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Study of Comparison of Anthropometric Parameters Among The Non-Obese, Overweight and Obese Subjects

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ABSTRACT

Background: Obesity is the biggest challenge in health management and public health problem in many countries since it is a significant risk factor for cardiovascular diseases. Therefore, it is to ascertain which anthropometric measurements are better predictors of obesity.

The main objective is to evaluate and compare the anthropometric parameters in non-obese, overweight, and obese subjects.

Materials and methods: This cross-sectional study was conducted with 82 subjects (male 36 and female 46) with the age group of 25 to 60 years recruited from the outpatient department of Medicine, Thanjavur Medical College, Thanjavur, South India. All the anthropometric data were collected.

Statistical analysis and results: Statistical analyses were carried out by using SPSS. The analysis by T-test was used to compare the means between the groups for normally distributed variables. All the statistical tests were two-tailed, and a p-value <0.05 was considered significant. Anthropometric parameters Height(Ht), Weight(Wt), Body mass index(BMI), waist circumference(WC), hip circumference(HC),waist-hip ratio(WHR), and Blood pressure were significant(p-value < 0.05)among the overweight and obese subjects. Among the obese subjects, the body mass index was positively associated with weight, WC, and HC.

Conclusion: In conclusion, the anthropometric markers, BMI, WC, HC, WHR, and Blood pressure were independently associated with obesity in this study. Elevated BMI and Blood Pressure are significantly related to several cardiovascular risk factors.

Keywords: Obesity, Body mass index, Cardiovascular risk factors, Anthropometric parameters.

INTRODUCTION

According to the World Health Organization (WHO), the prevalence of obesity is increasing very fast in the world and India. The WHO survey (2012) estimated that more than 200 million men and approximately 300 million women were obese(WHO-2012). Overweight and obesity are defined by the World Health Organization as abnormal or excessive fat mass (FM) that accumulates and presents a risk to health, which is most commonly characterized by the determination of a body mass index (BMI) ≥30 kg/m^2 [8].

Obesity has become a public health problem in many countries over the past decades. The financial burden and healthcare utilization from morbidity and mortality resulting from complications of Obesity

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and Cardiovascular Disease (CVD) is also increasing at an alarming rate[10]. Obesity is a strong independent predictor of CVD, even without other risk factors[11]. However, interestingly after the onset of CVD, the relationship between higher BMI and clinical outcomes is not linear. Excess adiposity contributes to the cardiovascular and other risks associated with being overweight or obese[12]. Even obesity in childhood and adolescence is associated with an increased risk for cardiovascular diseases later in life.

Being overweight and obese increases the risk of Coronary heart disease (CHD) by altering the lipid levels such as dyslipidemia, hypertension, and type 2 DM[1,4]. Obesity is associated with leptin concentrations, higher sympathetic nervous system activity, and angiotensin-aldosterone activity, which may lead to greater salt retention and blood pressure[5]. Obesity is the most significant health problem and becoming an epidemic, which affects a person both physically, and psychologically in many parts of the world[9].

Simple anthropometric measurements are used as surrogate measurements of obesity and have more practical value in both clinical practice and large-scale epidemiological studies[6]. Body mass index (BMI), which relates weight to height, is the most widely used and simple measure of body size and is frequently used to estimate the prevalence of obesity within a population[13]. BMI is consistently associated with an increased risk of cardiovascular disease (CVD) and type 2 diabetes[2]. Yet, this measurement does not account for variation in body fat distribution and abdominal fat mass, which can differ significantly across populations and vary substantially within a narrow range of BMI. Excess intra-abdominal fat is associated with a greater risk of obesity-related morbidity than overall adiposity[3]. Thus, waist circumference(WC) and waist-hip ratio (WHR) have been viewed as alternatives to BMI, with both measures regularly used in clinical and research settings. The cut-offs for WC recommended for men and women are 102 cm and 88 cm, respectively, suggesting that those individuals with greater values have a substantially increased cardiometabolic risk, independent of their BMI and total FM. Furthermore, an additional assessment of hip circumference allows us to further stratify the risk by calculating the waist-to-hip ratio (WHR) with cut-offs for men and women of ≥0.90 and ≥0.85, respectively(WHO report, 2008).

