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EFFECTIVENESS OF FRENKEL EXERCISE ON BALANCE AMONG PATIENTS WITH TYPE 2 DIABETIC NEUROPATHY IN MEDICAL WARD

Dr. Karpagam. K [1]* and Helen Vinitha. A [2]

[1] Assistant Professor, Saveetha College of Nursing, SIMATS,
Chennai, Tamilnadu, India. *Corresponding Author Email: karpagaraja1982@gmail.com
[2] Nurse Practitioner in Critical Care, Saveetha Medical College and Hospital.

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Abstract

Background: The most prevalent problem for type 2 diabetes outpatients is diabetic neuropathy, which is followed by hypertension (223%), neuropathy (184%), nephropathy (160%), diabetic retinopathy (125%), and neuropathy with imbalance (21.5%). diabetes patients also frequently experience other complications. Patients with type 2 diabetic neuropathy who have balance issues receive treatment with Frenkel's exercises. The purpose of this study is to determine whether type 2 diabetic neuropathy patients' balance is affected by Frenkel Exercise. In this work, the quasi experimental design was used. There were 60 total samples chosen using the MNSI. Additionally, the samples that met the requirements for inclusion were picked using the convenience sampling method. After that, the group was divided into experimental (n=30) and control (n=30) groups. The patients' demographic data was collected, and their balance was tested using the One leg stands Test (OLST) as a pre-test. The experimental group was given the Frenkel Exercise once a day for 5 days, up to 55 minutes. The exercise was provided for a period of three weeks. Only Regular therapy was given to the control group. After 3 weeks, samples were examined using the One leg stands Test (OLST) as a post-test. Descriptive and inferential statistics were used to analyse the data. There is a significant difference in the frequency and distribution of pre and post-test balance between experimental and control groups at p <0.001. According to this study, Frenkel exercise can help people with type 2 diabetic neuropathy improve their balance. The OLST was used as a pre-test to assess the patients' balance while also gathering demographic information about them. For five days, the Frenkel Exercise was administered to the experimental group once daily for up to 55 minutes. For three weeks, the exercise was made available. The control group received nothing but standard therapy. The OLST was used as a post-test to evaluate samples after 3 weeks. The data were analyzed using descriptive and inferential statistics. P 0.001 indicates a significant difference between the experimental and control groups in the frequency and distribution of pre- and post-test balancing. This study found that Frenkel exercise could assist persons with type 2 diabetic neuropathy gain better balance.

Keywords: Frenkel Exercise, Type 2 Diabetic Neuropathy, Michigan Neuropathy Screening Test, One Leg Stance Test.

INTRODUCTION

In the twenty-first century, diabetes has emerged as one of the most important global health problems. The number of diabetics is projected to triple between 2000 and 2030, reaching 366 million, the pandemic level. With a lifetime frequency of almost 50%, diabetic polyneuropathy (DPN) is the most common diabetic complication. DPN is a major contributor to disability because of gait instability, foot ulceration and amputation, and harm from falls. In 20 to 30 percent of DPN patients, neuropathic pain impairs their ability to balance [1]. With 285 million people predicted to have the condition in 2018, up from about 30 million in 2000, diabetes prevalence rates have climbed dramatically over the past 50 years, concurrently with obesity. [The American Diabetes Association]. As a result of conditions like Alzheimer's and vascular dementia, it has also been linked to an increased risk of dementia and cognitive decline. Exercises that increase the flow of blood, oxygen, and glucose to the

mitochondria, such as those that enhance balance and strength, as well as aerobic exercise, may make mitochondria more effective in producing energy. The reduction of neuropathic symptoms, enhanced strength and balance, and improved quality of life may be brought about by increased mitochondrial energy synthesis and peripheral nerve blood flow. According to the study, complications are common among type 2 diabetes outpatients. The most prevalent are diabetic foot (223%), hypertension (223%), neuropathy (184%), nephropathy (160%), and diabetic retinopathy (125%). 21.5 percent.

Additionally, it has been linked to an increased risk of dementia and cognitive decline brought on by conditions including Alzheimer's and vascular dementia. Exercises that increase the flow of blood, oxygen, and glucose to the mitochondria, like those that strengthen the body and promote balance, as well as aerobic exercise, may enable mitochondria to produce energy more effectively. Less neuropathic symptoms, better strength and balance, and a higher quality of life may be brought on by increased peripheral nerve blood flow and mitochondrial energy synthesis. According to the study, complications are frequent in type 2 diabetes outpatients, with diabetic foot complications being the most prevalent. Hypertension (223%), neuropathy (184%), nephropathy (160%), and diabetic retinopathy (125%) were all common. 21.5 %.

