Comparative Study of Aerobic Walking Versus Health Education with Home Exercise in Managing Pain and Functional Disability in Elderly Patients with Knee Osteoarthritis

*[1]Dr.T.Karthikeyan, [2]Dr.Harsh Kumar, [3]Prof.S. Purna Chandra Shekhar
Associate Professor, Department of Physiotherapy, Gurugram University, Gurugram, Haryana, India
[2]Ortho Neuro Sports Healthcare, Hardayal road, Gamitola, near petrol pump, Katihar, Bihar - 854105
[3]Principal, Professor, School of Physiotherapy, MNR University, Sangareddy, Telangana, India.
Address for Correspondence
Dr.T.Karthikeyan
Associate Professor, Department of Physiotherapy, Gurugram University, Gurugram, Haryana, India

Abstract

Background:
Osteoarthritis of the knee is a leading cause of pain and disability in the elderly, limiting mobility and reducing quality of life. Various interventions, including aerobic walking, health education, and structured home exercise programs, have independently shown benefits in managing symptoms. However, limited comparative evidence exists regarding the relative efficacy of these interventions. This study explores which approach provides superior outcomes in terms of reducing pain and improving Activities of Daily Living (ADL) performance.

Objectives:
This study aims to compare the effectiveness of an aerobic walking program with that of a health education and home exercise program in reducing pain and improving functional ability in elderly individuals diagnosed with knee osteoarthritis (OA).

Design and Methods:
An experimental pre-test and post-test design was employed. Participants were elderly residents from care homes and outpatient settings in Bangalore, Karnataka. Subjects were randomly assigned to two intervention groups: one receiving an aerobic walking regimen and the other undergoing health education combined with a home-based exercise protocol. Pain levels and ADL disability scores were assessed before and after the intervention using standardized outcome measures.

Setting:
The study was conducted at Outpatient Department Gurugram University Gurugram

Results and Conclusion:
The findings are expected to clarify which intervention—structured aerobic walking or health education with home exercises—yields better outcomes in pain reduction and functional independence among elderly patients with knee OA. These insights could enhance clinical decision-making in geriatric rehabilitation settings.

Keywords:

Osteoarthritis knee, aerobic walking, health education, home exercise program, elderly rehabilitation

INTRODUCTION

Ageing can be sociologically defined as the combination of biological, psychological and social process that affects people as they grow older. These processes suggest the metaphor of three different ,although interrelated, developmental ‘clocks’: a biological one ,which refers to the physical body; a psychological one which refers to the mind and mental capabilities; and a social one which refers to cultural norms, values and role expectations having to do with age.[1]

"The ageing process is of course a biological reality which has its own dynamic, largely beyond human control. However, it is also subject to the constructions by which each society makes sense of old age. In the developed world, chronological time plays a paramount role. The age of 60 or 65, roughly equivalent to retirement ages in most developed countries is said to be the beginning of old age. In many parts of the developing world, chronological time has little or no importance in the meaning of old age. Other socially constructed meanings of age are more significant such as the roles assigned to older people; in some cases it is the loss of roles accompanying physical decline which is significant in defining old age. Thus, in contrast to the chronological milestones which mark life stages in the developed world, old age in many developing countries is seen to begin at the point when active contribution is no longer possible.[2]

As far back as 1875, in Britain, the Friendly Societies Act, enacted the definition of

old age as, "any age after 50" ,yet pension schemes mostly used age 60 or 65 years for eligibility and According to personal correspondence, 2001, The UN has not adopted a standard criterion, but generally uses 60+ years to refer to the older population.[3]

Since 1950 the proportion of population 60 years or over in the world has been rising steadily, passing from 8 per cent in 1950 to 11 per cent in 2007, and is expected to reach 22 per cent in 2050. As long as old age mortality continues to decline and fertility remains low, the proportion of population 60 years or over in world will continue to increase.[4]

