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ORIGINAL ARTICLE

Indicators of Obesity and Cardiovascular Parameters in Obese and Non-Obese Subjects

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ABSTRACT

Background and Aim: Obesity is a worldwide epidemic that is endangering an increasing number healthy populations. Obesity is caused by a sedentary lifestyle and poor dietary habits. Although numerous studies on obesity effects on cardiovascular parameters (CVP) are existing, associations between obese and non-obese people are limited. Therefore, the present study aimed to evaluate the indicators for obesity and compared obese and non-obese association with cardiovascular parameters.

Materials and Methods: This cross-sectional study was carried out on 80 subjects in the Department of Physiology, Islamic International Medical College, Rawalpindi in collaboration with Railway General Hospital, Rawalpindi for duration of six months i.e from January 2020 to June 2021. All the subjects were divided into obese group-I and non-obese group-II. Each group consisted of 40 subjects. Individuals with body mass index 18 to 25 Kg/m2 and >26 Kg/m2 were considered as obese and non-obese respectively. Informed consent and ethical approval were taken from each individual and hospital ethical committee respectively. All the subjects (BMI> 26 Kg/m2) with medical issues specifically cardio-respiratory and smokers were excluded. Quetelet's index and Vernier Caliper was used for physical examination and triceps skinfold girth (TSG). SPSS version 23 was used for data analysis.

Results: Of the total 80 subjects, the study and control group had 40 subjects each. The overall mean age was 41.31±2.3 years. The mean value of body mass index in the study and control group was 34.6±5 Kg/m2 and 23.4±1.2 Kg/m2 respectively. Mean weight, body mass index, waist circumference (WC), and triceps skin girth (TSG) were found significantly higher in the study group as compared to the control group whereas study group subjects had lower height than the control group (p<0.005). Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), pulse pressure (PP) were significantly higher in the study group as compared to control group subjects considering 0.0005 level of significance, however, pulse rate (PR) was insignificant in the study group (0.05). Cardiovascular parameters were found significant and positive in the study group only with a 0.05 level of significance on Pearson's Correlation.

Conclusion: Our study found that shorter height with accelerated pulse rate subjects was prone to cardiovascular diseases. Also, short height with a higher pulse rate is obesity's best indicator correlating in obese or study group. Additionally, obesity has a significant association with subject lipid profile which may elevate the potential risk for cardiovascular disease development.

Keywords: Obesity; Cardiovascular Parameters, Obesity Indicators

INTRODUCTION

Obesity is a worldwide epidemic that is endangering an increasing number healthy populations [1]. Obesity is caused by a sedentary lifestyle and poor dietary habits. The excessive and abnormal accumulation of fat in adipose tissue compromising normal health is term as obesity [2]. Body mass index is a prominent measurement level for obesity. The most useful population-level measure of obesity is the body mass index (BMI). Its cataloging permits the substantial associations of adiposity levels and weight status within the population and risk group identified. Currently, obesity is a worldwide issue causing potential risks for various diseases due to environmental adoption with lower physical activities and increasing modernization across the globe [3]. Body mass index >30 Kg/m2 is considered obese. World Health Organization standards for obesity classifications are as follows; Overweight or pre-obese BMI≥25 Kg/m2 with a range of 25 to 29.9 Kg/m2, Class-I obese: 30 to 34.99 Kg.m2, Class-II: 35 to 39.99 Kg/m2, and Class-III: BMI≥40 Kg/m2. The cut-off value of BMI for overweight and obesity in Asian countries is≥23 and ≥25 Kg/m2 respectively [4]. Because BMI does not distinguish between weight associated with muscle and fat, fat content varies with body type and proportions across ethnic groups [5]. Obesity develops as a result of a complex interaction between poor dietary habits, a lack of physical activity, a sedentary lifestyle, and is exacerbated in some subsets of the population by genetic predisposition [6]. According to the WHO, the prevalence of overweight and obesity in 2016 was 1.9 billion (39%) and 650 million (13%) adults respectively [7].

The risk for hypertension, gallbladder diseases, degenerative bone diseases, diabetes (44%), Cancer (6-40%), and cardiovascular disease increased with obesity [8]. For a constricted variety of BMI, abdominal fat is highly variable. Abdominal aft accumulation is indicated by a high waist-hip ratio >1 for men and >0.85 for women [9]. Recent evidence suggests that waist circumference has a greater negative impact on cardiovascular and metabolic health (WC) [10, 11]. The pattern of physical activities, genetic factors, and eating habits are a complex combination of excessive weight gain mechanisms. Depression, social and emotional issues, and lower self-esteem are the side–effect complications of obesity. Concerns have grown over the years about how rising adult obesity may be affecting their cardiovascular health. When a person's adipose tissue accumulates, a number of changes occur in the cardiorespiratory structure and function [12]. As a result, the obesity risk factors such as glucose intolerance, hypertension, and dyslipidemia might affect the lungs and heart. Obesity-related cardiovascular disorders increase coronary artery disease mortality rates, arrhythmias, heart failure, and sudden death [13, 14].

