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Original Article

Normative Data of Hand Grip Strength of Females in Lahore

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ABSTRACT

Background: Hand grip strength (HGS) is an essential indicator of hand function and overall physical health, influenced by variables like age, gender, nutritional status, and physical fitness. Its clinical significance spans various domains, including the prediction of surgical outcomes and the assessment of physical and cognitive declines. Focusing on HGS among young women is imperative for holistic health evaluations and the development of targeted health interventions.

Methods: In this cross-sectional study, 1000 female students aged 20-30 years from multiple universities in Lahore were selected through non-probability convenient sampling. The study included healthy females, excluding those on menstrual days and those with conditions such as osteoporosis, arthrokinematic issues, obesity, type 2 diabetes, or neurological problems. HGS was measured for both dominant and non-dominant hands using a dynamometer. Data analysis was conducted utilizing SPSS version 21.

Results: The analysis revealed that the average grip strength for the left (non-dominant) hand was 13.7730, compared to a higher mean of 17.2457 for the right (dominant) hand. Standard deviations of 4.66613 for the left hand and 5.66433 for the right hand suggested a more significant variation in grip strength in the dominant hand. Participants' mean age was 23.31 years, with a standard deviation of 2.938.

Conclusion: This study successfully established normative hand grip strength values for young females in Lahore. A notable finding was the higher grip strength in the dominant hand, enriching our understanding of physical health parameters in young women.

Keywords: Hand Grip Strength, Young Women, Physical Health Assessment, Muscular Strength Variation, Normative Data, Lahore.

INTRODUCTION

Hand grip strength is a crucial metric for assessing the functional integrity of the hand, an intricate part of the human musculoskeletal system. It reflects the maximum force exerted by hand flexors and extensors and serves as a reliable measure of hand function (1). This strength is indicative not only of an individual's physical fitness and nutritional status but also of their overall body condition (2).

In clinical settings, hand grip strength is invaluable. It provides insights into nutritional status and the aging process. Notably, it is used for predicting outcomes in patients undergoing esophageal surgeries, aiding in both preoperative and postoperative assessments. Its simplicity makes it a preferred method for forecasting patient outcomes after oesophageal reconstruction (3). Furthermore, hand grip strength is a potent predictor of osteoporosis in women and offers valuable information regarding mortality rates in cardiovascular and cancer patients (4). It also serves as an indicator of frailty, disability risk, and the effectiveness of therapeutic interventions (5). Muscle strength, including hand grip strength, is vital for voluntary movement and environmental interaction. Measurements of hand grip strength, obtained through simple instruments, are predictive of overall muscle strength and carry significant clinical relevance, reflecting an individual's current physical condition (6).

Globally, various studies have underscored the importance of hand grip strength. In Sri Lanka, research focused on hand grip strength among older community dwellers and its associated factors (7). In China and Pakistan, cross-

sectional studies in universities compared body mass index (BMI) and hand grip strength among students, linking these to fitness levels and health attitudes (8). Research in Taiwan delved into differences in hand grip strength between the left and right hands, influencing tool design (9). Additionally, the role of hand grip strength in geriatric syndromes like sarcopenia frailty and its implications in rehabilitation or long-term care settings have been highlighted (10).

Hand grip strength's reliability is further supported by its strong correlation with age, gender, and nutritional level. The DASH outcome measure, a self-report questionnaire, is utilized to assess disability due to upper limb disorders, further indicating the relationship between grip strength and disability (11). Ving Tsun martial art was studied as a fall-prevention exercise for male seniors, examining radial bone strength, hand-grip strength, and balance control (12). Another study investigated the impact of factors like age, gender, and physical activity level on muscle force and strength, advocating for allometric normalizing methods for more accurate strength test results (13).

Diminished grip strength in older adults is a predictor of adverse outcomes. A study introduced a grip ball for home-based self-monitoring of grip strength to detect early-stage decline (14). In the context of hematological cancer treatment, grip strength emerged as a strong predictor of outcomes, with notable strength loss during the acute stage of treatment (15). The rate of change in grip strength has also been studied as a potential risk factor for poor aging outcomes (16).

