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Assessment of cardiovascular parameters in normal weight and obese subjects.

Medical Science

KEYWORDS: blood pressure, body mass index, obesity, pulse

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ABSTRACT

Obesity is a global epidemic becoming a threat to healthy populations in increasing number of countries. Recently, the prevalence of obesity has increased in younger population. It is related with a number of comorbid conditions like hypertension, diabetes Mellitus, pulmonary diseases, etc. Hence associated with an increased risk of morbidity and mortality as well as reduced life expectancy. **Objective:** To study the changes in various cardiovascular parameters like systolic blood pressure, diastolic blood pressure, mean arterial pressure, pulse pressure and pulse rate in obese and non-obese subjects. **Methods:** 50 Male and female between the age group of 25 – 50 years were selected randomly for the study. Body mass index and waist-hip ratio was calculated and skin fold thickness measurement was carried out. The pulse rate and recording of blood pressure was done in standing as well as in supine position. MS excel was used to analyse the data and p- value was calculated using paired t test. **Result** - There was statistically significant increase in the systolic blood pressure, diastolic blood pressure, pulse rate, pulse pressure and mean arterial pressure in obese subjects compared to non obese subjects. **Conclusion** - The excess adipose tissue creates increase in metabolic demand & this will increase total blood volume and cardiac output to keep up with the demand. This may be the reason why we found high systolic BP, Diastolic BP, pulse rate, pulse pressure and mean arterial pressure in obese individuals.

Introduction

The word Obesity comes from the Latin word "obesitas", which means "stout, fat, or plump." According to WHO, Obesity is defined as a condition of abnormal or excessive fat accumulation that presents a risk to health.[1] Obesity is a global epidemic becoming a threat to healthy populations in increasing number of countries.[2] Recently, the prevalence of obesity has increased in younger population. Obesity is related with a number of comorbid conditions like Hypertension, Diabetes Mellitus, Pulmonary diseases, etc. Hence associated with an increased risk of morbidity and mortality as well as reduced life expectancy. It contributes to 2.6 million deaths worldwide every year.[5] Over weight and obesity are associated with an increased risk of disabling conditions such as arthritis and impaired quality of life in general. A variety of adaptations in cardio respiratory structure and function occur in the individual as adipose tissue accumulates in excess amounts, even in the absence of co-morbidities.[7] Hence, obesity may affect the heart and lungs through its influence on known risk factors such as dyslipidemia, hypertension, glucose intolerance, inflammatory markers, obstructive sleep apnea, hypoventilation, and the prothrombotic state, in addition to as yet unrecognized mechanisms. The cardiovascular disorders due to obesity result in increased mortality from complications such as coronary artery disease, heart failure, arrhythmias and sudden death.[8] Economic development together with recent technological innovations and modern marketing techniques have modified dietary preferences, and consequently, led to major changes in the composition of diet. There was a shift towards high fat, refined carbohydrate and low-fibre diet.[4] Numerous studies have demonstrated a direct association between excess body weight and coronary artery disease (CAD). So, this study was done to find out the importance of cardiac parameters in obesity which is a preventable condition which inturn reduces the morbidity and mortality.

Objective:

To study the changes / variations in various cardiovascular parameters like Systolic blood pressure, diastolic blood pressure, mean arterial pressure, pulse pressure and pulse rate in obese and non-obese subjects.

Subjects and methods: The present work was carried out in the "Research Lab", Department of Physiology, Medical College, Baroda. 50 Male and female between the age group of 25 – 50 years were selected randomly for the study. Out of which, 25 were control subjects (BMI ≤ 25) and others 25 were in category of overweight and obese (BMI > 25). All the subjects were explained the purpose and importance of the study. Only those, who were motivated and who consented were included in the present study. Detailed history including name, age, socio – economical physical activity, any past / family history of illness etc. was taken. At the time of participation, they were asymptomatic and were not suffering from any cardio-respiratory diseases in the past and especially so on the date of test. None of the subject had any organic disease such as palpable or percussable hepatomegaly and splenomegaly or disorder of central or peripheral nervous system. Anthropometric measurements were taken and thorough clinical examination was done in all subjects. All the subjects had some amount of daily physical exercises in the form of long distance walking, cycling for job placing. Their physical activity was mild to moderate type. All the parameters were recorded throughout by the same instrument to avoid instrumental errors.