Examples of diabetes consequences include diabetic coma, diabetic cardiomyopathy, diabetic foot ulcers, diabetic ketoacidosis, hyperglycemia, and hypoglycemia. Neurological deterioration, which causes balance issues in diabetics, occurs in their bodies. Elderly people with diabetes-related diabetic neuropathy typically experience balance issues, and this condition is associated with an increased risk of falling [3]. Diabetes problems such as retinopathy, diabetic neuropathy, and peripheral neuropathy have all been associated with unsteady gait and accidents. The symptoms are dependent on the kind of nerve injury and which nerves are affected. For effective posture control, the vestibular, visual, and somatosensory systems must be coordinated spatiotemporally.

The chance of older people falling increases when one or more of these systems are damaged. A lack of balance may result from diabetic neuropathy, which can impair nerve conduction velocity, cause axonal degeneration, and delay reflex reaction time [4]. Patients with diabetic neuropathy showed worse stability readings in all balance indices than non-disabled adults, according to (Aly et al). They also demonstrated how these patients' equilibrium might be improved by applying visual cues. According to the study by (Emam et al.), diabetes patients with neuropathy demonstrated considerably worse balance skills than diabetic individuals without neuropathy. By raising the oxygen pressure in diabetic patients' lower limbs, skin, and chests, exercise therapy, which includes balance exercises, improves cutaneous blood flow.

Group exercise therapy can help seniors gain better balance and reduce their risk of falling. Patients with diabetic neuropathy may experience improved balance as a result of mechanoreceptor stimulation in the brain during standing tasks when there are variations in tension and pressure on the soles of the feet [3]. Patients with diabetic neuropathy may benefit from Frenkel's exercises as a sort of treatment to increase their level of balance. As was already mentioned, Heinrich Frenkel's exercise is a proprioception and balance exercise designed for people with diabetic ataxia. Exercises by Frenkel started with some support and advanced until the patients no longer needed it. Patients who were unable to complete the exercise due to insufficient

muscle strength were excluded. Patients with diabetic neuropathy who have poor sensory function were anticipated to benefit from Frenkel's exercise because it retrains proprioception and balance with an emphasis on the lower limbs [5]. The most frequent reason for falls in those with neuropathy is a loss of balance, which eventually happens. To compare different techniques for enhancing balance in diabetes patients, however, there are not enough data. In this investigation, individuals with type II diabetes who had diabetic peripheral neuropathy were evaluated for their responses to two therapeutic interventions on clinical balance criteria [6]. Balance exercises (Frenkel) both with and without aerobic workouts are effective in patients.

Patients initially needed some assistance, but as Frenkel's exercises advanced, they no longer did. Balance exercises (Frenkel) reveal considerable improvements in diabetic neuropathy patients when compared to aerobic activities [7]. Somatic sensory impairment has become the most important issue in diabetic peripheral neuropathy. Balancing and somatosensory stimulation are exercises that strengthen balance and somatosensory reactions. The somatosensory response following the practice of balance exercises and somatosensory stimulation, however, cannot be measured due to a lack of information. This study's objective is to determine how balance training and somatosensory stimulation impact somatosensory responsiveness in individuals with diabetic peripheral neuropathy [8]. Despite the fact that diabetics are advised to exercise, nothing is known about how exercise affects those with DPN. This was a pilot study involving just one group. It happened in an academic medical facility. People with type 2 diabetes who also showed signs of neuropathy and were interested in taking part in the study were interviewed. They ranged in age from 40 to 70 [9].

MATERIALS AND METHODS

The main study was conducted after receiving approval from the Institutional Ethical Committee (IEC) and formal authorization from the Medical Superintendent and Departmental Head of Medicine at Saveetha Medical College and Hospitals (SMCH) SIMATS. The degree of balance among type 2 diabetic neuropathy patients was measured using a quasi-experimental method. The Michigan Neuropathy Screening Instrument was used to choose 60 samples in total. In addition, convenience sampling was used to choose the samples that matched the inclusion requirements. Investigator gave samples a brief explanation of the study's goal. A signed informed consent was obtained from each sample after a patient information document in their native tongue was given and any questions were answered.

