The Relationship of Waist-Hip Ratio and Body Mass Index to Blood Pressure of Employee in Sulaimani Teaching Hospital

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Abstract:

Background: Several studies have shown that the reisa significant relationship between increase in weight and blood pressure. The anatomical distribution of weight has also been shown to be a factor in determining which people are moresusceptible to hypertension and thus, at risk of developing cardiovascular diseases.

Objectives: To examine the Body Mass Index profile and Waist Hip Ratio ratio measurements of Sulaimani Teaching Hospital employee and its relationship withblood pressure.

Methodology: Two hundred individuals of Sulaimani Teaching Hospital employeeaged20-65 years (according to inclusion criteria) were selected including males and females. Information was obtained about lifestyle, smoking, and occupation as well as family history of hypertension, diabetes, cardiac and renal diseases, that employee were asked to undergo physical examination, height, weight, waist circumference, hip circumference, mid arm circumference systolic and diastolic blood pressure and pulse rate were recorded. The partial correlation was used to quantify the association between Body Mass Index and Waist Hip Ratio and other anthropometrics with systolic and diastolic blood pressure.

Results: Mean Body Mass Index was 27.28 (SD±4.55). Descriptive analysis revealed that 1(0.5%) of the study populationis classified as underweight, 66(33 %) as normal weight, 91(45.5%) as overweight, and 42(21.0 %) as obese.

Abdominal adiposity, as measured by increased Waist Hip Ratio, was present in 126 subjects (63%) among them 23(18%) subjects hadnormal Body Mass Index.

Inspection of the data obtained for the hypertension, indicated.

That (16) subjects of the study population (8.0%) were hypertensive,

(6females and10 males) among those (5) males had normal Body Mass Index.

Partial correlation controlled for age, revealed that both Body Mass Index and Waist Hip Ratio were independently correlated with both systolic and diastolic blood pressures, this association was more with Waist Hip Ratio than that of Body Mass Index.

Conclusions: The present results indicate that there is a high prevalence of overweight and obesity specially among the young and adult sage groups more than that of the old age group in Sulaimani Teaching Hospital employee, additionally there is high prevalence of abdominal obesity specially young females in spite of having normal Body Mass Index. Thereishighincidenceofhypertensionandthisincidencerelatedmorewiththeincreasingweightandabdominalfatthan with ageing table (13) and figure (1 -A).

Keywords: Waist, Hip, Body, Mass, Ratio, Blood Pressure, Obesity.

Introduction:

The issue of overweight and obesity has become a serious public health concern all over the world during the last decades. The prevalence of overweight and obesity is increasing, and obesity is estimated to be a major leading cause of mortality and morbidity, causing anestimated 2.6 million deaths

worldwide and (2.3%) of the global burden of disease [1].

Obesity is closely associated with cardiovascular diseases such as hypertension and ischemic heart disease and stroke, as well as major risk factors for metabolic disorders, as diabetes mellitus, hypertriglyceridemia, hyperuricemia, high blood pressure, hypercholesterolemia, liver, biliary, joint, pulmonary, psychiatry and gynecological disorders [2, 3, 4].

Definition of Obesity:

Obesity is a state of excess adipose tissue mass, although often viewed as equivalent to increased weight, this need not to be the case—lean but muscular individuals may be overweight by numerical standard without having increased adiposity. Obesity therefore more effectively defined by assessing its linkage to morbidity and mortality [5].

Making use of the associations between obesity and it's complications, simple obesity index essuc has body mass index (BMI), waist circumference (WC), waist-to-hipratio (WHR), and other related indices such as waist-to-weight ratio (WHtR) and waist-to-stature ratio (WSR) may serve aspredictors of cardiovascular disease and obesity related metabolic disorders [3,4].

The anthropometric measurements BMI, WC, and WHR are essentially different in body fat distributions as indexes of overall and central adiposity. Waist circumference has been recommended as a simple and practical measure for identifying over weight and obese patients. It is particularly useful for individuals and population groups with different body builds [9, 10, 11].

