

**EFFECTS OF VIRTUAL REALITY WITH
SENSORY INTEGRATION ON GROSS
MOTOR FUNCTION IN CHILDREN WITH
SPASTIC DIPLEGIC CEREBRAL PALSY**

THESIS



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Registration Number

Master of Science in Physical Therapy
(Sports Physical Therapy)

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Riphah College of Rehabilitation & Allied Health Sciences

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AUTHOR'S DECLARATION

I **Sannia Batool** here by state that my MS thesis titled, Effects Of Virtual Reality Training With Sensory Integration On The Gross Motor Functions Of Lower Limb In Spastic Diplegic Cerebral Palsy is my own work and has not been submitted previously by me for taking any degree from this university **Riphah College of Rehabilitation & Allied Health Sciences** or anywhere else in the country/world.

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I solemnly declare that research work present in the thesis titled “ Effects Of Virtual Reality Training With Sensory Integration On The Gross Motor Functions Of Lower Limb In Spastic Diplegic Cerebral Palsy” is solely my research work with no significant contribution from any other person. Small contribution/help wherever taken has been duly acknowledged and that complete thesis has been written by me.

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At the very outset I owe all of my heart-felt gratitude to the real Blessor of the universe, **Allah Almighty** the most Merciful and Beneficent and also to His **Holy Prophet “MUHAMMAD” (peace and blessings of Allah be upon him)** the real source of knowledge and torch of guidance for the entire world forever.

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May Allah Almighty bless all of them (AMEEN)

(SANNIA BATOOL)

*Dedicated to my blessed parents, family and adored siblings
whose tremendous support and cooperation led me to this
wonderful accomplishment*

SIGNATURES

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SUPERVISOR CERTIFICATE

It is hereby certified that thesis is based on the results of work carried out by Sannia Batool and that it has not been previously presented for MSPT-NMPT Degree.

Miss Sannia Batool has done this research work under my supervision. He has fulfilled all the requirements and is qualified to submit the accompanying thesis for the degree of Doctor of Physical Therapy.

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ABSTRACT

Background:

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Keywords:

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LIST OF ABBREVIATIONS

Serial	Abbreviation	Description
1.	CP	Cerebral Palsy
2.	CNS	Central Nervous System
3.	GMFCS	Gross motor Function Classification System
4.	VR	Virtual Reality
5.	SIT	Sensory Integration Therapy
6.	PBS	Pediatric Balance Scale
7.	GMFM	Gross motor Function Measure
8.	MAS	Modified Ashworth Scale
9.	2MWT	2-Minute Walk Test

1. INTRODUCTION & LITERATURE REVIEW

Cerebral palsy is a blanket term for describing physical and mental disorders(1)mainly in pediatric population. They are non-progressive and non-contagious. It is actually reported with the physical limitation and motor impairment due to either poor development of brain or any trauma to brain during intrauterine life, natal or postnatally(2) which affects the motor control areas of brain .

1.1. Etiology

It can constitute multiple causes. Some etiological factors are of importance which include birth asphyxia, meconium aspiration, placental abnormalities, genetic defects, neonatal seizures, preterm birth, trauma during birth, maternal infections, kernicterus, iron folic acid deficiency and drug abuse during pregnancy.(3) Children and adults with cerebral palsy usually present with variegated features of vision, cognition, behavior, altered perception and motor impairment with or without convulsions or epilepsy. Communication and behavior may also be challenged(4). It is a non-progressive neurological disorder but the clinical presentations appear with development of child mainly targeting the musculoskeletal system(5). The fundamental problem in cerebral palsy is gross motor dysfunction(6). Cerebral palsy can be classified on the basis of the motor aberration or regarding to the affected part of body. The children with cerebral palsy have relatively feeble selective motor control. They have poor co-activation of antagonistic muscles and muscles activity is therefore disrupted resulting in loss of balance and coordination with inability to ambulate normally(7).

