

Sex Differences in the Impact of Body Mass Index (BMI) and Waist /Hip (W/H) Ratio on Patients with Metabolic Risk Factors in Baghdad

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Abstract

The aim of the study: is to evaluate the impact of sex as variable in measuring waist / hip ratio as risk factor predictor in patients with metabolic disease. **Methodology:** A longitudinal cross sectional study conducted on 234 patients with metabolic syndrome during 6 months duration, demographic data like Age and gender were recorded for each patient, other measures like waist circumference, hip circumference, height, weight, according to standards, & body mass index & waist/ hip ratio also calculated, blood tests including fasting blood sugar, lipid profile were also measured to the sample.

Statistical analysis: Data were analyzed using descriptive statistics (frequencies and percentages) and analytic statistics (person correlation two ways (ANOVA) by SPSS, version 11. $P < 0.05$ was considered statistically significant. **Results:** the mean age for male was $45.73(\pm 7.83)$ years, while for female was $46.92(\pm 7.83)$ years, There was significant difference with W/H ratio 0.007 (-0.05 to -0.008) for both sexes. (91.03%) of the total sample were having Diabetes mellitus, (63.25%) of the sample were having hypertension Most of the participants (85.74%) had no physical activity. A positive correlation was obtained between W/H ratio & BMI, FBS, TG & HDL in male participants. the mean of W/H ratio in both gender as cross classified with Physical Exercise, were the difference in mean is significantly associated **Conclusion:** WHR was significantly associated with the risk of incident CVD events. These simple measures of abdominal obesity should be incorporated into CVD risk assessments

Keywords: BMI (body mass index), W/H ratio (waist/ hip ratio), WC (waist circumference), HC (hip circumference) Metabolic syndrome

1. Introduction

Metabolic syndrome is a combination of medical disorders that increase the risk of developing cardiovascular disease and diabetes.[Medline Plus] It affects one in five people, and prevalence increases with age. The exact mechanisms of the complex pathways of metabolic syndrome are not yet completely known. The pathophysiology is extremely complex and has been only partially elucidated. Most patients are older, obese, sedentary, and have a degree of insulin resistance. The most important factors in order are; weight, genetics[Pollex, 2006][Poulsen, P., 2001][Leif, 2000][Bouchard, 1995], aging, and Sedentary lifestyle, i.e., low physical activity and excess caloric intake[Katzmaryk, 2003].

Central adiposity is a key feature of the syndrome, reflecting the fact that the syndrome's prevalence is driven by the strong relationship between waist circumference and increasing adiposity. However, despite the importance of obesity, patients that are of normal weight may also be insulin-resistant and have the syndrome.[Fauci, 2008]

The metabolic syndrome has been associated with several obesity-related disorders including fatty liver disease, chronic renal disease, polycystic ovarian syndrome, obstructive sleep apnea, and increase risk of cognitive decline and dementia.[Grundy SM, 2004]

Physical inactivity is a predictor of CVD events and related mortality. Many components of the metabolic syndrome are associated with a sedentary lifestyle, including increased adipose tissue (predominantly central); reduced HDL cholesterol; and a trend toward increased triglycerides, blood pressure, and glucose in the genetically susceptible. Compared with individuals who watched television or videos or used their computer for more less one hour daily, those that carried out these behaviors for greater than four hours daily have a twofold increased risk of the metabolic syndrome.[Fauci, 2008]

The metabolic syndrome affects 44% of the U.S. population older than age 50. A greater percentage of women older than age 50 have the syndrome than men. The age dependency of the syndrome's prevalence is seen in most populations around the world.[Lara-Castro C, 2007]

It is estimated that the large majority (~75%) of patients with type 2 diabetes or impaired glucose tolerance (IGT) have the metabolic syndrome. The presence of the metabolic syndrome in these populations is associated with a higher prevalence of CVD than found in patients with type 2 diabetes or IGT without the syndrome[Fauci, 2008] Hypoadiponectinemia has been shown to increase insulin resistance[Fauci, 2008], and is considered to be a risk factor for developing metabolic syndrome.[Renaldi O, 2009]

