ORIGINAL ARTICLE

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Ergograph Versus Power Lab: Gender Difference of Hand Muscle Fatigue Time

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ABSTRACT

Objective: Muscle Fatigue is associated with gender and there are different tools to measure it. We aimed to compare 'Hand Muscle Fatigue Time' (HMFT) in young healthy males and females through Ergograph as well as Power-Lab.

Methodology: Simple comparative study from Nov, 2014-Feb, 2017 was performed with 60 Male and 60 Female healthy students of Shalamar Medical and Dental College, Lahore, aged 20-23 years. Written consent was taken. Convenient sampling was employed. Study was approved from Institutional Review Board. HMFT was recorded through Ergograph along with student Kymograph and Power-Lab with LabTutor Software (AD Instruments 2005-2007). Adult Weighing Scale (ZT-160) used to measure height and weight. Mean, Standard Error of Mean and One-way ANOVA was applied through SPSS version 18.

Results: HMFT on Ergograph showed same value for both genders. On Power Lab males exhibited 107% longer time. Males revealed 30% longer fatigue time on Power Lab while females presented 60% longer fatigue time on Ergograph. Gender comparison of HMFT between males and females of same Body Mass Index (n=29) revealed that males owned 22% more on Ergograph and 164% longer on Power Lab in contrast to females. Machine comparison of HMFT explored 19% increased value on Power-Lab than Ergograph and females showed 83% raised value on Ergograph than Power-Lab.

Conclusion: Excluding BMI as confounder young healthy males showed longer HMFT compared to females on Power-Lab as well as Ergograph and the noted significant difference was much pronounced with Power-Lab in contrast to Ergograph (p=0.00001).

Keywords: Ergograph, Power-Lab, Gender Difference, HMFT.

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INTRODUCTION

Muscle Fatigue and its gender association has been studied with various different tools. Hand grip is a healthy state which usually is positively associated with bone density and inversely related to physical fragility.[1] Moreover literature also suggests the positive association of body Mass Index with hand grip force in both genders.[2-4] Fatigue is generally taken as an imprecise subjective though physiological phenomenon expressed by a person that causes difficulty in the execution of voluntary activity. It is a frequent physiological phenomenon that hinders the performance of a human.[5]

Fatigue may be classified as acute and chronic types in terms of its duration type as well as mental or physical depending upon motor performance. More precisely Muscle Fatigue is referred to a decline in attainment of maximum strength to perform certain task. Muscle Fatigue is a variable phenomenon that varies according to the underlying cause.[6]

Grip strength is not hard to measure, if a standard procedural protocol is followed to attain the reliable and valid results.[7] There are many instruments in use to measure hand grip strength and fatigue time including conventional Ergograph with dynamometers or specialized data acquisition devices containing sensitive hand Grip transducers.[8] All with somewhat different set of instructions and postural positions that vary with each set of different equipment in order to get the optimal findings in terms of hand grip measure and its fatigue time. Thus the 'selection of quantifying device' and 'number of trials' both are vital

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determinants to measure HMFT7. The aim of the present study is to compare and contrast the HMFT in healthy males and females recorded through two different measuring devices i.e. Ergograph and Power Lab.

METHODOLOGY

Participants: Total 120 subjects involved in the study, all were the students of Second year MBBS (Shalamar Medical and Dental college), with equal division of male and female. All the participants were 20 to 23 years of age.

Sampling Technique: Written consent was taken from each of them and convenient sampling technique was used to approach the subjects. The study was also approved from the Institutional Review Board of Shalamar Medical and Dental College.

Inclusion Criteria

- Medical students Shalamar Medical and Dental College, 2nd year (batch 2014-15)
- All healthy males and females
- With no present history of medical ailment.
- Willing to participate in the study
- With Right hand dominance

Exclusion Criteria

- Subject with any medical concern
- Subject on medication
- Subject involved in any endurance fitness/training program
- Subject with Left hand dominance
- Subject who is not willing to participate

Apparatus: In this study, the 'HMFT' was recorded and compared on two different measuring tools: one is of conventional type named Ergograph along with student Kymograph (Fig. 1*) and the other one is a latest computer assisted data acquisition system called Power Lab2005-2007(Model 26T) with LabTutor Software (Fig. 2*). Adult Weighing Scale ZT-160 was used to measure height and weight of all the subjects.

