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The Effect of Forearm Position, Hand Dominance, and Gender on Hand Grip Strength in Healthy Young Adults

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Abstract

Objective

The aim of this study was to examine hand grip strength measured in different forearm positions in healthy young individuals and to evaluate the effects of forearm position, hand dominance, and gender on grip strength.

Methods

A total of 141 healthy volunteer individuals aged between 18–30 years (78 females, 63 males) were included in this descriptive and comparative cross-sectional study. Hand grip strength measurements were performed using the J-Tech Commander Echo Wireless digital hand dynamometer in accordance with the standard measurement protocol recommended by the American Society of Hand Therapists (ASHT). Measurements were taken in three different forearm positions—supination, neutral, and pronation—in both the dominant and non-dominant hands. Three repeated measurements were obtained for each position and the maximum value was used in the analyses. Descriptive statistics, paired samples t-test, independent samples t-test, and repeated measures analysis of variance were used in the statistical analyses.

Results

Grip strength values measured in the supination position were found to be the highest in both sexes, followed by the neutral position, while the lowest values were obtained in the pronation position. Grip strength values measured in the dominant hand were significantly higher than those in the non-dominant hand in all positions ($p<0.001$). In addition, the grip strength values of male participants were significantly higher than those of female participants in all positions ($p<0.001$). Repeated measures analysis of variance showed significant main effects of forearm position ($F=368.85$; $p<0.001$; $\eta^2p=0.515$), hand dominance ($F=432.47$; $p<0.001$; $\eta^2p=0.384$), and gender ($F=184.61$; $p<0.001$; $\eta^2p=0.210$) on grip strength.

Conclusion

Forearm position is an important determinant of hand grip strength. Grip strength values are highest in the supination position and lowest in the pronation position. In addition, the dominant hand advantage and gender differences significantly influence grip strength. These findings emphasize the importance of standardizing forearm position in grip strength measurements and provide position-specific reference values for healthy young individuals.

INTRODUCTION

Hand grip strength is one of the objective measurements widely used in the evaluation of upper extremity function. This measurement not only reflects the functional capacity of the hand and forearm

muscles but also provides important information about an individual's general muscle strength, physical performance, and functional independence (Bohannon, 2019; Roberts et al., 2011). Therefore, grip strength measurements are widely used for both clinical evaluation and research purposes in many fields such as orthopedics, physiotherapy and rehabilitation, sports sciences, and ergonomics. In particular, it is considered an important parameter in monitoring functional recovery after upper extremity injuries, evaluating muscle strength, and determining the effectiveness of rehabilitation programs (Roberts et al., 2011).

Recent studies have also shown that grip strength is not only an indicator of upper extremity function but can also be considered an important biomarker of overall health status and physical capacity. Low grip strength values have been reported to be associated with loss of muscle strength, decreased functional capacity, and various health problems (Bohannon, 2019). Therefore, accurate and reliable measurement of grip strength is of great importance both in clinical assessments and in scientific research.

In order to obtain reliable results in hand grip strength measurements, standard measurement protocols should be applied. The measurement protocol recommended by the American Society of Hand Therapists (ASHT) is one of the most widely used standard methods in grip strength assessments (Fess, 1992). In this protocol, measurements are generally recommended to be performed in a seated position with the shoulder in a neutral position, the elbow flexed at approximately 90°, and the wrist in a neutral position. The use of standard measurement positions increases the repeatability of the measurements and allows comparable results to be obtained between different studies. Therefore, accurate and reliable measurement of grip strength is of great importance both in clinical evaluations and scientific research, and the standardization of measurement protocols is recommended (Roberts et al., 2011).

Grip strength is influenced by many factors. In the literature, variables such as age, gender, anthropometric characteristics, and hand dominance have been reported to have significant effects on grip strength (Massy-Westropp et al., 2011). In particular, gender differences have a marked effect on grip strength, and several studies have shown that men generally have higher grip strength values than women (Massy-Westropp et al., 2011; Mathiowetz et al., 1985). In addition, hand dominance also plays an important role in grip strength, and it has been reported that the dominant hand produces greater force than the non-dominant hand in most individuals (Agtuahene et al., 2023; Zadoń et al., 2025).