Body fat reference measurement determined by dual-energy X-ray absorptiometry has shown that BMI and WC conform better with the screening outcomes than does WHR [12], Cut points that define higher risk for men and women based on ethnicity are shown in Table (2).

In the Framingham Offspring Study, (78%) of cases of hypertension in men and (64%) in women were attributable to obesity [23].

Prospective studies have shown that obesity increases the risk of developing hypertension [23, 24]. Moreover, weight gain in adulthood is in itself an important risk factor for the development of hypertension [23, 25].

Weight gain after 18 years of age significantly increased the risk for hypertension, as found in the long-term Nurses Health Study, of (17) BMIs at 18 years of age and at midlife were positively associated (p value =0.002) with the occurrence of hypertension [24].

Compared with women who gained less than 2 kg (4.4 pounds), women who gained 5.0 to 9.9 kg (11-22 pounds) were (74%) more likely to have hypertension, and those who gained more than 25 kg (55 pounds) were more than 5 times more likely to have hypertension [24].

Excess weight and even modest adult weight gain substantially increase risk for hypertension: each 1-kg increase in weight after age 18 was associated with a (5%) increase in risk for hypertension [26].

The incidence of arterial hypertension, determined by systolic blood pressure greater than 139 mm Hg or diastolic greater than 89 mm Hg, the reading continuously increases with age and averages (30%) in the fifth decade, (40%) in the sixth decade and (50%) in the seventh decade [27, 28, 29].

Hypertension has been linked with a number of risk factors, for example, urbanization, dietary factors and metabolic disorders [30, 31, 32, 33]. Even though the same non communicable diseases(NCDs)risk factors may be prevailing globally, the causal relationship between them and the development of hypertension has never been resolved [34, 35, 36].

Table (2) Ethnic-Specific Values for Waist Circumference[5].

Ethnic Group	Waist Circumference
Europeans	
Men	>94 cm(37in)
Women	>80 cm(31.5in)
South Asians and Chinese	
Men	>90 cm(35in)
Women	>80 cm(35in)
Japanese	
Men	> 85cm(33.5in)
Women	>90cm(35in)
Ethnic south and central Americans	Use south Asian recommendations until more specific data are available
Sub-Saharan Africans	Use Europeanrecommendations until more specific data are available
Eastern Mediterranean and Middle East (Arab)populations	Use Europeanrecommendations Until more specific data are available

Aims of the Study:

To find the prevalence of obesity among Sulaimani Teaching Hospital employee.
To find prevalence of hypertension among Sulaimani Teaching Hospital employee.
To find the relationship of waist-hip ratio (WHR) and body mass index (BMI) with blood pressure and the significance of this relation**.**

Materials and Methods:

This analytic study was conducted in Northern Iraq in Sulaimani city in it's teaching hospital (a hospital that provide medical care for about 2400 patients/ year) on it's employee who worked over 24 hours in multiple work -shifts, in different departments. The data collection for this study started in1st of January and ended in 30th of May/ 2016.

Participants:

The participants were asked also about smoking habit, alcohol and any other diseases like renal and heart diseases, diabetes, asthma and endocrine diseases and about any family history of these disease.

Male and female participants who met the Inclusion criteria :

Those aged 20 to 60 years old, and they asked to give their written informed consent.

Exclusion criteria:

•Those with severe anatomicaldeformities (congenitalortraumatic) like kyphosis and scolios is to avoid incorrect anthropometrics .

•Those with anti hypertensive drugs or drugs affect the blood pressure reading .
•Those with palpitations and abnormal heart rhythm to avoid in correct reading.
•Those who ingested coffee or smoked cigarettesforwithinprevious30 minutes.
•Those with very tight clothing to avoid erroneousreading of the blood pressure.
BMI and WHR were used as indicator of obesity in the present study for two reasons:
First, due tosimplicity and reproducibility of (height, weight, hip and waist circumference measurements).
Second because both have been recognized as important indicators for estimating cardiovascular disease risk factors, inparticulartheir association with hypertension [48, 49].

