

COMPARISON OF GAME BASED REHABILITATION AND MIXED SPORT TRAINING ON BALANCE IN DIABETIC NEUROPATHY

Submitted to

Lovely Professional University

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CERTIFICATE

This is to certify that **Km. Snehi Pandey** has selected the MPT Dissertation titled **Comparison of game based rehabilitation and mixed sport training on balance in diabetic neuropathy** under my guidance and supervision.

Signature of Supervisor

Place:

Date:

DECLARATION

I hereby declare that the dissertation titled, **“Comparison of game based rehabilitation and mixed sport training on balance in diabetic neuropathy”** for the MPT is entirely my original work.

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Date: 2017

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DEDICATION

DEDICATED TO LORD KRISHNA

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CHAPTER-1

INTRODUCTION

INTRODUCTION

India has greater number of diabetics than any other country of the world. 62 Million diabetic patients are in India.¹ Diabetes Mellitus is characterized by increased blood glucose level which in turn caused by either improper insulin secretion from beta cells of pancreas or impaired action at tissue level. Common complications of diabetes mellitus are retinopathy, nephropathy, ulcers, amputations, charcot joints, autonomic neuropathy, peripheral neuropathy, cranial nerve neuropathy.² 30%-50% of diabetic mellitus patients are more prone to develop neuropathy.³

Age and duration of diabetes mellitus is risk factor for development of diabetic peripheral neuropathy.³ Reduced blood flow to the large and small diameter nerve fibers in Diabetic neuropathy adversely affect proprioceptive and exteroceptive sensations.^{4,5} Somatosensory deficits are responsible for impaired posture control in diabetic peripheral neuropathy.⁶

Somatosensory system gives information to individual about position and movement of body parts and supporting surface.⁷ Somatosensory system play major role in maintenance of balance.⁸ According to Menz B. H. et al individuals with diabetic peripheral neuropathy have impaired ability to maintain their body while walking on uneven surface. Diabetic neuropathy affects both static as well as dynamic balance. In static condition patients show increased postural sway and in dynamic condition such as walking shows reduced power generation at ankle and decreased ground reaction forces.⁹

Balance is ability to maintain body in equilibrium or to control body position in space for stability and orientation.¹⁰ Balance involves cooperation of visual, vestibular and somatosensory system.¹¹ Person with diabetic neuropathy have five time more chances of fall than person without diabetic neuropathy with same age. Balance impairment leads to limitation of activity of daily living such walking, climbing stairs, walking on uneven surface and ultimately reduce capacity of individual in doing household works. Activity limitation result in also lead to participation restriction, as the patient is unable to attend social events and outdoor and recreational activities. Activity limitation and participation restrictions together lead to reduced quality of life of the patient leading to more isolated life style and less indulgement in social activities thereby increasing more chances of depression.^{12, 13}

There are several novel approaches as well as traditional approaches available for balance training. Game based rehabilitation is a novel approach for balance training. Virtual reality is one of the game based rehabilitation programme. Different types of game based software programmes are available for virtual reality which includes Sony PlayStation and Nintendo Wii Fit. Traditional interventions include weight bearing training which enhance proprioceptive loading, fixed support and change in support strategy training, sensory integration training, postural awareness training which include center of mass control training and posturography feedback training, fall prevention strategy training. Many studies have used traditional protocol based exercises for balance training such as aerobic training, vibrating platform, combined resistance and balance training, Tai Chi exercise, proprioceptive training, vibrating insoles, neck flexion and scapular stabilization exercise, mixed sport training.^{10, 14, 15, 16, 17}

Nintendo Wii Fit consists of exercise based game software¹⁸. This is less expensive than any other virtual reality software.¹⁹ Nintendo Wii Fit is gaining popularity among all age groups.²⁰ Nintendo Wii Fit gives visual as well as auditory feedback because of which the virtual reality member feels that they are present in a real world.²¹ Brittany Gardner B. et al reported that use of Nintendo Wii Fit decrease balance problem and risk of fall in elderly²²

Mixed sport training is one of the treatment method which involves two types of exercises, proprioceptive training and lower limb muscle strengthening. Proprioceptive training improves oxygen supply to lower limb muscles thereby improving nerve conduction sensitivity as well as proprioception during walking. Lower limb muscle strengthening, practise of this exercise improves strength of muscle involved in posture control.¹⁵ Morrison S, Colberg R. S. et al reported that training session which combination of strength and balance training is more effective in improving balance of diabetic neuropathy patients²³.

Several tools are available for balance assessment such as Berg balance scale, Mini BES test, Forward reach test, Star excursion test, Functional Balance scale, With advancement in technology some latest techniques have been developed which includes wearable sensors, Force plate 54 dynamic computerized dynamic posturography,^{24, 25} According to Susan W M, Berg K. et al Berg balance scale has good discriminative ability to predict multiple falls.²⁶

Berg balance scale has moderate to high reliability to diagnose balance.²⁷ Assessing quality of life numerous questionnaires' are available some of them are include Short form-12, Pain quality assessment scale , Brief disability scale and Neuro-Qol.²⁸ .²⁹ Neuro-Qol is used to evaluate impact of diabetic peripheral neuropathy on the quality of life . It consists of specific questions that are related to diabetic neuropathy symptoms which has 35 components. Main domain of neuro-Qol is pain, loss or reduced sensation, diffuse sensory and motor symptoms, limitation of daily activities, interpersonal problem and emotional distress³⁰.

1.2 Need of the study:

However, individual studies for game based rehabilitation and mixed sport training has been done to evaluate the effect on balance and quality of life in diabetic neuropathy. There is lack of evidence to compare the effect of game based rehabilitation and mixed sport training in treating balance in diabetic neuropathy.

1.3 Significance of study

This study will be useful in clinical practice for treating balance problem. This study will develop confidence in patients regarding balance and the patients will become independent and ultimately will improve quality of life.

1.4 Aim and objectives of the study

Aim- To compare the effect of game based rehabilitation and mixed sport training on balance and quality of life in diabetic neuropathy.

Objectives-

- To find out the effect of game based rehabilitation on balance and quality of life in diabetic neuropathy.
- To find out the effect of mixed sport training on balance and quality of life in diabetic neuropathy.
- To compare the effect of game based rehabilitation and mixed sport training on balance and quality of life in diabetic neuropathy.

1.5 Hypothesis

Null hypothesis -

- There will be no significant effect of game based rehabilitation on balance and quality of life in diabetic neuropathy.
- There will be no significant effect of mixed sport training on balance and quality of life in diabetic neuropathy.
- There will be no significant difference between effect of game based rehabilitation and mixed sport training on balance and quality of life in diabetic neuropathy.

Alternate hypothesis-

- There will be significant effect of game based rehabilitation on balance and quality of life in diabetic neuropathy.
- There will be significant effect of mixed sport training on balance and quality of life in diabetic neuropathy.
- There will be significant difference between effect of game based rehabilitation and mixed sport training on balance and quality of life in diabetic neuropathy.

1.6 Operational definition

Diabetic neuropathy- It is nerve damage that leads to numbness, pain and weakness in hands and arm leg and feet.

Balance - Balance is defined as ability to maintain center of within base of support.

Game based rehabilitation- Nintendo Wii fit software used as game based rehabilitation in this study which provides visual and auditory feedback during training session.

Mixed sport training- This is balance-training exercise it involves combination of both proprioceptive training as well as muscle strengthening for lower limbs.

CHAPTER -2
REVIEW OF LITERATURE

Tsang WWN et al (2016) conducted a randomized control trial to evaluate the effect of virtual reality exercise to improve balance control in older adults at risk of fall. 79 Subjects were divided into Wii fit group and conventional physiotherapy group . Both groups received one hour session per week for six weeks. Berg balance scale timed up and go test and limit of stability test were used as outcome measure. This study concluded that Wii fit is effective tool for training balance in older adults. ³¹

Mck. M, Lowe J. et al (2015) conducted unsupervised Nintendo Wii fit training to evaluate effect on balance in older population.41 Participants were divided into two groups, 19 patients in experimental group and 22 patients in control group. Patients who were in experimental group received unsupervised Wii fit training for 6 weeks control group patients were continued their daily routine and exercise. Body mass index, balance and mobility, single leg stance test and usual gait speed used as outcome measure. This study concluded that Nintendo Wii fit training is effective in improving balance of older adults. ¹⁹

Olmwz N et al (2015) conducted a study to find out the influence of pain and disability on quality of life in patients with diabetic neuropathy.52 Subjects with diabetic neuropathy were participated. BDQ and short form 36 used for quality of life assessment. This study concluded that diabetic peripheral neuropathy is challenging and distressing burden due to its chronic and painful symptoms that diminish quality of life of the patients. ²⁸

Hakim M.R., Salvo J. C.et al (2014) conducted a study to find out effectiveness of Nintendo Wii fit training on fall in older adult with bilateral diabetic neuropathy. Treatment was given for 1 hour two times a week for six weeks.. This study concluded that with NintendoWii fit interesting as well as effective in improving balance . ³²

Dobrota D. V. et al (2014) conducted a study to find out the impact of neuropathic pain on quality of life in diabetic patients. Both types of diabetes mellitus were included in the study. All the patients who had painful neuropathy were included into group one patients without painful neuropathy were included into group two. All the participants undergone through neurophysiologic examination, examination with monofilament and then electromyography of both upper limb and lower limb and colour Doppler for carotid arteries. After examination assessment was done with short form 36 and back depression inventory scale . This study

concluded that painful, diabetic neuropathy is a major factor that influences various aspects of quality of life of diabetic patients.²⁹

Bansal D. et al (2014) conducted a study on prevalence and risk factors of development of peripheral diabetic neuropathy in type II diabetes mellitus in tertiary care setting, A cross sectional study was carried out in a tertiary care hospital patients with duration of diabetes less than six month of duration were considered to non insulin dependent diabetes mellitus . Diabetic peripheral neuropathy was diagnosed by combination of more than one abnormal 10 –g monofilament pinprick sensation and ankle reflex. This study concluded that diabetic peripheral neuropathy is very common in type II diabetes mellitus in north India .⁴

Jorgan G.M, Laessoe U. et al (2013) conducted a study to find out the efficacy of Nintendo Wii fit training on mechanical leg function and postural stability . All the Participants were divided into Wii fit group and control group. Participants of Wii fit group gone through Wii fit exercises and control group patients were treated ethylene vinyl acetate (EVM) copolymer both groups received 10 weeks protocol. Maximum isometric contraction strength using static adjustable leg press apparatus and postural balance capacity using centre of pressure velocity moment by force plate used as primary outcome measure. Rapid fall capacity, time up and go test, short form 36, Fall efficacy scale and a measurement of training motivation used as a secondary outcome measures. This study concluded that Wii fit training is effective in improving balance of older population.³³

Porta, L F, Caselli S. Susassi S. , Cavallini P , Tennant A, ,Franceschini, M et al(2012) conducted a study to find out the internal validity and reliability of berg balance scale . Across 217 Patients were participated in this study .Assessment were carried out using BBS14 item. This study concluded that berg balance scale has the internal validity and reliability³⁴

Franco R. J, JACOBS K, et al (2011) conducted a study to find out effect of Nintendo wii fit training and exercises on balance and quality of life . 32 Older individual were participated in this study. Participants were divided into three groups 11 in Wii fit group,11 in matter of balance group 10 in control group. Outcome measurement used were berg balance scale, tinetti gait and balance assessment and SF-36. Participants of Wii fit group played games and did exercise at home., for matter of balance group participants completed

group exercise program which consist of warm up exercise followed by balance and strength exercise and ended with cool down, control group received no intervention. This study concluded that there is no significant effects of Wii fit training as well as matter of balance group in improving balance²⁰.

Sahana P, Sengupta N, et al (2010) conducted a study to evaluate prevalence of high prevalence of neuropathy and peripheral arterial disease in type 2 .Diabetes in a tertiary care centre in eastern India. Total 410 subjects participated in this cross sectional study. Neuropathy was assessed with biothesiometer, pressure perception was assessed with 10 gm SWS monofilament and brachial index was measured by hand held Doppler. This study concluded that sensory neuropathy and peripheral arterial disease are highly prevalent in diabetic subjects.³⁵

Allet L , Armand S. ,Bie D. A.R , Golay A. , Monnin D. K. Aminian, Staal B. J. et al (2009) conducted a study to find out effect of circuit training on gait and balance of patient with diabetic neuropathy.71 Diabetic neuropathy patients were included in the study were randomly divided into intervention group and control group. Intervention group treated with circuit training program including balancing exercise and strengthening exercise. Control group received neither any treatment nor specific advice. Exercise was given for 12 weeks. This study concluded that circuit training can improve gait ,muscle strength and balance of diabetic neuropathy.³⁶

Lafond D et al (2004) conducted this study to evaluate the postural control mechanism during quite standing patients in diabetic neuropathy patients . 22 Healthy elderly without diabetes and 17 with type 2 diabetes with diabetic peripheral neuropathy were participated in study. Posture control analysis were done on forceplateform with eye open and eye close for both groups. This study concluded that postural control mechanism effected in medio-lateral direction even with vision in distal sensory neuropathy.³⁷

Steadman J.et al (2003) conducted a study to find outs the effect of enhanced balance training program to mobility in elderly patients .198 Elderly subject were participated in the study. They were divided into two groups . In group A participants received enhanced therapy program which involves conventional physiotherapy along with additional balance an endurance exercise 2 session per week for six weeks and participants in group B received

conventional exercise only for two times per week for 4 weeks and last two weeks for follow up. Ten meter timed walk test, berg balance scale, frenchay activity index, fall handicap inventory, European quality of life questionnaire were used as outcome measure. This study concluded that enhanced balance training improve confidence and quality of life elderly patients .³⁸

Richardson K. J, Sandman D et al (2001) conducted a study to find out the effectiveness of focused exercise regimen in improving patients with diabetic neuropathy. Twenty subjects were participated in this study. Subjects were divided into two groups one group received specific exercise regimen and other with control exercise regimen. Exercise were given for 3 weeks .Unipedal stance time ,functional reach test, tandem stance, score on activity specific balance confidence were used as outcome measures . This study concluded that a brief duration specific exercise regime improved balance in people with diabetic neuropathy³⁹.

