ATTAHADI MED J. 2025;2(4):360-366
https://doi.org/10.69667/amj.25404

Original article

Comparison of Height and Dominant Hand Grip Strength Among Female Physiotherapy Staff: A Cross-Sectional Study

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Keywords:
Hand Grip Strength, Height, Dominant, Correlation, Dynamometer, Physiotherapist, Cross-sectional.

ABSTRACT

This cross-sectional study investigated the relationship between dominant hand grip strength and height among female physiotherapists. Hand grip strength is a fundamental function for daily activities and a common measure of upper limb function and general muscular health. The study included a small sample size (n) of 18 female physiotherapists. Two observers recorded participant height (in centimetres) and dominant hand grip strength (in kilograms) using a JAMAR hand dynamometer across three consecutive tests. Statistical analyses included descriptive statistics, correlation coefficients, and linear regression. A strong, significant positive correlation was found between the participants' height and their dominant hand grip strength, with correlation coefficients (r) ranging from 0.730 to 0.838 (p <0.005). This indicates that taller participants generally had stronger grip strength. However, linear regression analysis showed that height only accounted for a small amount of the variance in grip strength, with an R2 of 0.134. This suggests that while there is a positive relationship, height is a weak predictor of grip strength. The study also found that grip strength measurements varied moderately between the three tests, indicating variability in measurement. The results suggest that height may influence grip strength, but it is not the primary factor. Future research should employ larger samples and include additional variables to fully understand the factors determining grip strength in this population.

Introduction

The hand is the most complex instrument of the human body. Although there are 27 bones, they only represent about 1 percent of the total body weight. It's controlled by about 25 percent of the motor cortex and is moved by 35 muscles. Three nerves supply it: the radial, median, and ulnar. However, the arm has 123 ligaments [1]. These structures serve our primary hand function, which is grasping, along with the functions of sociopsychology and fingerprinting. It serves an essential function in our activities of daily living (ADL). The strength of the hand grip is produced by the strong flexion of all the finger joints of the hand. The performance skill of the hand and the normal maximum voluntary strength of the subject are synchronised. There is a strong correlation between grip strength and several anthropometric parameters, including arm length, weight, and height. This has already been reported [2].

The opposition of the thumbs and fine motor controls is facilitated by a unique anatomical feature of the human hand that enhances dexterity and tool use. The strength of grip is a vital indicator of upper limb function. It is affected by many physiological and anthropometric factors, including body weight, creatinine clearance, and the muscles of the forearms and upper arm [3]. Height, age, and level of physical activity are all known to predict grip strength. Height is a strong predictor of upper body strength, especially in older women whose reduced grip strength is due to postmenopausal oestrogen depletion [4]. Studies looking at the grip strength of the dominant and non-dominant hand show that the dominant hand is always the stronger [5], especially in right-handed individuals [6].

Age, height, and physical activity are independent factors affecting the strength of the grip. In older women, height is the most important determinant of upper body strength, and loss of ovarian oestrogen after menopause decreases upper body strength [4]. Several studies comparing the grip strengths of dominant and non-dominant hands have been performed, and it is concluded that the grip strengths of the right hand are greater than the left in right-handed individuals, but the two sides should be considered equal in left-handed persons [5]. In physiotherapeutic students, grip strength shows a strong positive correlation with all anthropometric variables [7]. However, physiotherapists are considered to be ignored. In addition, a number of studies have found a positive correlation between height and grip strength, which suggests that height affects the performance of grip strength.

Although the study acknowledges its limitations, including its small size and its exclusive focus on right-handed subjects, it confirms the association between hand strength and body composition by recognizing the impact of hand strength and its relationship to Body Mass Index (BMI) [8]. BMI and gender are alternatively strongly affecting the HGS [9]. However, promoting healthier and more active lifestyles can have a significant impact on rehabilitation programmes for female students at Bahraini universities. Healthcare

Received: *18-08-2025* - ***Accepted***: *17-10-2025* - ***Published***: *25-10-2025*

professionals can develop targeted interventions that not only increase grip strength but also address more general muscle health problems and sarcopenia [1].
The relationship between grip strength and height has been investigated in relatively few studies, and the results show a positive correlation [10]. Research is still ongoing to determine the strength and consistency of this grouping. To improve the results of treatment and rehabilitation, Louise et al. (2025) proposes to develop normative data sets for specific populations that include these additional factors [11]. This study aims to investigate the relationship between height and dominant grip strength in full-time registered physiotherapists. While the experimental hypothesis (H_1) suggests a significant positive correlation between height and grip force, the null hypothesis (H_0) supposes that there is no relationship at all. To assess these hypotheses, a single-tailed statistical test was used.