Measurements: Standard anthropometric measurement such as,1) Weight (kg), 2) Height (cm), 3) Hip circumference, 4) Waist circumference (cm) was measured. Form this measurement Body mass index (kg /m^2) and waist: Hip ratio was calculated. Skin fold thickness measurement was carried out by vernier calliper for triceps, subscapular area and anterior superailiac skin fold thickness. Instrument used for the measurement of weight and height: DETECTO-SCALES INC.BROOKLYN.N.Y. U.S.A MODEL NO.239 CAPACITY 140 kg**.** Waist circumference was measured at the location of upper hip bone at the level of umbilicus by placing a measuring tape around the abdomen. Hip circumference was measured at the level of maximum prominence of the butt. The subject was instructed to stand tall and relaxed with feet together. (Or as close together as possible)

Cardiovascular evaluation: The pulse rate in standing and supine position was recorded by palpating the radial artery of the subject at wrist for one minute. Blood pressure was recorded by auscultatory method over the right brachial artery at the level of cubital fossa by using sphygmomanometer and stethoscope. The recording of blood pressure was done in standing as well as in supine position. Sphygmomanometer was kept at the heart level of subject. We have also measured Triceps skin fold thickness, subscapular skin fold thickness, suprailiac skin fold thickness. Triceps skin fold thickness

was measured on the right arm halfway between the olecranon process of the elbow and acromian process of scapula. Subscapular skin fold thickness was measured at the lower angle of the scapula. In case of difficulty in finding this landmark, the subjects were instructed to reach behind their back with their right arm, while feeling the movement of the scapula. Suprailiac skin fold thickness was measured just above the iliac crest, at its intersection with midaxilary line, little towards the front from the side of the waist. Skin fold thickness of all these three area were measured with the help of Vernier calliper.

Statistical analysis of the data:
MS excel was used to analyse the data and p- value was calculated using paired t test.

Result:
The table I shows the anthropometrical measurements of control subjects (n=25) and obese individuals (n=25). The mean age of control subjects was 31.68 ± 7.20 years while that of obese individuals was 39.36 ± 7.64 years. The mean height of control subjects was 167.92 ± 4.39 cm while that of obese individuals was 165.88 ± 5.26.There was a significant difference in weight of obese individuals (95.96 ± 11.02 kg) compared to the weight of control individuals (61.88 ± 8.66 kg).In the present study of random selection of case of 25 obese subjects, 18 were female subjects studied. Again, out of 25 obese subjects, 19 (83%) were having family history of obesity. The circumference at hip and waist was 119.24 ± 17.83 cm and 113.08 ± 11.51 cm respectively in obese individuals and 88.28 ± 8.26 cm and 80.92 ± 8.72 cm respectively in control subjects. The difference in both the parameters was found significantly higher in obese individuals compared to control individuals, though waist/hip ratio was found non significant. The body surface area of control and obese individuals were 1.70 ± 0.13 sq.m and 2.10 ± 0.13 sq.m respectively. Similarly Body Mass Index of control and obese individuals were 21.64 ± 2.79 kg/m^2 and 34.52 ± 3.42 kg/m^2 respectively. Both the values were significantly higher in obese individuals compared to control subjects, suggesting clear-cut obesity. The values for triceps skin fold thickness were 2.38 ± 1.03 cm and 4.52 ± 1.04 cm, for super iliac region 5.19 ± 1.41 cm and 9.38 ± 2.03 cm and for sub scapular region 2.92 ± 0.76 cm and 5.58 ± 1.70 cm in control and obese individuals respectively. The cardiovascular parameters of both the groups were shown in table II. The values for pulse rate were significantly higher (p<0.001) in obese individuals taken in standing posture, compared to those of control subjects. Though there was higher pulse rate of obese individuals in supine posture, the difference was found to be non-significant. The values of systolic blood pressure were found to be significantly higher (p<0.0001) in obese individuals irrespective of posture. Similarly, the diastolic blood pressure values were also found to be significantly higher for standing posture (P<0.001) and for supine posture (P<0.01) in obese individuals when compared with the values of control subject. We found significantly higher pulse pressure in standing position in obese subjects compared to control subjects (p<0.05). But no significant difference was found in pulse pressure in supine position between both the groups. We also found significantly higher mean BP in obese subjects in both standing and supine positions compared to control subjects (p<0.001)