Another important factor affecting grip strength is the position of the forearm during measurement. The forearm being in supination, neutral, or pronation may alter the length–tension relationship and biomechanical advantage of the forearm flexor muscles, which may influence the amount of force produced (Richards et al., 1996). Changes in the functional length of the muscles during forearm rotation may affect the force production capacity of the flexor muscles in different ways. Therefore, significant differences may occur between grip strength values measured in different forearm positions. Previous studies have shown that forearm position may have a significant effect on grip strength and that the force values obtained in the supination position may sometimes be higher than those obtained in other positions (Fan et al., 2019; Richards et al., 1996).

However, there are some inconsistencies in the findings of studies examining the effects of forearm position on grip strength in the literature. These differences may be due to variations in measurement protocols, sample sizes, participant characteristics, and measurement conditions (Roberts et al., 2011; Tomkinson et al., 2024). Furthermore, in many studies, variables such as gender, hand dominance, and forearm position have not been evaluated together, or position-specific normative data for healthy young individuals have not been adequately reported (Vaishya et al., 2024). Therefore, evaluating grip strength measured in different forearm positions together with gender and hand dominance may provide important contributions for both clinical practice and ergonomic assessments.

The aim of this study was to examine hand grip strength measured in supination, neutral, and pronation forearm positions in healthy young individuals and to evaluate the effects of forearm position, hand dominance, and gender on grip strength. In addition, based on the findings obtained, it was aimed to establish reference grip strength values according to forearm position and gender for young adult individuals. Accordingly, the study tested the hypotheses that forearm position has a significant effect on grip strength, that the dominant hand produces greater force than the non-dominant hand, and that male individuals have higher grip strength values than female individuals.

Although many studies have investigated hand grip strength in the existing literature, the number of studies evaluating the effects of different forearm positions on grip strength together with gender and hand dominance appears to be limited. Moreover, position-specific normative data regarding grip strength measured in supination, neutral, and pronation positions in healthy young individuals have not been sufficiently reported. By evaluating grip strength measured in different forearm positions together with the dominant and non-dominant hands, this study aims to contribute to this gap in the literature. In addition, presenting grip strength values according to forearm position and gender for young adults is expected to provide important reference data for clinical evaluations, rehabilitation applications, and ergonomic analyses.

MATERIALS AND METHODS

Study Design

This study was designed as a descriptive and comparative cross-sectional study to evaluate hand grip strength measured in different forearm positions in healthy young individuals and to examine the effects of forearm position, hand dominance, and gender on grip strength. In the study, grip strength values measured in three different forearm positions—supination, neutral, and pronation—were analyzed in order to determine the differences between positions. In addition, based on the data obtained, it was aimed to establish reference grip strength values according to forearm position and gender for young individuals.

Study Setting and Time

The data collection process of the study was conducted at the Vocational School of Health Services of Kilis 7 Aralık University between October 1, 2025 and March 1, 2026.

Ethical Approval

Ethical approval for the study was obtained from the Ethics Committee of Kilis 7 Aralık University (Meeting No: 2025/17, Decision No: 05, dated 23.10.2025). The study was conducted in accordance with the principles of the Declaration of Helsinki, and written informed consent was obtained from all participants. Participant data were evaluated anonymously.

Participants

Healthy young individuals aged between 18 and 30 years were included in the study. Female and male participants who voluntarily agreed to participate in the research were recruited. During participant selection, it was ensured that individuals did not have any neurological or orthopedic pathology that could affect hand and upper extremity functions.

Inclusion and Exclusion Criteria

The inclusion criteria of the study were defined as being between 18 and 30 years of age, voluntarily agreeing to participate in the study, and not having any neurological or orthopedic disorder that could affect hand and upper extremity functions. The exclusion criteria were defined as having a history of hand or upper extremity injury or surgery, the presence of neuromuscular disease, the presence of upper extremity musculoskeletal disorders, and the presence of pain in the hand or arm region within the last six months. These criteria were evaluated through the socio-demographic and clinical information form administered to the participants.

Data Collection Instruments

Socio-Demographic and Clinical Information Form

The socio-demographic and clinical information form prepared by the researchers was used to record participants' age, gender, height, weight, education level, occupation, and dominant hand information using a self-report method. In addition, information regarding hand or upper extremity injury history, presence of neurological disease, chronic musculoskeletal disorders, and the presence of pain in the hand or arm region within the last six months was also evaluated through this form.