Waist circumference is the best simple measure of intra-abdominal fat mass and total fat[14]. Several studies in adults have reported a stronger positive association between cardiovascular risk factors such as hypertension, and lipid and glucose concentrations, with abdominal adiposity (measured by waist circumference or WHR) than with overall adiposity (as measured by BMI). However, BMI has also been reported as being one of the most critical risk factors for type 2 diabetes[15]. Even though a close relationship is apparent between abdominal adiposity and the risk of CVD, the current waist circumference cut-off points suggested by the World Health Organization (WHO) are not based on associations with CVD risk factors but rather on their correlation with corresponding values of BMI[9].

The main objective is to evaluate and compare the anthropometric parameters more significantly with BMI in non-obese, overweight, and obese subjects.

MATERIAL AND METHODS

This is a cross-sectional study conducted in the department of Physiology, Thanjavur Medical College, Thanjavur. The study was conducted between April 2022 and June 2022, approved by the Institutional Ethical committee TMC no:957, dated 21-04-2022. Written informed consent was obtained from all study participants. A total of 82 subjects (male 36 and female 46) with the age group of 25 to 60 years were included in the study. All the subjects were recruited from the outpatient department of Medicine, Thanjavur Medical College, Thanjavur, Tamil Nadu, South India.

All the anthropometric data were collected on the pre-designed history proforma. For measuring weight, the subject was requested to stand still on the platform of a pre-calibrated digital weighing machine. Height was measured by stadiometer with the help of a fixed scale. The formula for calculating body mass index(BMI); is the weight (kg)/ height (m^2). Waist circumference (WC) was measured midway between the iliac crest and the lowermost margin of the ribs. Hip circumference (HC) was measured at the maximum protruding part of the buttocks at the level of the greater trochanter while keeping the feet together with the subjects and wearing minimal clothing. The waist-hip ratio was calculated with the help of the formula WC (cm.)/HC (cm.). Blood Pressure was measured by a manual mercury sphygmomanometer (Diamond) which was periodically calibrated during subject recruitment. All the recruited subjects were grouped into three categories (1) non-obese, (2) overweight, and (3) obese, as per the WHO guidelines. The WHO guidelines; are BMI <25 kg/m^2 Non-obese, BMI 25-29.9 kg/m^2 Overweight, and BMI >30 kg/m^2 obese. Other exclusion criteria include the subjects with malnutrition <18.5 kg/m^2, Known history of DM, Hypertension, CVD, History of chronic illness, and previous surgery in the past, who were excluded from the study.

Statistical analysis

The collected data were entered into the Microsoft Excel computer program and checked for inconsistency. The results were presented as Mean±SD and percentages. The chi-square test was used to compare dichotomous/categorical variables among the groups. The analysis by T-test was used to compare the means between the groups for normally distributed variables. All the statistical tests were two-tailed, and a p-value <0.05 was considered significant. All the analyses were carried out by using SPSS.

RESULTS AND DISCUSSION

A total of 82(36 males and 46 females) adult subjects aged between 25 and 60 comprised the study population and its Characteristics are presented in Table I.

Among the 82 subjects, 45 (54.88%) subjects were non-obese, 27 (32.93%) subjects were overweight, and 10 (12.19%) subjects were obese. The anthropometric measurements are described in Table II.

