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Research Article

Normative Values of Hand Grip Strength in Healthy Young females in Jazan, Saudi Arabia - A Cross Sectional Study

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Abstract

Background: The hand grip strength (HGS) assessment is important to understand the function and work capacity of the upper extremity. The hand gripping occurring during activities of daily living (ADLs). Therefore, assessing HGS is a critical component of upper limb functional assessment. HGS value has been shown as prognostic factor in different conditions in clinical settings and in general population. HGS assessment plays a key role in rehabilitation after hand injury and hand surgery. There are limited number of studies on HGS in Saudi Arabian population. To our knowledge, no study has been conducted in Jazan, Saudi Arabia on normative values of HGS among healthy females. Therefore, in this study we aimed to provide the normative values of HGS in healthy young females in Jazan, Saudi Arabia.

Methods: In this descriptive cross-sectional study, a total of 131 healthy females from 18-24 years of age were included from Jazan, Saudi Arabia. Information regarding the age, weight, height, BMI, and hand dominance were collected. HGS was measured by using a dynamometer in both dominant and non-dominant hands and the values are expressed in kilograms. The measurement was taken based on the standardized guidelines.

Results: The HGS showed incremental and significant increase as age progresses for both dominant and nondominant hands ($F(6) = 15.4$, $P < 0.001$) and ($F(6) = 14.1$, $P < 0.001$) respectively. There was no significant difference between dominant and non-dominant HGS ($p > 0.05$) in most of the age groups. HGS of dominant hand was positively and moderately correlated with age ($r = 0.666$ $p < 0.01$), positive and weak to moderate correlation with weight ($r = 0.331$ $p < 0.01$) positive and weak correlations with height ($r = 0.195$ $p < 0.05$) and BMI ($r = 0.280$ $p < 0.01$). Non-dominant HGS was positively and moderately correlated with age ($r = 0.663$ $p < 0.01$), positively and weakly correlated with height ($r = 0.231$ $p < 0.01$), weight ($r = 0.287$ $p < 0.01$) and BMI ($r = 0.218$ $p < 0.05$).

Conclusion: The study established the normal values of HGS stratified by age for young women in Jazan, Saudi Arabia. The results can be used as a reference value for rehabilitation of same age group.

Keywords: Hand Grip Strength (HGS); Dominant Hand; Non-Dominant Hand; Dynamometer; Saudi Arabia; Young Females

Abbreviations

HGS: Hand Grip Strength; ADL: Activities of Daily Living; ASHT: American Society of Hand Therapists; BMI: Body Mass Index

Introduction

The hands are important tactile organ [1] and differentiated musculoskeletal tool of upper extremity [2]. The hands are most important part in upper extremity and a creative tool used for non-verbal communications. Hands are used for a variety of tasks, including gripping, moving, writing, computing, and so on [1]. The hand grip strength (HGS) assessment is important to understand the function and work capacity of the upper extremity [1,3] The hand gripping occurring during activities of daily living (ADL) involving upper

extremity is an interaction of complex anatomical and functional structure of hand [4,5]. Therefore, assessing HGS is a critical component of upper limb functional assessment [4].

HGS can be quantified by measuring the amount of static force that the hand can squeeze around a dynamometer. The HGS is usually measured in kilograms and pounds, but can also be measured in milliliters of mercury and in Newtons. Following a standardized method and using a calibrated tool are important to have a reliable HGS values [5], even with different brand of dynamometer [6], and different accessors [7]. There are various ways and positions are used for measuring HGS. The American Society of hand Therapist has standardized the procedure and positions for measuring HGS [8,9].

HGS value has been shown as prognostic factor in different conditions in clinical settings and in general population [10]. HGS assessment can also be used to help establish appropriate therapies, measure therapeutic response, and manage healthcare resources after hand injury and hand surgery [5,11]. It is simple, portable, noninvasive, and generally inexpensive. To accurately interpret grip strength results, up-to date population-specific reference values for grip strength measures are required.

