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Relationship Between Obesity and Hypertension among Sudanese Hypertensive Patients Attending Health Centers in El-Obeid City, North Kordofan State, West of Sudan

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Abstract

Background: Hypertension has been recognized as the most common cardiovascular disorder and a major risk factor for cardiovascular diseases (CVDs), chronic kidney disease, cognitive impairment and loss of vision. It is known as 'the "silent killer" because it can be asymptomatic for many years. Obesity and/or abdominal obesity, are the main hypertensinogenic factor.

Objectives: The aim of this study is to determine the relationship between obesity indices and hypertension among Sudanese hypertensive patients.

Methodology: A cross-sectional hospital-based study was conducted in three health centers in El-Obeid city, West Sudan. Data were collected on anthropometric measurements (height, weight, Body Mass Index (BMI), waist circumference WC) and blood pressure (BP) measurement. The data were analyzed by the Statistical Package of Social Science (SPSS) software version 23.0. Independent sample t test, Chi-square ($\chi 2$) test and Pearson's correlation coefficient were used. p value of ≤ 0.05 was taken as measure of statistical significance.

Results: A total of 100 subjects, 19 males and 81 females, were voluntary enrolled in this study. The mean age was 53.05 (±8.28), the mean value of BMI was 28.21 (± 5.577), WC was 92.79 ± 11.009, SBP was 138.20 (±14.591), DBP was 85.50 (±9.252). Thirty-seven, (37%) were overweight, (33%) were obese, (25%) milled (class I), (6%) moderate (class II) and (2%) severe obesity (class III). Seventy-six, (76%) have central obesity (WC >102 cm for men and >88 cm for women). There was a statistically significant positive correlation between BMI and WC ($p < .001$), BMI and SBP ($p = .045$), WC and SBP ($p = .026$), WC and DBP ($P = .001$).

Conclusion: Hypertensive patients had a high prevalence of overweight, obesity, abnormal/high BMI, and WC (central obesity). BMI and WC were positively correlated with BP. Lifestyle modification toward weight reduction is recommended in these patients. Additionally, obese persons must pay attention to their weight and try to lose weight to prevent hypertension.

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Keywords: Obesity, Hypertension, Hypertensive Patients, Health Centers, Sudan, El-Obeid

Introduction:

Hypertension (HTN) is a term used to describe a high or raised blood pressure (HBP) [1,2]. It is defined as blood pressure equal or more than 140/90 mm Hg, or under antihypertensive medication (1–5). It is a global public health problem (2,4,6,7) in many countries including Sudan (6–9). It has been recognized as the most common cardiovascular disorder (1,10–12) and a leading cause of death (2,8,11,13,14) and disability worldwide (8,13). Hypertension is a major risk factor for chronic diseases such as cardiovascular diseases CVDs (1,10,15,16) and chronic kidney disease (4,8,10,17). In addition to cognitive impairment, loss of vision and blood vessels rupture (2). It is often known as 'the "silent killer" because It can be asymptomatic for many years (2,6,8,18). World Health Organization (WHO) reported that, 1.13 billion, 22% of the adult aged 18 years and older, one in four men, and one in five women had hypertension worldwide(19), and predicted to increase by 2025(17).In Sudan, about

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30-34.9% of the population have hypertension according to a report in 2015(20). Hypertension coexists with other risk factors for CVDs such as obesity and abnormal lipid profile (dyslipidemia) (12,21).

Obesity, is a complex disorder involving an excessive amount of body fat, it measured by abnormal body mass index (BMI) and waist circumference WC (12,21). It is a major risk for hypertension (7,22,23), CVDs , diabetes and renal diseases (23–26). It is also a risk factor for certain cancers, gallstones and osteoarthritis (3,25,27). Obesity is a major cause of hypertension this comes from multiple studies. A study suggests that about 65% to 75% of the risk for hypertension can be directly attributed to adiposity(28). Coexisting increases the risk of some conditions like coronary artery disease, renal insufficiency, atherosclerosis, atrial fibrillation, and congestive heart failure (29). There is a significant association between obesity and hypertension, yet there is a lack of data and information locally. Consequently, it is considered desirable and beneficial to assess the relationship between overweight/obesity and hypertension among Sudanese hypertensive patients.

