WAIST HIP RATIO AS AN INDEX FOR IDENTIFYING WOMEN WITH RAISED TC/HDL RATIOS

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Background: Obesity cannot be described solely as fat mass but the location of fat deposition is very important to determine the relation between obesity and disease. Abdominal type of obesity is linked to risk factors of atherosclerosis and to metabolic disease. Waist Hip Ratio (WHR) is a practical, simple and non-invasive index of adipose tissue distribution. **Methods:** We looked for a relation between WHR and TC/HDL-C ratios of a group of postmenopausal women. All the subjects in each major group were of comparable age and BMI, but the WHR varied from subject to subject. Each group was sub-divided into three tertiles based upon the WHR. Serum total cholesterol (TC) and HDL cholesterol (HDL-C) values were determined for all the subjects and TC/HDL-C ratio, which is a recognized CHD risk screening index was calculated. **Results:** The WHR distribution was significantly different in postmenopausal women from the pre-menopausal controls, and most of the postmenopausal women showed android type of obesity with no subject in the tertile with least WHR. It was noted that the TC/HDL-C ratio increased in direct proportion with the increase in WHR and its mean value was above the desirable value in both the tertiles of postmenopausal women. The test performance characteristics of WHR showed that WHR is a sensitive and specific index for screening of high TC/HDL-c ratio. **Conclusion:** We conclude that WHR (at a cut-off point of 0.84) can serve as a sensitive and specific outpatient screening index to detect postmenopausal women with an elevated TC/HDL-C ratio.

INTRODUCTION

Coronary heart disease (CHD) is the foremost cause of death in women as well as men, although the onset of CHD is earlier on the average in men[1]. Marked difference in the risk of CHD has been noted between men and women of reproductive age[2] but this gap closes with advancing age[3]. It seems likely that some factors of Reproductive Physiology are responsible for this[4]. Oestrogens affect lipid profile favorably, i.e. they lower LDL-C and elevate HDL-C[5]. The women have more body fat than men at the same relative body mass index[6]. Women however, show a relative preponderance for gluteal and femoral regions for fat deposition[7], which is under the influence of oestrogen[8]. After menopause oestrogen deficiency occurs due to menopausal ovarian involution[9] and women become prone to masculine type of adipose tissue distribution that is high waist/hip circumference ratio[10]. The health risks of the obesity cannot be assessed on the basis of adiposity alone but the location of fat deposition must be considered when studying the association between obesity and disease[11.] Numerous clinical and epidemiological studies point to association of android type of obesity with metabolic complications such as glyco-regulation, hyperlipo-proteinemia and accelerated atherosclerosis which all lead to cardiovascular disease[12] .

Waist Hip ratio (WHR) is a practical and simple index of adipose tissue distribution[7]. The waist hip ratio (WHR), as an indicator of body fat distribution is related to several clinical diseases[13]. The WHR can serve as an easy screening device used in conjunction with other proven measures to detect those at

elevated risk for coronary heart disease(CHD)[14]. Similarly serum total cholesterol/HDL-C (TC/HDL-C) ratio is important in indicating risk of CHD. Ratios $\geq$ 4.5 are dangerous while optimal ratios are around 3.5[3,4].

This study was designed to evaluate the performance characteristics of WHR (at a cut-off value of 0.84) as an index to determine the risk of CHD in postmenopausal women, by using TC/HDL-C ratio as statistical Gold Standard[15] at a cut-off point of 4[16].

MATERIAL AND METHODS

This study was carried out at Department of Biochemistry, Basic Medical Sciences Institute, Jinnah Postgraduate Medical Centre, Karachi. The subjects of same weight and height range were selected from women attending different units of Jinnah Postgraduate Medical Centre, Karachi. The age range was 60-62 years for postmenopausal women. The height range was 159-162 cm (5'3"-5'4") and the weight range was 60-65 kg for both the groups. This height and weight range gave a BMI range of 22.86 to 25.71 kg/m^2.

Fifty(50) postmenopausal women were included in the study after taking a detailed medical history and observing the exclusion criteria that included the diseases likely to alter lipid profile namely diabetes, liver and renal disease.

Five (5) ml venous blood was collected from each subject after an overnight fast of 12-14 hours. Serum was separated within one hour of blood collection and stored at -20°C until analyzed for lipid profile.

Waist circumference was measured in centimeters, one inch above umbilicus, while hip circumference was measured at the level of iliac crest in standing position[7,14]**.** The ratio between the two was calculated. The subjects were then divided into three tertiles (subgroups) according to WHR. The tertiles were as follows:

Tertile-1: WHR $\leq$ 0.76

Tertile-2: WHR > 0.76-< 0.84

Tertile-3: WHR $\geq$ 0.84

The serum total Cholesterol (TC) was estimated by the enzymatic colorimetric method using kit Cat No: 1001092 supplied by Spinreact, S.A.Spain. Serum HDL-Cholesterol (HDL-C) was determined by using Kit Cat No:1001095 supplied by Spinreact, S.A.Spain. The total cholesterol and HDL-Cholesterol ratio (TC/HDL-C ratio) was calculated from the two values. The ratio for each tertile of WHR were compared by 't' test for significance..

