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Study of Anthropometric Measurement in Relation to Rate Pressure Product in Obese Individuals

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Abstract

Obesity is associated with increased incidence of adverse cardiovascular events. Rate pressure product is an indicator of myocardial oxygen consumption. Higher RPP indicates myocardial work stress, or cardiac risk. Thus, RPP can be correlated with anthropometric indices such as BMI, WC, WHR. **Materials and Methods:** in this study 130 subjects were recruited. BMI and other measurement were taken, Heart rateand blood pressure was recorded. Subjects were divided into two obese and non-obese. **Result:** WC on RPP, SBP, and HR was assessed. Data analysis was done by unpaired t-test. RPP of subjects WC >90 cm was significant (P = 0.025) more than the WC ≤90 cm. SBP of subjects WC >90 cm was significant (P = 0.040) more than the WC ≤90 cm. HR of subjects WC >90 cm was significantly (P = 0.034) more than the WC ≤90 cm.The major findings of the studies show positive association between increased RPP and obesity.

Conclusion: Thus, it can be suggested that obesity is associated with increased RPP. And hence anthropometric indices can be used to assess cardiac dysfunction.

Keywords: BMI, WC, WHR, SBP, MVO2

Introduction

Rate pressure product (RPP) or double product (DP) is an artefact of heart rate (HR), and systolic blood pressure (SBP) is a major element of myocardial oxygen consumption (MVO2). It is a secondary and easy noninvasive method of measuring MVO2. DP indicates the internal myocardial work performed by the beating heart whereas the performance of the external myocardial effort is represented by the stages of exercise. (1,2) Heart, being a muscular organ, its consistent functioning needs steady supply of oxygen and nutrients; if these supplies are deficient, there is all chances of heart failure. Increased RPP, a catalogue of myocardial work stress, has been recognized to be an indicator of cardiovascular risk. (3)

The role of anthropometric dimensions in assessment of adiposity is widely used in both research and clinical situations. The indices, such as body mass index (BMI), and the waist hip ratio (WHR) have been used commonly to define overweight and obesity status, across various age groups. Lately, more indices such as the conicity index (CI); ponderosity index (PI); body surface are (BSA), and neck circumference (NC), involved great attention. Anthropometric indices such as WHR, waist circumference (WC), and BMI were found to be significantly associated with RPP amid health young adults (4,5) and an important analyst of cardiovascular events (6).

Overweight and obesity is highly accompanying with a number of non-communicable diseases together with cardiovascular disease, diabetes mellitus, cancers, arthritis, ovarian dysfunction and so forth. Globally, based on the world health organization (WHO), the incidence of obesity has tripled since 1975, as in 2016 only more than 1.9 billion adults of age 18 years and greater were overweight, of which 650 million were obese (7). Obesity plays a very vital role in the expansion of cardiovascular disease (CVD) (8,9,10). Several simple anthropometric parameters have been greatly associated with cardiovascular risk factors (11) and thus their relationship with hemodynamic parameters needs to be explored

The double product equivalent to the product of heart rate and systolic blood pressure has a well-established connection as a parameter expressing the load on the heart muscle. As an easily available parameter, it has been used in clinical trials for many years (16) and still proves its diagnostic (17) and prognostic (18,19) effectiveness.

RPP is a hemodynamic constraint which is an index of myocardial oxygen demand (MVO2) and work load on heart. This is also measured as an indirect degree of coronary blood flow. This easily measurable hemodynamic parameter was helping as a useful index for early acknowledgement of the coronary artery disease in vulnerable individuals on the basis of anthropometric indices.

Aim of the study

This study was planned to evaluate the association between various anthropometric indices with RPP.

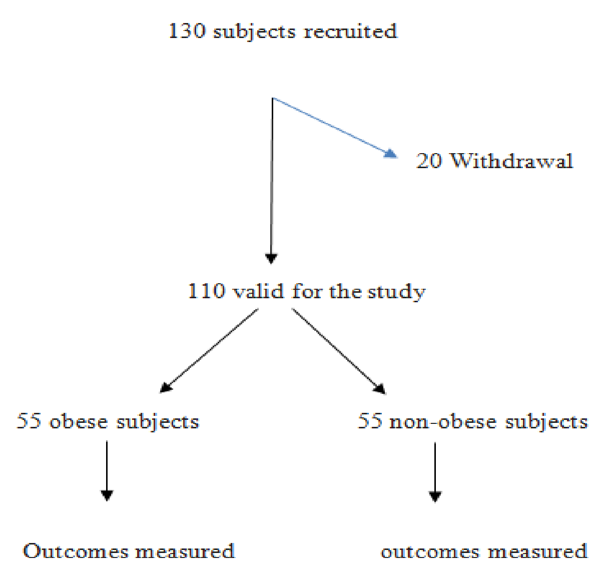
Methodology

A total of 130 subjects of both genders were recruited in the present study. The subjects were matched for age and sex. The subjects were recruited based on their BMI levels using WHO Asia Pacific guidelines .

