Section: Physiology

Original Research Article

A COMPARATIVE STUDY OF HANDGRIP STRENGTH AMONG MALE AND FEMALE MEDICAL STUDENTS

Anita.M [1], Dhiviya.G.S[2], H.R.Hari Babu[3], S.Gunavathi[4]

[1]*Professor and HOD, Department of Physiology, Tirunelveli Medical College, Tirunelveli, India.*
[2]*Postgraduate, Department of Physiology, Tirunelveli Medical College, Tirunelveli, India.*
[3]*Associate Professor, Department of Physiology, Tirunelveli Medical College, Tirunelveli, India.*
[4]*Postgraduate, Department of Physiology, Tirunelveli Medical College, Tirunelveli, India.*

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Corresponding Author:
Dr. Dhiviya G.S.,
Postgraduate, Department of Physiology, Tirunelveli Medical College, Tirunelveli, India.
Email: dhiviyageeth@gmail.com

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ABSTRACT

Background: Handgrip strength is the muscle strength and force that a person can generate with their hands and can be quantified by measuring the amount of static force that a person's hand can squeeze around a dynamometer. Handgrip muscle strength, a crucial measure of maximal voluntary contraction, serves as an objective index for assessing the functional integrity of the upper extremity. Reduction in muscle strength may cause limitation in function. Hence, muscle strength is an important indicator of health. Various other tests have also been designed to measure upper body muscular strength. In this study, measurement is performed using hand held dynamometers, which estimate the muscle strength primarily generated by the flexor muscles of the hand and the forearm. Hence, handgrip strength might be an adequate measurement for generalized muscle strength. It has a low cost and may be used in a time-efficient manner in clinical setting. **Aim:** To compare hand grip strength among male and female medical students.

Materials and Methods: This cross-sectional study included 50 healthy medical students (25 males and 25 females) aged 18–24 years, selected through convenience sampling. Inclusion criteria required participants to be healthy without any major illness, upper limb trauma, or skeletal muscular disorder. After obtaining informed consent, demographic details obtained using questionnaire and face to face interview, Anthropometric measurements taken and BMI was calculated, then participants were seated with their elbows straight and close to the body. The maximum grip strength of the dominant hand was measured twice, with the higher value recorded for analysis. Statistical analysis was conducted using paired t-tests with SPSS trial software to compare handgrip strength between males and females.

Results: Hand grip strength among male and female medical students were analyzed, Analysis done using SPSS 28 trial version. Male students exhibited statistically significant ($p < 0.001$) handgrip strength compared to females. Physical characteristics such as age, height, and weight showed no significant gender differences.

Conclusion: In this age group, male medical students demonstrated higher hand grip muscle strength than their female counterparts.

Keywords: Handgrip strength, Muscle strength, Gender difference, Dynamometer.

INTRODUCTION

Handgrip strength is an important measure of overall muscular strength and endurance. It reflects the maximum force generated by the muscles of the hand and forearm and is a crucial indicator of physical fitness and functional ability. Handgrip strength assessment has gained significant attention in clinical, athletic, and occupational health settings due to its strong correlation with overall muscular strength, nutritional status, and even mortality rates in various populations.[1] Measuring the strength of

individual muscle groups can be a lengthy process, handgrip dynamometer is beneficial to have a single, quick, and simple tool to assess overall muscle strength. Handgrip strength may serve as a reliable indicator of general muscle strength due to its strong correlation with other muscle groups. It is a cost-effective and time-efficient method that can be easily used in clinical settings. It serves as a reliable indicator of upper limb muscle function and overall muscular strength.[2] Handgrip strength is widely used in clinical and sports settings to assess muscular endurance, functional ability, and physical performance. It is associated with overall health status, mobility, and longevity.[3] Understanding gender-based differences in grip strength can help tailor fitness recommendations, rehabilitation strategies, and preventive health measures for different populations.[4]

Handgrip strength is influenced by several factors, including age, gender, body size, and lifestyle.[5] Studies have consistently shown that males generally exhibit higher handgrip strength than females, which is largely attributed to differences in muscle mass and hormonal variations.[6,7] Testosterone, a hormone prevalent in males, significantly contributes to muscle hypertrophy, leading to greater muscle strength. Conversely, females generally have a higher proportion of body fat and relatively lower muscle mass, contributing to reduced grip strength.[8,9] Muscle weakness is a common consequence of malnutrition associated with disease. When nutritional intake is insufficient, the body compensates by breaking down protein, primarily from muscle mass, which serves as the body's largest protein reservoir. Additionally, disease-related malnutrition can lead to a decline in muscle protein synthesis. This study offers normative data for a specific age group, aiding in the evaluation of malnutrition.