CHAPTER-3
MATERIALS AND METHOD

Material and method

3.1 Research design: Experimental design (pre and post test with comparison group).

3.2 Research setting: Tagore Hospital jalandhar and Rattan Hospital Jalandhar , participants home .

3.3 Population and sampling:

- **Sampling method** – Convenient sampling. Researcher has collected data according to her feasibility from nearby hospitals..
- **Sample size-** 20 Subjects were divided into two groups . 10 subjects in group A and 10 subjects in group B.

3.4 Sampling criteria:

3.4.1 Inclusion criteria:

- Age limit 45- 60 years.
- Gender- Both .
- Physician diagnosed cases of diabetic neuropathy with more than 2 years.
- Balance problem due to somatosensory deficits.
- Ability to walk household distance without assistance or with assistive devices.

3.4.2 Exclusion criteria:

- History of balance disorders unrelated to diabetic neuropathy that affects lower limb function and balance including but not limited to peripheral nerve compression, local neuropathies stroke Parkinson disease.
- Balance problem because of aging.
- Lower extremity pain that limits standing or weight bearing exercise.
- Symptomatic hypotension.
- A history or evidence on physical examination of planter skin pressure ulcers.
- History of angina or angina equivalent symptoms.
- History or evidence on physical examination of significant central nervous system dysfunction.

Parameters:

- Balance
- Quality of life

3.5 Instruments and tools

- Berg balance scale
- Neuropathy and foot ulcer specific quality of life questionnaire, Neuroqol.
- Nintendo Wii games
- Wii balance board
- Laptop
- TV tuner

Outcome measures

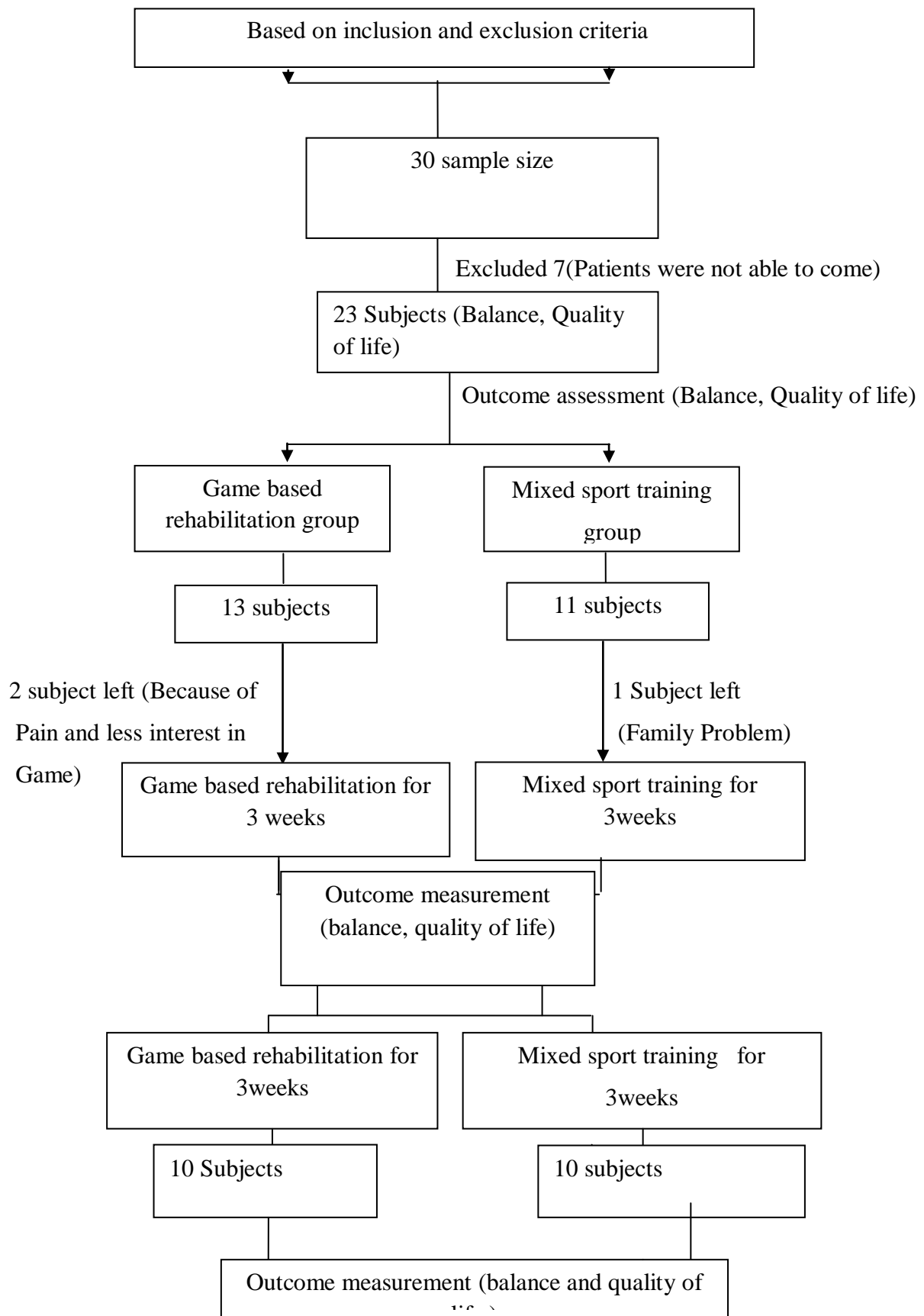
Primary outcome measure

- **Berg balance scale-** It consists of 14 component that are related to day to day activity. Each item is rated on a 5-point scale from 0 to 4 with overall score of 56. Higher scores indicating better balance.

Secondary outcome measure

- **Quality of life questionnaire-** Neuropathy and Foot Ulcer Specific Quality Of Life Questionnaire consist of diabetic neuropathy symptoms related question

3.6 Procedure- 20 Participants included in this study. Participants were divided into group A and group B. Group A received game based rehabilitation and group B received mixed sport training. Berg balance scale and Neuro-qol and quality of life were used as outcome measure. Data were evaluated at pre intervention, end of 3rd week and end of the 6 week. Single physiotherapist did assessment and treatment. Treatment was given for 30 minute , 2 times a week for 6 weeks.



Flowchart for Procedure

Group A Wii fit training group

Wii fit exercise:

Tennis for 15 minute.-Forehand and backhand shots.

Golf for 15 minutes-Shorts used are putter, wedge, iron.

Group B Mixed sport training group:

Balance training - Protocol for first three weeks

Stance on toes-10 repetition in one set, 15 second holds and 5 second rest for each repetition, 2-minute rest after each 5 repetition.

Tandem stanc-10 repetition in one set, 15 second holds and 5 second rest for each repetition, 2-minute rest after each 5 repetition.

One leg stance-10 repetition in one set, 15 second holds and 5 second rest for each repetition, 2-minute rest after each 5 repetition.

Balance training –Protocol for last three weeks.

Exercise performed on spongy surface –Same protocol as for first three weeks only complexity of task were increased.

Functional and endurance exercises

Sitting to standing, stair climbing-10 repetition ,2 minute rest after 5 repetition.

Stair climbing -10 Times, 5 stair up-down,2 minutes rest after 5 repetition.

Obstacle crossing-5 Minutes .³⁶



Fig 3.7.1: Nintendo Wii Fit Console



Fig 3.7.2: TV tuner

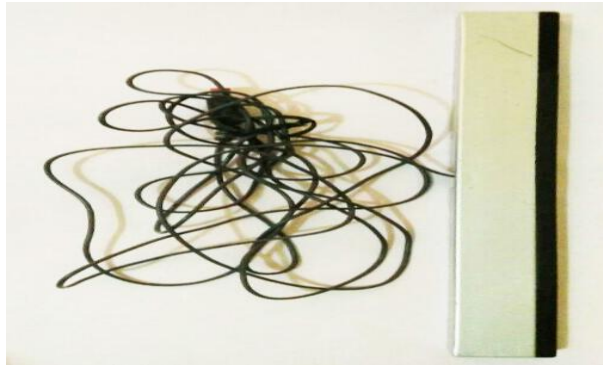


Fig 3.7.3: Sensor



Fig 3.7.4: Balance board

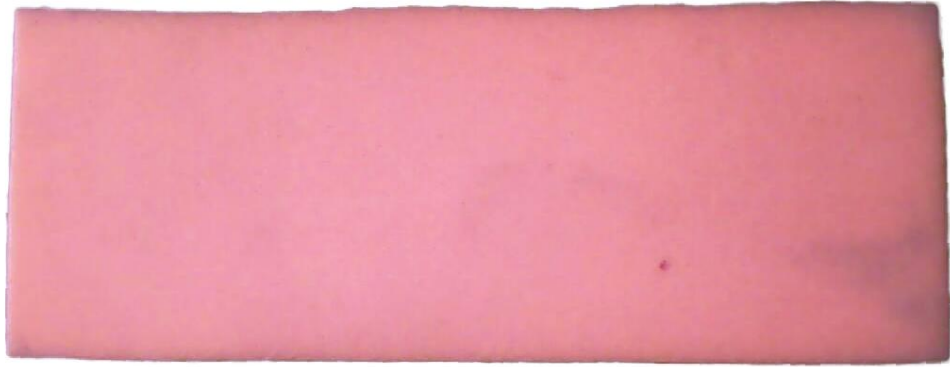


FIG 3.7.5: Sponge



Fig 3.7.6: Game based rehabilitation



Fig 3.7.7: Mixed Sport Training

CHAPTER 4
DATA ANALYSIS AND RESULT

Statistical analysis

Data were analysed using with SPSS version 16. All the data were expressed in mean and standard deviation. Independent t-test was used to asses' data between groups. Paired t test was used to analyse data within group difference. Repeated measure ANOVA was used to analyse baseline, mid and post values of both groups

Analysis was done by using paired t- test and unpaired t-test to know the significance within the group as well as between the groups.

Arithmetic mean: Using arithmetical formula for the mean, for a given number of subjects, mean was calculated:

$$\bar{X} = \sum X/n$$

Where,

\bar{X} = Arithmetic Mean

$\sum X$ = Sum of all the variables

n = Number of observations

Standard Deviation(σ): was calculated by

$$SD = \sqrt{\sum X^2/n}$$

Where:

$\sum X^2$ = The sum of the squares of the difference between the mean and each score

n = Number of scores

Standard Deviation Error (SE): Enables the management of magnitude of sampling error.

It was calculated by the following formula.

$$SE=SD/ \sqrt{N}$$

Where,

SD = Standard deviation

SE = Standard error.

Paired t test

This is considered an appropriate test for determining the significance of mean within the group when population variance is not known. The relevant t test statistics is calculated from the data and then compared with its probable value based on the t distribution at the specified level of significance for concerning degrees of freedom for accepting or rejecting the null hypothesis (Kothari, 2007).

Formula:

$$t = \frac{(\bar{X}_D - \mu_0)}{S_D/\sqrt{n}}$$

\bar{X}_D = Average

S_D = Standard deviation

μ_0 = Constant

Unpaired t test

Student t test is considered an appropriate test for judging the significance of a sample mean or for judging the significance of difference between the means of two samples when population variance is not known, the relevant t test statistics is calculated from the data and then compared with its probable value based on the t distribution at a specified level of significance for concerning degree of freedom for accepting or rejecting the null hypothesis (Kothari,2007).

Formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{X1X2} \cdot \sqrt{1/n_1 + 1/n_2}}$$

S_{X1X2} = Standard deviation

n_1 = Number of participants in group A

n_2 = Number of participants in group B

Repeated measure ANOVA –

$$SS_{\text{within}} = \sum SS_j = SS_1 + SS_2 + \dots + SS_k \quad \text{or} \quad SS_{\text{within}} = SS_{\text{total}} - SS_{\text{between}}$$

$$F_{(df_{\text{between}}, df_{\text{error}})} = MS_{\text{between}}/MS_{\text{error}}$$

SS_{subjects} = is the sum of squared deviations of the subject and mean.

SS_{error} = the sum of squared deviations due to sampling error.

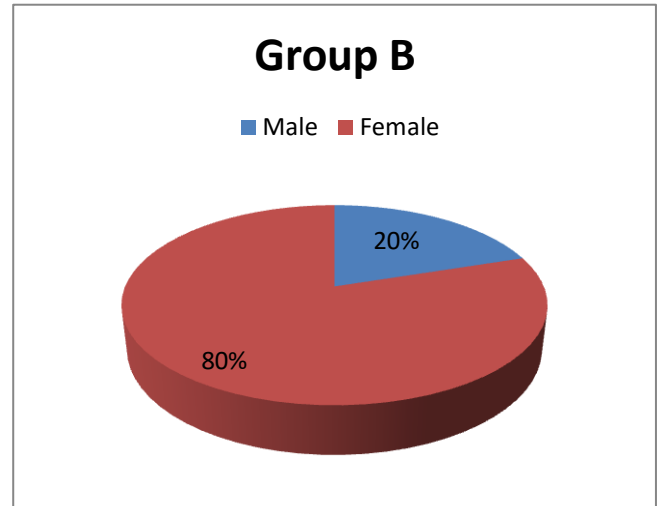
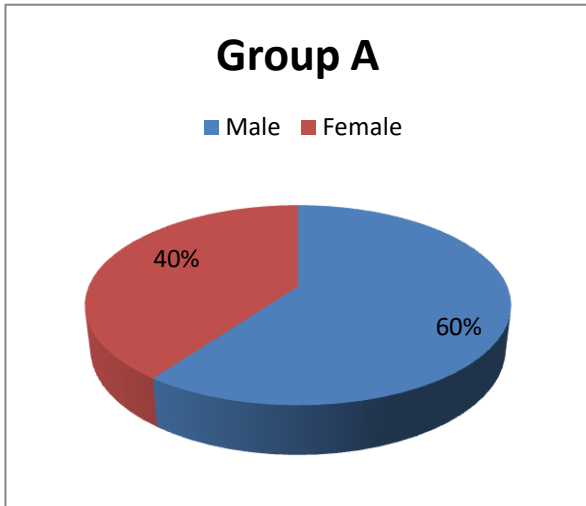
Table 4.1: Baseline characteristics for group A and group B

Serial		Group A			Group B			P Value	t
		Mean	SD	SE	Mean	SD	SE		
1	Age (years)	52.50	3.536	1.118	56.30	3.889	1.230	.035	-2.286
2	BBS	27.80	2.440	.772	27.10	3.604	1.140	.617	.509
3	Neuro-Qol	95.80	6.730	2.128	93.70	9.696	3.066	.581	.563
4	Years of Neuropathy	3.950	1.5357	.4856	3.450	1.1168	.3532	.416	.833

Significant difference between age present (p=0.35).

