

Comparison of Functional Tasks Exercise Versus Resistance Exercise to Improve Grip Strength and Hand Function in Elderly Population

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Abstract

Background: Ageing is an irreversible process; the effects of a sedentary lifestyle are very evident in most people due to inactivity. When physical capacity falls below the ability required for the performance of daily tasks, functional limitations and a loss of independence may occur. The aim of the study is to determine whether functional tasks exercise program and resistance exercise program have different effects on grip strength hand function in the community-living elderly population. Study design was Quasi-experimental.

Methods: This experimental study was conducted on 30 male and female patients (aged above 60 years) without any severe illness. 30 subjects were divided into 2 groups, Group A was taught functional tasks exercise and Group B was taught resistance exercise for both hands, three days per week for total of 4 weeks. For the outcome measures, grip strength was measured using handheld dynamometer and hand function using Michigan hand outcome questionnaire.

Findings: There is a statistical significance on comparison of pre and post mean values of functional tasks exercise group on grip strength measurements of both hands (Right $p < 0.05$, Left $p < 0.05$) and 3 components of Michigan hand outcome questionnaire (OAHF: over all hand function ($p < 0.05$), ADL: activity of daily living ($p < 0.05$) and work ($p < 0.05$)). The comparison of pre and post mean values of resistance exercise group also shows statistically significant effect on grip strength measurements of both hands (Right $p < 0.05$, Left $p < 0.05$) and 4 components of Michigan hand outcome measure questionnaire (OAHF: over all hand function ($p < 0.05$), ADL: activity of daily living ($p < 0.05$), work ($p < 0.05$) and satisfaction ($p < 0.05$)). But there is no statistical significance on comparing the posttest mean values of hand grip strength and Michigan Hand Outcome measure Questionnaire between both the functional tasks exercise (Group A) and resistance exercises (Group B).

Conclusion: There is no statistically significant difference between functional tasks exercise and resistance exercise in improving the grip strength and hand function in elderly population.

Keywords: Elderly; Hand function; Grip strength; Functional task exercise; Resistance exercise

Introduction

As per United Nation population fund (UNFPA) in march 8, 2013, India's population is likely to increase by 60% between 2000 to 2050 but number of elders, who have attained 60 years of age, will shoot up by 360 percentage; also the Government should start framing policies now, else the consequences will take it by surprise. Presently, India has around a hundred million elderly at present and expected to increase to 323 million, constituting 20 percentage of the total at 2050 [1].

Approximately 88% of individuals older than 65 have at least one chronic health limitation and a number of older adults suffer from impaired functioning or well-being. Old age and disablement are the main determinants of health care use and health issues regarding the older population are becoming increasingly important [2].

Ageing is characterized by a diminished function in multiple physiological domains, including the neuro musculoskeletal system (e.g., loss of skeletal muscle mass, muscle strength, alterations in muscle quality, deterioration in joint mobility, neuromuscular coordination, balance, etc.) deterioration of the respiratory system, cardiovascular system (e.g., diminished cardiovascular function, diminished endurance to exercise, postural hypotension, etc.) and so on.

While ageing is an irreversible process, the effects of a sedentary lifestyle are very evident in most people due to inactivity. When physical capacity falls below the ability required for the performance of daily tasks, functional limitations and a loss of independence may occur. Ultimately, loss of physical reserve can lead to institutionalization,

morbidity, and mortality. Aging is strongly associated with impaired mobility and decreased physical functional performance. As a consequence, there is a loss of independence and quality of life and the risk of falls and fractures increases [3,4].

Approximately 20% of people between 65 and 75 years of age need assistance performing activities of daily living (ADLs) and this increases to 48% in people older than 85. The first ADLs to be affected are climbing stairs, shopping, rising out of a chair or bed, house cleaning, washing and dressing oneself. The decline in functional task performance is partly caused by the aging process and is accelerated by a sedentary lifestyle [5]. Although aging is an irreversible process, the effects of decreased physical activity can be reversed in most people.

As one's age increase the manual function and quantity of hand muscle strength are decreased and activity restriction in the geriatric age group will be present. These can be measured through grip and pinch strength measurement [3,6].

Many changes occur with increasing age which may affect hand function. Changes in co-ordination, visual, touch and auditory processes in addition to changes in the muscular, skeletal and nervous system occurs with increasing age [7,8]. A decrease in muscle mass that is highly correlated with a decrease in muscle strength occurs with ageing especially after the age of 60 years. Decreased bone mass is also one of the causes reducing hand function. Nervous system changes include decrease in nerve conduction velocity, sensory activity, rate and magnitude of reflex response and arousal threshold. Impairment of sensory processes is also a key component of decreased motor coordination and function. Visual changes that can affect the hand function include acuity, accommodation, color differentiation, sensitivity to light, depth perception, eye hand coordination and accommodation to light and dark [9].