Many studies have been conducted for establishing the normative values of HGS in Greek [1], Indian [12], USA [13], Malaysia [14], South Korean [15], German [16], and Nigerian [17] populations. The reported HGS values in research varied significantly between different countries and geographic regions. Therefore, establishing the normative values of HGS for different countries and geographic regions are crucial in assessment and rehabilitation of hand injuries. There are limited number of studies on HGS in Saudi Arabian population. Some studies were conducted in geriatric population [18], female students in Riyadh, Saudi Arabia [19] and male college students in Taibah university, Saudi Arabia [20]. To our knowledge, no study has been conducted in Jazan, Saudi Arabia on normative values of HGS among healthy females. Therefore, in this study we aimed to provide the normative values of HGS in healthy young females in Jazan, Saudi Arabia.

Materials and Methods

Design and study participants

A descriptive cross-sectional study was conducted in Jazan, Saudi Arabia. A total of 131 healthy females from 18-24 years of age were included in this study, between December 2020 to November 2021. All participants were included via convenience sampling. Sample size was estimated by using the formula "N > 104+m" (N- sample size, m- number of independent variables) [21]. The independent variables were age, height, weight, BMI. Therefore, the estimated sample size was 108 participants and 10% dropout were expected, so the sample size increased as 120 participants. Inclusion criteria for the study were a) healthy Saudi females b) aged between 18 and 24 years. Participants with a) any neurological, musculoskeletal, cardiopulmonary, metabolic disorders affecting muscle strength b) any trauma, fractures and deformities in upper extremities, cervical region c) pain at the time of assessment d) pregnancy were excluded from the study. This study was approved by ethical committee of Jazan university.

Procedures

Prior to the dynamometer measurements the participants were examined for musculoskeletal and neurological function, active range of motion, presence of pain in upper extremities.

Demographic and anthropometric measurements

Information regarding the age, weight, height, BMI, and hand dominance were collected. Dominant hand was determined by one's preference in doing ADL such as eating, writing, throwing a ball, opening and closing doors [23]. Weight and height were measured using calibrated weighing machine and stadiometer to the nearest kilogram (kg) and centimeter (cm). BMI was calculated as the ratio between the weight and the square of height (kg/m^2).

Procedure of measuring hand grip

A Smedley spring dynamometer (Baseline, Model No:12-0286, Hong Kong) was calibrated according to the manufacturer's specifications. Data collection was performed according to the American Society of Hand Therapists (ASHT) guidelines [8]. The dynamometer handle was set in its second position and used for all tests. Hand-grip strength for both hands were recorded in a single session. Every participant was instructed to sit comfortably in an armless chair with the feet touching the floor. Participants had to sit with the trunk upright, shoulder adducted, neutrally rotated, elbow flexed to 90º, forearm and wrist in 0-30º and 0-15º of ulnar deviation. The face of the gauge was positioned away from the participant's face. The investigator showed all testing positions and provided oral instructions. Every participant was instructed to squeeze the handle of the dynamometer "as hard as possible" to exert a maximum force during each trial and hold for 5 seconds. There measurements were taken for each hand and average value was used for calculations. Fourth trail was taken if there is a difference over 10% than previously taken measurements [9]. HGS values were expressed in kilograms.

Statistical analysis

The data were analyzed using SPSS version 25.0 (SPSS Inc. Chicago, IL, USA). The distribution of data was examined prior to

analysis using Kolmogorov-Smirnov test. The data were presented as a mean ± standard deviation (SD) for continuous variables and as frequency and percentage for noncontinuous variables. The HGS measurement were stratified by age in 1 year increment. The analysis of variance (ANOVA) was utilized to check the effect of age in HGS values. Post hoc analysis was used to compare the differences between each age group. Pearson/Spearman correlation analysis to analyze the relationship between age, height, weight, BMI and HGS values. Independent sample 't' test-To compare between HGS values of dominant and non-dominant hands. A p-value of < 0.05 was considered as significant.

Results and Discussion

Results

A total of 138 participants were included in this study. Of these 7 participants were excluded due to pain in the neck (n=2), pain in the wrist (n=3) and neurological disorders (n=2). Thus, data from 131 participants were used for statistical analysis.

