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Handgrip Strength in Female Olympic-Style Weightlifters: An Investigation of Its Associations with Competitive Level, Performance, and Anthropometric Characteristics

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ABSTRACT

Background: Handgrip strength is widely used to assess upper limb function and overall health, and dynamometer-based measurements provide a simple, inexpensive, noninvasive method suitable for both clinical and sports settings. Objective: This study investigated the relationships between dominant and non-dominant handgrip strength, demographic and anthropometric variables, and snatch and clean & jerk performances in elite female weightlifters with international medals and non-elite lifters ranked at the national level. Methods: The study included 14 elite and 14 non-elite female weightlifters. Handgrip strength in both hands was measured with a digital dynamometer using a standardized protocol. One-repetition maximum snatch and clean & jerk results were obtained from official federation records. Statistical analyses were performed in SPSS 25.0. Normality was assessed with the Shapiro–Wilk test. Between-group differences were analyzed using independent-samples t-tests or Mann–Whitney U tests, and dominant–non-dominant comparisons with paired-samples t-tests or Wilcoxon tests. Correlations were examined using Pearson or Spearman coefficients, with significance set at $p < 0.05$. Results: Elite athletes were significantly older ($p = 0.002$) and had longer training experience ($p = 0.003$) than non-elite athletes; no significant differences were found for body weight, height, BMI, or handgrip strength. Elite lifters had significantly higher snatch performance ($p = 0.029$), while clean & jerk results did not differ significantly ($p = 0.204$). In the elite group, dominant handgrip strength showed moderate positive correlations with snatch and clean & jerk, and weak correlations with anthropometric variables. In the non-elite group, dominant handgrip strength demonstrated moderate correlations with snatch and clean & jerk, with weaker or inconsistent correlations with age, body weight, and BMI. Conclusions: Elite lifters were older, more experienced, and performed better in the snatch than non-elite lifters, with no significant difference in clean & jerk. Handgrip strength was positively associated with performance in both groups, with correlations generally moderate. Incorporating grip-strengthening exercises into training may benefit performance, though larger studies are needed to clarify whether handgrip strength helps distinguish competitive levels.

Keywords: Olympic-style weightlifting, Elite athletes, Non-elite athletes, Female weightlifters, Dominant and non-dominant handgrip strength

Introduction

Handgrip strength (HGS) is a measure of the maximum muscle force the hands can produce and has a wide range of applications, from clinical practice to sports science (Koley et al., 2009a). HGS is an isometric force that occurs during voluntary flexion of the finger joints, thumb, and wrist, and is primarily produced by the activation of the forearm flexor muscles (Gambetta, 1988; Shea, 2007). In isometric contractions, the joint angle and muscle length remain constant, but tension and energy levels may vary (Nazmi et al., 2016).

These types of contractions play a critical role in many contexts, ranging from activities of daily living to grip and balance movements in certain sports (Shea, 2007). For example, isometric muscle contractions are common during weightlifting, a power sport that requires high levels of muscular strength (Erdağı, 2022). HGS can be measured reliably, easily, and inexpensively using portable dynamometers (Bassey, 1997), and these measurements provide valuable data on overall muscle strength, functional capacity, nutritional status, and health profile (Nicolay and Walker, 2005; Schlüssel et al., 2008). Additionally, HGS is frequently used both to determine performance in certain sports (Fry et al., 2006; Visnapuu and Jurimae, 2007) and to indicate overall muscle strength (Bassey and Harries, 1993; Kallman et al., 1990).

Handgrip strength is influenced by various individual characteristics such as age, height, body weight, and body mass index (BMI) (Faraji et al., 2014; Singla and Hussain, 2018; Balogun et al., 1991; Schlüssel et al., 2008; Hammed and Obaseki, 2018; Koley et al., 2009b). Regular physical activity has been reported to contribute to increased HGS, and athletes generally have higher values than sedentary individuals (Koley et al., 2009b; Fallahi and Jadidian, 2011). Comparative studies conducted in different sports disciplines have yielded inconsistent results.

