"EFFECTIVENESS OF BALANCE AND STRENGTH TRAINING IN REDUCING THE FALL RISK IN SUBJECTS WITH DIABETIC NEUROPATHY"

A DISSERTATION SUBMITTED TO THE TAMILNADU Dr. M.G.R MEDICALUNIVERSITY, CHENNAI, AS PARTIAL FULFILLMENT OF THE MASTER OF PHYSIOTHERAPY DEGREE

APRIL 2012

“EFFECTIVENESS OF BALANCE AND STRENGTH TRAINING IN REDUCING THE FALL RISK IN SUBJECTS WITH DIABETIC NEUROPATHY”

Has been submitted in partial fulfillment for the requirement of

the Master of Physiotherapy Degree

April 2012

Internal Examiner		**External Examiner**

CERTIFICATE

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Principal

Place : Coimbatore

Date :

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ACKNOWLEDGEMENT

It is my privilege to thank God, the Almighty for showering his blessings and who has always been my source of strength and inspiration and has guided me in all endeavours leading to the completion of this project

With great awe, I would like to express my sincere thanks to **Padmashree. Dr. G. Bakthavathsalam,** Chairman, K.G. Hospital for providing a wonderful environment and the necessary infrastructure to cultivate knowledge.

With sincere gratitude, I would like to thank **Mrs. Vaijayanthi Mohandas,** Director of education, K.G. College of health science for her enthusiasm and concern for the well being of the students.

My sincere thanks to **Prof. S. Ramesh MPT,** Principal, K.G. College of Physiotherapy for his constant and unwavering encouragement and support.

My sincere thanks to **Prof. B. Arun. MPT,** Vice-Principal, K.G. College of Physiotherapy for his constant and unwavering encouragement and support.

My special thanks to my thesis guide, **Mrs. Arul Priya. M, M.P.T,**

Professor, K.G College of physiotherapy, Coimbatore, for her guidance,

timely help and extensive support in this thesis.

I am of course indebted to all the **Faculty Members** of **K.G. College of Physiotherapy** and **Physiotherapist** in the **Department of Physiotherapy**, **K.G. Hospital** and for their priceless contribution in cultivating education and special skills in me which stands significant for my career.

I whole hearted thank **Mr. Kathirvadivelu,** Librarian for providing me with needed reference materials.

I am obliged to offer my sincere thanks to all **My Subjects** for having consented to participate in this study forgoing all suffering.

My deep humble sense of gratefulness to **My Dad, Mom & Brother** for their everlasting and external love they have given me.

Last but not least, I submit my thanks to **My Friends** for their unwavering supports, encouragement and love which helped me in doing my project and my studies as well.

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I INTRODUCTION

Diabetes mellitus is defined as an endocrine disorder resulting from either a deficiency in production and release of insulin into blood stream (Type I) or resistance to insulin in body (Type II). (Thompson and Godwin 1995). Recently published findings revealing that in 2011, the country with the largest numbers of people with diabetes is India (40.9 million). The countries such as India are going to be as many as 80% of all diabetes from the entire world population, there which makes India the diabetic capital of the world. (Indian Med Association 2011 March).

It has been projected that 300 million individuals would be affected with diabetes by year 2025. (WHO). Diabetes has many serious complications including diabetic neuropathy, which presents clinically in many different ways. (Vinik, Park, Stansberry, & Pittenger, 2000)

The Diabetic neuropathies can be classified into 3 different categories: 1) focal neuropathies, 2) diffuse neuropathies, and 3) autonomic neuropathies.(Vinik, et al., 2000). The proposed study addresses one of the diffuse neuropathies, distal symmetric polyneuropathy, which is the "most common and widely recognized form of diabetic neuropathy"(Vinik, et al., 2000). Prevalence rates are as high as 50% in people with diabetes.(Dyck et al., 1993) . This type of diabetic neuropathy is often referred to as diabetic peripheral neuropathy (DPN).

Diabetic Peripheral Neuropathy is defined as "the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes". (Boulton et al., 2005)

Clinically, Diabetic Peripheral Neuropathy presents as abnormalities in sensory and sometimes motor function in the lower legs and the hands. Generally, sensory abnormalities in the lower leg present earlier in the progression of Diabetic Peripheral Neuropathy than motor abnormalities and the hands are usually involved only in more severe cases of Diabetic Peripheral Neuropathy.(Vinik & LeRoith, 2008). Symptoms of Diabetic Peripheral Neuropathy are often stocking like in nature and may include burning or aching pain in about 50% of individuals with Diabetic Peripheral Neuropathy; however, others may report painless, numb feet.(Boulton, et al., 2005;) Clinical signs of Diabetic Peripheral Neuropathy are more consistent than symptoms and usually include some degree of bilateral lower extremity loss of touch, pressure, vibratory, position, and temperature sensory perception and decreased ankle reflexes.(Feldman, et al., 1999;)

Overtime diabetes can lead to various problems like, cardiovascular problems, including coronary artery disease, hardening and narrowing of arteries (atherosclerosis) leading to stroke and other large blood vessel disease referred to as macro vascular. Diabetes can also lead to blindness, kidney failure and nerve damage to small vessels referred to as macro vascular. (Merck Manuals 1998) . Diabetic neuropathy has a tremendous impact on patients quality of life, predominantly by causing weakness, ataxia and in coordination. (Aaron vinik MD)

Falls have been studied extensively in older persons and it is estimated that 30% of people over the age of 65 fall every year.(Tinetti, Speechley, & Ginter, 1988). Diabetic peripheral neuropathy, influences sensory and depending on severity, motor nerve function in the distal lower extremities. Intuitively, one would think that sensory and motor changes in the distal legs may influence balance and gait in individuals with Diabetic Peripheral Neuropathy which may increase fall risk. (Cavanaugh and colleagues1992).

Diabetes is been recognised as an important risk factor for fall, among patients age 60 yrs and over. Individuals with diabetes are 1.6 times more likely to experience a fall and twice as likely to have falls with injuries than in individuals without diabetes. (Rein, 2011). Impaired gait and balance is one of the most significant causes and consequences of falls. Persons with peripheral neuropathy represent one of the largest population with impaired stability. Peripheral neuropathy include sensory and motor impairments that result in impaired gait and balance.(Patricia Ann Quigley,2005)

Evidence suggests that exercise programme can be effective in improving gait and balance in general fall risk population, as well as reducing falls and fall related injuries. Exercise interventions have been designed to reduce fall risk and promote successful ageing. (Patricia Ann Quigley,2005)

Physiotherapy may be helpful in maintaining strength, mobility and function regardless of underlying cause of peripheral neuropathy. Diabetic neuropathy patients tightly control their blood sugar level to prevent major fluctuation by regular exercises. The objectives of physiotherapy include strengthening muscles by exercising against increasing resistance using weights and isometric exercises. Balance training provides stability and prevent falls. (Maures MS, Burcham, 2002)

The major benefits of resistance training in individuals with diabetes are improved blood cholesterol profiles, increased heart function, decreased blood pressure, improved insulin sensitivity and blood glucose control, improved muscular strength, power and endurance, increased bone strength. (Souk up et al.) Resistance training for patients with diabetic neuropathy has the potential to improve muscle strength, endurance and flexibility which reduces the risk of fall.(Lord SR, Mckay HA, 2010)

1.2 NEED FOR THE STUDY:

In view of the fact that diabetic subjects are at increased risk of falls. Fall prevention efforts need to be incorporated into the management of the older diabetes. It is also been found that structured exercise programs that involve walking, strength and balance training are associated with improved functional status and reduce falls among diabetes. (Dr. Rein, 2011)

The risk factors for fall in diabetes are many. The important factor is balance and gait disorders. Diabetics with increased risk of fall are likely to experience fractures. Their functional status is also decreased due to fear of falling. Hence this study aims to determine the effectiveness of balance and strength training in reducing fall risk in subjects with diabetic neuropathy.

1.3 PURPOSE OF THE STUDY:

The purpose of this study was aimed to reduce the fall risk in subjects with Diabetic Peripheral Neuropathy following balance and strength training.

1.4 OBJECTIVES:

- To determine the balance impairment in diabetes subjects with peripheral neuropathy.
- To determine the prevalence of fall risk in diabetic subjects with peripheral neuropathy.
- To determine the effectiveness of balance and strength training in reducing the fall risk in subjects with diabetic neuropathy.

1.5 HYPOTHESIS:

NULL HYPOTHESIS:

There is no significant reduction in fall risk in diabetic subjects with peripheral neuropathy following balance and strength training.

ALTERNATE HYPOTHESIS:

There is significant reduction in fall risk in diabetic subjects with peripheral neuropathy following balance and strength training.

II REVIEW OF LITERATURE

M.S Ajimsha, et al., (2011)

They conducted a study to find out the efficacy of Stability Trainer in improving functional balance in Type II Diabetic patients, with Distal Sensory Neuropathy, a Randomized controlled single blinded trial. Thirty three patients with the diagnosis of Type 2 Diabetes with Distal Sensory Neuropathy participated in the trial. The Control Group received relaxation exercises, range of motion exercises, strengthening exercises and balance training. For Experimental Group, in addition to conventional treatment, balance training on Stability Trainer was given. The outcome was measured using Berg Balance Scale (BBS). Both groups showed significant improvement in functional balance performance. The Experimental Group showed statistically significant improvement in functional balance when compared to Control Group. The patients in the Experimental Group showed 28.2% improvement in their BBS scores; whereas Control Group showed 17.4% improvement in their BBS scores. Balance training on Stability Trainer seems to be beneficial in improving functional balance in diabetic patients with distal sensory neuropathy.

Lee SW, et al (2011)

They assessed the effects of an exercise program on balance and trunk proprioception. The researchers recruited 38 patients with diabetes having peripheral neuropathies. They were randomized and subdivided in two groups with the experimental group practicing a balance exercise program. The control group did not participate in the exercise program but both groups received health education on diabetes. The results showed that the experimental group experienced significant decrease in postural sway, an increase in one-leg stance test, and dynamic balance from the Berg Balance Scale, Functional Reach Test, Timed Up and Go test, and 10-m walking time improved significantly after balance exercise. A decrease in errors of trunk repositioning was also observed with training. The authors concluded "These results suggest that a balance exercise is suitable for individuals with diabetic neuropathy.

Romero et al.,(2011)

The purpose of this study was to use the standard error of measurement to investigate the minimal detectable change associated with Berg Balance Scale (BBS) and the Dynamic Gait Index (DGI) in older adults at risk of falling. A sample of 42 community dwellers (older than 65 years) with a history of falls or near falls was evaluated with the BBS and DGI. The results suggest that a change in the BBS and in the DGI is necessary to be 95% confident that genuine change in

function has occurred between 2 assessments. This information is important for assessing and monitoring progress and guiding treatment for community dwellers at high risk of falling.

Chang Ho Song, Ph.D., et al., (2011)

They assessed the effects of an exercise program on balance and trunk proprioception in older adults with diabetic neuropathy. Thirty-eight patients with diabetes having peripheral neuropathy were enrolled, randomized, and subdivided in two groups: an experimental group of 19 participants with diabetes and a control group of 19 participants with diabetes. Both groups received health education on diabetes. The experimental group practiced an additional balance exercise. The exercise training was performed two times per week for 8 weeks. Results were evaluated by both static and dynamic balance and trunk proprioception. Postural sway significantly decreased , the one-leg stance test significantly increased , and dynamic balance from the Berg Balance Scale, Functional Reach Test, Timed Up and Go test, and 10-m walking time improved significantly after balance exercise . Trunk repositioning errors also decreased with training. They concluded that the balance exercise program improved balance and trunk proprioception. These results suggested that a balance exercise is suitable for individuals with diabetic neuropathy.

Bird M et al., (2010)

They examined the long-term effects of a multi-component exercise program on balance, mobility and exercise behaviour. The benefits of a community-based resistance and flexibility exercise intervention in a group of healthy older (60-75 years) individuals were recorded 12 months after completion of the randomized control intervention. Differences between those participants who continued to exercise and those who discontinued were investigated. Significant improvements from baseline in sit to stand , timed up and go , and sway remained at follow up in the exercise intervention group, with a control group unchanged. Participants who continued exercising had significantly greater improvements in strength immediately after the intervention, compared to those who discontinued . Those who continued regular resistance training performed better in the step test at 12-month follow up and believed that the program was of more benefit to their physical activity than those who discontinued exercising.