Methods

Participants

A cross-sectional study was undertaken from 1st February to 31st March 2019. The study sample consisted of 18 healthy female physiotherapists working in the rehabilitation and physiotherapy department of Ali Omar Askar Hospital in Tripoli, Libya. Their ages ranged from 22 to 42 (according to their last birthdays). To ensure the consistency and reliability of the measurement, participants were selected based on inclusion and exclusion criteria.
Participants must be female students with no history of wrist or hand exercises or musculoskeletal injuries. Individuals who have previously suffered injury to their dominant hand (elbow, wrist, or fingers) or who are undergoing a strenuous exercise programme that focuses on the upper limbs are not eligible. The dominant hand was determined to be the one used for writing.

Study Design and Equipment

The design and equipment of the study were correlated and used the same subjects. The aim was to investigate the relationship between height (independent variable) and dominant grip strength (dependent variable).

Grip Strength Measurement

JAMAR dynamometer is a clinically validated and reliable dynamometer for hand gripping that is adjustable [12]. Benefits: Commonly used to assess grip strength, easy to use. Cons: Proper positioning and technique of the right hand are required for accurate reading. The study protocols and the operation of the dynamometer were carefully explained to the participants before the test [13].

Testing for Grip Strength

The participants turned in a neutral direction and stood straight with their shoulders back. The elbows were bent at 90 degrees, and the wrists and hands were neutral. While maintaining a comfortable grip on the dynamometer, each participant gave it everything he had. Before each test, the needle on the upper hand used for measurements in kilograms was adjusted. Two qualified observers took three measurements of the strength of the grip of each participant, for a total of six measurements per subject.

Height measurement

The participants stood with their heels together, legs straight, shoulders back, and removed their shoes. The heels, the back, and the scapula were all aligned with the vertical surface. To standardize the position of the head, the lower orbital margins have been aligned with the external auditory meatus. In accordance with the recommendations of Pharmacia and Upjohn (1996), the height was measured to the nearest full Millimetre. Each observer took three measurements of the height of each participant, for a total of six measurements per person. Observers were blinded to one another to minimize bias.

Statistical analysis

The analysis was performed using Minitab 15 English Statistics for Windows (Version 15.1.0©). The following statistical methods have been used to analyse the data: descriptive statistics to summarize central trends and variability in height and grip force. Pair t-tests: For comparison of measurements taken by different observers and to assess consistency. Correlation analysis shall be used to assess the strength and direction of the relationship between grip strength and height. Regression analysis is used to determine how the strength of the grip is predicted by height. All statistical tests were single-tailed, and the significance level was set at $p<0.05$. The study was conducted in line with the principles of the Helsinki Declaration, which was updated in Washington in 2013 [14], [15].

***Received**: 18-08-2025 - **Accepted**: 17-10-2025 - **Published**: 25-10-2025*

Results

During all three tests, the height measurements of the two observers were very consistent. Average heights measured by Observer 1 ranged from 166:59 to 166:70 cm with standard deviations ranging from 5:94 to 6:05 cm. Similar values were reported by Observer 2 with a mean of 166.49 cm to 166.63 cm. These results indicate that the altitude measurement is highly reliable between observers and with low measurement error (Table 1). On the other hand, the measurement of the strength of the grip showed greater variability. While Observer 2 reported values ranging from 31.94 kg to 34.28 kg, Observer 1 reported average values ranging from 32.33 kg to 34.44 kg for the average strength of the grip. The higher standard error (1.28) in the third test of Observer 2 indicated that the measurement was less consistent (Table 2).

The height measurements of both observers were very consistent over the course of the three tests. Observer 1 recorded mean heights between 166:59 and 166:70 cm, with standard deviations ranging from 5:94 to 6:05 cm. Observer 2 reported similar values, with means ranging from 166.49 cm to 166.63 cm. These findings suggest that there is minimal measurement error and high inter-observer reliability in height assessment (Table 1). However, there was greater variance in the grip strength measurements. Observer 1 recorded mean grip strengths between 32.33 kg and 34.44 kg, whereas Observer 2 reported values between 31.94 kg and 34.28 kg.

