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Research Article

Association of Waist Circumference, Waist Hip Ratio and Waist to Height Ratioamong Respondents in age between 20 to 50 Years

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Abstract
This study investigates the associations between waist circumference (WC), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR) in evaluating obesity-related health risks among 773 participants aged 20 to 50 in the Dindigul district of Tamil Nadu, India. The findings reveal significant correlations between these anthropometric measures and age, indicating that as participants age, their risk factors related to cardiovascular and metabolic health increase. WHtR emerged as the most effective predictor of hypertension and myocardial infarction, followed by WC, which is closely related to obesity-related conditions. WHR, while informative for fat distribution, was less definitive in predicting myocardial infarction. These results underscore the importance of these measurements in the early detection and management of obesity-related diseases, particularly in high-risk populations, and highlight the need for age-specific strategies in clinical settings.

Keywords: *Obesity, Waist circumference (WC), Waist-to-hip ratio (WHR) and Waist-to-height ratio (WHtR)*

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INTRODUCTION

The WC is an essential anthropometric parameter that functions as a marker for central obesity and is linked to a multitude of health hazards, such as diabetes, cardiovascular disorders, and infertility [1]. Empirical studies suggest that WC may yield a more precise evaluation of these risks in comparison to body mass index (BMI), especially within low- and middle-income nations and among particular demographic groups [2].The measurement of WC serves as a robust indicator of central adiposity. Empirical evidence has demonstrated a significant correlation between WC and the prevalence of hypertension as well as cardiovascular risk factors, particularly among female populations [3].

The normative values for WC differ by gender and are crucial for evaluating health risks, notably those related to cardiovascular and metabolic diseases. Investigations show that the advised cutoff points are 94 cm for males and 80 cm for females, as these limits are associated with heightened health threats, including hypertension and ischemic stroke [4].

The WHtR has been recognized as a more effective predictor of hypertension in comparison to BMI and WC, thereby underscoring its relevance in the evaluation of cardiovascular risk. Furthermore, it exhibits a strong correlation with body fat percentage in the geriatric demographic [5].The WHR serves as an essential anthropometric indicator for evaluating body fat distribution and related health risks, with normative values differing by gender and population, where a WHR of ≤0.9 for men and ≤0.85 for women is considered acceptable in the Asia-Pacific region [6].

The WHR serves as a critical health risk determinant, particularly concerning cardiometabolic disorders and obesity, with studies underscoring its predictive capacity for diabetes, hypertension, and cardiovascular diseases, thereby affirming its superiority over conventional measures such as BMI [7].General recommendations indicate that a WHR of 0.80 or

lower in females and 0.90 or lower in males is deemed normal, with elevated ratios potentially signifying a heightened risk for cardiometabolic disorders [8,9]

The WC, WHR, WtHRare critical anthropometric measurements for assessing health risks associated with obesity. Among these, WHtR is recognized as a more effective predictor of hypertension and myocardial infarction risk, showing a strong correlation with visceral fat and cardiovascular outcomes [10]. WC is also highly correlated with obesity-related disorders and BMI (r=0.75), making it a valuable metric for fat distribution assessment. While WHR provides insights into fat distribution, its predictive capacity for myocardial infarction is less definitive than WHtR. These indices are essential for the early identification and management of obesity-related diseases, particularly in high-risk populations such as individuals with diabetes [11].

Methodology

This study employed a cross-sectional methodology to investigate the associations among WC, WHR, WtHR in relation to health risks linked to obesity.Amongparticipants aged 20 to 50 in the Dindigul district of Tamil Nadu, India, with a total sample size of 773 individuals. The participant cohort comprised individuals from diverse demographic backgrounds, particularly emphasizing those with an elevated risk for cardiovascular and metabolic diseases. Ethical approval for the research was secured from Meenakshi Hospital in Madurai. Anthropometric data were collected in accordance with standardized protocols to ensure precision and uniformity. The measurement of waist circumference was conducted at the midpoint located between the lower rib and the iliac crest. The waist-to-hip ratio was determined by dividing the waist circumference by the circumference of the hips. Additionally, the waist-to-height ratio was obtained by dividing the waist circumference by the individual's height. Statistical analyses were conducted to explore the relationships between these anthropometric indices and health outcomes, including hypertension, myocardial infarction, diabetes, and other conditions associated with obesity.The results were compared to established normative values to assess the effectiveness of each metric in predicting cardiovascular and metabolic risks, with a particular focus on the superiority of WHtR as a predictor.

Result and Discussion

Table 1. Personal Profile of the Participants

Variables	**Frequency (Total 773)**	**Percent (100%)**
Age		
20-25 Years	126	16.3
26-30 Years	137	17.7
31-35 Years	187	24.2
36- 40 Years	110	14.2
41- 45 Years	48	6.2
46-50 Years	165	21.3
Gender		
Male	408	52.8
Female	365	47.2
Religion		
Christian	216	27.9
Hindu	446	57.7
Muslim	111	14.4
Employment Status		
Unemployed	422	54.6
Employed	351	45.4

The table 1 provides a demographic profile of 773 participants, highlighting age, gender, religion, and employment status. The largest age group is 31-35 years, comprising (24.2%) of the participants, while the smallest is 41-45 years, at (6.2%). The gender distribution is relatively balanced, with (52.8%) male and (47.2%) female. In terms of religion, the majority are Hindu (57.7%), followed by Christians (27.9%) and Muslims (14.4%). Regarding employment, a higher percentage of participants are unemployed (54.6%), compared to those who are employed (45.4%).