The study was conducted in accordance with ethical standards to safeguard the rights of the samples, and confidentiality was maintained throughout. Safety was also taken into consideration. Following that, the group was split into an experimental group (n=30) and a control group (n=30). From the medical ward, both groups were chosen. After that, patients' demographic information was gathered. Using Michigan neuropathy screening tools, the researcher evaluated the diabetic neuropathy, and demographic data were collected from samples, including age in years, gender, marital status, dietary pattern, BMI, duration of type 2 diabetes mellitus, occurrence of diabetic neuropathy previously, duration of diabetic neuropathy, treatment previously received for diabetic neuropathy, and any exercises previously practiced for the condition.

The one leg stance test was then used to gauge the degree of balance. The MNSI includes the way feet look, ulceration, ankle reflexes, and vibration perception. Poor, fair, medium, good, excellent, extraordinary, and astounding are the results of the one-legged stance test. Research professionals evaluated each tool's content validity. The tools' dependability was also examined in a prior study. Six patients with type 2 diabetic neuropathy served as the initial data. These diabetic neuropathy individuals were excluded from the primary investigation. It was completed in around 6 days. With the fast collection of data, participant outcomes were interpreted.

Ethıcal statement:

The Saveetha Institute of Medical and Technical Science Thandalam Chennai's research unit committee granted ethical permission for this study on April 9th, 2021, with approval number-059/04/2021/IRB-HS/SIMATS. Each participant signed their informed permission prior to the trial. The researchers provided a detailed explanation of the goals of the study and their nature. The study was conducted in accordance with ethical standards to safeguard the rights of the samples, to ensure their safety throughout, and to retain their secrecy. Additionally, the investigators were the only ones who had access to the collected data. Additionally, everyone who took part in the study had the freedom to leave at any time and without consequence.

RESULT

The experimental group's one-legged posture test had a mean pre-test score of 6.30 1.18 and a mean post-test score of 11.03 1.81. There was a 4.73 average difference score. At P 0.001, it was determined that the estimated paired "t" test value of 11.481 was statistically significant. The control group's one-leg stance test had a mean score of 6.43 1.45 on the pretest and a mean score of 8.67 2.11 on the posttest. It was 2.23 on average for differences. The estimated paired 't' test result of 6.357 was determined to be statistically significant at p 0.001.

Statistical analysis

The statistical analysis was performed using the SPSS program version 20. In addition to frequency and percentages, standard deviation, and mean were used to present the variables. The outcome criteria for the study groups were compared using the chi-square test and the paired 't' test to see if there was a statistically significant difference. P-value for statistically significant criteria was fixed at 0.001.

The information gathered was placed into an excel sheet, tallied, and statistically evaluated. The mean, standard deviation, chi square, and paired 't' test were among the statistical metrics used.

Section A: Frequency and percentage distribution of pre-test level of one leg stance test among patients with type 2 diabetic neuropathy between the experimental and control group.

Table 1: Frequency and percentage distribution of pre-test level of one leg stance test among patients with type 2 diabetic neuropathy between the experimental and control group.

N = 60(30+30)

One Leg Stance Test	Pretest		Post Test		Chi-Square Test Value
	No.	%	No.	%	
Poor (<8)	26	86.7	0	0	X^2=46.560 P = 0.0001 S***
Fair (8 – 12)	4	13.3	21	70.0	
Good (12 – 16)	0	0	9	30.0	
Excellent (>16)	-	-	-	-	

***p<0.001, S – Significant

The table 1 shows that in the experimental group, 19(63.3%) were aged above 50 years, 16(53.3%) were female, 30(100%) were married, 20(66.7%) were nonvegetarian, 10(33.3%) had a BMI of 27 – 30,19(63.3%) had type 2 diabetes mellitus of 10 –15 years, 25(83.3%) had no diabetic neuropathy previously, 25(83.3%) had had diabetic neuropathy for more than 8 hours, 27(90%) had not taken any treatment for diabetic neuropathy previously and 30(100%) had not practiced any exercises. In the control group, 14(46.7%) were aged above 50 years, 18(60%) were male, 24(80%) were married, 23(76.7%) were nonvegetarian, 9(30%) had a BMI of 27 – 30, 12(40%) had type 2 diabetes mellitus of 10 – 15 years, 25(83.3%) had no diabetic neuropathy previously, 24(80%) had had diabetic neuropathy for more than 8 hours, 25(83.3%) had not taken any treatment for diabetic neuropathy previously and 30(100%) had not practiced any exercises.