1.2. Classification

According to the motor deficits it can be clinically classified into four types- spastic, ataxic, dyskinetic or also named athetoid and hypotonic(8). It may represent with mixed type which presents the symptoms of more than one type in a single patient(9). Spastic type is the most commonly occurring type cerebral palsy which refers to the increase in muscular tone that is velocity dependent.(10) spasticity is usually the indication of upper motor neuron lesion. Dyskinesia shows the involvement of extra-pyramidal tracts and it can be either choreathetosis which presents with irregular spasms or as dystonic with hypertonicity and limited activity. Ataxia pertains to the loss of control and coordination and commonly

1.3. Rationale/Significance of Study

This study will help to determine the effects of sensory integration protocols on restoring the gross motor function in such individuals with the use of advanced technology like virtual reality training. This will help setting the foundation for further study and designing treatment protocols of the said population.

1.4. Objective of the study

1.5. Hypothesis

1.5.1. Null hypothesis

1.5.2. Alternate Hypothesis

.

2. MATERIALS AND METHODS

2.1. Study Design:

2.2. Sample Size:

2.3. Sampling Technique:

2.4. Study Setting:

2.5. Duration:

2.6. Sample Selection:

2.6.1. Inclusion Criteria:

2.6.2. Exclusion Criteria:

2.7. Data Collection Tools:

2.8. Data Collection Procedure:

2.9. Intervention:

**2.9.1. Experimental Group (VR Training + Sensory Integration Therapy +
Conventional Therapy)**

2.9.2. Control Group (VR Training + Conventional Therapy)

