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A Comparative Study of Isometric Strength, Endurance and Gender in Medical Students

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Abstract

Cardio respiratory fitness and nutrition influence skeletal muscle function. Motor fitness or skill related fitness can be determined by handgrip strength. Handgrip strength and endurance are important parameters for assessing muscular strength. Physiological variables like age, gender and body size effects the strength and endurance of an individual. Handgrip dynamometer which is a cheap and simple method can be used to evaluate strength and endurance. In our study we used hand grip dynamometer to measure strength and endurance in group of 50 subjects, 25 each male and female. The results showed a greater strength in males whereas females showed a greater endurance compared to males.

Keywords: strength, endurance, gender, hand grip dynamometer

Introduction

Our body's ability to move and to perform day to day activity depends on muscular endurance and strength. Muscular strength is the force produced by a muscle and is measured as the maximum force produced by a muscle in a single effort or single maximum effort. There are many factors such as gender, age and inherited physical attributes on which the strength of muscle depends. Though strong muscles are a requirement for athletic endeavours but strong muscles can help everyone in some way or another. The direct and indirect benefit includes good posture, easy movements and better performance of recreational activities, stronger bones and ligaments, tendons. These all also decreases risk of injury or fall altogether easier performance of work.

In contrast to muscular strength, muscular endurance is defined as the ability of a muscle or a group of muscles to exert a force against a resistance that is sub maximal and is extended for a period of time. The number of repetitions performed forms the basis of measurement of muscular endurance. An improved or better muscular endurance makes everyday activities a lot easier. When fatigue ensues in a working muscle the pace at which the muscle was working gets hampered. With increased tiredness the risk of injury in the working muscle as well as to any other part of body increases. An individual with poor muscular endurance is not able to finish the job in hand on time as he has to take frequent

short breaks because of development of tiredness in muscles. In this condition if a person tries to complete the job in hand might end up with a strained muscle or pulled muscle or with very sore muscles. In this condition an individual might find difficulty in performing the work that can usually be done with fewer efforts. [1]

Muscular strength and endurance can be easily predicted with the help of an effective tool Handgrip dynamometer. A person with strong muscles of hands, wrist and fingers can lift as well as hold the weights for a longer duration of time. A high activity level of flexor musculature of forearm and hands is required in many sporting events and during many daily activities. For studying growth and fitness of a population the assessment of these groups of muscles is of interest. When studying a larger group of population it is essential that that the techniques involved are fairly quick, cheap and simple moreover it should not require strict laboratory conditions .[2]In view of long duration of working hours of medical students this study was planned .The endurance plays a major role in academic as well as practical performance of a medical student. The handgrip dynamometer is a simple and cheap tool for assessing the strength and endurance without any strict laboratory conditions. In addition to this results of our study will add to the present knowledge of skeletal muscle strength and endurance in regards to the gender differences. This will also help in differentiating the historical or sociological bias from the differences that are physiologically based.[3]

Material and Methods

This study was done on a total of 50 apparently healthy participants, which included 25 females and 25 males with age varying from 19-23 years. This study was started after taking institutional ethical committee approval. The subjects were recruited randomly and purely on volunteer basis from a tertiary care hospital in Ludhiana, Punjab. Those subjects who fulfilled the inclusion criteria were selected for the study. The inclusion criteria was that there should be no history of hypertension, diabetes, exercise training of any kind or hand injury. The subjects with history of any acute or chronic illness, subjects who were involved in an isometric training or with history of traumatic injury were excluded from the study. The subjects who fulfilled the inclusion criteria were enrolled for the study. Each subject was explained thoroughly about the study and the procedure of the exercise training involved. Those who were willing to participate in the study a written informed consent was taken .A detailed history and a thorough physical examination was done for the study group.

Determination of Hand grip strength

Subjects were explained about the functioning of the Hand Grip Dynamometer (HGD) prior to beginning contraction exercise. Hand grip strength (HGS) was determined by using a hand grip dynamometer (Inco, Ambala,India) to test the maximum voluntary contraction. The best o f three trials were accepted with three minutes rest in between. Hand grip endurance (HGE) was determined by asking the subject to maintain 1/3rd of the maximum HGS score for as long as the subject could. All the hand grip measurements were taken with the arm straight, i.e. at 0^0 elbow-angles. In this position, the participant is asked to compress the HGS dynamometer with maximum strength. HGS can be quantified by measuring the

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amount of static force that the hand can compress/squeeze around a dynamometer. The mean of three trials of grip strength is taken. This is referred to as maximum isometric tension, Tmax in kg and ET is measured by the time of onset of fatigue for 70% of the in Tmax expressed in seconds. [4]

Results and analysis

Handgrip Strength		
Parameter	n	Mean± SD
HGS- Males	25	34.64±7.52
HGS- Females	25	24.18±5.67
Handgrip Endurance		
Parameter	N	Mean± SD
HGE- Males	25	54.35±22.98
HGE- Females	25	79.77±39.57

Result: The result in our study showed a highly significant HGS in males compared to females ($p<.0001$).Whereas the endurance was greater in females compared to males.

Discussion

The main objective of our study was to measure strength and endurance in male and female medical students along with it to compare the parameters. An individual with good muscular endurance can continue to work for a longer duration and recovery from fatigue is also faster ,making the person fit for the next day as well so that he can get on with what he usually do. A greater muscular endurance makes everyday activities easier as well as has other health benefits also such as decreased risk of injury because of stronger ligaments, bones and tendons and decreased risk of diseases. [5]

A greater muscular endurance capacity is shown by females compared to male per se the numerous studies done in past. [6-12]Though the physiological mechanisms behind the muscle fatigability in genders are not completely understood, there are two most purported hypothesis based on muscle mass and neuromuscular activation. Among these difference in muscle mass mediating fatigue response has gained more popularity.[13] the framework of the hypothesis is based on the fact that females have less muscle mass than men and it also assumes that when both the genders are performing similar work and for same specific tension females generate a lower absolute muscle force compared to males.[14] the generated lower absolute forces need less of oxygen and thus causes a less mechanical compression of the vasculature in the active muscle tissue. All this leads to lesser imbalances in the demand and supply of blood supply. [15]

According to other theory which is based on muscle mass , the main determinant of strength difference observed is the larger number of muscle fibres especially type I and a greater number of fibres per cross sectional area. Time duration of fatigue is different in the genders due to preferential metabolic pathways during exercise. Females a larger number of type II fibres conversely to males where type I fibres are found more. In some other studies it was cleared that there is no correlation in endurance and hormone levels during menstrual cycle [16] whereas fewer studies quote that oestrogen levels do have a role in muscle fatigue. These researches support that there is a relation in the oestrogen levels and muscle fatigue based on the fact that the increased glycogen stores ,increased body temperature which affects the blood supply during luteal phase all attribute to a greater fatigue resistance in females.[17]

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In our study these results were not supported by the findings, though the limiting factor is relying on subject's personal reporting of cycle which cannot be authenticated. The results of our study have added to the body of literature where an easy and affordable method like handgrip can be useful in measuring the strength and endurance of an individual.

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