Some studies have reported that elite wrestlers have higher HGS values (Nikooie et al., 2015), while other studies have found no significant difference between elite and sub-elite female volleyball players (Pion et al., 2015). It has been suggested that the differences in HGS observed between the dominant and non-dominant hands of basketball players may be related to their sporting histories and fitness levels (Pizzigalli et al., 2017), while in tennis players these differences may stem from asymmetric training (Gojanovic et al., 2009). Many studies report a positive relationship between HGS and athletic performance and suggest that this measure may be an important parameter in performance evaluations (Hoffman et al., 2009; Akkuş, 1994).

Numerous studies have compared handgrip strength (HGS) values among elite, sub-elite, and non-athletes across various sports (Franchini et al., 2005; Góngora et al., 2013; Drid et al., 2015; Gojanovic et al., 2009). There are also studies including both female and male athletes in Olympic-style weightlifting. Erdağı (2020) examined the relationships of HGS with anthropometric measurements (height, body weight, and forearm circumference) and with snatch and clean and jerk performance in elite and sub-elite male and female weightlifters, and reported that HGS in both hands was significantly correlated, particularly with body weight, height, and performance measures. Similarly, Erdağı et al. (2020a) compared Olympic-style male weightlifters with sedentary individuals and found that weightlifters had significantly higher HGS values for both dominant and non-dominant hands, as well as greater upper arm and forearm circumferences. These findings suggest that HGS may be a strong indicator of not only weightlifting performance but also upper-extremity morphology.

In this context, this study aims to compare the demographic characteristics, handgrip strength (HGS), and weightlifting performance of elite female weightlifters who won medals at international championships with sub-elite female weightlifters who competed at the national level, and to examine the relationships between HGS and both performance variables and demographic characteristics. Our research hypothesis is that elite female weightlifters will be older, have longer training duration, and have higher HGS values compared with sub-elite female weightlifters; furthermore, HGS values in both groups will be positively correlated with snatch and clean-and-jerk performance, and certain demographic variables.

Methods and Materials

Participants

The study included 14 elite (international medalists) and 14 non-elite (national medalists) female Olympic-style weightlifters. The elite group consisted of Olympic-level female weightlifters who had gathered from various provinces at the training camp in Konya as part of preparations for the 2028 Olympic Games. These athletes were also evaluated during this study as part of the training camp held in preparation for the 2025 European Junior & U23 Championships, scheduled to take place in Durrës, Albania, from October 28 to November 4, 2025. The non-elite group consisted of nationally competitive athletes who trained and competed at the national level in Turkey but had not yet won international medals. This group included athletes from the Turkey Olympic Preparation Center (Konya) as well as those affiliated with local private sports clubs.

The inclusion criteria were as follows: (1) at least two years of experience in Olympic-style weightlifting, and (2) active training at the time of data collection. For the elite group, eligibility additionally required winning a medal (gold, silver, or bronze) at the European or World Weightlifting Championships. For the non-elite group, eligibility required participation in, and ranking at, official national-level championships. The exclusion criteria included any history of injury to the hand, wrist, or elbow; previous fractures or surgical interventions affecting these areas; deformities of the upper extremities; and musculoskeletal or neurological disorders. Each athlete completed a personal information form that recorded demographic and anthropometric characteristics (age, height, body weight, and body mass index [BMI], years of weightlifting experience, and past and current competitive achievements. The athletes' one-repetition maximum (1RM) performances in the snatch and clean and jerk lifts were obtained from the official records of the Turkish, European, and International Weightlifting Federations.

Handgrip strength (HGS) was assessed for both the dominant (D-HGS) and non-dominant (ND-HGS) hands following a standardized protocol. Participants were seated with the elbow flexed at 90°, the forearm in a neutral position, and the wrist held in slight extension. Three consecutive measurements were obtained for each hand using a digital hand dynamometer; the highest value was recorded for analysis. Prior to data collection, each athlete performed a familiarization trial. A rest period of at least 30 seconds was provided between measurements to minimize fatigue.

The study was conducted in accordance with the Declaration of Helsinki (2013), and ethical approval was obtained from the Scientific Research Ethics Committee of Social and Human Sciences, Necmettin Erbakan University (Date: 17.10.2025, Decision No: 2025/869).