All Volunteers were first well-demonstrated regarding the application of both different measuring devices in order to get maximum reliable values for hand grip force and its fatigue time.

On Ergograph each participant was first instructed and guided about the test procedure. Volunteer griped the dynamometer part of Ergograph with his/her maximum right hand ability to squeeze, unless and until he/she fatigued enough to withdraw that grip. The values were recorded in the form of waves on the kymograph paper attached on the drum of student kymograph moving with speed 2.5mm/second, on which the stylus (ink pen) lever was moving as the subject griped (contracted) the connected dynamometer. Measurements of fatigue time were obtained by considering 1 small square on kymograph paper = 2.5 seconds (Fig.1).

HMFT was measured through Power Lab Grip force Transducer plugged into Input 1 of Hardware device, while Grip strength was depicted in percentages (%) along y-axis and Time in Seconds on x-axis in a digital graph on the screen connected to hardware. Instructions were taken from Lab Tutor Muscle Exercise program namely: Grip force Calibration, installed in data acquisition system. Maximum Grip Force Score and Fatigue Time (the point after which the value of hand grip force begin to decay) of a volunteer was directly attained from the digital graph (Fig.2).

Statistical Analysis: For statistical analysis SPSS version 20 was used. All the values were expressed as mean and Standard Error of Mean (SEM). One-way ANOVA (Analysis Of Variance) was used to test the level of significance. 95% confidence interval was taken, so p-value <0.05 was

Fig. 2: PowerLab Hardware with Handgrip dynamometer and its Digital graph for Fatigue time*.

*Taken from Physiology Laboratory, Shalamar Medical and Dental College, Lahore.

Table.1: Comparison of Fatigue time of all the participants measured on Ergograph and Power Lab

Categories		Measuring Tools	Mean ± SEM	p-value	
HMFT (sec.)	Males	Ergograph	182 ± 4.8	0.18	0.007*
		Power Lab	236 ± 40.4		
	Females	Ergograph	182 ± 1.5	0.0001*	
		Power Lab	114 ± 16.8		

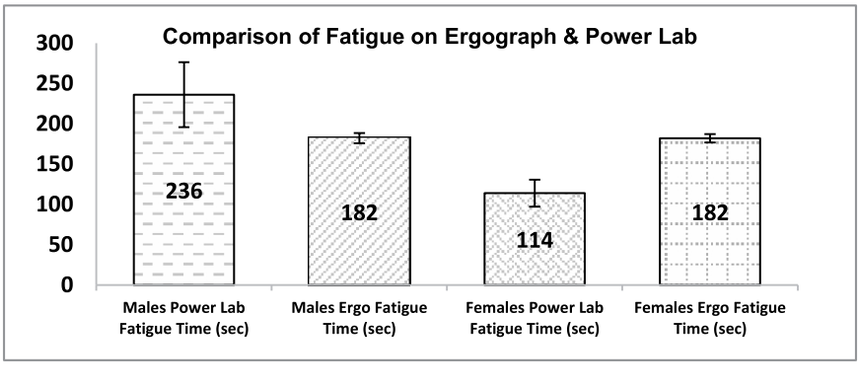

Fig. 3: Bar graph showing comparison of HMFT of males and females measured on Power lab and Ergograph (p=0.007).

Table 2: Gander based Comparison among males and females of same BMI measured on Ergograph and Power Lab

Categories		Measuring Tools	Mean ± SEM	p-value	
HMFT (sec.)	Males	Ergograph	191 ± 6.10	0.236	0.00001*
		Power Lab	227 ± 28.78		
	Females	Ergograph	157 ± 13.02	0.0004*	
		Power Lab	86 ± 12.37		

