National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Study of gender variation in muscle function among young adults

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Received: March 11, 2017; **Accepted:** April 03, 2017

ABSTRACT

Background: Muscles are the only tissue in the body that has the unique ability to contract which helps in movement of other body parts. Physical activity is one of the important factors which affect the skeletal muscle function. In the current scenario, regular physical activity is recommended to improve the physical and mental well-being in younger age groups. **Aims and Objectives:** The aim of this study was to assess the gender differences in muscle functions using hand-grip dynamometer, Mosso's ergograph, bicycle ergometer, and respiratory endurance in young adults. Materials and Methods**:** Anthropometric measurements such as chest circumference and chest expansion were taken and function tests were done to all the study participants. Muscle function was assessed using hand-grip dynamometer, Mosso's ergograph, and bicycle ergometer. **Results:** Maximum voluntary contraction, work done using Mosso's ergography and bicycle ergometer test, was higher in males when compared to females which is statistically significant ($P < 0.05$). **Conclusion:** From our results, we conclude that higher muscle strength was seen among males in both extremities compared to females. This could be mainly due to genetic factors and hormonal differences between both sexes. Higher muscle function could be achieved by training of the muscles. Hence, encouragement should be done to increase the physical activity in females in the modern world to lead a quality life.

KEY WORDS: Physical Activity; Work Done; Maximum Voluntary Contraction; Respiratory Endurance

INTRODUCTION

Males in general are physically stronger when compared to females which could be due to more number of muscle mass and less body fat when compared to females.[1-3] In spite of knowing the benefits of physical activity, large group of the population is not doing physical activity regularly. The reason for most of diabetes and cardiovascular disease that is prevailing in the community is mainly because of lack of physical activity. Muscle strength is one of the important factors in determining the muscle performance both in men and women.[4] There are many factors which determine the muscle performance. Some of them include age, sex, height, and physical build. Men can perform better than women because of multiple variables. The National Strength and Conditioning Association say women have two-thirds of muscle mass and also physically built in general as men.[5] There is a difference in strength of the muscles in males and many of the changes are based on cross-sectional area of the muscle and body size. Many studies have proven that when comparing with muscles of upper limb, the strength of the muscles of lower limb is almost equal to men. Most of the studies on physical education have elaborated on differences in gender in the area of competence of beliefs and the influence of gender based bias in self-perceptions of competence. Activities such as lunges and squats are easy to perform to women when compared to pullups and pushups. To improve women's involvement in physical activity, it is much important to find out key factors involved and the relationships among those factors.

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2017.7.0308402042017	

The ability of a muscle group to contract over long periods of time is called as muscular endurance. Muscle mass is more in men than women, but it is not necessary to have more muscular endurance.[6] There are many contradictory statements regarding muscular endurance difference between men and women. Moreover, there are some other variables which may influence muscular endurance between genders which includes hormones, training, and genetics.[7] Testosterone helps build lean body mass or muscle in males. The level of testosterone and body mass or muscle is more in male when compared female. The muscle tissues are the same in both genders, but there can be difference in fibers among them depending on genetic characters and regular activities.[7] Training is the one factor which increases muscle strength, endurance, and performance of the individual. However, in the modern world, physical inactivity is commonly seen among both sexes. Physical inactivity decreases the strength of the muscles which leads to changes in muscle mass. This could result in increased risk of falls, hip fractures, impaired glucose tolerance, and decrease in bone mineral density. These changes may result in many diseases and disorders such as osteoporosis, atherosclerosis, and diabetes mellitus which lead to complications that impair the daily activities of the life.[8] Hence, the present study was undertaken to study the gender differences in muscle function tests among younger population. The aim of the study is to assess the gender differences in muscle functions using hand-grip dynamometer, Mosso's ergograph, bicycle ergometer, and respiratory endurance in young adults.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Physiology, Sri Ramachandra Medical College and Research Institute, Porur, Chennai. 100 healthy students participated in this study and aged between 17 and 28. Both sexes were included in this study. A total of 60 males and 40 females were participated in this study. A history of any cardiac and respiratory illness was excluded from the study. Ethical clearance was obtained from the Institutional Ethics Committee, Sri Ramachandra University. Protocol of the study and the benefits of the study were explained to the participants and written informed consent was obtained from study participants. Anthropometric measurements such as chest circumference and chest expansion were taken and the following muscle function tests were done to all the study participants.

Assessment of Upper Extremity Muscle Function

Ergograph is an instrument used to assess the performance of the flexors of the finger of the hand. Proper instructions about the procedure were explained to the participants. The participants were asked to make a series of maximal contractions without moving the shoulder at regular intervals following the beat of metronome. Continue the contractions until the fatigue is so great that weight can no longer be moved and the reading was calculated.

Maximum voluntary contraction (MVC) was measured using hand-grip dynamometer (Inco). First, the participant was allowed to study the instrument for a short time, and then asked the participant to hold the dynamometer in the right hand so as to have a full grip of it, then instructed to close his eyes and to compress the handles with maximum effort. The tension developed was measured and waited for one minute. The whole procedure was repeated and best reading was taken. It is measured in kilogram.

Assessment of Lower Extremity Muscle Function

Lower extremity muscle function was assessed using bicycle ergometer. After explaining the procedure, the participant was instructed to seat in comfortable position adjust to the height. The tension was kept as 4 kg and then asks the participant to pedal the ergometer till he feels his leg fatigue. The distance, speed, and time were displayed on the digital monitor. The work done was calculated using the formula force × distance.