Instrumentation and Anthropometrical Measurements:

•Heightmetre:- A metallictape (STAREX) measure calibrated in centimeters (0-200) with the respondents standing on the board without footwear or headwear, facing the interviewer, placing their feet together, heels against the a wall, knees straight and looking straight ahead; and the interviewer moving the measuring stick down and placing it on top of the head and recording the height in centimeters and the stick could be adjusted to touch the vertex of the participant's head to the nearest 0.5cm with the shoulders in relaxed position and arms hanging freely.
• A portable bathroom weighing scale (Camry) calibratedfrom0-150kg was used to measure body weight with an accuracy of +100g. Subjects were weighed without shoes, in light clothing.
Body mass index (BMI) was then calculated as body weight in kilograms (kg) divided by square of the body height in meter (m^2) [45].
The sample was subdivided into four categories based on the body mass index (BMI, kg/m2): lean (underweight) less than 18.5, (normal) 18.6–24.9 and high BMI (overweight) 25—30 and (obese) greater than 30 [45].
•Sphygmomanometer: A mercury-in-glass sphygmomanometer (RISTER made in Germany) calibrated in centimeters of mercury from 0 – 300 mmHg was used to measure the blood pressure of participants to the nearest 1 millimeter of mercury with the aid of a Littman stethoscope (USA).
In order to measure blood pressure, subjects were seated in a chair with their back supported and their arms bared and supported at heart level.
Measurement was performed with the subject not having ingested coffee or smoked for 30 minutes and after at least five minutes of rest, the appropriate cuff size was used to ensure an accurate measurement, applied on the left and also right arm of the participants just above the cubitalfossa and the elbow joint could be flexed freely.
First and fifth Korotkoff sounds were recorded (after palpation of brachial pulse)for systolic and diastolic readings respectively to avoid missing peripheral artery diseases and also missing the gap between first and second kororkoff sounds also to notice if the fourth sound not disappeared ,two readings separated by two minutes were averaged. If the difference is more than 5mmHg, one additional reading was obtained and then averaged .
Using the BHS definition [46]. Hypertension was defined as systolic blood pressure (SBP)≥140 mm Hg and

diastolic blood pressure (DBP)≥ 90mmHg. Table (3)

Inelastictape measure (Butterfly model-made in China), graduated in centimeters (0-150) was used to measure the mid arm, waist and hip circumferences. Waist was measured horizontally at the level just above the uppermost border of the iliac crest.

The measurement was made ata normal minimal respiration (end of expiration), while the participant standing with both arms loosely hanged away (few centimeters) both sides and interviewer can take the measurement.

Hip was measured as the maximum circumference over the buttocks while the participant's legs stacked together in standing position .Central obesity was also calculated and defined on the basis of WHR.

The cut-off value of central obesity was considered >0.94 in males while the value for females was >0.80. [5,45]

Mid- arm circumference measured using tape measure with subject standing and right arm bared and hanging loosely and muscles relaxed at previously pointed mark in midway posteriorly between the upper most edge of posterior surface of acromion process and the tip of olcran on process while the forearm flexed at(90°).

Mid-arm circumference (MAC) values of 23.0 cm in men and 22.0 cm in women are useful cut-off points used as simple screening of nutritional state (NHANESIII) [47].

Table (3): Blood Pressure Categories According to (BHS) [46]:

Normal (optimal)	Systolic<120 and Diastolic< 80
Normal	Systolic<130 and Diastolic<85
High normal	Systolic 130-139 and Diastolic 85-89mm of Hg
Hypertension	
Grade-1 hypertensive(mild)	Systolic 140-159 and Diastolic 90-99 mmof Hg
Grade-2 hypertensive(moderate)	Systolic 160-179and Diastolic100-109mm of Hg
Grade-3 hypertensive(severe)	Systolic≥ 180andDiastolic≥ 110 mm of Hg
Isolatedsystolic hypertension	
Grade-1	Systolic140-159Diastolic<90 mm of Hg
Grade-2	Systolic≥160Diastolic< 90 mm of Hg

Statistical Analysis:

Statistical analysis was carried out using the statistical program available in SPSS version16.