Discussion:
Obesity and Overweight have in the last decade become a global problem – according to the World Health Organization. The scale of the obesity problem has a number of serious consequences for individuals and government health systems. Incidence of obesity being more marked in females than males was observed by many workers. We have used "body mass index" to analyze the effects of increased weight cardiovascular parameters, but its use is only valid when the contribution of fat and muscles are synergistic. Thus evaluation of the change in cardiac function in overweight subjects should be done by estimating body fat percentage.

In our study, Pulse rate measurement values were is higher in obese subjects than the control subjects. The higher value in obese subjects may be due to higher weight, higher BMI, BSA and skin-fold thickness of various regions. Increase body mass requires greater blood flow and thus loading the heart which cause increase in heart rate and blood pressure.

In our study, the values of systolic blood pressure were found to be significantly higher (p<0.0001) in obese individuals irrespective of posture. Similarly, the diastolic blood pressure values were also found to be significantly higher for standing posture (P<0.001) and for supine posture (P<0.01) in obese individuals when compared with the values of control subject. So, the Blood pressure measurement in our study showed significantly higher values in obese individuals compared to control subjects. Adipose tissue is an endocrine and paracrine organ that produces various hormones that are involved in regulating cardiovascular hemodynamics. The excess adipose tissue creates increase in metabolic demand & this will increase total blood volume and cardiac output to keep up with the demand. This increases the workload on the heart causing cardiac hypertrophy as well as increasing sympathetic activity. This in turn explains the statistically significant increase in the systolic BP, Diastolic BP, pulse rate, pulse pressure and mean arterial pressure which has been observed in our study. *Tuck ML et al(1981)* have showed in their study that the obese individuals have increased heart rate secondary to increased sympathetic activity and increased rennin-angiotensin-aldosteron system activity(9). Our results are comparable to the results of *Ravikeerthy et al (2015)*[10] who showed significantly higher SBP & DBP & HR in obese subjects compared to non obese subjects. *Ravisankar P et al (2005)* assessed the correlation between BMI, and heart rate, systolic pressure (SP), diastolic pressure (DP), pulse pressure (PP), mean arterial pressure (MP), rate-pressure product, endurance in the 40 mm Hg test, handgrip strength (HGS), and handgrip endurance in underweight, normal weight and overweight subjects. Their observations indicate that there are gender differences in the correlation between BMI and BP indices especially in underweight and overweight subjects. The observed differences between the three groups and gender differences in correlation between BMI and BP indices may be due to differences in autonomic function and or energy metabolism. *Stamler et al (1978)* carried out the study on weight and blood pressure in nearly one million Americans (screening for 3 years i.e. 1973-1975). They reported that the prevalence of hypertensions was higher in those overweight compared with those not overweight. (146) *Blumenthal et al (2000)* could also see the effect of exercises and weight loss on blood pressure in hypertensive subjects. In their study they concluded that although exercise alone was effective in reducing blood pressure, the addition of a behavioural weight loss program enhanced this effect. Aerobic exercise combined with weight loss was recommended for the management of elevated blood pressure in sedentary, overweight individuals.[148]