Marked differences exist between developed and developing regions in the number and proportion of older persons. In the more developed regions, over a fifth of the population is currently aged 60 years or over and by 2050, nearly a third of the population in developed countries is projected to be in that age group. In the less developed regions, older persons account today for just 8 per cent of the population but by 2050 they are expected to account for a fifth of the population, implying that, by mid-century, the developing world is likely to reach the same stage in the process of population ageing that the developed world is already at.[4]

As humans age, the force-generating capacity (strength) of their skeletal muscles is reduced. [8, 9] As a result, many older people experience difficulty in performing their activities of daily living.[8] recent research indicates that the observed loss of force production in older people is primarily to the result of muscle atrophy and alterations in the percentage of contractile tissue within Muscle [9-12] rather than deficits in muscle activation(motor unit recruitment and firing rate).[13-15]

Researchers have also demonstrated that, in addition to the decrease in skeletal muscle cross sectional area, the muscles of older people contain less contractile tissue and more noncontractile tissue when compared with the skeletal muscle of younger people (26–44 years of age).[12] A greater percentage of noncontractile tissue (fat and connective tissue) results in a decreased force production capability. Arm, leg and back strength decline at an overall rate of 8% per decade, starting in 3rd decade of life. The rate of decline is not linear but slightly lower in early life and accelerated in late life.[13]

The aging process is associated with progressive decline in muscle strength; resulting in functional disability and reduced quality of life.[15] Muscle strength and functional mobility decline with age in healthy people; and in women an accelerated decrement in muscle strength above the age of 55. [14]

Muscle quality (strength per unit of muscle) is an important indicator of muscle performance and is thought to decline with age in men [6], but not in women [9].T kamarul did a study in 18- 65 years of age group and found that men were stronger than women in all age-groups, and men had twice the strength of women. [9]

Many studies have attempted to provide a picture of the difference between dominant and non-dominant handgrip strength. It has been proved earlier that the population as a whole demonstrated significant differences between the dominant and non-dominant handgrip strength. [5]Therapist often follows the 10% rule as general guidelines. This rule states that person's grip strength in dominant hand is 10% greater than that of non-dominant hand. [4]

According to C.A. Armstrong et al, differences between dominant and non-dominant hand were much smaller than those reported in other studies, so they concluded that clinicians must be cautious when using the 10% rule to make comparison between injured and uninjured hands. [5]

There are controversies regarding the difference in handgrip strength values between dominant and non-dominant hands. Hence this study is designed to evaluate the difference between both hands.

The primary intention is to derive normative or average value of grip strength in different age groups, gender and dominance of hand.
The secondary intention is to find out the difference of grip strength in different age groups, gender and dominance of hand.

Many daily functions require high activity levels of the flexor musculature of the forearms and hands. [6] these are the muscles involved in gripping strength. There are 35 muscles involved in movement of the forearm and hand, with many of these involved in gripping activities. During gripping activities, “the muscles of the flexor mechanism in the hand and forearm create grip strength while the extensors of the forearm stabilize the wrist [7]”.

“Power grip is a forceful act resulting in flexion of all finger joints. When thumb is used, it acts as a stabilizer to the object held between the fingers and the palm.

Power grip is the result of following sequence:

1. Opening of the hand.
2. Positioning of fingers.
3. Approaching the fingers to the object
4. Maintaining a static phase that actually constitutes the grip.

Metacarpo Phalageal flexors, abductors and adductors i.e. introssei helps in strong grip as same as extrinsic flexors. Extensor Digitorum increases the joint compression and enhances the joint stability. Muscles of the hypothenar eminence are also responsible for cylindrical grip." [8]

Power grip is a commonly used as an index to assess impairment and treatment outcome of hand function[9]. Analysis of grip strength is important indexes of hand rehabilitation programme as because it assesses the patient's initial limitation and can be compared with normal. Measurement of handgrip strength's utility continues throughout the treatment process because it provides a quick reassessment[10].