Hand Grip Strength Measurement

Hand grip strength measurements were performed using a J-Tech Commander Echo Wireless digital hand dynamometer (JTech Medical, Midvale, Utah, USA). The measurements were conducted in accordance with the standard measurement protocol recommended by the American Society of Hand Therapists (ASHT) (Fess, 1992). During the measurement, participants were evaluated in a standard seated position. The upper extremity in which the measurement was performed was positioned with the

shoulder in a neutral position, the elbow flexed at 90°, and the wrist in a neutral position. Hand grip strength measurements were performed in three different forearm positions: supination, neutral, and pronation. Measurements were taken for both the dominant and non-dominant hands in each position. Participants were asked to squeeze the dynamometer with maximum force for 3–5 seconds. Three repeated measurements were obtained for each position, and a 60-second rest period was provided between measurements in order to prevent muscle fatigue. The maximum value obtained from the three measurements was used in the analyses. All measurements were recorded in kilograms (kg).

Sample Size

The adequacy of the sample size of the study was evaluated using G*Power 3.1 software, and it was determined that the statistical power for the current sample size (n = 141) was above 0.99.

Statistical Analysis

The data obtained in the study were first transferred to Microsoft Excel, and statistical analyses were performed using IBM SPSS Statistics version 25.0. Descriptive statistics were presented as mean, standard deviation, frequency, and percentage. The paired samples t-test was used to compare dominant and non-dominant hand grip strength values. Differences in grip strength between genders were analyzed using the independent samples t-test. In order to evaluate the combined effects of forearm position, hand dominance, and gender on hand grip strength, repeated measures analysis of variance (repeated measures ANOVA) was applied. Effect size was reported using the partial eta squared (η^2p) value. The statistical significance level was accepted as $p < 0.05$ for all analyses.

RESULTS

Table 1. Demographic Characteristics and BMI of the Participants

Group	n	Age (Mean ± SD)	Height (Mean ± SD)	Weight (Mean ± SD)	BMI (Mean ± SD)
Female	78	19.94 ± 1.57	163.01 ± 5.18	58.83 ± 11.04	22.11 ± 3.74
Male	63	20.11 ± 1.66	176.84 ± 4.94	77.97 ± 14.83	24.87 ± 4.20
Total	141	20.01 ± 1.61	169.19 ± 8.55	67.38 ± 15.98	23.34 ± 4.17

A total of 141 volunteers participated in the study. Among the participants, 78 were female (55.3%) and 63 were male (44.7%), and the mean age of the entire sample was 20.01 ± 1.61 years. The mean age was 19.94 ± 1.57 years for females and 20.11 ± 1.66 years for males (Table 1).

In the total sample, the mean height was 169.19 ± 8.55 cm and the mean body weight was 67.38 ± 15.98 kg. The mean height of female participants was 163.01 ± 5.18 cm and the mean weight was 58.83 ±

11.04 kg. For male participants, the mean height was 176.84 ± 4.94 cm and the mean weight was 77.97 ± 14.83 kg (Table 1).

The mean Body Mass Index (BMI) of the total sample was 23.34 ± 4.17 kg/m². The mean BMI was 22.11 ± 3.74 kg/m² in females and 24.87 ± 4.20 kg/m² in males (Table 1).

Table 2. Normative Reference Table of Grip Strength Values (kg, Mean ± SD)

Position	Hand	Male (n=63)	Female (n=78)
Supination	Dominant	47.08 ± 8.76	27.29 ± 4.80
	Non-Dominant	42.89 ± 8.82	25.01 ± 4.77
Neutral	Dominant	46.13 ± 8.33	27.02 ± 4.86
	Non-Dominant	41.90 ± 8.31	24.54 ± 4.72
Pronation	Dominant	40.83 ± 8.36	23.86 ± 4.73
	Non-Dominant	37.27 ± 8.26	21.45 ± 4.60

In the supination position, dominant hand grip strength was 47.08 ± 8.76 kg in males and 27.29 ± 4.80 kg in females, while in the non-dominant hand it was 42.89 ± 8.82 kg in males and 25.01 ± 4.77 kg in females (Table 2).

In the neutral position, dominant hand grip strength was 46.13 ± 8.33 kg in males and 27.02 ± 4.86 kg in females, while non-dominant hand grip strength was 41.90 ± 8.31 kg in males and 24.54 ± 4.72 kg in females (Table 2).

