 minutes at 2500 rpm and used for the following biochemical parameters. Omentin Human/Intelectin 1 (ITLN1) protein in serum was determined quantitatively by a solid- phase enzyme-linked immune sorbent assay (ELISA) according to the manufacture instruction. Insulin was quantitative determined by a solid phase enzyme-linked immune sorbent assay (ELISA) (DRG Diagnostic international, USA [16]. The HBA1c was determined by quantitative nephelometric directly for the percentage of glycated hemoglobin (HBA1c) to total hemoglobin (HbT) [17]. Enzymatic colorimetric assays were used to measure biochemical parameters such as fasting blood sugar (FBS) [18], total cholesterol (TC) [19], triglycerides (TG) [20], high density lipoprotein (HDL-C) [21]. Low density lipoprotein (LDL) was calculated by empirical relationship of Friedewald [22].

Statistical analysis

The data were processed and statistically analyzed using the IBM SPSS software for Windows, version 21.0. Results are presented as mean ± standard deviation. One-way analysis of variance (ANOVA) was applied to compare groups. Correlation analyses were performed to evaluate relationships between biochemical markers and anthropometric variables. Statistical significance was considered at $P < 0.05$.

Results

Sociodemographic data in Table 1, showed that there was a significant difference in the age distribution, education level, and place of residency among the studied groups ($P \leq 0.001$). The diabetic participants were generally older than control group with a mean age ranging from 48.1–49.2 years versus 41.1 years among controls. The highest percentage of diabetic individuals was observed in the 41–60 year. Regarding marital status, no statistically significant difference between the groups ($P = 0.274$), while significant difference was detected in educational level ($P = 0.001$). the percentage of bachelor's degrees holders where higher in controls, but the percentages of primary and secondary education levels were higher in diabetic groups especially those that were overweight and obese. Similarly, residency showed a significant difference ($P = 0.001$), with most diabetic participants living in Gaza Governorate. Overall, these findings indicate that age, educational status, and geographic location are important sociodemographic determinants associated with type 2 diabetes within the studied population.

Table 1
Sociodemographic characteristics of study population.

Parameter		Control		Diabetic patients						*P*-value
				Normal weight		Overweight		Obese		
N	**%**	**N**	**%**	**N**	**%**	**N**	**%**			
Age (years)	30–40	34	68.4%	5	10%	7	14.6%	7	14%	0.001
	41–50	11	21.1%	25	50%	18	35.4%	19	38%	
	51–60	5	10.5%	20	40%	25	50%	24	48%	
	Mean ± SD	41.1 ± 6.5		49.2 ± 8.1		48.5 ± 6.3		48.1 ± 6.3		0.001
Marital status	Married	45	90%	37	74%	44	88%	44	88%	0.274
	Widow	0	0.0%	5	10%	5	10%	2	4%	
	Divorced	0	0.0%	0	0.0%	1	2%	1	2%	
	Single	5	10%	8	16%	0	0.0%	3	6%	
Education	illiteracy	5	10%	5	10%	2	4%	2	4%	0.001
	Primary	13	26%	13	26%	26	52%	21	42%	
	Secondary	5	10%	15	30%	12	24%	23	46%	
	Bachelor's	27	54%	17	35%	10	20%	4	8%	
Residency	North Gaza Governorate	34	68%	18	36%	18	36%	10	20%	0.001
	Gaza Governorate	16	32%	32	64%	32	64%	40	80%	

N: number of the subject; **SD**: standard deviation,

The significant of difference was checked by checked by chi square test, significant at $P \leq 0.05$.

Table 2 presented anthropometric measurements that significantly differ between diabetic groups and controls, especially for weight, waist circumference, BMI, blood pressure and pulse. The body weight increased gradually among diabetic populations with obese diabetic, reaching weight of 96.4 ± 15.5 kg which is a 55.9% increase compared with controls (P = 0.001). The waist circumference also increased significantly, rising from 79.4 ± 6.3 cm in controls to 109.9 ± 10.4 cm in obese diabetics. BMI followed the same pattern, increasing from 22.6 ± 2.2 kg/m² in controls to 36.7 ± 5.4 kg/m² in obese diabetics, representing a 62.2% increase (P = 0.001). These results confirm the relationship between obesity and type 2 diabetes pathogenesis. The diabetic patients had a significant increase in blood pressure. The

systolic blood pressure increased by about 13–16%, and the diastolic pressure increased by 10–13%, while the pulse showed slight significant increase in obese diabetic patients (P = 0.019).