Section B: Comparison of pre-test and post-test level of one leg stance test among patients with type 2 diabetes mellitus in the experimental group.

Table 2: Comparison of pre-test and post-test level of one leg stance test among patients with type 2 diabetes mellitus in the experimental group.

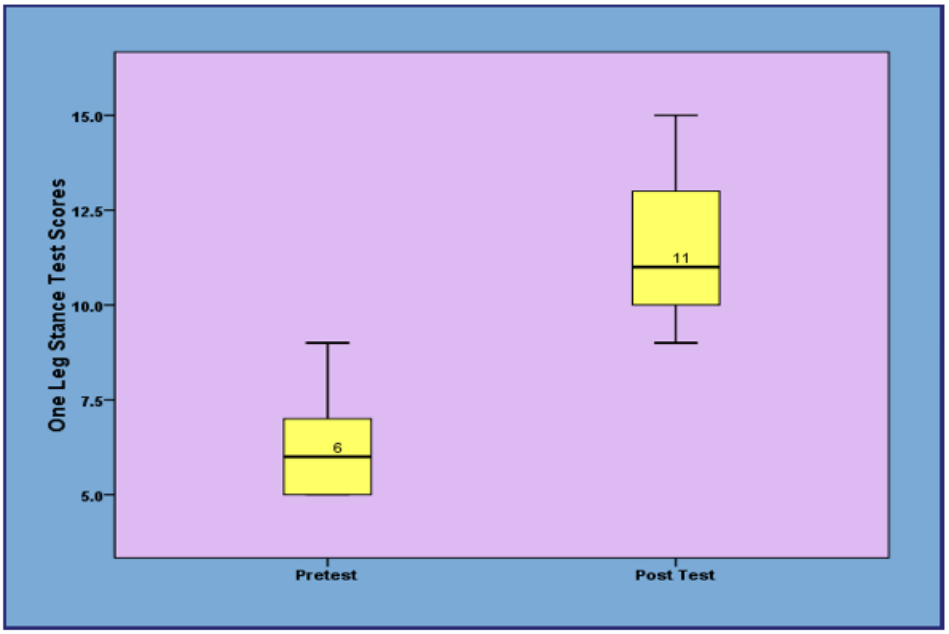
N = 30

One Leg Stance Test	Mean	S. D	Mean Difference Score	Paired 't' test Value
Pretest	6.30	1.18	4.73	t=11.481 p=0.0001, S***
Post Test	11.03	1.81		

***p<0.001, S – Significant

The table 2 depicts that in the pre-test mean score of one leg stance test in the experimental group was 6.30±1.18 test and the post-test mean score was and the post-test mean score was 11.03±1.81.

The mean difference score was 4.73. The calculated paired 't' test value of 11.481 was found to be statistically significant at P <0.001.



Section C: Comparison of pre-test and post-test level of one leg stance test among patients with type 2 diabetes mellitus in the control group.

Table 3: Comparison of pre-test and post-test level of one leg stance test among patients with type 2 diabetes mellitus in the control group.

N= 30

One Leg Stance Test	Mean	S. D	Mean Difference Score	Paired 't' test Value
Pretest	6.43	1.45	2.23	**t=6.357**
Post Test	8.67	2.11		**p=0.0001, S*** **

*** p < 0.0001, Significant.

The table 3 depicts that in the pretest mean score of one leg stance test in the control group was 6.43±1.45 and the posttest mean score was 8.67±2.11. The mean difference score was 2.23. The calculated paired 't' test value of 6.357 was found to be statistically significant at p <0.001.

The present study supported by Nida Kiani et al (2018) The finding of the study was balance exercises (Frenkel) shows marked improvements in balance of diabetic neuropathic patients as compared to Aerobic Exercises.

Section D: Association of post-test level of one leg stance among patients with type 2 diabetic neuropathy with their selected demographic variables in the experimental group.

Table 4: Association of post-test level of one leg stance among patients with type 2 diabetic neuropathy with their selected demographic variables in the experimental group.