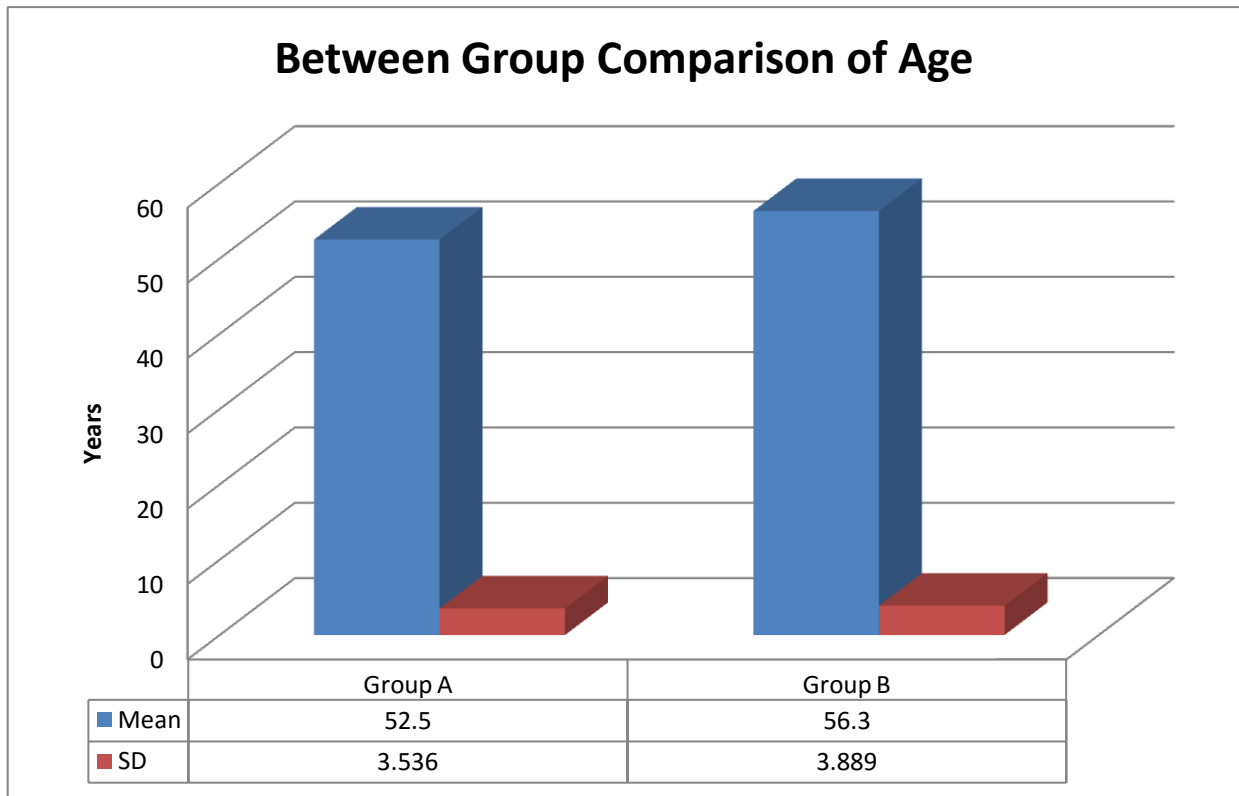
No significant difference present for berg balance scale ,years of neuropathy ,neuro-qol as (p=.617),(p=.581)and (p=.416) respectively between group A and group B.

Pie chart for gender

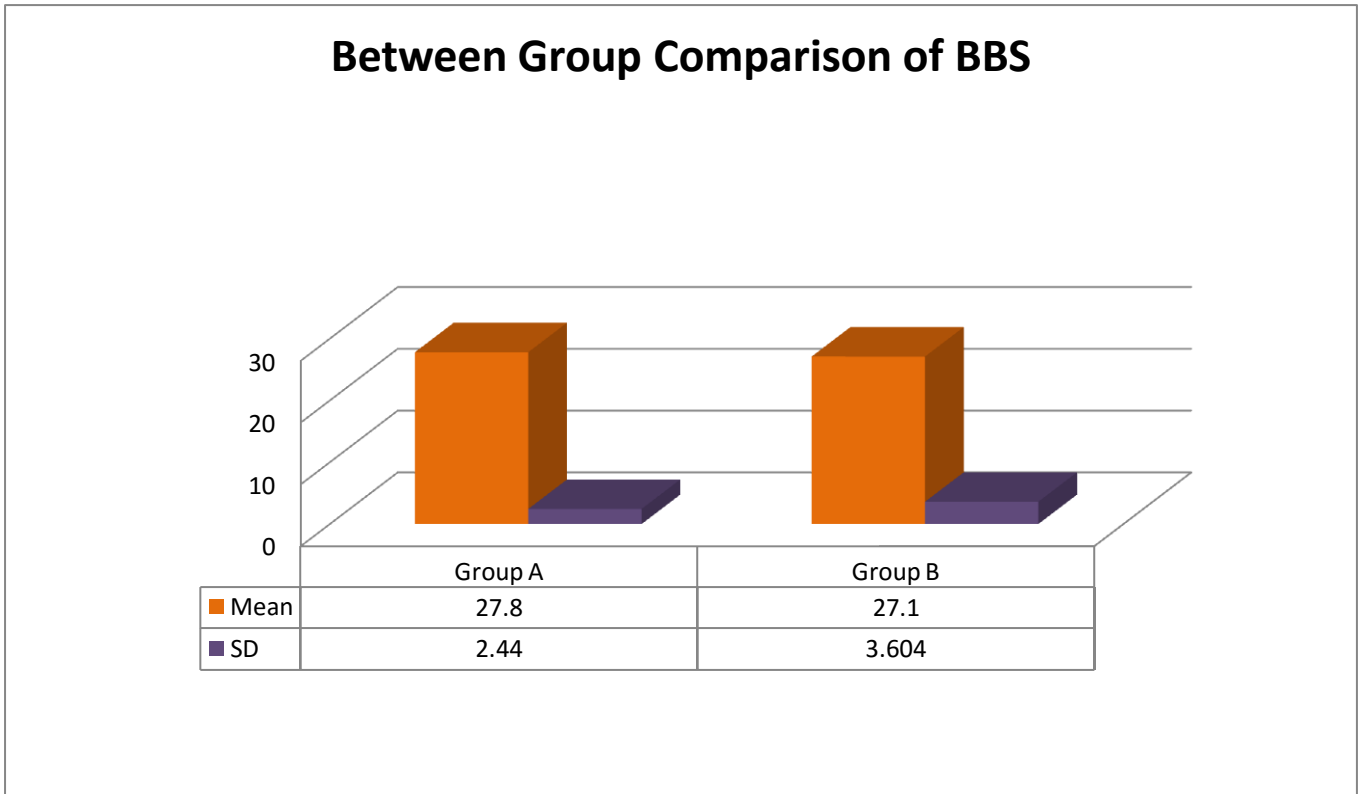


Graph 4.1: Percentage of male and female

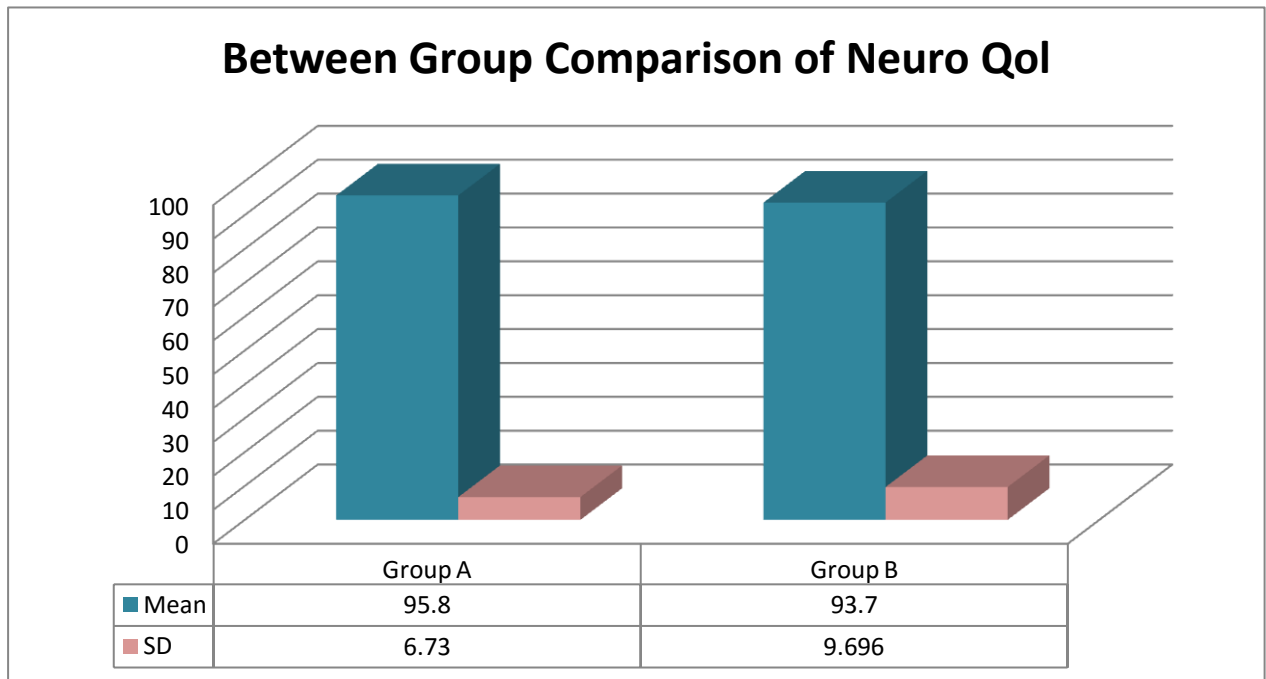
Graph 4.1.1 Comparisons of mean and SD of age for group A and group B



Graph 4.1.2: Comparison of mean and SD BBS of group A and group B



Graph 4.1.3: Comparisons of mean and SD of neuro-Qol for group A and group B



Graph 4.1.4 Comparison of mean and SD of years of neuropathy for group A and group B

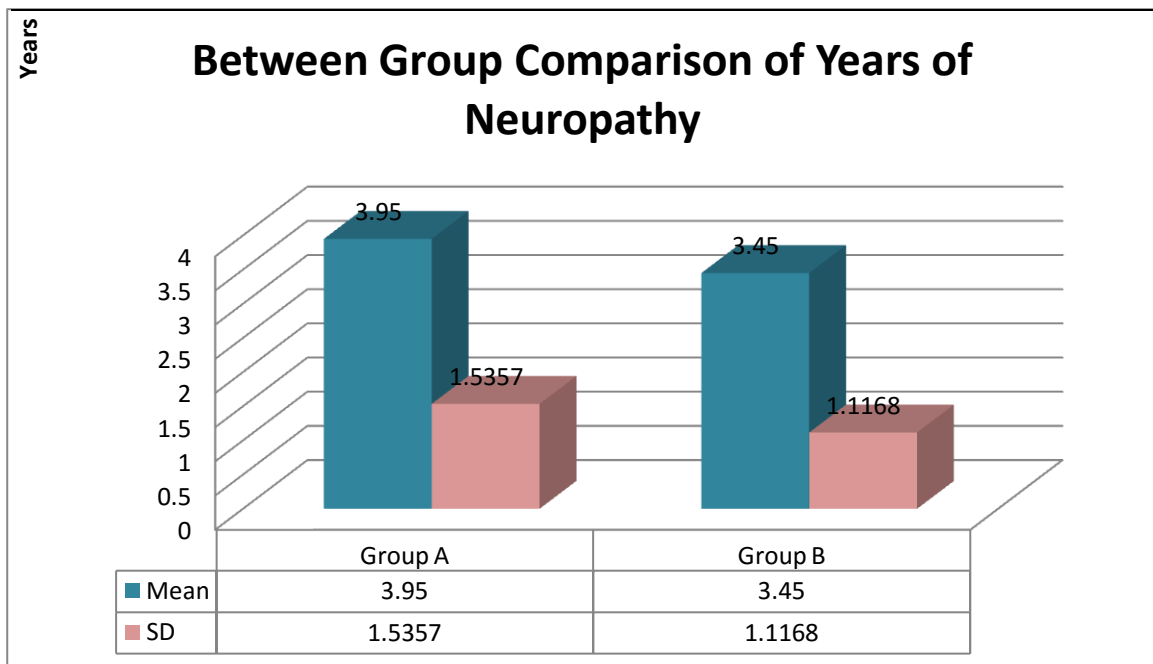


Table 4.2: Comparison of mean and standard deviation using repeated measure ANOVA for BBS for group A

Repeated ANOVA	Group A		
	Berg Balance Score		
	Pre	Mid	Post
Mean	27.80	29.00	35.70
S.D.	2.440	2.539	2.214
F Test	146.95		
P value	<0.001		
Table Value	3.555		
Result	Significant		
Turkey's method for Pair wise comparison	Pre		
Mean Difference & Result>	Mid	1.2Sig	Mid
	Post	7.9Sig	6.7Sig

This table illustrates within group difference for BBS for group A which showed (p value<0.001) significant difference.