Measurements

Anthropometric measurements

Prior to data collection, all measurement procedures were rehearsed to identify and address any potential operational issues. Stature was assessed to the nearest 0.1 cm using a stadiometer (Seca 274, Hamburg, Germany) with participants standing upright at maximal inspiration. Body mass was measured to the nearest 0.1 kg using a digital standing scale (Tanita DC-430MA, Tokyo, Japan). Body mass index (BMI) was subsequently calculated as body mass (kg) divided by height squared (m^2).

Dominance of the upper limb was determined by asking participants which hand they used for writing and for tasks requiring strength in daily life. In all cases, the right hand was identified as dominant, with no ambidextrous individuals reported. All measurements were conducted by the same researcher to ensure consistency.

Handgrip Strength Assessment

Before commencing handgrip strength (HGS) testing, participants performed a three-minute self-paced warm-up. HGS was measured for both dominant (D-HGS) and nondominant (ND-HGS) hands using a standard adjustable-handle hydraulic Jamar hand dynamometer (90 kg) (manufactured by Fabrication USA). Measurements were taken in accordance with the protocol recommended by the American Society of Hand Therapists (Fess, 1992). Participants were seated with the shoulder adducted and in neutral rotation, the elbow flexed at 90°, and the forearm and wrist in a neutral position.

Athletes were instructed to gradually increase force over two to three seconds until maximal effort was reached, while standardized verbal encouragement was provided. Three trials were performed for each hand, with at least one minute of rest between trials to minimize fatigue. For each hand, The highest value (kg) obtained from three attempts was used in the analysis.

Statistical Analysis

The statistical analyses were conducted using IBM SPSS Statistics 25.0 (IBM Corp. Released 2017, Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation (SD) and median with interquartile range (IQR), providing a comprehensive summary of central tendency and dispersion. Because of the relatively small sample size in each group ($n = 14$), The normality of the data distributions was tested using the Shapiro–Wilk test, and homogeneity of variances was evaluated with Levene's test.

Depending on the results of these preliminary tests, independent samples t-tests were planned for normally distributed variables with equal variances, whereas Mann–Whitney U tests were applied for non-normally distributed variables or variables with unequal variances. Within-group comparisons of dominant (D-HGS) and non-dominant (ND-HGS) handgrip strength were conducted using the paired t-test when differences were normally distributed, and the Wilcoxon signed-rank test when differences were not normally distributed.

Relationships between handgrip strength (D-HGS, ND-HGS) and demographic variables (age, height, body mass, BMI, training experience) and performance variables (maximum snatch, maximum clean and jerk) were examined using Pearson's correlation coefficient for normally distributed variables and Spearman's rank correlation coefficient for non-normally distributed variables. Correlation strength was interpreted according to Evans' classification criteria (Evans, 1996), following established guidelines for biomedical research (Mukaka, 2012). A two-tailed significance level of $p < 0.05$ was adopted for all analyses, with 95% confidence intervals reported.

Findings

Descriptive statistics and group comparisons are presented in Table 1. As data were not normally distributed ($p < 0.05$), non-parametric tests were applied. Between-group comparisons were performed using the Mann–Whitney U test, while within-group comparisons were conducted using the Wilcoxon signed-rank test. Relationships between variables were assessed using Spearman's rank correlation coefficients.

Statistically significant differences were found between elite and non-elite female weightlifters in age ($p = 0.002$), training experience ($p = 0.003$) and maximum snatch ($p = 0.029$). No significant differences were observed between groups in height ($p = 0.468$), body weight ($p = 0.097$), body mass index ($p = 0.871$), handgrip strength (right: $p = 0.707$; left: $p = 0.550$) or maximum clean and jerk ($p = 0.204$).

Table 1. Descriptive Statistics and Comparisons Between Elite and Non-Elite Female Weightlifters

