e-ISSN: 0976-822X, p-ISSN:2861-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(1); 204-210

Original Research Article

An Assessment of Anthropometric Parameters in Non-Obese, Overweight, and Obese Subjects: A Comparative Study

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Received: 04-12-2022 / Revised: 20-12-2022 / Accepted: 29-01-2023
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Conflict of interest: Nil

Abstract

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

Methods: This was a cross-sectional study conducted in the Department of Physiology, BMIMS, Pawapuri, Nalanda, Bihar, India. The study was conducted for the period of 14 months, Written informed consent was obtained from all study participants. A total of 100 subjects (male 45 and female 55) 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, BMIMS, Pawapuri, Nalanda, Bihar, India.

Results: Among the 100 subjects, 55 (55%) subjects were non-obese, 30 (30%) subjects were overweight, and 15 (15%) subjects were obese. 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.

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.

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

Introduction

Obesity has been defined as a risk factor for several cardiovascular (CV) risk factors, including hypertension, type II diabetes, and dyslipidemia [1] and shown to be responsible for higher morbidity and mortality rates in cardiovascular disease (CVD). [2] Accordingly, a recent systematic review and meta-analysis examining 95 cohorts showed that obesity was associated with a nearly 60% higher prevalence of CVD, as compared to normal weight figures. [3]

Overweight and obesity pandemics are increasing worldwide. According to the World Health Organisation (WHO), approximately two billion adults worldwide were overweight or obese in 2016, with more than 2.8 million people dying every year due to being overweight or obese. [4] Anthropometric measurements and indices are quantitative non-invasive tools used to measure the composition of the body. The significance of these measurements and indices is identifying individuals at increased risk of overweight or obesity. A number of epidemiological studies reported a substantial positive association between an increased body weight or obesity and cardiometabolic risks including raised blood cholesterol, high blood pressure and elevated blood glucose. [5,6] There are several anthropometric measurements and indices, such as body mass index (BMI), waist circumference (WC), waist–hip ratio (WHR) and NC. BMI was developed in the nineteenth century and is the method most commonly used by health professionals worldwide to assess weight status. [7]

Nevertheless, BMI is limited in that it does not consider differences in age, sex, bone structure or muscle mass. [8] In the late1990s, the WHO recognised central obesity evaluated by WC or WHR as an important measure for weight status. Moreover, several studies have identified central obesity as a strong predictor of overweight- and obesity-related health problems. [10-12] However, methods to measure central obesity are limited by certain factors, such as lack of ability to differentiate subcutaneous from visceral fat deposition. [9] Waist circumference is the best simple measure of intra-abdominal fat mass and total fat. [13] 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. [14] 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. [15]

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

Materials and Methods

This was a cross-sectional study conducted in the Department of Physiology, BMIMS, Pawapuri, Nalanda, Bihar, India. The study was conducted for the period of 14 months, Written informed consent was obtained from all study participants. A total of 100 subjects (male 45 and female 55) 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, BMIMS, Pawapuri, Nalanda, Bihar, 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 precalibrated 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 (m2). 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/m2 Non-obese, BMI 25-29.9 kg/m2 Overweight, and BMI >30 kg/m2 obese. Other exclusion criteria include the subjects with malnutrition <18.5 kg/m2, 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

Table 1: Demographic data

Gender	Number (n)	Age (years)	BMI (Kg/m2)
Male	45	41.69 +8.32	25.75 + 2.40
Female	55	40.80 + 6.54	25.45 + 2.80

A total of 100 (45 males and 55 females) adult subjects aged between 25 and 60 comprised the study population.

