

A Comparative Study of Grip Strength in Three Different Activities of Daily Living Positions in Geriatric Population

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DOI: <https://doi.org/10.52403/ijhsr.20220431>

ABSTRACT

Background & Aim: Geriatric population need to have their grip strength while doing Activities of Daily Living (ADL) in order to reduce the risk of falls. Hence, the aim of this study was to assess grip strength of both hands using three different positions according to ADL as well as to find the correlation between age and Grip Strength in geriatric population.

Methods: Forty participants between the age group of 60 to 80 years were evaluated for grip strength using Jamar hand dynamometer in 3 different ADL positions. The average of the three readings were taken for each hand for comparison.

Results: Subjects showed greater grip strength in Dominant hand. In position 1, subjects with age group between 60-69 years showed highest mean grip, whereas in age group between 70-80 years highest mean grip was seen in position 3. Also, this study also showed a negative correlation of age & grip strength in both the hands.

Conclusion: This study affirms that different joint positions have an effect on grip strength especially elbow & shoulder joint with respect to wrist positions. In conclusion, all three positions can be used to measure grip strength because they affect ADLs.

Key Words: falls, geriatric population, grip strength, Jamar Dynamometer

INTRODUCTION

Men & women attain maximum muscle strength between the second and third decades of life. After that there is a progressive decline in muscular strength in various muscle groups & during different types of muscle contraction. Studies have shown that after third decade of life there is a 16.5 % reduction in muscle strength and as aging accelerates there is further deterioration in muscular strength.[1]

Reduction in muscle strength is associated with reduced muscle mass. As men & women age, there is significant reduction in the cross-sectional area of

muscles in both the upper & lower extremities. Due to this reduced muscle mass, there is reduced activity & disuse atrophy which can further aggravate reduction in muscle mass as well as muscle strength. An increased risk factor for reduction in muscle mass could be an increase in body fat percentage & reduction in strength & VO₂ max between third and sixth decades of life. Another important key risk factor in fall injuries is the inability to produce powerful and quick muscle activation in the elderly population.[2] Recent clinical & epidemiological studies have shown that grip strength of middle

aged & older adults is an important marker of current health & therefore it is essential to counsel people during aging, injury & rehabilitation. Many studies suggest that grip strength can be used to screen people at risk for osteoporosis, loss of physical functionality & negative effects following health recovery after illness because low grip strength is correlated with sarcopenia, frailty, malnutrition & loss of bone mineral density, suggesting that this measure can be helpful.[2]

Evaluation of hand functions, physical fitness & nutritional status can be done by measuring the hand grip strength. It is regarded as the most reliable clinical measure of human strength. The power of hand grip is the result of forceful flexion of all finger joints with maximum voluntary force contraction that the subject is able to exert under normal biokinetic conditions.[3]

Many hand grip studies have found a positive correlation of height, weight & BMI with hand grip strength & also it is proved that the dominant hand has 10% stronger grip strength as compared with the non-dominant hand. Based on the incidence of disability, morbidity & mortality in adult population there is good evidence which suggest that hand grip strength is a strong indicator of health status.[1]

The major hand activities like pushing, adjusting objects & supporting the body in space are primarily adapted for reaching, grasping & manipulating the hand functions. Prehensile movements of the hand have been described as cylinder, ball, ring, pliers and pincer grips & all such grips are the variants of precision & power grips. Many forces affecting the fingers during gripping activities, the ability to develop a strong grip & maintain it during such activities has become an important element for elderly. Geriatric people need their hand grip strength in various daily activities because as the age increases grip strength tends to decrease due to various factors including weak hand muscles which can result in an increased risk of falls.[4] So, it is important to evaluate the hand grip

strength in elderly population in order to keep their hand functions & grip strength normal so that they can carry out their daily activities independently & thereby reducing the risk of falls by giving appropriate exercise interventions.[1]

An inherent process of aging is a decline in strength which has been reported extensively as a result of muscle atrophy. Elderly population need to have their grip strength while doing activities of daily living (ADL). Also, when using cane or walker, grip strength is necessary. Sometimes when the individual is suffering from osteoarthritis of knee or hip, the cane should be used on the contralateral side, but if the hand holding the cane on the contralateral side is not the dominant hand then grip strength becomes essential for the non-dominant hand as well. Hence, this study was done to assess grip strength in both hands in the aging population using three different positions according to their ADL's, as well as to find the correlation between age & grip strength in both the hands.

