Absolute and Relative Handgrip Strength Across Gender

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This project makes no effort to suggest generalizability. Instead, it was designed to demonstrate competency using lab equipment, capacity to integrate knowledge with application, and understanding of the scientific method.

Introduction

According to Gibson, Heyward, and Wagner (2019), handgrip strength is a measure of isometric strength and can be assessed by exerting maximum force onto a dynamometer in one contraction (p. 162). According to Caliskan, Harmanci, and Karavelioglu (2017), handgrip strength is indicative of muscle mass and performance, nutritional status, and physical strength. Relative handgrip strength can be determined by dividing handgrip values by body mass, forearm circumference, or fat free mass. Men display higher absolute strength values, but relative measures challenge that phenomenon (Gibson et al., 2019, p. 167). According to Benavides-Rodriguez and associates (2017), low handgrip strength may be indicative of sarcopenia or sarcopenic obesity, conditions marked by low muscle mass sometimes in addition to increased body fat. This condition causes increased risk of metabolic disorders, mortality, disability, and more (Benavides-Rodriguez et al., 2017). The purpose of this study is to evaluate existing differences between absolute and relative handgrip strength in men and women. It was hypothesized that male subjects will exhibit higher absolute hand grip strength, lower %BF, higher FFM, and higher forearm circumference when compared to women. However, men and women will have similar hand grip strength when compared relatively to body composition.

Methods

Four subjects, two male and two female, volunteered to participate in an analysis of grip strength in relation to body composition. Once height and weight were taken for each subject, the subject's waist, hip and forearm circumferences were measured using a Gulick tape. The forearm was measured with the elbow at 90° and the tape 12 cm distal to the tip of elbow. Three trials for each subject were recorded and averaged together for accuracy. BMI was then recorded for each subject using the Bioelectrical Impedance Analyzer. The subject must rest in a supine position for 3 to 5 minutes before using the BIA. After the BIA was completed, the fat distribution was recorded. Grip strength was measured next using the grip dynamometer. The hand grip dynamometer was calibrated for the handle to be at the second knuckle of the client's finger. With the elbow by the subjects side at 90°, the subject's performed maximum grip attempts. Three trials were performed for each hand in an alternating order and averaged together. After the completion of all three analyses, antibacterial wipes were used to sanitize the Gulick tape, BIA, analysis table, and the grip dynamometer. The lab area was swept and the equipment utilized was placed back in the appropriate storage area.

Results

Table 1

Subject Characteristics and Data

Data Points	Male	Female
Age (years)	21, 20	20, 20
Height (cm)	175, 174	156, 166
Weight (kg)	125.2, 71.7	65.5, 65.8
FFM (kg)	81.1, 65.2	47.4, 45.2
Forearm Circumference (cm)	---	---
Dominant Hand	27, 25.5	23.2, 20
Non-dominant Hand	27.2, 24.7	20.2, 20.2
Hand Grip Strength (kg)	---	---
Dominant Hand	51.3, 51.7	47.3, 28.7
Non-dominant Hand	45.3, 46.7	41.3, 22.7

[1]All subjects are right hand dominant.
[2]Subjects are listed in order A,B for males and C,D for females.

Table 2

Relative Hand-Grip Strength Ratios

	Body Mass (kg/kg)		Forearm Circumference (kg/cm)		Fat-Free Mass (kg/kg)	
	Dominant Hand	Nondominant Hand	Dominant Hand	Nondominant Hand	Dominant Hand	Nondominant Hand
Subject A	0.41	0.36	1.9	1.67	0.63	0.56
Subject B	0.72	0.65	2.03	1.89	0.79	0.72
Subject C	0.72	0.63	2.04	2.04	1.00	0.87
Subject D	0.44	0.34	1.4	1.12	0.63	0.50