Kruse RL, et al., (2010)

As part of a study of the effects of weight-bearing exercise on foot ulceration in people with DM and PN, the effects of a lower-extremity exercise and walking intervention on balance, lower-extremity strength, and fall incidence were determined. The study was an observer-masked, 12-month randomized controlled trial. The participants were 79 people who were randomly assigned to either a control group (n=38) or an intervention group (n=41).

Intervention Part 1 included leg strengthening and balance exercises and a graduated, self-monitored walking program; part 2 included motivational telephone calls. Both groups received regular foot care education, and 8 sessions with a physical therapist. The measurements collected were strength, balance, and participant-reported falls for the year after enrollment. There were no statistically significant differences between the groups for falls during follow-up. At 12 months, there was a small increase in the amount of time that participants in the intervention group could stand on 1 leg with their eyes closed. No other strength or balance measurements differed between the groups. The training program had a minimal effect on participants' balance and lower-extremity strength. Increasing weight-bearing activity did not alter the rate of falling for participants in the intervention group relative to that for participants in the control group. People who are sedentary and who have Diabetes Mellitus and Peripheral Neuropathy appear to be able to increase activity without increasing their rate of falling.

Allet L, et al., (2010)

They conducted the study to evaluate the effect of a specific training program on diabetic patients' gait. A randomized controlled trial (N=71) with an intervention group (N=35), and control group (N=36). The intervention consisted of physiotherapeutic group training including gait and balance exercises with function-oriented strengthening. Controls received no treatment. After intervention the Intervention Group increased their habitual walking speed on tarred terrain

and on the cobblestone. significant improvement was observed for cadence, gait cycle time and stance time on both terrains. All outcomes except stance time on the tarred terrain remained significant at the six-month follow-up. In control group all parameters remained unchanged compared to baseline values. The study concluded that a specific training program can improve diabetic patients' gait in a real life environment.

Kim delbaere et al., (2010)

They conducted a study to gain an understanding of elderly people's fear of falling.. It is a prospective cohort study with 500 men and women aged 70–90 years. Physiological profile assessment, and perceived fall risk estimated with the falls efficacy scale international. Participants were followed up monthly for falls over one year. The study concluded that many elderly people underestimated or overestimated their risk of falling. Such disparities between perceived and physiological fall risk were primarily associated with psychological measures and strongly influenced the probability of falling. Measures of both physiological and perceived fall risk should be included in fall risk assessments to allow tailoring of interventions for preventing falls in elderly people.

Ishir and colleagues (2010)

They conducted a study of 17 individuals with type 2 diabetes were placed into 2 groups, a strength training group and sedentary control group. The training group participants were instructed to train five times per week for 4-6 weeks at

workloads corresponding to 40-50% of their 1 repetition maximum. Two sets of 10 reps for upper body muscles and 2 sets of repetition for lower body muscles were done. The researchers reported that the rate of blood glucose entry into the working muscles increased after training. This study demonstrates that moderate intensity, high volume training improved insulin sensitivity by 48% in these individuals.

Eriksson and Colleague et al., (2009)

Illustrate the benefits of strength training in the management of diabetes. In the study, 8 participants who had type2 diabetes completed a 3-month progressive resistance program that consisted of two days a week of circuit weight training. The researches found that circuit weight training was responsible for improvements were significantly related to training induced muscle hypertrophy

Tabassom Ghanavati et al., (2009)

They compared the functional balance in diabetic neuropathic patients and normal subjects. The study consist of fifteen Distal peripheral neuropathy patients and 15 healthy individuals. As well as overall functional balance, five groups of these tests were taken into more consideration in this study, based on the probable effects of proprioceptive loss on various functions. , The tests are Berg balance scale (BBS), ability to control weight shifting (CWS), ability to transfer (T), and ability to control balance under different base of support (BOS) and visual (V)

conditions. DPN results in a remarkable functional imbalance which may expose these patients to danger of falling during activities of daily living and becomes more severe as the severity of neuropathy aggravates.

Renata Cereda Cordeiro et al., (2009)

They conducted a study to characterize balance and mobility among diabetic elderly outpatients and to estimate the extent to which functional balance and mobility abnormalities can be influenced by socio demographic, clinical and other functional factors in a cross-sectional study. Ninety-one elderly outpatients were assessed. Mobility was evaluated by the Timed Up and Go Test (TUGT) and the balance, by the Berg Balance Scale (BS). They concluded that elderly diabetic outpatients show abnormal balance and mobility related mainly to advanced age, disability, absence of step strategy, absence of proprioceptive sensitivity and presence of OH.

Muir SW et al., (2008)

They conducted a prospective cohort study to examine the predictive validity of the Berg Balance Scale (BBS) for 3 types of outcomes-any fall (> or =1 fall), multiple falls (> or =2 falls), and injurious falls-by use of sensitivity, specificity, receiver operating characteristic (ROC) curves, area under the curve, and likelihood ratio. A sample of 210 community-dwelling older adults received a comprehensive geriatric assessment at baseline, which included the BBS to

measure balance. Data on prospective falls were collected monthly for a year. The predictive validity of the BBS for the identification of future fall risk was evaluated. The BBS had good discriminative ability to predict multiple falls when ROC analysis was used. The predictive validity of this scale for multiple falls is superior to that for other types of falls, and the use of likelihood ratios preserves the gradient of risk across the whole range of scores.

Mathew s. Maurer et al., (2005)

They conducted a study to determine whether diabetes is an independent risk factor for falls in elderly residents of a long term care facility. The study was a prospective cohort study of 139 elderly residents of long term facility. Multiple domains were assessed for the associates with falls. Over the follow-up period (299 days), 49 participants 35% experienced a fall. The fall incident rate for the participants with and without diabetes mellitus was 78%and 30%. The result suggests that diabetes mellitus is an independent fall risk factor among elderly nursing home residents.

Anne Barnett et al., (2003)

States that the study determines whether participation in a weekly group exercise program with ancillary home exercise over one year improves balance, muscle strength, reaction time, physical functioning, health status and prevents falls in at risk community dwelling older people. 163 people aged over 65 years

were randomly recruited for the study and assigned into exercise intervention and control group. The results showed that within the 12 month trial period, the rate of falls in the intervention group was 40% lower than that of control group. Thus the study concludes that participation in a weekly group exercise programme with ancillary home exercise can improve balance and reduce the rate of falling in at risk community dwelling older people.

James K. Richardson MD, et al., (2001)

They conducted a study to determine the effect of a specific exercise regimen on clinical measures of postural stability and confidence in a population with peripheral neuropathy (PN). It is a Prospective, controlled, single blind study. Twenty subjects with diabetes mellitus and electro diagnostically confirmed PN. Ten subjects underwent a 3-week intervention exercise regimen designed to increase rapidly available distal strength and balance. The other 10 subjects performed a control exercise regimen. Unipedal stance time, functional reach, tandem stance time, and score on the activities-specific balance and confidence (ABC) scale were the outcome measures. The intervention subjects showed significant improvement in all 3 clinical measures of balance and nonsignificant improvement on the ABC scale. The study concluded that a brief, specific exercise regimen improved clinical measures of balance in patients with diabetic Peripheral Neuropathy.

Mary E. Tinetti, M.D et al., (1988)

They conducted a one-year prospective investigation to study the risk factor of falling using a sample of 336 persons at least 75 years of age who were living in the community. All subjects underwent detailed clinical evaluation, including standardized measures of mental status, strength, reflexes, balance, and gait; in addition, they inspected their homes for environmental hazards. Falls and their circumstances were identified during bimonthly telephone calls. During one year of follow-up, 108 subjects (32 percent) fell at least once; 24 percent of those who fell had serious injuries and 6 percent had fractures. Predisposing factors for falls were identified in linear-logistic models. They conclude that falls among older persons living in the community are common and that a simple clinical assessment can identify the elderly persons who are at the greatest risk of falling.

III METHODOLOGY

3.1 STUDY DESIGN:

An experimental study with 2 groups pre test and post test study design.

3.2 STUDY SETTING:

Study was conducted at Physiotherapy Outpatient department - K.G Hospital, K.G college of Physiotherapy, Community center – Chinnavedampatti, Coimbatore.

3.3 STUDY DURATION:

The study was conducted for a period of one year.

3.4 SUBJECTS:

A total of 30 diabetic subjects were selected and divided into two groups of 15 diabetic subjects each based on selection criteria using convenience sampling.

3.5 SELECTION CRITERIA

INCLUSION CRITERIA:

- Subjects with history of diabetes mellitus(Type I and Type II)
- Subjects with moderate & severe symptoms of distal sensory neuropathy- Michigan diabetic neuropathic score
- Age- 50-65 years
- Both sexes
- History with or without falls.

EXCLUSION CRITERIA:

- Cardiovascular disease
- Unstable proliferative retinopathy
- End stage renal disease
- Uncontrolled hypertension
- Peripheral neuropathy of any other type (Eg: leprosy, GBS, toxic neuropathy)
- CNS abnormalities like hemiparesis, syringomyelia, and cerebellar lesions.
- Lower extreamity musculoskeletal deformities
- Plantar fasciitis
- Hearing deficits

- Visual deficits
- Vestibular deficits
- Postural hypertension
- Systemic disease such as RA, SLE,etc.

3.6 VARIABLES:

INDEPENDENT VARIABLES

- Balance Training
- Strength Training

DEPENDENT VARIABLES

- Balance
- Strength
- Fall risk

3.7 OPERATIONAL TOOLS:

- Michigan Diabetic Neuropathy score (MDNS)
- Goniometry
- Inch tape

3.8 PARAMETERS:

- Berg balance scale
- Timed Up and Go Test
- Functional reach test

3.9 PROCEDURE:

The diabetic subjects were assessed by using patients profile which includes various components, signs and symptoms, medical history, a detailed sensory and motor evaluation.

GROUP A is given strength training and balance training programme.

1) STRENGTH TRAINING

- To determine resistance -1 repetition Max can be done.(stable)
- No of sets and repetitions-1-2 sets of exercise with 10-12 repetitions.
- Rest time between sets-30 to 60 seconds .Up to 2 minutes
- Frequency of strength training- At least 2 days per week.

TYPES OF STRENGTH TRAINING:

1. Arm curl

2. Military press

3. Bench press

4. Knee extension

5. Back extension

6. Back knee sit ups

- 2 set of 10 repetitions for upper limb muscles
- 2 sets of 20 repetitions for lower limb muscles
- Five times per week for 4-6 week at workloads corresponding to 40 to 50% of their 1 repetition maximum.

2. EXERCISE FOR BALANCE TRAINING:

1. Warm up (ankle ROM)exercises

2. Bilateral toe raises and heel raises

3. Bilateral inversion and eversion

4. To practice ankle strategy

5. Narrow base standing

6. Tandem walking

7. Standing on Rocker Board

GROUP B is the control group:

General mobility exercise to all joints is giv**e**n along with regular walking programme.

3.10 STATISITICAL TOOL:

Paired ‘t’ test

To compare pre test and post test values of experimental group and pre test and post test value of control group.

Formula: Paired t-test

$$S = \sqrt{\frac{\sum d^2 - [\sum d]^2}{n-1}}$$

$$t = \frac{\overline{d\sqrt{n}}}{s}$$

Where,

d = difference between the pre and post test

$\overline{d}$ = mean difference

n = total number of subjects

s = standard deviation

Unpaired‘t’ test:

The unpaired ‘t’ test was used to compare the post test values between the two groups, control and experimental group.