Few studies have been conducted to examine the relationship between BMI and cardiovascular parameters [15], BMI and anthropometric (ANPP) [16], and some studies have been conducted to examine the relationship between anthropometric indices and CVP [17, 18], but none have been conducted to examine the relationship between CVP in both obese and non-obese individuals for comparison. The purpose of this study was to examine the relationship between various cardiovascular parameters and obesity indicators (BMI, WC, and TSG), as well as the relationship of CVP and WC vs. TSG, in order to determine clinical conditions in obese groups in comparison to non-obese groups.

MATERIAL AND METHODS

This cross-sectional study was carried out on 80 subjects in the Department of Physiology, Islamic International Medical College, Rawalpindi in collaboration with Railway General Hospital, Rawalpindi for duration of six months i.e from January 2020 to June 2021. All the subjects were divided into obese group-I and non-obese group-II. Each group consisted of 40 subjects. Individuals with body mass index 18 to 25 Kg/m2 and >26 Kg/m2 were considered as obese and non-obese respectively. Informed consent and ethical approval were taken from each individual and hospital ethical committee respectively. All the subjects (BMI> 26 Kg/m2) with medical issues specifically cardio-respiratory and smokers were excluded. Quetelet's index and Vernier Caliper was used for physical examination and triceps skinfold girth (TSG). A detailed medical history, demographic details, clinical examination, smoking history, and hobbies related to physical activities were recorded. Based on medical history, respiratory and cardiovascular disease subjects were excluded. Demographic details included their social status, age, and gender, and physical examination proceeded with height [m], weight [kg], and BMI [kg/m2] measurement using Quetelet's index. Vernier Caliper was used for measuring the triceps skin girth between Ulna and Scapula olecranon and acromion, and waist circumference was measured in the standing position of subjects in centimeters. A Mercury sphygmomanometer was used for systolic and diastolic blood pressures. The subject's radial pulse rate and mean arterial pressure were recorded. SPSS-23 was used to analyze the data. Descriptive statistics were expressed as Mean and standard deviation. A Student's t-test. Pearson's correlation coefficient was used to determine the relationship between different parameters, and p 0.05 was considered statistically significant.

RESULTS

Of the total 80 subjects, the study and control group had 40 subjects each. The overall mean age was 41.31±2.3 years. The mean value of body mass index in the study and control group was 34.6±5 Kg/m2 and 23.4±1.2 Kg/m2 respectively. Mean weight, body mass index, waist circumference (WC), and triceps skin girth (TSG) were found significantly higher in the study group as compared to the control group whereas study group subjects had lower height than the control group ($p<0.005$). Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), pulse pressure (PP) were significantly higher in the study group as compared to control group subjects considering 0.0005 level of significance, however, pulse rate (PR) was insignificant in the study group (0.05). Cardiovascular parameters were found significant and positive in the study group only with a 0.05 level of significance on Pearson's Correlation.

Table-1 Anthropometric and cardiovascular parameters comparison in study and control group

Parameter	Study Group n=40	Control group n=40
Age (year)	42.4±3.1	40.22±1.5
Weight (Kg)	91.46±7.32	72.3±8.2
Height (cm)	160.12± 3.45	164.31±3.15
Body Mass Index (Kg/m2)	29.27±2.6	22.86±2.91
Waist circumference (WC) cm	0.95±0.12	0.78±0.08
Triceps Skin Girth (cm)	3.23±0.10	1.89±0.06
Pulse rate per minute	77.86±0.86	75.23±1.28
Systolic Blood Pressure (mmHg)	127.65±1.86	112.91±2.10
Diastolic Blood Pressure (mmHg)	84.05±1.39	76.21±1.39
Mean Arterial Blood Pressure (mmHg)	99.3±1.41	87.93±1.45
Pulse Pressure (mmHg)	42.91±1.10	39.42±1.28

The mean age of the study and control group was 42.4±3.1 and 40.22±1.5 years respectively. The mean height and body weight in the study and control group was 160.12± 3.45 cm and 164.31±3.15 cm, and 91.46±7.32 kg and 72.3±8.2 kg respectively. The mean BMI of the study and control group was 29.27±2.6 kg/m2 and 22.86±2.91 kg/m2 respectively whereas the waist-hip ratio was 0.95±0.12 cm and 0.78±0.08 cm respectively as shown in Table-1. The association of waist circumference (WC) and cardiovascular parameters (CVP) had a positive relationship with all parameters in the study and control group except mean arterial pressure and systolic blood pressure were insignificant as shown in Table-2. Table-3 illustrates Pearson's correlation between TSG and WC in the study and control group. The systolic, diastolic, and mean arterial pressure had a positive correlation in the study group (r=0.5). However, these parameters show a negative association in the control group (systolic blood pressure= -0.122, diastolic blood and mean arterial pressure=-0.189 and -0.175.