Material and Methods:

This was observational descriptive cross-sectional hospital-based study conducted in three health centers in Elobeid city, North Kordofan state , Sudan from October (2019) to the end of December (2020). These centers include; Wad Alias, Kordofan university and Algala'a health centers. The inclusion criteria: patients diagnosed with essential hypertension, both gender, and between 30-65 years of age who voluntary agree to participate in the study. The exclusion criteria: patients with secondary hypertension, chronic kidney disease, heart diseases, diabetes mellitus and hyperthyroidism, pregnant women, lactating mothers, smokers and alcoholic.

After obtaining an informed written consent, structured questionnaire was used to collect BP and anthropometric data. BP was measured using a calibrated portable mercury sphygmomanometer, with fitting cuff size (3,6,30–33). The average of the two readings was recorded (34) in millimeters of mercury (mmHg) as systolic over diastolic blood pressures (6,30,33,35). BMI was calculated by dividing the weight in kilograms (kg) by the height in meters (m) squared (3,30,32). BMI (kg/m2) is defined as: BMI <18.5 kg/ m2 as underweight, 18.5-24.9 kg/m2 as normal, 25–29.9 kg/m2 as overweight and (BMI) ≥ 30kg/m2 as obesity(8,9,36). Obesity is classified into Mild /Class I (BMI = 30-34.9 Kg/m2), moderate/Class II (BMI = 35-39.9 Kg/m2) while severe obesity/Class III (BMI ≥ 40 Kg/m2) according to (WHO) classification(3,22,37). WC was measured by using a calibrated flexible tape with subjects in the standing position from midway between the lowest rib and the iliac crest (34) and expressed in centimeters(cm). High WC (WC >102 cm for men and >88 cm for women) indicates central obesity(17,38). The data analysis was performed using the IBM statistical package for social science (SPSS) version 23. Data were presented as mean ± SD and comparison between groups was done using independent sample t test. while other categorical variables were expressed in frequencies and percentages. Chi-square ($\chi 2$) tests and Pearson's correlation coefficient were used. p value of ≤ 0.05 was taken as measure of statistical significance.

Results:

This study comprised of 100 adult hypertensive patients. The study population were 81 females and 19 males, with mean age of 53.05 (±8.28), for males it was 56.47(±7.121) and for females it was 52.25(±8.373). The mean (± SD) of SBP was 138.20 (± 14.591), there was no significant differences between males and females (p-value = 0.333). The mean (± SD) of DBP was 85.50 (± 9.252), there was significant differences between males and females (p-value = 0.018).

The mean (± SD) of BMI was 28.21 (± 5.577), females, had high mean BMI than males, the difference was significant (p-value = 0.012). The mean (± SD) for WC was 92.79 (± 11.009), there was no significant differences between males and females (p-value = 0.836) (Table 1).

Thirty-seven, (37%) were overweight [8(42.1% of males) vs 29(35.8% of females)] and (33%) were obese [2(10.5% of males) vs 31(38.3% of

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females)], (25%) milled (class I), (6%) moderate (class II) and (2%) severe obesity (class III) (Table 2). Among all participants (70%) have high BMI (≥25 kg/m2), females are affected more frequently than males 60(74.1% of females) vs 10(52.6% of males). Seventy-six, (76%) have high WC which indicates central obesity, females are affected more frequently than males 68(84.0%) vs 8(42.1%), p-value < 0.001 (Table 2, fig 2).

Correlations between anthropometric measurements and BP**:** There was a statistically significant positive correlation between weight and BMI (r =.900, p < .001), weight and WC (r = .867, p < .001), weight and SBP (r = .233, p =.020), weight and DBP (r =.320, p = .001); BMI and WC (r = .788, p < .001), BMI and SBP (r =.201, p = .045); WC and SBP (r = .223, p = .026), WC and DBP (r = .323, P = .001) (Table 3).