In the pronation position, dominant hand grip strength was 40.83 ± 8.36 kg in males and 23.86 ± 4.73 kg in females, whereas non-dominant hand grip strength was 37.27 ± 8.26 kg in males and 21.45 ± 4.60 kg in females (Table 2).

Table 3. Comparison of Dominant and Non-Dominant Hand Grip Strength

Group	Position	t	p
Male	Supination	11.154	<0.001
	Neutral	9.675	<0.001
	Pronation	7.726	<0.001
Female	Supination	13.909	<0.001
	Neutral	12.967	<0.001
	Pronation	13.382	<0.001

The difference between dominant and non-dominant hand grip strength was analyzed using a paired samples t-test for each gender group. In the male group, dominant hand grip strength was significantly higher than the non-dominant hand in the supination (t=11.154; p<0.001), neutral (t=9.675; p<0.001), and pronation (t=7.726; p<0.001) positions. Similarly, in the female group, dominant hand grip strength was significantly higher than the non-dominant hand in the supination (t=13.909; p<0.001), neutral (t=12.967; p<0.001), and pronation (t=13.382; p<0.001) positions (Table 3).

Table 4. Grip Strength Comparison by Gender

Position	Hand	t	p
Supination	**Dominant**	**17.053**	**<0.001**
	Non-Dominant	**15.341**	**<0.001**
Neutral	**Dominant**	**16.998**	**<0.001**
	Non-Dominant	**15.607**	**<0.001**
Pronation	**Dominant**	**15.179**	**<0.001**
	Non-Dominant	**14.383**	**<0.001**

Grip strength differences between genders were analyzed using the independent samples t-test. In the supination position, significant differences were found between genders in both the dominant (t=17.053; p<0.001) and non-dominant (t=15.341; p<0.001) hands. Similarly, significant gender differences were observed in the neutral position for both the dominant (t=16.998; p<0.001) and non-dominant (t=15.607; p<0.001) hands. In the pronation position, significant gender differences were also detected for both the dominant (t=15.179; p<0.001) and non-dominant (t=14.383; p<0.001) hands. In all positions, male participants demonstrated higher grip strength values than female participants (Table 4).

Table 5. Comparison of Grip Strength Between Positions by Gender

Group	Comparison	Dominant (t, p)	Non-Dominant (t, p)
Male	Supination – Neutral	2.199 ; 0.032	2.195 ; 0.032
	Supination – Pronation	13.743 ; <0.001	10.998 ; <0.001
	Neutral – Pronation	12.123 ; <0.001	8.944 ; <0.001
Female	Supination – Neutral	1.114 ; 0.269	2.039 ; 0.045
	Supination – Pronation	12.868 ; <0.001	13.667 ; <0.001
	Neutral – Pronation	12.318 ; <0.001	11.846 ; <0.001

Differences between positions were analyzed separately for dominant and non-dominant hands in male and female groups using the paired samples t-test. In the male group, statistically significant differences

were observed between positions in both dominant and non-dominant hands. In both hands, grip strength values were highest in the supination position, followed by the neutral position, and lowest in the pronation position. Comparisons between supination–pronation and neutral–pronation were statistically significant in all cases ($p<0.001$). The supination–neutral comparison was also significant in both hands ($p<0.05$). In the female group, although grip strength in the dominant hand was higher in the supination position compared with the neutral position, the difference was not statistically significant ($p=0.269$). However, in both dominant and non-dominant hands, grip strength measured in the supination position was higher than in the pronation position, and grip strength in the neutral position was also higher than in the pronation position. These differences were statistically significant ($p<0.001$). In the non-dominant hand, the supination–neutral comparison was also statistically significant ($p<0.05$). Overall, in both genders, grip strength values were higher in supination and neutral positions, whereas the lowest values were obtained in the pronation position (Table 5).

Figure 1. Hand Grip Strength Values According to Forearm Position, Hand Dominance, and Gender (Mean ± SD)

Grip strength values measured in the supination, neutral, and pronation positions for both dominant and non-dominant hands are presented separately for male and female groups. The points represent mean values, while the error bars represent the standard deviation (SD).Grip strength is expressed in kilograms (kg). The graph illustrates the general trend, showing that the order of strength across positions is:Supination > Neutral > Pronation (Figure 1).

