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Hemodynamic responses to isometric handgrip exercise in young adults with varying body mass index

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ABSTRACT

Background: The cardiovascular responses to static exercise depend on exercise intensity i.e. percentage of maximum voluntary contraction (MVC) and muscle mass involved. It has been seen that the cardiovascular responses is directly proportional to the % MVC used during static activity. Objective: To assess and compare the hemodynamic responses to isometric handgrip exercise among young adults of different BMI. Methods/Design-The subjects were asked to perform isometric handgrip exercise with their dominant hand, at maximum voluntary contraction. Heart rate (HR) and blood pressure (SBP and DBP) responses were recorded immediately just before the release of hand pressure. Following isometric activity, post exercise- HR and BP responses were recorded at 1 min, 3min and 5 min. Similar procedure was repeated with non- dominant and combined hand after giving a rest period of 10 minutes between each activity.Conclusion: Isometric activities impose the cardiovascular stress, by providing an excessive pressure overload on the heart. Therefore, the cardiovascular responses elicited during the isometric activities helps to assess the cardiac function.

Keywords: Hemodynamic Response, Handgrip exercise, Body Mass Index, Mean arterial Pressure, Hand held dynamometer

INTRODUCTION

Activities in which contraction principally causes a change in the tension of the muscle with little change in the length, is termed as isometric or static exercise whereas activities in which contraction of the skeletal muscle causes a change in the length of muscle with tension remaining the same is termed as isotonic or dynamic exercise.1Every physical activity requires some quick adjustments on the cardiovascular system in to order to maintain circulatory homeostasis.2 During exercise, changes in heart rate (HR), stroke volume (SV), systemic vascular resistance and mean arterial pressure (MAP) results due to adjustments in sympathetic and parasympathetic activity.

These autonomic adjustments to exercise are mainly mediated by central signals arising from the higher brain called as central command as well as by a peripheral reflex arising from the stimulation of chemo-sensitive receptors in the contracting skeletal muscle i.e. exercise pressor reflex, with further modulation, provided by the arterial baroreflex.[3]

Dynamic exercises involving a large mass of skeletal muscle results in large increase in cardiac output and heart rate with relatively little change in mean arterial pressure. On the other hand, static or isometric contraction, even of a small mass causes a marked increase in mean arterial pressure with only modest or little increase in heart rate and cardiac output. Thus dynamic exercise primarily increases volume overload on a heart whereas static exercise primarily produces pressure overload.[4]

Aims and Objectives

Primary objective: To assess and compare the hemodynamic responses to isometric handgrip exercise among young adults of different BMI. Secondary objective: To examine the changes in the hemodynamic responses to isometric handgrip exercise among young adults of different BMI according to the hand preferences (dominant, non- dominant and combined hand).

MATERIALS AND METHODOLOGY

Study Design- Experimental study with repeated measures design, Study Setting- Department of Physiotherapy .Population and Sampling- Healthy young adults were selected through convenient sampling. Samplesize-100. Inclusion criteria -Age group of 18-35 years of age. BMI range->14.0 to <50.0kg/m2. Exclusion criteria-Any cardiovascular disease including hypertension, Diabetes Mellitus, Drinking ethanol >60g/day,

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Smokers, Neuromuscular disorders affecting the hand muscle strength, Use of any medications altering the autonomic nervous system activity. Parameters-Heart rate and Blood pressure (Systolic and Diastolic)

Instruments and Tools-Digital BP and heart rate monitor: Rossmax model: MJ701-apparatus is valid according to British hypertension society and European hypertension society, with accuracy, pressure:± 3mmHg and pulse:±5% of reading. Hand held dynamometer- reliability (r= > 0.90)62, validity (r=.74-.77). Stopwatch, Weighing machine, Height measuring scale-stadiometer.