Table 2. Life Style Pattern of the Participants

Variables	**Frequency (Total 773)**	**Percent (100%)**
Life Style Pattern		
Sedentary Worker	606	78.4
Moderate Worker	157	20.3
Heavy Worker	10	1.3

Type of Diet		
Non-Vegetarian	694	89.8
Vegetarian	51	6.6
Ova Vegetarian	28	3.6
Duration of Sleep at Night Time		
< 5 Hours	14	1.8
5-9 Hours	542	70.1
> 9 Hours	217	28.1
No Sleep	14	1.8
Duration of Sleep at Day Time		
30 Mis	135	17.5
1-2 Hours	180	23.3
>2 Hours	207	26.8
No Sleep	251	32.5
Consumption of Snacks between Meals		
Yes	648	83.8
No	125	16.2

The table2 presents the lifestyle patterns of 773 participants, focusing on work activity, diet, sleep, and snack consumption. A significant majority (78.4%) are sedentary workers, with only a small fraction (1.3%) engaged in heavy work. Most participants follow a non-vegetarian diet (89.8%), while a minority are vegetarian (6.6%) or ova-vegetarian (3.6%). Regarding sleep patterns, (70.1%) sleep between 5-9 hours at night, with (28.1%) exceeding 9 hours. Daytime sleep varies, with (32.5%) not sleeping at all and (26.8%) sleeping for more than 2 hours. Additionally, (83.8%) of participants consume snacks between meals, indicating a common habit of snacking.

Table 3. Anthropometric Profile of the Participants

Variables	**Frequency (Total 773)**	**Percent (100%)**
Waist Circumference		
Normal	52	6.7
At Risk	721	93.2
Waist-to-Hip Ratio		
Normal	52	6.7
At Risk	721	93.2
Waist-to-Height Ratio		
Normal	54	7.0
At Risk	719	92.9

The table 3 outlines the anthropometric profile of 773 participants, focusing on WC, WHR, WtHR. A vast majority of participants are classified as "At Risk" across all three measures, with (93.2%) having at-risk WC and WHR, and (92.9%) having an at-risk WtHR. Only a small percentage of participants fall within the "Normal" range (6.7%) for WC and WHR (7.0%) for WtHR. This suggests that a significant portion of the population may be at increased risk for health issues related to these anthropometric factors.

Table 4. Association of Waist Circumference, Waist Hip Ratio and Waist to Height Ratio of the Participants

Gender	**Waist Circumference**		**Total**
	Normal	**High**	
Male	7(0.9%)	401(51.9%)	408(52.8%)
Female	45(5.8%)	320(41.4%)	365(47.2%)
Total	52(6.7%)	721(93.3%)	773(100.0%)
Gender	**Waist Hip Ratio**		**Total**
	Normal	**High**	
Male	38(4.9%)	370(47.9%)	408(52.8%)
Female	14(1.8%)	351(45.4%)	365(47.2%)
Total	52(6.7%)	721(93.3%)	773(100.0%)
Gender	**Waist to Height Ratio**		**Total**
	Normal	**High**	

Male	17(2.2%)	391(50.6%)	408(52.8%)
Female	37(4.8%)	328(42.4%)	365(47.2%)
Total	54(7.0%)	719(93.0%)	773(100.0%)

The table 4 explores the association between gender and three anthropometric measures: WC, WHR, WtHR ratio among 773 participants. The data indicates that a higher percentage of males (51.9%) have a high waist circumference compared to females (41.4%). However, more females (5.8%) fall within the normal waist circumference range than males (0.9%). Regarding waist-to-hip ratio, males again show a higher percentage with high values (47.9%) compared to females (45.4%), though more males (4.9%) have normal ratios compared to females (1.8%). For the waist-to-height ratio, a higher percentage of males (50.6%) have high ratios, while females (4.8%) are more likely to have normal ratios than males (2.2%). Overall, the majority of both males and females are at risk across all three measures, with only a small fraction in the normal range.

Table 5. Mean Comparison of WC, WHR, WtHR with Age of the Participants

ANOVA						
Variables		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Waist Circumference	BetweenGroups	14343.444	5	2868.689	58.615	.000**
	WithinGroups	37537.737	767	48.941		
	Total	51881.181	772			
Waist Hip Ratio	BetweenGroups	.201	5	.040	11.591	.000**
	WithinGroups	2.663	767	.003		
	Total	2.864	772			
Waist to Height Ratio	BetweenGroups	.726	5	.145	61.794	.000**
	WithinGroups	1.801	767	.002		
	Total	2.527	772			
	Total	14343.444	5	2868.689	58.615	

The table 5 presents the results of an ANOVA analysis comparing WC, WHR, WtHRacross different age groups among 773 participants. Significant differences were found for all three variables, with p-values of .000, indicating that age has a significant impact on these measures. The F-values are particularly high, with 58.615 for WC, 11.591 for WHR and 61.794 for WtHR, showing a strong variation between age groups. The results indicate that age significantly impacts WC, WHR, WtHR, with noticeable differences across age groups. As age increases, these anthropometric indicators change, reflecting heightened health risks associated with aging.

Conclusion

The study highlights the significant impact of age, gender, and lifestyle patterns on key anthropometric measures WC, WHR, WtHR which are crucial indicators of obesity-related health risks. The findings reveal that the majority of participants are at risk, with (93.2%) having high WC and WHR, and (92.9%) having a high WtHR. The data further indicate a clear gender difference, with males more likely to have higher WC (51.9%) and WHR (47.9%) compared to females. Additionally, the ANOVA results show that age significantly influences these measures, with F-values of 58.615 for WC, 11.591 for WHR, and 61.794 for WtHR, all with p-values less than .001, underscoring the heightened health risks associated with aging. The study underscores the importance of these anthropometric indicators in the early detection and management of obesity-related diseases, particularly in high-risk populations, and suggests that targeted interventions based on age and gender are essential for mitigating these risks.

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