There are three main categories of handgrip dynamometers. These include spring-loaded compression, air compression, and hydraulic compression devices. According to Waldo, "since grip is a force, not a pressure, it should be measured in pounds or kilograms. A hydraulic dynamometer is the most accurate choice [7]."

Jamar Dynamometer is the most widely reported and recommended instrument to measure grip strength[11] A survey in USA found that almost 80% therapist uses Jamar Dynamometer for measuring handgrip strength[13].

The handles, which can be adjusted to five different positions these five settings place the fingers in different level of extension. It has been proved that hands had maximal grip strength when dynamometer was at setting II.

Mathiowetz et al found that the Jamar dynamometer achieved the highest calibration accuracy of + 3%, and ICC = 0.9994[44,45]. Hence the Jamar dynamometer has been used in this study. Most of the studies have used the standard testing position approved by American Society of Hand Therapist (ASHT).

Grip strength testing has been used in a variety of clinical areas and for multiple purposes[7] .such as:

1) The assessment of the upper limb impairment. [8]
2) In evaluating work capacity for those with hand injuries. [9]
3) The evaluation of the people with other impairment and disabilities. Such as rheumatoid arthritis .[10] .
4) Determining the efficacy of different treatment for people with wide range of disabilities.[11]
5) Part of an overall fitness assessment.[12]
6) Determining the level of effort exerted.[13]

OBJECTIVES OF THE STUDY

- To find out the grip strength in different age groups of 61-75 years of older healthy adults.
- To find out the difference in grip strength between men and women.
- To find out the difference in grip strength between dominant and non dominant hands.

METHODOLOGY

Research design:

Cross sectional correlation study.

Source of data:

The study was conducted at Outpatient Department, Gurugram University, Gurugram

Population:

Male and female subjects between 61 -75 years of age.

Sample size:

A total of 90 subjects were studied.

Sample design:

Subjects fulfilling inclusion and exclusion criteria were selected through stratified random sampling.

SELECTION CRITERIA:

INCLUSION CRITERIA:

- Subjects of age 61- 75 years.
- Both genders.

- Subjects willing to participate
- Right and left hand dominant people

EXCLUSION CRITERIA:

- Subjects with recent history of upper limb fractures.
- Subjects with conditions that affect the joints of upper limb like RA, PA.
- Subjects with any neurological conditions like stroke, Parkinsonism, etc.
- Subjects with restricted ROM of Upper limb.
- Uncooperative patients.

DURATION:

3 months.

INSTRUMENTATION:

Tools used:

Jamar Hand held dynamometer.

OUTCOME:

Grip strength readings.

Grip strength:

The Jamar dynamometer is a standard tool in grip strength measurement for over thirty years and the grip strength was evaluated with Jamar hydraulic hand dynamometer (Sammons Preston- USA) which was set at second position for all 90 subjects and it continues the tradition of accuracy and reliability with virtually leak

proof hydraulic. It was made up of die cast aluminum- 5 position handle easily adjust to different grip spans. It measures isometric grip force from ‘0’ to ‘200’ pounds (90 kgs).

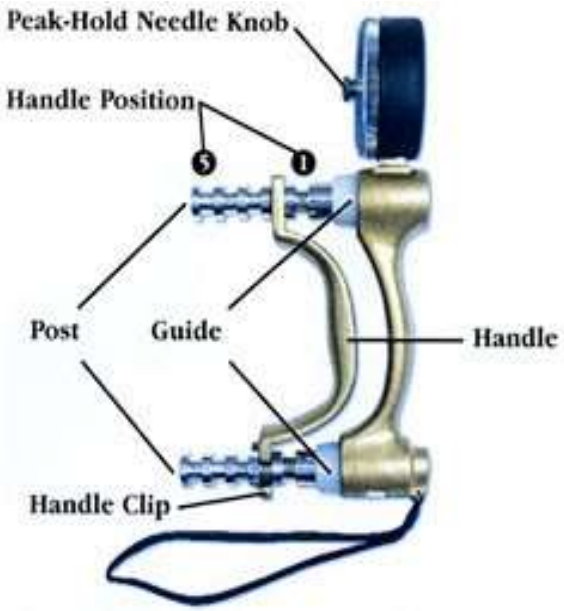

Figure. 1: Jamar dynamometer

Figure. 2: Jamar dynamometer (superior view)