The approximate prevalence of the metabolic syndrome in patients with coronary heart disease (CHD) is 50%, with a prevalence of 37% in patients with premature coronary artery disease (age 45), particularly in women. With appropriate cardiac rehabilitation and changes in lifestyle (e.g., nutrition, physical activity, weight reduction, and, in some cases, Drugs), the prevalence of the syndrome can be reduced.[Fauci, 2008]

Lipo dystrophic disorders in general are associated with the metabolic syndrome. Both genetic (e.g., Berardinelli-Seip congenital lip dystrophy, Dunnigan familial partial lipodystrophy) and acquired (e.g., HIV-related lipodystrophy in patients treated with highly active antiretroviral therapy) forms of lipodystrophy may give rise to severe insulin resistance and many of the metabolic syndrome's components.[Fauci, 2008]

Body mass index (BMI) is an index widely used to define obesity. The World Health Organization (WHO) sets a BMI range of 18.5–24.99 kg/m² as normal [Renaldi O, 2009]. Although Asians constitute a large proportion of the world's population, the majority of Asians, including the Japanese, are not clearly obese according to the WHO classification, [WHO., 2000; Yoshiike Y, 1990-1994] despite rapid westernization of lifestyles and a corresponding increase in metabolic risks.

BMI does not always accurately indicate the degree of fatness. [de Onis M, 1996] An increasing number of papers indicate that the degree of central fat distribution may be more closely tied to metabolic risks than BMI [Smalley KJ, 1990; Blair D, 1984; Kaplan NM., 1989] Measurement of the degree of central fat distribution thus appears to be important for the early detection of subsequent health risks, even among those of normal weight. [Deprès JP, 1991; Hsieh SD, 1995; Ruderman N, 1998]

The criteria for waist circumference proposed by WHO (midpoint between the lower border of the rib cage and the iliac crest) were based on studies of Caucasians, who generally have a higher BMI than many other ethnic groups. [Renaldi O, 2009] Also stating that obese individuals whose waist circumference (umbilical level) was 85 cm (men) or 90 cm (women) faced a higher risk of visceral fat accumulation. [Hsieh SD, 2000]

Several reports from Asia indicate that waist-to-height ratio (W/Ht) corresponds better to metabolic risk than BMI, waist circumference, waist-to-hip ratio, or skin fold measures[Japan Society for the Study of Obesity, 2000] There are also reports that the cutoff value for W/Ht (0.5) appears to offer a simple but effective index for identifying overweight individuals and those of normal weight who face higher risks,[Hsieh SD, 1995; Lee JS, 1995; Hsieh SD, 1996; Hsia HH, 2001]

2. Patients & Methods

This is a longitudinal cross sectional study conducted on 234 patients with metabolic syndrome, for the period from the 15 of November to 30 of April, 2010. Participants for the study group were recruited from The Specialized Center for Endocrinology & Diabetes(at Al-Rusafa sector) and The National Center for Treatment & Research of Diabetes in Al-Mustanseria College of Medicine (at Al-Karkh sector)- Baghdad. These two centers are the referral points for diabetic patients in Baghdad.

Patients included were diagnosed to have metabolic syndrome by specialists in both centers. Age and gender were recorded for each patient; height was calculated from the anthropometric measurements standing height measurement (CMS weighing equipment LTD, England).The patient stood shoeless with the heels and back in contact with the vertical column of the scale. Weight measurement was done by digitalweightscale(Seca, Australia).Before each measurement the digital scale was adjusted to zero, the patient was asked to take-off his or her shoes and jackets before weighing, and the weight was taken to the nearest fraction of Kg (to the closest 0.1 Kg).