Table 1 Age, anthropometric and BP measurements according to Sex

Sex of participant		Age years	Weight kg	Height m	BMI kg/m^2	WC cm	SBP mm Hg	DBP mm Hg
Male	Mean	56.47	74.91	1.72	25.34	93.26	141.05	90.00
	Std. Deviation	7.121	12.906	.0688	3.209	9.904	19.971	12.472
	N	19	19	19	19	19	19	19
Female								
	Mean	52.25	75.55	1.62	28.89	92.68	137.53	84.44
	Std. Deviation	8.373	16.240	.0602	5.809	11.307	13.089	8.062
	N	81	81	81	81	81	81	81
Total								
	Mean	53.05	75.43	1.64	28.21	92.79	138.20	85.50
	Std. Deviation	8.286	15.603	.0731	5.577	11.009	14.591	9.252
	N	100	100	100	100	100	100	100
	p-value(sig)	0.045	.873	0.000	0.012	0.836	0.333	0.018

Table 2 Classifications of BMI, Obesity and WC in the participants

Variables	**Frequency**	**Male**	**Female**	**p-value**
BMI classification				
Underweight (< 18.5 kg/m^2)	3		3(3.7)	
Normal (18.5 - 24.9 kg/m^2)	27	9(47.4)	18(22.2)	0.045
Over weight (25 - 29.9 kg/m^2)	37	8(42.1)	29(35.8)	
Obese (≥30 kg/m^2)	33	2(10.5)	31(38.3)	
BMI <25kg/m^2	30	9(47.4)	21(25.9)	0.066
BMI ≥25kg/m^2	70	10(52.6)	60(74.1)	
Obesity classification				
Mild	25	2(10.5)	23(28.4)	0.771
Moderate	6		6(7.4)	
Sever	2		2(2.5)	
WC classification				
Normal	24	11(57.9)	13(16.0)	<0.001
Abnormal	76	8(42.1)	68(84.0)	
Central obesity				
Yes	76	8(42.1)	68(84.0)	<0.001
No	24	11(57.9)	13(16.0)	
Total	100	19(100%)	81(100%)	

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Table 3 Correlation between anthropometric indices and BP

		Weight	BMI	WC	SBP	DBP
Weight	Pearson Correlation	1	.900**	.867**	.233*	.320**
	Sig. (2-tailed)		.000	.000	.020	.001
BMI	Pearson Correlation	.900**	1	.788**	.201*	.175
	Sig. (2-tailed)	.000		.000	.045	.082
WC	Pearson Correlation	.867**	.788**	1	.223*	.323**
	Sig. (2-tailed)	.000	.000		.026	.001
SBP	Pearson Correlation	.233*	.201*	.223*	1	.620**
	Sig. (2-tailed)	.020	.045	.026		.000
DBP	Pearson Correlation	.320**	.175	.323**	.620**	1
	Sig. (2-tailed)	.001	.082	.001	.000	
	N	100	100	100	100	100

