INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD ISSN: 2455-0620 Volume - 6, Issue - 12, Dec – 2020
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value: 86.87 Impact Factor: 6.719
Received Date: 16/12/2020 Acceptance Date: 28/12/2020 Publication Date: 31/12/2020

Effect of fixed and variable priority dual task training on balance in diabetic polyneuropathy

[1]Sharma Anita, [2]Sharma Deepti, [3]Bhattacharya Ujwal

[1]Assistant Professor, Department of Physiotherapy, College of Physiotherapy and Medical Sciences, Guwahati, India
[2]Associate Professor, Department of Physiotherapy, Manav Rachna International University, Faridabad, India
[3]Associate Professor, Department of Physiotherapy, The Assam Royal Global University, Guwahati, India
Email – [1]dr.anu16@gmail.com, [2]deeptidubey80@gmail.com, [3]ujwalbhatta@gmail.com

Abstract: *Diabetic neuropathy (DN) is a complex set of clinical syndromes that affect distinct regions of nervous system, either singly or combined. Depending on criteria, Diabetic Polyneuropathy (DPN) is estimated to occur in 50-90% of individuals with diabetes for more than 10 years. Researchers found that people with diabetic and peripheral neuropathy have a high incidence of injuries during walking or standing and a low level of perceived safety. There are few studies done to examine the gait parameters of those with DPN, during free walking and walking whilst verbally responding to an auditory signal but dual task paradigms have not been studied to any extent in those with diabetes. This study would tell us how the prioritization of task affects balance in diabetic polyneuropathy.*

Keywords: *Diabetic neuropathy, Diabetic Polyneuropathy, Single task, Dual task, Fixed Priority instructional set training, Variable Priority instructional set training, Berg Balance Scale, Timed up & Go Test, Activities specific balance confidence scale.*

1. INTRODUCTION:

American diabetes association (2008) defined, Diabetes mellitus as a group of metabolic disorder characterized by the presence of hyperglycaemia due to defective insulin secretion, defective insulin action or both. The chronic hyperglycaemia of diabetes is associated with significant long-term sequelae, particularly damage, dysfunction and failure of various system of the body[1]. Diabetic neuropathy is a set of clinical syndromes that affect distinct regions of nervous system, either single or combined. Distal symmetric polyneuropathy, the most common form of diabetic neuropathy, usually involves nerve fibres of different diameters. Small nerve fibre neuropathies occur early and are often present without objective signs or electro physiologic evidence of nerve damage. The greater risk is foot ulceration and subsequent gangrene. Large nerve fibre neuropathies, which involve the sensory and motor nerve are generally neuropathy of signs rather than symptoms. Clinical presentation usually includes a “glove and stocking” distribution of sensory loss and the greatest risk is Charcot’s neuroarthropathy[2]. Some studies reviewed in 2004 that diabetic neuropathy is a heterogeneous disorder that encompasses a wide range of abnormalities affecting proximal and distal peripheral sensory and motor nerves as well as the autonomic nervous system. Depending on criteria DPN is estimated to occur in 50%-90% of individuals with diabetes for more than 10 years. The impairment of peripheral nerve function in diabetic individuals should be regarded not as a neurological complication but as a neurological manifestation of the disease. It may present as symmetric polyneuropathies, focal and multifocal neuropathies and mixed form of neuropathy[3]. Various studies showed that people with diabetes and peripheral neuropathy have a high incidence of injuries during walking or standing and a low level of perceived safety[4]. Some studies investigated dual task training using two non-balance cognitive task which showed training related improvements in dual task performance[5]. Several authors suggested that many falls in older individuals with balance impairments occur not during normal walking condition but rather when they are walking and simultaneously performing a secondary task such as talking, manipulating an object. It means dual task activity challenges the balance in elders[6].

Dual task paradigms are used to study the degree of automaticity of movement. In this paradigms are primary task undertaken, often walking, which is the main focus of attention. Secondary task are added and the resulted effect on both task is examined[7, 8]. If the two or more task are undertaken together exceed the available attentional capacity then there will be insufficient capacity to perform both tasks optimally and the performance of either or both tasks will deteriorate[9]. In 2004 studies suggested that older people with DPN have an impaired ability to stabilize their body when walking on irregular surfaces, even if they adopt a more conservative gait pattern[10]. Several studies concluded that focused exercise regimen improves clinical measures of balance in patience with peripheral neuropathy, and highlighted the importance of brief, intense exercise regimen designed to improve distal lower extremity strength[11]. Some studies has proposed that peripheral neuropathy is common in the elderly and results in impairment in distal proprioception and strength that hinder balance and predispose them to falls. The loss of heel reflexes, decreased vibratory sense that

improves proximally, impaired position sense at the great toe, and inability to maintain unipedal stance for 10 seconds in three attempts all suggest functionally peripheral neuropathy[12].
So purpose of this study is to investigate whether the variable dual task balance training and fixed priority dual task balance training are effecting in improving balance in diabetic polyneuropathy and thereby preventing falls.