Body mass index (BMI) was calculated as weight (kg) divided by height squared (meter²) and was used as the criteria for diagnosis of overweight and obesity. Participants were divided into 3 groups: normal weight (BMI < 25 kg/m²), overweight (25 kg/m² ≤ BMI < 30 kg/m²) and obese (BMI ≥ 30 kg/m²) (27).

2.1 Standards used to collect patients indices

Waist circumference: measured on a horizontal plane 1cm above the iliac crest. The cutoff point is: > 94 cm (male), 80 cm (female). [Victor RG, 2004]

Hip circumference: measure the widest circumference of the buttocks at the area of the greater trochanters. The cutoff point of W / H ratio: > 0.9 (male), > 0.85 (female). The cutoff point of W / Ht ratio is: 0.5. [Hsieh SD, 1995; Hsieh SD, 2000; Hsia HH, 2001]

The cutoff point of BMI is 25 to 34.9.

2.2 Diabetes mellitus definition

Raised fasting plasma glucose : (FPG) >100 mg/dL (5.6 mmol/L). Or previously diagnosed type 2 diabetes. If FPG >5.6 mmol/L or 100 mg/dL, OGTT Glucose tolerance test is strongly recommended but is not necessary to define presence of the Syndrome. [IDF, 2006]

2.3 Dyslipidemia

Raised triglycerides: > 150 mg/dL (1.7 mmol/L), or specific treatment for this lipid abnormality. Reduced HDL cholesterol: < 40 mg/dL (1.03 mmol/L) in males, < 50 mg/dL (1.29 mmol/L) in females, or specific treatment for this lipid abnormality.[32]

2.4 Blood pressure:

Was measured and evaluated using a mercury sphygmomanometer and a standard clinical protocol according to the Joint National Committee (JNC-VII) report. After 10 minutes of resting, two readings of the systolic and diastolic BP separated by 5 minutes were averaged to the nearest 2 mmHg from the top of the mercury meniscus. Systolic BP was recorded at the first appearance of sounds, and diastolic BP at phase V at the disappearance of sounds. Hypertension was defined as systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg. The validity of the weight scales and sphygmomanometers was censured by calibration prior to their use [Chobanian AV, 2003].

3. Statistical Analysis

Data were analyzed using descriptive statistics (frequencies and percentages) and analytic statistics (person correlation two ways ANOVA) by SPSS, version 11. P < 0.05 was considered statistically significant [Girerd X, 2008], [Chronic Non, 2006].

4. Results

1- The studied sample consist of 234, with 125 male participants and 109 female, the mean age for male was $45.73(\pm 7.83)$ years, while for female was $46.92(\pm 7.83)$ years. The BMI mean was nearly the same for both sexes and showed no significant difference, but this difference was significant with W/H ratio 0.007 (-0.05 to -0.008). this is clearly shown in table 1.

2- About (91.03%) of the total sample were having Diabetes mellitus(DM) with nearly similar percentage of male & female, (63.25%) of the sample were having hypertension, (66.40%) were male & (59.63%) were female, as for hyperlipidemia nearly (83%) of the sample were suffering from elevated serum cholesterol level, 2/3 (74.36%) were having elevated triglycerides (table 2). Most of the participants (85.74%) have no physical activity, while (49.15%) of them had family history of hypertension & diabetes mellitus.

3- There was a positive correlation between BMI & age, WC, HC, W/H ratio, FBS, TG, and HDL, while there was a negative correlation between BMI & cholesterol, diastolic & systolic blood pressure in male participants. Similar result was obtained with female participants in except for negative correlation of BMI with TG. (Table 3)

4- A positive correlation was obtained between W/H ratio & BMI, FBS, TG & HDL, while negative correlation was found with age, cholesterol, systolic & diastolic blood pressure in male participants. Similar result was obtained for female participants except for the negative correlation of W/H ratio with FBS. (Table 5)

5- Regarding the mean of BMI in both gender as cross classified DM, HT, Cholesterol, TG, HDL, PE, FH (HT/DM) Two way ANOVA only, revealed no statistical association (table 4).