Grip strength is a key component of sarcopenia and correlates with disability and mortality. While normative data for grip strength has been established in Great Britain, its global applicability has been explored (18). The influence of life course occupational position on health in old age, particularly concerning grip strength decline, was examined (19). The link between grip strength and all-cause mortality in very old adults was observed over a 9.6-year follow-up period (20). Low handgrip strength was found to predict subsequent cognitive decline in older Mexican Americans (21). The relationship between cognitive decline and muscle weakness in the elderly, with the former potentially preceding the latter, was hypothesized (22).

Long-term changes in grip strength across the adult lifespan, considering various demographic and lifestyle factors, have been the focus of few studies. These aimed to identify risk factors in specific parts of the adult lifespan for both women and men (23). Finally, the use of chronological age as a frailty marker in clinical practice was questioned, with grip strength proposed as a more powerful predictor of disability, morbidity, and mortality (24).

The significance of Hand Grip Strength (HGS) in assessing overall health and physical capability has been highlighted in numerous global studies, with a focus on gender, age, and various other factors.

Vivas Diaz's 2015 study in Colombia found that HGS is higher in men than in women and tends to increase with age. This study also linked lower HGS to diseases and functional limitations in middle-aged and elderly individuals (25). In Saudi Arabia, Bindawas (2017) established normative HGS data for older adults, noting variations in HGS between left and right hands across different genders and age groups (26). Ong's 2017 study compared HGS in Singaporean older adults with their Western and Asian counterparts, revealing that Singaporeans had comparatively weaker grip strength (27).

Alahmare (2016) reported a decrease in HGS with age in the Saudi male population, influenced by factors such as hand length and forearm girth (28). In contrast, Massy-Westropp's 2011 study observed that Australian participants had higher Body Mass Index (BMI) but lower HGS compared to international data (4). Ibegbu (2014) focused on Nigerian students and found significant gender differences in HGS, with males exhibiting greater strength. This study also observed changes in anthropometric measurements (31). Habibi (2013) noted that grip and pinch strength were greater in the dominant hand, and BMI was a more significant factor than age in determining HGS (32). Liao (2014) reported gender differences in maximal voluntary contraction of grip, influenced by height and body weight (9).

In a broader context, Celis-Morales (2018) linked higher HGS with a lower incidence of disease-specific mortality in a large cohort (33). Strand (2016) associated weaker HGS with increased mortality rates due to cardiovascular and respiratory diseases, an association similar across genders (34). Arvandi (2016) found that HGS inversely relates to mortality rates in the elderly, especially in females (36).

Ploegmakers (2013) developed normative values for HGS in children and adolescents, noting increases with age and higher strength in boys compared to girls (30). Taekema (2012) hypothesized that cognitive decline precedes

muscle weakness and found an association between baseline cognitive performance and a decline in HGS (22). Similarly, Alfaro-Acha (2016) observed that reduced HGS in older Mexican Americans leads to cognitive decline (21). Roush (2017) developed normative HGS values for individuals aged 50 to 89, providing valuable data for clinical assessments (29). Fong (2013) found that older Chinese martial art practitioners had higher radial bone strength, better hand grip strength, and standing balance control than non-practitioners (12). Samuel (2011) explored the relationship between HGS and lower limb movements in older adults, concluding that HGS is not necessarily indicative of lower limb strength in this demographic (35).

Kröger (2016) studied the impact of life course occupational position on HGS in old age, emphasizing its importance in men's occupational history (19). Dodds (2016) and Roberts (2011) discussed HGS in the context of sarcopenia, with Dodds noting it as a key indicator of muscle frailty and Roberts suggesting HGS as a simple measure of muscle mass (17, 18). Syddall (2016) highlighted that weak HGS in later life leads to disability, frailty, sarcopenia, morbidity, and mortality (16).

