

WAIST HEIGHT RATIO (WHtR), BODY MASS INDEX (BMI) AND SERUM CHOLESTEROL

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Background & Aims: with obesity moving toward global epidemiology, the study was undertaken to identify the simpler and better indicator (WHtR and BMI) for identifying body fat level (measured by studying serum cholesterol in present study). Study was carried out in 100 volunteers (50 males and 50 females) in research laboratory of department of Physiology, PIMSR, Baroda in the age group of 18- 70 years. To find correlation between WHtR, BMI and serum total cholesterol and LDL and to compare which index (WHtR or BMI) signifies better correlation with serum total cholesterol and LDL and hence cardiovascular status.

Methods: Serum cholesterol was estimated using colorimetric method. BMI and WHtR were calculated by mathematical equation after recording height (with stadiometer), weight (with digital weighing scale) and waist circumference (with measuring tape). **Result:** The result though insignificant (p value 0.092, 0.087 by Chi square), the BMI showed better correlation with serum total cholesterol and LDL than WHtR.

Key Words; WHtR BMI total cholesterol LDL

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Introduction:

WHO puts Obesity as a leading but preventable cause of death¹ and Debaise and coworkers² view obesity as one of the most serious public health problems of the 21st century. The percentage of obesity is rising at rapid rates in adults and children and Afsin A et al 2015³ puts this figure at 600 million adults (12%) and 100 million children in their study. The rapid industrialization and urbanization is transforming India from under nutrition to obese nation. Obesity has been defined by WHO as a medical condition in which the accumulated excess body fat may start affecting health adversely¹. Cause of obesity is multifactorial but a faulty dietary pattern, lack of physical activity, and genetic leads the pack as a causative agent for obesity^{1,4}.

Obesity is known to be a predisposing condition for many diseases, the most important being the 'cardiovascular diseases, the type 2 diabetes and the obstructive sleep apnea^{5,6}. Numerous methods have been used to assess the body composition and obesity but anthropometric measurements are the most feasible. These measurements though an indirect one, provide a rapid and cheap way to estimate body fat and fat distribution^{7,8}. The BMI, waist circumference and waist-to-height ratio

(WHtR) and skin fold methods are the once which are most closely related to body fat⁹ and hence predictor of health risks.

Normal range for Body mass index (BMI) is 18.5 – 24.9 kg/m² and value above 25 and 30 is tagged as overweight and obese respectively¹ however few East Asian countries uses the lower values for the same³. Waist circumference is a common measure used to check for fat held around the stomach^{10, 11} and is an important indicator of obesity as it is found to be a measure of risk factor for CVD¹² and a value of 90 cm or more for men and 80 cm or more for women is categorized as central obesity¹³. Although waist circumference and BMI are interrelated, waist circumference provides an independent prediction of risk over and above that of BMI *and according to* Chan JM and co workers, 1994¹⁴, a high waist circumference is associated with an increased risk for type 2 diabetes, dyslipidemia, HT and CVD in patients with a BMI in a range between 25 and 34.9 kg/m². The other anthropometric parameter which has caught attention in recent time is waist to height ratio (WHtR). Higher values of WHtR indicate higher risk of obesity-related cardiovascular diseases¹⁵ as it is closely correlated with abdominal obesity¹⁶. Wise J 2017¹⁷ puts a

stress on problem of normal weight central obesity and recommends WHtR as a primary screening tool for identification of early health risk. A boundary value of WHtR is put at 0.5 and it delivers a simple health message to general public to "Keep waist to less than half height"^{18, 19}. A WHtR of over 0.5 is critical and signifies an increased risk. A systematic review by Browning Lucy M, et al. (2010)²⁰ of various published studies concluded that "WHtR may be advantageous because it avoids the need for age-, sex- and ethnic-specific boundary values. The critical value of WHtR is age dependent and is 0.5 for people under 40, 40–50 year age group value is between 0.5 and 0.6, and for those over 50 years values start at 0.6²¹. Flegal et al 2009²² states that WC, WSR, and BMI have a higher significant correlation more with each other than with percentage body fat. Oboh et al 2011²³ proposed WHtR to be a good indicator for predicting risk factor for cardiovascular diseases, though they did not observe raised LDL-C with increase in WHtR. The effectiveness and appropriateness of these indices at global level is questionable as it depends on gender, ethnicity and country.