Table 6. Percentage Differences Between Positions for Dominant and Non-Dominant Hands

Group	Hand	Comparison	Higher Value	Percentage Difference (%)
Male	Dominant	Supination – Neutral	Supination	2.03
	Dominant	Supination – Pronation	Supination	13.28
	Dominant	Neutral – Pronation	Neutral	11.48
	Non-Dominant	Supination – Neutral	Supination	2.29
	Non-Dominant	Supination – Pronation	Supination	13.09
	Non-Dominant	Neutral – Pronation	Neutral	11.05
	–	Supination (D–ND)	Dominant	9.79
	–	Neutral (D–ND)	Dominant	10.08
	–	Pronation (D–ND)	Dominant	9.55
Female	Dominant	Supination – Neutral	Supination	1.00
	Dominant	Supination – Pronation	Supination	12.58
	Dominant	Neutral – Pronation	Neutral	11.70
	Non-Dominant	Supination – Neutral	Supination	1.90
	Non-Dominant	Supination – Pronation	Supination	14.24
	Non-Dominant	Neutral – Pronation	Neutral	12.58
	–	Supination (D–ND)	Dominant	9.10
	–	Neutral (D–ND)	Dominant	10.10
	–	Pronation (D–ND)	Dominant	11.21

According to the results of the percentage change analysis conducted in male and female groups, grip strength values showed a similar pattern across positions in both genders. In both dominant and non-dominant hands, the highest force was observed in the supination position, followed by the neutral position, and the lowest values were observed in the pronation position. In males, in the dominant hand, supination was 2.03% higher than neutral and 13.28% higher than pronation, while the neutral position was 11.48% higher than pronation. In the non-dominant hand, similarly, supination was 2.29% higher than neutral and 13.09% higher than pronation, while neutral was 11.05% higher than pronation. In females, in the dominant hand, supination was 1.00% higher than neutral and 12.58% higher than pronation, while neutral was 11.70% higher than pronation. In the non-dominant hand, supination was 1.90% higher than neutral and 14.24% higher than pronation, while neutral was 12.58% higher than pronation. In addition, in both genders, the dominant hand produced approximately 9–11% greater grip strength than the non-dominant hand in all positions. These findings indicate that in both genders the

strength ranking follows the order: Supination > Neutral > Pronation, and the dominant hand advantage is consistently observed across all positions (Table 6).

Table 7. Effects of Gender, Forearm Position, and Hand Dominance on Hand Grip Strength

Effect	F	p	η²p (Partial Eta²)
Gender	184.61	<0.001	0.210
Position	368.85	<0.001	0.515
Hand	432.47	<0.001	0.384
Gender × Position	23.82	<0.001	0.064
Gender × Hand	28.63	<0.001	0.040
Position × Hand	0.44	0.644	0.001
Gender × Position × Hand	0.60	0.550	0.002

According to the repeated measures ANOVA results, position ($F=368.85$; $p<0.001$; $\eta^2p=0.515$), hand ($F=432.47$; $p<0.001$; $\eta^2p=0.384$), and gender ($F=184.61$; $p<0.001$; $\eta^2p=0.210$) had statistically significant main effects on hand grip strength. When effect sizes were examined, the largest effect belonged to forearm position, indicating that approximately 51% of the variance in grip strength was explained by forearm position. Hand dominance also demonstrated a large effect size, indicating a strong advantage for the dominant hand compared with the non-dominant hand. The main effect of gender also had a large effect size, showing that male participants had significantly higher grip strength values than female participants. When interaction effects were examined, Gender × Position ($F=23.82$; $p<0.001$; $\eta^2p=0.064$) and Gender × Hand ($F=28.63$; $p<0.001$; $\eta^2p=0.040$) interactions were statistically significant, although their effect sizes were smaller than the main effects. This finding suggests that although the position effect and dominant hand advantage show similar patterns in both genders, the magnitude of these effects may vary slightly. The Position × Hand interaction ($p=0.644$) and the three-way interaction (Gender × Position × Hand) were not statistically significant, indicating that the effect of forearm position occurs similarly in both dominant and non-dominant hands (Table 7).

DISCUSSION

In this study, hand grip strength values measured in different forearm positions in healthy young individuals were examined, and the effects of forearm position, hand dominance, and gender on grip strength were evaluated. The findings obtained indicate that grip strength varies significantly depending on forearm position, and in both genders the strength values were ranked as supination > neutral > pronation. In addition, grip strength values measured in the dominant hand were higher than those measured in the non-dominant hand, and male participants demonstrated significantly higher grip

strength values than female participants. These findings indicate that grip strength is influenced not only by individual characteristics but also by biomechanical and functional factors.