Similar result was obtained regarding the mean of W/H ratio in both gender as cross classified with, Cholesterol, Triglycerides, High Density Lipoprotein, Family History Hypertension/Diabetes Mellitus) except for Physical activity, where the difference in mean is significantly associated. (table 6)

5. Discussion

5.1 Associated conditions (determinant) by sex

Most of our studied sample had Diabetes mellitus(DM) with nearly similar percentage of male & female, in addition to hypertension & hyperlipidemia, this is because the sample was chosen from Specialized Centers for Endocrinology & Diabetes (at Al-Rusafa sector) and (at Al-Karkh sector)- Baghdad. These two centers are the referral points for diabetic patients in Baghdad.

5.2 Relation of W/Hip ratio and mean age

The BMI mean was nearly the same for both sexes and showed no significant difference, but this difference was significant with W/H ratio.

In a sample of Dutch women, a lower WHR was associated with high fecundity and was a better predictor than other variables such as body mass index (Zaadstra, 1993). In a second study, without the weight categories and with frontal WHR ranging from 0.4 to 1.0, Hadza men preferred the highest ratios of 0.9 and 1.0 (Marlowe, 2001). This may be because women with a larger waist appear heavier.

5.3 BMI & W/Hip ratio Correlation

A positive correlation was obtained between W/H ratio & BMI, FBS, TG & HDL. Compared with body mass index (BMI), anthropometric measures of abdominal obesity [e.g. waist circumference (WC), waist-to-hip ratio (WHR), sagittal abdominal diameter] appear to be more strongly associated with metabolic risk factors (Wang Y, 2005) incident CVD events, and death. The cardio-metabolic risk associated with abdominal obesity is attributed to the presence of visceral adipose tissue (VAT), which promotes insulin resistance, dyslipidaemia, and hypertension (Despres JP, 2006).

5.4 Physical Activity

With Physical activity, the difference in mean was significantly associated. Two recent reviews have evaluated the relation between physical activity and CVD/cancer incidence and mortality. (Blair SN, 2001, Wannamethee SG, 2001) They conclude that individuals who report regular physical activity are less likely than sedentary individuals to die from coronary heart disease, stroke, CVD, certain cancers and all causes. Several studies have assessed the independent and combined effects of fattiness and physical fitness on mortality. (Wannamethee SG, 2001; Haapanen-Niemi N, 2000; Stevens J, 2002) Moderate or high level of cardio respiratory fitness may be protective against the excess mortality among overweight and obese individuals.

6. Conclusion

WHR was significantly associated with the risk of incident CVD events. These simple measures of abdominal obesity should be incorporated into CVD risk assessments in metabolic syndrome.

Physical activity, showed significant difference. Both regular physical activity and normal weight can reduce the risk of CVD. Physical inactivity seems to have an independent effect on CVD risk, whereas obesity increases the risk partly through the modification of other risk factors.

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Table 1. Characteristics of the studied sample by sex and age

	Male (n=125)		Female (n=109)		Total (N=234)		P value (95% CI)
	Mean	SD	Mean	SD	Mean	SD	
Age (years)	45.73	7.83	48.29	8.59	46.92	8.28	0.02 (-4.67 to -0.44)
BMI (KG/m ²)	29.45	4.55	30.17	4.97	29.78	4.75	0.25 (-1.95 to 0.51)
WC (CM)	110.63	11.75	117.32	12.70	114.02	12.20	0.0001 (-9.84 to -3.54)
HC (CM)	101.50	9.12	104.75	9.02	103.09	9.07	0.006 (-5.59 to -0.91)
W/H ratio (%)	1.09	0.08	1.12	0.09	1.11	0.08	0.007 (-0.05 to -0.008)
FBS	10.08	5.04	10.74	5.36	10.39	5.19	0.333 (-0.00-0.68)
TG	3.59	3.75	4.42	8.10	3.98	6.17	0.305 (-2.42-0.76)
Chole	3.86	1.57	3.78	1.48	3.86	1.57	0.69 (-0.31-0.47)
HDL	1.41	1.10	1.40	1.13	1.41	1.11	0.95 (-0.28-0.30)
SBP (mmHg)	140.58	17.73	139.03	17.80	139.85	17.74	0.50 (-3.03-6.15)
DBP (mmHg)	91.64	12.01	90.54	11.34	90.66	11.72	0.47 (-1.92-4.12)