2. MATERIALS & ASSESSMENT TOOLS:

1. Inch/measuring tape 2. Chair with arm rest 3. Footstool 4. Ball 5. Book 6. Wooden block as obstacles (60cm long, 4cm high, 8cm wide) 7. Stop watch

Assessment tools: 1. Berg balance scale (BBS). 2 Timed Up and Go (TUG) Test 3. The Activities Specific-Balance scale (ABC). 4. Mini mental state examination (MMSE) 5. Beck Depression Inventory Scale (BDIS) 6. Michigan Neuropathy Screening Instrument (MNSI)

3. METHOD:

30 subjects of age above 50 years who met inclusion and exclusion criteria participated in this experimental pre- post study design. DPN patient as diagnosed by Michigan neuropathy screening instrument. All the subjects were patients at the Jain Neuro hospital, Delhi. In the study the assessment tools are used:

Berg Balance Score (BBS): In a study by Riberio and Pereira in 2005, this instrument in the elderly is used to assess balance and risk of fall in the elderly. This instrument show excellent reliability (0.96) and moderate to high correlation with other balance functional assessment instruments such as Barthel Mobility scale 0.67; Timed up & Go test 0.76; Tinetti Balance scale 0.91. The scale has excellent test-retest objectivity. (ICC=0.98)[13].

Timed Up & go test(TUG) : A study titled predicting the probability for falls in community- dwelling older used the Timed Up & Go test was done by Shumway- cook et al in 2000 and TUG was found to be sensitive (sensivity=87%) and specific (specificity=87%) and measures for identifying individuals who are prone to falls[14].

Activity specific balance confidence scale (ABC): Powell and Myers in 1995 found both Falls Efficacy Scale and ABC scale to be internally consistent and they demonstrate good test – re-test reliability, convergent and criterion validity while both scales were able to discriminate between the two mobility groups, the ABC scale was a more efficient discriminator and yielded a wide range of responses. It was concluded the greater item responsiveness of the ABC scale make it more suitable to detect loss of balance confidence in more highly functioning seniors. Greater situation-specificity of item may also assist clinicians in targeting appropriate interventions[15].

Mini-Mental State Examination (MMSE): The MMSE is the almost universally accepted screening tool for cognitive impairment. While it is most useful for detecting dementia, low score may be due to a number of conditions including delirium and depression. It is across a range of physiotherapy settings including ambulatory, home, and in-patients settings. Cognitive impairment is unreliably detected by interaction with the client, so a policy of routine screening using a tool such as the MMSE should be considered, especially with higher risk groups such as older in-patients [16].

Beck Depression Inventory Scale (BDIS): In a study by Ivon Aben in 2001, depression was evaluated using Beck Depression Inventory. This instrument is used to assess depression in stroke patients. This instrument shows sensitivity 73.1 and specificity 80.0[17].

Michigan Neuropathy Screening Instrument (MNSI): Moghtaderi A et al (2005) concluded that the accuracy of MNSI scoring makes it a useful screening test for diabetic neuropathy in taking a decision regarding which patients should be referred to a neurologist for electrophysiological studies. High specificity, likelihood ratios over 5 and a moderate to good post – test probability give a high diagnostic impact for MNSI scoring. Specificities were 65, 83%, 91% and 94% and sensitivities were 79%, 65%, 50% and 35%[18].

The sample was divided according to permuted multiple block randomization into three groups.

Subjects in Gr A were trained under dual task balance training under a variable priority instructional set. During each session half of the training was done with a focus on postural task and half with focus on secondary task performance. Subjects were instructed to vary their priority between primary task (Tandem walking, obstacle crossing) and secondary task (motor task- Rapid alternating hand movement or cognitive task (counting backwards)

In the other hand subjects in Gr B were given dual task balance training under fixed priority instructional set, subjects did same set of balance activities as Group A, while simultaneously performing cognitive task at all times. Subjects were instructed to maintain attention on both postural and secondary task at all times. Attention to both primary task (tandem walking) and secondary task (motor task- Rapid alternating hand movement or cognitive task (counting backwards)

In the third Gr C the subjects were trained under single task balance training. The participants in the single task balance training group receive balance activities under single task condition (Only balance task were given) like Tandem walking.