Table 2
anthropometric, blood pressure (BP) and pulse measurements among study population

Parameters	Control	Diabetic patients Means ± SD				
	Means ± SD	Normal weight	Overweight	Obese	% Change	P-value
Weight (kg)	61.9 ± 8.5	62.2 ± 6.6	76.0 ± 6.7	96.4 ± 15.5	0.6%	0.887
					22.9%	0.001
					55. 9%	0.001
Length (cm)	164.9 ± 6.5	162.3 ± 4.8	164.4 ± 5.4	162.0 ± 5.8	− 1.6%	0.154
					- 0.3%	0.732
					- 1.8%	0.065
Waist circumference (cm)	79.4 ± 6.3	84.8 ± 8.1	95.5 ± 7.8	109.9 ± 10.4	6.7%	0.028
					20.3%	0.001
					38.4%	0.001
BMI (Kg/m^2)	22.6 ± 2.2	23. 5 ± 1.8	28.0 ± 1.4	36.7 ± 5.4	3.7%	0.202
					23.8%	0.001
					62.2%	0.001
Systolic B P (mmHg)	111.5 ± 11.6	127.5 ± 18.7	126.2 ± 15.4	130 ± 17.4	14.4%	0.003
					13.2%	0.001
					16.2%	0.001
Diastolic B P (mmHg)	73.0 ± 8.6	81.4 ± 11.4	80.7 ± 12.5	82.3 ± 9.1	11.5%	0.014
					10.5%	0.017
					12.7%	0.001
Pulse (beats/min)	78.2 ± 7.4	81.4 ± 13.5	83.9 ± 12.13	84.3 ± 10.25	4.9%	0.370
					7.3%	0.061
					7.8%	0.019
Each reading represents Mean ± SD of 50 subjects.						
The significance of difference was checked by One Way ANOVA, significant at $P < 0.05$, compare all vs control.						

Table 3 showed that the levels of serum omentin levels were found to be significantly high in overweight (36.3 ± 8.9 ng/ml) and obese diabetic patients (36.4 ± 10 ng/ml) with 50% increase compared with (24.3 ± 11.3 ng/ml) in the controls, P ≤ 0.01. in diabetic groups, although increase in insulin levels than in controls, these increases were not significant. Controversy, HbA1c levels were significantly elevated in all diabetic groups (P ≤ 0.001), ranging between 5.2% in controls to 7.6–7.8% in diabetic patients, confirming poor glycemic control. Similarly, the glucose levels were significantly increased, to around 146–161 mg/dL, representing increases of 78–98% compared to controls.

Table 3
Omentin, Insulin, Hemoglobin A1C, and Glucose determination among study population.

Parameters	**Control**	**Diabetic patients**				
	Mean ± SD	**Mean ± SD**				
		Normal weight	**Overweight**	**Obese**	**% Change**	**P-value**
Omentin (ng/mL)	24.3 ± 11.3	26.3 ± 14.7	36.3 ± 8.9	36.4 ± 10.0	8.2%	0.708
					49.6%	0.001
					50%	0.003
Insulin (μ IU/ml)	11.6 ± 1.39	13 ± 1.56	15.9 ± 1.51	15.6 ± 1.45	11.4%	0.781
					36.2%	0.297
					34.1%	0.297
HBA1C (%)	5.2 ± 0.3	7.6 ± 1.9	7.8 ± 1.7	7.6 ± 1.6	45.9%	0.001
					48.6%	0.001
					45.1%	0.001
Glucose (mg/dl)	81.8 ± 10.6	161.6 ± 84.2	154.7 ± 55.9	146.2 ± 63.1	97.6%	0.001
					89.1%	0.001
					78.7%	0.001

Each reading represents Mean ± SD of 50 subjects. The significance of difference was checked by One-Way ANOVA, significant at $P < 0.05$, compare all vs control.

Lipid profile analysis revealed that diabetic patients have a significant dyslipidemia demonstrated in Table 4. Diabetic groups had significantly higher levels of total cholesterol (P < 0.05), with percentage of increase from 14–18% compared to the controls. Similarly, there was a significant increase in triglyceride levels especially in the overweight diabetic patients, where the levels increased by over 114%. A moderate increase in LDL cholesterol levels and it was only statistical significance in the overweight group (P ≤ 0.05). In the other hand, there was a decrease in HDL cholesterol levels, especially in overweight diabetic patients (P ≤ 0.01).

Table 4
Determination of lipid profile among study population

Parameters	Control	Diabetic patients (Mean ± SD)				
	Mean ± SD	Normal weight	Overweight	Obese	% Change	P-value
Cholesterol (mg/dl)	175.0 ± 29.4	199.9 ± 44	207.6 ± 46.9	200.5 ± 47.6	14.2%	0.046
					18.6%	0.007
					14.6%	0.031
Triglyceride (mg/dl)	100.8 ± 45.1	164.2 ± 87.9	215.8 ± 64.1	180.6 ± 70.9	62.9%	0.008
					114.1%	0.004
					79.2%	0.003
LDL (mg/dl)	115.1 ± 30.1	133.5 ± 34.8	135.5 ± 39.8	124.7 ± 37.2	15.9%	0.087
					17.7%	0.049
					8.3%	0.309
HDL (mg/dl)	40.7 ± 12.9	33 ± 13.3	32.2 ± 13	38.9 ± 15.4	19.00%	0.074
					21%	0.018
					4.5%	0.636
Each reading represents Mean ± SD of 50 subjects.						
The significance of difference was checked by One-Way ANOVA, significant at $P < 0.05$, compare all vs control.						

Correlation analysis in Table 5, showed that there is a strong positive correlation between BMI and body weight and waist circumference in all groups ($P \leq 0.001$). BMI also showed a significant positive correlation with the levels of cholesterol in the control group ($P < 0.01$). Strong positive correlations were found between BMI with weight, waist circumference, omentin in the female among normal weight group. There was a strong positive correlation between female weight and waist circumference with overweight and obese groups of females ($P < 0.01$). However, BMI was not significantly correlated with glucose, HbA1c, insulin, or triglycerides in most diabetic groups.

Table 5
Correlation between BMI and the biochemical parameters among the study populations.

Parameters	BMI							
	Control		Normal weight		Overweight		Obese	
	r	P	r	P	r	P	r	P
Weight	0.813**	0.001	0.866**	0.001	0.614**	0.001	0.895**	0.001
Waist circumference	0.727**	0.001	0.716**	0.001	0.362*	0.012	0.804**	0.001
Omentin	-0.479	0.162	0.515*	0.020	0.054	0.777	0.285	0.127
Insulin	0.059	0.811	0.110	0.644	0.131	0.374	0.004	0.974
HBA1C (%)	0.143	0.559	0.227	0.335	-0.049	0.743	-0.155	0.230
Glucose	0.084	0.732	0.089	0.708	-0.048	0.747	-0.016	0.904
Cholesterol	0.607**	0.006	0.209	0.377	0.184	0.210	0.013	0.922
Triglyceride	0.057	0.817	0.177	0.456	0.040	0.789	0.133	0.302
LDL	0.139	0.570	0.239	0.311	0.123	0.404	-0.053	0.681
HDL	0.295	0.220	− 0.217	0.358	-0.029	0.846	0.052	0.686
** Correlation is significant at the 0.01 level (2-tailed).								
* Correlation is significant at the 0.05 level (2-tailed								
significant positive correlation with cholesterol concentrations ($P < 0.01$).								

Discussion

The present study demonstrated that there were significant differences in age, educational level, and place of residency between the studied groups. Diabetic patients were significantly older than the control group, and most of cases fell within the 41–60 years old range. These findings are consistent with other epidemiological studies that indicated the prevalence of type 2 diabetes mellitus increases with advancing age due to progressive insulin resistance and pancreatic β-cell dysfunction. Zheng et al., in 2018 and Sun et al., in 2022, who reported that middle-aged and old people have much higher incidence of T2DM than younger populations [23] and [24]. The study also revealed a significant association between lower educational level and the presence of diabetes. Participants with diabetes were more likely to have primary or secondary education compared with the control group, where higher education levels predominated. This finding is in agreement with the study conducted by Agardh et al. in 2011 and later confirmed by Hill-Briggs et al. in 2020, who reported that low level of education is linked to higher risk of diabetes because of low health literacy, unhealthy lifestyle behaviors, and insufficient access to preventive healthcare services [25, 26]. Additionally, the distribution of residency differed significantly

among groups, with more patients with diabetic being residing in Gaza Governorate. The same geographic differences in the prevalence of diabetes were reported in regional studies from the Middle East and North Africa, where environmental, urbanization conditions, and socioeconomic disparities contribute to differences in the distribution disease [27].

The results showed significant increases in body weight, waist circumference, BMI, and blood pressure among diabetic patients compared to the control group. These results indicated that obesity and T2DM have strong association. Waist circumference is a sign of central obesity, which is known to be a key importance in the mechanism of insulin resistance development. Kohlgruber & Lynch in 2015 and Hruby and Hu in 2015, also reported similar results and revealed that excess adiposity, especially the presence of visceral fat tissue is a strong predictor of T2DM on the basis of inflammatory processes and insulin signaling [28, 29]. The elevated blood pressure observed among diabetic patients in the present study also supports the previous studies showing that hypertension is a common comorbidity in diabetes. According to Fox et al. (2015) hypertension combined with diabetes is a significant risk factor for cardiovascular complications, such as coronary artery disease and stroke [30].

Biochemical examination revealed that HbA1c and fasting glucose levels were significantly higher in diabetic patients than controls, thus showing that the patients had poor glycemic control. These findings are in accordence with the diagnostic criteria and pathophysiological characteristics of T2DM. Similar increases in HbA1c and fasting glucose levels have been reported [31, 32]. Interestingly, the present study showed that the levels of omentin was significantly elevated in overweight and obese diabetic patients. Omentin is an adipokine released by visceral adipose tissue primarily and has been involved in glucose metabolism and insulin sensitivity [7].

Although insulin levels were slightly elevated in diabetic groups, these differences were not statistically significant. This observation may reflect underlying insulin resistance, where increased insulin production fails to maintain normal glucose levels. Similar patterns have been reported in patients with T2DM [33, 34]. The current study reported high levels of dyslipidemia among diabetic patients, which manifested by increased levels of total cholesterol and triglycerides, and decreased HDL levels. These findings are in agreements with the typical lipid abnormalities observed in T2DM, which known as diabetic dyslipidemia. The high triglyceride levels found in overweight diabetic patients, which are closely linked to hypertriglyceridemia, which is strongly associated with insulin resistance and increased cardiovascular risk. According to Mooradian (2009), diabetic dyslipidemia is a major cause of atherosclerosis and cardiovascular disease among diabetic populations [35]. Correlation analysis demonstrated that BMI and anthropometric measures including weight and waist circumference had a strong positive relationship. This relationship is expected since BMI is directly influenced by body mass and fat accumulation. BMI was found to have strong positive correlation with cholesterol in the control group, suggesting that increase in body weight may influence lipid metabolism even in non-diabetic individuals. Similar results were described by Després (2012), who reported that obesity causes dyslipidemia due to the change lipid metabolism and increased hepatic lipid synthesis .[36]

Conclusions

In conclusion, individuals with type 2 diabetes mellitus exhibited significant differences in anthropometric measurements, glycaemic markers, and lipid profile compared with healthy subjects. Elevated omentin concentrations observed among overweight and obese diabetic patients suggest a potential role for this adipokine in metabolic regulation. These findings highlight the possible importance of omentin as a biomarker associated with metabolic disturbances in T2DM. Further investigations are required to clarify the mechanisms underlying the relationship between omentin and metabolic disorders.

Declarations

Clinical trial number: not applicable

Conflicts of interest: The authors declare no conflicts of interest.

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Author contributions: All authors contributed to writing and reviewing the manuscript, and approved the final version. All authors have made a significant contribution to this manuscript, have seen and approved the final manuscript, and have agreed to its submission.

Ethical consideration: the necessary approval to conduct this study was obtained from the Helsinki Committee for Ethical Approval number PHRC/HC/899/21, in the Gaza Strip, and all study participants signed an informed consent form.

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