OPEN ACCESS

ORIGINAL ARTICLE

Comparative Effectiveness of Resistance Training With and Without Finger Movement Exercises on Hand Grip Strength and Hand Function in Elderly Population: A Randomized Controlled Trial

Nimra Arshad[1], Hira Zahid[2], Shaiza Assad[3]

[1]Lecturer, The University of Faisalabad, Pakistan
[2,3] Physiotherapist, physiotherapy department, Allied Hospital, Faisalabad, Pakistan

Author`s Contribution

[1-3]Conception and design, [2- 3] Collection and assembly of data, [2-1]Analysis and interpretation of the data, [3]Critical revision of the article for important intellectual content, [2]Statistical expertise,[1]Final approval and guarantor of the article.

Article Info.

Received: September 21, 2021
Acceptance: 2022-10-05

Conflict of Interest: None
Funding Sources: None

Address of Correspondence

Nimra Arshad
Email Id: nimraarshad70@yahoo.com
ORCID: 0000-0003-4020-1221

Cite this article as: Arshad N, Zahid H, Assad S. Comparative Effectiveness of Resistance Training With and Without Finger Movement Exercises on Hand Grip Strength and Hand Function in Elderly Population: A Randomized Controlled Trial. JRCRS. 2023; 11(1):03-07
DOI: 10.53389/JRCRS.2023110102

A B S T R A C T

Background: Aging is an irreversible process and with ageing ability to perform daily tasks is reduced and loss of independence may occur. Loss of hand muscle strength and functioning are also important factors in ageing which affects the activities of daily living (ADLs).

Objective: This study aimed to determine the effectiveness of finger movement exercises on handgrip strength and hand function among elderly individuals.

Methodology: A quantitative study was carried out having a Randomized Controlled Trial design. 24 participants were selected from the community after screening the population and equally divided into two groups (Group A =12 & Group B =12). Group A received resistance exercises while Group B received resistance exercises along with finger movement exercises, including pinching, filliping, crooking, finger counting, and pressing. Handgrip strength was measured through a dynamometer, and hand function was measured through Dorouz Hand Index (DHI) before starting intervention and at the end of the intervention. These exercises were performed in 3 sessions per week for a total of 4 weeks.

Results: According to the T-test measurements, In the treatment group, the right and left-hand grip strength p-value were 0.000, and the DHI p-value was 0.002. In the control group, the right and left-hand grip strength p-value were 0.000, and the DHI p-value was 0.001. A statistically significant difference was found in improving grip strength and function of the hand by comparing the pre-and post-treatment values within treatment and control groups. But there is no statistical difference between treatment and control groups in the improvement of grip strength and function of the hand.

Conclusion: Finger movement exercises and Resistance training without Finger movement exercises in improving grip strength and hand function in the elderly population.

Keywords: Aged, Hand, Hand Strength, Exercise Therapy, Resistance Training, Rehabilitation, Activities of Daily Living

Introduction

Ageing is a natural and irreversible process. In Agha Khan Hospital, one out of five inpatients, the older population is above 65 years.[1] With the advancing age, physical ability decrease gradually, the ability to perform daily tasks is reduced, and loss of independence may occur. In most people effects of a sedentary lifestyle are marked due to inactivity.[2] Muscle strength is an essential factor in the healthy ageing process. Reduction in muscle strength impairs body function, resulting in difficulty in performing activities of daily living.[3] The association between muscle mass strength and functional mobility is essential because it illustrates the reduction in physical ability in the elderly population and in general.[4] The decrease in the number of motor units is more evident after age 60. Decreases in muscle endurance, speed of muscle contraction, and ability to recover from muscle fatigue also occur with increasing age.[5] With age, there is a similar loss of muscle strength and muscle

mass for women and men.[6] Reduction in muscle mass associated with the ageing process is the significant cause of muscle decreased strength.[7] Low levels of hormones such as cortisol or testosterone and change in the ageing muscle itself also contribute to loss of grip strength with age.[8] Production of force decreases disproportionately in intrinsic muscles of the hand.[9]

The hand acts as a valuable tool through which we manipulate and control our environment. The vital function of the hand is to provide sensory feedback to the central nervous system. The balance between intrinsic and extrinsic muscles of the hand and wrist results in complex hand function.[5] Handgrip strength (HGS) is also known for predicting the health of muscles of the arm and helps us identify which older adults have the risk of developing the disease. Bilajac et al. reported an association between physical activity and social, physical, and psychological well-being. Older people in rehabilitation and care home settings had lower grip strength than reported for those living at home.[10]