Variables	Elit Female Weightlifter (n= 14)		Non Elit Female Weightlifter (n= 14)		p Value
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
Age (years)	19.42 ± 0.99	19.33 (1.13)	18.20 ± 0.97	18.11 (1.34)	**0.002**
Height (cm)	157.96 ± 8.19	155.02 (8.46)	159.95 ± 8.11	157.90 (7.24)	0.468
BW (kg)	58.38 ± 12.83	53.77 (13.25)	61.49 ± 12.71	58.28 (11.35)	0.097
BMI (kg/m2)	23.21 ± 4.02	21.76 (4.15)	24.18 ± 3.98	23.18 (3.56)	0.871
TE (years)	7.42 ± 3.17	7.13 (3.61)	3.53 ± 3.09	3.25 (4.27)	**0.003**
HGS (right) (kg)	35.58 ± 7.60	34.77 (12.11)	34.71 ± 7.61	34.20 (12.68)	0.707
HGS (left) (kg)	34.62 ± 8.09	34.49 (10.99)	33.70 ± 8.09	34.34 (11.89)	0.550
Max Snatch (kg)	77.12 ± 11.45	76.82 (15.22)	67.68 ± 11.53	67.49 (14.78)	**0.029**
Max Clean&jerk (kg)	94.37 ± 14.25	93.98 (20.67)	83.09 ± 14.32	83.14 (21.52)	0.204

Data are presented as mean ± standard deviation (Mean ± SD) and median (interquartile range) [Median (IQR)]. TE: Training experience; BW: Body weight; BMI: Body mass index; HGS-right: Handgrip strength – dominant hand; HGS-left: Handgrip strength – non-dominant hand.

Dominant and non-dominant handgrip strength did not differ significantly between elite and non-elite female weightlifters (p = 0.690 and p = 0.952, respectively). Descriptive statistics and group comparisons are summarized in Table 2.

Table 2. Comparison of handgrip strength between elite and non-elite female weightlifters

Variables	D-HGS (kg)		ND-HGS (kg)		p Value
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
Elit Female Weightlifter	35.58 ± 7.60	34.77 (12.11)	34.71 ± 7.61	34.20 (12.68)	0.690
Non Elit Female Weightlifter	34.62 ± 8.09	34.49 (10.99)	33.70 ± 8.09	34.34 (11.89)	0.952

D-HGS: Dominant handgrip strength (right hand); ND-HGS: Non-dominant handgrip strength (left hand). Data are presented as mean ± standard deviation (Mean ± SD) and median (interquartile range) [Median (IQR)].

In the elite group, dominant handgrip strength showed a moderate positive correlation with maximum snatch (r = 0.553) and a weak positive correlation with maximum clean and jerk (r = 0.320). Its correlation with height was very weakly positive (r = 0.191), whereas weakly negative correlations were observed with body weight (r = -0.332), BMI (r = -0.222), and age (r = -0.253). The correlation with training experience was very weak and negative (r = –0.125). Non-dominant handgrip strength showed a strong positive correlation with the maximum snatch (r = 0.611) and a moderate positive correlation with the maximum clean-and-jerk (r = 0.551). Its correlation with height was also moderate and positive (r = 0.464). Weak or very weak correlations were observed with age (r = –0.103), body weight (r = 0.187) and BMI (r = –0.059), while the correlation with training experience was moderate and negative (r = –0.451) (Table 3).

In the non-elite group, dominant handgrip strength showed moderate positive correlations with the maximum clean-and-jerk (r = 0.552), the maximum snatch (r = 0.437), and the height (r = 0.455). Weak positive correlations were found with body weight (r = 0.279), whereas correlations with BMI (r = –0.073) and training experience (r = –0.169) were very weak and negative. Non-dominant handgrip strength was strongly correlated with maximum clean and jerk (r = 0.658) and moderately correlated with maximum snatch (r = 0.556) and height (r = 0.560). Weak negative correlations were observed with age (r = –0.323) and BMI (r = –0.240), while correlations with body weight (r = 0.138) and training experience (r = 0.305) were very weak and weakly positive, respectively (Table 3).

Table 3. Correlations between handgrip strength and demographic/performance variables in elite and non-elite female weightlifters.

Variable Elite Group (n=14)	**D-HGS (kg)**	**ND-HGS (kg)**
Age (years)	-0.253	-0.103
Height (cm)	0.191	0.464
BW (kg)	-0.332	0.187
BMI (kg/m2)	-0.222	-0.059
TE (years)	-0.125	-0.451
Max Snatch (kg)	0.553	0.611
Max Clean and jerk (kg)	0.320	0.551
Variable Non-Elite Group (n=14)	**D-HGS (kg)**	**ND-HGS (kg)**
Age (years)	0.015	-0.323
Height (cm)	0.455	0.560
BW (kg)	0.279	0.138
BMI (kg/m2)	-0.073	-0.240
TE (years)	-0.169	0.305
Max Snatch (kg)	0.437	0.556
Max Clean and jerk (kg)	0.552	0.658

D-HGS: Dominant handgrip strength (right hand), ND-HGS: Non-dominant handgrip strength. (left hand)
Spearman’s correlation coefficients are shown.

