WAIST-HIP RATIO AND WAIST CIRCUMFERENCE AS SIMPLE MEASURES OF CARDIOVASCULAR RISK ASSESSMENT AND WEIGHT MANAGEMENT AMONG MEDICAL STUDENTS

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ABSTRACT

BACKGROUND

The Waist-Hip Ratio (WHR) and Waist Circumference (WC) were used to identify people at health risk both from being overweight and having visceral fat distribution.

The aim of this study was to determine the association of WHR and WC in measuring the abdominal obesity, cardiovascular risk and weight management.

MATERIALS AND METHODS

The study involved 200 medical students (102 boys and 98 girls) in the age group of 18-23 years (mean age 20.43 ± 8.9 years) of Government Medical College, Amritsar, Punjab.

WHR was divided into three groups in females- ≤0.80, 0.81-0.85 and >0.86 and males- ≤0.90, 0.90-1.0 and >1.0. WC was also divided into three groups in females- <80 cm, 80-88 cm and >88 cm and males- <94 cm, 94-102 cm and > 102 cm.

RESULTS

The results of measurement of Waist-Hip Ratio (WHR) of females were ≤0.80 (2%), 0.81-85 (10%) and >0.86 (88%) and males ≤90 (82%), 0.90-1.0 (15%) and >1.0 (3%). Waist Circumference (WC) of females was <80 cm (32%), 80-88 cm (49%) and >88 cm (19%) and males <94 cm (86%), 94-102 cm (10%) and >102 cm (4%).

CONCLUSION

WHR is a better predictor of Cardiovascular Diseases (CVD) than WC. WHR and WC are measures of abdominal obesity and should be incorporated in weight management. WHR 0.81-0.86 in girls and 0.90-1.0 in males have moderate health risk, while >0.86 in females and >1.0 in males have high health risk.

Men with WC ≥94 cm and women ≥80 cm should gain no further weight while men with WC ≥102 cm and women with ≥88cm should reduce their weight to avoid cardiovascular risks. Waist circumference is another alternative.

KEYWORDS

Waist-Hip Ratio (WHR), Waist Circumference (WC), Overweight, Obesity, Cardiovascular Disease Risk Factors, Body Mass Index and Visceral Fat.

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BACKGROUND

The abdominal obesity is internationally recognised as a major risk factor for cardiovascular diseases. Waist-Hip Ratio (WHR) and Waist Circumference (WC) are associated with metabolic risk factors, cardiovascular diseases and death.[1-2] These risk factors are associated with abdominal obesity due to presence of Visceral Adipose Tissue (VAT), which is responsible for insulin resistance, dyslipidaemia and hypertension.[3-4] There has been an increase in prevalence of overweight and obesity in developing and developed countries. The obesity is a rapidly growing threat to health of populations worldwide (WHO 1998).[5] Accurate and simple measures are essential for its early detection. The commonly used measure for obesity is Body Mass Index (BMI), which is a comparatively poor predictor of death. Recently, the hazards of central or visceral obesity using measures of WHR and WC have been emphasised as useful markers of the obesity-related health problems.[6,7] However, the increased risk of Cardiovascular Disease (CVD) has been found in individuals presenting with distribution of excess fat in the abdominal region and pattern of fat distribution in body, e.g. in torso and abdomen versus hips, thighs and buttocks. Torso and abdominal fats referred as visceral, central or intra-abdominal fat is related to health abnormalities including insulin resistance, abnormal blood lipid levels, thus

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increasing the risk of diabetes mellitus and cardiovascular diseases, respectively.[8,9,10,11]

The visceral fat measurement requires the use of computerised axial tomography, magnetic resonance imaging and dual energy x-ray absorptiometry, which are scientific techniques that visually depict the internal tissue compositions, but these techniques are very expensive and not feasible for routine use.[12] WHR and WC are common, simple and easy techniques for measurement of abdominal obesity and are positively associated with CVD risk.

WHR is also sensitive marker for central obesity and less influenced by muscle mass and is a better indicator of risk associated with obesity. Waist circumference and waist-hip ratio are measures of central obesity that appear to predict cardiovascular and diabetic risk better than BMI. The Indians have high upper adiposity and higher visceral fat when compared with western population. As per WHO recommendations, a WHR of 0.8 or lower in women and 0.9 or lower in men is healthy. While in men and women, a WHR of 1.0 or higher increases the risk of heart diseases and other conditions linked to overweight.