In our study, the skin fold thickness of various body surface areas (viz triceps, superior iliac, and chest and sub scapular region) and blood pressure showed significantly higher values in obese individuals compared to control subjects. These results are consistent with the findings of *Khosla and Lowe (1965)* where they have shown the relationship of blood pressure and arm circumference. Their result indicates that age and body weight appears to be significant predictor for sphygmomanometer readings of systolic and diastolic arterial pressure. They discussed that age has more pronounced effect on systolic blood pressure than diastolic while diastolic pressure is relatively sensitive to differences in body weight. Result of our study also consistent with the study done by *Kanavi Roopa Shekharappa et al (2011).* They found statistically significant increase in heart rate, systolic blood pressure and diastolic blood pressure in obese subjects when compared to non-obese in all age group. Also they found there was a positive correlation between body mass index and heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure and pulse blood pressure. The degree of rise was higher for the systolic blood pressure than the diastolic blood pressure. *Ajay K T et al (2014)* studied effect of obesity on Cardiovascular Functions in adolescent Male. They showed that SBP, DBP and

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MAP are significantly increased with increase in BMI and also the Heart rate was significantly higher in obese compared to non-obese. They concluded that the increase in the prevalence of obesity is primarily due to the increasingly obesogenic environment rather than 'pathology' in metabolic defects or genetic mutations within individuals. The control of obesity can be achieved by dietary changes, increased physical activity and a combination of both & hence health education has an important role to play in teaching people the hazards of overweight and to prevent obesity.

Conclusion:

We found cardiovascular alterations to be common among obese people. These alterations may be attributed to excess deposition of adipose tissue. These alterations reflect the body's adjustments to cope for the increased workload. The anatomical alterations secondary to increase in work load results into cardiac hypertrophy and other microscopic/molecular changes. These contribute to forming risk factors for cardiovascular disease in the long run. So, obesity is major risk factor cardiovascular disease and diabetes which in turn are responsible for morbidity and mortality. As obesity is a preventable condition, early steps to prevent obesity will reduce the major morbidity and mortality.

Table 1: Showing Standard Anthropometrical Measurements of Control (n=25) and Obese (n=25)

	Control			Obese
Parameters	Mean	SD	Mean	SD
Age	31.68	7.2	39.36	7.64
Height	167.92	4.39	165.88	5.26
Weight	61.88	8.66	95.96***	11.02
Waist	80.92	8.72	113.08***	11.51
Hip(cm)	88.28	8.26	119.24***	17.87
Waist/Hip ratio	0.92	0.07	0.95	0.08
BSA (m^2)	1.7	0.13	2.10***	0.15
BMI (kg/m^2)	21.64	2.79	34.52***	3.42
Skin fold thickness				
1)Triceps SF (cms)	2.38	1.03	4.52***	1.04
2)Sub Scapular SF (cms)	2.92	0.76	5.58***	1.7
3)Sup iliac SF (cms)	5.19	1.41	9.38***	2.03

BSA = Body Surface Area, BMI = Body Mass Index, SF = Skin fold thickness

*** = P < 0.001, highly significant differ

Table 2: Showing Pulse Rate (per minute) and Systolic and Diastolic blood pressure in standing and supine postures in Control (n=25) and Obese (n=25)

	Control		Obese	
Parameters	Mean	SD	Mean	SD
PR/min (St)	78	3.66	84.36***	5.54
PR/min (sup)	75.76	3.21	81.52**	3.43
SBP in mmHg (St)	122.2	8.54	137.60***	11.56
DBP in mmHg (St)	122.2	8.55	89.80***	1.21
SBP in mmHg (Sup)	126	6.92	142.00**	13.15
DBP in mmHg (Sup)	81.8	5.93	95.60***	9.61
pulse pressure (St)	40.8	9.64	47.8*	9.36
pulse pressure (Sup)	44.2	9.31	49.4	16.6
mean BP (St)	94.9	3.75	105.7***	7.02
mean BP (Sup)	96.52	4.48	112.06***	7.58

PR = Pulse Rate, SBP = Systolic blood pressure, DBP= Diastolic blood pressure,

St = Standing posture, Sup = Supine posture.

*= P < 0.05, significant difference

** = P < 0.01, very significant difference

*** = P < 0.001, highly significant difference