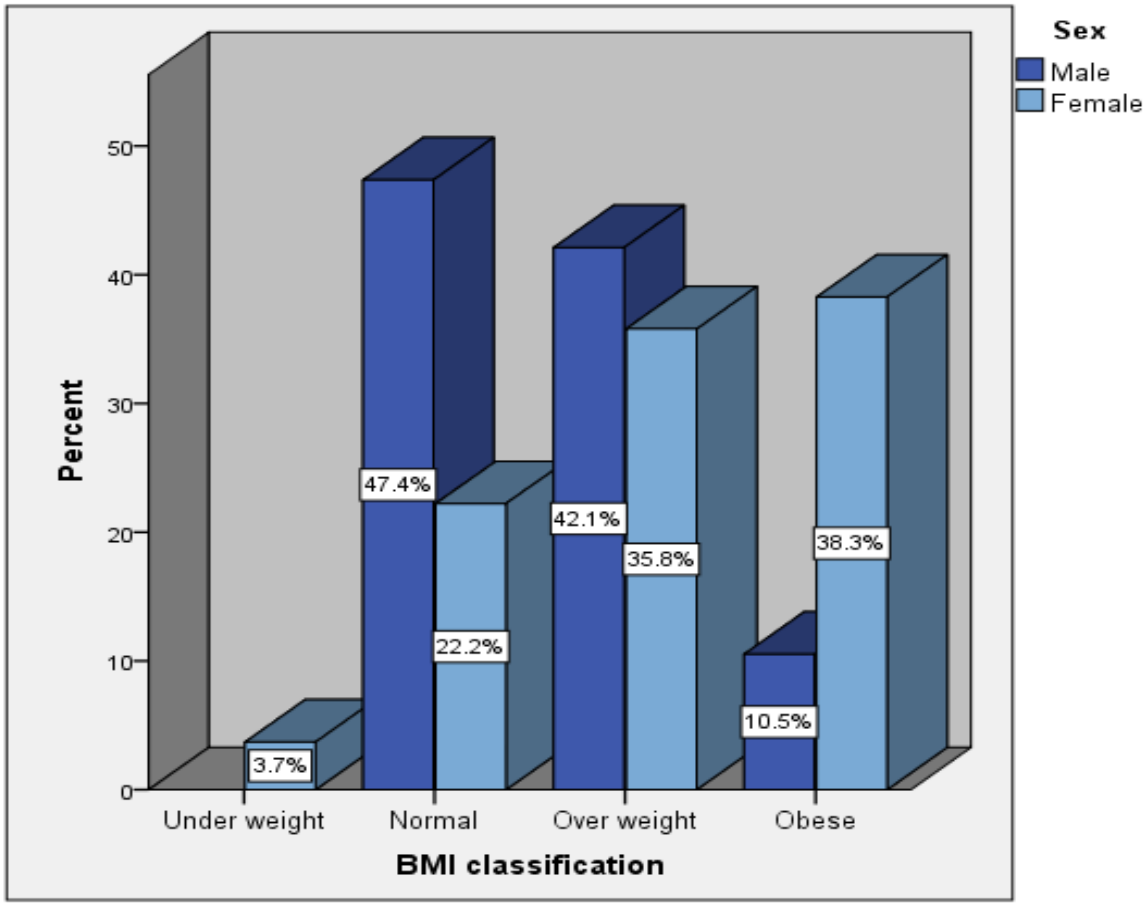

Figure 1 classification of BMI in each sex

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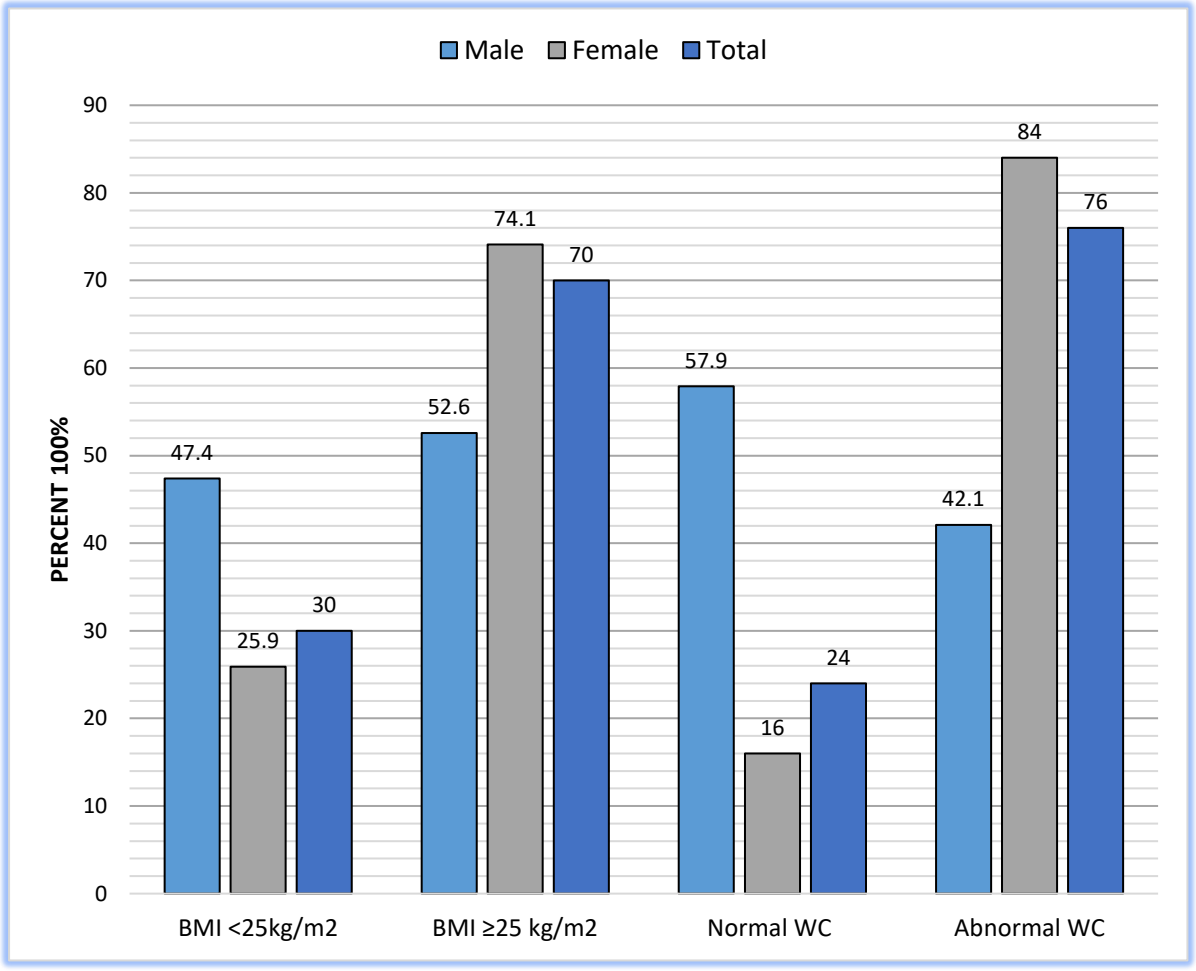