In the rehabilitation area, handgrip strength is used clinically and primarily to determine musculoskeletal function and weakness. A manual handheld dynamometer measures the handgrip strength and measures isometric strength. Manual dynamometry test is non–invasive, easy, fast, and inexpensive.[11] A cross-sectional study was conducted to determine handgrip strength factors associated with the elderly population. The total eligible subjects in the study were 352, and the result showed that risk factors were age greater than 75 years and malnutrition that causes lower handgrip strength.[12] According to Wearing et al. a cross-sectional study was conducted. Both males and females aged ≥75 years were included, and isometric maximal handgrip strength was evaluated using both hands' hydraulic hand dynamometer. Three repeated trials and maximum values from these were used for analysis. This study showed that handgrip strength lowers in both sexes; however, the decline was more significant in men than women.[3]

After the age of 65 years, the functional ability of the hand starts to decline gradually, and because of normal ageing and including other disorders, deterioration in hand function occurs.[13] The excitability of motor neurons decreases with ageing, and the reduction of alpha motor neurons' excitability plays a role in the decline of hand function.[14] Resistance training has positive effects on improving the strength of muscles. It also enhances neuromuscular and psychological function, the density of bones, and balance; it makes a person independent in performing daily routine activities. Despite all these benefits of resistance exercises, 8.7% of the older population only participate in such exercise programs because of many barriers like fatigue, health and safety issues, pain, and no social support.[15] In a study, 204 people participated, and a resistance exercise program was done for 12 weeks. The result showed that resistance exercise improves muscle weakness and strength, prolongs healthy ageing, and maintains independence.[16] According to Carmeli, et al, commonly elderly people faced problems with hand functioning and dexterity that affects everyday actions.[17]

Different biological mechanisms have been proposed that cause reduction in grip strength and risk factors including sex, age, cigarette smoking, reduced physical activity, and some systemic diseases. However, only a few studies have examined many risk factors associated with the long-term change in grip strength performance during an adult's life.[18] Older people in rehabilitation and care home settings had lower grip strength than reported for those living at home. Furthermore, grip strength varied widely between healthcare settings independent of known major influences.[19]

Most of the data about grip strength are available on the very elderly population (≥80 years). Little evidence is present in the early old age group. Hence, our study focuses on declining handgrip strength and hand function in people above 65 years and to see the effect of resistance training with and without Finger Movement Exercises in this population.

Methodology

A quantitative study was carried out with a Randomized Controlled Trial design with the IRCT registration number IRCT20200720048148N1. The total Study duration was one year from data collection to the data analysis. After taking the data collection permission from the University of Faisalabad's ethical committee and review board, consent was also obtained from participants in old age homes, ensuring that their data remained confidential and used for research purposes only. Before obtaining consent, the subjects were also provided with an explanation of the study.

Screening of the population was done by using the inclusion and exclusion criteria. Inclusion criteria were individuals who were willing to participate by signing the consent form, Male and female aged 65-95 years, Conscious and able to communicate, no defect in upper extremity and able to give us the measurement of handgrip strength, having no disease that causes a restriction to the individual to perform an exercise and Ability to remain in sitting position. Exclusion criteria were severe impairment in cognitive function and severe arthritis, Fracture and nerve injury in the upper extremity, and

any chronic illness—systemic disease including diabetes and hypertension.

Twenty four participants were selected from the community after screening through a convenient sampling technique and equally divided into two groups (Group A =12 Group B =12) by the lottery method of randomization. Sample size was calculated using formula: $n = (z)^2 p (1 – p) / d^2$ where n=number of participants/sample size, z=Desired confidence interval, p =Proportion in population, d=acceptable level or sampling error. This was a single-blinded study in which only participants were blinded to the intervention group allocation. Group A received resistance exercise with a hand gripper as a baseline treatment. The individuals performed resistance exercises through a hand gripper in a sitting position. Individuals compressed both arms of the hand gripper with maximum force. This resistance exercise for intrinsic hand muscles was performed for both right and left hands with four sets of 10 repetitions, having a resting interval of two minutes between each set. Each set has a resting interval of 2 minutes. Group B also received resistance exercise with a hand gripper as a baseline treatment and a set of finger movement exercises that included pinching, filliping, crooking, finger counting, and pressing. Each movement was repeated 20 times in a single session for both hands. These exercises were performed in 3 sessions per week for a total of 4 weeks.