Table-2 Waist circumference and cardiovascular parameters correlation

Parameters	Study (Obese) Group n=40	Control (non-obese) group n=40
Systolic blood pressure (mmHg)	0.428	0.173
Diastolic blood pressure (mmHg)	0.516	0.382
Mean Arterial Pressure (MAP)	0.498	0.309

Table-3 Cardiovascular parameters correlation in study and control group

Parameters	Study group n=40	Control group n=40
Pulse rate		
Systolic	0.571	-0.122
Diastolic	0.510	-0.189
Mean Arterial pressure (mmHg)	0.573	-0.175
Systolic Blood Pressure		
Pulse Pressure	0.706	0.401
Diastolic	0.795	0.693
Mean Arterial pressure (mmHg)	0.928	0.889

DISCUSSION

Obesity is one of the major health issues causing significant complications to individuals as well as to society. Insulin tolerance, endothelial dysfunction, and arterial stiffness are all related to obesity [19]. Obesity can be prevented, reverse, and reduced with the simplest and reliable procedures. The cardiovascular parameters and dyslipidemia can be effectively predicted with anthropometric measurements for surrogating body fat. These procedures are simple, economical, and shortly require no sophisticated apparatus and lengthy processing. The population geography, characteristics, and study design varied causing different anthropometric indexes as reported by several studies [20, 21]. The human body's central fat distribution and body fitness could be indicated with waist circumference, body mass index, and waist-hip ratio. In the current study, the prevalence of cardiovascular parameters was significantly associated with anthropometric measures where our findings matched with previous studies' findings [22, 23]. Additionally, waist circumference and waist-hip ratio accurately predicted the lipid profile and dyslipidemia, and cardiovascular disease.

Waist circumference increases are highly linked with elevated risk due to accumulation of visceral fat and liver excessive exposure to fatty acid [24]. Abnormal body mass index has been accurately indicated by waist circumference as validated by Quebec health survey by Lemeui et, al. [25]. Shamai et al [26] carried out a broad-based study on insignificant lipid profile deranged with the inability to predict correct BMI because increased muscle weight, visceral mass, and bone weight is not considered in BMI measurement. Therefore, body mass index significantly varies serum lipid profile range. Waist circumference and waist-hip ratio are better indicators than body mass index for body fitness among adults observed in our study where central fat distribution and population-level additional information must be provided. These findings matched with Xu C et al. study found and validated that waist circumference is a significant predictor of waist-hip ratio and body mass index [27].

Several studies published their investigation on obesity individual indicators without considering anthropometric and cardiovascular parameters [28, 29]. Our study found that shorter height among the obese (study) group is a significant indicator of obesity. However, the body mass index cut-off values should meet the American National Heart Lung Association (ANHI) [30]. Similar findings regarding short height being the best indicator for obesity were reported in another study [31] illustrated that the shorter height population usually had a greater body mass index. They also reported that physical activities, diet adjustment, and environmental factors play a significant role in correlating short stature with body mass index. The short stature prevalence in men and women was reported at 19.6% and 15.4% respectively indicating that for high waist-hip ratio and overweight short stature is an independent risk factor [32].

Cardiovascular parameters are profoundly affected by obesity. In our study, the obese or study group had higher values of CVP compared to the non-obese or control group. The pulsation rate in the control group was higher than the study group which results in sympathetic nervous system portable activation with concomitant parasympathetic dysfunction in the obese group responsible for blood pressure elevation. Pulse rate was associated with body fat percentage in a previous study [33]. Whereas present study results about pulse rate contradict previous studies.

Obesity mainly depends on body mass index which is in turn is associated with height and body weight. Adiposity surrogated measures and children's height are significantly and moderately associated with body mass index [34]. From childhood, adults height was predicted for both gender and had a strong correlation found in previous research [35]. Similar results were observed in the present study where height and body mass index had a negative correlation. Waist circumference and triceps skin girth had a positive association with body mass index in the study group. Similar results were reported in earlier studies [36]. In comparing body mass index, triceps skin girth was less significant than waist circumference. The descending order of key or significant parameters were height, weight, waist circumference, triceps skin girth, and age.

The cardiovascular parameters in the obesity group population were pulse rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, and pulse pressure. Most studies reported waist-hip ratio, triceps skin girth, body mass index, and waist circumference as the key indicators for obesity [37, 38]. However, limited research yet found an association between CVP parameters in the obese and non-obese groups. In our study, a significantly positive association of pulse rate with pressure (SBP, DBP, and MAP) in the study group (obese) compared to negative association except pulse rate in the non-obese group. The cardiac cycle pulsatile component is referred to as pulse pressure which had a significant association with heart diseases. Pulse rate is an independent factor or predictor for coronary heart disease incidence, heart failure, and mortality as reported by Vaccarino et al [39]. Pulse pressure is the arterial stiffness measurement. Systolic blood pressure was correlated with pulse rate among the obese and non-obese populations in the present study. Pulse pressure significantly indicates cardiovascular disease development related to obesity. Univariate analysis was used in an earlier study [40] to investigate the association between pulse pressure and systolic blood pressure.

CONCLUSION

Our study found that shorter height with accelerated pulse rate subjects was prone to cardiovascular diseases. Also, short height with a higher pulse rate is obesity's best indicator correlating in obese or study group. Additionally, obesity has a significant association with subject lipid profile which may elevate the potential risk for cardiovascular disease development.

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