Formula: Unpaired t – test

$$S = \sqrt{\frac{\sum (x_1 - \bar{x}_1)^2 + \sum (x_2 - \bar{x}_2)^2}{n1 + n2 - 2}}$$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

n1 = total number of subjects in group A

n2 = total number of subjects in group B

$\bar{x}_1$ = mean of group A

$\bar{x}_2$ = mean of group B

s = standard deviation

Level of significance: 5%

IV DATA ANALYSIS AND INTERPRETATION

4.1.A TABLE-I

BERG BALANCE SCALE

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	28.00	± 6.77	0.3316
2.	GROUP B	27.20	± 6.44	

Table shows statistical analysis of pretest values of Berg balance scale of Group A and Group B.

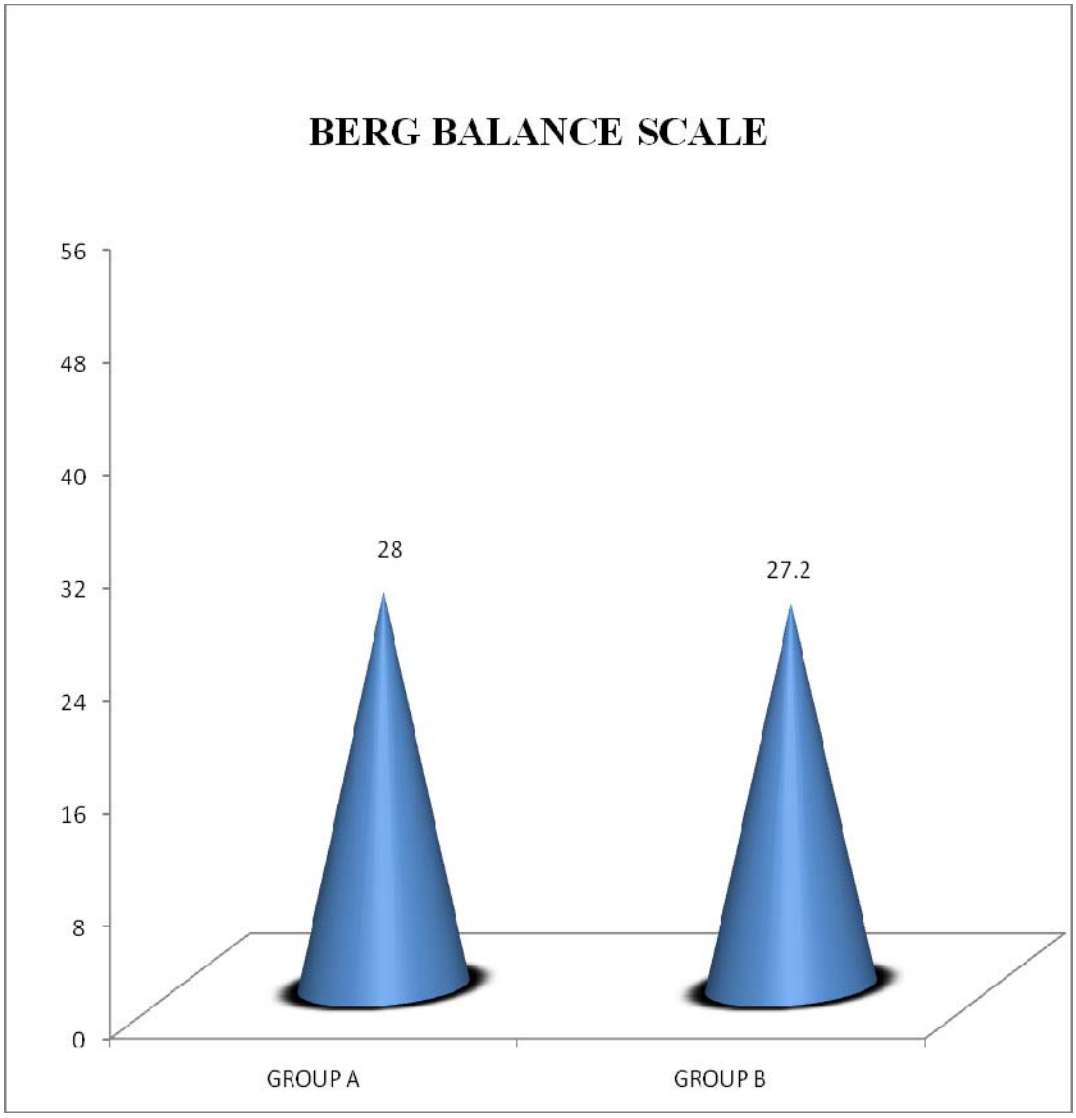
4.1.B ANALYSIS OF RESULT

Using unpaired 't' test

Comparing pre test of Berg balance scale in Group A and Group B. Calculated 't' value (0.3316) is less than table value (1.701) at 5% level significance for two tailed 't' test showing that there is no significant difference between two groups.

4.1.C. GRAPH-I

GRAPHICAL REPRESENTATION PRE TEST VALUES OF GROUP A AND GROUP B



Graph shows the pre test means of Berg Balance Scale of Group A and Group B.

4.2.A TABLE-II

BERG BALANCE SCALE

S.NO	GROUP A	MEAN	STANDARD DEVIATION	't' VALUE	Percentile difference
1.	Pre test	28	± 6.77	16.08	16.3%
2.	Post test	37.13	± 5.95		

Table shows statistical analysis of pre and post test values of Berg Balance Scale of Group A

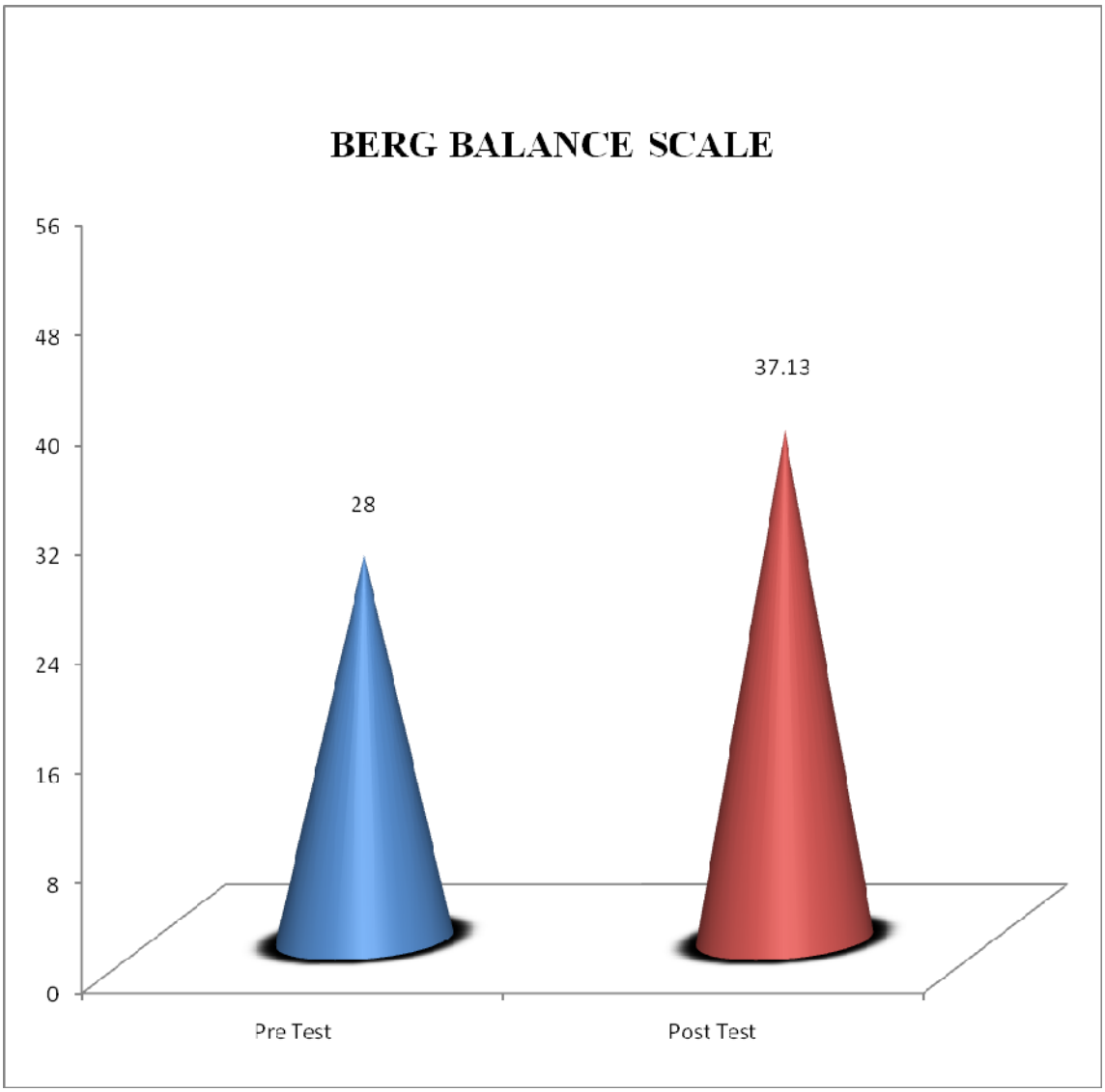
4.2.B ANALYSIS OF RESULT

Using paired 't' test

Comparing pre and post test of Berg Balance Scale Group A. Calculated 't' value (16.08) is greater than table value (1.761) at 5% level significance for two tailed 't' test showing that there is significant difference between values.

4.2.C. GRAPH-II

GRAPHICAL REPRESENTATION PRE TEST AND POST TEST VALUES OF GROUP A



Graph shows the pre test and post test means of Berg Balance Scale of Group A.

4.3.A TABLE-III

BERG BALANCE SCALE

S.NO	GROUP B	MEAN	STANDARD DEVIATION	't' VALUE	Percentile difference
1.	Pre test	27.20	± 3.327	15.0570	8.01%
2.	Post test	31.80	± 11.520		

Table shows statistical analysis of pre and post test values of Berg Balance Scale of Group B