4. ANALYSIS:

The collected data was statistically analyzed using SPSS (version 15.0), Data were summarized as mean ±SD. The age of 3 independent Groups (group A : VPDT, group B : FPDT, group C : single task) were compared by analysis of variance (Anova) followed by Newman- keuls test while proportion of gender were analyzed with X^2 test.

5. RESULT:

Table 1.1: Frequency distribution of sex in the three groups

Sex	Group A (n=10)	Group B (n=10)	Group C (n=10)	P value
Male	5 (50.0%)	7 (70.0%)	7 (70.0%)	0.5632
Female	5 (50.0%)	3 (30.0%)	3 (30.0%)	

ns = not significant

Table 1.2 : Summary of age in subjects of three groups

Statistics	Group A (n=10) (Mean ± SD) (years)	Group B (n=10) (Mean ± SD) (years)	Group C (n=10) (Mean ± SD) (years)	P value
Mean	58.80 ± 5.83	57.20 ± 6.48	59.00 ± 7.79	0.8089

ns = not significant

Table 1.3 : Within group comparison of BBS score

Groups	Pre Training (Mean ± SD)	Pre Training (Mean ± SD)	p value
Group A	45.60± 3.66	53.30 ± 3.13	0.0002*
Group B	45.10± 4.12	48.40 ± 3.17	0.0056*
Group C	45.50± 3.81	49.20 ± 3.43	0.0019*

*= significant at p≤0.05

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single task

Table 1.4 Within group comparison of TUG score

Groups	Pre Training (Mean ± SD) (seconds)	Pre Training (Mean ± SD) (seconds)	p value
Group A	12.40± 0.70	9.80 ± 0.92	0.0001*
Group B	12.50± 0.71	11.20 ± 1.03	0.0005*
Group C	12.20± 0.79	10.80 ± 1.14	0.0002*

*= significant at p≤0.05

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single task

Table 1.5 : Within Group comparison of ABC score

Groups	Pre Training (Mean ± SD) (%)	Pre Training (Mean ± SD) %	p value
Group A	72.16 ± 6.20	88.36± 5.12	0.0001*

Group B	72.10± 6.36	79.60 ± 5.33	0.0010*
Group C	72.38 ± 6.18	88.13 ± 5.59	0.0002*

*= significant at p≤0.05

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single task

Table 1.6: Between group comparison of BBS score

Groups	Group A Mean ± SD	Group B Mean ± SD	Group C Mean ± SD	p value			F value
				Group A vs. Group B	Group A vs. Group C	Group B vs. Group B	
Pre training	45.60 ± 3.66	45.10 ± 4.12	45.50 ± 3.81	0.9475^{ns}	0.9505^{ns}	0.8036^{ns}	7.322
Post training	53.30 ± 3.13	48.40 ± 3.17	49.20 ± 3.43	0.0110*	0.0145*	0.6193^{ns}	

^{ns} = not significant
*= significant at p≤0.05

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single task

Table 1.7: Between group comparison of TUG score

Groups	Group A Mean ± SD (seconds)	Group B Mean ± SD (seconds)	Group C Mean ± SD (seconds)	p value			F value
				Group A vs. Group B	Group A vs. Group C	Group B vs. Group B	
Pre training	12.40 ± 0.70	12.50 ± 0.71	12.20 ± 0.79	0.8041^{ns}	0.6202^{ns}	0.7359^{ns}	7.322
Post training	9.80 ± 0.92	11.20 ± 1.14	10.80 ± 1.14	0.0032*	0.0166*	0.3236^{ns}	