Figure. 3: Jamar dynamometer (lateral view)

Figure.4: hand grip strength evaluation position

Figure.5: measurement of grip strength in male subject.

Figure. 6: measurement of grip strength in female subject

PROCEDURE:

After fulfilling the inclusion criteria, the subjects were recruited to the study after obtaining a informed consent. Details about the procedure and purpose were explained. Total 90 subjects participated in the study. They were aged 61-75 years, and were distributed in three groups according to age 61-65, 66-70 and 71-75 year in group ‘A’, ‘B’and ‘c’ respectively with equal numbers of men and women.

Hand grip strength was measured using Jamar hand grip dynamometer based on the procedure given by the American society of hand therapist (ASHT), subjects were made to sit with shoulder adducted, elbow flexed at 90 degree and forearm and wrist in neutral position. Testing protocol followed the procedure outlined and each participant was asked to grip first with the right and then with the left hand. Squeeze the handle as forcefully as possible for 3 seconds and then should be released. Three average trials were done, and one minute rest was given between each attempt. Out of which the mean score was considered. The procedure was performed for both the dominant and non dominant hands.

The data collected was used for statistical analysis for obtaining the results.

RESULTS

Study Design: An Observational study consisting of 90 subjects , 45 male subjects and another 45 female subjects, further divided into age groups of 61-65, 66-70 and 71-75 was undertaken to study the changes in Grip strength in relation to Gender, age and Hand dominance.

Statistical Methods: Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients, Student t test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale within each group. 95%confidence interval has been computed to find the significance of change. If 95%ci does not include 0, then the difference (delta) is statistically significant otherwise not significant.

Table 1: Distribution of subjects according to age and gender

Gender	Group A (61-65years)	Group B(66-70years)	Group C(71-75 years)
Male	15 (50.0%)	15 (50.0%)	15 (50.0%)
Female	15 (50.0%)	15 (50.0%)	15 (50.0%)
Total	30 (100.0%)	30 (100.0%)	30 (100.0%)

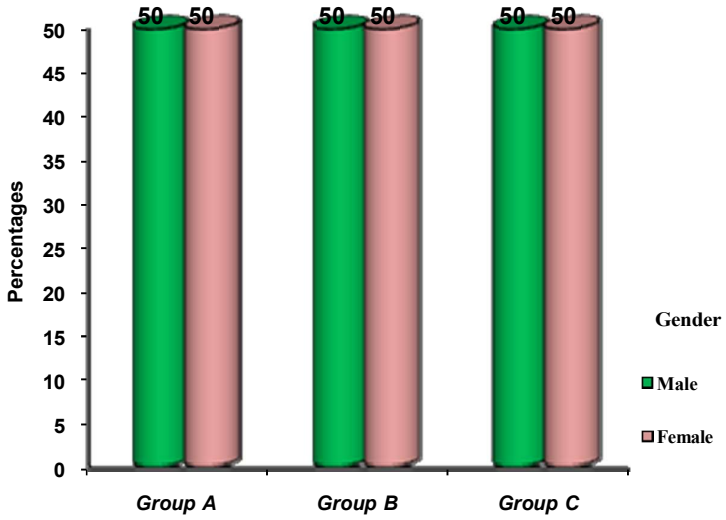

Figure 7: age and gender distribution

Table 1 and figure 7 shows the information related to age and gender distribution in the study. There is equal distribution of male and female in all the groups, 61-65, 66-70 and 71-75 that is group A, group B, and group C respectively.