Table 1. Descriptive Statistics of Height Measurements (cm)

Observer	Test 1 Mean ± SD	Test 2 Mean ± SD	Test 3 Mean ± SD
Observer 1	166.59 ± 5.94	166.65 ± 6.01	166.70 ± 6.05
Observer 2	166.49 ± 5.98	166.55 ± 6.00	166.63 ± 6.03

Table 2. Descriptive Statistics of Grip Strength Measurements (kg)

Observer	Test 1 Mean ± SD	Test 2 Mean ± SD	Test 3 Mean ± SD
Observer 1	32.33 ± 4.83	34.22 ± 4.63	34.44 ± 5.35
Observer 2	31.94 ± 4.61	33.89 ± 4.47	34.28 ± 5.41

Figure 1 shows dot plots of height measurements, showing that the majority of subjects measured between 160 and 162 cm, with a total of 155 to 178 cm. The gripping strength varies slightly. The plots in Figure 2 showed a general agreement between the mean values of the two observers, which were between 33 and 36 kg.

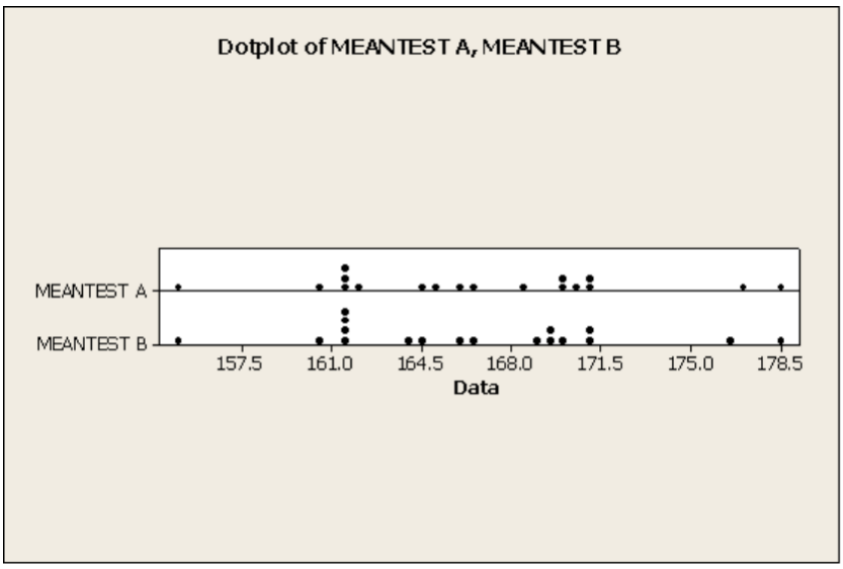

Fig. 1. The dot plot of the mean height observed by the two testers

Received*: 18-08-2025 -* ***Accepted****: 17-10-2025 -* ***Published****: 25-10-2025*

ATTAHADI MED J. 2025;2(4):360-366
https://doi.org/10.69667/amj.25404

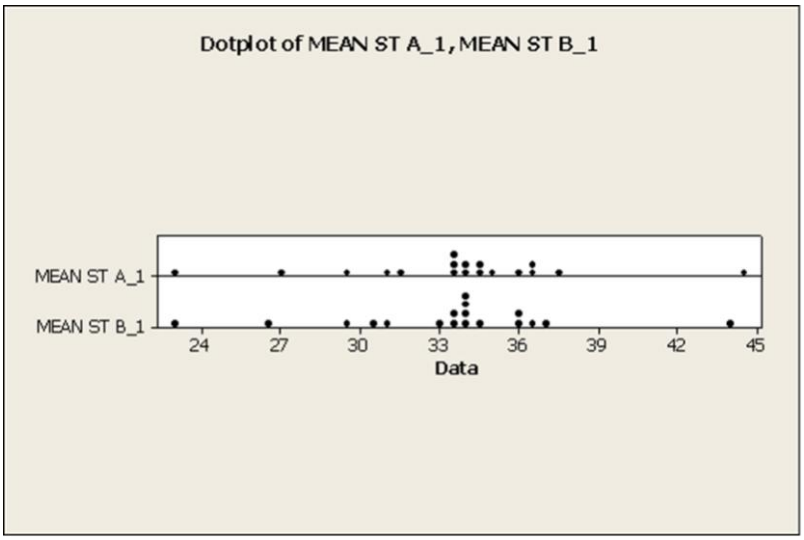

Fig. 2. The dot plot of the mean grip strength observed by the two testers

Correlation Analysis

Height: In clinical and research environments, accurate and consistent measurement of height is essential, particularly in the presence of multiple observers or repeated observations. The height measurements performed by the two assays in this analysis showed an exceptionally strong correlation, and the Pearson correlation coefficient was almost perfectly correlated with r = 0.999 (df = 16, p < 0.0005, one-tailed). Correlation between first and third observations (r = 0.998) and between second and third observations (r = 0.998) further support the consistency of the measurements at different times.