WC measures central or abdominal fat, WHO expert committee on obesity in Asia pacific suggested revised cut-off points for waist circumference- 90 cm for men and 80 cm for women for identifying persons with abdominal obesity. The majority of current studies agree that Waist Circumference (WC) and Waist-Hip Ratio (WHR) measure visceral fat and responsible for cardiovascular diseases. A waist circumference of 80 cm or greater in women and 94 cm in men or greater have been reported to be indicative of need for weight management 14/18 and is associated with higher cardiometabolic risk. As WC increases to 102 cm or greater in men and 88 cm or greater in women, the symptoms of breathlessness and arthritis begin to develop from overweight. The waist circumference is superior to body mass index in predicting cardiovascular disease risk. Recently, the investigators have examined the predictive role of abdominal adiposity markers such as Waist-Hip Ratio (WHR) and Waist Circumference (WC) for CVD risk.[13]

The aim of present study is to examine the role of these indices as a future risk of cardiovascular diseases. WHR and WC are measures of central obesity or visceral fat and maybe better indicator than other anthropometric measures including BMI. The WHR and WC reflects the proportion of body fat located intra-abdominally.

MATERIALS AND METHODS

The present study was conducted on 200 medical students, 120 males and 98 females of 18-23 years age, mean age 20.43 ± 8.9, Department of Physiology, Government Medical College, Amritsar. The waist and hip circumference were measured.

Waist Circumference (WC)- Subject is asked to stand straight and breathe out. The measuring tape is used to check distance around the smallest part of waist, just above belly button and measured in cm.

Hip Circumference (HC)- The distance around the largest parts of hips - the widest parts of buttocks and is measured in cm.

Calculation of Waist-Hip Ratio (WHR)- Waist-hip ratio (WHR) is calculated by dividing waist circumference by hip circumference.

According to World Health Organization (WHO), a healthy WHR is-

- 0.9 or less in men.
- 0.80 or less for women.
- In both men and women, a WHR of 1.0 or higher increases the risk for heart disease and other conditions that are linked to being overweight.

Health Risk	Women	Men
Low	0.80 or lower	0.95 or lower
Moderate	0.81-0.85	0.96.1.0
High	0.86 or higher	1.0 or higher

Waist-Hip Ratio Chart

RESULTS

The present study was conducted on 200 medical students including 102 boys (51%) and 98 girls (49%) in the age group of 18-23 years (mean age 20.43 ± 8.9 years).

Waist-Hip Ratio	Boys	Girls	p-value
No	102	98	
Percentage	51.0	49.0	
Mean waist	84.55 ± 9.00	81.22 ± 10.36	0.039
Mean hip	90.80 ± 8.13	87.85 ± 11.74	0.016
Waist-hip ratio	0.931 ± 0.006	0.922 ± 0.008	0.852

Table 1. Mean Waist-Hip Ratio

Health Risk	Boys			Girls			p-value
	Range	N	Mean ± SD	Range	N	Mean ± SD	
Low	0.90 or lower	84	0.90 ± 0.40	0.80 or lower	2	0.71 ± 0.12	0.01
Moderate	0.90-1.0	15	0.98 ± 0.16	0.81-0.85	10	0.83 ± 0.17	0.04
High	1.0 or higher	3	1.13 ± 0.50	0.86 or higher	86	0.95 ± 0.70	0.01
Total		**102**	**0.92 ± 0.61**		**98**	**0.93 ± 0.86**	**0.42**

Table 2. Waist-Hip Ratio

Table 1 Shows- The Mean waist circumference of boys 84.55 ± 9.00 and girls 81.22 ± 10.36, while mean hip circumference of boys 90.80 ± 8.13 and girls 87.85 ± 11.74. The mean waist-hip ratio of boys and girls was 0.931 ± 0.006 and 0.922 ± 0.008 respectively.