N= 30

Demographic Variables	Fair (8 – 12)		Good (12 – 16)		Chi-Square Test Value
	No.	%	No.	%	
Age					
35 – 40 years	3	10.0	2	6.7	X^2=0.393 d.f=3 p=0.942 N. S
41 – 45 years	2	6.7	1	3.3	
46 – 50 years	2	6.7	1	3.3	
Above 50 years	14	46.7	5	16.7	
Gender					X^2=0.408 d.f=1 p=0.523 N. S
Male	9	30.0	5	16.7	
Female	12	40.0	4	13.3	
Marital status					
Married	21	70.0	9	30.0	-
Unmarried	-	-	-	-	
Dietary pattern					X^2=0.714 d.f=1 p=0.398 N. S
Vegetarian	8	26.7	2	6.7	
Non-vegetarian	13	43.3	7	23.3	
BMI					**X^2=11.270 d.f=3 p=0.010 S***
18 – 21	1	3.3	5	16.7	
21 – 24	6	20.0	0	0	
24 – 27	6	20.0	2	6.7	
27 – 30	8	26.7	2	6.7	
Duration of type 2 diabetes Mellitus					X^2=3.567 d.f=3 p=0.312 N. S
Below 10 years	3	10.0	2	6.7	
10 – 15 years	14	46.7	5	16.7	
15 – 16 years	1	3.3	2	6.7	
More than 16 years	3	10.0	0	0	
Have you had diabetic neuropathy previously?					X^2=0.286 d.f=1 p=0.593 N. S
Yes	3	10.0	2	6.7	
No	18	60.0	7	23.3	
If yes, how long are you having diabetic neuropathy?					X^2=0.444 d.f=2 p=0.801 N. S
Less than 1 year	1	3.3	1	3.3	
2 – 5 years	2	6.7	1	3.3	
5 – 8 years	-	-	-	-	
More than 8 hours	18	60.0	7	23.3	
Have you taken any treatment for diabetic neuropathy previously?					X^2=0.018 d.f=1 p=0.894 N. S
Yes	2	6.7	1	3.3	
No	19	63.3	8	26.7	
Have you practiced any of the exercises mentioned below previously for improving your diabetic neuropathy?					-
Swiss ball exercises	-	-	-	-	
Burger Allen exercises	-	-	-	-	
Frenkel exercises	-	-	-	-	
None of the above	21	70.0	9	30.0	

**p<0.01, S – Significant, N.S – Not Significant

The table 4 shows that the demographic variable BMI (x 2=11.270, p=0.010) had shown statistically significant association with post- test level of balance among patients with type2 diabetic neuropathy in the experimental group at p<0.05 level. The other demographic variables had not shown statistically significant association with post-test level of trunk control among patients with type 2 diabetic neuropathy in the experimental group. The current study supported by **Zahra Rojhani Shirazi et al (2020)** therapeutic exercise programs significantly improved balance in single leg stance, star excursion test, and Berg balance scale test (P<0.05) compared to the control group. Besides, this was more significant in the Frenkel training group (P<0.05).

DISCUSSION

The study's major objective was to ascertain how Frenkel exercise affected patients with type 2 diabetic neuropathy. The convenience sampling technique was used to choose 60 samples, of which 30 were used to create an experimental group and 30 were used to create a control group.According to Table 2, the experimental group's one-leg stance test had a mean pre-test score of 6.30 1.18 and a mean post-test score of 11.03 1.81 for the same test. 4.73 was the average difference score. P(0.001) statistical significance was obtained for the estimated paired 't' test value of 11.481.In order to examine the effects of two therapeutic activities on clinical balance measurements in patients with type II diabetic peripheral neuropathy, Zahra Rojhani Shirazi (2020) funded this study. As a consequence of this study, balance in single leg stance was considerably improved by both types of therapeutic exercise regimens. But the Frenkel training group's degree of balance was more significant (P 0.05). According to this study's findings, Frenkel training is preferable to Swiss ball exercise for improving balance in diabetic neuropathy. Shamshiya, C. P. (2011) Effectiveness of Experimental Group (Balance Exercise with Medical Treatment) provided funding for this study. The Paired' test was used to compare the pre-test and post-test values of the experimental group, and the results show that there was a significant difference between the two. The post-test mean value is higher than the pre-test when comparing the two mean values. Therefore, it is confirmed that the post-test experimental group significantly improved over the pre-test experimental group. According to the study's findings, balance exercises may help people with diabetic neuropathy maintain better balance and experience fewer falls overall.

CONCLUSION:

According to this study, Frenkel exercise can help patients with type 2 diabetic neuropathy in the medical ward balance levels. It aids in reducing problems and shortening hospital stays.**Limitation of the study**

- ✓ The study will be limited to a period of one month.
- ✓ The study findings are limited to only diabetic neuropathy patient with age group of above 35 years.

Author's Contribution: All authors contributed equally to the manuscript.

Conflict of Interest: The authors declare no conflict of interest.

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