Graph 4.2 Comparison of mean and standard deviation for BBS for group A.

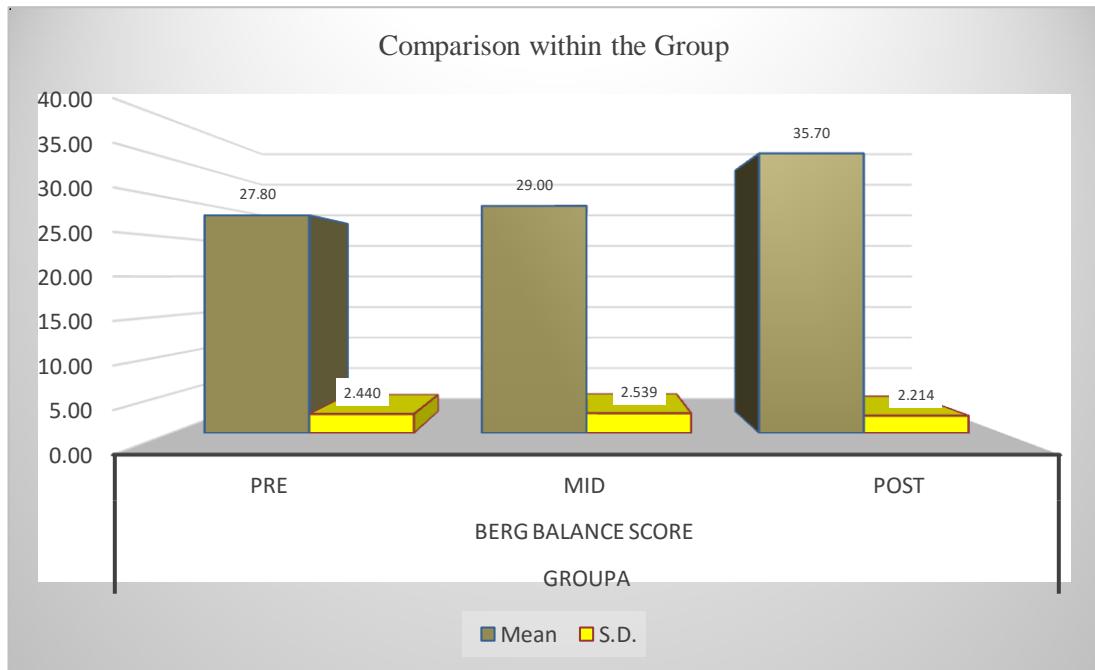


Table 4.3 Comparison of Mean and standard deviation for Neuro-Qol using repeated measures ANOVA of group A

Repeated ANOVA	Group A		
	Neuroqol		
	Pre	Mid	Post
Mean	95.80	92.70	77.90
S.D.	6.730	6.993	5.280
F Test	227.30		
P value	<0.001		
Table Value	3.555		
Result	Significant		
Turkey's method for Pair wise comparison	Pre		
Mean Difference & Result>	Mid	3.1Sig	Mid
	Post	17.9Sig	14.8Sig

This Table Illustrates within Group Difference for Neuro-Qol For group A showed(P<0.001) Significant Deference.

Graph 4.3 Comparison of mean and standard deviation of Neuro-Qol for group A

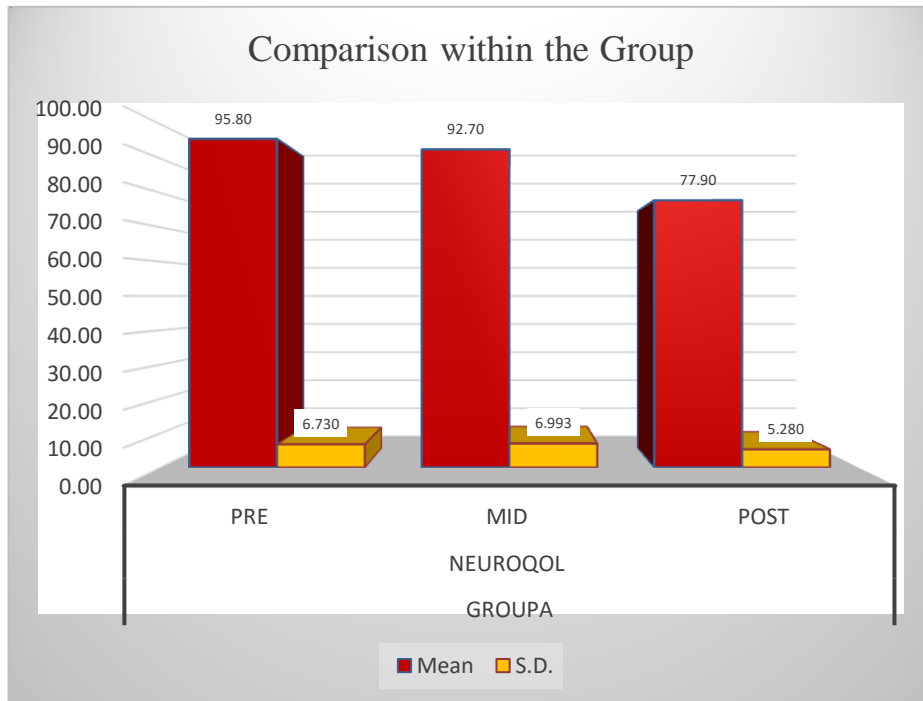


Table 4.4: Comparison of mean and Standard deviation for BBS using repeated ANOVA for group B

Repeated ANOVA	Group B		
	Berg Balance Score		
	Pre	Mid	Post
Mean	27.10	28.60	33.40
S.D.	3.604	3.471	2.914
F Test	59.55		
P value	<0.001		
Table Value	3.555		
Result	Significant		
Turkey's method for Pair wise comparison	Pre		
Mean Difference & Result>	Mid	1.5Sig	Mid
	Post	6.3Sig	4.8Sig

This table illustrates the within groups difference for BBS for group B shown significant difference (p value<0.001).

Graph 4.4: Comparison of mean and standard deviation for BBS for group B

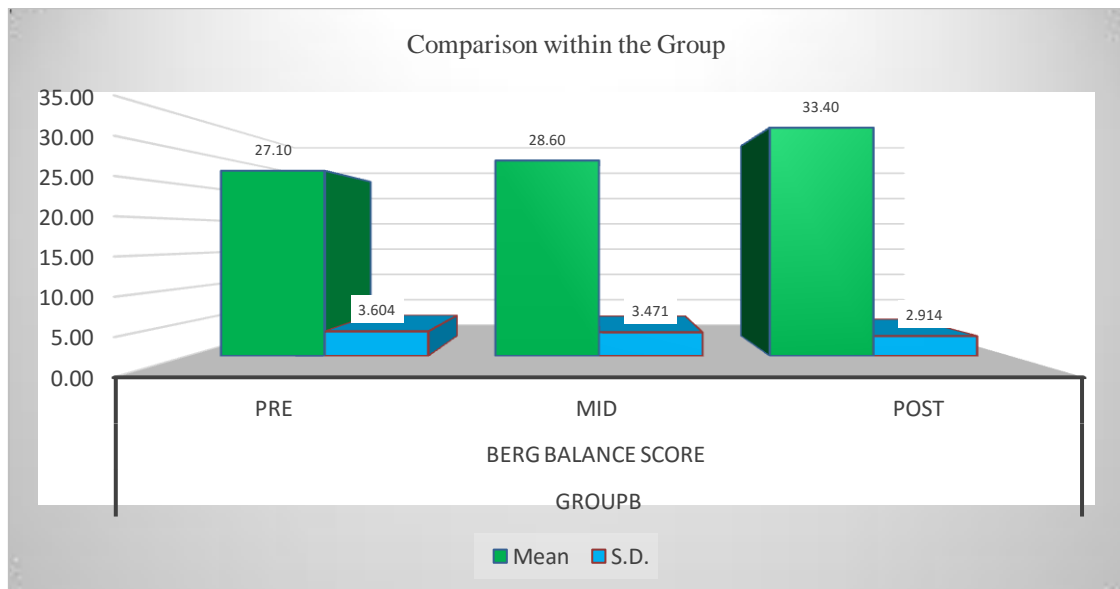


Table 4.5: Comparison of mean and standard deviation for Neuro-Qol using repeated measure ANOVA for group B.

	Group B		
Repeated ANOVA	Neuroqol		
	Pre	Mid	Post
Mean	93.70	90.40	79.90
S.D.	9.696	8.540	9.723
F Test	132.15		
P value	<0.0013		
Table Value	3.553		
Result	Significant		
Turkey's method for Pair wise comparison	Pre		
Mean Difference & Result>	Mid	3.3Sig	Mid
	Post	13.8Sig	10.5Sig

This table illustrates within group difference for neuro-Qol for group B showed($p = <0.001$) significant difference .

Graph 4.5 Comparison of mean and standard deviation of Neuro-Qol for group B

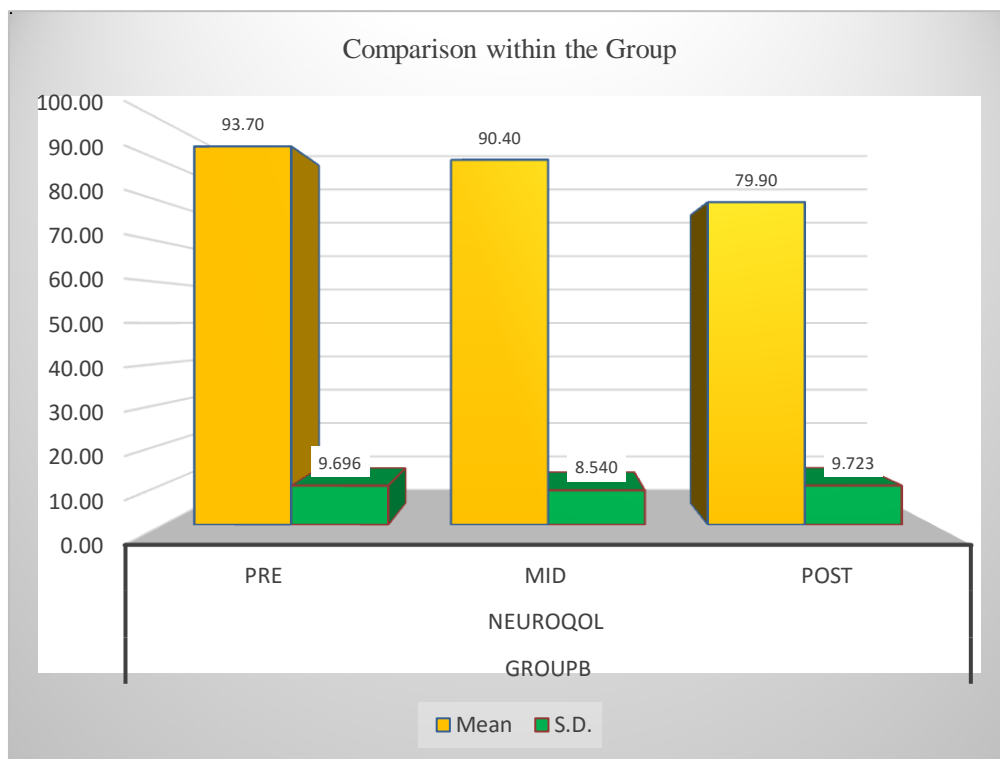


Table 4.6 Comparison of mean and standard deviation for BBS using paired t-test for group

A

Paired T Test Group A	Berg Balance Score					
	Pair1		Pair2		Pair3	
	Pre	Mid	Mid	Post	Pre	Post
Mean	27.80	29.00	29.00	35.70	27.80	35.70
S.D.	2.440	2.539	2.539	2.214	2.440	2.214
Paired T Test	3.674		11.991		13.941	
P value	0.0051		<0.001		<0.001	
Table Value at 0.05	2.26		2.26		2.26	
Result	Significant		Significant		Significant	

This table illustrates within group differences for BBS (group A) at baseline, 3rd week and 6th week. There was significant difference ($p < 0.001$) between pre and post values.

Graph 4.6: Comparison of mean and standard deviation for BBS for group A

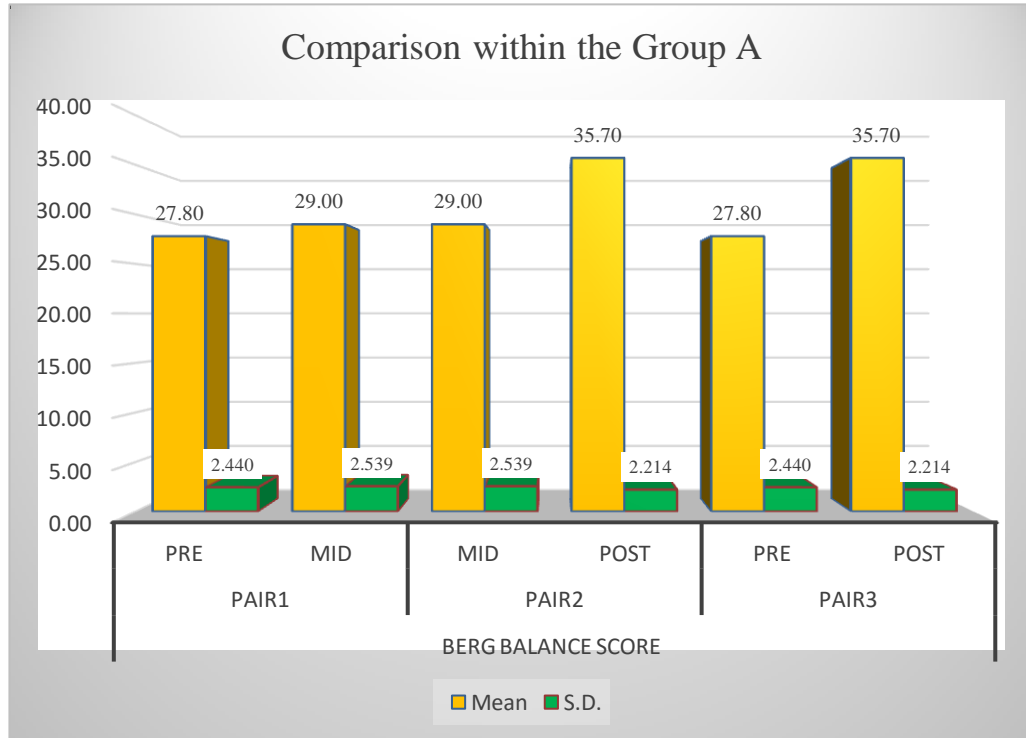


Table 4.7 Comparison of mean and standard deviation using paired t test for Neuro-Qol for group A

Paired T Test Group A	Neuroqol					
	Pair1		Pair2		Pair3	
	Pre	Mid	Mid	Post	Pre	Post
Mean	95.80	92.70	92.70	77.90	95.80	77.90
S.D.	6.730	6.993	6.993	5.280	6.730	5.280
Paired T Test	7.154		15.001		15.982	
P value	0.0001		<0.001		<0.001	
Table Value at 0.05	2.26		2.26		2.26	
Result	Significant		Significant		Significant	

This table illustrates within the group differences for Neuro-Qol (group A) at baseline 3rd week and 6th week. There was significant difference ($p < 0.001$) pre and post value.