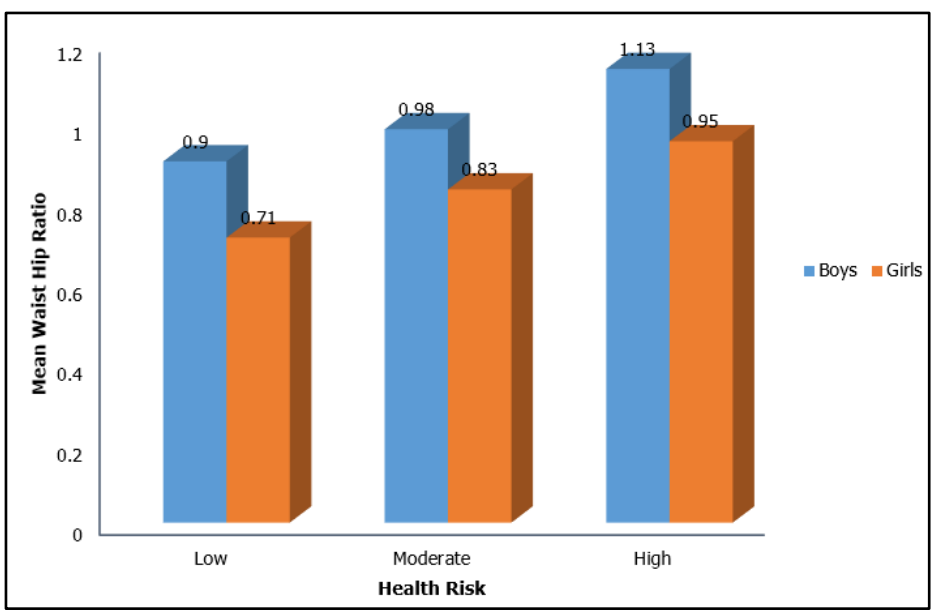
Table 2 Shows- When Waist-Hip Ratio (WHR) was analysed on the basis of sex and health risk The 82% boys (WHR <0.90) and 2% girls (WHR <0.80) have low health risk (p-value 0.01), while 15% boys (WHR 0.90-1.0) and 10% girls (WHR 0.81-0.85) have moderate health risk (p-value 0.03) and 3% boys (WHR >1.0) and 88% girls (WHR >0.86) have high health risk (p-value 0.01 and were significant.

Health Risk	Girls (n=98)				Boys (n=102)				
	Range (cm)	Number	Percentage	Mean	Range (cm)	Number	Percentage	Mean	p-value
Low	<80	31	32.0	77.17 ± 10.91	<94	88	86.0	89.11 ± 6.90	0.00
Moderate	80-88	48	49.0	82.68 ± 2.49	94-102	10	10.0	95.50 ± 1.58	0.00
High	>88	19	19.0	95.78 ± 8.70	>102	4	4.0	106.89 ± 5.54	0.00
Total		**98**	**100.0**	**87.85 ± 11.74**		**102**	**100.0**	**90.80 ± 8.13**	**0.01**

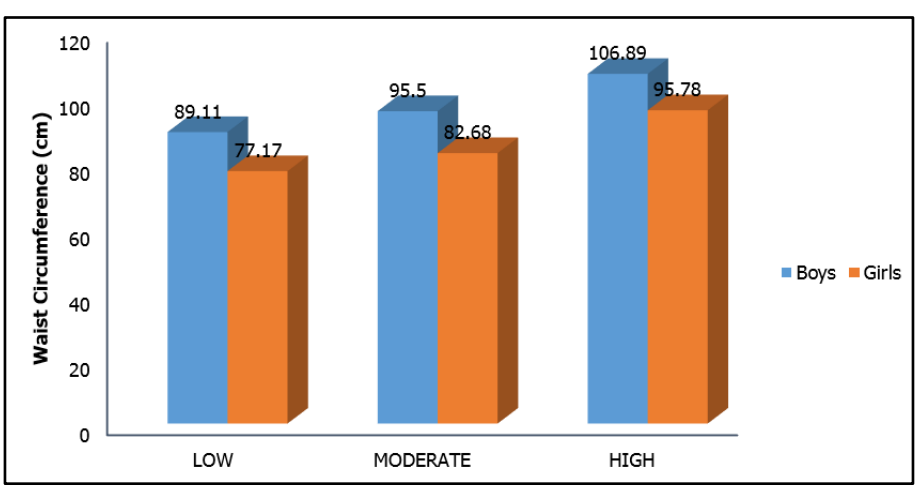
Table 3. Waist Circumference

Table 3 Shows- The mean waist circumference of boys 84.55 ± 9.00 and girls 81.22 ± 10.36.