Figure 2 Categorization of participants according to BMI and WC in each sex

Discussion:

This study was conducted to investigate the relationship between obesity (BMI and WC) and BP among Sudanese adults with essential hypertension in Elobeid City, North Kordofan State, West of Sudan. In the present study, 100 patients with essential hypertension (81females and 19 males), ages between 30 to 65 years, (74%) were married, (61%) of total females were housewives. Significantly larger proportions of patients were found to have elevated BP, high weight, and high BMI and WC.

This study showed that more than half of hypertensive patients (55%) had poorly controlled blood pressure despite (96%) of them were using at least one antihypertensive drug prescribed. Poorly controlled blood pressure is when it is not well controlled despite using antihypertensive drugs, when BP ≥ 140/90 mm Hg, while controlled blood pressure is when BP less than 140/90 mm Hg(21). In this study, male subjects have statistically significant higher DBP than female subjects but no statistically significant variation between sexes regarding SBP. These results were in contrast with Gebrie et al study in Ethiopia (21) who observed that females had significantly higher SBP and DBP than males. There was no statistical significance between SBP and DBP in male and female patients in Akintunde et al study in Nigeria(3). In Dua, et al. study in India (2014), reported that both SBP and DBP were found to be significantly higher among men as compared with women(36). There is a significant relationship between obesity and hypertension (3,24,28,39), which is now widely recognized both in children and adults(39). Obesity is often related to hypertension, either as a causative or a coexisting factor (3,12). Experimental studies shows that weight gain raises BP and excess weight gain predicts future development of hypertension, and the relationship between (BMI) and (BP) appears to be almost linear in different populations(28).

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This study revealed that the mean BMI is high (28.21 (± 5.577) in the study participants. In Gebrie et al. study in Ethiopia, showed that the mean BMI in the study participants is normal 24.60 (±3.72)(21), which does not agree with our finding. The mean BMI for females was higher than males. This result was in agreement with Akintunde et al(3) and Gebrie et al(21) Moreover, WC was found to be higher in hypertensive subjects than their respective cut-off values (WC >102 cm (40 in) for men and >88 cm (35 in) for women). This was in agreement with Gebrie et al(21).