When the demographic characteristics of the participants were examined, it was observed that the study group consisted of healthy young individuals. The fact that the participants were within a similar age range limited the effect of age-related changes on grip strength. In the literature, it has been reported that grip strength may change with age and may particularly show a significant decrease in older age groups (Bohannon, 2019; Dodds et al., 2014; Tomkinson et al., 2024). Studies examining the lifetime changes in grip strength have also shown that strength reaches its peak during young adulthood and gradually declines with aging (Dodds et al., 2014).

One of the most important findings of our study is that grip strength varies according to forearm position. Grip strength values measured in the supination position were found to be higher than those measured in other positions in both male and female participants. During forearm rotation, the length–tension relationship and mechanical advantage of the flexor muscles may change, leading to differences in the amount of force produced in different positions. Previous studies have shown that forearm position may have a significant influence on grip strength. In particular, it has been reported that grip strength values may vary in measurements performed at different forearm rotation positions and that assessments should therefore be conducted in different forearm positions (Fan et al., 2019; Richards et al., 1996).

Because the mechanical advantage of the flexor muscles changes depending on forearm position, differences in grip strength values may occur. Previous studies have demonstrated that forearm position may have a significant effect on grip strength and that values measured in the supination position may sometimes be higher than those obtained in other positions (Fan et al., 2019; Quattrocchi et al., 2024; Richards et al., 1996).

When comparisons between positions were examined, the neutral position produced higher grip strength values compared with the pronation position. This finding suggests that the mechanical advantage of the flexor muscles may decrease in the pronation position. The literature also reports that grip strength may decrease in the pronation position, which may be related to changes in muscle activation (Ikeda et al., 2025; Richards et al., 1996). It has been emphasized that the measurement position used in grip strength assessments may significantly influence the results and that standardization of the measurement protocol is necessary (Quattrocchi et al., 2024; Roberts et al., 2011). Therefore, it is recommended that forearm position should be clearly defined in grip strength measurements and that standardized measurement protocols should be applied.

Establishing normative reference values for hand grip strength plays an important role in the clinical assessment of upper extremity function. Studies in the literature indicate that grip strength is significantly influenced by factors such as age, sex, anthropometric characteristics, and hand dominance. A large-scale study reported that grip strength varies according to age and sex among individuals aged 18–85 years, with men demonstrating significantly higher values than women (Wang et

al., 2018). More recent epidemiological studies have similarly shown that grip strength reaches high levels during early adulthood and that average values are higher in men than in women (Huemer et al., 2023; Vaishya et al., 2024). In addition, a large-scale systematic review analyzing data from more than 2.4 million individuals across 69 countries reported that grip strength generally peaks between the ages of 30 and 39 years (Tomkinson et al., 2024). The grip strength values obtained in the present study appear to be generally consistent with the normative values reported in the literature. Furthermore, by evaluating grip strength in different forearm positions together with hand dominance and sex variables, the present study provides position-specific reference data that have been relatively limited in the literature and may contribute to clinical assessment and rehabilitation practice.

In our study, a significant strength difference was observed between the dominant and non-dominant hands. Grip strength values measured in the dominant hand were higher than those measured in the non-dominant hand across all forearm positions. The results of the percentage analysis showed that the dominant hand produced approximately 9–11% greater grip strength compared with the non-dominant hand. This finding is consistent with the dominant hand advantage reported in the literature. Previous studies have indicated that the dominant hand may produce approximately 10% greater grip strength compared with the non-dominant hand (Foley et al., 2025; Petersen et al., 1989).

The strength superiority observed in the dominant hand may be associated with neuromuscular adaptations resulting from the more frequent use of the dominant hand in daily life activities. Recent studies also indicate that grip strength values measured in the dominant hand are higher than those measured in the non-dominant hand in most individuals and that hand dominance is an important determinant of force production (Myles et al., 2025; Ruiz-Tovar et al., 2025). Furthermore, recent analyses and meta-analyses conducted on large samples have demonstrated that grip strength measured in the dominant hand is generally higher than that measured in the non-dominant hand, and that this difference typically ranges between 8–12% in most individuals (Foley et al., 2025; Zadoń et al., 2025). These findings indicate that the dominant hand advantage observed in our study is consistent with the existing literature.