Since the sedentary life style is considered to be one of the most important factors contributing to loss of independent performance of daily tasks (mainly hand function), many randomized trials have demonstrated the positive effect of regular exercise on older people for improving muscle strength [7].

An exercise is an accessible form of prevention of physical functional decline. Several studies have found that adherence to a regular exercise program can improve hand muscle strength and function [10]. Sufficient evidence exists to recommend that older people should exercise to increase hand function.

Many studies have shown that regular exercise is beneficial to basic physical function in older adults, increasing muscle strength, balance, endurance and flexibility. However, the effects of exercise programs on the performance of daily tasks have not been proven indisputably. This may be because most exercise interventions aim to enhance performance of functional tasks by improving just one basic physical function, mostly muscle strength, flexibility, or balance [11]. The performance of functional tasks, however, is more complex and involves interplay of cognitive, perceptual, and motor

functions and is closely linked to the individual's dynamic environment.

To improve the hand function ability of older people to perform daily task, two types of exercises are recognized. First, resistance exercises were developed. Also, exercise programs were developed focusing on functional tasks of everyday life, which are affected early in the ageing process. The aim of the study is to determine whether functional task exercise programmer and resistance exercise programmer have different effects on grip strength and hand function in the community-living elder people [12].

Methods

The study design was Quasi-Experimental, Pre and Post-test study. Subjects aged 60-75 years old, both males and females, who were able to perform the exercise, and those who were willing to participate were included in the study. Exclusion criteria of the study are recent fractures in upper limb, recent nerve injury in upper limb, unstable cardiovascular or metabolic diseases, musculoskeletal diseases or other chronic illnesses that might limit training or testing, severe airflow obstruction. This study was conducted after getting approval from the Institution Ethical Committee 30 subjects who met the inclusion and exclusion criteria were selected by random sampling. The subjects were allotted in to two groups based on lottery method. The study duration was 4 weeks. The study was conducted at Sivanadha old age home, Kattankulathur.

Subjects in Group A underwent functional tasks exercises for hand and subjects in Group B underwent resistance exercises for hand for 4 weeks. Group A underwent 10 repetitions of each of the functional task exercises (**Figure 1**). In Group B resistance protocol, intrinsic muscle of hand are trained in four sets of 10 repetitions with hand gripper, elastic bands, putty exercise and squeezing ball with 2 minutes rest between the sets. Exercises will be performed three times a week in 1-hour session for 4 weeks, with sessions separated by 1 day of rest. Pre-test and post-test values of Hand grip strength was recorded using handheld dynamometer and Hand function was assessed by using Michigan Hand Outcome Measures Questionnaire.



Figure 1 Handheld dynamometer.

Materials which are used for Functional tasks exercise are as follows: Plastic bottle of water, Sandbags, Paper, the door lock, Pencil, table, Sand, Coins, Marbles, Button, Clay, Cards, Clothes, Water, Bowl, Spherical and cylindrical shape objects. Resistance exercise are done by hand gripper, squeezing resistance ball, Elastic band, Putty clay.

Functional tasks exercise (Group A)

- Carrying a plastic bottle of water transfer from one hand to another.
- Transfer sandbag from one hand to another.
- Crumple a sheet of a paper into a ball try to spread it back out into a flat piece of paper.
- Gripping the door lock.
- Roll a pencil between the thumb and fingers.
- Place hand on the table and try to lift each finger one at a time off the table.
- Fill a bowl with sand or rice and place object in the sand try to find out the object without seeing.
- Take different objects, reaching and grasping.
- Molding the clay.
- Turn cards over.
- Do typing movement.
- Wringing out the wet clothes.

Functional tasks exercise

Below (Figures 2-5).



Figure 2 Carrying a plastic bottle of water, transfer from one hand to another.



Figure 3 Transfer sandbag from one hand to another.



Figure 4 Crumple a sheet of a paper.

Resistance exercises

Four sets of exercises are given with 10 repetitions and 2 minutes break in between the sets.

They are:

- Hand gripper
- Squeezing resistance ball
- Elastic band
- Putty clay



Figure 5 Squeezing ball.