Graph 4.7 Comparison of mean and standard deviation for Neuro-Qol for group A.

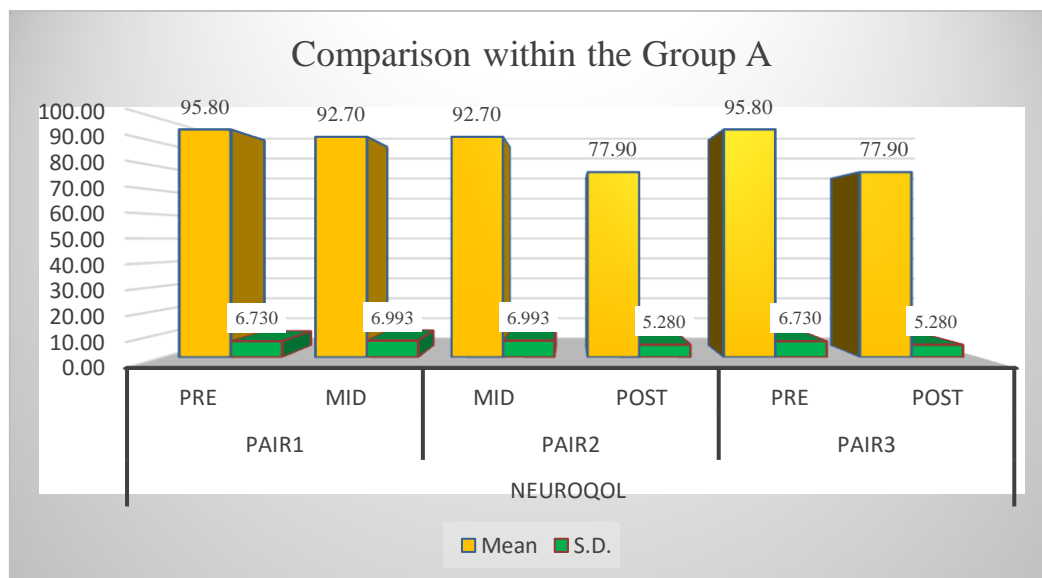


Table 4.8 Comparison of mean and standard deviation using paired T test for BBS for Group B

Paired T Test Group B	Berg Balance Score					
	Pair1		Pair2		Pair3	
	Pre	Mid	Mid	Post	Pre	Post
Mean	27.10	28.60	28.60	33.40	27.10	33.40
S.D.	3.604	3.471	3.471	2.914	3.604	2.914
Paired T Test	3.503		7.236		9.211	
P value	0.0067		<0.001		<0.001	
Table Value at 0.05	2.26		2.26		2.26	
Result	Significant		Significant		Significant	

This table illustrates within the group difference for BBS at baseline, 3rd week and 6th week. There is significant difference (<0.001) between pre and post test values.

Graph 4.8: Comparison of mean and standard deviation for BBS for group B

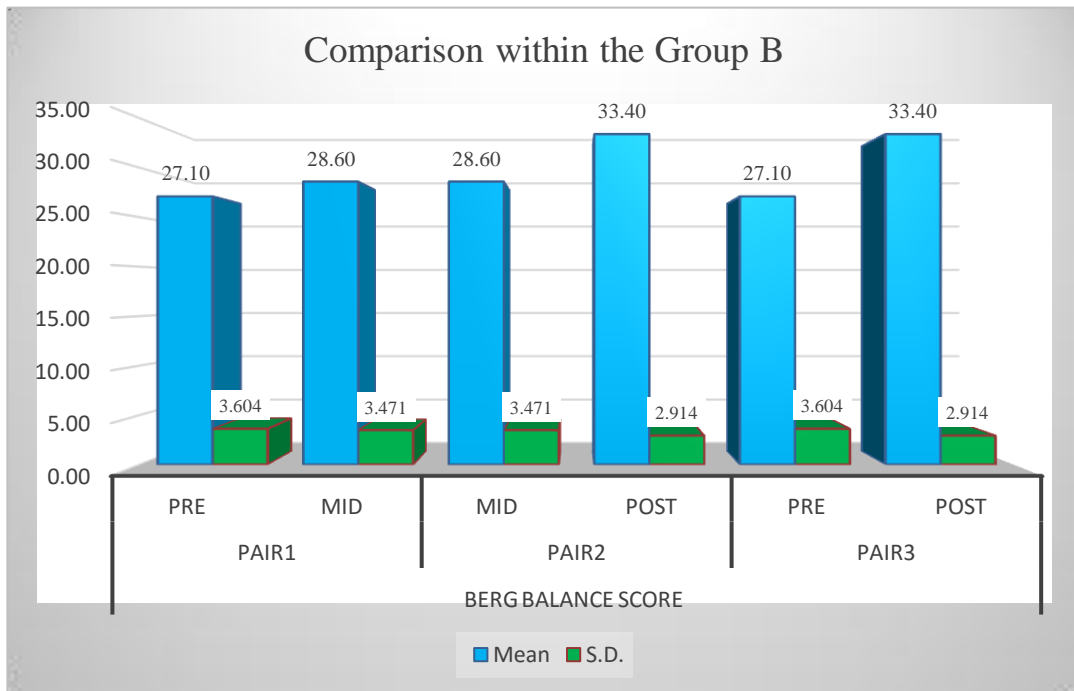


Table4.9 Comparison of mean and standard deviation using paired t test for Neuro-Qol for group B

Paired T Test Group B	Neuroqol					
	Pair1		Pair2		Pair3	
	Pre	Mid	Mid	Post	Pre	Post
Mean	93.70	90.40	90.40	79.90	93.70	79.90
S.D.	9.696	8.540	8.540	9.723	9.696	9.723
Paired T Test	3.910		10.471		17.250	
P value	0.0036		<0.001		<0.001	
Table Value at 0.05	2.26		2.26		2.26	
Result	Significant		Significant		Significant	

This table illustrates within the group differences for Neuro-Qol (group B) at baseline, 3rd week and 6th week .There was significant difference (p =0.0036)between pre and post test values

Graph 4.9: Comparison of mean and standard deviation for Neuro-Qol for group B.

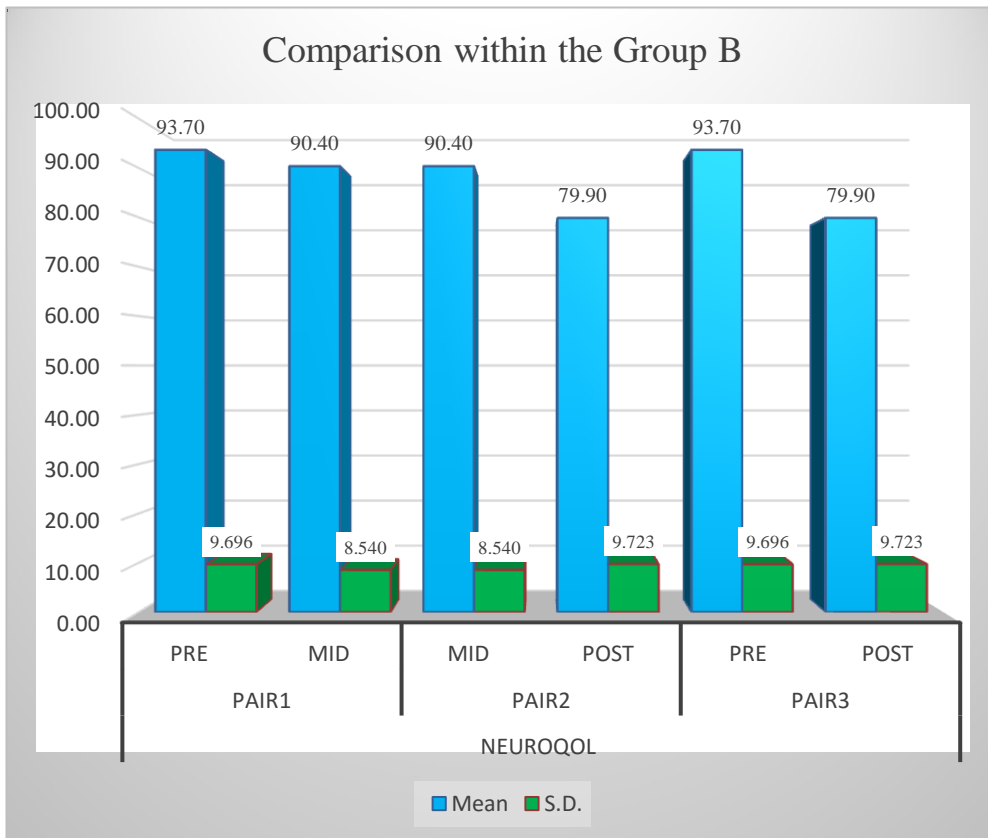


Table 4.10 Comparison of mean standard deviation for BBS using unpaired t-test for group A and group B.

Unpaired T Test	Berg Balance Score					
	Pre		Mid		Post	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	27.80	27.10	29.00	28.60	35.70	33.40
S.D.	2.440	3.604	2.539	3.471	2.214	2.914
Mean Difference	0.70		0.40		2.30	
Unpaired T Test	0.509		0.294		1.988	
P value	0.6172		0.7720		0.0623	
Table Value at 0.05	2.10		2.10		2.10	
Result	Not-Significant		Not-Significant		Not-Significant	

This table illustrates the between group differences for BBS. Pre-test ($p=0.6172$), mid test($p=0.7720$) and post test (0.0623) of both the group showed no significant difference.

Graph 4.10 Comparison of mean and standard deviation for BBS for group A and Group B.

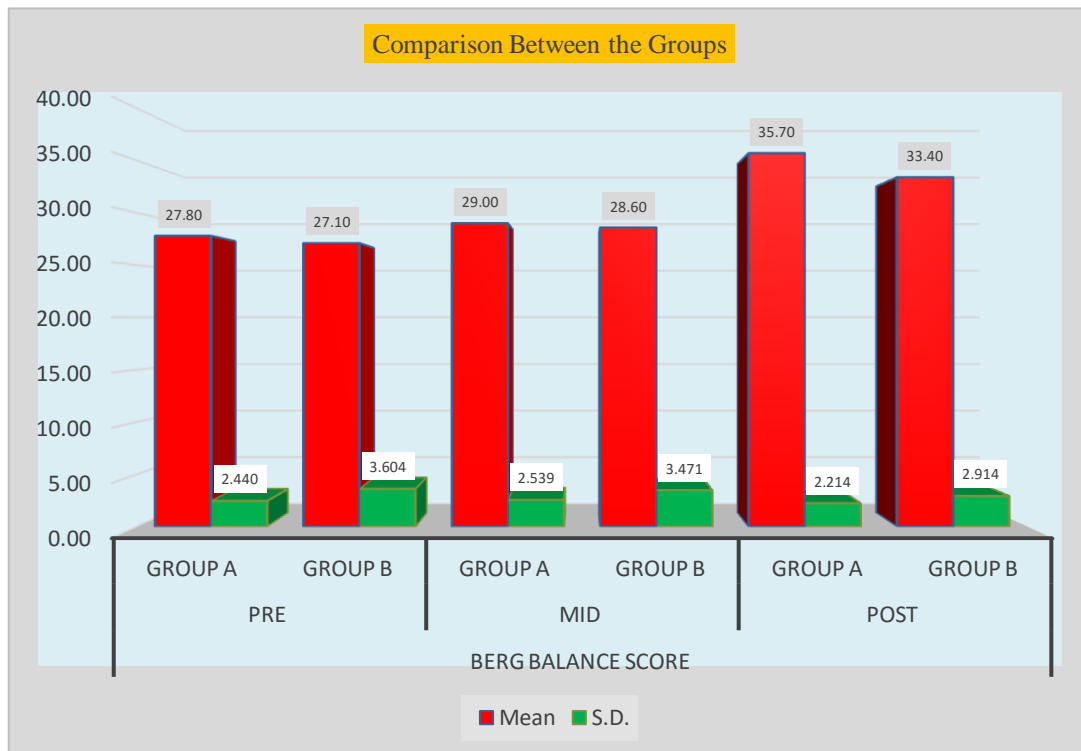
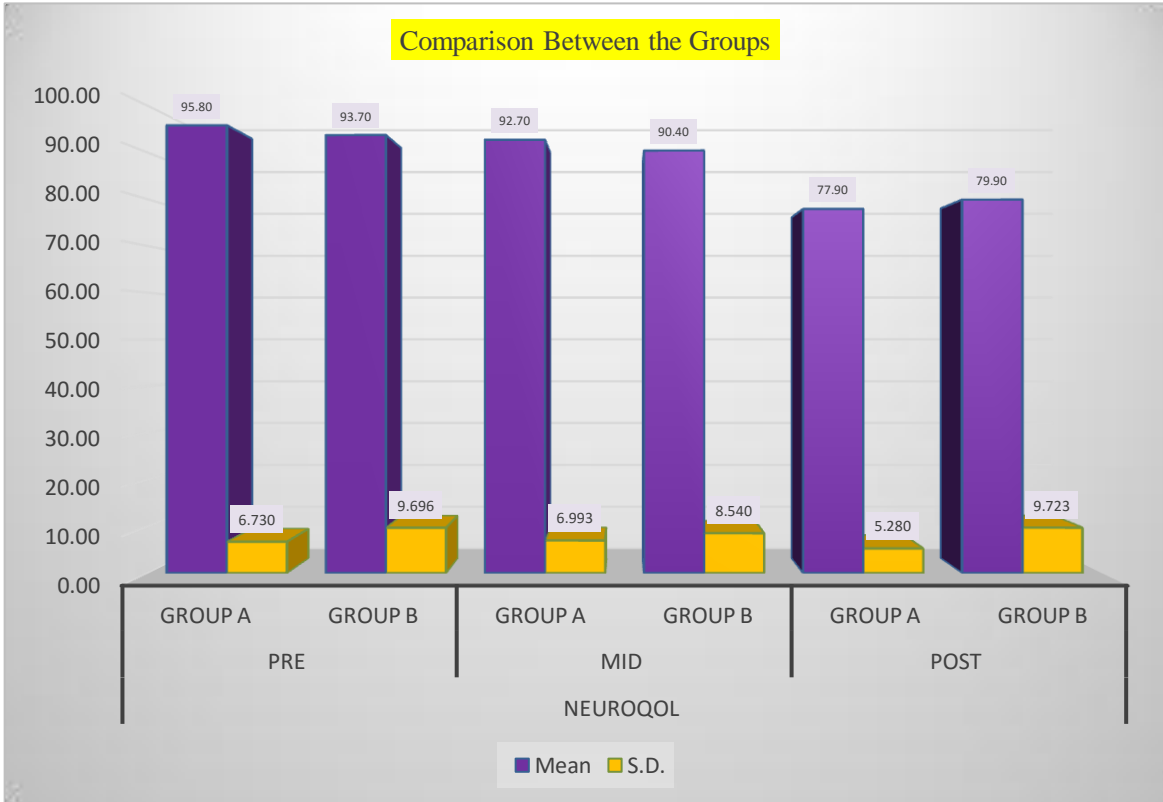