Discussion

In our study, anthropometric characteristics, training history, handgrip strength, and weightlifting performance were compared between elite and non-elite female weightlifters. Elite elite athletes were older and had more training experience , suggesting that accumulated training time may influence competitive level. The significant difference observed in snatch performance supports the contributions of technical proficiency and strength development to attaining elite status. In contrast, no significant difference was found between groups in clean-and-jerk performance. Although no significant differences in handgrip strength were observed between groups, weak to moderate correlations were generally found between handgrip strength and certain performance and anthropometric variables in both elite and non-elite athletes.

These findings largely support the hypotheses stated at the beginning of the study. Specifically, the significantly older age and greater training experience in the elite group confirm this aspect of the hypothesis. Similarly, in both groups, weak-to-moderate correlations were generally observed between handgrip strength and snatch and clean-and-jerk performances, as well as between handgrip strength and certain demographic variables, partially supporting the second part of the hypothesis.

However, the absence of statistically significant differences in handgrip strength between groups prevented this aspect of the hypothesis from being confirmed as expected. This finding may be explained by the technical nature of Olympic weightlifting, which involves symmetrical use of the upper extremities, and by the small sample size.

Additionally, the negative correlations observed between training experience and handgrip strength in the non-elite group are noteworthy. This suggests that increased experience does not always translate directly into greater strength, and that individual differences may play a significant role. Overall, the findings provide novel contributions to the literature on anthropometric and strength-related factors that may influence performance in female weightlifters.

In this study, the significantly older age and greater training experience of elite female weightlifters may be considered a potential explanation for differences in performance. Similarly, the literature reports that cumulative training duration and technical proficiency can contribute to performance in elite weightlifters. Erdağı (2020a) reported that, in elite weightlifters, one-repetition maximum (1RM) performances in the snatch and the clean and jerk were significantly and positively associated with handgrip strength, whereas no significant relationship was found between training experience and handgrip strength.

Similarly, a study conducted by Koley and Kaur (2017) on inter-university female hockey players in India reported that handgrip strength was positively associated only with the grip strength of the opposite hand, while no significant relationships were found with other anthropometric variables. A similar trend has also been observed among elite female volleyball players in Latin America. In this group, athletes' long training histories were considered alongside their significantly higher grip strength and upper-extremity measurements (Camacho-Villa et al., 2024). A recent study conducted in canoe slalom reported that female athletes in the highest-performance group had a significantly higher mean sport age than elite-level athletes, with a difference of approximately 31.6%. The study emphasized that, along with sport age, lower body fat and higher muscle mass, particularly in the upper extremities, were key determinants of strength performance (Busta et al., 2024). Similarly, Trivic et al. (2020) reported that elite female sambo athletes with higher body mass demonstrated significantly greater handgrip strength than lighter athletes. The authors attributed this difference primarily to increased muscle mass and stated that grip strength tends to develop in parallel with anthropometric variables. These findings suggest that athletic performance is influenced not only by training experience but also by the interaction of multiple factors such as strength development, muscle mass, and technical proficiency. Although similar trends were observed in our current study, the correlations between handgrip strength and certain anthropometric variables were weak or negative, highlighting the importance of individual differences.

In our study, no statistically significant differences were found between elite and non-elite groups in either dominant or non-dominant handgrip strength. Similarly, Erdağı (2020a) reported no significant differences in handgrip strength between elite and sub-elite weightlifters of both sexes, and no asymmetry between dominant and non-dominant hands was observed. In a study conducted by Kızılca and Okut (2025) among male and female kickboxers, a four-week strength training program led to a significant increase in grip strength in the dominant hand only, while no notable change was detected in the non-dominant hand. These findings suggest that training adaptations may have side-specific effects (Kızılca & Okut, 2025). Similarly, in a study of Indian female hockey players, Koley and Kaur (2017) reported no significant differences in handgrip strength across playing positions, but found a significant positive correlation between the dominant and non-dominant hands.