2.10. Data Analysis Procedure:

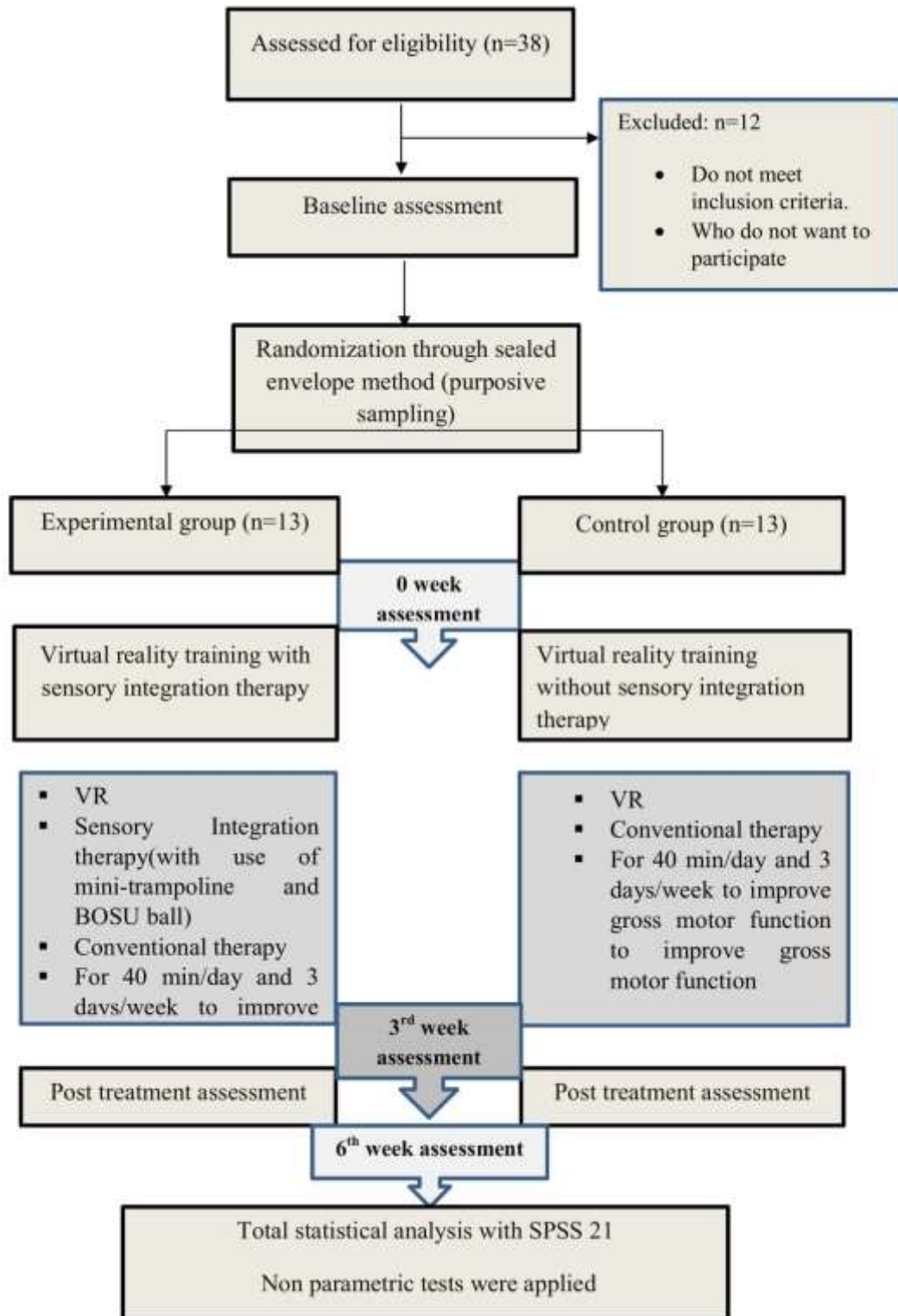


Figure 1: CONSORT Diagram

3. RESULTS

The mean age of individuals in experimental group is 7.75 ± 2.22 and the individuals of control group are 7.27 ± 2.28 .

The percentage of females in experimental group is 16.7% and that of male is 83.3%. The percentage of male in control group is 81.8% and of female is 18.2%.

The percentage of variable of Modified Ashworth Scale in experimental group entails 8.3% individuals with MAS-1 level and 58.3% individuals with 1+ scoring. 33.3% individuals presented with MAS-2 score. In control group 27.3% individuals have MAS-1 score, 54.5% individuals presented with MAS-1+ and only 18.2% with MAS-2 level. The Gross Motor Function Classification System includes 8.3% individuals with level I and 91.7% with level II.

For between group analyses we applied Mann Whitney-U test. For Gross motor function measure sitting domain Mann Whitney-U test showed that there was no significant difference between experimental and control group at baseline with p-value (0.404) and significant difference at 3rd week with p-value (0.00) and significant difference at 6th week with $p < 0.0001$.

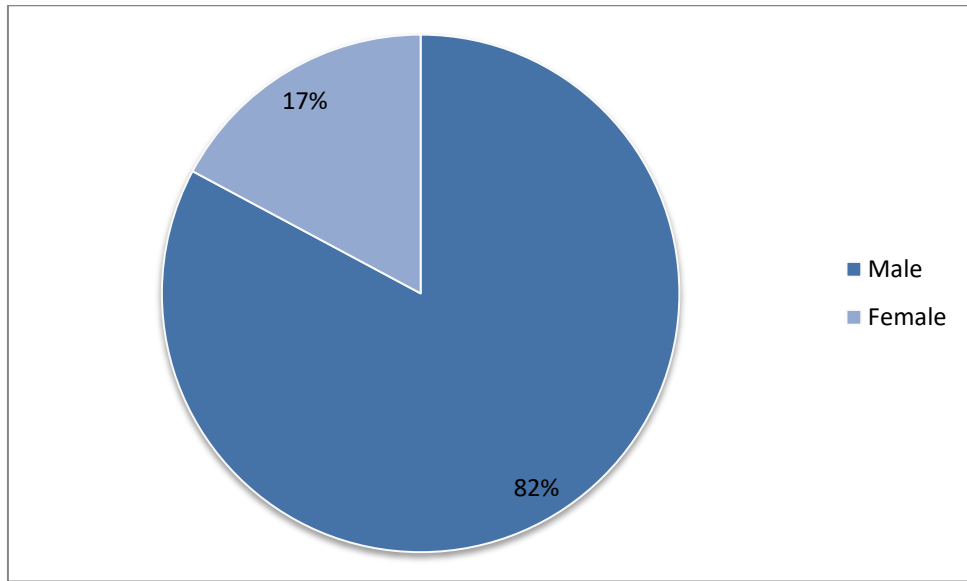


Figure 2: Gender frequency

Table 1: Mann Whitney U-test for PBS and 2MWT

Variable	Group	Baseline		3 rd week		6 th week	
		Median (IQR)	p-value	Median (IQR)	p-value	Median (IQR)	p-value
PBS	Control	20.0(2.00)	.011	24.0(3.00)	.000	30.0(2.00)	<.0001
	Experimental	22.0(2.75)		31.0(3.5)		42.0(1.00)	
2MWT	Control	6.0(1.00)	.397	7.6(1.5)	.000	8.8(0.9)	<.0001
	Experimental	6.4(0.7)		9.4(0.67)		11.0(0.3)	