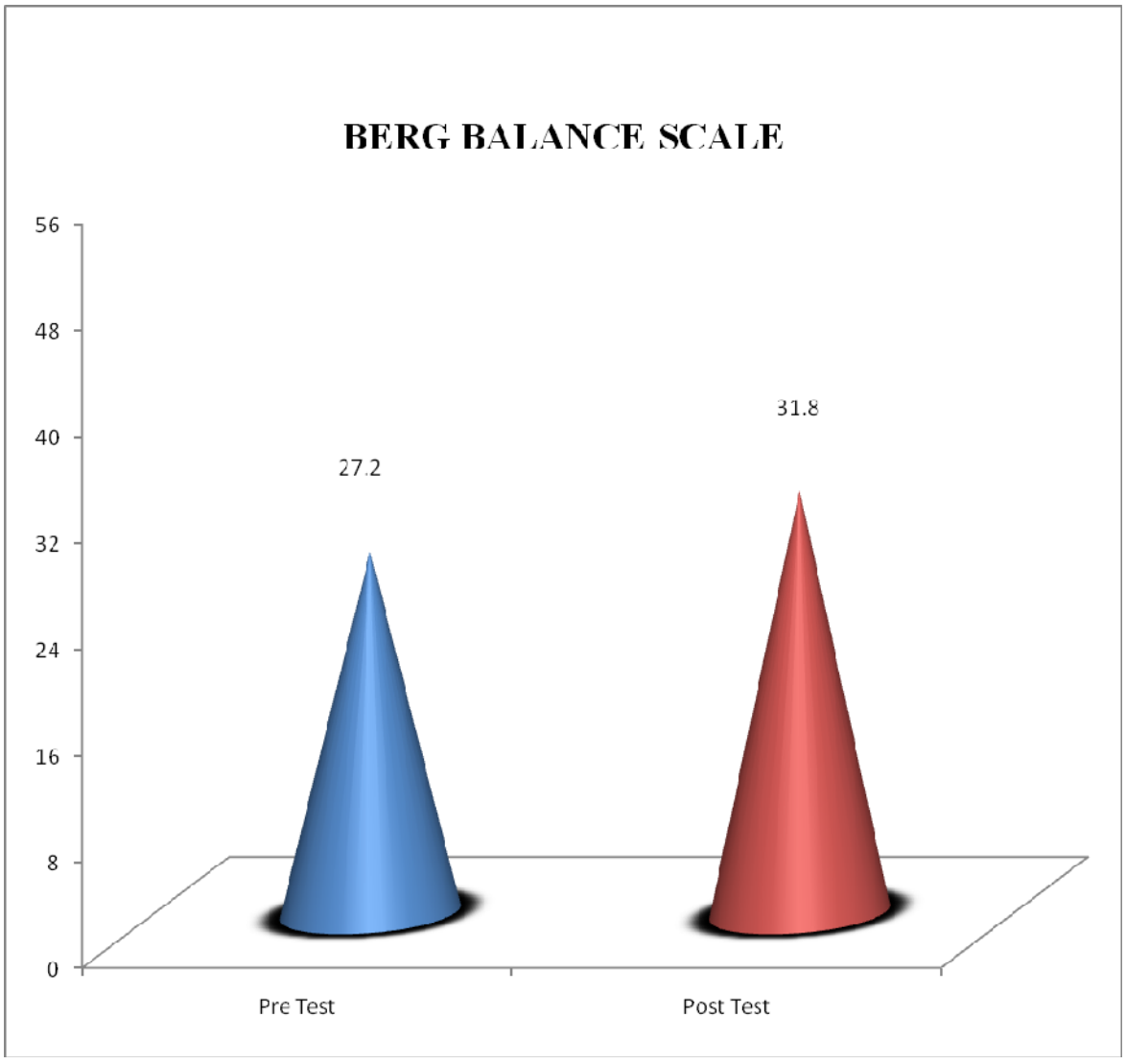
4.3.B ANALYSIS OF RESULT

Using paired 't' test

Comparing pre and post test Berg Balance Scale of Group B. Calculated 't' value (15.0570) is greater than table value (1.761) at 5% level significance for two tailed 't' test showing that there is significant difference between values.

4.3.C. GRAPH-III

GRAPHICAL REPRESENTATION PRE TEST AND POST TEST VALUES OF GROUP B



Graph shows the pre test and post test means of Berg Balance Scale of Group B.

4.4.A TABLE-IV

BERG BALANCE SCALE

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	37.13	± 5.95	2.3760
2.	GROUP B	31.80	± 6.34	

Table shows statistical analysis of Post test values of Berg Balance Scale of Group A and Group B.

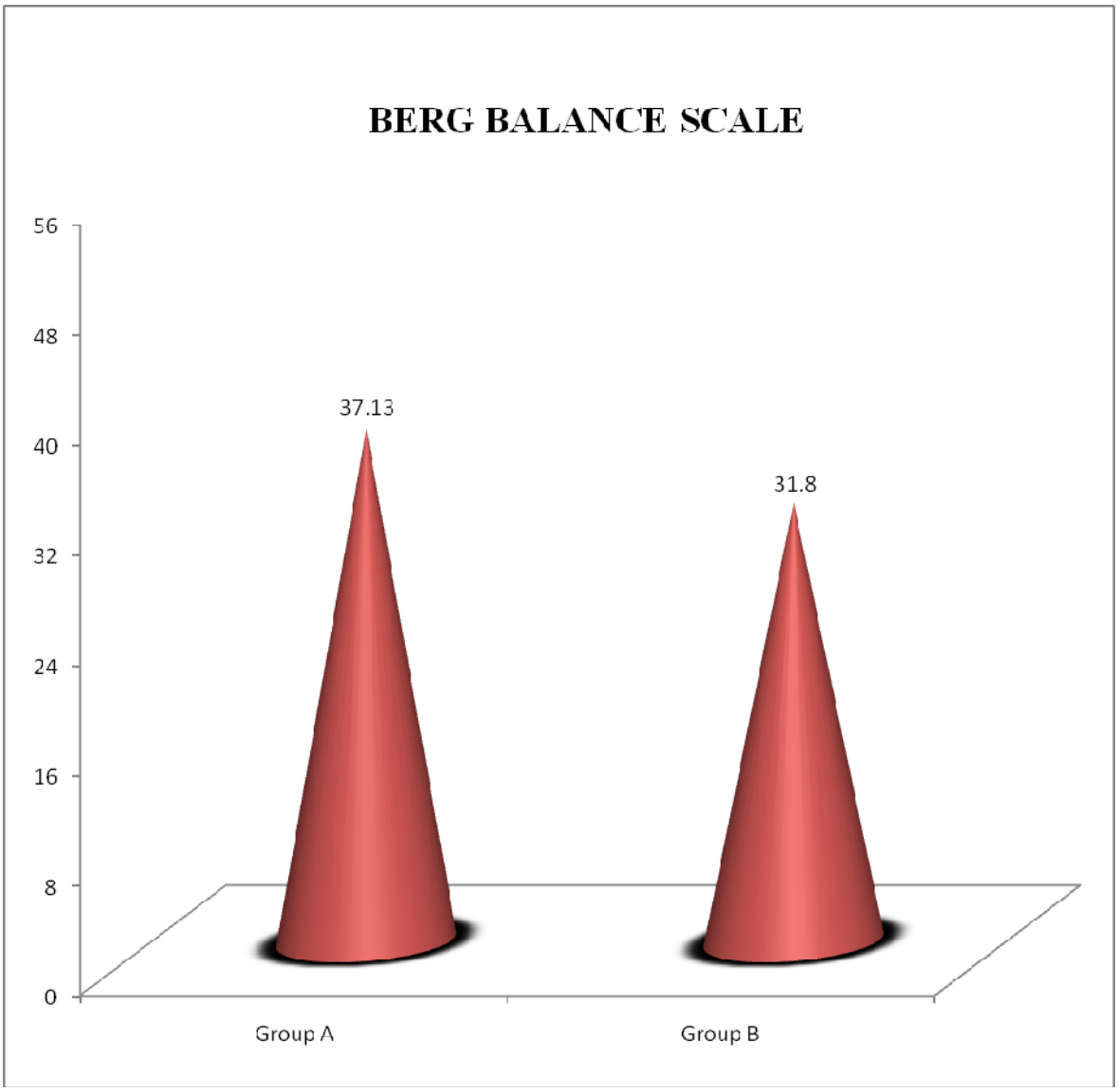
4.4.B ANALYSIS OF RESULT

Using unpaired 't' test

Comparing post test of Berg Balance Scale of Group A and Group B. Calculated 't' value (2.3760) is greater than table value (1.701) at 5% level significance for two tailed 't' test showing that there is significant difference between two groups.

4.4.C. GRAPH-IV

GRAPHICAL REPRESENTATION POST TEST VALUES OF GROUP A AND GROUP B



Graph shows the post test means of Berg Balance Scale of Group A and Group B.

4.5.A TABLE-V

TIMED UP AND GO TEST

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	24.60	± 5.87	0.0978
2.	GROUP B	24.80	± 5.32	

Table shows statistical analysis of Pre test values of Timed Up and Go Test of Group A and Group B.

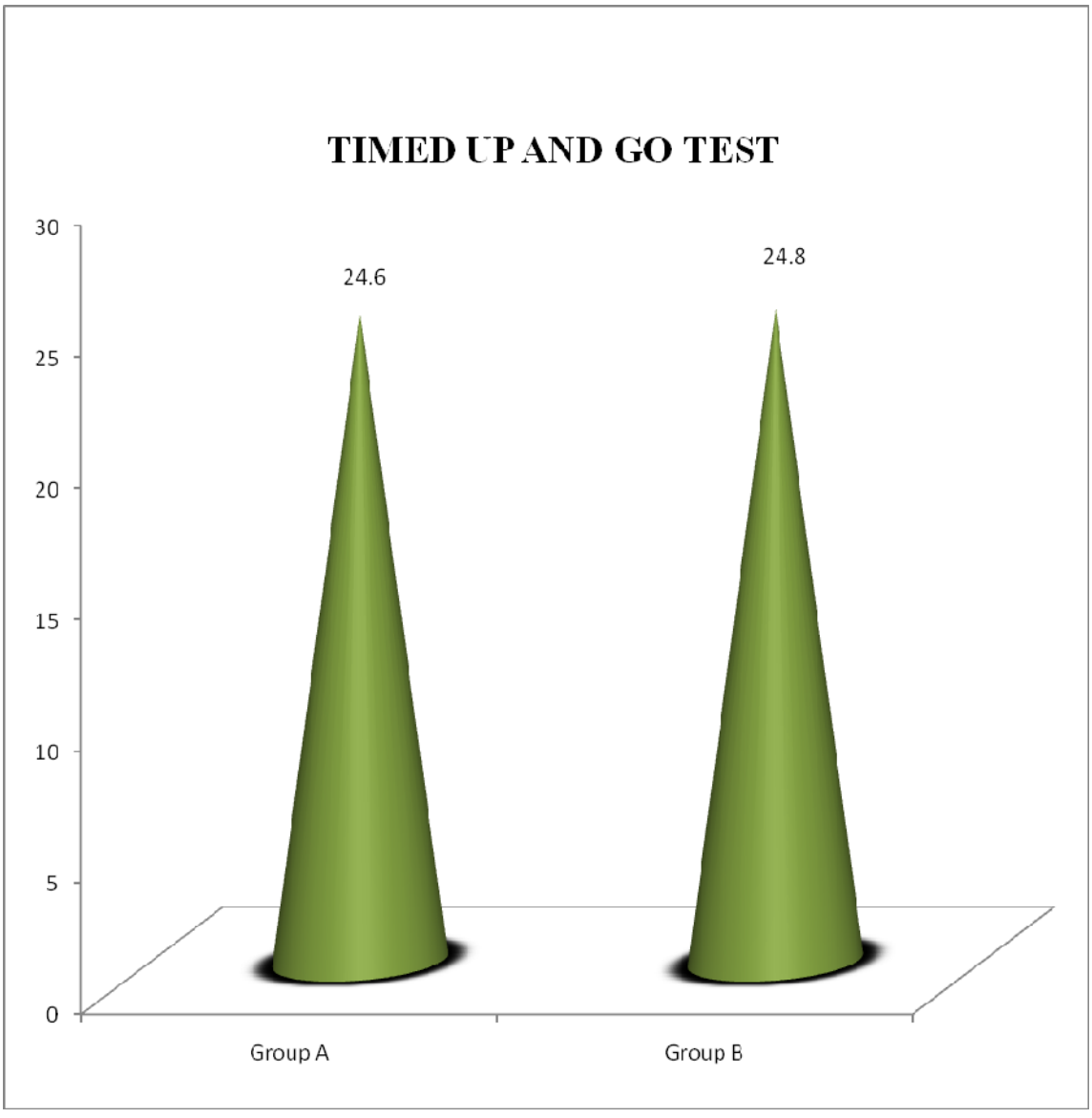
4.5.B ANALYSIS OF RESULT

Using unpaired 't' test

Comparing pre test Timed Up and Go Test of Group A and Group B. Calculated 't' value (0.0978) is less than table value (1.701) at 5% level significance for two tailed 't' test showing that there is no significant difference between two groups.

4.5.C. GRAPH-V

GRAPHICAL REPRESENTATION PRE TEST VALUES OF GROUP A AND GROUP B



Graph shows the pre test means of Timed Up and Go Test of Group A and Group B.

4.6.A TABLE-VI

TIMED UP AND GO TEST

S.NO	GROUP A	MEAN	STANDARD DEVIATION	't' VALUE	Percentile difference
1.	Pre test	24.60	± 2.40	15.6157	84.7%
2.	Post test	16.13	± 4.26		

Table shows statistical analysis of pre and post test values of Timed Up and Go Test of Group A.