MATERIALS AND METHOD

Study design, Setting & Participants:

This was an observational study carried out in the Out Patient Department of Dr. D. Y. Patil college of Physiotherapy, Pimpri, Pune from August 2017 to February 2018. Forty samples fulfilling the inclusion criteria were chosen by purposive sampling method. Geriatric population of both genders between the age group of 60 to 80 years were included. Participants were excluded if they had any hand deformity, any musculoskeletal injuries of Upper Extremity, recent surgery of upper extremity in past 6 months, upper extremity neurological conditions / deficits & subjects not willing to participate in the study.

Procedure:

The study was conducted in Dr. D.Y Patil college of physiotherapy OPD, after the approval from Institutional Ethical Committee. After explaining the procedure

& motive of the study, a written informed consent was taken from all the participants. Detailed explanation was given to all the participants regarding the study. Pre-participation data such as age, gender, hand dominance was collected from all the samples. All the participants were evaluated for grip strength with the help of Jamar Hand Dynamometer in three different positions. In the first position (P1) (Fig. 1), the subjects were seated upright with shoulder in neutral, elbow flexed at 90 degrees, forearm neutral, wrist between 0 & 30 degree of dorsiflexion (this position represents pulling or pushing of door).[2] In the second position (P2) (Fig. 2), shoulder abducted to 90 degree, shoulder in external rotation, elbow flexed to 90 degree, forearm pronated & wrist between 0 – 30 degree of dorsiflexion (this position represents holding of an overhead railing).

In the third position(P3) (Fig. 3), shoulder is neutral, elbow flexed to 30 degree & wrist in 20degree of ulnar deviation (this position represents holding of cane or walker). The grip handle was adjusted to fit comfortably within the subjects hand with fingers in 90 degree flexion at proximal & distal interphalangeal joints with thumb in 90 degree abduction.[2] Detailed explanation about the dynamometer usage was explained to all the subjects. They were then instructed to squeeze the dynamometer as hard as possible with care not to hold their breath for 5 seconds & rest for 30 seconds to overcome fatigue & repeat the test two more times. The contralateral hand was then examined using the same protocol. The average of the 3 readings were taken for each hand & used for comparison of 40 subjects[14].



Figure 1: Position 1



Figure 2: Position 2



Figure 3: Position 3

Statistical Analysis:

Statistical analysis was done using Primer of Biostatistics (version 7). The software was utilized to calculate the mean values and correlation of all the variables with level of significance set at $p < 0.05$.

RESULT

The study consisted of 40 subjects in which grip strength was measured in three different ADL positions using the Jamar Hand Dynamometer.

Table 1: Descriptive statistics of the subjects.

Gender	Total No.	Age in years (Mean)	Dominance	
			Right	Left
Male	20	66	15	5
Female	20	67.75	19	1

Table 1 represents the demographic characteristics of the participants, with mean age of males and females. Also, majority of the subjects had Right hand Dominance.

Table 2: Grip strength of Dominant & Non-dominant Hand in three positions.

Hand Dominance	Dominant hand (Male)	Non-dominant hand (Male)	Dominant hand (Female)	Non-dominant hand (Female)
Position 1(Kg)	28.03 ± 5.58	27.92±10.49	15.1±4.666	12.2±3.747
Position 2(Kg)	28.91 ± 5.53	25.6±5.017	15.2±4.245	12.2±3.724
Position 3(Kg)	28.83 ± 5.13	25.9±4.833	15.1±4.411	12.3±3.678

Table 3: Correlation of Age and Grip strength in Dominant & Non-Dominant hand of both the genders.

Hand Dominance	Dominant Hand (Male & Female)	Non-dominant Hand (Male & Female)
Correlation co-efficient (r)	-0.5164	-0.435
P value	<0.05*	<0.05*

*Statistical significance

The correlation co-efficient i.e. value of (r) in the dominant hand was -0.5164, while the correlation co-efficient i.e. value of (r) in the non-dominant hand was -0.435. The negative value signifies that the variables have a negative correlation. Also, the p value is <0.05, so it was statistically significant.