Assessing handgrip strength is particularly relevant for medical students, who often face demanding academic schedules and may engage in limited physical activity. Understanding the normative values for this population can provide insights for promoting physical well-being and identifying individuals at risk of reduced muscle strength.

This study aims to compare handgrip strength between male and female medical students, establish baseline data for the targeted age group, and contribute to the broader understanding of gender-based physiological differences in muscle function.

MATERIALS AND METHODS

This study was conducted as a cross-sectional study. The study population comprised 50 healthy medical students (25 males and 25 females). All participants were within the age group of 18 to 24 years.

A convenience sampling method was adopted to recruit participants. This non-probability sampling technique allowed for easy access to willing participants who met the eligibility criteria within the specified population.

Inclusion Criteria: To ensure participant suitability, inclusion criteria were defined to include only healthy medical students within the specified age group of 18 to 24 years. Participants without underlying health issues were selected to minimize confounding variables that might affect handgrip strength.

Exclusion Criteria: Students with a history of any major illness (present or past), prior trauma to the upper limbs, or those diagnosed with skeletal or muscular disorders were excluded from the study. This helped ensure that all participants had optimal musculoskeletal function for an accurate assessment of handgrip strength.

The study was conducted in the Research Laboratory, Department of Physiology, Tirunelveli Medical College, Tirunelveli, after getting institutional ethical committee approval and participants were tested between 10 AM and 1 PM. Before data collection, all participants were briefed on the study's purpose and procedures. Written informed consent was obtained from each subject to ensure ethical standards were met. Participants were seated comfortably in a chair with their elbow fully extended and kept close to the body to ensure consistency in posture during the measurement process. A standardized dynamometer was used with standards of American Society of Hand Therapists (ASHT) followed, to ensure accuracy and reliability in measurements to measure the maximum grip strength of the dominant hand. Each participant performed two trials with a one-minute rest period between attempts to minimize fatigue. The higher value obtained from the two trials was recorded as the participant's maximum handgrip strength. This method ensured that only the participant's best performance was included in the analysis.

Data analysis was performed using trial version of SPSS software. Paired t-tests were applied to compare the handgrip strength between male and female students. Statistical significance was set at $p < 0.05$ to ensure robust conclusions from the study data.

RESULTS

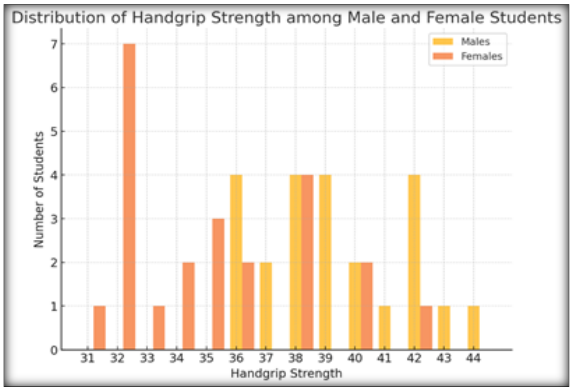

Figure 1

The result of 25 male and 25 female students were available for analysis. The mean age of the population was 19.7 (SD 1.18). The various baseline parameters of the study participants are described in table 1. There was no significant difference between males and females in terms of their age, height, weight and BMI.

The hand grip strength on dominant group was measured. The distribution of hand grip strength in males and females are shown in figure 1. The mean hand grip strength observed on the dominant hand was 36.7 (SD 3.35). In males, the mean hand grip strength was 38.88 (SD 2.6) and in females it was 34.7 (SD 3.38). The difference between the hand grips strength was statistically significant with p value of <0.001 as described in table 1.