Understanding the consistency and reliability of the measurement of grip strength across multiple observations is essential for clinical evaluation and the validity of the research [16]. There was a strong and statistically significant correlation between the first-time and second- and third-time values for grip force, as shown by Pearson r values of 0.730 and 0.838 (df = 16, p < 0.005), respectively. A correlation between the first and third read (r = 0.698, p<0.005) is further evidence that repeat measurements are valid.

Table 3. Correlation Coefficients Between Tests

Variable	Test Comparison	r-value	df	p-value	Interpretation
Height	Test 1 vs 2	0.999	16	<0.0005	Very strong correlation
Height	Test 2 vs 3	0.998	16	<0.0005	Very strong correlation
Grip Strength	Test 1 vs 2	0.730	16	<0.005	Moderate correlation
Grip Strength	Test 2 vs 3	0.838	16	<0.005	Strong correlation

Paired t-Tests

Height: T = 1.58 (df = 17, p < 0.05) was obtained by a paired t-test comparing the mean height of the two observers, and the accuracy of the height data was confirmed.

Grip Strength: Paired t-test revealed a t = 4.97 (df = 17, p < 0.0005), indicating statistically significant differences between the two groups, but within correlatively acceptable limits.

Table 4. Paired t-Test Results

Variable	t-value	df	p-value	Conclusion
Height	1.58	17	<0.05	Significant difference
Grip Strength	4.97	17	<0.0005	Highly significant difference

Regression Analysis

(Table 5) shows that a weak correlation between height and grip strength was found in a regression analysis (p = 0.135). On the other hand, Yang et al. (2025) suggest that height alone may not be a reliable indicator for the strength of the grip in this sample [17]. This conclusion is further supported by the adjusted R2 of 8 points of 0 percent. Although three outliers (subjects 5, 7, and 11) deviated from the standard deviation, the scatter plot showed a general positive correlation trend (Figure 3).

Received*: 18-08-2025 -* ***Accepted****: 17-10-2025 -* ***Published****: 25-10-2025*

Table 5. Regression Analysis Summary

Predictor	R^2	Adjusted R^2	p-value	Interpretation
Height	0.134	0.080	0.135	Weak correlation

Outlier Data

Subject 5: Height = 166 cm, Grip Strength = 23.00 kg
Subject 7: Height = 177 cm, Grip Strength = 44.33 kg
Subject 11: Height = 179 cm, Grip Strength = 29.50 kg
The overall result of the regression may have been affected by these anomalies.