DISCUSSION

The hand is considered as the most active and important part of the upper extremity. The purpose of testing the grip strength is diverse, including to diagnose diseases, to evaluate & compare treatments, to document progression of muscle strength, to provide feedback during rehabilitation process. It is also able to predict a decline in function in old age.[5] Important factors of impaired hand function in elderly adults includes common metabolic & skeletal diseases such as Osteoarthritis, Rheumatoid Arthritis, Osteoporosis & hormonal changes.[6] The main aim of this study was to compare grip strength using 3 ADL positions in geriatric population as well as to find the correlation of age and grip strength. After assessing the grip strength in 3 ADL positions following findings were observed. In Table 2, mean grip values of Dominant hand (Male) in the age group of 60-69 years, there was not much difference between the 3 positions, but from the age group of 70-80 yrs, there was 1 kg difference in all the 3 positions. Similar

findings were seen for the non-dominant hand (Male) as well. In Dominant hand (Female) & Non-Dominant hand (Female) mean grip values in the age group of 60-69 & 70-80 years, there was not much difference seen between all 3 positions. In the present study, subjects showed greater grip strength in Dominant hand than that in non-dominant hand. This might be because of difference in muscle strength between the two hands. According to Rabergs et.al, one explanation for the difference in grip strength may be due to use of more muscle & muscular hypertrophy which leads to increase strength in the dominant hand.[7]

In relation to the grip strength measured in 3 different ADL positions. In Dominant hand (Male) in the age group of 60-69yrs & in Dominant hand (Female) in the age group of 70-80yrs position 2 (i.e shoulder abducted to 90 degree & externally rotated, elbow flexed to 90 degree, forearm neutral) had highest mean grip, the reason for this may be that the synergistic muscles of the back & shoulder may be able to act to their best advantage when shoulder is elevated, this elevated position may allow those proximal muscles involved to be stretched beyond their normal resting length which would increase their efficiency for optimum exertion according to length-tension relation as stated by Carlstedt et.al.[8]

In Non-Dominant hand (Male: 60-69yrs) & Dominant hand (Female: 60-69yrs) position 1 (Shoulder neutral, elbow flexed to 90 degree, forearm neutral) had highest mean grip, a possible reason may be that a direct relation exists between grip strength and forearm muscles. Flexor muscles originate from lower part of

humerus which is above elbow joint, so elbow position may have significant effect on grip strength as stated by Su C.Y et.al.[9]

Highest grip strength in position 3 (shoulder neutral ,elbow flexed to 30 degree & wrist in 20 degree of ulnar deviation) was seen in age group of 70-80 years of Dominant & Non-Dominant hand in male subjects, the reason for this may be that when the wrist is positioned at neutral with slight ulnar deviation the muscular compartments for individual fingers attain optimal length for maximum force production , as wrist moves in extension the muscle compartment length for each finger exceeds the optimal range, because flexor digitorum profundus has to cross many joints like the wrist, MCP joint ,PIP & DIP joints leading to decrease in grip force as stated by Loren et.al.[10] Hence, this could be a reason why grip strength was higher in this position because wrist was positioned in neutral.

Our study confirms that different joint positions can affect the grip strength especially elbow & shoulder joint with respect to wrist positions. This study also showed a negative correlation of age & grip strength in both the hands, meaning as the age increased grip strength decreased, as well as the graph was statistically significant. There may be intrinsic factors (Genetic, endocrine, metabolic, pathological factors) or extrinsic factors (Environmental, nutrition, physical activity, traumatic injuries) that may affect the hand function in the aging population. One of the most common changes in aging skeletal muscle is decrease in muscle mass also called as 'sarcopenia'. With aging the hand bones & joints, especially synovial joints are accompanied with morphological & pathological changes common to aging skeletal tissue. Manual activities that require grip & pinch strength can become difficult and cause restrictions if the person is suffering from osteoarthritis of hands & fingers. Many of the tools used in everyday living are not designed for elderly people. Much more thought has to be given for

modifying tools and instruments of daily living for elderly population. These can include basic items such as cutlery, pen, scissors, combs, toothbrushes etc. age-related changes in hands can be minimized by introducing simple regular exercise programs for hand strengthening and hand flexibility. Equipment's like squeezable rubber balls, or elastic bands on fingers or moldable clay can be utilized in the exercise protocol. Such exercises should be designed so as to strengthen the grip and to maintain joint flexibility of fingers and the wrist.[6]

Another result of this study showed that Grip strength of elderly males was greater than grip strength of elderly females. One explanation for this finding was the difference in type of activity of each gender. Males are more active than females & perform more physical work, sometimes males are involved in more weight handling than their female counterpart.[11] The difference in body composition may be another factor. According to a study done by Janssen et.al on skeletal muscle mass & distribution in men & women aged 18-88yrs concluded that strength variations between men & women may be mainly related to smaller amount of absolute muscle mass & a higher body fat percentage in women. These differences occur due to different muscle mass distribution & different day-to-day activities which could give an explanation why males have higher grip strength as compared to females.[12]