Seventy percent (70 %) of the participants had high BMI, while (76%) had high WC. Females are affected more frequently than males 60(74.1%) vs 10(52.6%) high BMI and 68(84.0%) vs 8(42.1%) with high WC. A study done by Anwar S et al in Oman 2019, reported that, (77.3%) of hypertensive population had high BMI which was alike to our findings; whereas (63.5%) of hypertensive had WC more than the gender specific cutoff point (40). Michael et al in Nigeria 2019 reported that a relatively high proportion of hypertensive subjects were obese, as indicated by different anthropometric indices: abnormal WC (58.5%), abnormal BMI (30.7%), higher number of females had abnormal measures for obesity, a total of 218 females (75.2%) had high WC as compared to 24 (19.4%) of the males (12), which agree in a part with our findings except of higher prevalence in ours. This was also in agreement with Dua, et al who reported that, BMI was found to be higher among females as compared with males(36).

In the present study, (3%) of all participants were underweight, (27%) were normal, (37%) were overweight and (33%) were obese. This agrees in part with a similar report from earlier study done by Akintunde et al (3), except that the frequency of underweight and normal BMI were less in our study than reported there (3% vs 7.6%), (27% vs 31.9%). The study also showed high prevalence of overweight and obesity among hypertensive patients which agreed with earlier study done by Akintunde et al (3). The frequency of overweight in the two studies were 37% in ours vs 35% while the frequency of obesity in our study was more than reported there (33% versus 25.6%). There were more men with overweight than females [8(42.1%) of males vs 29(35.8%) of females] in this study, while obesity is more common among females than males 31(38.3% females) vs 2(10.5% of males), this finding was in agreement with similar studies by Akintunde et al (3) and in India 2014 done by Dua, et al (36). In Saudi Arabia (2020), AlMarri and Al-Hamad conducted a similar study and they reported that 21.2% were overweight and (75.39%) were obese (41). The frequency of overweight was less than reported in ours while the frequency of obesity was extremely high.

Mild (class I), moderate (class II) and severe obesity (class III) found in (25%), (6%) and (2%) of the participants respectively. Akintunde et al also reported that (16.5%), (5.3%) and (3.7%) had mild, moderate and severe obesity respectively (3), which was close to our findings. AlMarri and Al-Hamad study had high prevalence at different stages (31.7%), (25.7%) and (18.0%) respectively (41).

The higher prevalence of obesity among the female subjects was partly attributed to physical inactivity, most of the females were housewives with sedentary life style. Women are however more susceptible to gluteo-femoral lipogenesis and fat deposition and account for the increased frequency of obesity among females in this study. Also, this might be attributed to the weight gained by females during pregnancy which is not lost after delivery. Obesity recognizes as a major cardiovascular risk factor and was reported that a weight loss of 10kg reduces the blood pressure of up to 5-20 mmHg. Therefore it is a major lifestyle modification in the management of hypertension(3).

Conclusion:

More than two thirds of Sudanese hypertensive patients were either overweight or obese in this study. Hypertensive patients had a high prevalence of overweight, obesity and high BMI and WC (central obesity). BMI and WC were positively correlated with BP.

Limitation of the study :This study has several limitations, first, the sample size was obtained from a three urban primary health centers related to the National Health Insurance Fund (NHIF) in Sheikan locality and may not be representative of all hypertensive patients in El-Obeid city. Second, the sample size is small, only 100 sample in a long period of time.

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Recommendations:

Measuring BMI and WC at regular intervals for patients who attending health centers and hospitals is recommended. It is very necessary to provide follow-up clinics for those who suffer from overweight or obesity. Lifestyle modification toward weight reduction is recommended in hypertensive patients. Additionally, obese persons must pay attention to their weight and try to lose weight to prevent hypertension. Since a small number of the population was considered for the present study, future studies on higher populations are recommended.

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Ethical Consideration:

Ethical clearance was taken from the ethical clearance committee of International University of Africa, Officials of Wad Alias Health center, Kordofan University Health Center, and Algala'a Health Center Committee were consulted and their agreement was taken. A written obtained from each participant before participation. Care was taken to affect no harm between patients and confidentiality of data as well anonymity of individual identity.

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