Statistical Analysis

The data collected was tabulated and data analysis was done by using the software SPSS (**Tables 1-3; Figures 6-8**). The mean and standard deviations of all the variables were analyzed. Paired 't' test and independent 't' test were used and the result were considered if $p < 0.05$.

Table 1 Comparison of pre and post of functional tasks exercise (Group A).

S.NO	Group	MEAN	N	Standard Deviation	Standard Error	t- value	Sig
1	Group A Pre and Post DMRT	8.6000 11.2000	15	7.00816 6.89928	1.80950 1.78139	-4.453	0.001
2	Group A Pre and Post DMLT	6.8000 9.2667	15	5.40106 5.71298	1.39455 1.47508	-6.154	0
3	Group A Pre and Post OAHF	50.0000 52.0667	15	14.01530 13.25824	3.61873 3.42326	-3.837	0.002
4	Group A Pre and Post ADL	65.1333 70.1333	15	17.41455 18.49273	4.49642 4.77480	-5.839	0
5	Group A Pre and Post work	38.2000 42.4000	15	17.28005 16.78775	4.46169 4.33458	-4.482	0.001
6	Group A Pre and Post Pain	56.0000 56.0000	15	29.71291 29.71291	7.67184 7.67184	-	-
7	Group A Pre and Post Appearance	70.5333 70.5333	15	13.90204 13.90204	3.58949 3.58949	-	-

8	Group A Pre and Post Satisfaction	59.6000 60.4667	15	17.01176 16.73690	4.39242 4.32145	-1818	0.091
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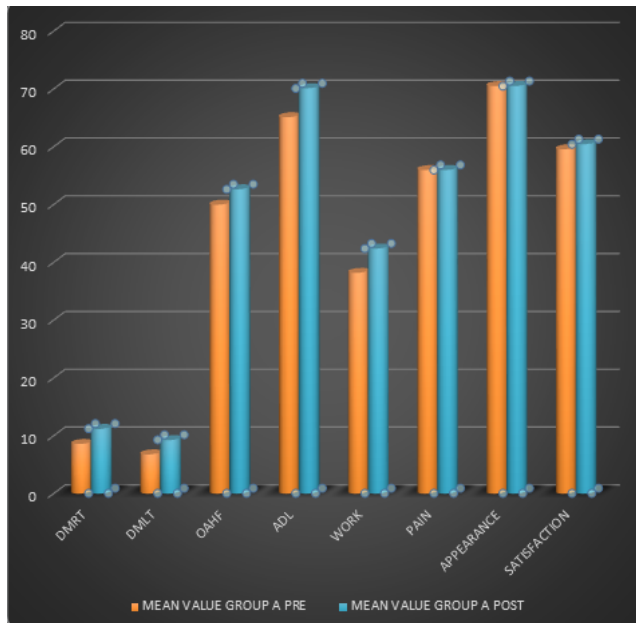


Figure 6 Pre and post mean value of functional tasks exercise (group A).

Table 2 Comparison of pre and post of resistance exercise (Group B).

S.NO	GROUP	MEAN	N	Standard Deviation	Standard Error	t-value	Sig
1	Group B Pre and Post DMRT	13.4000 17.2667	15 15	7.05894 8.01308	1.82261 2.06897	-4.919	0
2	Group B Pre and Post DMLT	11.9333 15.0000	15 15	6.93301 6.71884	1.79010 1.73480	-7.744	0
3	Group B Pre and Post OAHF	58.3333 61.7333	15 15	15.31417 14.24513	3.95410 3.67808	-4.362	0.001
4	Group B Pre and Post ADL	71.3000 74.0667	15 15	17.97399 17.43751	4.84086 4.50235	-3.748	0.002
5	Group B Pre and Post work	52.6000 54.4667	15 15	12.64796 11.64270	3.26569 3.00613	-3.336	0.005
6	Group B Pre and Post Pain	65.0000 65.0000	15 15	34.38230 34.38230	8.87747 8.87747	-	-
7	Group B Pre and Post Appearance	66.9333 66.9333	15 15	17.16919 17.16919	4.43306 4.43306	-	-
8	Group B Pre and Post Satisfaction	66.1333 67.6667	15 15	16.49618 16.11418	4.25929 4.16066	-3.36	0.005