BMI, previously called the Quetelet index, is a measure for representing nutritional grade in adults. It is demarcated as a person's weight in kilograms divided by the square of the person's height in meters (kg/m2). For example, an adult who weighs 70 kg and whose height is 1.75 m will have a BMI of 22.9.

During screening, 15 subjects were excluded from the present study due to various reasons. The reasons for exclusion of 15 patients include: presence of either diabetic or due to hypertensive and other pathological complications.

Study protocol was explained to the study subjects. Medical history and relevant clinical examination were done of those participants who are fulfilling the study. Inclusion criteria were included into the study. Anthropometry and blood pressure measurements was done as per the standard protocol to derive anthropometric indices.



Anthropometric measurements

Assessment of Weight (kg) was done in light clothing without shoes using calibrated weighing machine to the nearest 0.5 kg. Wall mounted Stadiometer was used to measure Height to the nearest 01cm. Mid upper arm circumference (MUAC) and Waist circumference (WC) was measured by a non-elastic measurement tape to the nearest 01cm at midway between acromion process of scapula and olecranon process of ulna ; the lowest rib and the iliac crest respectively. Hip circumference (HC) was measured transversely around the widest portion of the buttocks.

Calculation of Anthropometric indices.

The following obesity indices were calculated using the following formula:

Body Mass Index (BMI) = Weight (kg) / Height (m^2)

Waist to Hip ratio (WHR)= WC (cm)/HC (cm)

Waist to Height ratio (WHtR) = WC (cm)/height (cm)

Blood Pressure measurements

For determination of RPP blood pressure was recorded by standardized sphygmomanometer from 10:00 AM to the 12:00 PM from right arm in after giving adequate rest to the subject. All the measurements were done using standard protocol by the investigator of the project. Blood pressure (BP) was measured after 5 minutes of rest in a seated position using standardized and calibrated sphygmomanometer with appropriate size of cuff applied to the right upper arm. Korotkoff phase-I was recorded as SBP and Korotkoff phase-V as DBP. Two readings with an interval of one minute will be recorded. Mean of last two readings was used as final measurement.

Calculation of HR

It was recorded in supine position with continuous electrocardiographic (ECG) on Cardiomin machine using standard limb lead-II. The ECG record was analyzed for determining HR recorded. The R-R interval was measured on ECG with a ruler, HR was calculated as:

Calculation of Rate Pressure Product (RPP)

The following formula was used for its calculation:

RPP = HR × SBP × 10-2 mmHg

SBP: Systolic BP in mmHg

HR: Heart rate in beats per minutes

The value thus obtained was expressed as mmHg beats per min. Cutoff limits of RPP: The values <Mean ±2SD was used as normal RPP whereas values > Mean ±2SD accordingly subjects were grouped into normal and high RPP.

Inclusion Criteria

1. Age: 25-45yrs.
2. Willingness to participate in the study
3. Normal Sinus rhythm
4. Non-smokers
5. Non-hypertensive subjects

Exclusion Criteria:

1. Hypertensive
2. History of medications and Systemic diseases
3. Evidence of cardiac disease or conditions responsible for hypertension
4. Diabetics, Bradyrrhythmia, Hypotensive
5. Inability or Unwillingness to participate in the study

Results

Table 1: Comparison of anthropometric measurements between controls and obese in both genders

Males	**Obese**	**Non-obese**	**P-value**
Age (years)	36.84±1.1	30.23±1.4	0.065
WT(kg)	70.48±7.0	86.16±10.03	<0.001
HT(cm)	157.11±7.5	158.33±8.2	0.366
BMI (kg/m^2)	20.89±2.0	35.27±2.1	<0.001
HC(cm)	80.29±7.0	88.14±10.4	<0.001
WC(cm)	67.02±7.4	81.05±10.4	<0.001
WHR	0.83±0.1	0.92±0.1	<0.001
Female (mean)			
Age (years)	35.93±1.3	32.97±1.2	0.089
WT(kg)	65.91±5.6	76.00±7.3	<0.001
HT(cm)	153.26±5.9	153.14±7.1	0.918
BMI(kg/m^2)	23.32±2.0	32.17±2.2	<0.001
HC(cm)	81.95±5.9	87.03±10.3	<0.001
WC(cm)	65.93±6.1	78.36±10.1	<0.001
WHR	0.80±0.0	0.90±0.1	<0.001

Table 1 shows mean anthropometric measurement values in both boys and girls. The mean weight, height, BMI, WC, HC, WHR were 63.16±10.03 kg, 158.33±8.2 cm, 32.27±2.09 kg/m2 , 81.05±10.41 cm, 88.14±10.4 cm, 0.92±0.05 cm respectively in obese/overweight boys. The mean weight, height, BMI, WC, HC, WHR were 59.00±7.3 kg, 153.14±7.1, 25.17±2.23 kg/m2 , 78.36±10.07 cm, 87.03±10.3cm, 0.90±0.10 respectively in obese/overweight girls. All of the anthropometric parameters were found to be significantly higher in overweight/obese children than with their normal weight peers and higher in boys compared to girls.