The results obtained from all the tests under evaluation were arrayed in a 2x2 statistical table shown in table 4. The gold standard used in this study was TC/HDL-C ratio with a cut-off point (arbitrarily selected) of 4. The cut-off value for WHR was arbitrarily set at 0.84.

The calculations of the performance characteristics of each test were made by using the four cells and their marginal totals as shown in table 5. The performance characteristics included sensitivity, specificity, false positives, false negatives, and positive and negative predictive values[17].

RESULTS

The results of this study are summarized in Tables 1-4.

Table-1 shows the mean BMI, WHR, number and percentage of the postmenopausal subjects in each one of the three tertiles of WHR. The highest percentage of women was in the tertile 3 followed by tertile 2 while there was no subject in tertile 1.

Table-2 shows the mean TC/HDL-C ratio in all the tertiles of postmenopausal women. The TC/HDL-C ratio is significantly ($p<0.05$) higher in tertile 3 of the postmenopausal women as compared with the tertile 2.

Figure-1 is a graph showing the gradual increase in TC/HDL-C ratios from tertile-1 to tertile-3 in both pre and postmenopausal subjects.

Out of the 50 postmenopausal women 28 were found to have high TC/HDL-C ratio (at a cut-off point of 4.00). WHR at a cut-off point of 0.84 identified 22 (True Positive) out of these 28, while it missed the rest 6 subjects with high TC/HDL ratio (False Negative). Similarly 22 women were having TC/HDL-C ratio within normal range. WHR at a cut-off point of 0.84, identified 17 (True Negative) while gave false results for the rest 5 (False Positive). All these values were arranged in the 2x2 Table as shown in table-3. The performance characters were calculated using the values in table 3 and they are reported in table-4.

Table-1: Waist hip ratio of different tertiles of postmenopausal women

TERTILE	BMI (kg/m^2)	WHR (Mean±SEM)	No. of cases	% n=50
TERTILE-1 WHR < o.76	---	---	0	0
TERTILE-2 WHR>0.76-<0.84	25	0.81±0.002	18	36
TERTILE-3 WHR > 0.84	25.5	0.87±0.005	32	64

Table-2: TC/HDL-ratio in different tertiles of WHR in postmenopausal women

TC/HDL-C RATIO(Mean±SEM)

TERTILE 1 WHR < o.76	TERTILE 2 WHR>0.76-<0.84	TERTILE 3 WHR > 0.84
--- (n=0)	4.27±0.22 (n=18)	5.16±0.14* (n=32)

P<0.05

Table-3: 2 x 2 table for determining performance characteristics of WHR in determining risk of elevated TC/HDL-C ratio in postmenopausal women

	TC/HDL-C>4 Present (D+)	Absent (D-)	
POSITIVE (T+) **WHR >.84**	a = 22 True Positive	b = 5 False Positive	a+b = 27
NEGATIVE(T-)	c = 6 False Negative	d = 17 True Negative	c+d = 23
TOTAL	a+c = 28	b+d = 22	a+b+c+d = 50

Table-4: Performance characteristic calculations of WHR based upon table-3

TEST CHARACTERISTIC	FORMULA USING THE 2x2 TABLE	VALUE
Sensitivity	a / (a+c)	0.78
Specificity	d / (b+d)	0.77
False negative	c / (a+c)	0.21
False positive	b / (b+d)	0.22
Positive predictive value	a / (a+b)	0.81
Negative predictive value	a / (c+d)	0.95

DISCUSSION

Obese people have a much greater risk of dying earlier than the people with acceptable levels of fatness[18]. Both fat distribution and physical fitness are reported to be independently related with some important cardiovascular risk factors in obese women[19, 20]. Central fat distribution carries most metabolic risks and is associated with a predisposition towards coronary heart disease, stroke, diabetes, breast cancer and gallstones[18].

A high WHR seems to be a proxy measure of excess intra-abdominal fat. People with high WHR measurements can be said to have a central fat distribution: people with low WHR measurements can be said to have a peripheral fat distribution. High WHR is associated with NIDDM, impaired glucose tolerance, elevated blood pressure and serum lipids[24]. Oshaug et al.,[21] reported positive relation between WHR and serum cholesterol, triglycerides, fibrinogen and diastolic blood pressure.

A high WHR indicates predominance of abdominal adipocytes over the hip adipocytes. The abdominal adipocytes have been shown to have higher rates of basal lipolysis. This increases free fatty acid flux into the portal vein, causing increase in triglyceride and VLDL synthesis in liver. The free fatty acid may also inhibit cholesterol esterification and decrease the acquisition of cholesterol by HDL particles[25].

In this study we included the subjects with a comparable BMI but variable WHR. We observed that WHR generally has a higher trend in postmenopausal women as compared with the premenopausal women. We found that a high WHR was significantly associated with a high TC/HDL-C ratio. The results indicate that in postmenopausal women the distribution of fat deposits as indicated by tertile of WHR may be a reliable predictor of the risk of elevated TC/HDL-C ratio.

We conclude that WHR at a cut-off point of 0.84 can be used as an easy, specific and sensitive screening method to detect the postmenopausal women with increased risk of raised TC/HDL-C ratio, that is an established risk factor for CHD.

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