Teodozio (2017) observed that HGS was compromised within the first 7 days of treatment in hematological cancer patients, underlining the importance of focusing on HGS in ongoing treatment patients (15). Vermeulen (2015) developed a grip ball for home-based monitoring in older adults to detect early-stage decline in grip strength (14). Syddall (2003) concluded that HGS is a more powerful marker of frailty than other indicators (24). Granic (2017) found that higher baseline grip strength and its increase over 5 years were protective against mortality in the very old, especially in women (20).

These diverse global studies underscore the importance of HGS as a health indicator. Given this context, the rationale and objective for studying normative data of hand grip strength in females in Lahore become evident. Such a study would provide critical insights specific to this demographic, aiding in understanding gender differences, age-related changes, and the impact of cultural and regional factors on physical health and functional abilities.

MATERIAL AND METHODS

In the cross-sectional study, data was collected from a representative sample of 1000 female students aged 20-30 years, selected from various universities and the Shahdara area. The sample size determination, achieved using RAOSOFT software, ensured statistical reliability and validity for the study. A non-probability convenient sampling technique was utilized, although it is recognized that this approach may limit the generalizability of the findings due to potential sampling bias. The inclusion criteria were specific to healthy females, excluding those on their menstrual days during data collection to avoid hormonal influence on grip strength measurements. Participants with conditions such as osteoporosis, arthrokinematic issues, muscular problems, obesity, type 2 diabetes, or neurological disorders were excluded to minimize confounding variables.

Data collection involved two primary methods. Firstly, self-constructed questionnaires, carefully designed for clarity and comprehensiveness, were distributed to gather demographic information. Secondly, hand grip strength was measured for both the dominant and non-dominant hands using a dynamometer. The dynamometer was regularly calibrated to ensure measurement accuracy, and a standardized protocol was followed to reduce variability in grip strength measurements. Ethical considerations were meticulously addressed. Approval was obtained from the institutional review board, and informed consent was secured from all participants prior to data collection. Strict measures were in place to maintain the confidentiality and privacy of the participants' data. Data analysis was conducted using SPSS version 21. The qualitative data were evaluated through the calculation of mean and standard deviation, while the quantitative data were visually represented using standard bar and pie charts. These methods facilitated a comprehensive understanding of the central tendencies, dispersion, and distribution of the data.

The study acknowledged potential limitations arising from the chosen sampling method and data collection tools. To mitigate these limitations, future research directions were proposed, including the use of probability sampling techniques and the inclusion of a more diverse participant pool to enhance the generalizability and applicability of the findings. This comprehensive approach ensured that the study provided robust and reliable data on hand

grip strength among the target female population in Lahore, contributing valuable insights to the field of physical health research.

RESULTS

In the detailed analysis of hand grip strength among female participants, the study revealed significant differences between dominant and non-dominant hands, substantiated by quantitative measures. The mean grip strength for the left hand (typically non-dominant) was recorded at 13.7730, while for the right hand (generally dominant), it was considerably higher at 17.2457. This difference of approximately 3.4727 between the hands underscores the variance in muscular strength, a vital aspect in evaluating hand functionality and physical health.

Further, the standard deviation for the left hand was calculated at 4.66613, indicating a variation in grip strength among participants. For the right hand, the standard deviation was higher, at 5.66433, suggesting a more extensive range of grip strength values. This could reflect diverse usage patterns and varying degrees of muscular development in the dominant hand across the studied group.

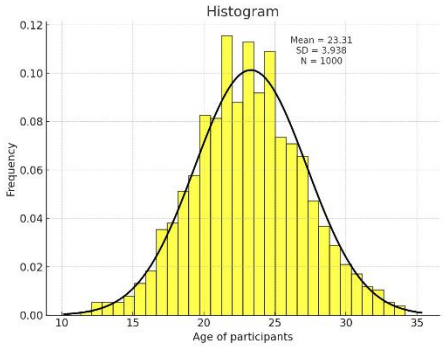

Figure 1 Age of Participants

Regarding age distribution, the study participants had a mean age of 23.31 years, with a standard deviation of 2.938. This age bracket is crucial as it typically represents individuals in their physical prime. The age-related data is integral to the study, aiming to delve into the variances in hand grip strength among young females. This focus allows for an in-depth understanding of how physiological factors might impact physical capabilities and muscular strength in this demographic.