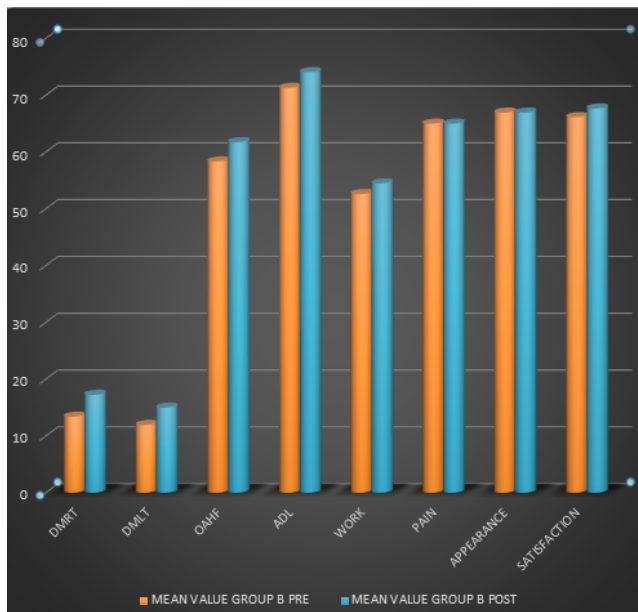


Figure 7 Pre and posttest of resistance exercise (group-B).

Table 3 Comparison of posttest of functional tasks exercises group and resistance group.

S.NO	GROUP	MEAN	N	Standard Deviation	Standard Error	t-value	Sig
1	GROUPAVSGROUPBPOSTDMRT	11.2000 17.2667	15 15	6.89928 8.01308	1.78139 2.06897	-4.4	.035 .035
2	GROUPAVSGROUPBPOSTDMLT	9.2667 15.0000	15 15	5.71298 6.71884	1.47508 1.73480	-5	.018 .018
3	GROUPAVSGROUPBPOSTOAHF	52.0667 61.7333	15 15	13.25824 14.24513	3.42326 3.67808	-3.8	.65 .65
4	GROUPAVSGROUPBPOSTADL	70.1333 74.0667	15 15	18.49273 17.43751	4.77480 4.50235	-1.2	.554 .554
5	GROUPAVSGROUPBPOSTWORK	42.4000 54.4667	15 15	16.78775 11.64270	4.33458 3.00613	-4.6	.030 .031
6	GROUPAVSGROUPBPOSTPAIN	56.0000 65.0000	15 15	29.71291 34.38230	7.67184 8.87747	-1.5	.449 .450
7	GROUPAVSGROUPBPOSTAPPEARANCE	70.5333 66.9333	15 15	13.90204 17.16919	3.58949 4.43306	.631 .633	.533 .533
8	GROUPAVSGROUPBPOSTSATISFACTION	60.4667 67.6667	15 15	16.73690 16.11418	4.32145 4.16066	-2.4	

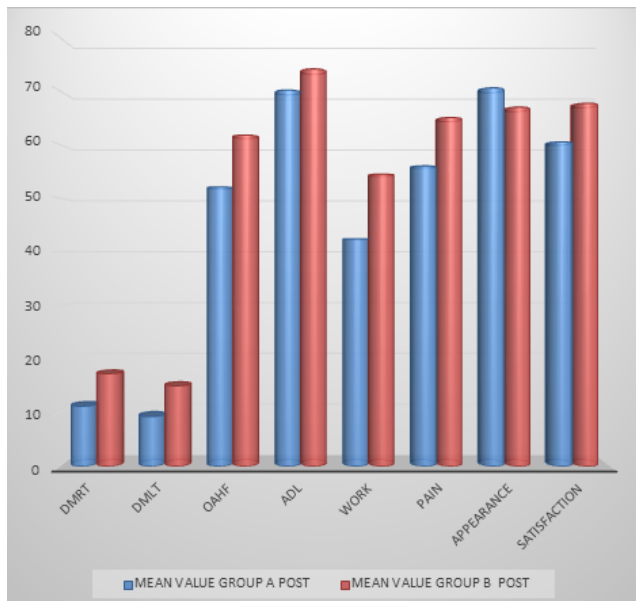


Figure 8 Mean values of posttest functional tasks exercise (Group A) and resistance exercise (Group B).

The post-test mean values of the resistance exercise (Group B) are higher than that of the functional tasks exercise (Group A). The posttest mean values of grip strength in resistance exercise group is, right hand: 17.2667, left hand: 15.0000 and in functional task exercise group is, right hand: 11.2000, left hand: 9.2667 and 4 components of Michigan questionnaire (Components: Over all hand function posttest mean in Group B is 61.7333 and in Group A is 52.0667, Activity of daily living in Group B is 74.0667 and in Group A is 70.1333, Work posttest mean in Group B is 54.4667 and in Group A is 42.4000, Satisfaction mean in Group B is 67.6667 and in Group A is 60.4667) except other two component (Pain post mean value in Group A is 56.0000 and in Group B is 65.0000, Appearance post mean value in Group A is 70.5333 and in Group B is 66.9333). But statistically there is no significant difference between functional tasks exercise and resistance exercise in improving the grip strength and hand function.