Table 1: Profile of subjects

Gender	*Number (n)*	*Age¥ (years)*	*BMI¥ (Kg/m2)*
Male	36	40.80 +7.29	24.76 + 2.55
Female	46	40.98 + 7.53	25.51 + 2.93
¥: Mean + SD			

Table 2: Comparison of anthropometric parameters among the overweight and obese subjects.
(t-test for equality of means between overweight and obese BMI groups)

S. No.	*Parameters*	*DF*	*Mean Difference*	*Std.Dev difference*	*95%CL*		*p-value*
					lower	*upper*	
1.	Age (Years)	35	-9.630	7.58	-6.66	4.53	0.734
2.	Gender(Female)	19	-1.071	2.01	-3.02	0.88	0.265
3.	Weight(kg)	35	-5.823	4.36	-9.10	-2.54	0.001*
4.	Height(cm)	35	5.966	5.07	2.16	9.78	0.003*
5.	Body mass index (kg/m^2)	35	-4.445	1.19	-5.33	3.35	0.001*

S. No.	Parameters	DF	Mean Difference	Std.Dev difference	95%CL		p-value
					lower	upper	
6.	Waist Circumference (cm)	35	4.700	3.99	-7.70	-1.69	0.003*
7.	Hip Circumference (cm)	35	-1.692	4.65	-5.18	1.80	0.332
8.	Waist hip ratio	35	0.030	0.04	0.063	0.002	0.070
9.	Systolic Blood Pressure (mm of Hg)	35	11.7778	9.71	-19.08	-4.47	0.002*
10.	Diastolic Blood Pressure (mm of Hg)	35	-9.4889	5.60	-13.70	-5.27	0.0001*

* - p-value <0.05 was considered Statistically significant

Table 3: Comparison of anthropometric parameters among the non-obese and overweight subjects. (t-test for equality of means between non-obese and overweight BMI groups)

S. No.	Parameters	DF	Mean Difference	Std.Dev difference	95%CL		p-value
					lower	upper	
1.	Age (Years)	70	-0.459	7.44	-4.07	3.15	0.800
2.	Gender(Female)	37	-3.226	1.20	-4.03	-2.40	**<0.001***
3.	Weight(kg)	70	-7.356	4.54	-9.56	-5.15	**0.001***
4.	Height(cm)	70	0.778	5.08	-1.69	3.24	0.531
5.	Body mass index (kg/m^2)	70	-3.051	1.26	-3.66	-2.43	**<0.001***
6.	Waist Circumference (cm)	70	1.335	5.61	-4.08	1.36	0.32
7.	Hip Circumference (cm)	70	0.037	3.97	-1.89	1.96	0.96
8.	Waist hip ratio	70	-0.014	0.04	-0.03	0.08	0.203
9.	Systolic Blood Pressure (mm of Hg)	70	-5.555	11.75	-11.26	0.14	**0.05***
10.	Diastolic Blood Pressure (mm of Hg)	70	-4.222	7.00	-7.26	-0.82	**0.015***

* - p-value <0.05 was considered Statistically significant

Table 4: Comparison of anthropometric parameters among the non-obese and obese subjects.
(t-test for equality of means between non-obese and obese BMI groups)

S. No.	Parameters	DF	Mean Difference	Std. Dev Difference	95%CL		p-value
					Lower	upper	
1.	Age (Years)	53	-1.422	7.39	-6.60	3.76	0.584
2.	Gender(Female)	30	-7.49	1.03	-8.39	-6.58	<0.001*
3.	Weight(kg)	53	-13.17	4.40	-16.26	-10.0	<0.001*

S. No.	Parameters	DF	Mean Difference	Std. Dev Difference	95% CL		p-value
					Lower	upper	
4.	Height(cm)	53	6.744	4.90	3.30	10.18	0.0002*
5.	Body mass index (kg/ m^2)	53	-7.496	1.11	-8.27	-6.71	<0.001*
6.	Waist Circumference (cm)	53	-6.05	5.76	-10.11	-1.99	0.004*
7.	Hip Circumference (cm)	53	-1.655	3.19	-3.89	0.58	0.144
8.	Waist hip ratio	53	-0.045	0.046	-0.07	-0.01	0.008*
9.	Systolic Blood Pressure (mm of Hg)	53	-17.33	11.68	-25.52	-9.13	<0.001*
10.	Diastolic Blood Pressure (mm of Hg)	53	-13.71	6.72	-18.42	-8.99	<0.001*

* - p-value <0.05 was considered Statistically significant

On comparing normal and overweight groups, Weight, BMI, Systolic Blood pressure, and Diastolic Blood pressure were significant p=0.001; ($p < 0.05$) among the overweight group compared to the normal group. While Height, Waist circumference, Hip circumference, and WHR were not significant between the two groups.

