

The Association of Overweight and Obesity With Hypertension and Diabetes Mellitus At Al-Diwaniyah Province

Noora Flayyih Flek¹, Majid Abdulwahab Maatook², Aqeel Raheem Hassan³

¹Department of Community Health Techniques / College of Health and Medical Techniques/ Southern Technical University Basrah/ Iraq

²Department of Community Health Techniques / College of Health and Medical Techniques/ Southern Technical University Basrah/ Iraq
m.maatook@stu.edu.iq

³College of Medicine/ Al-Qadisiya University Diwaniyah / Iraq draqeelbf1972@gmail.com

KEYWORDS

Association,
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ABSTRACT

Background: Noncommunicable diseases (NCDs) represent a major concern for public health, and one of the main reasons for the global illness burden. Cardiovascular diseases (CVDs) are still the main reason for mortality worldwide and are a major contributor to both health loss and excessive expenditures on healthcare. Aim of study: to determine the prevalence of overweight and obesity among hypertensive or diabetic patients and identify the effect of these conditions on them. Methods: This observational cross-sectional study applied a convenient sample of 322 patients diagnosed with Hypertension or Type 2 diabetes, or both, who attended the Specialized Center for Diabetes and Endocrinology (SCDE) and Internal medicine consultant at Al-Diwaniyah province. An interview-based questionnaire is composed of several questions that have been gathered by researchers and assessed by a number of professionals. From the tenth of September to the beginning of February, the data was collected. Results: A total of 322 participants enrolled in this study, we found that the prevalence rate of obesity and overweight in groups of patients was 37.3% and 53.1%, respectively. There was a significant association between control of blood pressure in the diabetic group ($p = 0.007$), and there was a significant difference in mean age among the diabetes group, the hypertensive group, and the group with both diseases: 51.02 ± 9.64 years, 50.58 ± 12.06 years, and 54.14 ± 9.97 years, respectively ($p = 0.018$). The difference in mean BMI among study groups was significant ($p = 0.003$); the highest mean BMI was seen in patients with both type 2 DM and hypertension, followed by the hypertension group, and the least mean BMI was noted in the diabetic group. Conclusions: The prevalence rate of obesity was higher than that of overweight among study groups. Age and education level were important risk factors for the development of comorbidity among patients. people with hypertension and type 2 diabetes had the greatest mean BMI, followed by hypertension patients, while diabetic patients had the lowest mean BMI ($p = 0.003$). The study discovered a substantial inverse connection between HDL-C, triglyceride, serum creatinine, and cholesterol in hypertensive patients, while A favorable association was identified among VLDL-C "and" cholesterol, whereas in diabetic patients, there was a significant favorable relationship between "LDL-C," "VLDL-C," "cholesterol," and "TG" and an inverse connection between "HDL-C," cholesterol, and blood urea.

1. Introduction

Noncommunicable diseases (NCDs) are a significant public health problem and one of the main reasons for the global illness burden (Kundapur et al., 2022). Cardiovascular diseases (CVDs) continue to be the world's leading cause of mortality overall and have a significant role in both health loss and excessive expenditures on the healthcare system (Roth et al., 2020).

The co-occurrence of essential hypertension and diabetes mellitus (DM) seems to be commonplace, which is not expected given the prevalence of both illnesses. Treatment of these disorders is crucial, as they are regarded as risk factors for congestive heart failure, renal failure, cerebrovascular illness, and coronary artery disease. There has been discussion over the years on whether individuals with diabetes should have their blood pressure (BP) decreased to a different goal. Regarding the goal blood pressure for diabetes patients, current standards are not uniform. Despite some standards suggesting aiming for a blood pressure of less than 140/90 mmHg (Grossman & Grossman, 2017).

Insulin resistance is one condition associated with diabetes mellitus, and fat makes it worse (Chobot et al., 2018). Obesity increased the release of pro-inflammatory cytokines, hormones, glycerol, and non-esterified fatty acids in adipose tissue, which affected insulin resistance conditions (Wondmkun, 2020). Adolescents and early adults who experience severe obesity during childhood and adolescence are more likely to develop diabetes mellitus. For those who are genetically prone to insulin

resistance, obesity is associated with a significant increase in carbohydrate intake (Malone & Hansen, 2019). The age at which obesity first appeared was the only reliable indicator of type 2 diabetes, and the obese year indicates the degree and persistence of obesity (Tanamas et al., 2016). Blood pressure, blood glucose, and other health problems have all been linked to overweight and obesity (Margawati, 2019).