Table 1 and Figure 6 shows that Group A (Functional tasks exercise) shows statistical significance in the grip strength [both right hand $p < 0.05$ and left hand $p < 0.05$], overall hand function $p < 0.05$ activity of daily living $p < 0.05$, work $p < 0.05$ and statistically insignificant in satisfaction $p > 0.05$. Pain and appearance did not show any difference between the pre and posttest measurement.

Table 2 and Figure 7 shows that Group B (Resistance exercise) shows statistical significance in the grip strength [both right $p < 0.05$ and left hand $p < 0.05$], overall hand function $P < 0.05$, activity of daily living $p < 0.05$, work $p < 0.05$ and in satisfaction $p < 0.05$. Pain and appearance did not show any difference between the pre and post-test measurement.

Table 3 and Figure 8 shows that there is no statistically significant difference between the post test of Group A (Functional task exercise) and Group B (Resistance exercise) in

grip strength (right and left hand) and components of Michigan hand outcome measure questionnaire ($p > 0.05$).

Discussion

In this present study, there is a statistical significance on comparison of pre and post mean values of functional tasks exercise group on grip strength measurements of both hands (Right $p < 0.05$, Left $p < 0.05$) and 3 components of Michigan hand outcome questionnaire (OAHF: over all hand function ($p < 0.05$), ADL: activity of daily living ($p < 0.05$) and work ($p < 0.05$)) (**Table 1 and Figure 6**) The functional task exercises concentrates more on the day to day activities like wringing out the wet clothes, turn cards, gripping the door lock, etc. and not specific, training the wrist flexors and extensors like resistance exercises. Nelson showed that the minimally supervised functional exercises are safe and can improve functional performance in elderly individuals.

The comparison of pre and post mean values of resistance exercise group also shows statistically significant effect on grip strength measurements of both hands (Right $p < 0.05$, Left $p < 0.05$) and 4 components of Michigan hand outcome measure questionnaire (OAHF: over all hand function ($p < 0.05$), ADL: activity of daily living ($p < 0.05$), work ($p < 0.05$) and satisfaction ($p < 0.05$)), (**Table 2; Figure 7**). Resistance exercises concentrates more on the flexion and extension activity of fingers with the hand gripper, putty clay, elastic band and squeezing ball. Barry showed that older adults experience neural adaptation to resistance training and these adaptations will improve the functional movement capabilities of older individuals.

While comparing the pre and posttest mean values of functional tasks exercise (Group A) and resistance exercise (Group B), the resistance exercise group values are more than the functional task exercise group. This shows that the resistance exercises has better effect on improving grip strength in elderly population than the functional task exercise group.

But there is no statistical significance on comparing the posttest mean values of hand grip strength and Michigan Hand Outcome measure Questionnaire between both the functional tasks exercise (Group A) and resistance exercises (Group B). This inference may be due to a smaller sample size. But both exercise groups has some effect on improvement of grip strength and hand function in elderly ($p > 0.05$).

Bastone have concluded that it might be more beneficial to train using movements that closely mirror daily activities rather than to train to increase strength and the power of the individual muscle groups [9]. Vreedel showed that the functional tasks exercise shows better improvement on hand function when compared to the resistance exercise in elderly population [7], which means that older individuals may continue exercising and thus maintain the effects of exercise. Several studies argue that the benefits from functional tasks exercise group are more sustainable which is not demonstrated in this study.

Two components of Michigan hand outcome questionnaire (pain and appearance) shows no improvement on both groups as the subjects in both the groups complained of no pain or very little pain. Limitations of the study are small sample size; duration of the study was short, only normal elderly were studied. Recommendations for further studies are larger sample size, any other age groups can be targeted, long duration study can be done, comparison of male and female grip strength can be assessed, and any other hand condition can be studied like in stroke patients, post traumatic hand conditions.

Though this study shows that there is no much difference between the functional tasks exercise and resistance exercises on hand function and grip strength, the individual effects of exercises are proved.

Conclusion

Both Functional tasks exercise group (Group A) and Resistance exercise group (Group B) have some effect on improvement on hand function and grip strength in elderly population. But statistically there is no significant difference between functional tasks exercise and resistance exercise in improving the grip strength and hand function in elderly population.

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