The primary outcome measure was Handgrip strength, which was measured using a CAMRY handheld dynamometer (which has excellent test-retest and inter-test reliability).[3] Before starting the grip strength measurement, participants were taught the test procedure and the correct position of the hand dynamometer. Participants were seated with feet flat on the floor, hip, and knee joint flexed at 90°, shoulder in adduction and neutral position, elbow flexed at 90°, forearm in the neutral position and wrist between the 0° and 30° of dorsiflexion and 0° and 15° of ulnar deviation. The second smallest dynamometer handle position was used. Each participant prepared himself/herself according to demonstrated protocol beforehand for grip strength measurement. Once told, the participant to press the dynamometer's handle to the best of their ability and continue to exert for 3 seconds as much force as possible for the subject. After 5 minutes, again tested for the second time and then after 5 minutes tested for the third time. Values were recorded, and their mean was considered as the handgrip strength of the subject. The same protocol was followed on the other hand. During the measurement of handgrip strength, no verbal or visual encouragement was given to the subject. Grip strength measurement was taken before and after the intervention. Based on the preferred hand use in activities, hand dominance was reported by the subject himself. The secondary outcome measure was Hand function, which was assessed using the Dorouz Hand Index (DHI) before starting intervention and at the end of the intervention after 4 weeks. The other name for this scale is Cochin Hand Functional Disability Scale. This scale has 18 items with a total score from 0-90, divided into hand activities related to the kitchen (8), hygiene (2), dressing (2), and others (4). Each item score ranges from 0-5 with 0 being no difficulty and 5 being impossible to perform activities.[20]

Statistical analysis was performed through Statistical Package of Social Sciences (SPSS) version 20. Since the sample size for this study was fewer than 50, the data's normality was checked using the Shapiro-Wilk normality test. No outliers were identified in the study. For each group, the mean of the pre-treatment and post-treatment scores was determined. The baseline handgrip strength and Doruoz Hand Index scores in each group were compared with the post-intervention values at the fourth week using a paired t-test. The unpaired t-test was used to compare the outcome measure scores of the two groups following the 4-week intervention; a p-value of less than 0.05 was considered significant for the two treatment outcomes. Descriptive and inferential statistics were used for the result presentation with the help of tables and charts.

Results

Forty participants were evaluated based on inclusion and exclusion criteria. Twenty-four were designated out of 40 participants and divided into different groups according to inclusion criteria. The population of females was 58.33% which was greater than the male population which was 41.67%. The table shows the Demographic baseline characteristics of 24 participants in both groups. (Table I)

Table I: Demographic comparison of both groups

Study Group		Min	Max	Mean	SD
Treatment Group (n=12)	Age in Years	66	92	72.50	7.06
	Height in centimetres	151	173	162	4.37
	Weight in kg	43	110	66.08	19.06
	Body Mass Index(kg\cm2)	19.1	39.5	26.54	5.58
Control Group (n=12)	Age in Years	65	89	69.67	6.28
	Height in centimetres	152	179	165.5	3.20
	Weight in kg	55	81	68.42	9.67
	Body Mass Index(kg\cm2)	20.7	42.1	28.96	5.70

The post-treatment Right and left-hand Grip Strength and DHI scores for the Resistance exercise group and Finger exercise groups were as presented in Table II. There were no

Table II: Independent t-test Comparisons of Right-Hand Grip Strength, Left-Hand Grip Strength, and Doruoz Hand Index Scores

		Study Groups		P-value
		Treatment group	Control group	
Grip Strength of Right Hand	Pre-treatment (Mean±SD)	20.37±7.51	16.83±7.59	0.26
	Post-treatment (Mean±SD)	22.70±8.00	18.90±7.69	0.24
Grip Strength of Left Hand	Pre-treatment (Mean±SD)	20.21±7.47	15.34±6.74	0.10
	Post-treatment (Mean±SD)	22.63±7.80	16.71±7.07	0.06
Doruoz Hand Index	Pre-treatment (Mean±SD)	17.00±18.02	12.58±9.52	0.46
	Post-treatment (Mean±SD)	15.58 ±17.55	11.50±9.21	0.48

significant differences ($p > 0.05$) in the post treatment mean Grip Strength and DHI scores between the two groups.

