Available online at www.ijpab.com

International Journal of Pure & Applied Bioscience

ISSN: 2320 – 7051
Int. J. Pure App. Biosci. **3 (4):** 109-115 (2015)

INTERNATIONAL JOURNAL OF PURE & APPLIED BIOSCIENCE

Research Article

OPEN ACCESS

Effect of Sub Maximal Exercise Test on Cardiovascular Parameters in Young Obese Adults

B. Gowdhami[1], V. Abirami[1]*, R. Padmavathi[1], Vijayalakshmi Thanasekaran[2], B. Rajagopalan[2]
[1]Department of Physiology, [2]Department of Pulmonology
Sri Ramachandra Meical College and Research Institute Sri Ramachandra University, Porur, Chennai, Tamilnadu
*Corresponding Author E-mail: abiramiomprakash@gmail.com

ABSTRACT

Back ground: *The arterial pressure response to exercise is exaggerated in obese subjects compared with lean adults. Blood pressure response to exercise is an important predictor of incident hypertension and future cardiovascular events.*

Aim: *Aim of the study is to evaluate the effect of submaximal exercise test on blood pressure and oxygen saturation in young obese adults.*

Method: *This cross sectional study was conducted among 60 apparently healthy volunteers (obese-30, normal -30) in the age group of 18-35 years in Chennai. After measuring anthropometric parameters, base line cardiovascular parameters (Heart rate, Systolic blood pressure and Diastolic Blood Pressure) and oxygen saturation (SatO$_{2)}$ of the subjects were recorded. Then subjects were asked to perform Six Minutes Walk Test (6MWT) according to the guidelines given by American Thoracic Society. Post test cardiovascular parameters and SatO$_2$ were recorded. The post exercise dyspnoea score and fatigue levels were calculated using Borg's scale. The analysis was done using independent't' test. P value < 0.05 was taken as significant.* ***Results:*** *Obese subjects showed a significant increase in SBP and DBP after exercise. There was significance in reduction (< 0.05) in oxygen saturation after 6 MWT.* ***Conclusion:*** *The increased in blood pressure response to sub-maximal exercise test in obese individuals may predict future incidence of hypertension and cardiovascular risk. Decrease in oxygen saturation, implies that the obese subjects have poor exercise tolerance compared to normal subjects.*

Key words: *Obesity, Submaximal exercise, Blood pressure*

INTRODUCTION

Obesity is an important risk factor for increased blood pressure which leads to premature cardiovascular morbidity and mortality[1]. The prevalence of obesity has increased to epidemic proportions in South India, second highest being in Tamilnadu (24.4%) [2]. The overall prevalence of coronary artery disease in native South Indian population reported in recent times by CUPs(no.5) [3] study is found to be 11%. In obese subjects, a variety of prohypertensive alterations in blood pressure homeostasis have been found [4,] in spite of their resting blood pressure being within normal limits. Previous studies have demonstrated that the hemodyanamic responses to exercise are an important predictor of cardiovascular disease (CVD) risk and incident hypertension[15, 16].

Walking often represents the most feasible and accessible form of isotonic exercise which helps in weight management[5,6]. Six Minutes Walk test (6 MWT) is a simple, non-invasive, sub maximal exercise testing which resembles the normal activities of daily living, as most of our daily activities involve sub maximal levels of exertion. The hemodyanamic changes recorded during and after 6 MWT test may be compared to the blood pressure changes that occur during our daily activities of physical excertion. So the present study was planned to evaluate the effect of a submaximal exercise test (6 MWT) on cardiovascular parameters and $SatO_2$ in obese South Indian adults.

MATERIALS AND METHODS

This cross sectional study was carried out in 60 subjects (30 obese and 30 normal) from Chennai city who were in the age group of 18 to 35 yrs. Both the study groups had 15 males and 15 females each. The study population was categorized into normal and obese based on the current lower cut-off points for BMI recommended by WHO for Asian population. (WHO 2007). The BMI of normal subjects is between 18.00-22.99 Kg/m2 and obese was >30 Kg/m2.

Subjects with H/o any acute illness three weeks prior to the time of study, systemic disorders,smoking, pregnancy, physically active individuals on exercise program, people on diet restriction were excluded. Ethical clearance was obtained from institutional ethical committee and informed written consent was also obtained from all the study subjects.

Initially anthropometric indices like height, weight, BMI were measured. Baseline cardiovascular parameters (heart rate, Systolic blood pressure, Diastolic blood Pressure) and oxygen saturation ($SatO_{2)}$ were evaluated manually in the study subjects. Baseline Dyspnoea score and fatigue levels were measured by Borg's scale [7]. Then the subjects were asked to perform the 6 minute walk test (6MWT) following the guidelines given by American Thoracic Society (ATS). Then post 6MWT assessments of cardiovascular parameters were done. Pre and post test $SatO_2$ readings were also taken using pulse oximeter. Post test dyspnoea scoring and fatigue level were also assessed by Borg's scale [7]

Statistical Analysis:

Statistical analysis was done by SPSS 11.1 software. Data is represented as Mean ±SD.Comparison test of significance used was independent "t' test. The level of significance was taken at 5% level.