Table 4.11 Comparison of mean and standard deviation for Neuro-Qol using unpaired t-test for group A and group B

Unpaired T Test	Neuro-Qol					
	Pre		Mid		Post	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	95.80	93.70	92.70	90.40	77.90	79.90
S.D.	6.730	9.696	6.993	8.540	5.280	9.723
Mean Difference	2.10		2.30		-2.00	
Unpaired T Test	0.563		0.659		0.572	
P value	0.5806		0.5183		0.5747	
Table Value at 0.05	2.10		2.10		2.10	
Result	Not-Significant		Not-Significant		Not-Significant	

This table illustrates the between group difference for Neuro-Qol. Pre-test($p=0.5806$), mid value($p=0.5183$),post value ($p=0.5747$)shows no significant difference.

Graph 4.11 Comparison of mean and standard deviation for Neuro-Qol for group A and B.



Result

This study conducted to compare the effect of game based rehabilitation and mixed sport training on balance in diabetic neuropathy. After analysing the collected data statistically, following inferences were drawn.

Repeated measure of ANOVA used to calculate within group changes at baseline, week 3 and week 6.

Table 4.2: The mean and SD of BBS within group A was at baseline, week 3, week 6, 27.80 ± 2.440 , 29.00 ± 2.539 , 35.70 ± 2.21 respectively with level of significance ($p < 0.001$).

Table 4.3: The mean and SD of Neuro-Qol within group A was at baseline, week 3, week 6, 95.80 ± 6.730 , 92.70 ± 6.993 , 77.90 ± 5.280 respectively with level of significance ($p < 0.001$).

Table 4.4: The mean and SD of BBS within group B was at baseline, week 3, week 6, 27.10 ± 3.604 , 28.60 ± 3.471 , 33.40 ± 2.914 respectively with level of significance ($p < 0.001$).

Table 4.5: The mean and SD of Neuro-Qol within group B was at baseline, week 3, week 6 93.70 ± 9.696 , 90.40 ± 8.540 , 79.90 ± 9.723 respectively with level of significance ($p < 0.001$).

Paired t-test was used to calculate within group difference for BBS, Neuro-Qol for both the groups.

Table 4.6 : The mean and SD of BBS for group A at baseline and week 3 is and respectively 27.80 ± 2.440 and 29.00 ± 2.539 . There was significant difference ($p = 0.0051$) between baseline and 3 week.

Table 4.6: The mean and SD of BBS for group A at week 3 and week 6 is 29.00 ± 2.539 and 35.70 ± 2.214 respectively. There was difference ($p < 0.001$) between week 3 and week 6.

Table 4.6: The mean and SD of BBS for group A at baseline and week 6 is 27.80 ± 2.440 and 35.70 ± 2.214 respectively. There was significant difference ($p < 0.001$) between baseline and week 6.

Table 4.7: The mean and SD for Neuro-Qol group A at baseline and week 3 is 95.80 ± 6.730 and 92.70 ± 6.993 respectively. There was significant difference ($p < 0.0001$) between baseline and 3 week.

Table 4.7 :The mean and SD for Neuro-Qol for group A at week 3 and week 6 is 92.70 ± 77.90 and 6.993 ± 5.280 respectively .There was significant difference ($p < 0.001$) between week 3 and week 6.

Table 4.7 :The mean and SD for Neuro-Qol group A at baseline and week 6 is 95.80 ± 77.90 and 6.730 ± 5.280 respectively .There was difference ($p < 0.001$) between baseline and week 6.

Table 4.8: The mean and SD for BBS group B at baseline and week 3 is 27.10 ± 28.60 and 3.604 ± 3.471 respectively .There was difference ($p = 0.0067$) between baseline and week 3.

Table 4.8: The mean and SD for BBS group B at week 3 and week 6 is 28.60 ± 33.40 and 3.571 ± 2.914 respectively .There was difference ($p < 0.001$) between week 3 and week 6.

Table 4.8: The mean and SD for group B at baseline and week 6 is 27.10 ± 33.40 and 3.604 ± 2.914 respectively .There was difference ($p < 0.001$) between baseline and week 6.

Table 4.9: The mean and SD for Neuro-Qol group B at baseline and week 3 is 93.70 ± 90.40 and 9.696 ± 8.540 respectively .There was difference ($p = 0.0036$) between baseline and week 3.

Table 4.9: The mean and SD for Neuro-Qol group B at week 3 and week 6 is 90.40 ± 79.90 and 8.540 ± 9.723 respectively .There was difference ($p < 0.001$) between week 3 and week 6.

Table 4.9: The mean and SD for Neuro-Qol group B at baseline and week 6 is 93.70 ± 79.90 and 9.696 ± 9.723 respectively .There was difference ($p < 0.001$) between baseline and week 6.

The score of BBS, Neuro-Qol for between the group differences was calculated using unpaired t-test.

Table 4.10: The mean and SD for BBS for group A and group B at baseline is 2.80 ± 27.10 and 2.440 ± 3.604 respectively with mean difference of 0.70. The result showed that lies non-significant difference $p = 0.6173$ with respect to BBS at baseline.

Table 4.10: The mean and SD of BBS at week 3 for group A and group B is 29.00 ± 28.60 and 2.53 ± 93.47 respectively with mean difference of 0.40 .The result showed there is no significant difference (0.7720) with respect to BBS score at 3 week.

Table4.10: The mean and SD of BBS at week 6 for group A and group B is 35.70 ± 33.40 respectively with mean difference of 2.30. The result showed there is no significant difference (0.0623) with respect to BBS score at 3 week.

Table4.11: The mean and SD of Neuro-Qol at baseline for group A and group B is 95.80 ± 93.70 and 6.730 ± 9.696 respectively with mean difference of 2.10. The result showed there is no significant difference (0.586) with respect to neuro-Qol score at baseline.

Table4.11: The mean and SD of Neuro-Qol at week 3 for group A and group B is 92.70 ± 90.40 and 6.993 ± 8.540 respectively with mean difference of 2.30. The result showed there is no significant difference (0.5183) with respect to Neuro-Qol score at 3 week.

Table4.11: The mean and SD of neuroqol At Week 6 FOR group A and group B is respectively with mean difference of 77.90 ± 79.90 and 5.280 ± 9.723 . The result showed there is no significant difference (0.572) with respect to Neuro-Qol score at 6 week

CHAPTER 5
DISCUSSION

Discussion:

Aim of the present study was to compare the effect of game based rehabilitation and mixed sport training on balance and quality of life in diabetic neuropathy.

The result of present study supported that game based rehabilitation as well as mixed sport training are effective in improving balance and quality of life in diabetic neuropathy patients but there is no significant difference between both groups.

Baseline characteristics are similar for both groups for BBS, Neuro-Qol and duration of diabetic neuropathy except age .BBS (p value 0.67), Neuro-Qol(p value .581)and duration of diabetic peripheral neuropathy(p value .416). There was significant difference (p value 0.35) between age of both groups .This similar baseline characteristics can also be responsible for not significant difference between groups.

In this study participants were divided into two groups game based rehabilitation and mixed sport group. Participants in game based rehabilitation group played Wii games and those participants who were in mixed sport training group performed balance and strength exercise training. Training was given for 30 minute session 2 times a for 6 weeks for both groups..Outcomes were assessed at baseline, end of the 3rd week and end of the 6th week.

Extensive studies has been done on Nintendo Wii fit and they shown that Wii fit training that shown positive effect on balance and motor function .⁴⁰Bainbridge K,. Reported that Wii fit is effective rehabilitation tool to improve balance in older population .⁴¹ Williams A.M.et al founded that Nintendo Wii fit training is acceptable for balance treatment.⁴² Similar to these previous literatures this study also founded that game based rehabilitation was effective in improving balance and quality of life of patients with diabetic neuropathy. In this study there was significant effect of game based rehabilitation on balance as berg balance score improved from baseline to three weeks(p=.0051) and three weeks to six week(p=<.001), but mean difference was more between three to six weeks . Quality of life was also improved as Neuro-Qol score between baseline to three week (p=0.0001),an three week to six week(p=<.001). For Neuro-Qol also mean difference was more between three to six week. Based on the result of this study alternate hypothesis accepted,. Nintendo Wii fit, was released in 2006.⁴³Wii fit system is affordable and easily assessable Tennis involves moment of whole body lower limb, trunk and upper limb . While playing tennis patient move his

body in all the planes saggital, frontal and horizontal. Patient went out of base of support while playing frequently and he learn to maintain his body balance. Playing golf involves movement mainly in saggital plane and horizontal plane. While playing the game person has to change the weight in different directions frequently this challenge the posture control system of body to maintain centre of mass within the limit of base of support. These all components was responsible for balance improvement in game based rehabilitation group Wii fit system provide knowledge of performance and knowledge of result and according to motor learning theory these components are important to learn any new skill .^{31,44}

Raghav D found that focused exercise is appropriate for improving gait, balance in patients with diabetic neuropathy in comparison to strengthening of muscle.⁴⁵ The mixed sport training also shown significant improvement in balance and quality of life in diabetic neuropathy patients . Significant improvement was present for balance as berg balance score improved between baseline to three week($p=.0067$)and three week to six week($p<.001$). Mean difference between three to six week was more than baseline to three week .Improvement in Neuro-Qol found as significant difference between baseline to three week ($p=0.0036$)and three week to six week($p<0.001$) but mean difference was more between three to six week is more than the baseline to three week. Based on the result of this study alternate hypothesis accepted . Mixed sport training is oriented toward lower limb muscle strengthening and balance training, tandem stance, standing on toes exercise on spongy surface and for endurance and strength training sitting to standing, stair climbing, climbing on slope. The rationale behind improvement in mixed sport training group was positive modulation of regenerative mechanism like altered expression of growth factors induction for remyelination or accelerating axonal regeneration.⁴⁶

There was lack of evidence to compare effect of game based rehabilitation and mixed sport training . This study shown non-significant difference between game based rehabilitation and mixed sport training for berg balance score as p value at baseline ($p=.6172$), at third week($p=0.7720$) and at six week($p=0.0623$). Non-significant difference found between game based rehabilitation and mixed sport training for Neuro-Qol also p value at baseline ($p=.5806$),third week($p=.5183$)and six week($p=.5787$). This study found that both game based rehabilitation as well as mixed sport training were equally effective in improving balance and quality of life of diabetic neuropathy patents. Based on the result of this study null hypothesis accepted . Game based rehabilitation system teaches participants to keep body balanced while playing the game, so by this practise they became able to do activities

without loss of balance control⁴⁷. Participants in mixed sport group also improved muscle strength of quadriceps, hamstring, ankle muscle these all changes improve balance enhanced proprioception so ultimately balance will be improved.³⁶

Researcher experienced that improvement was present in balance and quality of life in both groups and confidence level of participants was increased. Patients who were participated in mixed sport training were more satisfied and they took more interest in training in comparison to game based rehabilitation group participants. Reason for this can be language problem related to game, people known about exercise but game based exercise was something new for them, age is also other responsible factor for it because elderly population in India don't take very much interest in playing.

Adverse event reported by the patients, 9 patients out of 20 suffered from delayed onset muscle soreness, lack of interest of participants, fatigue, difficulty in understanding game language.

Limitation of the study-

- Difficulty in getting expected number of patients ..
- Blinding has not been followed.
- Difficulty to follow the language used in game based rehabilitation group.
- No control group was used.