^{ns} = not significant
*= significant at p≤0.05

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single task

Table 1.8: Between group comparison of ABC score

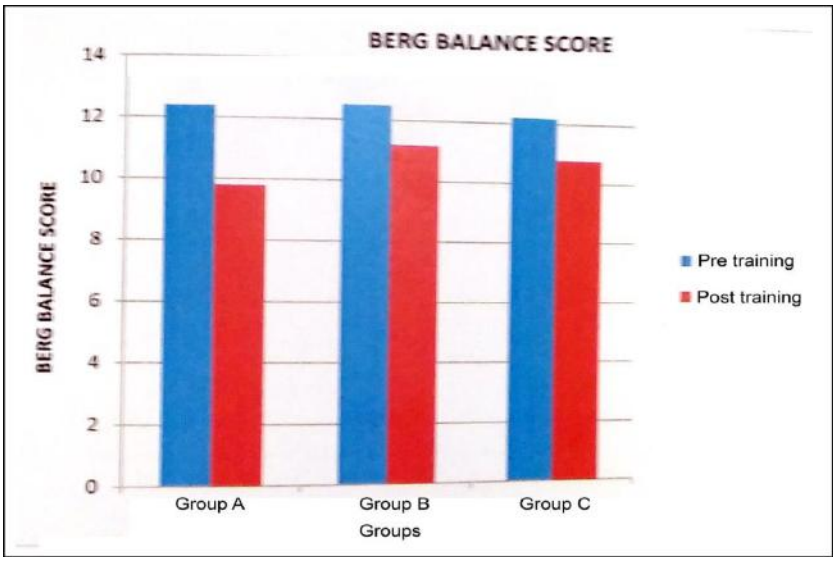
Groups	Group A Mean ± SD (%)	Group B Mean ± SD (%)	Group C Mean ± SD (%)	p value			F value
				Group A vs. Group B	Group A vs. Group C	Group B vs. Group B	
Pre training	72.16± 6.20	72.10 ± 6.36	72.38 ± 6.18	0.9810^{ns}	0.9354^{ns}	0.9939^{ns}	8.255
Post training	88.36 ± 5.12	79.60 ± 5.33	88.13 ± 5.59	0.0047*	0.9278*	0.0023^{ns}	

^{ns} = not significant
*= significant at p≤0.05

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single task

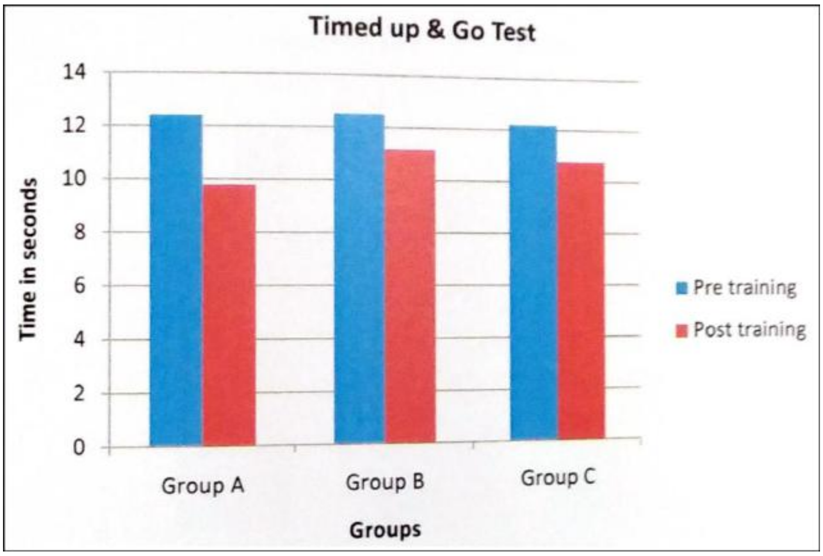
Graph 1.1: Comparison of BBS scores within three groups

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single Task



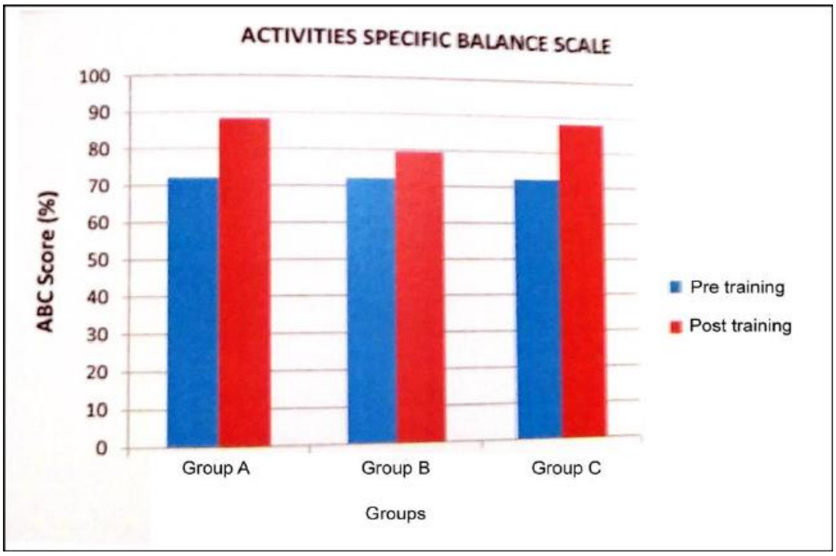
Graph 1.2: Comparison of TUG scores within three groups