Obesity as well as overweight are significant contributors to disability and a number of illnesses, including type 2 diabetes, hypertension, cardiovascular disease, osteoarthritis, obstructive sleep apnea, Alzheimer's disease, asthma, liver steatosis, gallbladder disease, hypercholesterolemia, and metabolic syndrome (Chiolo, 2018). Additionally, obesity raises the likelihood of unemployment and lowers income (Segal et al., 2021).

2. Methodology

An observational, cross-sectional study was chosen to accomplish the goals of the current study. The study included all adults of both sexes who are 18 years of age and older and who were diagnosed with essential hypertension, type 2 diabetes, or both diseases according to inclusion and exclusion criteria and who attended Al-Diwaniya Teaching Hospital during the period of study. The data was obtained for all adult patients' participants in the study during the period from the first of September, 2023, to the beginning of February, 2024. The study took about five months to continuously collect the data.

Socio-demographic characteristics

The study's general participant data includes the following: sex (male or female), age (in years), The four groups (illiterate, primary, secondary, and tertiary) were based on educational level.

Anthropometric Measurements

Weight and Height

Each participant was told to stand up straight, dress comfortably, and walk on a stadiometer to measure their height. In order to determine their weight, they were also requested to stand on a calibrated scale.

Weight: It represents the patient's weight in kilograms during the patient's visit to the hospital.

Height: It is the length of the patient in centimeters when he visited the hospital.

Body mass index (BMI): It has been estimated by the following formula:

$$\text{BMI} = \text{weight in kilograms} / \{\text{height (in centimeters)}\}^2$$

BMI has been categorized by WHO as below 18.5 (underweight), 18.5 to 24.9 (normal weight), 25.0 to 29.9 (overweight), 30.0 to 34.9 (obesity class I), 35.0 to 39.9 (obesity class II), and above 40 (obesity class III).

Inclusion And Exclusion Criteria

Inclusion criteria

Age: ≥ 18 years, Patient's with type 2 diabetes, patients with essential hypertension. and patients who have both essential hypertension and type 2 diabetes.

Exclusion criteria

Age: < 18 years, Patients with type 1 diabetes, pregnant women, patients with secondary hypertension, psychiatric patients, emergency conditions, and patients who do not like to participate in the study.

Validity of the questionnaire

Before beginning the sample procedure, the questionnaire was sent to seven experts from different specializations for evaluation and assessment of its validity and relevance for this study. The final copy of the study instruments beneficially included opinions from experts.

3. Results and discussion

The prevalence rate of obesity and overweight in the groups of patients enrolled in this study

The current study included 31 patients with normal weight, whose proportion was 9.6%, and 120 patients with overweight, who accounted for 37.3%, in addition to 171 (53.1%) patients who were obese, as shown in figure 1.