Materials and Method:

Aims:

1. to find correlation between WHtR and serum total cholesterol and LDL.
 2. to find correlation between BMI and serum total cholesterol and LDL.
 3. to compare which index (WHtR or BMI) signifies better correlation with serum total cholesterol and LDL and hence cardiovascular status.
- Study as carried out in 100 volunteers in research laboratory of department of Physiology, PIMSR. 50 males and 50 females in the age group between 18-70 years were selected. Volunteers were explained the purpose and methodology of the study. After obtaining consent from volunteers, a detailed history and anthropometric values were obtained.

Selection criteria

Overnight fast, (The amount of water, food or gas in the gastrointestinal tract will affect the accuracy of the waist measurement. Gibson (1990) suggests that a waist measurement be made after the subject has fasted overnight or is in a fasted state, to reduce this effect²⁴ of ingested food. Willingness,

one having lipid profile done within past 6 months, non diabetic, no apparent history of cardiovascular disease.

Exclusion criteria

Musculoskeletal disorders, endocrine disorders

Measurements;

Height of participants (without footwear) in cm was measured with stadiometer.

Weight (with only innerwear) was measured on digital weighing scale.

Waist circumference; was measured using measuring tape.

Site for measurement;

Males ; Measured at umbilicus

Females – measured at halfway point between lowest rib and top of the hip bone (narrowest point)

Measurement is done horizontally at above points with the help of a tape placed directly on skin and not on clothes. Ask the subject to breathe out normally, hold the tape lightly taking care not to compress the skin and take the measurement in cm.

Waist to height ratio: is calculated mathematically by dividing the value of waist circumference (by height both in cms).

BMI ; is calculated mathematically by using formula

$$\text{BMI} = \frac{\text{weight in kg}}{\text{Height}^2 \text{ in metres}}$$

All the measurements were taken in morning after overnight fasting.

The participants were asked to bring their lab report of lipid profile done within last six months.

The values of various lipid parameters were noted.

The results obtained were analysed using Chi square test.

Result:

Table 1 Frequency distribution of Participants

Statistics		Wt	Ht	WC	WH	Cho	LDL
		kg	m	cm	tR	I	
N	Valid	100	100	100	100	100	100
	Missing	0	0	0	0	0	0
Mean		64.3	1.6	90.4	.55	24.3	182.3

Std. Deviation	10.757	.08341	8.056	.06612	4.2822	28.110	18.533
Minimum	41	1.50	70	.40	13.7	135	65
Maximum	80	1.79	101	.67	33.3	230	152

Wt – weight, Ht- height, Chol- cholesterol
WC- waist circumference

Table 1 highlights the mean values of parameters measured in the present study and the level of serum cholesterol and LDL. It can be seen from the table that LDL and cholesterol is on high normal side, BMI value is in normal range while WHtR is just more (0.55) than the normal i.e. 0.5.

Table 2 . WHtR and Sr. Cholesterol

Crosstab					
		Category for Chol. levels	Total		
Category of WHtR	Healthy	Count	34	11	45
		% within Category of WHtR	75.6%	24.4%	100.0%
		% within Category for srChol	44.7%	45.8%	45.0%
	Unhealthy	Count	42	13	55
		% within Category of WHtR	76.4%	23.6%	100.0%
		% within Category for srChol	55.3%	54.2%	55.0%
Total		Count	76	24	100
		% within Category of WHtR	76.0%	24.0%	100.0%
		% within Category for srchollevels	100.0%	100.0%	100.0%

Chi-square test p-value = 0.925 and therefore, there is insignificant association between the

categories of Waist-Height ratio and Cholesterol levels.