When gender differences were examined, male participants demonstrated significantly higher grip strength values than female participants in all forearm positions. This finding is consistent with results reported in the literature. Recent studies have shown that grip strength values measured in males are generally higher than those measured in females and that grip strength may show significant differences depending on biological sex (Agtuahene et al., 2023; Myles et al., 2025; Pérez et al., 2024). This difference may be associated with physiological characteristics such as greater muscle mass, larger muscle cross-sectional area, and higher neuromuscular capacity in males. In this context, the findings obtained in the present study indicate that the gender-related differences in grip strength are consistent with the existing literature.

When the results of the repeated measures ANOVA were examined, forearm position was found to have a significant effect on grip strength. The effect size values indicated that a substantial portion of the

variance in grip strength is associated with forearm position. This finding is consistent with studies reporting that forearm rotation may affect muscle alignment and muscle activation, leading to changes in force production capacity (Fan et al., 2019; Ikeda et al., 2025; Richards et al., 1996).

Furthermore, it has been emphasized that standardization of the measurement protocols used in hand grip strength assessments is of great importance in terms of the reliability of results and comparability between studies (Quattrocchi et al., 2024; Roberts et al., 2011). Without standardized measurement protocols, comparisons between studies may become difficult and interpretation of the results may be challenging. Therefore, it is recommended that evaluation methods in which forearm position is clearly defined and standardized measurement protocols are applied should be used in grip strength assessments.

One of the important contributions of this study is that it provides reference values for grip strength measured in different forearm positions in healthy young individuals. Since hand grip strength measurement is a simple, rapid, and reliable method, it is widely used both in clinical evaluations and epidemiological research (Quattrocchi et al., 2024; Bohannon, 2019).

Indeed, recent studies have demonstrated that grip strength is one of the important indicators associated with an individual's overall health status, physical performance, and functional capacity (Ruiz-Tovar et al., 2025; Tomkinson et al., 2024). In addition, recent studies examining the biological and functional factors affecting grip strength have emphasized that grip strength is an important parameter in evaluating upper extremity function (Myles et al., 2025). Therefore, the position-specific grip strength values obtained in the present study may provide important reference data for the evaluation of upper extremity function, monitoring of rehabilitation processes, and ergonomic analyses.

Limitations of the Study

This study has several limitations. First, the research included only healthy young individuals aged between 18 and 30 years. Therefore, the findings obtained may not be directly generalizable to other age groups, particularly middle-aged and older populations.

Additionally, since the study was conducted within a single university setting, the sample represents a specific population and may not adequately reflect individuals with different sociodemographic characteristics.

Another limitation is that certain factors that may influence grip strength—such as physical activity level, sports history, and occupational hand use—were not examined in detail. Since these variables may affect muscle strength, it is recommended that future studies consider these factors.

Furthermore, because the study had a cross-sectional design, the relationship between forearm position and grip strength was evaluated only based on the current condition. Longitudinal studies conducted in the future may provide a more comprehensive understanding of how muscle strength changes over time in different forearm positions.

CONCLUSION

In this study, hand grip strength values measured in different forearm positions in healthy young individuals were examined, and the effects of forearm position, hand dominance, and gender on grip strength were evaluated.

The findings obtained indicate that forearm position is an important determinant of grip strength and that grip strength values significantly vary across different forearm positions. Additionally, grip strength measured in the dominant hand was found to be higher than that measured in the non-dominant hand, and male participants demonstrated significantly higher grip strength values than female participants.

These findings emphasize the importance of standardizing forearm position in grip strength measurements and suggest that position-specific reference values should be considered in clinical evaluations.

Declarations

Author Contributions

Abdulmetin Hartavi contributed to data analysis, study design, and manuscript writing.
Zeynettin Kasırga contributed to conducting the data collection process, study design, supervision of the research, data analysis, and manuscript writing. All authors reviewed the final version of the manuscript and approved it for publication.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Statement

This study was approved by the Ethics Committee of Kilis 7 Aralık University (Meeting No: 2025/17, Decision No: 05, dated 23.10.2025). All procedures performed in this study were conducted in accordance with the ethical standards of the institutional research committee and the principles of the

Declaration of Helsinki.Written informed consent was obtained from all participants prior to participation in the study.