Table 2: Hand dominance distribution

Hand dominance	Group A	Group B	Group C
Right hand	26 (86.7%)	26(86.7%)	27(90.0%)
Left hand	4(13.3%)	4(13.3%)	3(10.0%)
Total	30(100.0%)	30(100.0%)	30(100.0%)

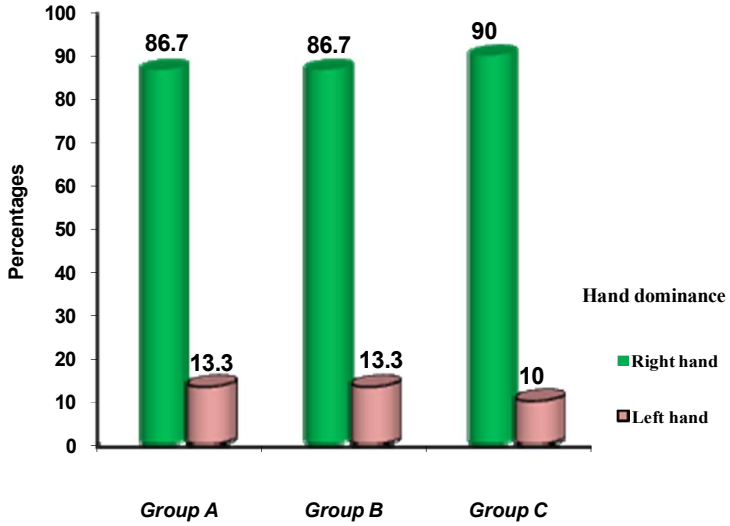

Figure 8: hand dominance distribution

Table 2 and figure 8 shows the distribution of hand dominance. In group A, 26 people were right hand dominant and 4 people were left hand dominant. In group B, 26 people were right hand dominant and 4 people were left hand dominant. In group C, 27 people were right hand dominant and 3 people were left hand dominant.

Table 3: Comparison of grip strength between Dominant hand and Non-dominant hand in male.

Group	Dominant	Non-dominant	Delta	95%CI	P value
Group A	27.88±4.15	26.33±4.20	1.55±1.18	0.90-2.21	<0.001**
Group B	24.77±3.94	23.57±4.01	1.20±0.89	0.70-1.69	<0.001**
Group C	21.61±4.26	20.46±4.29	1.15±0.69	0.77-1.54	<0.001**
Significance	F=8.688; P<0.001**	F=7.425 P<0.001**	-	-	-

Delta is the difference between Grip strength between Dominant and non-dominant

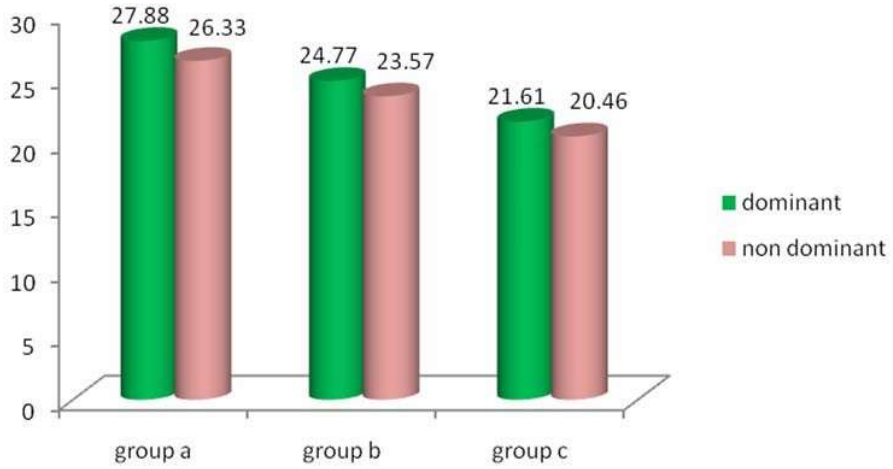

Figure 9: grip strength in male subjects

Table 3 and figure 9 shows the comparison of Grip strength between Dominant hand and Non-dominant hand in male subjects. The mean grip strength score of dominant hand in Group A (61-65 years) was 27.88(SD: 4.15), in Group B (66-70 years) was 24.77 (SD: 3.94) and in Group C (71-75 years) was 21.61 (SD: 4.26).