BMI Body mass index, WC waist circumference, HC hip circumference, W/H waist hip ratio, FBS fasting blood sugar, TG triglycerides, Chol. Cholesterol, HDL high density lipoprotein, SBP systolic blood pressure, DBP diastolic blood pressure

Table 2. Associated conditions (determinants) by sex

		Male (n=125)		Female (n=109)		Total (N=234)		P value
		No	%	No	%	No	%	
DM	yes	114	90.20	99	90.83	213	91.03	0.92
	No	11	8.20	10	9.17	21	8.97	
HT	yes	83	66.40	65	59.63	148	63.25	0.284
	No	42	33.60	44	40.37	86	36.75	
↑Chol	yes	100	80.00	94	86.24	194	82.91	0.219
	No	25	20.00	15	13.76	40	17.09	
↑TG	yes	90	72	84	77.06	174	74.36	0.207
	No	35	28	25	22.94	60	25.64	
↑HDL	yes	69	55.20	64	58.72	133	56.84	0.588
	No	56	44.80	45	41.28	101	43.16	
Phy Ex	yes	17	13.60	17	15.60	34	14.53	0.666
	No	108	86.40	92	84.40	200	85.74	
FH(HT/DM)	Yes	62	49.60	53	48.62	115	49.15	0.882
	No	63	50.40	56	51.38	119	50.85	

DM. Diabetes mellitus, HT Hypertension, Chol. Cholesterol, TG triglycerides HDL high density lipoprotein, Phy. A. Physical activity, FH Family history

Table 3. Correlation of BMI with the studied variables

	BMI					
	Male		Female		Total	
	r	p	r	p	r	p
Age (years)	0.118	0.19	0.114	0.239	0.126	0.091
WC	0.707	0.00	0.653	0.00	0.681	0.000
HC	0.740	0.00	0.708	0.00	0.725	0.000
W/H ratio (%)	0.438	0.002	0.473	0.002	0.495	0.000
FBS	0.264	0.003	0.195	0.004	0.224	0.001
TG	0.146	0.104	-0.002	0.982	0.049	0.456
Chole	-0.14	0.119	-0.75	0.439	-0.102	0.119
HDL	0.106	0.238	0.052	0.588	0.079	0.228
SBP(mmHg)	-0.056	0.538	-0.021	0.827	-0.042	0.523
DBP(mmHg)	-0.040	0.654	-0.056	0.565	-0.054	0.411

WC waist circumference, HC hip circumference, W/H waist hip ratio, FBS fasting blood sugar, TG triglycerides, Chol. Cholesterol, HDL high density lipoprotein, SBP systolic blood pressure, DBP diastolic blood pressure, r = correlation coefficient, P= p value

Table 4. Association of BMI with the studied variables (2 ways ANOVA)

	W/H R					
	Male		Female		Total	
	r	p	r	r	p	r
Age (yr)	-0.090	0.318	-0.003	0.976	-0.024	0.520
BMI	0.438	0.002	0.473	0.002	0.495	0.000
FBS	0.115	0.203	-0.112	0.246	0.001	0.983
TG	0.045	0.616	0.061	0.530	0.054	0.410
Chole	-0.089	0.321	-0.062	0.525	-0.074	0.260
HDL	0.113	0.208	0.120	0.214	0.117	0.075
SBP	-0.071	0.432	-0.015	0.876	-0.044	0.501
DBP	-0.093	0.310	-0.051	0.597	-0.074	0.258

DM. Diabetes mellitus, HT Hypertension, Chol. Cholesterol, TG triglycerides HDL high density lipoprotein, PA Physical activity, FH Family history