*Level of significance: $p < 0.001$ *** & $p < 0.05$ ***

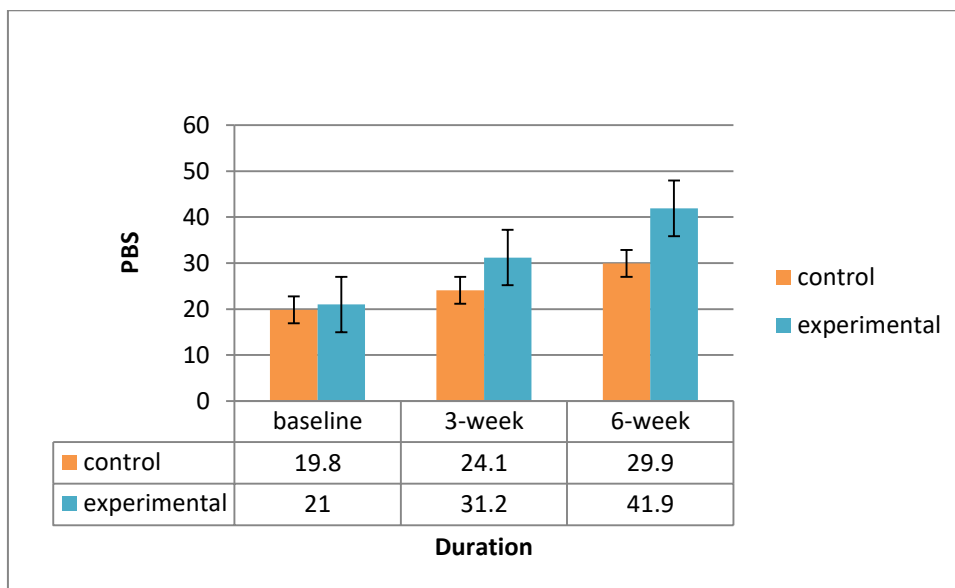


Figure 1: Pediatric balance scale (with-in group analysis)

4. DISCUSSION

The objective of the study was to determine the effectiveness of Fracture Integrated Rehabilitation Management (FIRM) on mobility, activity of daily living and cognitive functioning as compared to conventional physical therapy (CPT) in elderly with hip fracture. The results suggested that participants in both group showed significant improvement in indoor mobility with walker and crutches and activities of daily living. But cognitive functioning was significantly improved only in FIRM group. While comparing both groups after 10th session FIRM group showed significant improvement in stair climbing and mobility with walker or crutches as compared to conventional PT group.

The results of current study suggested significant improvement in walking with crutches or walker and stair climbing ability, in FIRM group as compared to CPT group. Several studies(2,5,7) supported the current study, including a randomized controlled trial performed to evaluate the effectiveness of fragility fracture integrated rehabilitation management (FIRM) following hip fractures in the elderly patients, reported significantly increased mobility and ADL scores, and improved physical functioning in the intervention group as measured by Koval Scale.(2) Norstrom-P et al reported that systematic rehabilitation performed by geriatric interdisciplinary teams, improved the physical function and mobility when compared with conventional care.(7)

There are several studies suggesting that comprehensive rehabilitation program significantly improved mobility and lower the risk of depression among hip fracture patients. In a single-center controlled trial on n=1077 geriatric hip fracture patients aging from 70 years or older, complete geriatric rehabilitation for four months improved mobility significantly as compared to usual orthopedic care.(8) Shyu Yi et al compared three groups of elderly patients (n=229) with hip fracture treated with different approaches: usual care, interdisciplinary care (geriatric consultation, continuous rehabilitation, and discharge planning), and comprehensive care (interdisciplinary care plus nutrition consultation, depression management, and fall prevention). This research found a lower risk of depression and malnutrition in the comprehensive care group than in the interdisciplinary care group 1 year after discharge. Therefore, better functional outcomes can be expected following the

provision of a comprehensive postoperative rehabilitation program to hip fracture patients.(9) In current short duration study FIRM protocol that included comprehensive rehabilitation program provided by rehabilitation physician, physical therapist, occupational therapist, nutritionist, clinical nurse and social worker