Descriptive statistics for anthropometric characteristics and SBP and DBP were calculated. Partial correlation controlled for age was used to quantify the association between independent variables (BMI, MAC, WC, HC and WHR) and dependent variables (SBP and DBP).

All tests for statistical significance were two tailed and significance was selected at P-value <0.05.

Results:

•There were a total of200 employee 113(56.5%) were female while 87(43.5%) were male. Figure (2).

•Ages ranged from 20 to 65 years with a mean age of 34.68 years (SD±8.32). Figure (1)

•Anthropometric and blood pressure characteristics of the subjects are shown in table (4)

•Mean BMI according to definition used, was 27.75 (SD±4.55) while descriptive analysis revealed that 1male (0.5%) of the study population was classified as underweight, 66(33 %) as normal weight, 91(45.5%) as overweight and 42(21 %) as obese as shown in figure (3) and table (5).

•The results revealed that at the WHR cut-off point recommended for central obesity (males WHR> 0.94cm; females WHR> 0.80cm), abdominal adiposity was present in 126 subjects (63%) of the study population of which 26(13%) were male while100 (50%) were females as shown in Figure (4) and Table (6).

•The results also shows a consider able number of participant shaving high blood pressure 16(8 %). Of them 6(37.5%) were females and 10(62.5%) were males Table (7).

• Among those133 (66.5%) with BMI> 25(over weight and obese) high blood pressure found in 11(8.3%) of whom (6 females and 5 males) additionally they show central obesity according to WHR in 103(77.4%) of which (84 females (63.2%) and 19 males (14.2%) These results shown in Table (8) and Table (9).

• The results show that 67 subjects with normal BMI they have central obesity in 23(34.3%) of which 16(23.9%) females and 7(10.4%) males, additionally those 67(33.5%) with normal BMI also show high blood pressure in 5(7.5%) all of them were males as shown in Table (10, 11).

• Results of the partial correlation controlled for age, shows significant positive correlation between BMI and WHR and other anthropometrics(apart from MAC with DBP) as independent variables with dependent variables SBP and DBP (P value <0.05) Table (12) .

The partial correlation controlled for age show very strong positive relation between WHR and SBP (R = 0.169, P= 0.017) which is more significant than that between BMI and SBP (R = 0.133, P = 0.040) also the relation between WHR and DBP (R = 0.184, P = 0.009) was also more significant than that between BMI and DBP (R = 0.146, P = 0.040) .as shown in Table (12).

Table (4): Anthropometric Measurements and SBP and DBP of the Study Population.

Measurements	Minimum	Maximum	Mean	SD
Age(years)	20	64	34.68	8.324 ±
Weight(kg)	36.0	140.5	72.750	13.6951 ±
Height(m)	1.35	1.90	1.6330	.09478 ±
BMI(kg/m^2)	17.32	43.81	27.28	4.55 ±
WC(cm)	65	137	91.65	11.017 ±
HC(cm)	83	134	102.36	8.176 ±
WHR(%)	67	113	89	676 ±
Puls Rate(b/min)	60	120	83.86	9.343 ±
SBP(mmHg)	95	160	116.93	14.157 ±
DBP(mmHg)	50	100	76.10	10.611 ±

Table (5): BMI Categories of the Study Population.

BMI Category	Frequency	Percent
Underweight	1	.5%
Normal	66	33.0%
Overweight	91	45.5%
Obese	42	21.0%
Total	200	100.0%

Table (6): Prevalence of Male and Female Central Obesity in the Study Population.

Central obesity for male and female	Frequency	Percent
Female central obesity	100	50.0 %
Male centrally obesity	26	13.0 %
Normal Female	13	6.5 %
Normal Male	61	30.5 %
Total	200	100.0

Table (7): Percent's of Hypertensive and Normotensive Subjects in Study Population.