Table 5. Correlation of W/H R with the studied variables

		BMI						P value
		Male (n=125)		Female (n=109)		Total (N=234)		
		No	Mean (SD)	No	Mean (SD)	No	Mean	
DM	Yes	114	30.48 (4.65)	99	30.27(4.98)	213	30.44 (4.81)	0.678
	No	11	28.42 (3.53)	10	29.15 (5.03)	21	28.72 (4.19)	
HT	Yes	83	29.38 (4.40)	65	30.43 (4.57)	148	29.90 (4.52)	0.687
	No	42	29.58 (4.89)	44	29.77 (5.55)	86	29.67 (4.82)	
Chol	Yes	100	31.98 (4.72)	94	31.34 (4.89)	194	31.66 (4.84)	0.724
	No	25	28.28 (4.31)	15	29.98 (4.98)	40	29.13 (4.74)	
TG	Yes	90	29.62 (4.59)	84	30.54 (4.68)	174	30.08 (4.60)	0.168
	No	35	29.00 (4.48)	25	29.46 (4.72)	60	29.24 (4.58)	
HDL	Yes	69	29.60 (4.19)	64	30.64 (4.62)	133	30.12 (4.48)	0.214
	No	56	29.35 (5.16)	45	29.38 (4.34)	101	29.36 (4.86)	
PE	Yes	17	27.89 (5.14)	17	29.93 (4.90)	34	28.91 (5.02)	0.189
	No	108	30.54 (4.28)	92	31.34 (5.30)	200	30.94 (5.70)	
FH(HT/DM)	Yes	62	29.78 (4.96)	53	30.21 (4.88)	115	29.99 (4.90)	0.386
	No	63	29.12 (4.13)	56	30.09 (4.72)	119	29.60 (4.58)	

BMI Body mass index, FBS fasting blood sugar, TG triglycerides, Chol. Cholesterol, HDL high density lipoprotein, SBP systolic blood pressure, DBP diastolic blood pressure, r=correlation coefficient,

P= p value

Table 6. Association of W/HR with the studied variables (2 ways ANOVA)

		BMI						P value
		Male (n=125)		Female (n=109)		Total(N=234)		
						No	Mean	
DM	Yes	114	1.13 (0.07)	99	1.14 (0.08)	213	1.13 (0.08)	0.205
	No	11	1.05 (0.12)	10	1.10 (0.07)	21	1.08 (0.09)	
HT	Yes	83	1.10 (0.07)	65	1.12 (0.08)	148	1.11 (0.07)	0.312
	No	42	1.09 (0.08)	44	1.11 (0.08)	86	1.10 (0.08)	
↑Chol	Yes	100	1.14 (0.07)	94	1.16 (0.07)	194	1.15 (0.07)	0.07
	No	25	1.04 (0.09)	15	1.08 (0.08)	40	1.07 (0.08)	
TG	Yes	90	1.11 (0.07)	84	1.13 (0.07)	174	1.12 (0.07)	0.205
	No	35	1.07 (0.08)	25	1.11 (0.08)	60	1.09 (0.08)	
HDL	Yes	69	1.09 (0.08)	64	1.11 (0.08)	133	1.10 (0.08)	0.204
	No	56	1.10 (0.07)	45	1.13 (0.07)	101	1.11 (0.07)	
PE	Yes	17	0.98 (0.09)	17	1.02 (0.07)	34	1.01 (0.08)	0.030
	No	108	1.20 (0.07)	92	1.22 (0.08)	200	1.21 (0.07)	
FH(HT/DM)	Yes	62	1.11 (0.08)	53	1.13 (0.08)	115	1.12 (0.08)	0.126
	No	63	1.08 (0.06)	56	1.11 (0.07)	119	1.10 (0.07)	

DM. Diabetes mellitus, HT Hypertension, Chol. Cholesterol, TG triglycerides HDL high density lipoprotein, Physical activity, FH Family history