Where as for non dominant hand mean grip strength score was, in Group A (61-65 years) it was 26.33 (SD: 4.20), in Group B (66-70 years) was 23.57 (SD: 4.01) and in Group C (71-75 years) was 20.46 (SD: 4.29). The difference of grip strength score in both dominant and non dominant hand was statistically significant in all three groups (P<0.001) and also there was significant decrease with progress in age between all three groups (P<0.001).

Table 4: Comparison of grip strength between Dominant hand and Non-dominant hand in Female.

Group	Dominant	Non-dominant	Delta	95%CI	P value
Group A	22.55±3.06	20.97±3.43	1.57±0.96	1.05-2.11	<0.001**
Group B	17.59±1.93	16.06±1.61	1.51±0.92	1.00-2.02	<0.001**
Group C	13.57±2.10	12.29±2.19	1.29±1.14	0.66-1.92	<0.001**
Significance	F=52.010; P<0.001**	F=44.475; P<0.001**	-		-

Delta is the difference between Grip strength between Dominant and non-dominant

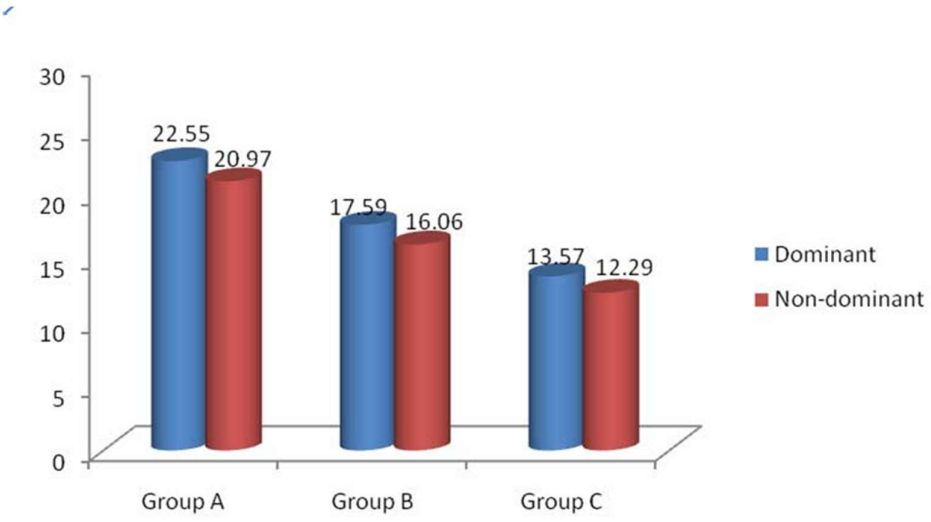

Figure 10: grip strength in female subjects

Table 4 and figure 8, shows the comparison of Grip strength between Dominant hand and Non-dominant hand in female subjects. The mean grip strength score of dominant hand in Group A (61-65 years) was 22.55 (SD: 3.06), in Group B (66-70 years) was 17.59 (SD: 1.93) and in Group C (71-75 years) was 13.57 (SD: 2.10).

Whereas for non dominant hand mean grip strength score, in Group A (61-65 years) was 20.97 (SD: 3.43), in Group B (66-70 years) was 16.06 (SD: 1.61) and in Group C (71-75 years) was 12.29 (SD: 2.19). The difference of grip strength score in both dominant and non dominant hand was statistically significant in all three groups ($P<0.001$) and also there was significant decrease with progress in age between all three groups ($P<0.001$).