Table 2 classifies the percentage of studied population on basis of serum cholesterol (desirable, acceptable unhealthy) and WHtR (healthy and unhealthy). The cut off (critical) value for WHtR to demarcate between healthy and unhealthy is 0.5. for total cholesterol desirable and acceptable level is less than 200 and between 201-239 mg% respectively the same for LDL is less than 100 and 101-129 mgs%.

Table 3. BMI and Sr. Cholesterol

Crosstab					
		Category for Cholesterol levels	Total		
Category of BMI	Under weight	Count	7	0	7
		% within Category of BMI	100.0%	0.0%	100.0%
		% within Category for srChol	9.2%	0.0%	7.0%
	Normal	Count	36	10	46
		% within Category of BMI	78.3%	21.7%	100.0%
		% within Category for srChol	47.4%	41.7%	46.0%
	Overweight	Count	23	13	36
		% within Category of BMI	63.9%	36.1%	100.0%
		% within Category for srChol	30.3%	54.2%	36.0%
	Obese	Count	10	1	11
		% within Category of BMI	90.9%	9.1%	100.0%

		% within Category for srChol	13.2%	4.2%	11.0%
Total		Count	76	24	100
		% within Category of BMI	76.0%	24.0%	100.0%
		% within Category for srCho	100.0%	100.0%	100.0%

Chi-square test p -value = 0.087 and therefore, there is insignificant association of the categories between BMI and Cholesterol levels.

Table 3 depicts BMI and serum cholesterol correlation in studied population wherein value of BMI between 18.5-24.9 kg/m^2 normal and any value more than kg/m^2 is typified as overweight.

The result though insignificant (p value 0.092, 0.087 by Chi square), the BMI showed better correlation with serum total cholesterol and LDL than WHtR.

Discussion:

World Health Organization (WHO) has put obesity as one of the most common, yet among the most neglected problems in public health care, in developed as well as developing countries²⁵. Obesity in simple language means a state of grossly fat or overweight which is related with multiple health effects especially on heart and it is a central obesity (measured by WHtR) which is more closely related to heart disease than total body fat(BMI). A strong & positive relation between serum cholesterol level and death due to coronary artery disease was observed by Chen, Peto et al 1991²⁶. BMI was a reliable index for assessing weight and obesity status for a decade or more but with a deeper insight into interplay between obesity and cardiovascular ailment; central obesity is more significant than total body fat. Serum TC, LDL-C, level was found to have a better correlation with WHtR than BMI in a study by Chehrei A et al²⁷. The result obtained in present study is contrary to our hypothesis that 'WHtR relates better to serum cholesterol than BMI'. We need to have a bigger

sample size to overcome the reason for insignificant ' p ' values and also need to compare the latest lipid profile (done in last one week or so) rather than relying on 6 months old value to correlate BMI and WHtR to serum lipid levels. Also the study should be divided into various age groups rather than having a blanket age group of 18-70 years. Dietary and activity pattern should be taken into consideration while finding correlation between anthropometric measurement and obesity and lipid profile.

Conclusion:

1. For adult patients with a BMI of 25 to 34.9 kg/m^2 , sex-specific waist circumference cut-off should be used in conjunction with BMI to identify increased disease risk.
2. The effectiveness and appropriateness of these indices depends on gender, ethnicity, and country.
3. Present study suggests a better correlation between BMI and serum total cholesterol and LDL, so it nullifies our hypothesis of 'WHtR as a better parameter for assessing obesity and hence heart disease'.
4. A larger study with much defined and refined participant is needed.
5. Other indices such as the forehead to waist ratio, forehead to rib ratio, and forehead to chest ratio also should be measured along with BMI and WHtR.

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