Future scope-

- New simplified method of game based training based on activities of daily living.
- Distributed model of motor learning strategies will be incorporated to avoid fatigue.
- Interventions can be evaluated with particular time of the day.
- Short duration intervention can be evaluated with larger sample size.
- Evaluate the retention effects through follow up.
- Randomized control trail should

CHAPTER 6
CONCLUSION

Conclusion

This study concluded that game based rehabilitation and mixed sport training both are effective in improving balance and quality of life of patients with diabetic neuropathy.. Portable game based rehabilitation instrument are available so can be easily used and mixed sport training programs are easy to perform. So any one method of practise can be used to treat balance problem in diabetic neuropathy patients based on feasibility and practicality.

CHAPTER 7
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CHAPTER 8
APPENDIX

APPENDIX 8.1.1 CONSENT FORM ENGLISH

TITLE:

Comparison of game based rehabilitation and mixed sport training on balance in diabetic neuropathy.

INVITATION TO PARTICIPATION:

You are invited to participate in this study that's aims to determine comparison of Wii fit and mixed sport training on balance in diabetic neuropathy. Before deciding, it is necessary that you understand the purpose of research as well as the steps it will involve. Please take time to go through the information provided carefully and discuss it with others if deemed necessary. Any queries regarding the study are most welcome.

BASIS OF SUBJECT SELECTION:

The reason you are invited to participate in this study is because you are meeting to inclusion criteria of this study.

PURPOSE OF THE RESEARCH:

The purpose of this study is to find the comparison of Wii fit and mixed sport training on balance in diabetic neuropathy.

EXPLANATION OF THE PROCEDURE: The subject will be divided into two groups

Group A- game based rehabilitation program, it's a kind of game based rehabilitation. It has different component like Wii fit system and balance board, laptop, participants will stand on balance board and play the games (tennis ,golf) that will be shown on laptop. Participants will have both visual and auditory feedback during the session. Treatment protocol is for 6 weeks.

Group B-Mixed sport training programs it involves different kind of exercises like proprioception exercise and lower limb muscle strengthening exercises. Treatment protocol is for 6 weeks.

Participants can fall in any of the above-mentioned group.

POTENTIAL RISKS AND DISCOMFORTS:

During there the study ,you may experience some discomfort ,loss of balance or unwillingness to continue but researcher will be there to protect you in any that type of situation and appropriate rest periods are allowed during the course of holding session if required . However, session will also be resumed upon your request if not able to do for how so ever means.

POTENTIAL BENEFITS:

Once a safe and viable treatment is determined, after this treatment your balance will be improved and you will develop confidence, you can do your activity of daily living and can go to outside without any support with no fear of fall.

ASSURANCE OF CONFIDENTIALITY:

Any information will not be share .All the information will be strictly confidential, only researcher having asses to it. The finding obtained in this study may be published in appropriate journals or presented at professional meetings.

REQUEST FOR MORE INFORMATION:

If you have any questions, please don't hesitate to ask the researcher.

REQUEST FOR WITHDRAWAL FROM THE STUDY:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your present and future relationship with researcher. You are free to withdraw any time without consequence, fear or prejudice. In case of withdraw. If, please contact the researcher at the earliest opportunity and all data related to you would be destroyed.

Principle investigator

Name –Snehi Pandey

MPT (Neurology)

Address: Department of physiotherapy

Lovely professional university

Phagwara, Punjab

Contact NO:

I -----have agreed to participate in this study .I have read and understood all the information presented and all my queries have been answered with satisfaction .I have also received a single copy of the consent form. The purpose of this research, the procedure needed and possible risks and benefits if the best of my ability in the language best of his/her understanding.

Signature of Investigator

Signature of Participants Snehi Pandey

APPENDIX 8.1.2
INFORMED CONSENT –HINDI

सहमति सूचना प्रपत्र

शीर्षक

डायबिटिक न्यूरोपैथी की बिमारी में गेम बेस्ड रिहैबिलिटेसन तथा मिक्स स्पोर्ट ट्रेनिंग का बैलेंस पर पड़ने वाला प्रभाव

भाग लेने के लिए आमंत्रण -

हम आपको इसके तुलनात्मक प्रभाव के संदर्भ में खोज के लिए आमंत्रित करते हैं , जो की डायबिटिक न्यूरोपैथी में बेलेन्स के ऊपर गेम बेस्ड रिहैबिलिटेसन और मिक्स स्पोर्ट ट्रेनिंग के तुलनात्मक अध्ययन के लिए किया जा रहा है। कृपया इस सूचना पत्र को पूरा पढ़ें , इस खोज के संदर्भ कोई जानकारी प्राप्त करने के इच्छुक हैं , तो आपका स्वागत है।

भाग लेने का आधार -

इस खोज के लिए जो जरूरी चीजे हैं , आप उसके बराबर हैं।

खोज का उद्देश्य

इस खोज का उद्देश्य यह ज्ञात करना है की , डायबिटिक न्यूरोपैथी के बेलेन्स की परेशानी को दूर करने के लिए गेम बेस्ड रिहैबिलिटेसन और मिक्स स्पोर्ट ट्रेनिंग में कौन ज्यादा बेहतर है।

प्रक्रिया की व्याख्या -

इस खोज में दो समूह हैं।

समूह ए - गेम बेस्ड रिहैबिलिटेसन , इस समूह के भागीदारों को बेलेन्स बोर्ड पर खड़े होकर कम्प्यूटर पर गेम खेलना होगा।

समूह बी - मिक्स स्पोर्ट ट्रेनिंग इस समूह के भागीदारों को व्यायाम करना है।

भागीदार ऊपर लिखे समूह में से किसी एक समूह में भाग लेंगे।

संभावित जोखिम - व्यायाम के समय भागीदारों को बेलेन्स की परेशानी महसूस हो सकती है।

संभावित लाभ -

इस खोज में हिस्सा लेकर व्यायाम के बाद आप के अंदर स्फूर्ति व विश्वास जगेगा। जिसका बेहतर परिणाम आप के काम काज पर पड़ेगा।

गोपनीयता -

आप द्वारा प्रदत्त जानकारी पूर्णतया गोपनीय होगी। उसे खोजकर्ता ही देख सकता है किसी अन्य के साथ साझा न की जायेगी।

अधिक जानकारी के लिए निवेदन -

आप इस खोज के संदर्भ में कोई प्रश्न पूछना चाहते हैं तो पूछ सकते हैं।

खोज छोड़ने के संदर्भ में -

आप अपनी इच्छा से इस खोज से जुड़ रहे हैं , जब आपकी इच्छा हो खोजकर्ता को सूचित कर इस खोज से अलग हो सकते हैं।

मुख्य जांचकर्ता का नाम -

स्नेही पाण्डेय

मास्टर ऑफ़ फिजियोथेरेपी (न्यूरोलोजी)

पता - डिपार्टमेंट ऑफ़ फिजियोथेरेपी

लवली प्रोफेसनल यूनिवर्सिटी फगवाड़ा , पंजाब।

मैं इस खोज में भाग लेने के लिए सहमत हू। इस खोज के संदर्भ में मैंने सारी जानकारी व सूचनाएं भलीभांति समझ ली है। मेरे सभी प्रश्नों के जवाब दे दिए गए हैं। सूचना प्रपत्र की एक प्रति प्राप्त कर ली है।

मुख्य जांचकर्ता के हस्ताक्षर

स्नेही पाण्डेय

मास्टर ऑफ़ फिजियोथेरेपी

भागीदारों के हस्ताक्षर

APPENDIX 8.1.3

INFORMED CONSENT PUNJABI

ਸੂਚਨਾ ਸਹਿਮਤੀ ਫਾਰਮ

ਟਾਈਟਲ

ਗੋਮ ਅਧਾਰਤ ਰਿਹੈਬੀਟੇਸ਼ਨ ਅਤੇ ਮਿਕਸਡ ਸਪੋਰਟ ਟਰੇਨਿੰਗ ਦੇ ਬੈਲਾਂਸ ਉੱਪਰ ਡੈਬਟਿਕ ਨਿਊਰੋਪੈਥੀ ਵਿੱਚ ਤੁਲਨਾ।

ਭਾਗ ਲੈਣ ਲਈ ਸੱਦਾ

ਗੋਮ ਅਧਾਰਤ ਰਿਹੈਬੀਟੇਸ਼ਨ ਅਤੇ ਮਿਕਸਡ ਸਪੋਰਟ ਟਰੇਨਿੰਗ ਦੇ ਬੈਲਾਂਸ ਉੱਪਰ ਡੈਬਟਿਕ ਨਿਊਰੋਪੈਥੀ ਵਿੱਚ ਤੁਲਨਾ ਦੀ ਖੋਜ ਵਿੱਚ ਆਪ ਜੀ ਨੂੰ ਸੱਦਾ ਦਿੱਤਾ ਜਾ ਰਿਹਾ ਹੈ। ਫੇਸਲਾ ਲੈਣ ਤੋਂ ਪਹਿਲਾਂ ਆਪ ਲਈ ਜ਼ਰੂਰੀ ਹੈ ਕਿ ਇਹ ਜਾਣ ਲਓ ਕਿ ਇਹ ਖੋਜ ਕਿਉਂ ਕੀਤੀ ਜਾ ਰਹੀ ਹੈ। ਆਪ ਇਸ ਫਾਰਮ ਨੂੰ ਚੰਗੀ ਤਰ੍ਹਾਂ ਨਾਲ ਪੜ੍ਹ ਲਵੋ ਅਤੇ ਵਿਚਾਰ ਕਰ ਲਓ। ਜੇਕਰ ਆਪ ਇਸ ਸਬੰਧੀ ਮੇਰੇ ਪਾਸੋਂ ਕੋਈ ਜਾਣਕਾਰੀ ਪ੍ਰਾਪਤ ਕਰਨਾ ਚਾਹੁੰਦੇ ਹੋ ਤਾਂ ਆਪ ਜੀ ਦਾ ਬਹੁਤ ਸਵਾਗਤ ਹੈ।

ਵਿਸ਼ੇ ਦੀ ਚੋਣ ਲਈ ਬੁਨਿਆਦ

ਇਸ ਸਟਡੀ ਵਿੱਚ ਆਪ ਜੀ ਨੂੰ ਸੱਦਾ ਦੇਣ ਦਾ ਕਾਰਣ ਇਹ ਹੈ ਕਿ ਆਪ ਇਸ ਵਿਸ਼ੇ ਦੀ ਖੋਜ ਦੇ ਅਧਾਰ ਨਾਲ ਮੇਲ ਖਾਦੇ ਹੋ।

ਖੋਜ ਦਾ ਉਦੇਸ਼

ਇਸ ਖੋਜ ਦਾ ਉਦੇਸ਼ ਗੋਮ ਅਧਾਰਤ ਰਿਹੈਬੀਟੇਸ਼ਨ ਅਤੇ ਮਿਕਸਡ ਸਪੋਰਟ ਟਰੇਨਿੰਗ ਦੇ ਬੈਲਾਂਸ ਉੱਪਰ ਡੈਬਟਿਕ ਨਿਊਰੋਪੈਥੀ ਵਿੱਚ ਤੁਲਨਾ ਕਰਨਾ ਹੈ।

ਵਿਧੀ ਦੀ ਵਿਆਖਿਆ

ਭਾਗੀਦਾਰਾਂ ਨੂੰ ਦੋ ਭਾਗਾਂ ਵਿੱਚ ਵੰਡਿਆ ਜਾਵੇਗਾ:-

ਸਮੂਹ ਓ:- ਗੋਮ ਅਧਾਰਤ ਰਿਹੈਬੀਟੇਸ਼ਨ, ਇਸਦੇ ਵੱਖ ਵੱਖ ਅੰਗ ਹਨ ਜਿਵੇਂ ਕਿ ਵਿਟ ਫਿਟ ਸਿਸਟਮ, ਬੈਲਾਂਸ ਬੋਰਡ, ਲੈਪਟਾਪ. ਭਾਗੀਦਾਰ ਬੈਲਾਂਸ ਬੋਰਡ ਉੱਪਰ ਖੜੇ ਹੋਣਗੇ ਅਤੇ ਖੇਡ ਖੇਡਣਗੇ(ਟੈਨਿਸ, ਗੋਲਫ) ਜੋ ਕਿ ਲੈਪਟਾਮ ਤੇ ਵਿਖਾਈ ਦੇਵੇਗੀ। ਭਾਗੀਦਾਰ ਨੂੰ ਅੱਖਾਂ ਅਤੇ ਕੰਨਾਂ ਦੋਵਾਂ ਰਾਹੀਂ ਸੁਝਾਅ ਖੇਡ ਖੇਡਦੇ ਸਮੇਂ ਮਿਲਦਾ ਰਹੇਗਾ। ਇਹ ਇਲਾਜ ਛੇ ਹਫਤਿਆਂ ਲਈ ਹੈ।

ਸਮੂਹ ਅ:- ਮਿਕਸਡ ਸਪੋਰਟ ਟਰੇਨਿੰਗ, ਇਸ ਨਾਲ ਪੈਰਾਂ ਦੀਆਂ ਮਾਸਪੇਸ਼ੀਆਂ ਦੀ ਕਸਰਤ ਸਿਖਾਈ ਜਾਵੇਗੀ। ਇਹ ਇਲਾਜ ਵੀ ਛੇ ਹਫਤਿਆਂ ਲਈ ਹੋਵੇਗਾ।