The demographic and anthropometric measure of study participants are shown in Table 1. The mean age was 20.92 ± 1.92 years and the mean values of height, weight and BMI were 154 ±6.6 cm, 51.95 ± 11.9 Kg and 21.73 ± 4.6 Kg/m^2. Overall, there were no statistical difference between weight, height and BMI across different age groups (P > 0.05). Among the participants 90.1 % (n=118) were right hand dominant, 9.9% (n=13) were left hand dominant and no one was reported ambidextrous.

Age (years)	N	Height (cm)	Weight (Kg)	BMI Kg/m^2
18	17	153.8 ± 7.6	48.2 ± 8.5	20.1 ± 3.2
19	20	152.4 ± 7.9	50.9 ± 11.4	21.8 ± 4.8
20	16	155 ± 6.9	50.2 ± 9.3	20.9 ± 3.4
21	31	154 ± 4.9	51.8 ± 13.9	21.6 ± 5.4
22	16	153.6 ± 4.6	54.8 ± 16.4	23.2 ± 6.6
23	12	156.8 ± 7.5	54.8 ± 12.7	22.1 ± 4.1
24	19	156.9 ± 8.1	53.9 ± 7.8	21.9 ± 3.5
Total	131	154 ± 6.6	51.95 ± 11.9	21.73 ± 4.6

Table 1: Demographic and anthropometric characteristics of all participants.

Data are represented as mean ± SD.

Hand grip strength

The normative values of HGS including means and SDs of dominant and non-dominant hands is shown in Table 2 and Graph 1. The HGS showed incremental and significant increase as age progresses for both dominant and nondominant hands (F (6) = 15.4, P < 0.001) and (F (6) = 14.1, P < 0.001) respectively. In dominant hand significant mean difference (p < 0.05) was noted between all age groups except between a) 20 and 21, 22, 23 b) 22 and 21, 23, 24 c) 23 and 24 age groups, whereas in non-dominant hand significant mean difference was observed between all age groups except between a) 20 and 21,22 b) 22 and 21, 23, 24 c) 23 and 21, 24 age groups.

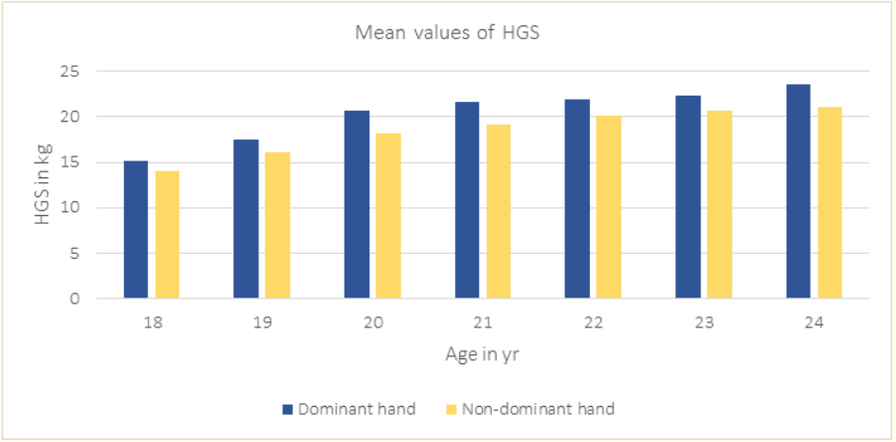
There was no significant difference between dominant and non-dominant HGS of all age groups (p > 0.05) except 22 and 23 age groups (p < 0.05). The lowest mean difference between dominant and non-dominant (1.1 kg) was reported in18-year age group and the highest mean difference (2.5 kg) was reported in 20-year, 21-year and 23-year age groups.