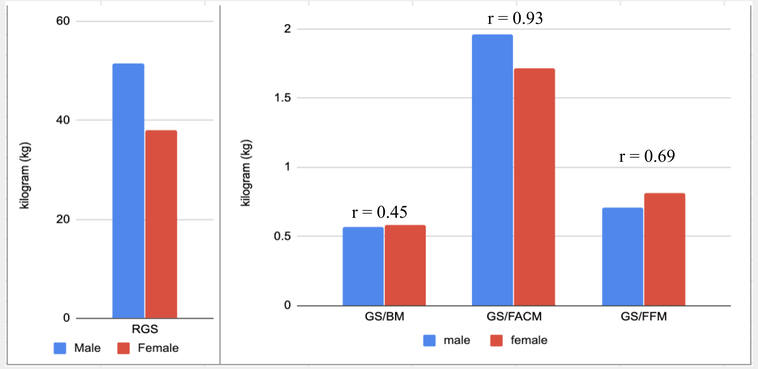

Figure 1. Absolute and Relative Grip Strength Results Across Gender. This figure indicates the absolute grip strength compared to grip strength relative to body mass, forearm circumference, and fat free mass of the dominant hand of all subjects.

Subject data, including height, weight, FFM, forearm circumference, and handgrip strength (HGS), is reported in Table 1. Handgrip strength to body mass, forearm circumference, and fat free mass ratios are reported in Table 2. Figure 1 compares the average absolute HGS and ratios of relative HGS of the dominant hand across genders. The male subjects displayed higher absolute HGS compared to females. When compared to body mass, average HGS of male and female subjects was approximately identical; body mass and HGS had a moderate correlation (r = 0.45). In comparison to fat free mass, average HGS of the female subjects was higher than that of males. HGS and FFM values reveal a moderate, positive correlation (r = 0.69). However, males displayed higher HGS relative to forearm circumference which accounts for the strong correlation of HGS and forearm circumference values (r = 0.93).

Discussion

According to Anakwe, Huntley and Mceachan (2007), the average forearm circumference for dominant and nondominant hand in males are 24.3 cm and 23.9 cm. The average forearm circumference for dominant and nondominant hand in females are 20.4 cm and 20.2 cm. The average dominant and nondominant grip strength for males is 48.6 kg and 44.8 kg. The average female grip strength for dominant and nondominant hand is 28.5 kg and 26.6 kg. When comparing our male and female subjects to the norms, both female and male subjects had above average forearm circumference and grip strength for dominant and nondominant hands. The male subjects displayed a higher forearm circumference than the female subjects, which explains the HGS/FACM ratio being higher in the male subjects while the other relative comparisons were similar to or lower than that of the females.

According to Bredella (2017), body composition differs between men and women. Men have more lean mass, while women have more fat mass. It is common for men to have more body mass as well. The male subjects displayed higher body mass and much higher fat free mass than the female subjects, while the females subjects' values were very similar. One male subject displayed a much higher body mass, body fat %, fat mass, and fat free mass than all other clients, while the other male subject had the lowest body fat % and fat mass, but the highest fat free mass. The larger male individual accounted for much of the smaller relative handgrip strength scores, because his large body mass makes his relative HGS much smaller than the other subjects. One of the female subjects had an on average body mass and fat distribution, but had low HGS, making her relative HGS smaller than the other female subject as well.

According to Al-Asadi (2018), men possess greater strength for all muscles than women due to a difference in muscle mass because of an increase of type II fibers with highly active glycolytic enzymes caused by male testosterone. Handgrip strength is correlated positively with body mass index. In our study the males clients had significantly more fat free mass than the females. Average female fat-free mass was 46.3 kilograms and the average male fat-free mass is 73.15 kilograms. This shows that the male clients had more fat free mass than females and their total body mass was higher than the females. Due to a male subject having a much higher fat distribution and body mass compared to other subjects, the relative HGS/ FFM is lower compared to females.

Conclusion

In conclusion, absolute HGS was higher in men while relative HGS was approximately equal among the genders. It was also found that when comparing our male and female subjects to the norms found by Anakwe, Huntley, and Mceachan (2007), both female and male subjects had above average forearm circumference and grip strength for dominant and nondominant hands. These results were influenced by a male subject with an increased body mass and fat distribution, which affects the relative HGS by making the male range quite large. The female subjects were significantly similar in all body mass and fat distribution values, which also affects the overall outcome of relative HGS values.

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