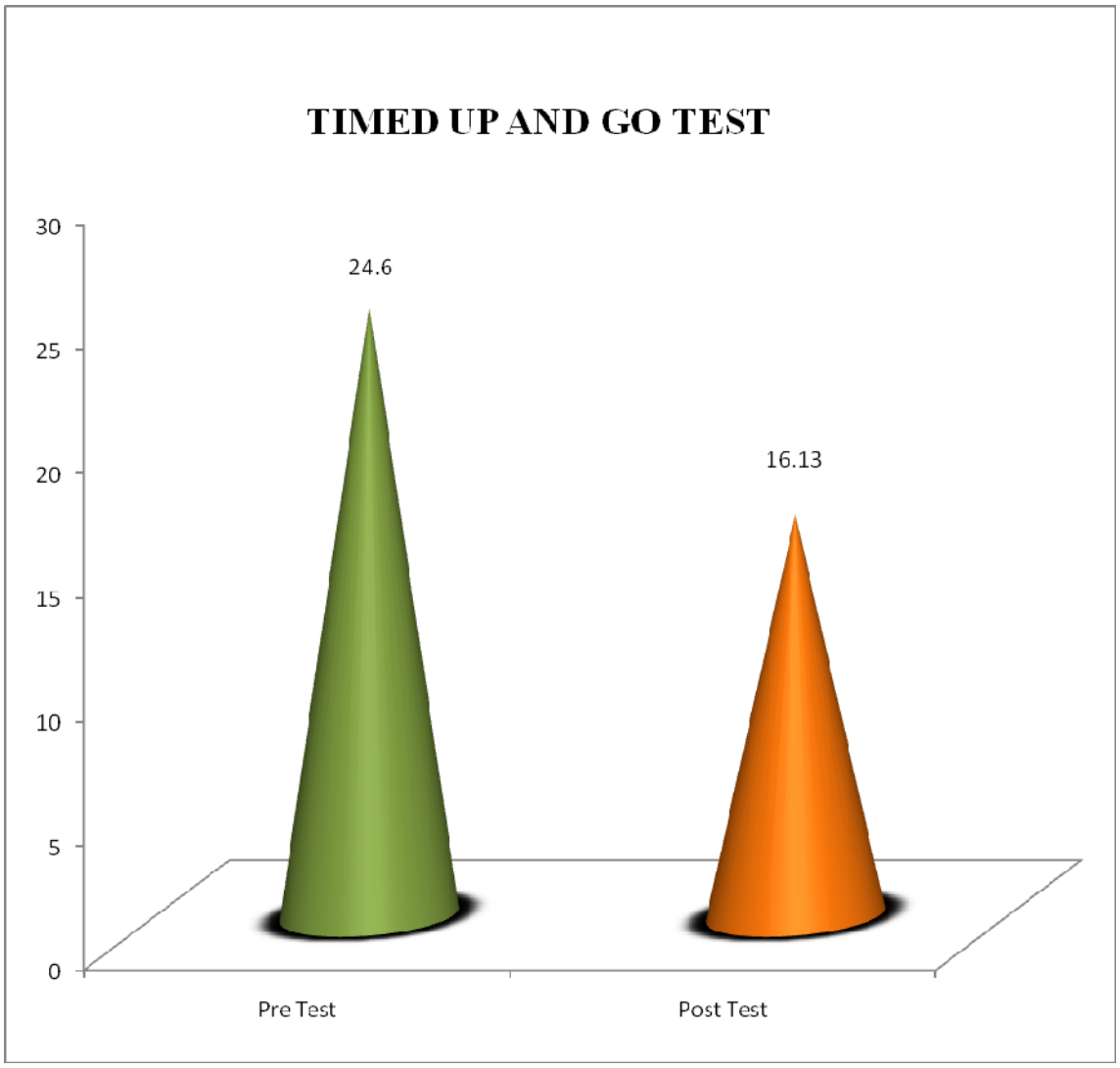
4.6.B ANALYSIS OF RESULT

Using paired 't' test

Comparing pre and post test Timed Up and Go Test of Group A. Calculated 't' value (15.6157) is greater than table value (1.761) at 5% level significance for two tailed 't' test showing that there is significant difference between values.

4.6.C. GRAPH-VI

GRAPHICAL REPRESENTATION PRE TEST AND POST TEST VALUES OF GROUP A



Graph shows the pre test and post test means of Timed Up and Go Test of Group A.

4.7.A TABLE-VII

TIMED UP AND GO TEST

S.NO	GROUP B	MEAN	STANDARD DEVIATION	't' VALUE	Percentile diference
1.	Pre test	24.80	± 5.32	18.8965	44.7%
2.	Post test	20.33	± 5.52		

Table shows statistical analysis of pre and post test values of Timed Up and Go Test of Group B.

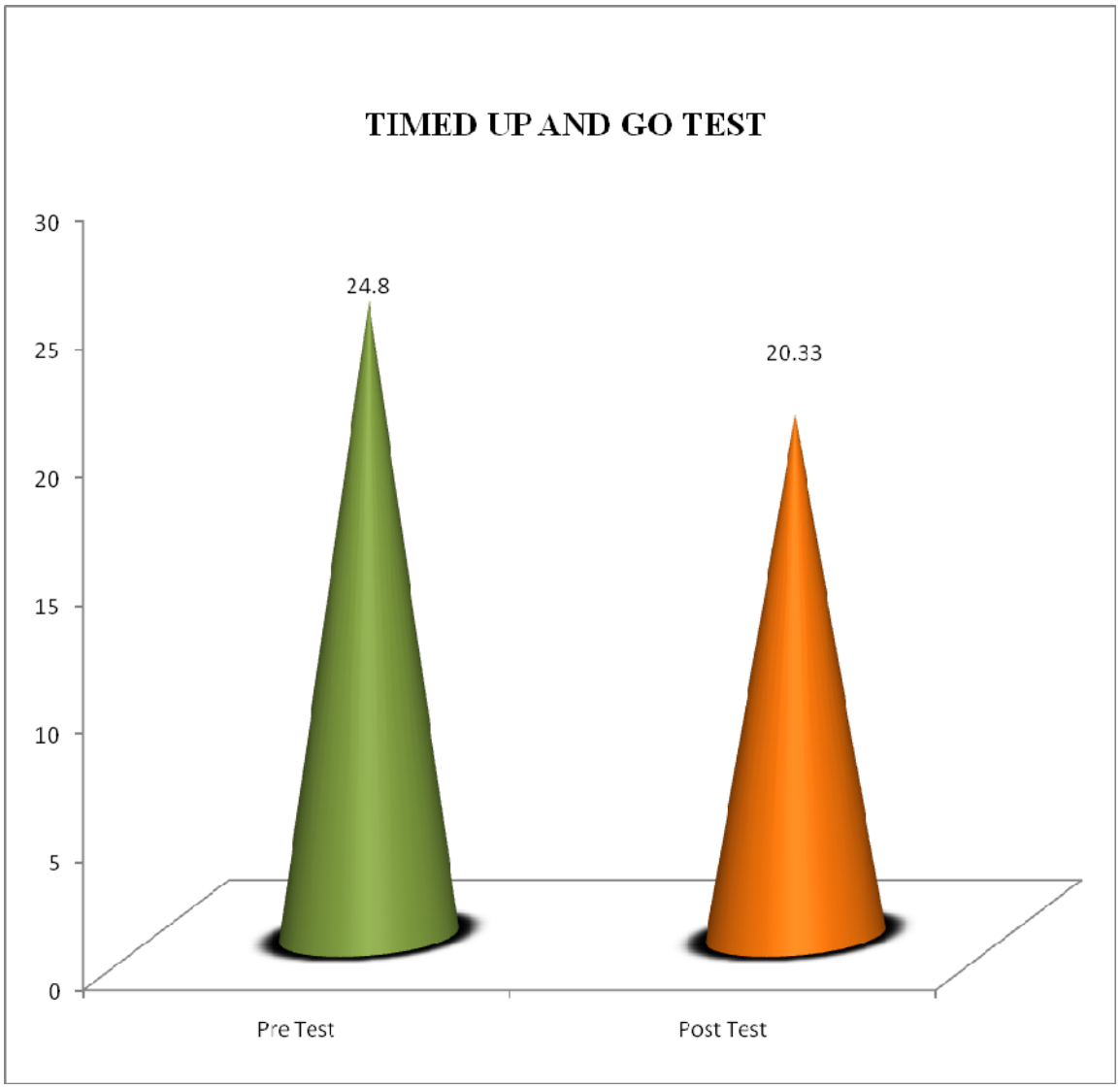
4.7.B ANALYSIS OF RESULT

Using dependent 't' test

Comparing pre and post test of Timed Up and Go Test Group A . Calculated 't' value (18.8965) is greater than table value (1.761) at 5% level significance for two tailed 't' test showing that there is significant difference between values.

4.7.C. GRAPH-VII

GRAPHICAL REPRESENTATION PRE TEST AND POST TEST VALUES OF GROUP B



Graph shows the pre test and post test means of Timed Up and Go Test of Group B.

4.8.A TABLE-VIII

TIMED UP AND GO TEST

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	16.13	± 5.38	2.1087
2.	GROUP B	20.33	± 5.52	

Table shows statistical analysis of Post test values of Timed Up and Go Test of Group A and Group B.

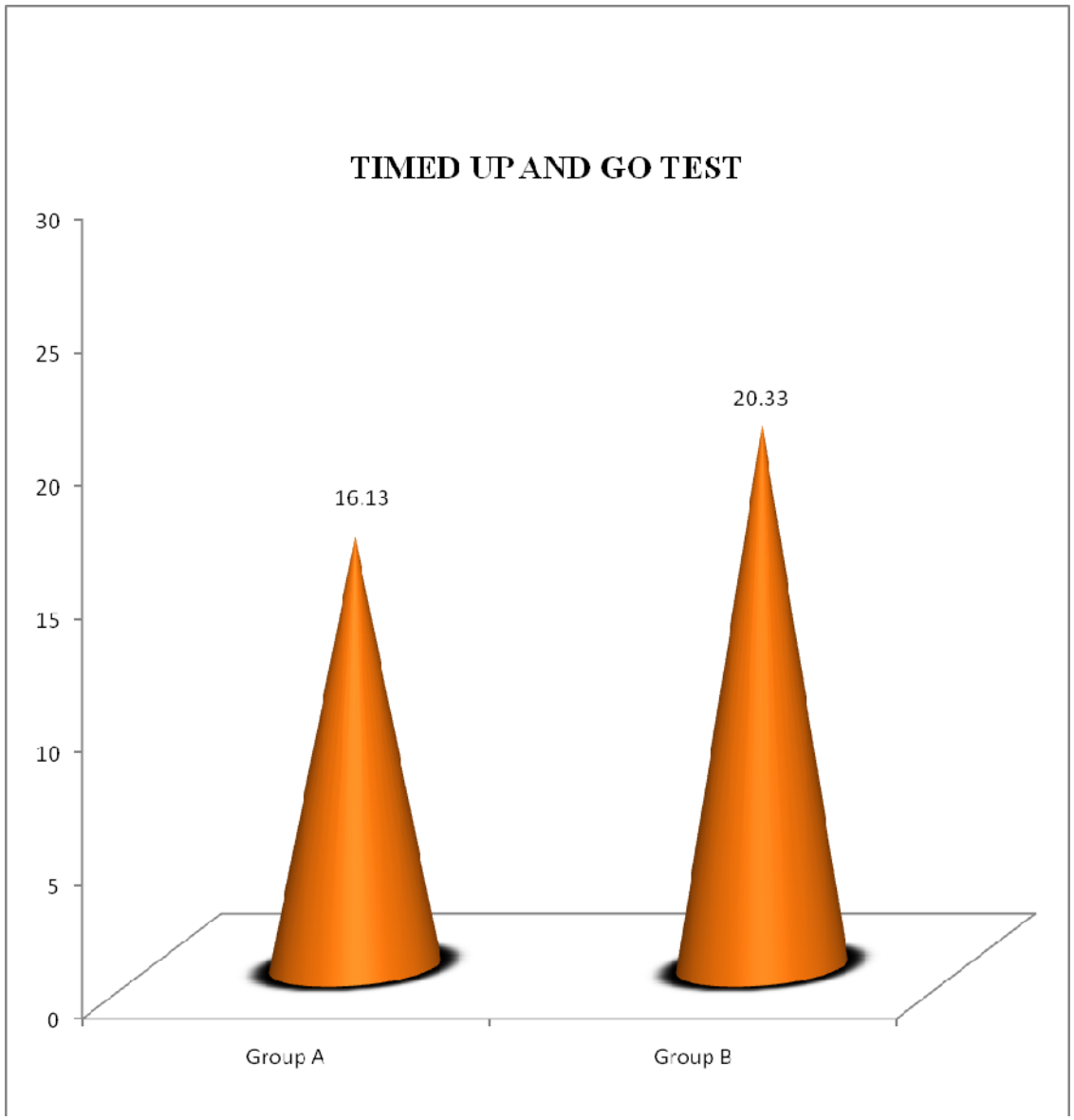
4.8.B ANALYSIS OF RESULT

Using unpaired 't' test

Comparing post test Quality of life questionnaire of Group A and Group B. Calculated 't' value (2.1087) is greater than table value (1.701) at 5% level significance for two tailed 't' test showing that there is significant difference between two groups.