Table 5: difference of grip strength in Dominant hand and Non-dominant hand between male and female.

Group	Dominant	Non-dominant	95%CI	P value
Group A	5.33±1.09	5.36±0.77	1.05±2.19	<0.001**
Group B	5.18±2.01	7.51±2.4	0.82±2.01	<0.001**
Group C	8.04±2.16	8.17±2.1	0.79±1.80	<0.001**

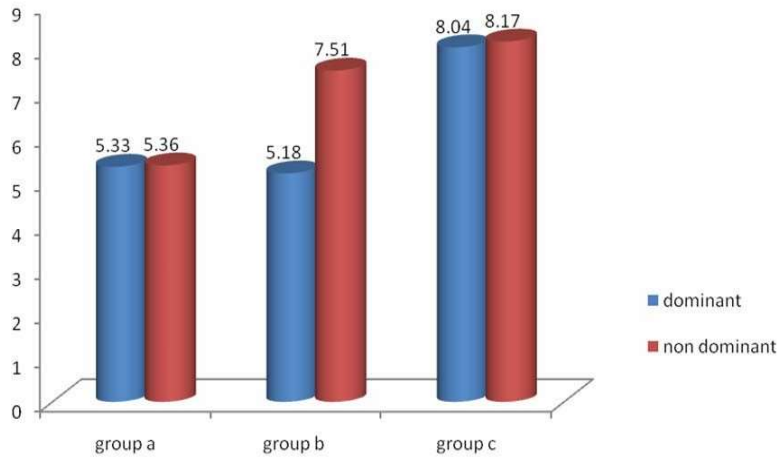

Figure 11: difference of grip strength between men and women.

Table 5 and figure 11, shows the difference of Grip strength between male and female subjects. The difference of grip strength score of Dominant hand in Group A was 5.33 (SD:1.09), in Group B was 5.18(SD:2.01) and in Group C was 8.04 (SD: 2.16), the difference of grip strength score was statistically significant in all the three groups (P<0.001) While for non dominant hand difference of grip strength score, in Group A it was 5.36 (SD: 2.01), in Group B it was 7.51 (SD:2.4) and in Group C it was 8.17 (SD:1.80), the difference of grip strength score was statistically significant in all three groups (P<0.001).

Table 6: Difference of Grip strength between Dominant hand and Non-dominant hand in all subjects.

Grip strength	Number of subjects	Dominant	Non-dominant	Delta	P value
Right handed subjects	79	21.52±5.86	19.94±5.90	1.57±0.87	<0.001**
Left handed subjects	11	20.03±4.61	20.02±4.63	0.0009±0.14	0.984

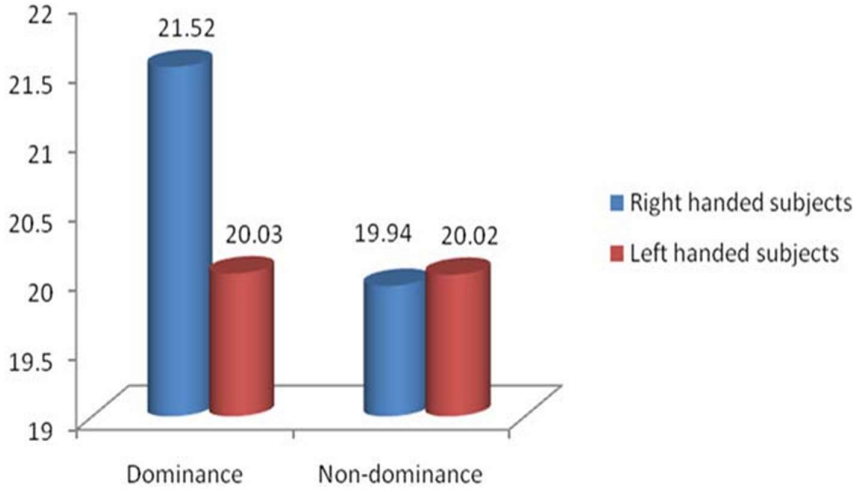

Figure 12: difference of grip strength between both sides of hand in all subjects