Category	Frequency	Gender		Percent
		Male	Female	
Hypertensive	16	10	6	8.0 %
Normotensive	184	77	107	92.0 %
Total	200	87	113	100.0

Table (8): Hypertensive and Normotensive Percents in Subjects with High BMI.

High BMI Cross tabulation With Hypertension	Frequency	Gender		Percent
		Male	Female	
Hypertensive	11	5	6	8.3 %
Non hypertensive	122	40	82	91.7 %
Total	133	45	88	100.0 %

Table (9): Central Obesity Percents in Subjects with High BMI.

High BMI Cross tabulation with WHR	Frequency	Percent
Female Central Obesity	84	63.2%
Male Central Obesity	19	14.3%
No Female Central Obesity	4	3.0%
No Male Central Obesity	26	19.5%
Total	133	100.0

Table (10): Hypertensive and Normotensive Percent's in Subjects with Normal BMI.

Normal BMI Cross tabulation With Hypertension	Frequency	Gender		Percent
		Male	Female	
Hypertensive	5	5	-	7.5%
Non Hypertensive	62	37	25	92.5%
Total	67	42	25	100.0%

Table (11): Central Obesity Percents in Subjects with Normal BMI.

Normal BMI Cross tabulation with WHR	Frequency	Percent
Female Centrally Obese	16	23.9%
Male Centrally Obese	7	10.4%
No Female Central Obesity	9	13.4%
No Male Central Obesity	35	52.3%
Total	67	100.0%

Table (12): Age Controlled Partial Correlations of Anthropometrics and SBP and DBP.

Control Variables			BMI	WHR	WC	MAC	HC
Age	SBP	Relation	.133	.169	.243	.173	.195
		P value	.040	.017	.001	.015	.006
		Degree of freedom	197	197	197	197	197
	DBP	Relation	.146	.184	.238	.099	.171
		P value	.040	.009	.001	.165	.015
		Degree of freedom	197	197	197	197	197

Table (13) A-CROSSTABULATION OF HYPERTENSION WITH AGE GROUPS.

Crosstab				
		HYPERTENSION		Total
		HYPERTENSIVE	NONHYPERTENSIVE	
GROUPS	20 - 29 years	2	57	59
	30 - 39 years	8	86	94
	40 - 49 years	3	32	35
	50 - 59 years	3	8	11
	60 - 69 years	0	1	1
Total		16	184	200

B - CROSSTABULATION OF TRUNCAL OBESITY WITH AGE GROUPS.

CROSSTABULATION OF TRUNCAL OBESITY WITH AGE GROUPS							
		AGE GROUPS					Total
		20 - 29 years	30 - 39 years	40 - 49 years	50 - 59 years	60 - 69 years	
TRUNCAL OBESITY	NORMAL WHR	29	32	9	4	0	74
	INCREASED MALE WHR	3	13	7	3	0	26
	INCREASED FEMALE WHR	27	49	19	4	1	100
Total		59	94	35	11	1	200