Table 2: Comparison of hemodynamic variables based on waist circumference

Variables	Controls	obese	
WC	≤90 (n=55)	>90 (n=55)	P
RPP	91.5±1.4	110±3.4	0.025
SBP	118±9.2	129±21.7	0.040
HR	76±9.2	83±12.6	0.034

P<0.05. Data expressed in mean±SD form. Statistical test was unpaired t-test. n=Number of subjects, WC=Waist circumference, RPP=Rate pressure product, SBP=Systolic blood pressure, HR=Heart rate, SD=Standard deviation

Table 2 depicts the effect of WC on RPP, SBP, and HR. Data analysis was done by unpaired t-test. RPP of subjects WC >90 cm was significantly (P = 0.025) more than the WC ≤90 cm. SBP of subjects WC >90 cm was significantly (P = 0.040) more than the WC ≤90 cm. HR of subjects WC >90 cm was significantly (P = 0.034) more than the WC ≤90 cm.

Table 3: Comparison of hemodynamic variables based on waist-hip ratio

Variables	Controls	obese	
WHR	<0.90(n=55)	≥0.90 (n=55)	P
RPP	89.3±1.3	108.8±2.8	0.001
SBP	118±9.5	127±17.9	0.009
HR	75±8.9	84±10.8	0.000

P<0.05. Data expressed in mean±SD form. Statistical test was unpaired t-test. n=Number of subjects, WHR=Waist-hip ratio, RPP=Rate pressure product, SBP=Systolic blood pressure, HR=Heart rate, SD=Standard deviation

Table 3 depicts the effect of WHR on RPP, SBP, and DBP. Data analysis was done by unpaired t-test. RPP of subjects WHR ≥0.90 was significantly (P = 0.001) more than the WHR <0.90. SBP of subjects WHR ≥0.90 was significantly (P = 0.009) more than the WHR <0.90.

Table 4: Correlation between rate pressure product and hemodynamic variables

Pearson correlation	r	P
BMI-RPP	0.540	0.100
WC-RPP	0.599	0.000
WHR-RPP	0.339	0.000

P<0.01. Correlation was analyzed by Pearson correlation. r=Pearson correlation coefficient, BMI=Body mass index, WC=Waist circumference, WHR=Waist-hip ratio, RPP=Rate pressure product

Table 4 depicts the correlation of RPP with anthropometric indices, i.e., BMI, WC, and WHR. Data analysis was done by Pearson correlation. Significant positive correlation (P = 0.000) was found between RPP and anthropometric indices.

Discussion

Rate pressure product or DP acts as a marker of myocardial stress. Myocardial oxygen consumption (mVO2) increases with increase in the anthropometric indices, which was specified by increase in pulse pressure, mean arterial pressure and blood pressure.

Anthropometric indices suggestively predict the hemodynamic parameters in adolescents. These remarks carry physiological significance, as the increase in anthropometric indices results into increased stress on the cardiovascular system, as specified by increase in hemodynamic parameters. Rpp1.The findings of my study are in agreement with those from a study that involved 104 male young adults' product (20). Additionally, a study amid primary pupils of 6–14 years found significant correlation in anthropometric indices such as height, weight, waist hip ratio with blood pressure and pulse pressure (21).

In a study done in the ageing population, it was found that higher values of anthropometric indices such as waist to height ratio and conicity index were related to increased diastolic BP, body fat and lipid profiles [22]. The same findings were testified among the postmenopausal women in Tehran in Iran [23]. The observations in my study also shows positive correlation among increase in blood pressure with increase in anthropometric measurements. In an earlier study by Katamba G et al Neck circumference in children was found to show very comparable associations as those of BMI, WHR, WHtR and was closely associated cardiovascular disease risk factors among the 324 children aged 9–13 years in Greece (24) The major findings of the study which was conducted by Katamba G et al suggested that obese subjects SBP, HR, and RPP were more increase than normal and overweight subjects. It was also noted that the subjects of WC >90 cm had higher SBP, HR, and RPP than the subjects of WC ≤90 cm. The subjects of WHR ≥0.90 had higher SBP, HR, and RPP than WHR < 0.05) and there was significant correlation between RPP and anthropometric indices, i.e., BMI, WC, and WHR.

In the present study correlations of BMI and WC with cardiovascular risk factors (hypertension, serum LDL-C and HDL-C, glucose and insulin levels) were assessed. It was observed that WC had a significant correlation with SBP and DB. The findings of the present study suggest positive correlation between RPP with BMI, WC, and WHR which indicates that cardiovascular risk increases with increase in anthropometric Indices. (25). Zhou suggested that visceral obesity, measured by WC or WHR was more closely allied with blood pressure and/or the presence of hypertension than overall obesity, measured by BMI.

Conclusion

This study establishes the relation between RRP and Anthropometric measurement. With increasing anthropometric indices there is increase in the RPP. This study also suggests that RPP and anthropometric indices can be used as a tool for assessing cardiac dysfunction. But further study is required to strengthen the relationship between RPP and cardiac problems. And what could be other indices and parameters which could be utilized for better evaluation of cardiac function.

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