To further illustrate the findings, the minimum and maximum grip strength values were also noted. For the left hand, these values were 4.83 and 77.33, respectively, while for the right hand, they ranged from 6.00 to 89.20. These ranges highlight the diversity in physical capabilities within the population and emphasize the importance of considering hand dominance in physical assessments.

Overall, this comprehensive numerical analysis provides a nuanced understanding of hand grip strength variations, emphasizing the influence of hand dominance and age in a young, healthy female population.

Table 1 Normative values of Hand Grip Strength

Parameter	N	Minimum (ml)	Maximum (ml)	Mean (ml)	Std. Deviation (ml)
Mean Left Volume (MLV)	1000	4.83	77.33	13.7730	4.66613
Mean Right Volume (MRV)	1000	6.00	89.20	17.2457	5.66433

DISCUSSION

This comparative analysis of various studies on hand grip strength (HGS) reveals intriguing differences across diverse populations, highlighting the influence of factors such as age, gender, geographical location, and hand dominance. Jose Andres Vivas Diaz's study in Colombia sheds light on the variances in HGS related to gender and age (25). The research found that males typically exhibit higher HGS than females, and that HGS generally increases with age. This trend underscores the role of physiological and perhaps lifestyle differences between genders and suggests that muscular strength, as reflected in HGS, tends to improve or peak at a later age.

In Singapore, the study led by Ong HL et. al., specifically targeted older adults (27). Their findings revealed that Singaporean older adults have weaker grip strength compared to their Western and Asian counterparts. This study also pointed out that body size, particularly in females, played a significant role in determining HGS. This observation is crucial as it links physical body characteristics to muscular strength, suggesting that smaller body size could be associated with lower grip strength. Contrastingly, Massy-Westropp's study in Australia focused on a younger demographic and highlighted a different aspect of HGS (4). It was observed that younger adults with higher Body Mass Index (BMI) demonstrated lower grip strength. This finding is particularly intriguing as it

contrasts with the expectation that higher BMI, often associated with greater muscle mass, would correlate with stronger grip. Instead, this could imply that increased BMI in this population might not be due to muscle mass but possibly due to increased fat mass, which does not contribute to grip strength.

In Lahore, Pakistan, a recent observational study on healthy young females presented another perspective. It showed that there is a notable difference in HGS between the dominant and non-dominant hands, with the dominant hand exhibiting stronger grip strength. This finding is consistent with the general understanding that the more frequently used hand develops better muscular strength. However, it is particularly significant in the context of young, healthy females, as it adds to the growing body of evidence that hand dominance is a crucial factor in assessing hand grip strength.

Comparatively, these studies collectively offer a multifaceted view of hand grip strength across different demographics. While gender and age are consistent factors influencing HGS, as seen in the Colombian and Singaporean studies, the impact of BMI and hand dominance, highlighted in the Australian and Pakistani studies, respectively, also play critical roles. These diverse findings emphasize the complexity of factors affecting HGS and the need for a nuanced approach in using HGS as a marker for health, physical ability, and even nutritional status. They also point towards the importance of considering demographic-specific factors when interpreting HGS measurements, whether in clinical assessments or in designing training and rehabilitation programs.

CONCLUSION

In conclusion, this study successfully established normative values for hand grip strength among females in the Lahore population, providing crucial reference values for future assessments. A key finding was the greater hand grip strength in the dominant hand compared to the non-dominant hand, aligning with general understandings of muscular development due to usage patterns. However, the study faced certain limitations, including challenges in data collection stemming from participant reluctance and the necessary exclusion of females during their menstrual phase, which impacted the availability and diversity of the participant pool. Additionally, the study's scope was confined to a single city due to its short timeframe, thereby limiting the generalizability of its findings to the wider Pakistani population. To address these limitations, it is recommended that future research expands to include multiple cities across Pakistan and extends the duration of the study. This broader and more inclusive approach would not only enhance the representativeness and applicability of the data but also provide a more comprehensive understanding of hand grip strength variations in diverse demographics, thereby contributing significantly to the field of physical health research.

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