On the other hand, in certain sports, particularly those with distinct sport-specific technical demands, significant group differences in handgrip strength have been reported. Camacho-Villa et al. (2024) noted that elite Latin American female volleyball players exhibited higher handgrip strength values in both hands compared to a control group. Similarly, Busta et al. (2024) found that, in canoe slalom, female athletes in the highest-performance group had significantly higher handgrip strength values than those in the elite group, both in absolute terms and when normalized to body weight. These differences are emphasized as potentially related to sport-specific technical requirements, high training volume, and increased muscle mass.

Trivic et al. (2020) also reported significant differences in handgrip strength across weight categories among elite female sambo athletes, noting that athletes in heavier weight classes demonstrated greater grip strength. This difference was largely attributed to increased muscle mass and upper extremity girth.

Additionally, in a study of male weightlifters, Erdağı et al. (2020a) found no significant differences between dominant and non-dominant handgrip strength, attributing this to the symmetrical technical structure of Olympic weightlifting.

Similarly, our study found comparable grip strength in both hands.

Finally, in a study of healthy adults, Schlüssel et al. (2008) reported a decline in handgrip strength with age and a significant relationship between handgrip strength and BMI. These findings suggest that handgrip strength may be influenced not only by athletic level but also by factors such as age and body composition.

In our study, dominant handgrip strength in the elite group showed moderate positive correlations with maximal snatch (r = 0.553) and maximal clean and jerk (r = 0.320). Correlations with other variables including height (r = 0.191), body weight (r = –0.332), body mass index (r = –0.222), age (r = –0.253), and training experience (r = –0.125) were weak or negative. In the non-elite group, dominant handgrip strength was moderately positively correlated with maximum clean & jerk (r = 0.552), maximum snatch (r = 0.437), and height (r = 0.455). Correlations with age (r = 0.015), body weight (r = 0.279), and BMI (r = –0.073) were weak or negligible. A negative correlation was also observed between handgrip strength and training experience (r = −0.169).

In the elite group, non-dominant handgrip strength showed moderate-to-strong positive correlations with maximum snatch (r = 0.611) and maximum clean and jerk (r = 0.551). A moderate positive correlation was also observed with height (r = 0.464). Correlations with other variables such as age, body weight, BMI, and training experience remained weak. In the non-elite group, non-dominant handgrip strength demonstrated strong positive correlations with maximum clean and jerk (r = 0.658), maximum snatch (r = 0.556), and height (r = 0.560). Correlations with body weight (r = 0.138), BMI (r = –0.240), age (r = –0.323), and training experience (r = 0.305) were weak. These findings suggest that handgrip strength may, to a certain extent, be associated not only with performance but also with certain structural parameters such as height, body weight, and BMI.

Indeed, a study examining the flexor digitorum superficialis (FDS) tendon reported that the presence of this tendon was not associated with a significant difference in handgrip strength (Erdağı, 2020b). Similarly, the presence or absence of the palmaris longus tendon was shown to have no significant effect on grip strength (Erdağı, 2020c). These findings indicate that handgrip strength cannot be explained solely by anatomical structures; rather, it is shaped by the dynamic interaction of multiple factors such as training history, neuromuscular coordination, and force transmission capacity.

The correlations observed in the present study are consistent with those reported in the literature. For example, in a study by Erdağı (2020a), handgrip strength in elite weightlifters was significantly associated with height, body weight, body mass index (BMI), and weightlifting performance, whereas these relationships were more limited in the sub-elite group. Likewise, in a large-sample study involving non-athletes, handgrip strength showed significant positive correlations with height, body weight, and BMI, whereas a negative association with age was reported (Budziareck et al., 2008).

These findings suggest that similar trends in the relationship between handgrip strength (HGS) and basic anthropometric characteristics may also be observed in the general population. A study conducted by Camacho-Villa et al. (2024) on elite Latin American female volleyball players reported that dominant handgrip strength was positively and significantly correlated with key anthropometric measures such as hand length, hand width, and height. In the non-dominant hand, a moderate positive correlation with hand width was found, whereas correlations with other upper-extremity measurements were weak. These findings indicate that handgrip strength develops in conjunction with sport-specific upper extremity morphology. Trivic et al. (2020) reported that, among elite female sambo athletes, handgrip strength was positively associated with body weight, muscle mass, and upper-extremity girth measurements, and significant differences between weight classes were observed for these variables.