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single Task

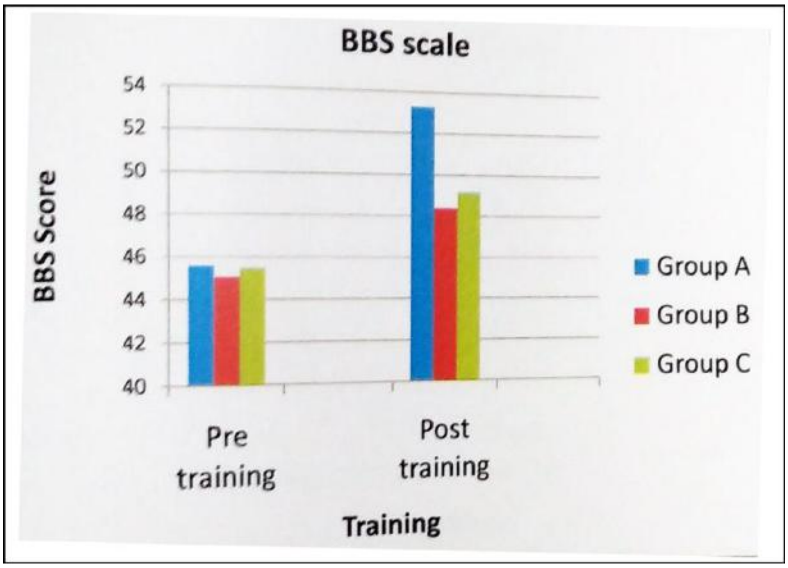


Graph 1.3: Comparison of ABC scores within three groups

Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single Task

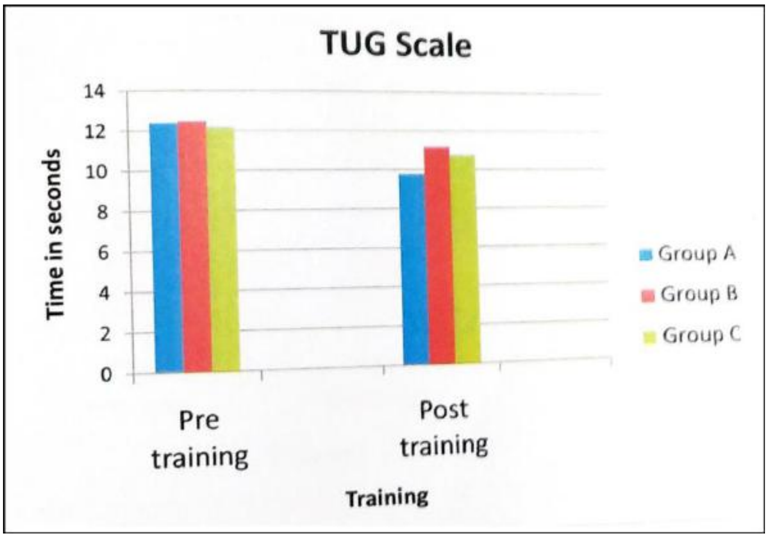


Graph 1.4: Comparison of BBS scores within three groups



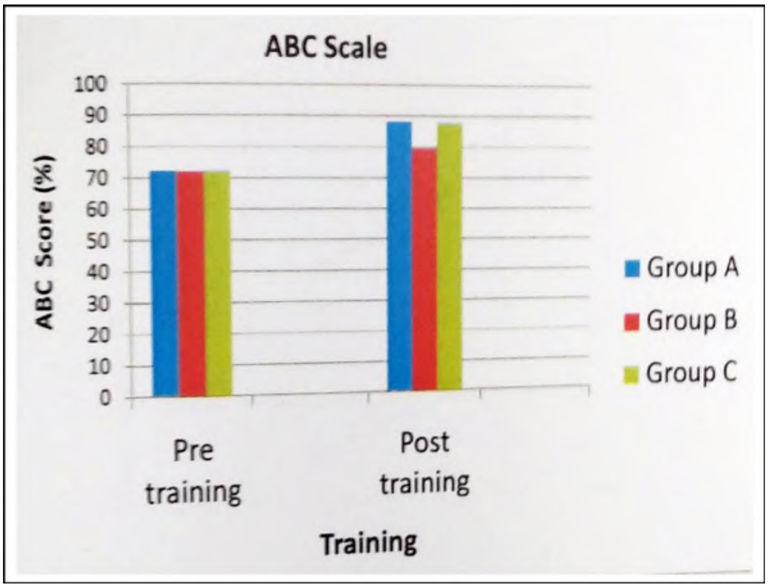
Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single Task