ਭਾਗੀਦਾਰ ਓਪਰੇਕਤ ਲਿਖੇ ਹੋਏ ਦੋਵਾਂ ਸਮੂਹਾਂ ਵਿੱਚੋਂ ਕਿਸੇ ਵੀ ਇਕ ਵਿੱਚ ਭਾਗ ਲੈ ਸਕਦੇ ਹਨ।

ਸੰਭਾਵੀ ਖਤਰੇ ਅਤੇ ਬੇਅਰਾਮੀ:- ਇਸ ਇਲਾਜ ਦੇ ਦੌਰਾਨ ਆਪ ਨੂੰ ਕੁੱਝ ਬੇਅਰਾਮੀ ਮਹਿਸੂਸ ਹੋ ਸਕਦੀ ਹੈ, ਜਿਵੇਂ ਕਿ ਬੈਲਾਂਸ ਬਣਾਉਣ ਵਿੱਚ ਪਰੇਸ਼ਾਨੀ ਆ ਸਕਦੀ ਹੈ। ਜੇਕਰ ਆਪ ਨੂੰ ਕਿਸੇ ਸਮੇਂ ਵੀ ਮਹਿਸੂਸ ਹੋਵੇ ਕਿ ਆਪ ਇਹ ਇਲਾਜ ਨਹੀਂ ਕਰਵਾਉਣਾ ਚਾਹੁੰਦੇ ਤਾਂ ਆਪ ਖੋਜਕਰਤਾ ਨੂੰ ਦੱਸ ਕੇ ਇਲਾਜ ਛੱਡ ਸਕਦੇ ਹੋ।

ਸੰਭਾਵੀ ਲਾਭ:- ਇਸ ਇਲਾਜ ਤੋਂ ਬਾਅਦ ਆਪ ਦਾ ਬੈਲਾਂਸ ਠੀਕ ਹੋ ਜਾਵੇਗਾ ਅਤੇ ਆਪ ਵਿੱਚ ਆਤਮ ਵਿਸ਼ਵਾਸ ਵੀ ਆਵੇਗਾ। ਇਸ ਤੋਂ ਬਾਅਦ ਆਪ ਘਰ ਤੋਂ ਬਾਹਰ ਬਿਨਾਂ ਡਿਗਣ ਦੇ ਡਰ ਤੋਂ ਜਾ ਕੇ ਆਪਣੀ ਰੋਜ਼ਾਨਾ ਰੁਟੀਨ ਦੇ ਕੰਮ ਕਰ ਸਕਦੇ ਹੋ।

ਗੁਪਤਤਾ ਦੀ ਵਚਨਬੱਧਤਾ:- ਆਪ ਪਾਸੋਂ ਜੋ ਵੀ ਸੂਚਨਾ ਲਈ ਗਈ ਹੈ। ਉਹ ਕਿਸੇ ਨਾਲ ਵੀ ਸਾਂਝੀ ਨਹੀਂ ਕੀਤੀ ਜਾਵੇਗੀ। ਕੇਵਲ ਖੋਜਕਰਤਾ ਹੀ ਉਸਨੂੰ ਦੇਖ ਸਕਦਾ ਹੈ।

ਹੋਰ ਜਾਣਕਾਰੀ ਲਈ ਬੇਨਤੀ

ਜੇਕਰ ਆਪ ਕੋਈ ਹੋਰ ਪ੍ਰਸ਼ਨ ਪੁੱਛਣਾ ਚਾਹੁੰਦੇ ਹੋ ਤਾਂ ਆਪ ਖੋਜਕਰਤਾ ਪਾਸੋਂ ਪੁੱਛ ਸਕਦੇ ਹੋ।

ਇਲਾਜ ਚੱਡਣ ਲਈ ਬੇਨਤੀ

ਇਸ ਇਲਾਜ ਵਿੱਚ ਆਪ ਦੀ ਭਾਗੀਦਾਰੀ ਆਪ ਦੀ ਇੱਛਾ ਉੱਤੇ ਨਿਰਭਰ ਹੈ। ਆਪ ਜੇਕਰ ਭਾਗੀਦਾਰੀ ਕਰਨਾ ਚਾਹੁੰਦੇ ਹੋ ਜਾਂ ਨਹੀਂ ਤਾਂ ਇਸਦਾ ਆਪਦੇ ਅਤੇ ਖੋਜਕਰਤਾ ਦੇ ਰਿਸ਼ਤੇ ਤੇ ਕੋਈ ਫਰਕ ਨਹੀਂ ਪਵੇਗਾ। ਆਪ ਜਦੋਂ ਚਾਹੋ ਇਹ ਇਲਾਜ ਚੱਡ ਸਕਦੇ ਹੋ।

ਮੁੱਖ ਜਾਂਚਕਰਤਾ

ਨਾਮ: ਸਨੇਹੀ ਪਾਂਡੇ

ਮਾਸਟਰ ਆਫ ਫਿਜ਼ਿਓਥੈਰੇਪੀ (ਨਿਉਰੋਲੋਜੀ)

ਪਤਾ: ਡਿਪਾਰਟਮੈਂਟ ਆਫ ਫਿਜ਼ਿਓਥੈਰੇਪੀ

ਲਵਲੀ ਪ੍ਰੋਫੈਸ਼ਨਲ ਯੂਨੀਵਰਸਿਟੀ

ਫਗਵਾੜਾ, ਪੰਜਾਬ

ਸੰਪਰਕ ਨੰ:

ਮੈਂ ਇਸ ਖੋਜ ਵਿੱਚ ਸ਼ਾਮਲ ਹੋਣ ਲਈ ਸਹਿਮਤ ਹਾਂ। ਮੈਂ ਉਪਰ ਦਰਸਾਈ ਸਾਰੀ ਸੂਚਨਾ ਚੰਗੀ ਤਰ੍ਹਾਂ ਪੜ੍ਹ ਲਈ ਹੈ। ਮੇਰੇ ਸਾਰੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਜਵਾਬ ਦੇ ਦਿੱਤੇ ਗਏ ਹਨ ਅਤੇ ਉਹਨਾਂ ਜਵਾਬਾਂ ਤੋਂ ਸੰਤੁਸ਼ਟ ਹਾਂ। ਮੈਨੂੰ ਸਹਿਮਤੀ ਫਾਰਮ ਦੀ ਕਾਪੀ ਮਿਲ ਗਈ ਹੈ।

ਜਾਂਚਕਰਤਾ ਦੇ ਹਸਤਾਖਰ

ਭਾਗੀਦਾਰ ਦੇ ਹਸਤਾਖਰ

APPENDIX 8.2 ASSESSMENT FORM

NAME:

Age :

Gender:

Occupation:

Address:

Chief complaint:

History of present illness :

Past medical history:

H/o of diabetes mellitus-yes /no years on DM

Medical history:

Type I or Type II dm –

Whether on regular medication- yes or no

Insulin dependent-yes /no

Family history:

On observation:

Tropical changes :

Deformity:

External appliances

On examination-

Sensory examination-

Sensory system

Location	Upper Extremity		Lower Extremity	
	RT	LT	RT	LT
Superficial				
Pain				
Temperature				
Light Touch				
Pressure				
Deep Sensation				
Movement Sense				

Position				
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Muscle power

	Muscles	RT	LT
H	Flexor		
	Extensor		
I	Abductor		
	Adductor		
P	Int-Rotator		
	Ext-Rotator		

K N E E	Flexor		
	Extensor		
A N K L E	Dorsi -Flexor		
	Planter-Flexor		

Muscle Girth

Area	RT (cms)	LT(cms)
Thigh		
Calf		

Reflexes:

Jerks	RT	LT
Knee		
Ankle		

Balance:

Clinical testing of sensory integration of balance-

Provisional diagnosis:

Assesment tools:

Berg balance scale			Neuroqol			
	Pre-test	Mid – test	Post – test	Pre-test	Mid – test	Post-test

APPENDIX 8.3.1 BERG BALANCE SCALE

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 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 supervision
- () 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

Berg Balance Scale continued...

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.

(Examiner may 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)

APPENDIX8.3.2

Neuropathy and Foot Ulcer Specific Quality Of Life Questionnaire, Neuroqol

Subject code:

PHYSICAL SYMPTOMS		Never	Rarely	sometimes	often	Always
	PAIN	1	2	3	4	5
1	Burning in your foot or leg					
2	Excessive heat or cold in your leg or feet					
3	Pins and needles in your leg or feet					
4	Shooting or stabbing pain your legs or feet					
5	Throbbing in your legs or feet					
6	Sensation in your leg and feet that make them jump					
7	Irritation of the skin caused by something touching your feet					
	REDUCED FEELING					
1	Numbness in your feet					
2	Inability to feel the difference between hot and cold with you feet					
3	Inability to feel object with your feet					
	UNSTEADINESS					
1	Weakness in your hands					
2	Problems with balance or unsteadiness while standing					
3	Problem with balance or unsteadiness while walking					

PSYCHOSOCIAL SYMPTOMS						
Activity limitation						
1	Foot problem interfere with					
2	Ability to perform paid work					
3	Ability to perform daily task					
4	Ability to take part in leisure activities					
Interpersonal And Emotional Burden						
1	Foot problem interface with close relationships close relationship					
	As a result of foot problems					
2	Your self confidence has been effected					
3	You feel older than your years					
4	Your life is a struggle					
5	You feel frusteded					
6	You feel embarrassed					
7	You feel depressed					
8	You feel more physically dependent					
9	You feel more emotionally dependent					
10	Your role in family changed					
11	You are treated differently					
		Poor	Fair	Good	Very good	Excellent
		1	2	3	4	5
	Overall would rate my quality of life as					

APPENDIX 8.4

DATA COLLECTION FORM

Date..... Patient's code Group..... Serial no.....

Name:

Age:

Gender:

Occupation:

Address:

Contact no:

Diagnosis:

1. BALANCE MEASURED BBS

Parameters	Pre-reading	Mid -reading	Post -reading
Balance			

2. TENDERNESS MEASURED BY NEURO-QOL

Parameters	Pre-reading	Mid -reading	Post-reading
Quality of life			

APPENDIX8.5

MASTER CHART

GROUP A Game Based Rehabilitation Group	Berg Balance Score			Neuroqol		
	Pre	Mid	Post	Pre	Mid	Post
AA101	29	30	36	94	92	82
AA102	31	31	37	84	81	68
AA103	30	31	40	93	90	77
AA104	23	23	32	98	97	83
AA105	28	31	37	98	94	77
AA106	28	29	36	97	91	77
AA107	29	31	35	102	99	81
AA108	25	27	36	107	104	83
AA109	29	29	35	98	96	81
AA110	26	28	33	87	83	70
GROUP B Mixed Sport Training Group	Berg Balance Score			Neuroqol		
Code	Pre	Mid	Post	Pre	Mid	Post
BB101	29	30	32	85	84	70
BB102	21	22	28	103	102	92
BB103	28	30	36	91	89	76
BB104	29	33	36	89	83	72
BB105	29	29	35	84	83	69
BB106	23	25	30	101	99	86
BB107	30	30	35	80	78	72
BB108	22	25	32	111	102	97
BB109	30	32	33	98	93	84
BB110	30	30	37	95	91	81

APPENDIX 4.6

BASELINE CHARACTERISTICS MASTER CHART

Group A						Group B					
S.N.	Age	Gender	BBS	Neuro-Qol	Years of neuropathy	S.N.	Age	Gender	BBS	Neuro-Qol	Years of neuropathy
A1	50yr	F	29	94	3yr	B1	60yr	F	29	85	5/2yr
A2	49yr	M	31	84	5/2yr	B2	50yr	F	21	103	5yr
A3	50yr	M	30	93	2yr	B3	60yr	F	28	91	4yr
A4	55yr	F	23	98	5yr	B4	58yr	M	29	89	4yr
A5	53yr	F	28	98	3yr	B5	60yr	F	29	84	2yr
A6	49yr	F	28	97	5yr	B6	52yr	F	23	101	3yr
A7	57yr	M	29	102	4yr	B7	55yr	F	30	80	3yr
A8	53yr	M	25	107	5yr	B8	60yr	F	22	111	5yr
A9	50yr	M	29	98	3yr	B9	52yr	F	30	98	4yr
A10	59yr	M	26	87	7yr	B10	56yr	M	30	95	2yr

APPENDIX 8.7

TREATMENT PROTOCOL

	Group A - Game Based Rehabilitation	
Games	Tennis	
	Backhand ,forehand shots	15 minutes
	Golf	
	Putter,wedge,iron shots	15 minutes
	Group B Mixed Sport Group	
Balance training	First three weeks	
	Stance on toes	10 repetition , 15 second hold 5 second rest for each repetition, 2-minute rest after each 5 repetition.
	Tandem stance	
	One leg stance	
	Last three weeks protocol(exercise on uneven surface)	
	Stance on toes	10repetition 5 second rest for each repetition, 2-minute rest after each 5 repetition.
	Tandem stance	
	One leg stance	
Functional and endurance training		

	Sitting to standing	10 repetitions, 1 minute rest after 5 repetitions.
	Stair climbing	10 times, 5 stair up-down, 2 minutes rest after 5 repetitions.
	Obstacle crossing	5 minutes

ABSTRACT

COMPARISON OF GAME BASED REHABILITATION AND MIXED SPORT TRAINING ON BALANCE IN DIABETIC NEUROPATHY

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Background- Somatosensory system is a major contributing factor for balance in human beings. In diabetic neuropathy somatosensory deficits is responsible for balance impairment and that will affects quality of life. Game based rehabilitation and mixed sport training improves balance and quality of life but lack of evidence to support which one is best method.

Objective: To compare the effect of game based rehabilitation and mixed sport training on balance and quality of life in diabetic neuropathy.

Study design: Experimental design - Pre and post test with comparison group.

Setting: Tagore hospital and Rattan hospital Jalandhar and participant's home.

Participants: 20 Subjects were participated based on the inclusion criteria.

Measurements: Berg balance scale used for balance assessment and Neuro-QOL for evaluation of quality of life.

Intervention: 20 Subjects equally divided in to group A and group B. Participants in group A and group B received game based rehabilitation and mixed sport training respectively for six weeks .

Result: Analysis with paired T test revealed significant improvement for group A and B for BBS score ($P < 0.001$), (<0.001) respectively. Quality of life also for both groups significant improvement ($p < 0.001$), ($p < 0.0013$). Independent T test used to evaluate between group difference. Statistically no significant difference found between group A and group B for BBS($p < 0.623$) and neuro-qol($p < 0.5747$).

Conclusion –This study concluded that Game based rehabilitation and mixed sport training are effective in improving balance and quality of life.

Keywords –Balance, Diabetic neuropathy, Game based rehabilitation, Mixed sport training.