However, in our study, dominant handgrip strength did not show strong correlations with height, body weight, or BMI. In contrast, the non-dominant hand showed weak to moderate correlations with these variables. This suggests that the relationship between HGS and anthropometric features may vary depending on the sport discipline, the pattern of upper limb use, and the level of athletic performance.

Busta et al. (2024) reported that, among elite female canoe slalom athletes, dominant handgrip strength values of the high-performance group were significantly higher than those of the lower-performance group. The study also found positive correlations between HGS and fundamental anthropometric measures such as height, body weight, and BMI. These findings align with our study, highlighting the relationship between grip strength and intra-sport performance level. In our study, moderate positive correlations were observed between HGS and both snatch and clean & jerk performance in elite and non-elite athletes.

However, in our findings, dominant handgrip strength did not correlate strongly with anthropometric variables such as height, body weight, and BMI. In contrast, non-dominant handgrip strength showed a moderate correlation with height. This suggests that the relationship between HGS and anthropometric characteristics may vary depending on the sport discipline, the specific upper limb used, and the level of athletic performance.

Furthermore, a study by Koley and Kaur (2017) on inter-university Indian female hockey players similarly reported that handgrip strength was significantly and positively correlated only with the opposite hand's grip strength, and no correlations were found with other anthropometric measurements. These findings indicate that the relationships between HGS and anthropometry may vary depending on the sport, playing position, and study sample.

However, another study conducted in male weightlifters (Erdagi et al., 2020a) reported that handgrip strength was positively and significantly associated with height, body weight, BMI, forearm and upper arm circumference, and with weightlifting performance. In contrast, these relationships were more limited in our study, particularly in the dominant hand, where correlations with anthropometric variables were weak or negative. A study by Koley et al. (2009) involving male cricketers aged 17–21 found that both right and left handgrip strengths were significantly positively correlated with height, body weight, BMI, hand length, and hand width. Additionally, right-hand grip strength was positively associated with forearm length. Although this study was conducted in a different sport and included male participants, it supports the general trend that handgrip strength may be positively associated with certain fundamental anthropometric variables. Nevertheless, in our study, the strength of these relationships remained limited; particularly in the dominant hand, correlations with height, body weight, and BMI were weak or negative. This suggests that the relationships between HGS and anthropometric variables may vary depending on sport discipline, sex, or level of athletic performance.

In contrast, a study by Franchini et al. (2005) on male judo athletes found no statistically significant difference in handgrip strength between elite and non-elite competitors. However, the elite group had larger arm, forearm, and wrist circumferences, suggesting greater muscle mass and potential force production in these areas.

Although the study was conducted in a different sport and among participants of a different gender, the findings indicate that grip strength may be influenced by sport-specific technical demands and that this measure alone may not be sufficient to distinguish elite status. Similarly, in our study, no significant differences were observed in either dominant or non-non-dominant handgrip strength between elite and non-elite female weightlifters. This may be attributed to the symmetrical technical nature of Olympic-style weightlifting, which imposes relatively equal loads on both upper extremities.

Practical Applications and Future Research

When considered alongside similar findings in the literature, handgrip strength (HGS) can be proposed as a parameter that reflects not only general strength levels but also upper extremity morphology and weightlifting performance. In this context, several studies have suggested that HGS may serve as a practical assessment tool in talent identification and training program design (Erdağı et al., 2020).

Camacho-Villa et al. (2024) highlighted the relationship between handgrip strength and upper extremity anthropometric structures, emphasizing that HGS is a cost-effective, applicable, and efficient tool for talent identification and athlete profiling. Similarly, Trivic et al. (2020) reported that HGS differed significantly across weight categories and attributed these differences to greater muscle mass and larger upper-limb circumferences.

These findings suggest that HGS may be considered not only an indicator of general strength but also a parameter reflecting diversity in physical profiles among athletes. Indeed, Busta et al. (2024) found that elite female canoe slalom athletes with higher performance levels had significantly greater HGS in both the dominant and the non-dominant hands. These differences were attributed to sport-specific technical demands, high training volumes, and greater muscle mass.