Table 2: Comparison of anthropometric parameters among the overweight and obese subjects

Parameters	Mean Difference	Std. Dev difference	95%CL		p-value
			lower	upper	
Age (Years)	-9.615	6.40	-5.66	4.25	0.725
Gender(Female)	-1.060	2.04	-4.00	0.85	0.245
Weight(kg)	-5.805	4.40	-8.12	-2.45	0.001
Height(cm)	5.920	5.03	2.20	9.81	0.002
Body mass index (kg/m^2)	-4.420	1.20	-5.40	3.14	0.001
Waist Circumference (cm)	4.700	3.80	-8.40	-1.70	0.002
Hip Circumference (cm)	-1.685	4.15	-4.16	1.60	0.334
Waist hip ratio	0.030	0.06	0.060	0.002	0.075
Systolic BloodPressure (mm of Hg)	11.7785	9.41	-18.04	-4.16	0.002
Diastolic BloodPressure (mm of Hg)	-9.4865	5.55	-12.60	-6.30	0.0001

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.

Table 3: Comparison of anthropometric parameters among the non-obese and overweight subjects

Parameters	*Mean Difference*	*Std. Dev difference*	*95% CL*		*p-value*
			lower	upper	
Age (Years)	-0.440	7.40	-4.06	3.14	0.750
Gender(Female)	-3.220	1.15	-4.03	-2.75	<0.001
Weight(kg)	-7.355	4.75	-9.40	-5.20	0.001
Height(cm)	0.754	5.02	-1.56	4.28	0.520
Body mass index (kg/m^2)	-3.052	1.23	-3.55	-2.48	<0.001
Waist Circumference(cm)	1.345	5.16	-4.06	1.39	0.30
Hip Circumference (cm)	0.034	3.45	-1.75	1.85	0.95
Waist hip ratio	-0.012	0.04	-0.02	0.07	0.202
Systolic Blood Pressure(mm of Hg)	-5.569	11.20	-12.28	0.12	0.04
Diastolic Blood Pressure (mm of Hg)	-4.290	7.00	-7.22	-0.80	0.012

Among the 100 subjects, 55 (55%) subjects were non-obese, 30 (30%) subjects were overweight, and 15 (15%) subjects were obese. 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.

Table 4: Comparison of anthropometric parameters among the non-obese and obese subjects

Parameters	*Mean Difference*	*Std. Dev Difference*	*95% CL*		*p-value*
			Lower	*upper*	
Age (Years)	-1.430	7.25	-5.40	3.50	0.545
Gender (Female)	-7.55	1.02	-8.32	-6.34	<0.001
Weight(kg)	-13.12	4.35	-16.34	-10.0	<0.001
Height(cm)	6.720	4.80	3.32	10.20	0.0002
Body mass index (kg/ m^2)	-7.450	1.12	-8.40	-5.75	<0.001
Waist Circumference(cm)	-6.04	5.74	-10.30	-1.55	0.003
Hip Circumference(cm)	-1.62	3.16	-3.75	0.55	0.130
Waist hip ratio	-0.044	0.042	-0.07	-0.01	0.007
Systolic Blood Pressure (mm of Hg)	-17.32	11.77	-25.45	-9.21	<0.001
Diastolic Blood Pressure (mm of Hg)	-13.56	6.54	-18.52	-8.59	<0.001

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.

Discussion

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. [16]

However, Nevill and Metsios [17] called for redefining overweight and obesity cutoff values based on age groups and gender, as adiposity levels may vary according to these factors. The study results are consistent with Haregu et al [18] who had similar findings among a Kenyan population, with moderate agreement between BMI and WC, fair agreement between WC and WHR, and poor agreement between BMI and WHR. Similarly, a large study [19] that included participants from 29 countries in Asia, Europe, Latin America and North America reported good agreement between BMI and WC in high- and low-weight subjects and moderate agreement in subjects with intermediate weight.

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. Several findings suggested 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. [15] 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 complications10. Blood pressure findings are most closely associated with obesity which is consistently a most potent cardiovascular risk factor. [20] Haregu et al [21] reported WC and WHR as the strongest predictors of hypertension and hyperglycaemia, while BMI was a stronger predictor of hypercholesterolaemia. Moreover, the study results are consistent with several studies reporting that BMI, WC and WHR are strong predictors of metabolic syndrome. [22]

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.

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