Age (yr)	N	HGS (kg) (D)	HGS (kg) (ND)
18	17	15.2 ± 2.7	14.1 ± 2.2
19	20	17.5 ± 3.3	16.1 ± 2.0
20	16	20.7 ± 4.3	18.2 ± 3.7
21	31	21.7 ± 1.3	19.2 ± 1.7
22	16	21.9 ± 2.5	20.1 ± 2.6
23	12	22.4 ± 1.8	20.7 ± 1.7
24	19	23.6 ± 4.9	21.1 ± 5.1
Total	131	20.5 ± 4.1	18.5 ± 3.6

Table 2: Mean and SD of HGS of different age groups.

yr year, kg kilogram, HGS handgrip strength, D dominant hand ND non-dominant hand.

Table 3 shows the Spearman's rank correlation values of HGD of dominant and non-dominant hand with demographic and anthropometric variables. HGS of dominant hand was positively and moderately correlated with age (r = 0.666 p < 0.01). HGS of dominant hand was showing positive and weak to moderate correlation with weight (r = 0.331 p < 0.01). Furthermore, HGS od dominant hand showed positive and weak correlations with height (r = 0.195 p < 0.05). and BMI (r = 0.280 p < 0.01).



Graph 1: Mean of HGS of different age groups.
yr year, kg kilogram, HGS handgrip strength.

Independent variables	HGS (kg) (D)	HGS (kg) (ND)
Age (yr)	0.666**	0.663**
Height (cm)	0.195*	0.231**
Weight (kg)	0.331**	0.287**
BMI (kg/m^2)	0.280**	0.218*

Table 3: Spearman's rank correlation values of HGS with demographic and anthropometric variables.

yr year, kg kilogram, cm centimeter, BMI body mass index, kg/m2 kilogram/meter square, HGS handgrip strength, D dominant hand ND non-dominant hand.

*P < 0.05, **P < 0.01.

Non-dominant HGS was positively and moderately correlated with age (r = 0.663 p < 0.01), positively and weakly correlated with height (r = 0.231 p < 0.01), weight (r = 0.287 p < 0.01) and BMI (r = 0.218 p < 0.05).

Discussion

This study aimed to establish the HGS normative values in a sample of healthy females aged 18–24 years in Jazan region, Saudi Arabia. The results illustrated that the age is positively and moderately correlated with HGS. HGS shows incremental increase with the age from 18 to 24 years old. HGS of the dominant hand and the nondominant hand, shows no significant difference except in 22- and 23-year age group.

The mean value of HGS in this study is 20.46 kg and 18.5 kg for dominant and non-dominant hands, respectively. This result is consistent with previously reported studies in Saudi Arabia [19], India [12], Sri Lanka [22], and Nigeria [23]. However, other studies show different values of HGS such as, Iran [24] and Brazil [25]. The differences of the HGS between participants in different studies could be attributed to different methods in measuring HGS values, research type, geographic differences, nutritional factors, and ethnicity. The variations in anthropometric and demographic measures among different population could be an explanation for difference in HGS.

This study investigated the correlation between HGS and demographic variables (height, weight and BMI) in dominant and non-dominant hands. The findings show that dominant hand and non-dominant hand HGS positively and moderately correlates with age. These results agree with the Shaheen, A.A.M., *et al*. (2021) [19], Amaral CA., *et al*. (2019) [26], and Alan M. Nevill and Roger L. Holder (2000) [27]. In addition, positive and week to moderate correlation between the weight and HGS, positive and week correlation with height, BMI and HGS. These results agree with the Piumi Nakandala., *et al*. (2019) [22].

This study has some limitations. The study is conducted in a Jazan region of Saudi Arabia. The results cannot be utilized for the other regions in Saudi Arabia and other ethnic groups. Another limitation is, we did not include upper extremity measurements like arm circumference, palmar width and wrist circumference in this study. The study was incorporating healthy females aged from 18-24 years. Sample size was very limited. A larger sample size is recommended for future studies.

Conclusion

This study established the normal values of HGS stratified by age (18-24 years) for young women in Jazan, Saudi Arabia. The results of this research can be used for treating the patient of the same age group and can also be used as a reference value for HGS.

Conflict of Interest

Nil.

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