4.8.C. GRAPH-VIII

GRAPHICAL REPRESENTATION POST TEST VALUES OF GROUP A AND GROUP B



Graph shows the post test means of Timed Up and Go Test of Group A and Group B.

4.9.A TABLE-IX

FUNTIONAL REACH TEST

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	15.70	± 0.36	0.2228
2.	GROUP B	15.67	± 0.49	

Table shows statistical analysis of pretest values of Functional Reach Test of Group A and Group B.

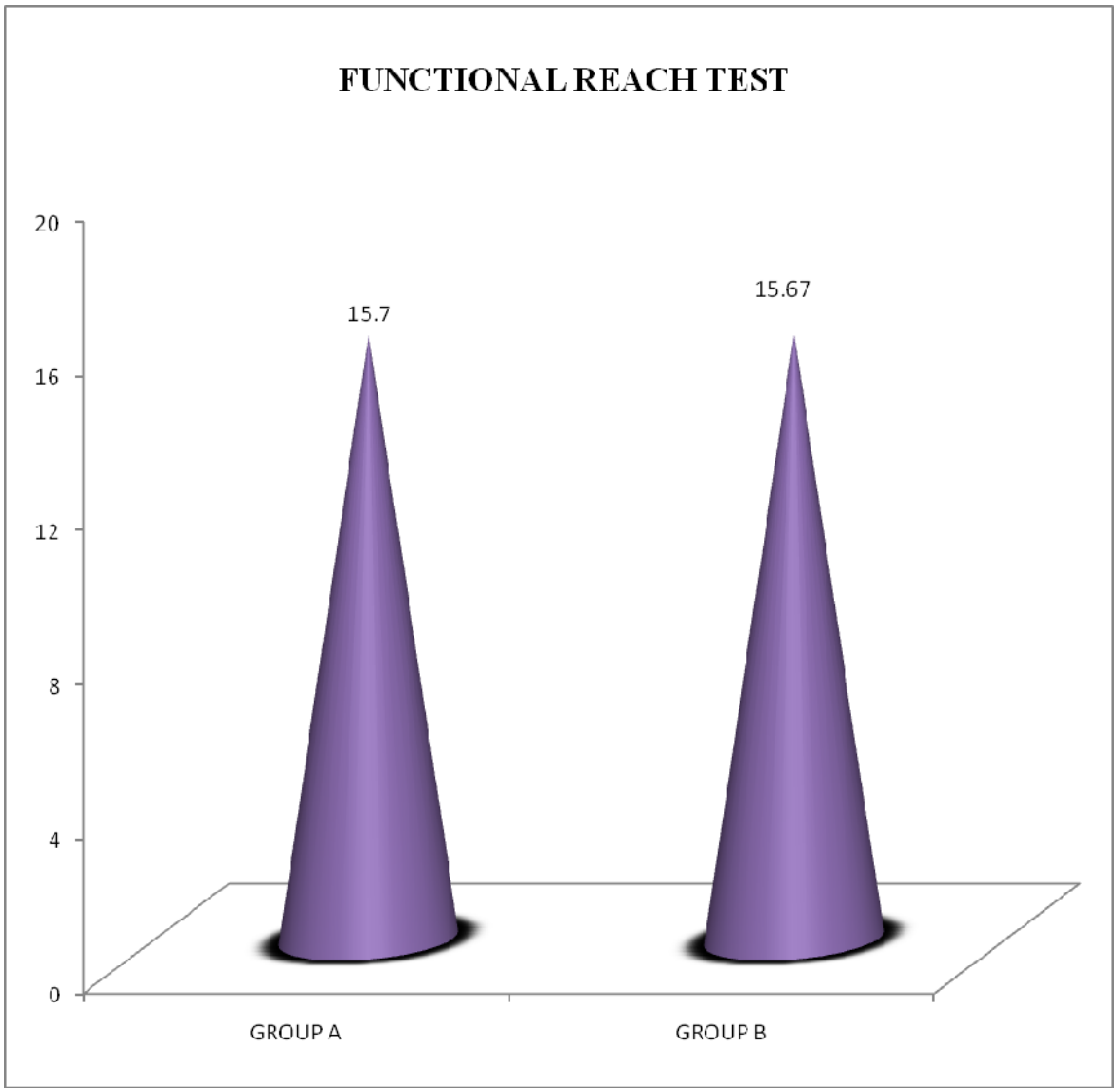
4.9.B ANALYSIS OF RESULT

Using unpaired 't' test

Comparing pre test of Functional Reach Test in Group A and Group B. calculated 't' value (0.2228) is less than table value (1.701) at 5% level significance for two tailed 't' test showing that there is no significant difference between two groups.

4.9.C. GRAPH-IX

GRAPHICAL REPRESENTATION PRE TEST VALUES OF GROUP A AND GROUP B



Graph shows the pre test means of Functional reach Test of Group A and Group B.

4.10.B TABLE-X

FUNTIONAL REACH TEST

S.NO	GROUP A	MEAN	STANDARD DEVIATION	't' VALUE	Percentile difference
1.	Pretest	15.70	± 0.37	20.172	18.8%
2.	Posttest	17.58	± 0.40		

Table shows statistical analysis of pre and post test values of Functional Reach Test of Group A.

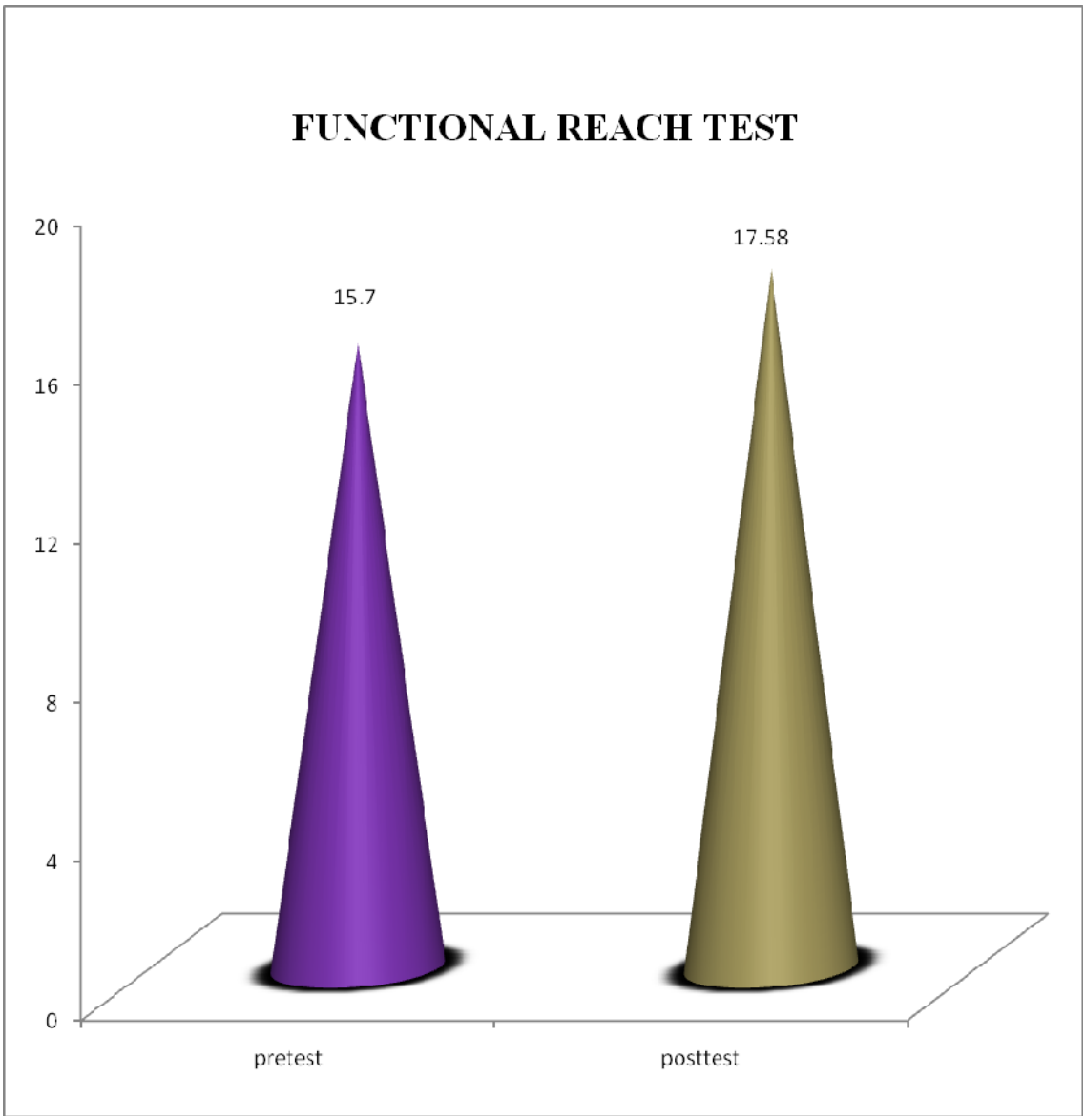
4.10.B ANALYSIS OF RESULT

Using paired 't' test

Comparing pre and post test of Functional Reach Test in Group A. Calculated 't' value (20.172) is less than table value (1.701) at 5% level significance for two tailed 't' test showing that there is significant difference between the values.

4.10.C. GRAPH-X

GRAPHICAL REPRESENTATION PRE AND POST TEST VALUES OF GROUP A



Graph shows the pre and post test means of Functional Reach Test of Group A.

4.11.A TABLE-XI

FUNTIONAL REACH TEST

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE	Percentile difference
1.	pretest	15.67	± 0.49	16.801	13.3%
2.	posttest	17.00	± 0.63		

Table shows statistical analysis of pre and post test values of Functional Reach Test of Group B.