Graph 1.5: Comparison of TUG scores within three groups



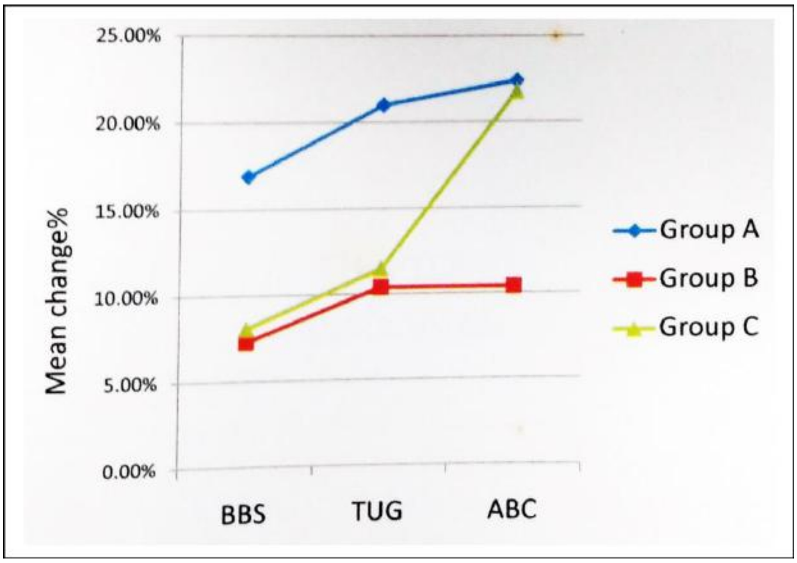
Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single Task

Graph 1.6: Comparison of ABC scores within three groups



Group A – Variable Priority Dual Task
Group B – Fixed Priority Dual Task
Group C – Single Task

Graph 1.7: Mean percentage change of BBS, TUG, ABC score of three groups



6. DISCUSSION:

The purpose of the study was to test the hypothesis that variable priority dual task training will prove more effective than fixed priority dual task training in improving balance in diabetic polyneuropathy.

On analysis it was found that the subjects in Gr A were more benefited than group B and C. The variable priority instructional set (VP) offers advantage over the fixed priority instructional set (FP) in terms of degree of improvement, the rate of learning, and the retention of dual task training benefits. Although participant in all training groups demonstrated significant improvement on balance performance under dual task condition, the VP group improved to a greater extent than the FP, single balance activities.

Rutruff et al suggested that the underlying assumptions for a dual task paradigm are deprived from a well-known “capacity sharing” model of information processing. According to this model, information-processing capacity is limited and these limited resources could be shared among all tasks in a graded fashion (also known as graded capacity sharing). Dual task interference will be observed only if two tasks require common limited resources. Because there is less capacity for each individual task during which the capacity is shared, the performance on at least one task will be impaired. It is assumed that one could voluntarily allocate the capacity among different tasks and the efficiency of the task performance is proportional to the amount of capacity allocated to it [19].

Work by Kramer et al using cognitive tasks demonstrated that dual task training allowed participant to practice coordinating the 2 concurrent tasks. In addition, the instructional set regarding attentional focus (fixed priority (FP) versus variable priority (VP) was an important factor when training under dual task conditions. The participants who received dual task training with VP instructions (shifting attention between tasks) learned tasks faster and performed better than those who received training with FP instructions (placing equal amounts of attention on both tasks)[20].

Kramer et al suggested that efficient improvement on dual task performance was the result of both automatization of an individual task and the development of task coordination skills. If task automatization was the only mechanism underlying the improvement in dual task balance performance, the magnitude of training benefits should be comparable across training groups. Similarly, if the efficient integration of the two tasks was the only mechanism underlying changes, the magnitude of training benefits acquired during FP training should be equivalent to those acquired during VP training. Since it indicates that VP groups have learned to efficiently coordinate performance between the two tasks (task integration) as they improved performance on each task (task automatization) [20].

Study also showed that the participants in single task balance training group increased their self-reported confidence when performing daily activities. This is because single task activities was easier.

ABC scale scores increased with BBS and TUG scores. Similar findings were reported by Hatch et al that balance performance and functional mobility are strongly associated with balance confidence[21].

A comparison of pretest and posttest score indicated that the patient showed a substantial improvement in balance after 4 weeks of training. This is supported by another study by Steindler et al that concluded the effects of short-term training are modest for functionally independent adults.

Efficient allocation of attention between concurrent tasks is necessary for functional independence involving activities of daily living as well as higher multilevel motor processing tasks. It is now fairly established that postural control is an attentional demanding task. In real settings treatment is therefore needed for diabetic polyneuropathy, so

INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD ISSN: 2455-0620 Volume - 6, Issue - 12, Dec – 2020
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value: 86.87 Impact Factor: 6.719
Received Date: 16/12/2020 Acceptance Date: 28/12/2020 Publication Date: 31/12/2020

that sufficient attention is allocated in activities of daily living, in a dual task context; thereby promoting postural stability and preventing falls in them.

Typically therapeutic programs for balance control focused on a single task protocol. This study offers support for a balance training program that focuses on dual tasks that progress in difficulty. This dual-task training program may be an appropriate intervention choice for the improvement in specific subpopulations of patients with balance impairment. Also, it increased the subject's confidence in performing daily activities as an important determinant of daily functioning. The findings from this study may serve as a basis for the development and implementation of new balance retraining program to improve walking stability and gait characteristics with the use of dual tasks. Further research can be done to find the effect on risk of falls with this particular therapeutic approach

7. DISCUSSION:

The purpose of the study was to test the hypothesis that variable priority dual task training will prove more effective than fixed priority dual task training in improving balance in diabetic polyneuropathy.

On analysis it was found that the subjects in Gr A were more benefited than group B and C. The variable priority instructional set (VP) offers advantage over the fixed priority instructional set (FP) in terms of degree of improvement, the rate of learning, and the retention of dual task training benefits. Although participant in all training groups demonstrated significant improvement on balance performance under dual task condition, the VP group improved to a greater extent than the FP, single balance activities.

Rutruff et al suggested that the underlying assumptions for a dual task paradigm are deprived from a well-known "capacity sharing" model of information processing. According to this model, information-processing capacity is limited and these limited resources could be shared among all tasks in a graded fashion (also known as graded capacity sharing). Dual task interference will be observed only if two tasks require common limited resources. Because there is less capacity for each individual task during which the capacity is shared, the performance on at least one task will be impaired. It is assumed that one could voluntarily allocate the capacity among different tasks and the efficiency of the task performance is proportional to the amount of capacity allocated to it [19].

Work by Kramer et al using cognitive tasks demonstrated that dual task training allowed participant to practice coordinating the 2 concurrent tasks. In addition, the instructional set regarding attentional focus (fixed priority (FP) versus variable priority (VP) was an important factor when training under dual task conditions. The participants who received dual task training with VP instructions (shifting attention between tasks) learned tasks faster and performed better than those who received training with FP instructions (placing equal amounts of attention on both tasks)[20].

Kramer et al suggested that efficient improvement on dual task performance was the result of both automatization of an individual task and the development of task coordination skills. If task automatization was the only mechanism underlying the improvement in dual task balance performance, the magnitude of training benefits should be comparable across training groups. Similarly, if the efficient integration of the two tasks was the only mechanism underlying changes, the magnitude of training benefits acquired during FP training should be equivalent to those acquired during VP training. Since it indicates that VP groups have learned to efficiently coordinate performance between the two tasks (task integration) as they improved performance on each task (task automatization)[20].

Study also showed that the participants in single task balance training group increased their self-reported confidence when performing daily activities. This is because single task activities was easier.

ABC scale scores increased with BBS and TUG scores. Similar findings were reported by Hatch et al that balance performance and functional mobility are strongly associated with balance confidence[21].

A comparison of pretest and posttest score indicated that the patient showed a substantial improvement in balance after 4 weeks of training. This is supported by another study by Steindler et al that concluded the effects of short-term training are modest for functionally independent adults.

Efficient allocation of attention between concurrent tasks is necessary for functional independence involving activities of daily living as well as higher multilevel motor processing tasks. It is now fairly established that postural control is an attentional demanding task. In real settings treatment is therefore needed for diabetic polyneuropathy, so that sufficient attention is allocated in activities of daily living, in a dual task context; thereby promoting postural stability and preventing falls in them.

Typically therapeutic programs for balance control focused on a single task protocol. This study offers support for a balance training program that focuses on dual tasks that progress in difficulty. This dual-task training program may be an appropriate intervention choice for the improvement in specific subpopulations of patients with balance impairment. Also, it increased the subject's confidence in performing daily activities as an important determinant of daily functioning. The findings from this study may serve as a basis for the development and implementation of new balance retraining program to improve walking stability and gait characteristics with the use of dual tasks. Further research can be done to find the effect on risk of falls with this particular therapeutic approach

8. CONCLUSION:

Typically, the therapeutic programs for balance control focus on a single task protocol. A balance training program that focuses on dual tasks that progress in difficulty and shifting priority between two tasks is efficacious in improving balance in diabetic polyneuropathy.

Patients with DPN have a more conservative balance, which is partly maintained by cognitive attention. This effect was more evidence in people with diabetic peripheral neuropathy possibly putting such patients at particular risk of falls. It is important that health care professionals recognize the potential for falls in those with DPN and implement early preventative strategies.

REFERENCES:

1. Position statement, Diagnosis and Classification on Diabetic Mellitus, American Diabetes Association, Diabetes Care 2008; 28: S37-S42
2. Vinik AI. Management of neuropathy and foot problems in diabetic patients. Clin Cornerstone 2003; 5 (2): 38-55.
3. Vinik AI. Advances in diabetes for the millennium: new treatments for diabetic neuropathies. Med Gen Med 2004; Aug 17 6 (2): 13.
4. Cavanagh PR, Derr JA, Ulbrecht JS, Maser RE, Orchard TJ. Problems of Gait and Posture in Neuropathic Patients with Insulin- Dependent Diabetes Mellitus. Diabet Med 1992: 9: 469-474.
5. Kramer A F, Larish JF. Training for attentional control in dual task settings: a comparison of young & old adults. J Exp Psychol Appl 1995:50-76.
6. Lundin – Olsson L, Nyberg L, Gustafson Y. “Stops walking when talking” as a predictor of falls in elderly people. Lancet 1997; 349:617.
7. Regnaux JP, Daniel DO. Cognitive processes involved in the control of steady state walking in healthy subjects and after cerebral damage. Neurorehabil Neural Repair 2005: 19:125-132.
8. Regnaux JP, Robertson J. Human treadmill walking needs attention. J Neuroeng Rehabil 2006; 3:1-
9. Wollacott M and Shumway-Cook A. Attention and the control of posture and gait; a review of an emerging area of research. Gait Posture 2002; 16:1-14
10. Menz HB, Lord SR. Walking stability and Sensorimotor Function in Older People with Diabetic Peripheral Neuropathy, ArchPhysMedRehabil, 2004Feb, 85:245-252.
11. Richarson JK, Sandman D. A focused exercise regimen improves balance in patient diabetic polyneuropathy. Arch Phys Med Rehabil 2001; 82:205-209
12. Richardson JK and Hurvitz EA. Peripheral Neuropathy: a true risk factor for falls. J Gerontol 1995; 50: M211-M215.
13. Riberio ASB. Pereira JS. Balance improvement and reduction of likelihood of falls in older women after cawthorne and Cooksey excercises. Revists Brasileriade Ottolaringologia.
14. Shumway-Cook A, Baldwin M, Polissar NL et al. Predicting the probability for falls in community-dwelling older adults. PhysTher 1997;77:812-819.
15. Powell LE, Myers AM. The Activities-specific Balance Confidence (ABC) Scale. J Gerontol A Biol Sci 1995;50A:M28-34.
16. Michacl Woodward. Mini mental state examination. Australian journal of physiotherapy 2005 Vol 51
17. Ivon Aben et al. Validity of beck depression inventory, hospital anxiety and depression scale, SCL-90 and Hamilton depression rating scale as screening instrument for depression in stroke patients. 2001
18. Validation of Michigan neuropathy screening instrument for diabetic peripheral neuropathy. Moghtaderi A, Baskshipour A, Rashidi H. Clin Neurol Neursurg. 2006 Jul; 108 (5): 477-81. Epub 2005 sep 16
19. Ruthruff E, Van Selst M, Johnston JC et al. How does practice reduce dual-task interference: integration, automatization, or just stage-shortening? Psychol Res 2006;70:125-142
20. Kramer AF, Larish JF, Strayer DL. Training for attentional control in dual task settings: A comparison of young and old adults. J exp Psychol Appl 1995; 1:50-76.
21. Hatch J. Gill-Body. Determinants of balance confidence in community-dwelling elderly people. Phys Ther 2003 December; 83:1072-1079