The mean pre-and post-treatment Grip Strength of Right-Hand left hand and Doruoz Hand Index (DHI) scores were compared for the Resistance exercise group and Finger exercise groups. Both groups scored significantly lower ($p < 0.05$) on Grip strength and DHI scores in the fourth week compared to the baseline scores. (Table III)

Table III: Paired t-test Comparison of the Two Groups' Pre-Treatment and Post-Treatment Right-Hand, Left-Hand Grip Strength, and Doruoz Hand Index Scores

		Study Groups	
		Treatment group	Control group
Grip Strength of Right Hand	Post-treatment – Pre-treatment (Mean±SD)	2.33± 0.87 P=0.00	2.06±1.46 P=0.00
Grip Strength of Left Hand	Post-treatment – Pre-treatment (Mean±SD)	2.41± 1.37 P=0.000	1.37± 0.90 P=0.00
Doruoz Hand Index	Post-treatment – Pre-treatment (Mean±SD)	1.41± 1.24 P=0.002	1.08± 0.79 P=0.001

Discussion

The primary purpose of the current study was to evaluate the effectiveness of finger movement exercises with resistance exercises on hand function and handgrip strength in the elderly population. We measured grip strength through the CAMRY handgrip dynamometer, and the function of the hand through the Dorouz Hand Index, which showed no significant effect between groups. According to Anandhi et al, a study was conducted which included both males and females aged 60-75 years old. Pre- and post-mean handgrip strength values were compared with the functional tasks exercise and resistance exercise groups and resistance exercises showed a more substantial effect in the elderly population on grip strength than functional task exercises. But statistical results showed no significant difference between the resistance exercise group and functional task exercise group on the Michigan Hand Outcome measure Questionnaire while comparing post-test mean values.[2] It is parallel to our study which shows no statistical difference between finger movement exercises with or without resistance exercises.

A study conducted by Chen et al aimed to examine the impact of finger movement exercise with weight lift training on handgrip strength and ADL values. Hand Grip strength was measured by a CAMRY handgrip dynamometer. Age criteria were ≥ 80 years, and the study duration was three months. Results showed no improvement of finger movement exercises on handgrip strength but, when combined with weight lift training, showed the effect on grip strength and ADL score. Our study duration was four weeks, and most people in the current study were 65 to 80 years male and female and showed no effect of finger movement exercises on handgrip strength and function of the hand. The above-mentioned study supports the result of the current research that finger movement exercises in addition to resistance training exercises do not affect handgrip strength and hand function.[21]

In contrast, another trial approved the finger movement exercises for the added benefits, a randomized control trial for 12 weeks was undertaken in which 40 older people greater than 60 years of age with dementia were enrolled. 20 people in each experimental group and the control group. The experimental group received everyday passive finger exercises for 25 minutes, and the control group received nothing but routine nursing care. After the intervention, the experimental group showed no effect on handgrip strength but a considerable improvement from the control group in defecation function, urinary control, and activity of daily living.[22]

The study's main limitation was that as it was conducted on a smaller sample size from a single setting so generalization to the population is not quite possible. The intervention period of the study was relatively short, and no follow-up was carried on. Due to the COVID-19 pandemic, it was difficult to recruit patients and perform the intervention as certain restrictions were imposed on closed contacts. The recommendation for better results is that the study should be conducted on a more significant sample and for a more extended period so that long-term effects can be observed. Further studies are needed on post-traumatic hand conditions and stroke patients in clinical settings to confirm our study

results and determine whether the intervention used in this study improves grip strength.

Conclusion

The current study concluded that Finger Movement Exercises and Resistance training improved grip strength and hand function within treatment and control groups. But statistical analysis showed no significant difference between treatment and control groups in enhancing grip strength and hand function in the geriatric population.