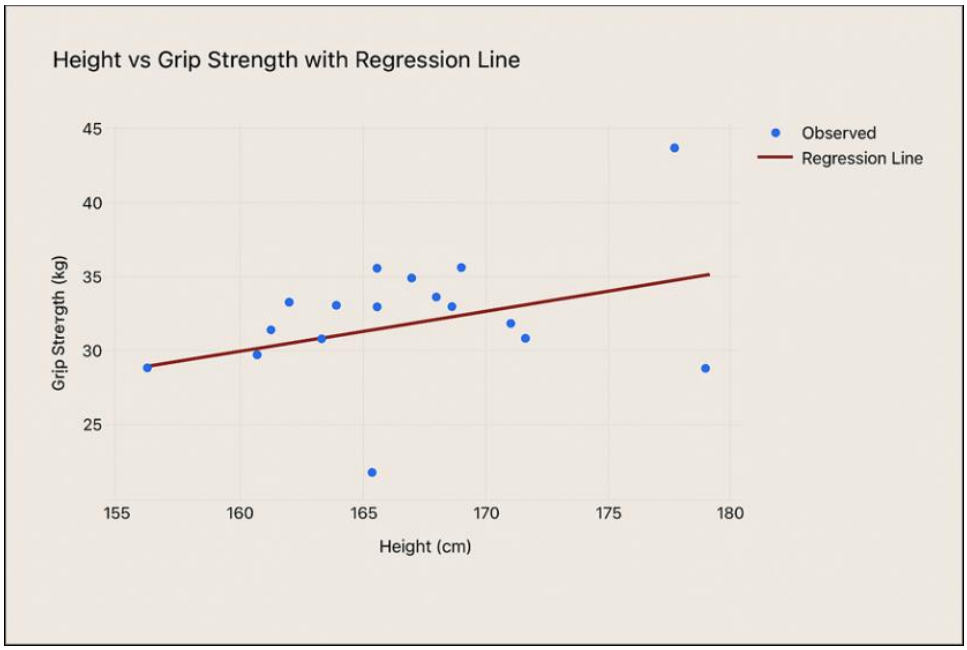

Fig. 3. The graph of linear regression for the mean height and mean grip strength observed by the two testers with 3 Outlier participants

Discussion

The results of this study show that height and dominant grip strength are statistically correlated among female physiotherapist staff. The reliability of the data collection process was confirmed by descriptive statistics and correlation analysis, showing a high degree of consistency in the measurement of height between observers and tests. HGS is an important health biomarker with strong correlations to mortality, quality of life, and a variety of diseases. Raju et al. (2024) propose HGS as a new vital sign for improving clinical practice and public health [18]. Although somewhat more varied, the measurement of the grip strength also showed a high degree of internal rigidity.

Regression analysis showed that height and grip strength have a weak predictive relationship, with an adjusted R^2 of only 8 percent, despite the strong correlation observed in descriptive and non-descriptive statistics. This means that height alone is not a reliable predictor, although it may be related to the strength of grasp. The regression result may have been affected by the presence of outliers, especially those from subjects 5, 7, and 11. However, Peralta et al. (2024) highlighted the interaction between age and test performance. Measuring grip strength is a direct way of evaluating physical ability in rehabilitation. They stressed that the strength of the grip is a predictor of many medical conditions [19].

The importance of procedural standardization and the understanding of participants is underlined by the possibility that these variations are due to factors such as fatigue, inconsistent techniques, or measurement errors. Considering that the fully extended elbow showed the highest grip strength and reliability than the flexed elbow [20]. Patients of all ages can benefit from the clinical use, affordability, portability, and ease of use of the device. The results, which show a positive relationship between height and force of gripping, disprove the null hypothesis (H_0) and support the experimental hypothesis (H_1). However, the strength of this prediction power appears to be limited, and further study is required.

In previous studies [21],[4], many factors, such as muscle mass, coordination, body weight, and age, were found to affect grip strength. Although there is a positive correlation between height and strength of grip, this relationship is usually less pronounced than for other factors such as weight and gender. Research must go beyond BMI and height alone. For accurate determination of the true volume of contractile tissue

Received*: 18-08-2025 -* ***Accepted****: 17-10-2025 -* ***Published****: 25-10-2025*

and for statistical control of Lean Body Mass (LBM), high-resolution body composition metrics such as LBM or fat-free mass (FFM) determined by two-dimensional X-ray absorptiometry (DEXA) shall be included [22]. Future research should use larger and more diverse samples, considering other factors such as hand size, hormone levels, and physical activity levels. In addition to occupation, hand dominance, and ethnicity, height, arm length, and arm width or wrist length are the most important predictors of HGS [11]. The presence of male and female subjects would improve the robustness of the findings and allow for gender comparisons.

Conclusion

The study found that the dominant grip strength of female physiotherapist staff and their height positively correlated, supporting the experimental hypothesis. Regression analysis showed that height alone is a poor predictor of grip strength, with only 8 percent of the variance explained. The consistency of the height measurements was high, but the measurement of grip strength was more variable, which underlined the importance of standard operating procedures. The limitations include the small sample, which is gender-specific, and possible procedural irregularities. Future studies should explore more variables such as body composition, hand size, and physical activity levels, as well as include larger and more diverse populations. These findings, which add to an expanding body of research on grip strength as a functional health indicator, highlight the complexity of its determinants.

Conflict of interest. The author declares no conflict of interest.

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Received*: 18-08-2025 -* ***Accepted****: 17-10-2025 -* ***Published****: 25-10-2025*

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Received*: 18-08-2025 -* ***Accepted****: 17-10-2025 -* ***Published****: 25-10-2025*