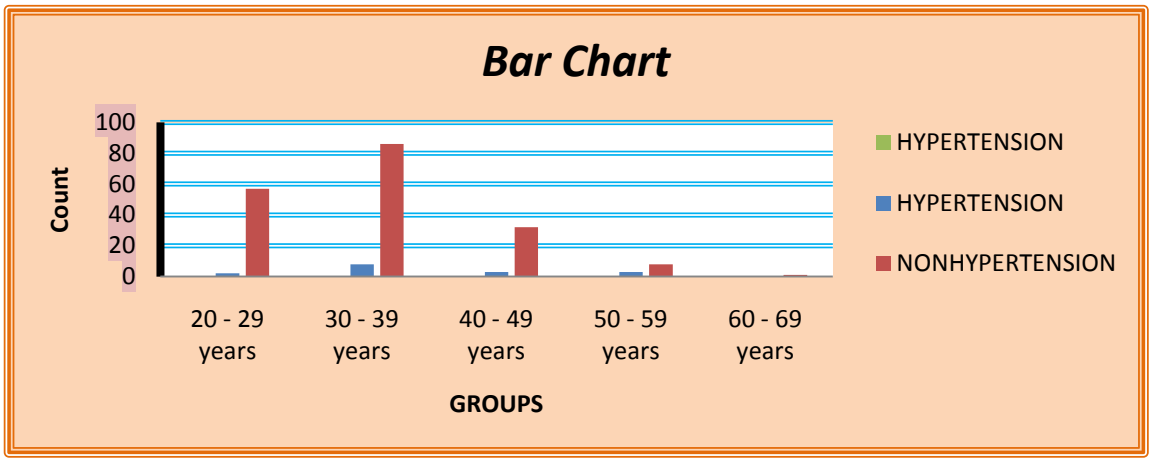
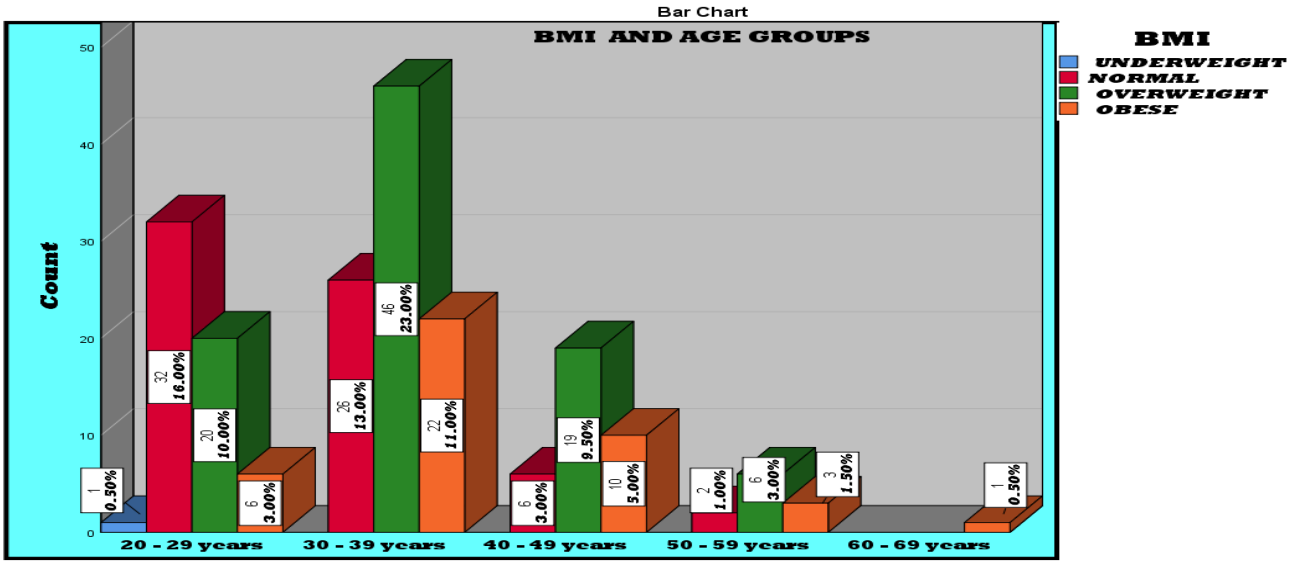
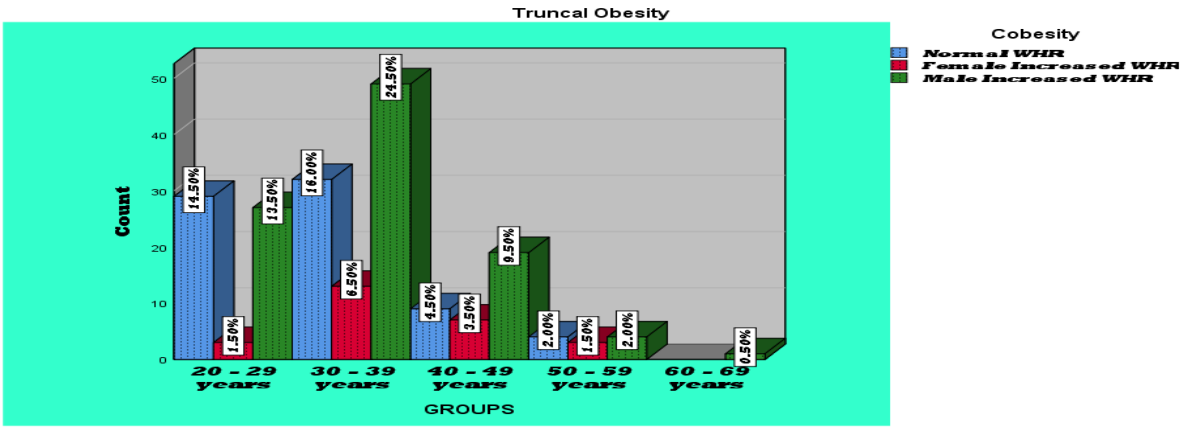