Assessment of Respiratory Muscle Strength

40 mmHg endurance tests were conducted by asking the participant to take in a full breath and blow against the mercury column in a sphygmomanometer to the pressure of 40 mm, maintaining it as long as possible. The time (in seconds) for which the participant could maintain the mercury level at 40 mmHg was noted. Three trials were given with five minutes rest interval between the trials and the best value was taken for statistical analysis.

Statistical Analysis

The data were expressed in mean±standard deviation. Comparisons between groups for all the measured variables were made using independent *t*-test. Data were analyzed using Statistical Package for Social Sciences version 11.5. A 5% level of probability was used to indicate statistical significance.

RESULTS

A total of 100 healthy students were participated in this study with mean age of 20 ± 3. The chest circumference (male 88.8 ± 2.99, female 84.08 ± 3.73), mid arm circumference right (male 29.72 ± 2.24, females 27.97 ± 2.12), mid arm circumference left (males 30.2 ± 1.83, females 28.4 ± 2.1), and chest expansion (males 3.9 ± 0.69, females 3.4 ± 0.62) were significantly higher in males when compared to females ($P < 0.05$) (Table 1).

Muscle function which includes MVC (males 28.9 ± 5.4, females 25.9 ± 4.8), work done using Mosso's ergograph

Table 1: Comparison of different parameters between males and females

Parameter	Mean±SD	*P* value
Chest circumference (cm)		
Male	88.8±2.99	0.0001
Female	84.08±3.73	
Chest expansion (cm)		
Male	3.9±0.69	0.001
Female	3.4±0.62	
Mid-arm circumference left (cm)		
Male	30.2±1.83	0.000
Female	28.4±2.1	
Mid-arm circumference right (cm)		
Male	29.72±2.24	0.000
Female	27.97±2.12	
Maximal voluntary contraction (kg) (hand-grip dynamometer)		
Male	28.9±5.4	0.006
Female	25.9±4.8	
Work done (g/m) (bicycle ergometer)		
Male	3584±1345	0.01
Female	2948±1156	
Work done (g/m) (Mosso's ergograph)		
Male	2792±1445	0.009
Female	2402±896	
Respiratory endurance (s)		
Male	31.2±10.6	0.023
Female	28.6±10.2	

(males 2792 ± 1445, female 2402 ± 896) and bicycle ergometer (male 3584 ± 1345, female 2948 ± 1156) were significantly higher in males when compared to females ($P < 0.05$). There was no significant difference in respiratory endurance test between male and female (males 31.2 ± 10.6, females 28.6 ± 10.2) (Table 1).

DISCUSSION

Our study results showed that muscle function is higher in males compared to females and it is statistically significant. Because of many factors, women are forced to be quiet and ladylike while men are motivated to involve in physical activity. In the study population, the anthropometric parameters were higher in males than in females which are statistically significant. Differences in muscle mass, muscle metabolism, and gender-specific muscle fiber characteristics have been the most suitable explanations for the changes in performance between male and females. Muscle fibers development among individuals could differ which depends on genetics and their regular activities. Due to higher levels of circulating testosterone in males, muscle mass is reported to be higher because of increased muscular hypertrophy.[9] Three types of muscle fibers which are responsible for muscle contraction are Type I fibers (slow twitch), Type IIa fibers (fast twitch), and Type IIb fibers. Endurance of the muscle is determined by slow-twitch fibers and while power is determined by fast-twitch fibers. The number of fast-twitch fiber is more in men compared to women. Testosterone helps build lean body mass or muscle in males. The level of testosterone and body mass or muscle is more in male when compared female. Earlier studies have shown that there are differences in muscle strength and endurance between men and women in similar population.[1] MVC was higher in male participants than female participants.[10-12] This can be because of increased muscle power, endurance, and increased capacity to perform greater in physically active men when compared to women.[13] This may also be due to hypertrophy of the different muscle fibers. Our results showed that work done assessed using bicycle ergometer and Mosso ergograph was significantly higher in males than females. This shows the higher performance of the male participants. A 40 mm endurance test is one of the simple respiratory efficiency tests. The gender variation observed in our study was that 40 mm endurance was slightly higher in male participants than female participants (but not statistically significant) which could be because of increase oxygen debt in males. The gender difference is likely due to increase in levels of androgenic hormones, more muscle mass, and more height and weight in male.[14-16] Estrogen tends to produce deposition of fat in females. When age advances, boys have more levels of fat-free mass when compared to girls.[17]

Benefits of Using Muscle Functions Parameters

Muscle function parameters can be used as functional indicators for nutritional status whether weight loss on obese or weight gain in case of underweight with appropriate nutritional interventions. The changes observed in functional indicators after nutritional corrections appear much earlier than changes in anthropometric or biochemical indicators. Hand-grip strength has been used as a strong predictor of mortality in Mexican Americans.

Limitations of the Study

Sample size is less. We have used only limited number of muscle function parameter in our study due to logistic reasons.

CONCLUSION

We conclude that higher muscle strength was seen among males in both extremities compared to females. This could be mainly due to genetic factors and hormonal differences in both sexes. Higher muscle function could be achieved by training of the muscles. Hence, encouragement should

be done to increase the physical activity in females in the modern world to lead a quality life.

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How to cite this article: Mohan S, Geetha MB, Padmavathi R. Study of gender variation in muscle function among young adults. Natl J Physiol Pharm Pharmacol 2017;7(8):793-796.

Source of Support: Nil, **Conflict of Interest:** None declared.