The relation of Waist Circumference (WC) and health risk of both sexes were analysed. The 86% boys (WC <94 cm) and 32% girls (WC <80 cm) had low health risk, while 10% boys (WC 94-102 cm) and 49% girls (WC 80-88 cm) had moderate health risk and 4% boys (WC >102 cm) and 19% (WC >88 cm) girls had high health risk.



Graph 1. The Relation of Mean WHR and Health Risks of Both Sexes



Graph 2. The Relation of WC and Health Risks of Both Sexes

Graph 1 Shows- The relation of mean WHR and health risks of both sexes.
Graph 2 Shows- The relation of WC and health risks of both sexes.

WHR of 10% girls and 15% boys have moderate health risk, while 88% girls and 3% boys have high health risk. So, in total 98% girls and 18% boys have moderate-to-high health risk.

Similarly, WC of 49% girls and 10% boys have moderate health risk, while 19% girls and 4% boys have high health risk. In total, 68% girls and 14% boys have moderate-to-high health risk. WHR shows comparatively higher health risk than WC in both girls and boy indicating that WHR is a superior anthropometric index than WC.

DISCUSSION

The overweight and obesity is a global problem and is associated with leading causes of death. The WHR and WC are measured for visceral fat assessment, which is a major determinant of cardiovascular risk of hypertension, diabetes mellitus and metabolic syndrome in both sexes. Many factors such as genetic, behavioural, cultural, socioeconomic and psychosocial mechanisms are related to health.[14-15] Many of these factors affect health independently or through mechanisms other than body weight, while excess body weight is responsible for variety of health hazards.

In our study, 98% girls and 18% boys have moderate to high health risk on WHR measurement, while on WC measurement 68% girls and 14% boys have moderate to high health risk as per WHO guidelines. The study clearly shows that WHR is a superior anthropometric measure than WC in health-risk assessment. The cut-off values of WHR in our study were 0.90 or lower in males and 0.80 or lower in females while cut-off values in WC were 94 cm or lower in males and 80 cm or lower in females and values above which health risk increases appreciably. The values of WHR and WC of girls were alarmingly higher than boys. The students have health risks and are prone to diabetes, hypertension and cardiovascular diseases in later life. The students take western and junk foods instead of green vegetables and fruits. Even medical students have to study for long hours and are unable to spare time for exercise.

According to Ramachandran et al,[16] in Indians with normal Body Mass Index (BMI), the cut-off values for WC was 85 cm for men and 80 cm for women and for WHR was 0.89 for men and 0.81 for women. The cut off values of WHR and WC are near to our study except for WC 85 cm in men, while in our study was 94 cm. A Misra et al[17] in their first study on Asian Indians showed detailed analysis of WC cut-off points using multiple cardiovascular risk factors and BMI.

The waist circumference level 1 cut-off points with one cardiovascular risk factor and BMI levels of 21-23 kg/m^2 was ≥78 cm for men and ≥72 cm for women. Waist circumference level 2 cut-off points with cardiac risk factors and BMI >25 kg/m^2 was ≥90 cm in men and ≥80 cm in women, respectively. Snehalatha[18] et al studied healthy urban Indian men and women both with BMI <23 kg/m^2 and cut-off values for WC was 85 cm for men and 80 cm for women and for WHR was 0.88 for men and 0.81 for women. Gupta et al[19] proved that WHR >0.9 in men and >0.8 in women is associated with increase in multiple risk factors and significant increase in hypertension, diabetes and metabolic syndrome at WC >90 cm in men and >80 cm in women.

M. Deepa[20] et al in Chennai Urban Rural Epidemiology study (CURES-2007) suggested WC is a better index than BMI to identify metabolic risk factors in Asian Indians. In their study of age standardised the prevalence of generalised obesity (BMI >23 kg/m^2) was 45.9%, while that of abdominal obesity (WC ≥90 cm in men and ≥80 cm in women) was 46.6% using WHO Asia Pacific guidelines. In their study prevalence of obesity, both generalised and abdominal was alarmingly high in urban population. The generalised obesity was more common in men, whereas isolated abdominal obesity was more common in women and abdominal obesity shows a greater correlation with cardiometabolic abnormalities. These findings suggest that in Asian Indians measuring WHR is a better method of estimating obesity-related cardiovascular risk than BMI and even suggested the inclusion of WC as a component of Indian Diabetes Risk Score (IDRS), which has been shown to be very effective tool for predicting undiagnosed diabetes. While in our study the abdominal obesity of females and males were 68% and 14% (WC females ≥80 cm and males ≥94 cm), respectively.