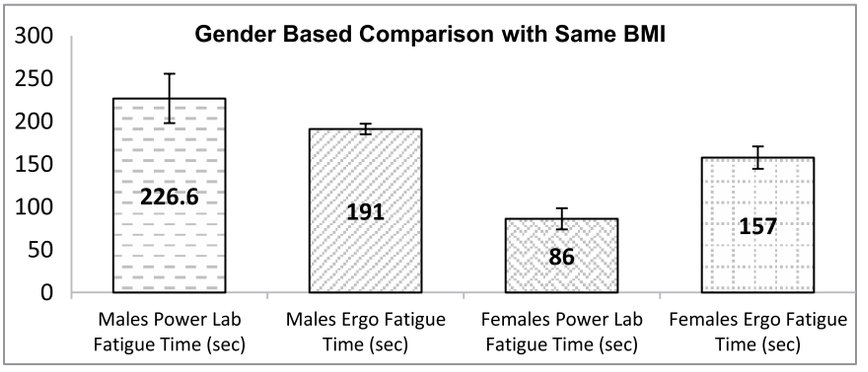

Fig. 4: Gender Based Comparison of HMFT, with same BMI of males and females on Power lab and Ergograph (p=0.00001).

considered as significant.

RESULTS

The recorded fatigue time of hand muscles measured on Ergograph showed same mean value (i.e. 182 seconds) for male category as well as for female category, exhibiting no difference between the two genders. While the same measurement of fatigue time of hand muscles on Power Lab demonstrated 107% longer fatigue time in males compared to females' category (Tab. 1 and Fig. 3).

Comparatively it was noticed that the average fatigue time in males displayed 30% longer fatigue time when measured through Power Lab compared to Ergograph. However the average measured fatigue time of females showed 60% longer fatigue time on Ergograph compared to PowerLab

(Table.1 and Figure. 3).

To compare the gender differences in relation to 'HMFT', only those males and females compared who had same/equal Body Mass Index (BMI) in order to eliminate the confounders in terms of weight and height discrepancies in both the genders18, 19. It was noted that on Ergograph males exhibited 22% more fatigue time than their counterpart females. While when same measurement was taken through Power Lab, males exhibited 164% enhanced fatigue time compared to the females who even possessed the same BMI as that of males (Tab. 2 and Fig. 4).

Machine comparison between Ergograph and Power Lab of males and females with same/equal BMI explored that males exhibited 19% longer fatigue time of hand muscles on Power Lab in contrast to Ergograph. On the other hand females showed 83% more fatigue time on Ergograph in contrast to Power Lab (Tab. 2 and Fig. 4).

DISCUSSION

Gender differences prevailed in skeletal muscle fatigue, healthy women owned more resistance to muscle fatigue compared to healthy men.[9, 10] Might be it is because of the difference in histological and functional features in the motor control mechanisms of both genders.[11]

Muscle fatigue can easily be defined as a weakening of voluntary muscular power upto its maximum level. The onset of muscle fatigue is experienced with sustained muscular task.[12] It is a frequent phenomenon experienced by everyone in our routine lives.[13] Researchers used several indicators including breakdown products of ATP, biomarkers of oxidative stress and immune-inflammatory reactants to study muscle fatigue.[14]

It is considered that there exists more than one physiological factor that contributes to fatigue length during skeletal muscle compressions in both genders.15 These factors may be the neuromuscular excitation, muscle mass muscle morphology, and neuromuscular activation. Undoubtedly the exact related physiological facts in relation to fatigue time in both genders are still not entirely explained.16 Though most considered factors include high concentration of acidic metabolic end products.[15]

Gender differences in terms of muscle fatigability vary with varying tasks and it has also been considered an age-related phenomenon.[17] Moreover it is also observed that males and females both owned an altered pattern of muscle fatigability.[18,19] Many studies conclude that females are more fatigue resistant than their counterpart males to withstand modest intensities of muscular contractions.[20-23] More specifically it is elaborated that females have more endurance time than males especially in isometric muscular activity. In lower limb fatigability, a study found similar fatigue time in both genders measured through EMG signals.[15] Brian et al claimed that males showed longer fatigue time than females with respect to muscle contraction of lumbar region.[15] With same BMI of both genders, we also found longer fatigue time of Hand Muscles on both tools (i.e. Ergograph and PowerLab) compared to counterpart females. Similar to our results another recent study by Urooj et al noticed longer hand muscle contraction time in males compared to females in young medical students of same age group.[24] Another study by Tarata et al in the same regard announced very close muscle fatigue time in both males and females.[25]

CONCLUSION

Excluding BMI as confounder the studied young healthy males showed a longer HMFT compared to their counterpart females on Power Lab as well as Ergograph. Moreover this longer HMFT was much pronounced with Power Lab than Ergograph.

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