Figure (1): A- prevalence of hypertension according to age groups.



(B) BMI according to age groups.



(C) WHR according to age groups.

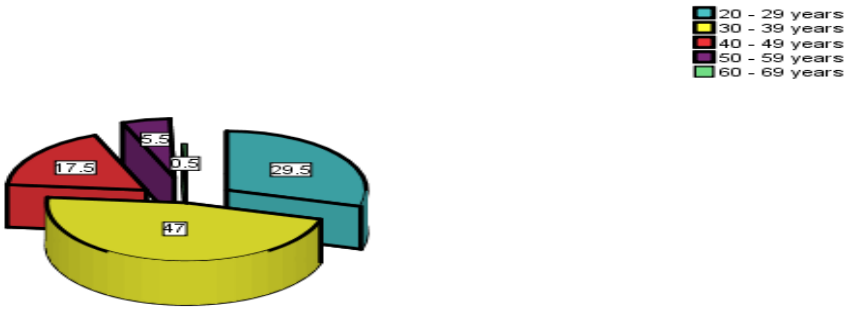


Figure (1): Age Groups Percents in Study Population.

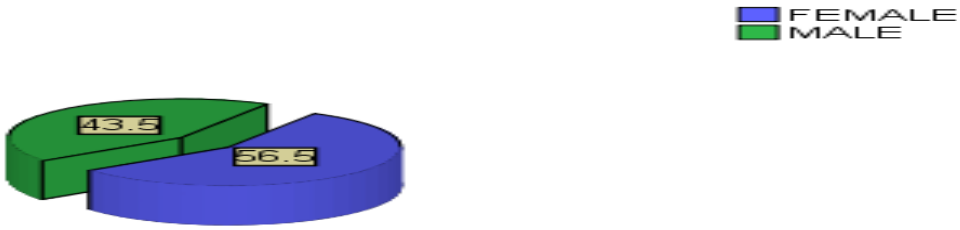


Figure (2): Male and Female Percents of the Study Population.

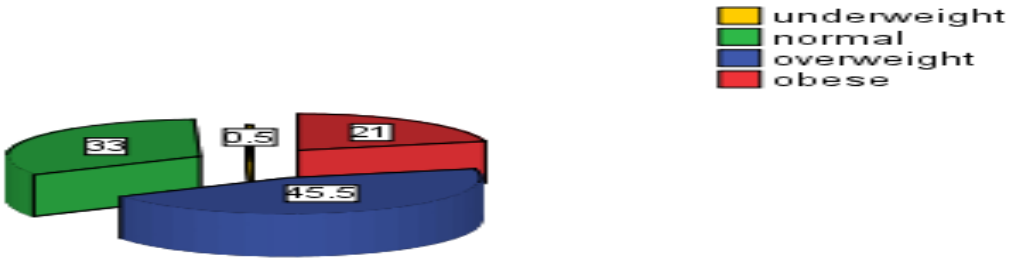


Figure (3): Percents of BMI Categories of the Study Population.