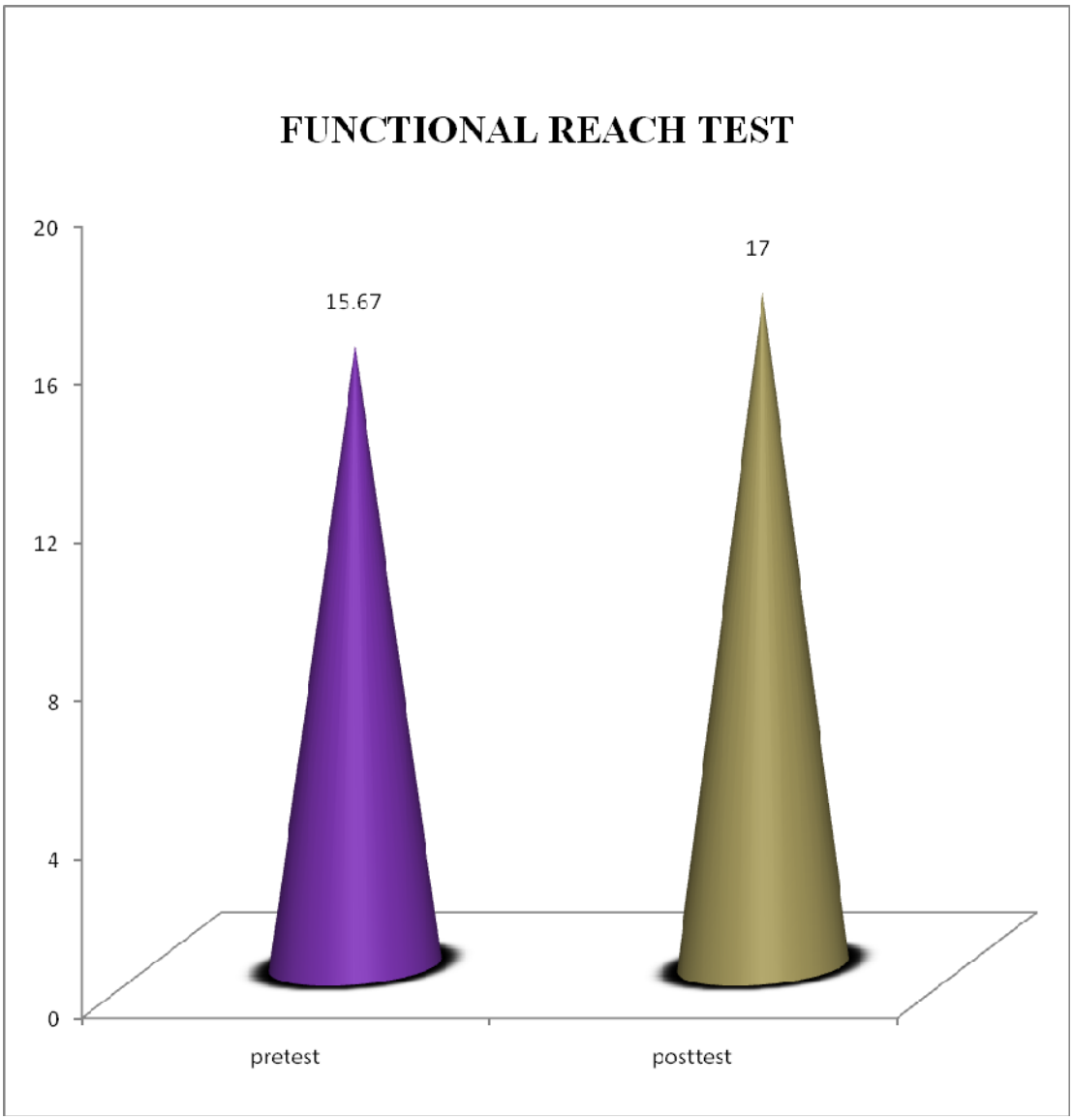
4.11.B ANALYSIS OF RESULT

Using paired 't' test

Comparing pre and post test of Functional Reach Test in Group B. calculated 't' value (16.801) is greater than table value (1.701) at 5% level significance for two tailed 't' test showing that there is no significant difference between two groups.

4.11.C. GRAPH-XI

GRAPHICAL REPRESENTATION PRE AND POST TEST VALUES OF GROUP B



Graph shows the pre and post test means of Functional Reach Test of Group B.

4.12.A TABLE-XII

FUNTIONAL REACH TEST

S.NO	GROUPS	MEAN	STANDARD DEVIATION	't' VALUE
1.	GROUP A	17.58	± 040	2.967
2.	GROUP B	17.00	± 0.63	

Table shows statistical analysis of post test values of Functional Reach Test of Group A and Group B.

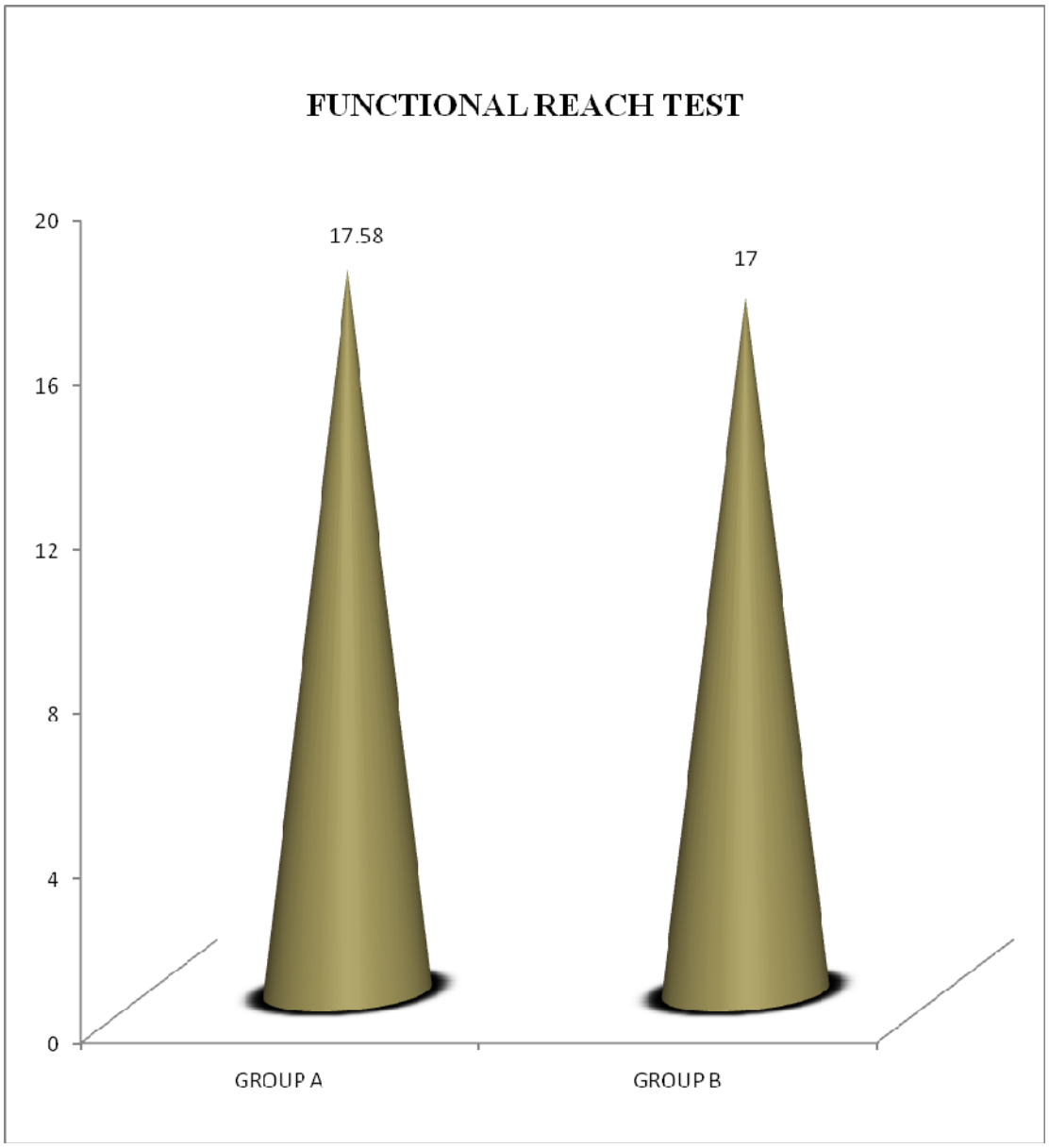
4.12.B ANALYSIS OF RESULT

Using unpaired 't' test

Comparing post test of Functional Reach Test in Group A and Group B. Calculated 't' value (2.967) is greater than table value (1.701) at 5% level significance for two tailed 't' test showing that there is significant difference between two groups.

4.12.C. GRAPH-XII

GRAPHICAL REPRESENTATION POST TEST VALUES OF GROUP A AND GROUP B



Graph shows the post test means of Functional Reach Test of Group A and Group B.

V DISCUSSION

This is an experimental study to find out the effectiveness of balance and strength training in reducing fall risk as evidenced by the outcome measures -Berg Balance Scale, Timed Up and Go test and Functional Reach Test in subjects with Diabetic Peripheral Neuropathy. Results obtained from statistical analysis between pre test and post test values of Group A which is the Experimental group at 5% level of significance showed improvement in BBS, TUGT and FRT following balance and strength training.

Analysis of pre test means of Group A and Group B of BBS, TUGT and FRT revealed that there is no significant difference between the two groups indicating that they are unmatched group of subjects undergoing different exercise program but were selected from same population.

Analysis of results also shows that there is an increase of about 32.6% in Group A when compared with Group B has only 16.91% increase in BBS. Analysis of TUGT shows that there is an increase of 34.43 % in Group A and 18.02% in Group B. There is also an increase of 11.97% in Group A and 8.48% in Group B in FRT. This shows the superiority of Balance and Strength training given to Group A over general mobility exercise and walking given to Group B.

According Uccicoli et al the major risk factors for falling are increasing age, previous falls history, increased postural sway and presence of diabetes. Aging

results in slower cognitive processes, slower postural reactions and decreased muscle strength. Decrement is more pronounced in diabetes especially with mild to moderate neuropathy and associated with increased fall risk (Steve Morrison et al)

Diabetes is an independent fall risk factor among elderly nursing home residents. According to Mathew S Maurer et al the fall incident rate for the participants with and without diabetes mellitus was 78% and 30% respectively. Recently published findings reveal that in 2011, the country with the largest numbers of people with diabetes is India (40.9 million). The countries such as India are going to be as many as 80% of all diabetes from the entire world population, there by making India the diabetic capital of the world. (Indian Med Association.)

Diabetic Peripheral Neuropathy results in a remarkable functional imbalance which may expose these patients to danger of falling during activities of daily living and becomes more severe as the severity of neuropathy increases. (Jabasson et al)

Participation in a weekly group exercise program with ancillary home exercise can improve balance and reduce the rate of falling risk in community dwelling older people (Anne Barnett et al).According to Lee SW et al there is a significant decrease in postural sway, increased one leg stance test and dynamic balance as evidenced by BBS, TUGT and FRT after balance exercise. There was also decreased errors of trunk repositioning with training.

Balance training seems to be beneficial in improving functional balance in diabetic subjects with Distal Sensory Neuropthy (Ajimsha et al). The researchers also reported that the rate of blood glucose entry into the working muscles increased after training. Moderate intensity high volume training improved insulin sensitivity by 48%(Ishir)

It has been shown that management of sensory problems causing balance difficulty focuses on facilitation of demand system and encouragement of remaining system. For example in the absence of reduction in proprioceptive system and the other systems like visual and vestibular system can be promoted by narrow base standing, tandem walking, standing on rocker boards, walking on rough terrains and stairs. (Taly)

Dynamic strength training results in compensation of proprioceptive input by Ankle strength. Subjects increased level of confidence also reduces fall risk. (Leonard et al). Training leads to improvements in a range of fall risk factors impacting positively on sensory, motor and cognitive process.

Improvement in reaction time and reduction in fall risk could be attributed to improvement in proprioception due to increased physical activity, increased Hamstrings and Quadriceps strength. In addition learning effect could also be added. Hence it can be concluded that Balance and Strength training can reduce fall risk in Diabetic subjects with Peripheral Neuropathy.

VI SUMMARY AND CONCLUSION

This study was focused on analyzing the effect of Balance and Strength training in reducing the fall risk in subjects with Diabetic Peripheral Neuropathy. About thirty subjects were selected after fulfilling Inclusion and Exclusion criteria. The subjects were divided into Experimental and Control group with fifteen subjects in each group.

Experimental group subjects underwent Balance and Strength training and Control group underwent general mobility exercise along with regular walking. Based on Statistical analysis (student ‘t’ test) at 5% level of significance, the P value is less than 0.05 and calculated value is greater than tabulated value, there by showing significant improvement in reducing fall risk on Group A compared to Group B.

This study therefore rejects null hypothesis and supports alternate hypothesis. There is a significant difference between Balance with Strength training and general mobility exercise with walking in reducing the fall risk in subjects with Diabetic Peripheral Neuropathy. This concludes that the Balance and Strength training will reduce the fall risk in subjects with Diabetic Peripheral Neuropathy.