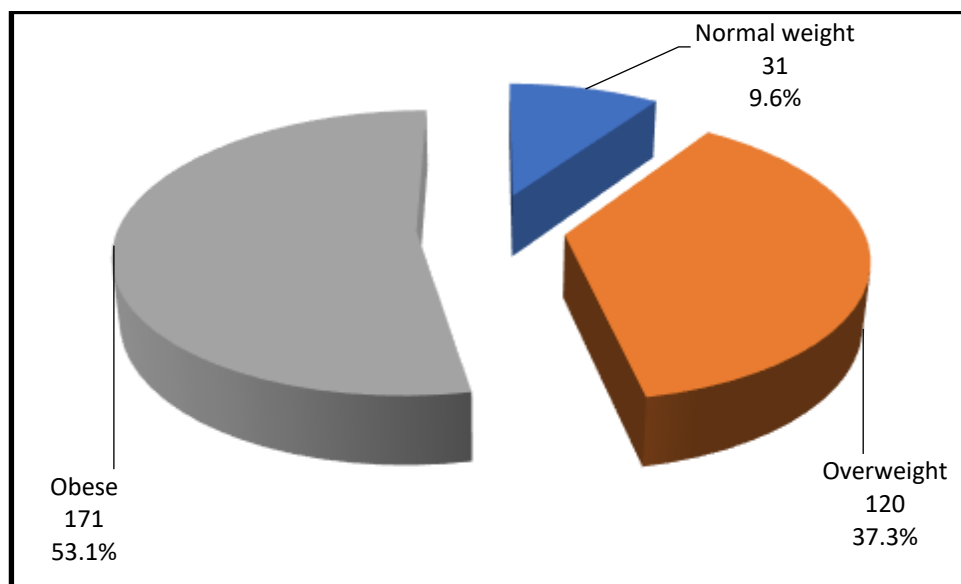


Figure 1: A pie chart showing the categorization of enrolled patients according to body mass index (BMI)

Sociodemographic characteristics of the patients enrolled in the present study

There was a significant difference in mean age among the diabetes group, the hypertensive group, and the group with both diseases: 51.02 $\pm$ 9.64 years, 50.58 $\pm$ 12.06 years, and 54.14 $\pm$ 9.97 years, respectively ($p = 0.018$). With respect to sex, there was no significant difference in proportions of males and females among study groups ($p = 0.233$). With respect to level of education, there was significant variation among study groups ($p = 0.031$) in such a way that the proportion of illiterate subjects was more frequent in the group of both diseases and the proportion of secondary education was less frequent in the group of both diseases in comparison with other groups.

Table 1: Sociodemographic characteristics of the patients enrolled in the present study

Characteristic	Diabetes mellitus <i>n</i> = 123	Hypertension <i>n</i> = 57	Hypertension and diabetes <i>n</i> = 142	<i>P</i>
Age (Years)				
Mean $\pm$SD	51.02 $\pm$ 9.64 B	50.58 $\pm$ 12.06 B	54.14 $\pm$ 9.97 A	0.018 O *
Range	26 -72	20 -81	30 -81	
Sex				
Male	52 (42.3 %)	27 (47.4 %)	50 (35.2 %)	0.233 C NS
Female	71 (57.7 %)	30 (52.6 %)	92 (64.8 %)	
Education level				

Illiterate	23 (18.7 %)	10 (17.5 %)	48 (33.8 %)	0.031 C *
Primary	54 (43.9 %)	20 (35.1 %)	53 (37.3 %)	
Secondary	35 (28.5 %)	23 (40.4 %)	32 (22.5 %)	
Tertiary	11 (8.9 %)	4 (7.0 %)	9 (6.3 %)	

The association of control of blood pressure with overweight and obesity in study groups

There was a significant association between control of blood pressure in the diabetic group ($p = 0.007$) but no such association in the group of both diseases. This association cannot be calculated statistically in the hypertensive group because control of blood pressure was never reported in this group.

Table 2: The association of control of blood pressure with overweight and obesity in study groups

Characteristic	Hypertension $n = 57$		Diabetes mellitus $n = 123$		Hypertension and diabetes $n = 142$	
BMI (kg/m^2)	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled
Normal weight	0 (0 %)	6 (10.5 %)	14 (11.3 %)	4 (3.3 %)	1 (0.7 %)	6 (4.2 %)
Overweight	0 (0 %)	21 (36.9 %)	16 (13.0 %)	31 (25.2 %)	8 (5.6 %)	44 (31.1 %)
Obese	0 (0 %)	30 (52.6 %)	28 (22.8 %)	30 (24.4 %)	6 (4.2 %)	77 (54.2 %)
P	---		0.007 C **		0.307 NS	

The association of diabetes control with overweight and obesity in study groups

There was no significant association between control of diabetes in the diabetic group ($p = 0.300$) and the group of both diseases ($p = 0.456$). This association cannot be calculated statistically in the hypertensive group because control of diabetes was reported in all patients in this group.

Table 3: The association of diabetes control with overweight and obesity in study groups

Characteristic	Hypertension $n = 57$		Diabetes mellitus $n = 123$		Hypertension and diabetes $n = 142$	
BMI (kg/m^2)	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled
Normal weight	6 (10.5 %)	0 (0 %)	0 (0.0 %)	18 (14.6 %)	2 (1.4 %)	5 (3.5 %)
Overweight	21 (36.9 %)	0 (0 %)	1 (0.8 %)	46 (37.4 %)	8 (5.6 %)	44 (31.1 %)
Obese	30 (52.6 %)	0 (0 %)	4 (3.3 %)	54 (43.9 %)	10 (7.0 %)	73 (51.4 %)
P	---		0.300 C NS		0.456 C NS	

Comparison of mean body mass index and rates of overweight and obesity among study groups

The mean body mass index of diabetic patients was $29.92 \pm 5.13 \text{ kg}/\text{m}^2$, that of the hypertensive group was $31.19 \pm 5.65 \text{ kg}/\text{m}^2$, and that of patients with both diseases was $32.19 \pm 5.29 \text{ kg}/\text{m}^2$. The difference in mean BMI among study groups was significant ($p = 0.003$); the highest mean BMI was seen in patients with both type 2 DM and hypertension, followed by the hypertension group, and the least mean BMI was noted in the diabetic group. The prevalence rates of overweight were 38.2%, 36.8%, and 36.6% in the diabetic group, hypertensive group, and group of comorbidity, respectively. The prevalence rates of obesity were 47.2%, 52.6%, and 58.5% in the diabetic group, hypertensive group, and group of comorbidity, respectively.

Table 4: Comparison of mean body mass index and rates of overweight and obesity among study groups

Characteristic	Diabetes mellitus n = 123	Hypertension n = 57	Hypertension and diabetes n = 142	P
Body mass index (kg/m ²)				
Mean ±SD	29.92 ±5.13 B	31.19 ±5.65 A	32.19 ±5.29 A	0.003 O **
Range	18.8 -48.6	20.8 -44.8	22.4 -51.4	
Normal weight	18 (14.6 %)	6 (10.5 %)	7 (4.9 %)	0.087 C NS
Overweight	47 (38.2 %)	21 (36.8 %)	52 (36.6 %)	
Obese	58 (47.2 %)	30 (52.6 %)	83 (58.5 %)	

Correlations among variables in the group of hypertension

The study found that in hypertensive patients, there was a significant positive correlation between systolic blood pressure (SBP), diastolic blood pressure (DBP), and cholesterol ($r = 0.419$, $p = 0.001$) and $r = 0.328$, $p = 0.013$), respectively. There was also a significant positive correlation between “LDL-C and each of VLDL-C, cholesterol, and TG” ($r = 0.470$, $p < 0.001$), ($r = 0.847$, $p < 0.001$), and ($r = 0.273$, $p = 0.040$), respectively. There was a significant negative correlation between “HDL-C and each of TG and serum creatinine” ($r = -0.352$, $p = 0.007$) ($r = -0.327$, $p = 0.004$), respectively. There was a significant positive correlation between “VLDL-C and cholesterol” ($r = 0.698$, $p = 0$).

Table 5: Correlations among variables in the group of hypertension

Characteristic		SBP (mmHg)	DBP (mmHg)	FBG (mg/dl)	HbA1C%	LDL	HDL	VLDL	Cholesterol	TG	Blood urea	Serum creatinine
Body mass index	r	0.018	-0.213	0.340*	0.152	-0.049	0.012	0.212	0.069	-0.108	0.088	-0.111
	P	0.894	0.111	0.010	0.258	0.718	0.93	0.113	0.61	0.425	0.516	0.409
SBP (mmHg)	r		0.419***	-0.066	0.096	-0.093	0.111	-0.062	-0.092	0.328*	-0.105	0.024
	P		<0.001	0.627	0.477	0.492	0.409	0.645	0.495	0.013	0.437	0.858
DBP (mmHg)	r			0.057	-0.116	0.172	0.156	0.008	0.101	0.041	-0.023	0.075
	P			0.675	0.388	0.200	0.246	0.954	0.457	0.764	0.865	0.578
FBS (mg/dl)	r				0.239	0.143	-0.051	0.065	0.092	0.226	-0.039	-0.078
	p				0.074	0.290	0.709	0.633	0.495	0.09	0.774	0.566
HbA1C %	r					-0.065	-0.084	0.127	0.006	0.085	0.176	0.094
	p					0.632	0.532	0.345	0.968	0.529	0.191	0.486
LDL (mg/dl)	r						-0.188	0.470***	.847***	.273*	0.051	0.07
	p						0.161	<0.001	<0.001	0.040	0.708	0.606
HDL (mg/dl)	r							0.044	0.143	-0.35**	0.001	-0.372**
	p							0.747	0.288	0.007	0.994	0.004
VLDL (mg/dl)	r								.698**	0.253	0.23	-0.026
	p								0	0.057	0.085	0.85
Cholesterol (mg/dl)	r									0.214	0.088	-0.049
	p									0.111	0.516	0.719
TG (mg/dl)	r										0.074	0.119
	p										0.583	0.378
BU (mg/dl)	r											0.254
	p											0.057

*: significant at $p \leq 0.05$; **: significant at $p \leq 0.01$; ***: significant at $p \leq 0.001$

DISCUSSION

The prevalence rate of obesity and overweight in the groups of patients enrolled in this study

The current study illustrates that 9.6% of patients were of normal weight, 37.3% were overweight, and 53.1% were obese, as shown in **Figure 1**. These outcomes were consistent with research conducted in the Emirate by (Mussa et al., 2016), which showed that 57% of patients with type 2 diabetes were obese. The present study is higher than another one by (Mandal, 2014), which found that the study population's obese group (20.2% and 22.2%, respectively) and overweight group (15.5% and 8.2%, respectively) had higher rates of type 2 diabetes and hypertension. (Wondmkun, 2020) showed that obesity is one of the risk factors for diabetes that is connected to insulin resistance, which helps to explain the increase in the prevalence of obesity.

Sociodemographic characteristics of the patients enrolled in the present study

The mean age of the diabetic patients in this study was 51.02 ± 9.64 , which was greater than the mean age of the hypertension patients (50.58 ± 12.06) and lower than the mean age of the diabetes patients (54.14 ± 9.97), with a significant difference ($p = 0.018$) as seen in **Table 1**. These findings agreed with the results of a study conducted in Gaza City, Palestine, (Ellulu, 2018) which discovered that the group with hypertension and type 2 diabetes was older and had a higher body mass index than the groups with hypertension and type 2 diabetes. According to the current study, the sex distribution showed that most participants were female and that there was no significant difference between the groups ($p = 0.233$). While (Shivpuri et al., 2012) and (Ishii et al., 2012) found that female participants had higher inflammatory susceptibility, which might make them more prone to metabolic syndrome and diabetes, According to (Moradi-Lakeh et al., 2015), Saudi Arabian female participants self-reported their health as poorer than that of male adults. According to research by (Abdeen et al., 2012), female participants in Palestine had twice the rate of obesity as male subjects did. This shows that obesity in the female population may elevate the risk of sickness. According to these findings, those with both conditions had a higher likelihood of being illiterate ($p = 0.031$) than people with either diabetes or hypertension. These findings were in line with those of (Ellulu, 2018), who discovered that patients with higher education levels had a larger percentage of HT (49.2%), whereas patients with lower education levels had a higher proportion of T2DM + HT (49.3%). Lower education levels have been linked to diabetes and hypertension, according to different research by (Sabuncu et al., 2021).

The association of control of blood pressure and control of diabetes with overweight and obesity in study groups

The study shows that overweight and obese diabetics had greater rates of uncontrolled blood pressure than those with normal weight, as shown in **Table 2**. Overweight and obese people with hypertension and diabetes also have greater chances of having uncontrolled blood pressure. The statistical analysis showed a significant connection ($p = 0.007$) between overweight or obesity and uncontrolled blood pressure in the diabetes group but not in the hypertension and diabetes groups ($p = 0.307$). These findings suggest that weight management strategies are needed to enhance hypertension management in diabetic and nondiabetic individuals due to the relationship between obesity and poor blood pressure control. These results agreed with (Dulskiene et al., 2014), there were significant correlations between high blood pressure and being overweight or obese. Specifically, hypertension (overweight: aOR = 3.56; 95% CI 3.02–4.19; obesity: aOR = 6.64; 95% CI 4.65–9.49).

The association of diabetes control with overweight and obesity in study groups

The results of this study indicate that among the diabetic mellitus group, many overweight and obese people had uncontrolled diabetes, whereas in the hypertension group, none of them had uncontrolled diabetes, as shown in **Table 3**. Although not statistically significant, more overweight and obese

people with hypertension and diabetes had uncontrolled diabetes than normal-weight people. These results are nearly in agreement with (Hernández-Mijares et al., 2009), which reported that the relative prevalence ratio (RPR) for people with HT who were overweight was 2.00 [95% CI: 1.21–3.32] compared to adults of normal weight; for subjects with HT who were obese, it was 1.91 [95% CI: 1.48–2.446]; and for patients with DM, it was 1.50 [95% CI: 1.25–1.81].

Comparison of mean body mass index and rates of overweight and obesity among study groups

During this research, people with hypertension and type 2 diabetes had the greatest mean BMI, followed by hypertension patients, while diabetic patients had the lowest mean BMI ($p = 0.003$), as shown in **Table 4**. These results agreed with the study findings done by (Lee et al., 2011), which found that subjects with high body mass index (BMI) and high glucose levels during fasting within the hypertensive group had a 40-fold increased likelihood of getting diabetes mellitus (DM) as compared to those with low BMI and low glucose levels (0.3 vs. 13.2%, $P = 0.001$).

Correlations among variables in the group of hypertension

The study found that in “hypertensive patients,” there was a significant positive correlation between “diastolic blood pressure (DBP),” “systolic blood pressure (SBP),” and “cholesterol ($r = 0.419$, $p = 0.001$) and ($r = 0.328$, $p = 0.013$),” respectively, as shown in **Table 5**. These findings were in line with the research conducted by (Whelton et al., 2020), which found that the risk of atherosclerotic cardiovascular disease, coronary artery calcium, and the prevalence of established risk factors for atherosclerotic cardiovascular disease increased gradually. Atherosclerotic cardiovascular disease was associated with a 53% higher danger for every 10 mm Hg increase in systolic blood pressure. Also, a study by (Kim et al., 2018) revealed that high variability of total cholesterol levels, “body mass index,” and “systolic blood pressure” was an autonomous cardiovascular incident predictor.

In this study, the findings showed that there was also an effective positive connection among “LDL-C” and “each of VLDL-C, cholesterol, and” triglyceride “(TG)” “($r = 0.470$, $p < 0.001$),” “($r = 0.847$, $p < 0.001$),” and “($r = 0.273$, $p = 0.040$),” “respectively.” These results agreed with (Srinivaspai et al., 2014), which found that all the lipid fractions (TGL, VLDL, and LDL-C) ratios were greater in the hypertensive patients. Another study by (Sidmal & Leelamohan, 2021) reported that “total cholesterol,” “LDL cholesterol,” and triglyceride ratios are significantly raises in patients with hypertension.

There was a significant negative correlation between HDL-C and each of TG and serum creatinine ($r = -0.352$, $p = 0.007$) ($r = -0.327$, $p = 0.004$), respectively. These results are consistent with those of (Liu et al., 2020), who found similar results.

The finding of the study found that there was a “significant positive correlation” between “VLDL-C” and “cholesterol.” These findings agreed with the study outcomes done by (Bansal et al., 2021), which reported that there was a strong beneficial connection among “VLDL-C” and “cholesterol.”

4. Conclusion and future scope

The prevalence rate of obesity was higher than that of overweight among study groups.

Age and education level were important risk factors for the development of comorbidity among patients.

The rates of uncontrolled blood pressure were higher in overweight and obese diabetics compared to normal-weight individuals. Patients who are overweight or obese and have diabetes and hypertension are also more likely to have uncontrolled blood pressure.

Uncontrolled diabetes affects a large number of overweight and obese individuals with diabetes mellitus, whereas in the hypertension group, none of them had uncontrolled diabetes.

The study discovered a substantial inverse connection between HDL-C, triglyceride, serum creatinine, and cholesterol in hypertensive patients, while A favorable association was identified among VLDL-C “and” cholesterol, whereas in diabetic patients, there was a significant favorable relationship between “LDL-C,” “VLDL-C,” “cholesterol,” and “TG” and an inverse connection between “HDL-C,” cholesterol, and blood urea.

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