On comparison with other Indian studies, our results of WHR and WC show high values indicating the trend towards overweight and obesity in younger or teenage population, then leading to early lifestyle-related diseases, especially diabetes mellitus, hypertension and cardiac diseases.

Lower WC cut-off points than presently accepted have been reported for several non-Asian populations in the countries such as Nigeria, Cameroon, Jamaica, St. Lucia and Barbados.[21] BMI is another useful measures for generalised obesity, but was not included in this analysis, because the aim of present study was to measure abdominal or visceral obesity. Wellborn and Dhaliwal[22] studied Australian urban population and WC cut-off values for males 94 cm and females 80 cm and WHR 0.90 males and 0.80 females and highest mortality in raised WHR which are similar to our study cut-off values of WC and WHR. While in our study, cut-off values of WC and WHR are same except for WHR of females, which is 85. Waist-hip ratio is the preferred clinical measure of obesity for predicting all cause and cardiovascular disease mortality and WC is the practical alternative. Lawrence de Koning et al[23] measured abdominal obesity by WC and WHR and found significant association with CVD events as 1 cm increase of WC is associated with 2% increase risk of CVD and 0.01 increase in WHR is associated with 5% increase in risk. Lean et al in their study found 48% women and 38% men had their WHR ≥0.95 and ≥80, respectively. The metabolic risk factors, especially serum triglycerides and HDLC improve with weight loss.

European fat distribution study and[24] Paris prospective study[25] have demonstrated the importance of abdominal fat and elevated WHR in cardiovascular and coronary heart disease mortality. Abdominal obesity was diagnosed when WHR was >0.90 in men and >0.80 in women according to second report of US National Cholesterol Education Programme (ATP-II)[26] and WC more than 102 cm in men and 88 cm in women according to US National Cholesterol Education Programme (ATP-III).[27]

The measurement of WHR and WC have been popularised as simple and practical tools to identify central obesity and are superior to BMI. It is a useful indicator of weight reduction for clinical purposes. The males with WC of <94 cm and females <80 cm should not gain weight while males with WC of >102 cm and females >88 cm should reduce weight, Lean et al.[11]

The simplicity of measurement and its relation to fat distribution are major advantages of waist-hip ratio and waist circumference over body mass index. Even self-measurement and reporting of waist circumference has been acceptable in recent epidemiological studies.[28]

In Indians, WHR is more reliable indicator of multiple cardiovascular risk factors. There is need of larger prospective studies to confirm these findings. The present study showed lack of physical activity, dietary habits and study burden in weight gain, thereby increasing circumference of waist, hip and WHR. The diet being the major determinant of overweight or obesity, the dietary habits and type of food to be taken is learnt from childhood. The choice of food of youth these days is sweetened carbonated drinks, bakery products, pizza and burgers. The youth these days are in the habit of taking readymade bazaar made unhealthy, non-nutritious and fast foods. The youth is all time busy on mobiles, laptops, Whatsapp and Facebook and spare no time for exercise or physical fitness. The visceral, central or abdominal obesity is measured by WHR and WC and is associated with escalating prevalence of CVS risk. The WHR, WC and BMI are interrelated indices for assessment of obesity and influence metabolic and cardiovascular diseases. So, weight loss should be urged for all those with high WHR and WC. Most of those with high WC have high WHR, which still justifies weight management. Prevention of overweight in early childhood can reduce cardiovascular mortality. Everybody's slogan should be leaner the better.

CONCLUSION

The waist-hip ratio is the preferred clinical measure of obesity for predicting cardiovascular risk and waist circumference is a practical alternative. The present study forms basis for health promotion awareness and action on weight reduction. The males and females should maintain healthy WHR and WC. They should gain no further weight and above these measures should reduce weight. These measures should be used to measure visceral fat and weight management.

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