RESULTS

The descriptive parameters of the study population are given in table 1. The study subjects were assigned into two groups' normal (30) and obese (30) based on their BMI. Both the study groups had equal number (15) of male and female participants.

Table 1: Descriptive parameters of the study population

DESCRIPTIVES	Normal(n=30) (BMI 18-22.99 kg/m^2)		Obese(n=30) (BMI <30 kg/m^2)	
	Males (n=15)	Females (n=15)	Males (n=15)	Females (n=15)
AGE(yrs)	21±3	22±3	23±5	21±3
HEIGHT(cm)	169±8.38	158±3.9	171±6.69	157±3.47
WEIGHT(kg)	63.86±7	54.53±3	98.26±16*	85.46±10*
BMI(kg/m^2)	21.89±1	21.6±1.21	33.4±4.3 *	33.8±3.1*

BMI- Body mass index Data expressed as Mean ±SD; *statistically significant (P<0.05).

The base line characteristics of study population were similar in both the groups Height was not significantly different, However, weight and BMI showed significance in difference between normal and obese groups ($p < 0.05$).

Table 2: Comparison of 6 Minutes walk distance between normal and obese study subjects

Parameter		Number of subjects(n)	Normal (n=30)	OBESE (n=30)	P value
TDW(m)	Male	15	565.8±23.7	500±40.27	0.00
	Female	15	531±20.83	487±48.52	0.00

TWD- Total distance walked; Data expressed as Mean ±SD, Statistical significance (P<0.05)

Table 2: shows comparison of total distance walked by normal and obese subjects during 6 minutes walk test (6MWT).The distance walked in six minutes was found to be significantly higher in normal population compared to obese group (P <0.05) and also males subjects covered a longer distance compared to female subjects.

Table 3: Comparison of pre and post exercise parameters between normal and obese Male population

PARAMETERS		NORMAL	OBESE
HR(/min)	PRE	72±9.33	75±12
	POST	116±11.2	111±11.6
SBP(mmHg)	PRE	115±5.1	122±8.6*
	POST	128±6.39	144±11.2*
DBP(mmHg)	PRE	75±5.16	81±5.16*
	POST	80±2.58	83±4.81
SPO_2	PRE	98±0.74	98±0.74
	POST	99±0.35	96±1.22*
LEG FATIGUE	POST	0	1*
DYSPNOEA	POST	0	1*

HR- Heart Rate; SBP-Systolic Blood Pressure; DBP- Diastolic Blood Pressure;spo_{2-} oxygen saturation; Data expressed as Mean ±SD; *statistically significant (P<0.05).

Table 3 shows Comparison of pre and post exercise hemodynamic parameters between normal and obese Male population. After exercise both systolic and diastolic pressure increased in obese females compared to their counter parts. SPO_2 level was significantly reduced after exercise. Mean Dyspnoea score as estimated by Borg' s scale was 1 for obese male subjects.

Table 4: Comparison of pre and post exercise parameters between normal and obese female population

CARDIO VASCULAR PARAMETERS		NORMAL	OBESE
HR(/min)	PRE	69±9	81±10*
	POST	112±10	116±10
SBP(mmHg)	PRE	115±6	118±7
	POST	126±7	136±9*
DBP(mmHg)	PRE	77±4	80±5.3
	POST	80±0	84±5*
SPO_2	PRE	98±0.7	98±0.4
	POST	99±0.4	96±1*
LEG FATIGUE	POST	0	1*
DYSPNOEA	POST	0	1*

Heart Rate; SBP-Systolic Blood Pressure; DBP- Diastolic Blood Pressure; SPO_{2-} oxygen saturation; Data expressed as Mean ±SD; *statistically significant (P<0.05).

Table 4 shows Comparison of pre and post exercise parameters between normal and obese female population. Resting heart rate was more in obese female subjects. After exercise both systolic and diastolic pressure increased in obese females compared to their counter parts. SPO_2 level was significantly reduced after exercise. Mean Dyspnoea score as estimated by Borg' s scale was 1 for obese female subjects.

DISCUSSION

This cross sectional study has evaluated the effect of submaximal exercise test (6MWT) on blood pressure and oxygen saturation in young obese adults.

Several epidemiological studies have consistently revealed a lower lean mass and a higher proportion of body fat compositions in south Asians compared to Caucasians [8, 9] .And also the people of South Asian origin are more prone to visceral obesity, which imposes a great level of metabolic and CVD risk, even in subjects who would not be classified as obese based on their BMI. So the WHO Consultation has recommended a current lower cut-off points for BMI to categorize overweight and obesity in Asian population[10] Our study population(60) was grouped into Normal (30) and obese (30) based on WHO current cut off value for Asians. (BMI- <22.99kg/m2 as Normal and >30.0 0Kg/m2 as obese).