Thus, from the above study it is concluded that various joint positions can affect the grip strength especially that of elbow & shoulder joint with respect to wrist positions. All three positions can be used to measure grip strength because they affect ADL's. Some clinically useful information may be derived from these findings, such as in rehabilitation programs it would be feasible to evaluate the patients grip strength using different combined elbow & shoulder positions to determine their maximal grip force. Later with this knowledge, an individualized treatment protocol can be designed to train the patients in this specific

upper extremity positioning that will provide greater efficiency. In regard to hand dominance, Watson HD et.al concluded in his study that training of non-dominant hand may cause activation of other motor cortex. This suggests that training of one hand may improve performance of the other hand as well.[13]

This study confines the extreme importance of muscle strength for activities of daily living as a negative correlation of age & grip strength was found in the study. Hence, in geriatric population a regular muscle strengthening may be helpful in maintaining functional activity along with some ergonomic modifications of equipment's used in daily living.

CONCLUSION

From the above study, it is concluded that various joint positions can affect the grip strength especially elbow and shoulder joint with respect to wrist positions. All three positions can be used to measure grip strength because they affect ADLs. Some clinically useful information may be derived from these findings, such as in rehabilitation programs it would be feasible to evaluate the patients grip strength using different combined elbow and shoulder positions to determine their maximal grip force. Later with this knowledge, an individualized treatment program can be designed to train the patient in the specific upper extremity positioning that provides greater efficiency.

Limitations:

1. Small sample size used in the study
2. Another Limitation was fatigue since three positions were used for both the hands.

Acknowledgement: None

Conflict of Interest: None

Source of Funding: None

Ethical Approval: Approved

REFERENCES

1. Nurgul Arinci ,Esma Ceceli , Meleksezgin , Ismet As & Gunsahsahin. Correlation of Hand Muscle Function & Activity Restriction in Elderly. International Journal of Rehabilitation Research 2009; 32(3): 213-18.
2. Abazar Teimoori, Mohammad Nasiri, Aslan Khodamoradi & Khadijeh Ebrahimi. A Study on Effects of Aging on Hand Grip in Adult Iranian Population. Australian Journal of Applied Sciences 2011; 5(12) : 970-73.
3. Johanne desrosiers , Gina bravo ,Elisabeth dutil. Normative Data for Grip Strength of Elderly Men & Women. American Journal of Occupational Therapy 1994; vol 3: 542-50.
4. Simona Giampoli ,Francesca Cecchi , Cinzia Lonoce , Agatapoce , Maria Fenecia, Alessandro Menotti. Hand Grip Strength Predicts Incident Disability in Non-disable Older Men. Journal of Age & Ageing 1999; 28(3): 283-88.
5. Rantanen.T ,Guralnik , Foley.D, Mid Life Hand Grip Strength as Predictor of Old Age Disability. Journal of Am.Med.Asso 1999; 281:558-60.
6. Eli Carmeli , Hagar Patish , Raymond coleman. The Aging Hand. Journal of Gerontology 2003; 58A(2): 146-52.
7. Rabergs. G and Roberts. L. Effect of Handedness on Grip Strength. Archv.Phys.Med.Rehab 1997; 76: 410-14.
8. Carlstedt.C.A , Nordin M & Frankel V. H. Basic Biomechanics of Musculoskeletal System. 2nd edition 1989: 258-61.
9. Su , C.Y Lin, J.H Chein , Sung.Y.T. Grip Strength in Different Positions of Elbow & Shoulder. Archv.Phys.Med.Rehab 1994b; 75: 812-15
10. Loren. G. J , Shoemaker. S. D , Burkholder Jacobson. M. D , Friden. J. Human Wrist Motors: Biomechanical Design & Application to Tendon Transfer. Journal of Biomechanics 1996; 29: 331-42.
11. Sengupta. P , Maity. P , Pal. A , Dhara. P.C. Effect of Body Posture on Hand Grip Strength in Adult Bengalee Population. Journal of Exercise Science & Physiology 2011; 7(2): 79-88.

12. Janssen I , Heymsfield S. B , Wang. Z. M , Ross R. Skeletal Muscle Mass & Distribution in Men & Women Aged 18-88 yrs. Journal of Applied Physiology 2000; 89(1) : 81-88.
 13. Alan.H.D Watson. What Studying Musicians Tell us About Motor Control of Hand. Journal of Anatomy 2006; 208: 527-42.
 14. David J. Magee. Orthopedic Physical Assessment. 6th edition. 2014; Ch 7: 453-55
- How to cite this article: Desai R, Choudhary R, Dogra P et.al. A comparative study of grip strength in three different activities of daily living positions in geriatric population. *Int J Health Sci Res.* 2022; 12(4): 269-275. DOI: <https://doi.org/10.52403/ijhsr.20220431>