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Figures

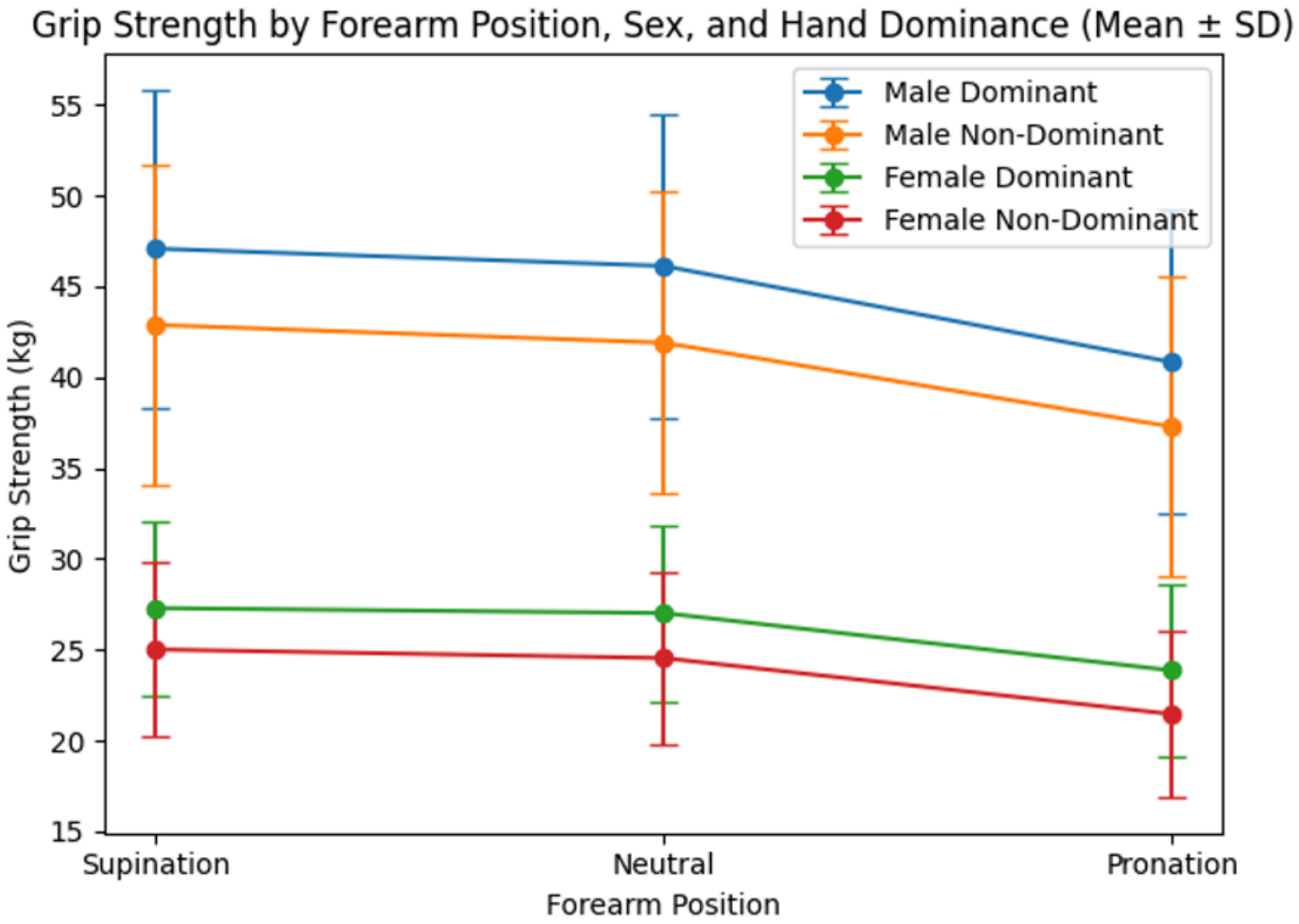


Figure 1

Hand Grip Strength Values According to Forearm Position, Hand Dominance, and Gender (Mean ± SD)

Grip strength values measured in the supination, neutral, and pronation positions for both dominant and non-dominant hands are presented separately for male and female groups. The points represent mean values, while the error bars represent the standard deviation (SD).Grip strength is expressed in kilograms (kg). The graph illustrates the general trend, showing that the order of strength across positions is:Supination > Neutral > Pronation (Figure 1).