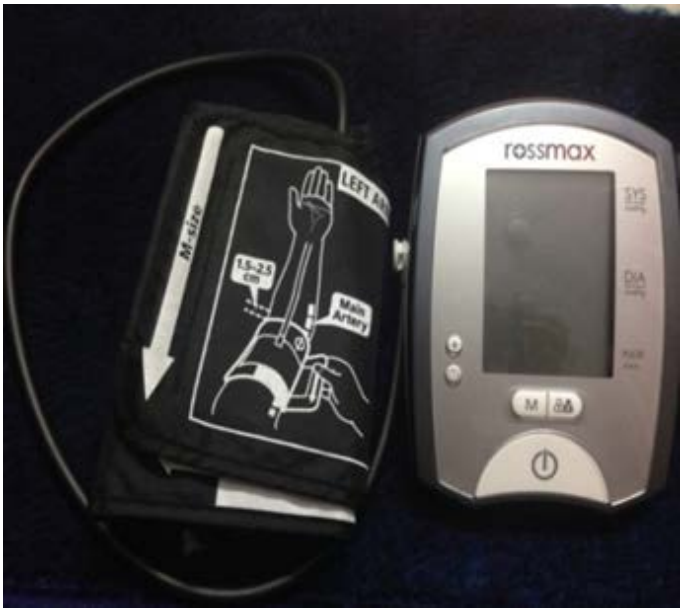

Figure 1. Digital heart rate and BP monitor-Rossmax model MJ-701

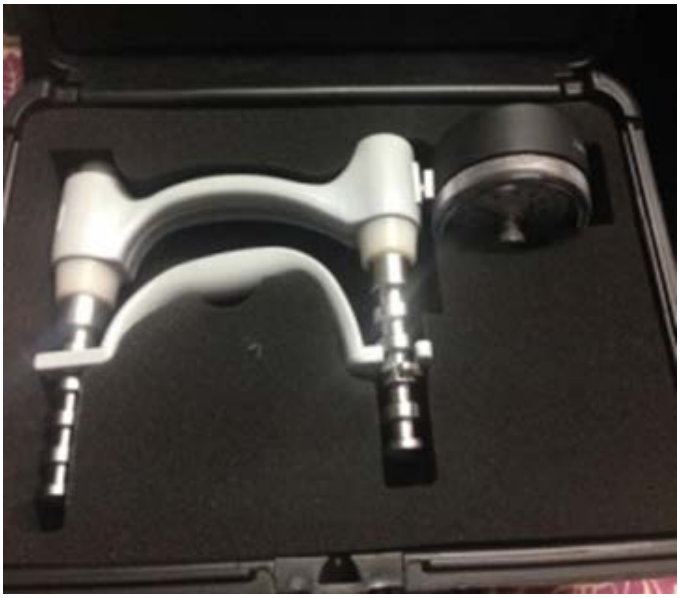

Figure 2. Hand held Dynamometer

PROCEDURE

In this study, 117 subjects were screened for inclusion and exclusion criteria. Among them 100 subjects were enrolled in the study. All the subjects were fully informed about the purpose of the study and their written consents were obtained. BMI (Kg/m2) was calculated as per Quetelet's index and all subjects were categorized into 6 groups based on BMI (Kg/m2). Subjects were asked to avoid intake of caffeine, alcohol consumption 24 hours before the start of the study.

Before initiating the study, practical demonstration about how to perform isometric handgrip exercise was given. Subjects were asked to sit comfortably on chair and allowed to rest for 10 minutes in a quiet room to avoid anxiety. The resting blood pressures and heart rate of all the subjects were taken with an appropriately sized cuff placed on the right upper arm parallel to the trunk, using a Digital BP and Heart Rate Monitor. The subjects were asked to perform isometric handgrip exercise with their dominant hand, at maximum voluntary contraction (100% MVC) by compressing the handles of the handheld dynamometer and putting in maximum effort for few seconds. Heart rate (HR) and blood pressure (SBP and DBP) responses were recorded immediately (i.e. within 30 seconds of time duration) just before the release of hand pressure. Following isometric activity, post exercise- HR and BP responses were recorded at 1 min, 3min and 5 min. Similar procedure was repeated with non- dominant and combined hand after giving a rest period of 10 minutes between each activity.

DISCUSSION

Previous studies have shown that body mass has been associated with the alternations in the cardiac autonomic activity which regulates the cardiovascular system at rest and activity. There exists increased cardiovascular mortality in underweight and overweight relative to normal weight category. So it was important to find out the cardiovascular responses in young adults with varying BMI, in order to early diagnose and provide further management to prevent progression of the disease.

Studies have shown that changes in body mass has been associated with changes in the cardiac autonomic activity, with evidence suggesting, presence of high cardiovascular mortality in underweight (BMI <18.5 kg/m2) and obesity(BMI ≥30 kg/m2) relative to normal weight category. Till now, hemodynamic responses to isometric handgrip exercise have been well studied in adults with normal BMI (18.5-24.9 kg/m2); however literature demonstrating the hemodynamic responses to isometric handgrip exercise in population with different BMI is very much limited.

Many of the studies dealing with post- exercise responses have found that exercise reduces blood pressure during the recovery period.[5-11] However, there is inconsistency in the magnitude as well as the time course of blood pressure changes that occur after exercise. Some of the investigators have observed an increase in heart rate levels during the recovery period while others have reported that there is no change, even decrease in post-exercise heart rate.12 Moreover results related to post-isometric handgrip exercise blood pressure and heart rate responses are less conclusive.

Recovery of heart rate immediately after an exercise is due to function of vagal reactivation. Delayed decrease in heart rate during the first minute after graded exercise, reflect a decrease vagal activity which is considered to be is a powerful predictor of overall mortality and cardiovascular events, independent of workload, the presence or absence of myocardial perfusion defects and changes in heart rate during exercise.13 It has been found that subject with metabolic syndrome have delayed heart rate recovery and have higher resting heart rate.14 So following exercise, evaluation of blood pressure and heart rate responses in population with different BMI are necessary.

CONCLUSION

Since in India, prevalence of obesity, overweight and underweight is rising among young adults. So there was a need to investigate the changes in hemodynamic responses to isometric handgrip exercise in young adults with different BMI, which could be important for predicting and preventing the excessive cardiac load during single or both upper extremities static activity. This study gave an insight about the hemodynamic responses to isometric handgrip exercise at 100% MVC in young adults with varying BMI. This study also contributes to determine about how the hemodynamic responses varies with hand preferences (dominant, non- dominant and combined hand). The results of the study could be used as a reference for prescribing and practising the isometric exercise safely to the healthy as well as disease young adults with different BMI.

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