6 Minutes Walk Test(6MWT) is a sub maximal exercise test which is self-paced, inexpensive and can easily be applied. This test is considered more as a global performance test than a mere measure of motor capacity. 6MWT, is a physical stressor which matches the normal activities of daily living and so the 6 minutes walk distance will reflect the functional exercise level of daily physical activities[7.] Moreover employing low- intensity exercise will standardize the exercise exposure and also reduces confounding by heterogeneity in fitness level and motivation.

BP changes during normal exercise are brought about by the interaction between increased cardiac output and reduced total peripheral vascular resistance. In normal healthy individuals, the increase in cardiac output during exercise is balanced in part, by a fall in peripheral artery resistance via endothelium-dependent vasodilation and microcirculatory reserve[11,12] .Blood pressure response to exercise is an important marker of CVD risk and cardiovascular mortality. BP changes during sub-maximal exercise represents a physiological response to low-to- moderate daily physical activity which can be closely correlated with ambulatory BP[11], mean daily BP and end-organ damage[13].

In obese individuals, the proposed prohypertensive mechanisms which may alter the blood pressure homeostasis are increased sympathetic nervous system activity and activation of the renin-angiotensin-aldosterone pathway which act together to increase peripheral vascular resistance and promote sodium retention[4].Moreover obesity is a proinflammatory state and releases adipokines like tumor necrosis factor-alpha,interleukin-6, etc that may play a role in metabolic and cardiovascular complications of obesity[14].

An enhanced blood pressure response of increase in systolic blood pressure from rest of >10mmHg per metabolic equivalent or a diastolic blood pressure change of >10mmHg at any workload) to acute dynamic exercise bout has been considered as an indicator of cardiovascular risk[15,16]. Miyai et al showed a significant and independent threefold higher risk for future hypertension in middle-aged normotensive men with a exaggerated exercise response[17].

Obese subjects, (both male and female) of our study population showed significant increase in systolic and diastolic blood pressure to a sub maximal level of physical activity, 6MWT. Various factors like age, gender, smoking, BMI, family history of hypertension, resting BP and total cholesterol have been found to influence the blood pressure response to physical activity [18,19].

A large population study by Thanassoulis et al demonstrated that abnormal vascular function, which is influenced by the factors like arterial stiffness, microvascular reactivity and endothelial function is a main contributing factor to disproportionate BP response observed with exercise. The essential parameters evaluated by Framingham Offspring Study, which confirmed the cross sectional relationship between exercise BP and cardiovascular risk factors were pulsatile arterial load, steady-flow arterial load, aortic stiffness and endothelial function and forearm microvascular reactivity.

It has also been reported that individuals with hypertensive response to exercise may have impaired vascular function, which limits their ability to compensate for the increased cardiac output during normal activities that results in frequent rises in BP. It may also provide an important mechanistic link between a hypertensive response to exercise, LVH and increased risk of cardiovascular events[20].

Another study by Tounian P et al has also highlighted, the blood pressure response to exercise in obese individuals, is mainly lead by increased muscle neurovascular sympathetic tone and central arterial stiffness[21].The enhanced sympathetic activation in response to low intensity exercise and increased vagal reactivation upon stopping the exercise[22] may have been correlated with adverse outcomes, like ventricular ectopy[23] and delayed heart rate recovery after exercise[24].

We have also observed a significant drop in post exercise oxygen saturation in both the genders among the obese study population. This can be linked to an imbalance in the V/Q ratio and further reduction of ERV during exercise in obese individuals. During exercise, there is increase in cardiac output but no increase in ventilation which worsens the V/Q ratio which leads to decrease in SatO2. This directs more stress on the oxygen extraction reserve and leads to increased cardiac output as a compensatory mechanism to improve oxygen saturation [25,26] There was also increased dyspnoea score and leg fatigue in obese study subjects.

The blood pressure response to dynamic exercise may represent a reliable clinical tool to assess decreased arterial compliance or vascular endothelial dysfunction in resting normotensive obese subjects. More than the systolic blood pressure, the increase in diastolic blood pressure during low intensity exercise is an independent predictor of future cardiovascular mortality and morbidity[27].

Weight loss is the key to improve cardiorespiratory fitness in obese subjects. Recent studies suggest that subjects who have consistently increased their exercise level over time have a decreased mortality rate compared to those who were consistently unfit [28, 29]. It is a proven way to reduce resting blood pressure[30],to improve sympathetic muscle nerve overactivity[31,32], and may well normalise the enhanced blood pressure response to exercise in obese individuals. Further studies in large population are warranted to gain good insight in to this research area.

CONCLUSION

In conclusion, there was an enhanced blood pressure response to submaximal exercise test in obese subjects compared to the control study population. It may imply the abnormal vascular function in obese individuals and predicts the increased cardiovascular risk and incidence of future hypertension.

In summary, this study provides new data for clinical practice and adds to the limited research on cardiovascular response to exercise in sedentary obese South Indian population. This simple and non-invasive exercise testing may provide physicians with valuable screening data prior to further more invasive testing for cardiovascular risk in obese individuals

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