Table 1

	Males	Females	Total	Difference	p-value
Mean Age (SD)	20.1 (1.344)	19.3 (0.86)	19.7 (1.18)	0.8	0.27
Height in cm (SD)	160.2 (7.94)	156.9 (6.94)	158.8 (5.12)	3.28	0.12
Weight in kg (SD)	57.1 (5.5)	55.4(4.66)	56.2 (5.12)	1.7	0.25
BMI in Kg/m^2 (SD)	22.2 (1.26)	22.6 (1.47)	22.41 (1.37)	0.4	0.31
Hand Grip Strength on dominant hand (SD)	38.88 (2.6)	34.7 (3.38)	36.7 (3.35)	4.2	<0.001

Table 2

Study Reference	Sample Population	Mean Male Handgrip Strength (kg)	Mean Female Handgrip Strength (kg)
Present Study	Medical Students (18-24 yrs)	38.8	34.7
Leyk et al. (2007) (11)	Young Adults (18-25 yrs)	46.0	28.3
Hiroshi & Demura (2011) (12)	Young Adults (18-24 yrs)	46.6	32.9
Buge K(2019) (13)	Young adult (18-24yrs)	44.21	38.30

DISCUSSION

The findings of this study are consistent with previous research that highlights the higher handgrip strength in males compared to females. This difference is attributed to greater muscle mass in males, which results from hormonal differences such as higher testosterone levels.[10]

The study findings compared to various other study results are summarized in table 2.[11-13]

The results from this study align with the reported trend that males consistently exhibit higher handgrip strength. However, the values reported in this study are slightly lower than some earlier studies. This may be attributed to differences in lifestyle, levels of physical activity, or dietary factors within the studied population. Despite similar age, height, and BMI among participants, males exhibited superior grip strength, suggesting intrinsic gender-related muscular differences rather than anthropometric variations.[14] Higher muscle mass and fiber type composition in males contribute to enhanced handgrip strength.[15] Handgrip strength is a crucial indicator of overall muscle function and health. Regular strength training could help bridge the gap in grip strength between genders. Handgrip strength is a widely recognized surrogate marker for total body muscle strength, making it a valuable tool in clinical assessments of muscular health and physical function. Lower grip strength in females may indicate reduced overall muscle function, which could be an early sign of conditions such as sarcopenia, osteoporosis, or frailty in later life. Regular strength monitoring can aid in early intervention. Low hand grip strength has been correlated with high arterial stiffness.[16] Low hand grip strength has also been associated with depression in certain studies.[17] Handgrip strength testing can be used in rehabilitation programs to track recovery progress in individuals with musculoskeletal injuries, neurological conditions, or post-surgical recovery. Personalized therapy plans can be developed based on grip strength assessments. Since muscle strength naturally declines with age, maintaining grip strength through strength training and proper nutrition can enhance longevity and improve the quality of life, particularly in older adults. Given the observed differences in grip strength, gender-specific recommendations for strength training and nutritional intake may be necessary to ensure optimal musculoskeletal health across both sexes.

Furthermore, the present study's focus on medical students, a population that may experience limited physical activity due to academic commitments, may have contributed to the observed strength differences. Such findings reinforce the need for promoting physical activity and muscle-strengthening exercises among young adults to improve overall musculoskeletal health.

CONCLUSION

In this age group, male medical students demonstrated statistically significant higher hand grip muscle strength than their female counterparts. The observed gender difference highlights the impact of muscle mass differences between the two groups. These findings establish baseline data for handgrip strength in young adults aged 18-24 years, which may prove useful in clinical assessments, sports science, and rehabilitation practices. The

results also encourage future research to explore additional factors like physical activity levels, diet, and lifestyle habits that could influence handgrip strength in this population.

LIMITATIONS: The study included only 50 participants (25 males and 25 females), which limits the generalizability of the findings to a larger population. A larger sample would provide more reliable results. Participants were selected through convenience sampling rather than random sampling, which may introduce selection bias and limit the study's applicability to a broader demographic. The study focused on medical students aged 18–24 years, making it difficult to extrapolate findings to other age groups, such as children, middle-aged adults, or the elderly.

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Competing Interest

There is no competing interest

Authors Contribution

All authors in our study contributed to the data collection of the patients

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