Table 6 and figure 12, shows that in right handed people the mean grip strength for dominant side was 21.52(SD:5.86) and non dominant side 19.94 (SD-5.90), and the difference was 1.57(SD:0.87) which was statistically significant (p <0.001).where as in left handed people the mean grip strength was 20.03(SD:4.61) and non dominant side 20.02(SD: 4.63), and the difference was 0.0009 (SD: 0.14) which was not statistically significant (P 0.984).

DISCUSSION:

The aim of the study was to investigate the normative values of grip strength in different age groups, and also to compare the differences of grip strength in relation to age, gender and dominance of hand in geriatric people using Jamar hand dynamometer.

The result suggests that grip strength decreases with increasing age for both male and female and in both dominant and non dominant hand for all age groups. The results are statistically significant ($P<0.001$) for both genders. This coincides with a previous study done by, Mathiowetz (1985) and Ira M Fiebert (1996).

As humans age the force generating capacity (strength) of the skeletal muscle reduces, recent research indicates that “observed loss of force production in older people is primarily as a result of muscle atrophy and alteration in the percentage of contractile tissue within the muscle rather than deficit in muscle activation”. Also it has been observed that muscle of the older age group contain less contractile tissue and more non contractile tissue when compared with the skeletal muscle of the younger age group. This results in lesser force production capability

The result also shows that the grip strength of males is more than that of females in all the three groups ($p<0.001$) and this finding coincides with the study conducted by T. Kamarul et al,(2006) where they found that men were stronger than women in all age groups with a ratio of 1.75:1.

This difference between the genders shows that there is lower grip strength among women. It can be attributed to an existence of a positive, significant relationship

between strength to weight and height and the superiority of men on these variables over women. And also the loss of ovarian estrogen in menopause may be related to the loss of strength in post menopausal women.

There is disagreement regarding difference of hand grip strength between dominant and non dominant side. The result shows that there is a statistical significant difference between dominant and non dominant hand in all groups in both male and female with $p<0.001$ and the dominant hand is 7.88% stronger than non dominant hand in right handed people. But in left handed people no such significant difference between sides could be documented, and the difference is > 1%.

Nargul Arinci Incel et al (2002) conducted a study on effect of hand dominance while measuring grip strength; they concluded that dominant hand was significantly stronger in right handed subjects(8.20%) but no significant difference in left handed subjects(3.20%). score for dominant hand was less than 10%. So 10% rule cannot be generalized to the whole population.

While interpreting these results I have taken into account that the world we live in is mostly designed for right handedness. Most tools and daily appliances are designed for the right hand. As a result the right hand of both right and left handed people is exercised more often than left on a daily basis.

These reference values of three groups can be used to quantify muscle weakness or to evaluate the possible effect of treatment in older people suffering from any problem that affects the muscle strength of hand.

CONCLUSION:

The aim of this study was to find out average values and also difference in grip strength in relation to age, gender and dominance of hands in geriatric people of 61 to 75 years.

This study provides data of the grip strength in older people. And from this study it can be concluded that,

- There was a steady decrease in grip strength in all three groups, in both male and female and in both dominant and non dominant hands.
- The grip strength in men was stronger than that of women in all three groups.
- In right handed people grip strength in dominant hand was stronger than that of the non dominant hand in both men and women in all three groups. But in left handed people there was minimal difference which was not significant

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Address for Correspondence

Dr.T.Karthikeyan, PhD,D.LITT
Associate Professor,
Department of Physiotherapy, Gurugram University,
Gurugram, Haryana, India
dr.t.karthikeyan@gurugramuniversity.ac.in

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