On the other hand, in a study by Koley and Kaur (2017) of female hockey players, HGS was reported to be significantly associated only with the strength of the contralateral hand; no meaningful correlations were found with other anthropometric variables. This suggests that the practical value of HGS is closely linked to the sport discipline in which it is measured and to the specific performance components being targeted.

Limitations of the Study

This study included a limited number of elite and non-elite female weightlifters, which introduces certain limitations. The low number of participants may reduce the statistical power and restrict the generalizability of the findings to broader populations. Furthermore, including only athletes who were actively competing in Turkey precludes assessment of potential influences of cultural and geographical diversity.

Although handgrip strength was measured using a digital dynamometer, biomechanical variables such as hand morphology (e.g., hand length, finger proportions) and muscle mass were not assessed. This omission limits a more detailed examination of the relationship between HGS and performance. Additionally, the data were collected at a single point in time, and no longitudinal follow-up was conducted; therefore, causal relationships cannot be established.

Finally, the study included only female athletes, which prevents direct generalization of the results to male weightlifters. Considering these limitations, the findings should be interpreted with caution, and future research is recommended to include larger and more diverse samples in terms of gender and performance level.

Conclusion and Recommendations

This study examined the relationships between handgrip strength (HGS) and demographic, anthropometric, and performance variables in elite and non-elite female Olympic-style weightlifters and evaluated whether significant differences existed between the athlete levels. The findings revealed that elite athletes were significantly older and had greater training experience, which was reflected in their weightlifting performance, particularly in the snatch. However, no statistically significant differences were found between the two groups in either dominant or non-dominant handgrip strength. This may suggest that the symmetrical technical nature of Olympic-style weightlifting, which involves the balanced use of both upper extremities, leads to an equal distribution of strength over time.

The study also found that HGS was positively associated with certain performance and anthropometric variables in both elite and non-elite groups. In elite athletes, HGS showed stronger correlations with snatch and clean and jerk performance, as well as with height, whereas in the non-elite group, stronger correlations were observed with age and body mass index (BMI). Interestingly, a negative relationship between HGS and training experience was observed in the non-elite group. These findings suggest that HGS may reflect not only physical capability but also athletic level and adaptations related to training history.

In conclusion, handgrip strength may serve both as a performance-supporting factor and as a practical and valid tool for athlete profiling. Accordingly, integrating specific grip-strengthening exercises into weightlifting training programs could enhance performance. Additionally, incorporating HGS assessments into talent identification and athlete development monitoring could provide valuable insights into physical fitness and potential. Considering its relationship with upper extremity morphology, supplementing HGS evaluation with sport-specific assessment protocols may further enhance its effectiveness in sports science applications.

Future studies are recommended to include larger sample sizes and comparisons across different age groups and weight categories. Moreover, in-depth investigations into the relationships between HGS and biomechanical parameters such as upper limb muscle mass, hand morphology, and force production characteristics are needed. Such research could further establish HGS not only as a predictor of athletic performance but also as a holistic indicator of physiological and morphological fitness.

Practical Applications

This study demonstrated that handgrip strength (HGS) can serve as a practical and low-cost assessment tool reflecting upper extremity strength in female Olympic-style weightlifters and may be considered a performance-related parameter. Although no statistically significant differences in HGS levels were found between elite and non-elite athletes, positive correlations between HGS and both the snatch and the clean and jerk performance were observed in both groups.

Coaches and practitioners can support performance enhancement by integrating isometric grip exercises, grip endurance training, and bilateral upper extremity resistance exercises into training programs aimed at improving handgrip strength. Additionally, regular monitoring of both dominant and non-dominant hand strength may help detect potential muscular imbalances at an early stage, thereby contributing to injury prevention.

Due to its ease of application, handgrip strength testing may also be used in talent identification and athlete profiling processes. Given its positive associations with basic anthropometric variables such as height and body weight, HGS testing could be used as a screening tool in early-stage athlete assessments.

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Data Availability Declaration

Data Availability Upon Formal Request: While the primary datasets utilized in this study are not publicly accessible due to certain constraints, they are available to researchers upon a formal request. The authors have emphasized maintaining the integrity of the data and its analytical rigor. To access the datasets or seek further clarifications, kindly reach out to the corresponding author. Our aim is to foster collaborative academic efforts while upholding the highest standards of research integrity.

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