VII LIMITATION AND RECOMMENDATION

- The period of time allotted for the study was found to be insufficient for the inclusion of greater number of subjects.
- The small sample size directly influenced ability to conduct more substantial and definitive statistical analysis.
- Individual variation in age range, sex difference, handedness has not taken into account.
- Ankle muscle strength was not taken as an outcome measure.
- Improvement in proprioception was not taken as an outcome measure.
- Prognostic variables such as mood fluctuations, environmental conditions and usage of drugs have not been taken into account.
- Instantaneous glucose levels are not taken.
- Study could be further refined by addition of parameter such as Ankle strength, Proprioception and assessment.
- Validation tools can be changed and results can be further analysis to confusion the results.

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IX APPENDIX

APPENDIX - I

EVALUATION CHART

Name:

Age:

Sex:

Occupation:

Chief complaints:

Past/present medical History:

Duration of Diabetes Mellitus:

Medications:

Other medical problems:

Cardiac:

1.Hypertension

2.Ishaemic Heart Disease

3.Angina

4.Artificial pacemakers.

Respiratory:

1.COPD

2.wheezing/Asthmatic

Neurological:

1.Stroke

2.Head Injury

3.Demyelinating disease

4.Neuromuscular problems

Musculoskeletal:

1.Artritic conditions

2.Recnt fractures

3.Recent injury

4.Foot ulcers

5.Deformity

Surgical history if any;

Visual deficit:

Hearing deficit:

Vestibular deficit:

Walking aids if any:

On Examination:

Michigan Diabetic Neuropathy Score(MDNS) Neuropathy Severity

Mild - 2 abnormal nerves(7-12 points)

Moderate - 3-4 abnormal nerves (13-29 points)

Severe - 5 abnormal nerves (>29 points)

Michigan Diabetic Neuropathy Score(MDNS

Tests	**Scoring Definitions**		
Sensory Impairment			
Right	Normal	Decreased	Absent
Vibration at big toe	0	1	2
10-g filament	0	1	2
Pinprick on dorsum of great toe	Painful 0	Not painful	2
LEFT	Normal	Decreased	Absent
Vibration at big toe	0	1	2
10-g filament	0	1	2
Pinprick on dorsum of great toe	Painful0	Not painful	2

MUSCLE STRENGTH				
RIGHT	Normal	Mild to Moderate	Severe	Absent
Finger Spread	0	1	2	3
Great toe extension	0	1	2	3
Ankle dorsiflexion	0	1	2	3

LEFT	Normal	Mild to Moderate	Severe	Absent
Finger Spread	0	1	2	3
Great toe extension	0	1	2	3
Ankle dorsiflexion	0	1	2	3
REFLEXES				
RIGHT	Present	Present with reinforcement	Absent	
Biceps brachii	0	1	2	
Triceps brachii	0	1	2	
Quadriceps femoris	0	1	2	
Achillies	0	1	2	
LEFT	Normal	Mild to Moderate	Severe	
Biceps brachii	0	1	2	
Triceps brachii	0	1	2	
Quadriceps femoris	0	1	2	
Achillies	0	1	2	
TOTAL: 46 Points				

APPENDIX - II

Berg Balance Scale

Name: _____ Date: _____

Location: _____ Rater: _____

ITEM DESCRIPTION SCORE (0-4)

Sitting to standing _____

Standing unsupported _____

Sitting unsupported _____

Standing to sitting _____

Transfers _____

Standing with eyes closed _____

Standing with feet together _____

Reaching forward with outstretched arm _____

Retrieving object from floor _____

Turning to look behind _____

Turning 360 degrees _____

Placing alternate foot on stool _____

Standing with one foot in front _____

Standing on one foot _____

Total _____

GENERALINSTRUCTIONS

Please document each task and/or give instructions as written. When scoring, please record the lowest response category that applies for each item.

In most items, the subject is asked to maintain a given position for a specific time. Progressively more points are deducted if:

• The time or distance requirements are not met

• The subject's performance warrants supervision

• The subject touches an external support or receives assistance from the examiner

Subject should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will adversely influence the performance and the scoring. Equipment required for testing is a stopwatch or watch with a second hand, and a ruler or other indicator of 2, 5, and 10 inches. Chairs used during testing should be a reasonable height. Either a step or a stool of average step height may be used for item # 12.

SITTING TO STANDING

INSTRUCTIONS: Please stand up. Try not to use your hand for support.

( ) 4 able to stand without using hands and stabilize independently

( ) 3 able to stand independently using hands

( ) 2 able to stand using hands after several tries

( ) 1 needs minimal aid to stand or stabilize

( ) 0 needs moderate or maximal assist to stand

STANDING UNSUPPORTED

INSTRUCTIONS: Please stand for two minutes without holding on.

( ) 4 able to stand safely for 2 minutes

( ) 3 able to stand 2 minutes with supervision

( ) 2 able to stand 30 seconds unsupported

( ) 1 needs several tries to stand 30 seconds unsupported

( ) 0 unable to stand 30 seconds unsupported

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL

INSTRUCTIONS: Please sit with arms folded for 2 minutes.

( ) 4 able to sit safely and securely for 2 minutes

( ) 3 able to sit 2 minutes under supervision

( ) 2 able to able to sit 30 seconds

( ) 1 able to sit 10 seconds

( ) 0 unable to sit without support 10 seconds

STANDING TO SITTING

INSTRUCTIONS: Please sit down.

( ) 4 sits safely with minimal use of hands

( ) 3 controls descent by using hands

( ) 2 uses back of legs against chair to control descent

( ) 1 sits independently but has uncontrolled descent

( ) 0 needs assist to sit

TRANSFERS

INSTRUCTIONS: Arrange chair(s) for pivot transfer. Ask subject to transfer one way toward a seat with armrests and one way

toward a seat without armrests. You may use two chairs (one with and one without armrests) or a bed and a chair.

( ) 4 able to transfer safely with minor use of hands

( ) 3 able to transfer safely definite need of hands

( ) 2 able to transfer with verbal cuing and/or supervision

( ) 1 needs one person to assist

( ) 0 needs two people to assist or supervise to be safe

STANDING UNSUPPORTED WITH EYES CLOSED

INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.

( ) 4 able to stand 10 seconds safely

( ) 3 able to stand 10 seconds with supervision

( ) 2 able to stand 3 seconds

( ) 1 unable to keep eyes closed 3 seconds but stays safely

( ) 0 needs help to keep from falling

STANDING UNSUPPORTED WITH FEET TOGETHER

INSTRUCTIONS: Place your feet together and stand without holding on.

( ) 4 able to place feet together independently and stand 1 minute safely

( ) 3 able to place feet together independently and stand 1 minute with supervisions

( ) 2 able to place feet together independently but unable to hold for 30 seconds

( ) 1 needs help to attain position but able to stand 15 seconds feet together

( ) 0 needs help to attain position and unable to hold for 15 seconds

REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Examiner places a ruler at

the end of fingertips when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The recorded measure is the distance forward that the fingers reach while the subject is in the most forward lean position. When possible, ask subject to use both arms when reaching to avoid rotation of the trunk.)

( ) 4 can reach forward confidently 25 cm (10 inches)

( ) 3 can reach forward 12 cm (5 inches)

( ) 2 can reach forward 5 cm (2 inches)

( ) 1 reaches forward but needs supervision

( ) 0 loses balance while trying/requires external support

PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

INSTRUCTIONS:

Pick up the shoe/slipper, which is in front of your feet.

( ) 4 able to pick up slipper safely and easily

( ) 3 able to pick up slipper but needs supervision

( ) 2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance independently

( ) 1 unable to pick up and needs supervision while trying

( ) 0 unable to try/needs assist to keep from losing balance or falling

TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING

INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. (Examinermay pick an object to look at directly behind the subject to encourage a better twist turn.)

( ) 4 looks behind from both sides and weight shifts well

( ) 3 looks behind one side only other side shows less weight shift

( ) 2 turns sideways only but maintains balance

( ) 1 needs supervision when turning

( ) 0 needs assist to keep from losing balance or falling

TURN 360 DEGREES

INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.

( ) 4 able to turn 360 degrees safely in 4 seconds or less

( ) 3 able to turn 360 degrees safely one side only 4 seconds or less

( ) 2 able to turn 360 degrees safely but slowly

( ) 1 needs close supervision or verbal cuing

( ) 0 needs assistance while turning

PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touched the step/stool four times.

( ) 4 able to stand independently and safely and complete 8 steps in 20 seconds

( ) 3 able to stand independently and complete 8 steps in > 20 seconds

( ) 2 able to complete 4 steps without aid with supervision

( ) 1 able to complete > 2 steps needs minimal assist

( ) 0 needs assistance to keep from falling/unable to try

STANDING UNSUPPORTED ONE FOOT IN FRONT

INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width.)

( ) 4 able to place foot tandem independently and hold 30 seconds

( ) 3 able to place foot ahead independently and hold 30 seconds

( ) 2 able to take small step independently and hold 30 seconds

( ) 1 needs help to step but can hold 15 seconds

( ) 0 loses balance while stepping or standing

STANDING ON ONE LEG

INSTRUCTIONS: Stand on one leg as long as you can without holding on.

( ) 4 able to lift leg independently and hold > 10 seconds

( ) 3 able to lift leg independently and hold 5-10 seconds

( ) 2 able to lift leg independently and hold L 3 seconds

( ) 1 tries to lift leg unable to hold 3 seconds but remains standing independently.

( ) 0 unable to try of needs assist to prevent fall

TOTAL SCORE (Maximum = 56)

APPENDIX III

TIMED GET UP AND GO TEST

Measures mobility in people who are able to walk on their own

(assistive device permitted)

Name_____

Date_____

Time to Complete_____ seconds

Instructions:

The person may wear their usual footwear and can use any assistive device they normally use.

1. Have the person sit in the chair with their back to the chair and their arms resting on

the arm rests.

2. Ask the person to stand up from a standard chair and walk a distance of 10 ft. (3m).

3. Have the person turn around, walk back to the chair and sit down again.

Timing begins when the person starts to rise from the chair and ends when he or she returns to the chair and sits down.

The person should be given 1 practice trial and then 3actual trial. The times from the three actual trials are averaged.

Predictive Results

Seconds Rating

<10 Freely mobile

<20 Mostly independent

20-29 Variable mobility

>30 Impaired mobility

APPENDIX IV

FUNCTIONAL REACH TEST

The Functional Reach Test is a single item test developed as a quick screen for balance problems in older adults.

Interpretation:

A score of 6 or less indicates a significant increased risk for falls.

A score between 6-10 inches indicates a moderate risk for falls.

Age related norms for the functional reach test:

Age	Men (ininches)	Women (in inches)
20-40yrs	16.7 ± 1.9	14.6 ± 2.2
41-69yrs	14.9 ± 2.2	13.8 ± 2.2
70-87	13.2 ± 1.6	10.5 ± 3.5

Requirements:

The patient must be able to stand independently for at least 30 seconds without support, and be able to flex the shoulder to at least 90 degrees.

Equipment and Set up:

A yard stick is attached to a wall at about shoulder height. The patient is positioned in front of this so that upon flexing the shoulder to 90 degrees, an initial reading on the yard stick can be taken. The examiner takes a position 5-10 feet away from the patient, viewing the patient from the side.

Instructions:

Position the patient close to the wall so that they may reach forward along the length of the yardstick. The patient is instructed stand with feet shoulder distance apart then make a fist and raise the arm up so that it's parallel to the floor. At this time the examiner takes an initial reading on the yard stick, usually spotting the knuckle of the third metacarpal. The patient is instructed to reach forward along the yardstick without moving the feet. Any reaching strategy is allowed but the hand should remain in a fist. The therapist takes a reading on the yardstick of the farthest reach attained by the patient without taking a step. The initial reading is subtracted from the final to obtain the functional reach score.

APPENDIX - V

CONSENT FORM

This is to certify that I _____ freely and voluntarily agree to participate in the study **"EFFECTIVENESS OF BALANCE AND STRENGTH TRAINING IN REDUCING THE FALLRISK IN SUBJECTS WITH DIABETIC NEUROPATHY".**

I have been explained about the procedures and the risks that would occur during the study.

Participant:

Witness:

Date:

I have explained and defined the procedure to which the subject has consented to participate.

Researcher:

Date: