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The Effect Of Nintendo Wii Fit Balance Board Virtual Reality Games Improving Functional Mobility Among Persons With Post Operative Intervertebral Disc Prolapse

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ABSTRACT
Functional mobility is important in a person's life since it allows them to carry out their employment and live a healthy and balanced lifestyle. Patients who underwent surgery for intervertebral disc prolapse are unable to engage in their occupation, affecting their daily activities, absenteeism at work, absence of roles and routine, and functional mobility issues, all of which affect their occupation and quality of life. Quality of life. The research is to investigate the influence of Nintendo Wii fit balance board VR games and improving functional mobility among people with post-operative intervertebral disc prolapse and to investigate the impact of Nintendo Wii fit balance board VR games on the functional mobility of the post-operative intervertebral disc. Fifty patients with post-operative intervertebral disc prolapse were enrolled in the trial, with 25 in the control group (A group) and 25 in the experimental group (B group) The BESTest (Balance evaluation system test) scale was utilized for the study's pre and post-tests. The study methodology is quasi-experimental, with a convenient sampling approach used, and the therapeutic regimen was administered for three months, consisting of 36 sessions lasting 35 minutes. The comparison of the control and experimental groups indicated statistically significant differences in the mean values of both the Wilcoxon signed-rank and Mann-Whitney U tests. Nonetheless, both groups demonstrated statistically significant differences in all outcome indicators. Furthermore, this study presents preliminary evidence for the usefulness of the Nintendo Wii Fit Balance Board.

Keywords – Nintendo Wii fit therapy, functional mobility, occupational therapy, intervertebral disc prolapse

INTRODUCTION

Intervertebral disc prolapse is a prevalent musculoskeletal condition affecting the lumbar spine and extends its influence beyond the realms of physical discomfort and neurological symptoms. Acute disc herniation or prolapse in the intervertebral column is caused by underlying disc degeneration. Recurrent intervertebral disc prolapse (IDP) is a primary source of pain, disability, and reoperation, with the reported rate of recurrence following lumbar discectomy being 5-11%**(Quah et al., 2014)** It occurs most frequently in the fourth to fifth decades of life, is more prevalent in males than women (3:1), and is mostly seen in the L4-L5 and L5-S1 disc levels. Disc failure has been linked to Annulus integrity fractures that begin on the inside and advance to the outside border. This occurs when the extracellular matrix of a degenerating disc changes and weakens, and the forces exerted on the annulus surpass its tensile strength and shatter its outer boundaries. The posterolateral region is inherently the weakest portion of the annulus, and so becomes the most prevalent location of nucleus herniation. Therefore, disc herniation is more prevalent in adults in their third and fourth decades of life. (Nikhil Jain et al, 2020). A frequent presentation is abrupt severe back pain that resolves, followed by the development of pelvic and leg discomfort (sciatica) a few days afterward. Muscle weakness and paraesthesia or numbness in the leg or foot are possible. Usually, the patient stands with their list to one side. Occasionally, the afflicted side's knee is gently extended to reduce tension on the sciatic nerve; nevertheless, doing so highlights the skewback and restricts all back movements during forward flexion. As a condition with far-reaching implications, understanding the intricate interplay between disc prolapse and occupational productivity is crucial for holistic patient care and workplace health considerations. Individuals grappling with persistent pain, reduced mobility, or neurological symptoms may experience challenges in meeting the demands of their work, leading to absenteeism, presenteeism, and diminished overall job performance. The Nintendo Wii Fit Balance Board has emerged as a pioneering tool, transcending its gaming origins to become an influential asset in the realm of occupational therapy. This exploration delves into the developmental journey of the Wii Fit Balance Board and its transformative usage in occupational therapy, where it has become a valuable adjunct to traditional interventions, enriching the rehabilitation experience for individuals facing diverse physical and cognitive challenges. Development of the device started in the mid-2000s; the Nintendo Wii Fit Balance Board was conceived as an innovative means of engaging players in physical activity through video games. Released in 2007 as a component of the Wii Fit package, the Balance Board aimed to revolutionize the gaming experience by incorporating physical activity

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and exercise into gameplay. The Nintendo Wii Fit Balance Board aims to restore mobility and function through specialized virtual activities and treatment plans tailored to individual needs. Therapists could design customized exercise routines that target balance, strength, and coordination, with real-time feedback provided by the Balance Board. Lumbar disc herniations present rehabilitation with complex difficulties, and occupational therapy holds significant importance in tending to the many interrelated needs commonly encountered among those seeking relief. This research aims to investigate the techniques employed in utilizing the Nintendo Wii Fit Balance Board as an innovative tool within occupational therapy interventions for lumbar intervertebral disc prolapse patients. By exploring the potential benefits and challenges of these techniques, this study aims to contribute to the evolving landscape of rehabilitation strategies for this specific population. This research seeks to unravel the efficacy and potential challenges of employing Nintendo Wii Fit Balance Board techniques within occupational therapy interventions for lumbar intervertebral disc prolapse patients. By exploring the impact of these techniques on balance, core strength, joint mobility, functional tasks, and cognitive functions, this study aims to contribute valuable insights to optimize rehabilitation strategies and enhance the overall well-being of individuals navigating lumbar disc prolapse. Although significant research has been conducted on intervertebral disc prolapse in various aspects they have not proven using the Nintendo Wii fit balance board improves functional mobility as evidence–based practice. hence, it is important to prove the effect of Nintendo Wii fit balance board VR games in improving functional mobility. This study has been undertaken to find out the effect of Nintendo Wii fit balance board VR games in improving functional mobility for post-operative intervertebral disc prolapse patients.

Materials and methods

The study employs a quasi-experimental study design with non-probability convenient sampling was used to recruit sixty subjects both men and women at the range of Age 27- 65 years presented with a condition of Acute post-operative IVDP patients with a minimum of 15 days after surgery from Muthu hospitals purasaivakkam, Chennai. The dependent variable is functional mobility while the independent variable includes Nintendo Wii fit balance board VR games and conventional occupational therapy. The screening criteria for inclusion encompasses patients with lumbar intervertebral disc prolapse The scoring was done using BESTest which consists of 36 questions examining the performance of six balancing systems namely stability limits/verticality, biomechanical constraints, postural responses, anticipatory stability in gait, and responses to sensory orientation. The intervention was delivered for three months (36 sessions/12 weeks), with each session lasting around 45 minutes for each patient. For the experimental group (B group), each patient received 15 minutes of preparatory stretch games followed by 35 minutes of Nintendo Wii fit balance board games. For the control group(A group), each patient received conventional occupational therapy with posture stabilization, energy conservation, joint protection, and work simplification techniques.

Intervention protocol

Session	Wii fit games	Time
1-3	Pre test	30 mins
4-5	• Warm up stretching exercise by Torso Twist Demonstration of Wii fit balance games with researcher assistance. • Ski Slalom x 3 times (therapist assistance) • Penguin Slide x 3 times (therapist assistance)	45 mins
6-7	• Ski Slalom x 3 times (independently) • Penguin Slide x 3 times (independently)	45 mins
8-9	• Ski Slalom x 3 times (independently) • Penguin Slide x 3 times (independently)	45 mins
10-11	• Penguin Slide x 3 times (independently) • Ski Jump x 3 times (therapist assistance)	45 mins
12-13	• Penguin Slide x 3 times (independently) • Ski Jump x 3 times (independently)	45 mins
14-15	• Ski Jump x 3 times (independently) • Table tilt x 3 times (therapist assistance)	45 mins
16-18	• Ski Jump x 3 times (independently) • Table tilt x 3 times (therapist assistance) • Penguin Slide x 3 times (independently)	45 mins
19-20	• Penguin Slide x 3 times (independently) • Hula Hoop x 3 times (therapist assistance) • Table tilt x 3 times (therapist assistance)	45 mins
21-23	• Ski Jump x 3 times (independently)	45 mins

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	• Penguin Slide x 3 times (independently) • Hula Hoop x 3 times (independently) • Table tilt x 3 times (independently)	
24-27	• Penguin Slide x 3 times (independently) • Hula Hoop x 3 times (independently) • Table tilt x 3 times (independently)	45 mins
28-31	• Ski Slalom x 2 times (independently) • Penguin Slide x 2 times (independently)	45 mins
32-34	• Ski Slalom x 2 times (independently) • Penguin Slide x 2 times (independently) • Penguin Slide x 2 times (independently) • Hula Hoop x 1 times (independently) • Table tilt x 1 times (independently)	45 mins
35-36	• Post test	30 mins

Result

A quantitative study was carried out by the analysis of inferential statistics in this study. Mean and Standard deviation (Minimum – Maximum) were used as a measurement criterion on a repeated basis for the result. The descriptive statistics examined records distribution to summarize the data. The results were measured and categorized in number (%).

Significant figures

** Strongly significant ($P < 0.05$).

* Moderately significant ($P < 0.01$).

+Suggestive significance (P value < 0.1)

The sample size was 50 and was determined using convenient sampling. Both the control and experimental groups of pre- and post-test scores were compared statistically using the non-parametric test. The pre-test and post-test findings of the control and experimental groups were compared using the Mann-Whitney U and the Wilcoxon signed-rank tests, respectively. The Mann-Whitney U test was used to examine if the hypothesis being tested had statistically significant differences from the treatment provided. The alpha level of $P = 0.05$ was considered to be statistically significant. The statistical analysis was done using IBM SPSS version 23.0.

Table 1: Demographic distribution based on Age, Gender for CONTROL GROUP

DEMOGRAPHIC VARIABLES		FREQUENCY	PERCENTAGE
AGE	< 30 years	2	8.0
	31 to 40 years	12	48.0
	41 to 50 years	6	24.0
	51 to 60 years	5	20.0
	MEAN ± SD	41.44 ± 8.476	
GENDER	MALE	16	64.0
	FEMALE	9	36.0
TOTAL		25	100.0

A total of 60 participants only 50 had taken part in the study. A total of 9 females and 16 males participated. 16 males (64 %) and 9 female (36%) were in control group.

Table 2: Demographic distribution based on Age, Gender for EXPERIMENTAL Group

DEMOGRAPHIC VARIABLES		FREQUENCY	PERCENTAGE
AGE	< 30 years	4	16.0
	31 to 40 years	11	44.0
	41 to 50 years	8	32.0
	51 to 60 years	2	8.0
	MEAN ± SD	39.36 ± 8.200	
GENDER	MALE	14	56.0
	FEMALE	11	44.0
TOTAL		25	100.0

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A total of 60 participants only 50 had taken part in the study. A total of 11 females and 14 males participated. 14 males (56 %) and 11 female (44%) were in experimental group.

Table 3: Difference between Sections & Total Score of Balance evaluation system test for Control Group (group A) Pre and post-test (Wilcoxon Signed Rank Test)

		Mean	N	Z value	p-value
SECTION – I A group	Pre-test	3.52	25	-4.416	0.000*
	Post-test	8.04	25		
SECTION – II A group	Pre-test	7.64	25	-4.383	0.000*
	Post-test	12.56	25		
SECTION – III A group	Pre-test	2.00	25	-4.425	0.000*
	Post-test	6.52	25		
SECTION – IV A group	Pre-test	3.76	25	-4.412	0.000*
	Post-test	7.96	25		
SECTION – V A group	Pre-test	8.08	25	-4.400	0.000*
	Post-test	11.92	25		
SECTION – VI A group	Pre-test	1.60	25	-4.440	0.000*
	Post-test	6.36	25		
TOTAL SCORE A group	Pre-test	26.64	25	-4.377	0.000*
	Post-test	53.36	25		

*Significant at 1% ($p < 0.01$) level

Hence, the p-value of 0.000 is less than 0.01, there is Acceptance of the alternative hypothesis. As a result, the pre and post-tests show a statistically significant difference. of all Sections and the Overall Score for the Control Group on Balance Evaluation System Test.

Table 4: Difference between Sections & Total Score of of Balance evaluation system test for experimental group (group B) Pre-test and Post-test (Wilcoxon Signed Rank Test)

		Mean	N	Z value	p value
SECTION – I B group	Pre-test	5.04	25	-4.399	0.000*
	Post-test	11.20	25		
SECTION – II B group	Pre-test	5.56	25	-4.395	0.000*
	Post-test	11.44	25		
SECTION – III B group	Pre-test	4.56	25	-4.403	0.000*
	Post-test	10.48	25		
SECTION – IV B group	Pre-test	4.24	25	-4.387	0.000*
	Post-test	11.44	25		
SECTION – V B group	Pre-test	4.60	25	-4.384	0.000*
	Post-test	15.08	25		
SECTION – VI B group	Pre-test	4.08	25	-4.409	0.000*
	Post-test	11.00	25		
TOTAL SCORE B group	Pre-test	28.28	25	-4.377	0.000*
	Post-test	70.64	25		

*Significant at 1% ($p < 0.01$) level

The alternative hypothesis is supported since the p-value is 0.000, which is less than 0.01. As a result, the before and post-tests demonstrate a statistically significant difference of all parts and the overall score of the Balance Evaluation System exam for the experimental group.

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Table 5: Difference between Sections and Total Score of the Balance Evaluation System Test for group A and group B Post-tests (Mann Whitney U)

		Mean	N	U value	p-value
SECTION - I Post-test	A group	14.94	25	-5.167	0.000*
	B group	36.06	25		
SECTION - II Post-test	A group	13.86	25	-5.676	0.000*
	B group	37.14	25		
SECTION - III Post-test	A group	13.94	25	-5.654	0.000*
	B group	37.06	25		
SECTION - IV Post-test	A group	15.12	25	-5.073	0.000*
	B group	35.88	25		
SECTION - V Post-test	A group	15.36	25	-4.964	0.000*
	B group	35.64	25		
SECTION - VI Post-test	A group	13.56	25	-5.840	0.000*
	B group	37.44	25		
TOTAL SCORE Post-test	A group	13.00	25	-6.071	0.000*
	B group	38.00	25		

*Significant at 5% ($p < 0.05$) level

Since the p-value of 0.000 is less than 0.01 for ALL Sections & Total Score of Balance evaluation system test, an alternate hypothesis is accepted. Hence, there is a statistically significant difference in post-test scores between the control Group (A group) and the experimental (B group) of the total score.

Discussion

This study detailed to determine the effect of Nintendo Wii fit balance board virtual reality games on improving functional mobility among persons with post-operative intervertebral disc prolapse. It also described the impact of Nintendo Wii fit balance board virtual reality games to improve the functional mobility of the patients This study was based on previous literature to explore the desired outcome by using this intervention. A total of sixty (60) patients were selected using the selection criteria described in the methodology and 10 people left the study in which the experimental and control groups were assigned 25 samples each by using a convenient sampling technique. The age of selected samples ranged from 25 to 65 years. The study included males and females. A total of 50 participants had taken part in the study. A total of 9 females and 16 males participated in the control group (A group) and 14 males and 11 females were in the experimental group (B group)

Among the participants, two were under the age of 30, twelve were between the ages of 31 and 40, six were between the ages of 41 and 50, five were between the ages of 51 and 60 in the control group, and four were between the ages of 30 and 40, eleven between the ages of 31 and 40, eight between the ages of 41 and 50, and two between the ages of 51 and 60 years.

The study's findings and interpretation revealed a statistically significant improvement in the pre and post-test of the Balance Evaluation System Test experimental group comparison (table 4, figure 4). The before and post-test comparison of the Balance Evaluation System Test for the control group (Table 3, Figure 3) reveals statistically significant improvement. The post-test comparison of the control and experimental groups reveals a statistically significant improvement between the groups (table 5, figure 5). This demonstrates that the progress is considerably greater when utilizing the Nintendo Wii Fit Balance Board VR games.

Table 3 and Figure 3 depict the results of the Balance Evaluation System Test for the **c**ontrol group's pre-test and post-test comparisons. The results show a substantial difference in scores ($Z = -4.377$, $p < 0.00$), indicating that the group got traditional occupational therapy and saw significant progress.

Table 4 and Figure 4 display the results of the pre-test and post-test comparisons for the Balance Evaluation System Test for the experimental group. The study found a statistically significant difference in scores ($Z = -4.377$, $p < 0.00$), indicating that the group who got Wii Fit Balance Board VR games improved significantly.

Table 5 and Figure 5 show the results of the before and post-test comparison between the control and experimental groups for the Balance Evaluation System Test. The results indicate a statistically significant difference in scores between the experimental and control groups ($U = -6.071$, $p < 0.00$). Ji-Hyuk Park (2013) used the Nintendo Wii exercise program on chronic work-related low back pain (LBP) in factory workers. The study involved 24 workers diagnosed with chronic LBP and divided them into three groups: control, lumbar stabilization exercise, and Nintendo Wii exercise. The study

found that exercise programs significantly improved physical functions related to LBP, with the Nintendo Wii exercise program showing significant improvement in both mental and physical health. Ben Rohof1 2020 said that his prospective study intended to examine the diagnostic usefulness of the Wii Fit balancing Board in 41 healthy participants, concentrating on two particular measurements: the yoga job "tree," done in a one-leg posture, and the balancing game "table tilt." These parameters were compared to two established systems, the MFT-S3 Check and the Posturomed, using correlation and agreement studies utilizing Bland-Altman plots, as well as demographic data assessments. The findings revealed a moderate link between the yoga practice 'tree' and the Sensory Organisation Test, as well as the MFT-S3 Check and the Posturomed. As a result, the Wii Fit Balance Board looks to be appropriate for assessing postural stability and may have application in fall prevention measures for the elderly. One of the study's therapeutically important findings was that participants were motivated and interested in performing functional mobility-based activities. Furthermore, in all areas of the Balance Evaluation System Test, the experimental group outperformed the control group significantly. It suggests that Nintendo Wii fit balance board VR games would enhance other functions such as balance, walking, good posture maintenance, and occupational independence in people with an intervertebral disc prolapse.

Conclusion

Functional mobility is important in an individual's life since it allows them to carry out their employment and live a healthy and balanced lifestyle. Patients who have undergone surgery for intervertebral disc prolapse are unable to resume their occupation, affecting their ADL/IADL, absenteeism at work, absence of roles and routines, and functional mobility issues that affect their occupation and quality of life. This study looked at how Nintendo Wii Fit Balance Board VR games can help post-operative intervertebral disc prolapse patients recover functional mobility. The outcomes showed that there was a statistically significant difference between the experimental and control groups' post-test scores. Further examination of this study showed that the intervention using Nintendo Wii Fit Balance Board VR games resulted in a greater increase in functional mobility among participants in a shorter amount of time than the people who only got standard occupational therapy intervention. The Nintendo Wii Fit Balance Board VR games should be considered and supplied with appropriate assistance. The limitations of the study are: The sample size was tiny. Because a handy sampling strategy was adopted, results were not able to be applied generally. The intervention's long-term effects were not looked at. The study's advice is to continue following up with individuals to determine the long-term effects of Wii Fit Balance Board VR games on their functional mobility. Furthermore, this analysis may be applied to a larger probability sample.