Among the normal and obese groups comparison, Height, Weight, BMI, Waist circumference, WHR, Systolic Blood pressure, and Diastolic Blood pressure were significant p=0.001; ($p < 0.05$) in the obese group compared to the normal group. In comparison, Hip circumference was insignificant between the normal and obese groups.

When the overweight and obese groups were compared, Height, Weight, BMI, Waist circumference, WHR, Systolic Blood pressure, and Diastolic Blood pressure were found to be significant p=0.001; ($p < 0.05$) among the Obese group compared to the Overweight group. In comparison, Hip circumference was insignificant between the overweight and obese groups.

This study was based on estimating anthropometric findings in 82 adult individuals and its correlation with BMI, WHR, Blood pressure findings, and WC. In a clinical and research setting, it is necessary to minimize the number of anthropometric measurements. In this study, we compared BMI with other anthropometric parameters of obesity among non-obese, overweight, and obese subjects in South India. Our result suggested that the BMI was positively correlated with WC and HC among overweight and obese subjects. This may be because the extremeness of obesity is at a higher BMI cut-off range.

Currently, a significant health issue among people is obesity. There are various anthropometric measurements for the assessment of obesity. BMI and WC are the two most widely used methods. While direct assessment of fat mass may be a better index of obesity-related health risk, it is difficult to measure this accurately in the field setting. Thus, anthropometry remains the most widely used method for clinical and epidemiological purposes. In the present study, 33% of the population is overweight,12% is obese when classified according to BMI and when classified according to WC cut-offs, 17% of males and 20% of females were obese.

On the other hand, several findings suggest that BMI is a flawed measure as it does not correctly identify individuals with excess body fat due to its inability to differentiate between fat and fat-free mass, and it does not account for the effect of age and ethnicity

on body fat distribution[9]. Furthermore, our findings indicate that BMI, WC, HC, and WHR were independent markers for obesity, suggesting that only one of these measures must be obtained for clinical and research purposes. However, WHR was positively correlated with BMI in obese subjects. Carbone et al. found that overweight and obese patients are at particularly high risk for further cardiovascular complications[10]. Blood pressure findings are most closely associated with obesity which is consistently a most potent cardiovascular risk factor[16].

Therefore it seems that using only a single marker to assess obesity is still insufficient to achieve optimal accuracy. Thus, we recommended a detailed study with larger sample size is required to validate the accuracy of the findings.

CONCLUSION

Based on these findings, we concluded that the anthropometric marker BMI, WC, HC, WHR, and BP were independently associated with obesity. In conclusion, according to the results of the present study, elevated BMI and Blood Pressure are significantly related to several cardiovascular risk factors.

LIMITATIONS

However, the study has several limitations; The main limitation of this study is its cross-sectional nature, which does not allow interpretation for causality. The study also included a small sample size with a limited ethnic distribution. Other anthropometric measurements like neck circumference, arm circumference, waist-height ratio, deltoid skin fold thickness, and triceps skin fold thickness were also not included in the study. For the validation and implementation of results, it is recommended that further study with a larger sample size and evaluation of cardiac risk factors (Eg. Lipid profile) will be conducted in the future to find an association with CVD risk factors. Appropriate strategies must be planned to prevent overweight and obesity to overcome morbidity and mortality.

Conflict of Interest: Nil

Source of funding: Self

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