References

1. Sabzwari SR, Azhar G. Ageing in Pakistan—a new challenge. Ageing International. 2011;36(4):423-7.
2. Anandhi D, Gokila D, Sivakumar V. Comparison of functional tasks exercise versus resistance exercise to improve grip strength and hand function in elderly population. J Physiother Res. 2018;2(1):15.
3. Wearing J, Konings P, Stokes M, de Bruin ED. Handgrip strength in old and oldest old Swiss adults–a cross-sectional study. BMC geriatrics. 2018;18(1):1-9.
4. Pratama I, Setiati S, editors. Correlation between hand grip strength and functional mobility in elderly patients. Journal of Physics: Conference Series; 2018: IOP Publishing.
5. Kisner C, Colby LA, Borstad J. Therapeutic exercise: foundations and techniques: Fa Davis; 2017.
6. Leenders M, Verdijk LB, van der Hoeven L, van Kranenburg J, Nilwik R, van Loon LJ. Elderly Men and Women Benefit Equally From Prolonged Resistance-Type Exercise Training. The journals of gerontology Series A, Biological sciences and medical sciences. 2013;68(7):769-79.
7. Dodds RM, Syddall HE, Cooper R, Kuh D, Cooper C, Sayer AA. Global variation in grip strength: a systematic review and meta-analysis of normative data. Age and ageing. 2016;45(2):209-16.
8. Leong DP, Teo KK, Rangarajan S, Lopez-Jaramillo P, Avezum Jr A, Orlandini A, et al. Prognostic value of grip strength: findings from the Prospective Urban Rural Epidemiology (PURE) study. The Lancet. 2015;386(9990):266-73.
9. van den Noort JC, Kortier HG, Beek Nv, Veeger DH, Veltink PH. Measuring 3D hand and finger kinematics—a comparison between inertial sensing and an opto-electronic marker system. PLoS One. 2016;11(11):e0164889.
10. Bilajac L, Juraga D, Žuljević H, Glavić M, Vasiljev V. The influence of physical Activity on handgrip strength of elderly. Arch Gerontol Geriatr Res. 2019;4(1):020-4.
11. Amaral CA, Amaral TLM, Monteiro GTR, Vasconcellos MTL, Portela MC. Hand grip strength: Reference values for adults and elderly people of Rio Branco, Acre, Brazil. PloS one. 2019;14(1):e0211452.
12. Riviati N, Setiati S, Laksmi PW, Abdullah MJAMI. Factors related with handgrip strength in elderly patients. 2017;49(3):215-9.
13. Hogrel J-Y. Grip strength measured by high precision dynamometry in healthy subjects from 5 to 80 years. BMC musculoskeletal disorders. 2015;16(1):1-12.
14. Vieira AI, Nogueira D, de Azevedo Reis E, da Lapa Rosado M, Nunes MV, Castro-Caldas A. Hand tactile discrimination, social touch and frailty criteria in elderly people: A cross sectional observational study. Archives of gerontology and geriatrics. 2016;66:73-81.
15. Fragala MS, Cadore EL, Dorgo S, Izquierdo M, Kraemer WJ, Peterson MD, et al. Resistance training for older adults: position statement from the national strength and conditioning association. The Journal of Strength & Conditioning Research. 2019;33(8).
16. Geirsdottir OG, Arnarson A, Briem K, Ramel A, Tomasson K, Jonsson P, et al. Physical function predicts improvement in quality of life in elderly Icelanders after 12 weeks of resistance exercise. The journal of nutrition, health & aging. 2012;16(1):62-6.
17. Carmeli E, Patish H, Coleman R. The aging hand. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2003;58(2):M146-M52.
18. Sternäng O, Reynolds CA, Finkel D, Ernsth-Bravell M, Pedersen NL, Dahl Aslan AK. Factors associated with grip strength decline in older adults. Age and ageing. 2015;44(2):269-74.
19. Roberts HC, Syddall HE, Sparkes J, Ritchie J, Butchart J, Kerr A, et al. Grip strength and its determinants among older people in different healthcare settings. Age and ageing. 2014;43(2):241-6.
20. Gökşenoğlu G, Paker N, Çelik B, Buğdaycı D, Demircioğlu D, Kesiktaş N. Reliability and validity of Duruoz Hand Index in carpal tunnel syndrome. Turkish Journal of Physical Medicine and Rehabilitation. 2018;64(3):277.
21. Chen X-P, Lu Y-M, Zhang J. Intervention study of finger-movement exercises and finger weight-lift training for improvement of handgrip strength among the very elderly. International Journal of Nursing Sciences. 2014;1(2):165-70.
22. Liu B, Chen X, Li Y, Liu H, Guo S, Yu P. Effect of passive finger exercises on grip strength and the ability to perform activities of daily living for older people with dementia: a 12-week randomized controlled trial. Clinical interventions in aging. 2018;13:2169.