Figure (4): Percents of Male and Female Central Obesity in the Study Population.

Discussion:

Iraq is a country facing 'double-burden' of diseases. While efforts continue to prevent and control infectious disease such as vaccine-preventable diseases (e.g. measles, polio, hepatitis), and those related to water and sanitation (e.g. gastroenteritis). Non-communicable diseases (NCDs), such as CVD, hypertension and diabetes, alsoposea healthburden.

Globalization, politically unstable situations and increasing gurbanization, changes intraditional family structures and life styles, and a more mechanized work place directly affect dietary and physical activity patterns and ultimately increase the risk of such diseases.

The results of the present study demonstrated that the overall prevalence of overweight and obesity were (45.5%) and (21.0%), respectively which corroborates with Asian Shamail Zafar et al study (99 (20.5%) as overweight, and 30(6.2 %) as obese in medical students [51].

In this study, the mean values of WHR for female participants (> 0.87) fall within the range classified as obese in women, also the 23 centrally obese subjects in this study with normal BMI support the fact of an increase in abdominal fat for this group of participants as founded in (Flier, 2005) [50], this also corroborates the observation by Welborn (2003) which also say that WHR may provetobea more appropriate and universal indicator of risk for an ethnically-diverse population [11].

It has also been suggested to be a better in dicator of cardiovascular risk, as it is less dependent on body size and height [50, 51].

However, these results of female subjects in young adult age group were not consistence with the findings of Brown et al which say that male gender and the old age group more predominant [25].

The Furthermore, the measurements used for obesity assessment in this study–BMI and WHR, correlated significantly with systolic and diastolic blood pressures. This result is similar to that of Canoy et al [52] in which it was observed that waist and hip circumferences were positively related to systolic and diastolic blood pressures. However this relationis less significant for males and females separately.

In this study the results indicate that therewasa strong association of hypertension to BMI and WHR rather than age, also the prevalence of obesity, overweight is more in the younger age groups specially for females than the older groups may be dueto other factors include sedentary work, lack of physical activities and low energy expenditure.

Moreover, responsibilities tend to increase in middleages, there by producing stress, which may lead to anxiety and depression, there was a significantly high percent age of hypertension in subjects in the age group of 30 –39 years in the overweight category of BMI, this seems to be somewhat consistent with that documented by Mertens (2000) which found that obesity and hypertension more in the same age group[55].

These results do not corroborates with the observation by Welborn. [11] and Canoy et aland Shamail Zafar [51,52]which says obesity and overweight and hypertension more in old age stable 13A,B.

The results obtained in this study revealed that significance of the relation of WC with SBP and DBP (P value=0.001) was more that of both WHR and BMI this corroborates with Yang F Study 2006[12].

The study 'results revealed high blood pressure in 5 of non obese males which indicate that other risk factor (s) for developing high blood pressure are needed to consider, this corroborates with the observation by Anjum Humayun, et al (2009) which found (2%) of normal BMI

and WHR subjects were found to be hypertensive[53].

Conclusions:

•In current study there is high prevalence of overweight 91 subjects (45.5%) and obesity 42 subjects (21.0%) in Sulaimani Teaching Hospital employee.

•There is clear predominance of central obesity especially among the young and adults age groups (with female predominance) more than that of old age group.

•The hypertension incidence increase more with the increasing weight and abdominal fat (high BMI and WHR) than that with increasing in age table 13(A,B) and figure 5(A,B) .

Recommendation:

• Larger studies needed to be performed including more factors like stress, family history, diet type and psychological state for further evaluation of their relation with blood pressure and also with obesity also screening CVD factors among young and older adults in addition to those above 50 years old in general populations is an important preventive measure to increase the therapeutic options.

•Government should increase the public awareness on this establishing disease taking inconsideration all possible risk factors and the advantages on healthy life style.

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