In a study by Yea-Ing L. Shyu et al, intervention group elderly hip fracture patients receiving an interdisciplinary program of geriatric consultation, continuous rehabilitation and discharge planning was compared to control group receiving conventional care. The results showed significant improvement in walking ability and fewer depressive symptoms in the intervention group.(10) In another study participants receiving geriatric interdisciplinary rehabilitation at home with those receiving conventional rehabilitation, showed no significant difference in walking ability and use of walking device, however the time spent in hospital was significantly shorter in the geriatric interdisciplinary home rehabilitation group.(5)

The current study did not showed significant difference in FIRM and CPT group regarding improvement of cognitive functioning on MMSE score after 10th session. But a study reported, the results of two year follow up of interdisciplinary rehabilitation program as compared to those receiving routine care, that 75% less likelihood of post-discharge cognitive impairment in patients receiving.(11) Depression and poor cognitive functioning also cause poor physical functioning and daily life activities in hip fracture patients.(12)

5. CONCLUSION

5.1 Limitation of study

5.2 Recommendations

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REFERENCES

1. Arliani GG, Astur DC, Yamada RKF, Yamada AF, Fernandes AdRC, Ejnisman B, et al. Professional football can be considered a healthy sport? Knee surgery, sports traumatology, arthroscopy. 2016;24(12):3907-11.
2. Hall Z, Baxter G, Dong NX, Chou S-F. Prevention Strategies of Traumatic Brain Injury in Football Players. 2018.
3. Sisodia V, Hamid J, Guru K. Efficacy of vestibular rehabilitation in management of balance deficit in Indian collegiate football players, with sport-related concussion—randomized clinical trial. Physiotherapy. 2015;101:e1403-e4.
4. Park E, Baker AJ. Translational Mild Traumatic Brain Injury Research: Bridging the Gap Between Models and Clinical Uncertainty. Neurotrauma: A Comprehensive Textbook on Traumatic Brain Injury and Spinal Cord Injury. 2018:271.
5. Gerard Gasquoin P. Historical perspectives on evolving operational definitions of concussive brain injury: From railway spine to sport-related concussion. The Clinical Neuropsychologist. 2019:1-18.
6. Broglio SP, Collins MW, Williams RM, Mucha A, Kontos AP. Current and emerging rehabilitation for concussion: a review of the evidence. Clinics in sports medicine. 2015;34(2):213-31.
7. Clark MD, Asken BM, Marshall SW, Guskiewicz KM. Descriptive characteristics of concussions in National Football League games, 2010-2011 to 2013-2014. The American journal of sports medicine. 2017;45(4):929-36.
8. O'Connor KL, Rowson S, Duma SM, Broglio SP. Head-impact—measurement devices: a systematic review. Journal of athletic training. 2017;52(3):206-27.
9. Collins MW, Sandel N, Norwig JA, Ruff S. Sport-related Concussion: Experience from the National Football League. Return to Play in Football: Springer; 2018. p. 699-711.
10. Langlois JA, Rutland-Brown W, Wald MM. The epidemiology and impact of traumatic brain injury: a brief overview. The Journal of head trauma rehabilitation. 2006;21(5):375-8.
11. Alsalaheen BA, Mucha A, Morris LO, Whitney SL, Furman JM, Camiolo-Reddy CE, et al. Vestibular rehabilitation for dizziness and balance disorders after concussion. Journal of Neurologic Physical Therapy. 2010;34(2):87-93.
12. McCrea M, Guskiewicz K, Marshall S, Barr W, Randolph C, Cantu R, et al. Acute effects and recovery time following concussion in collegiate football players. Br J Sports Med. 2004;38:369-71.
13. McCrea M, Guskiewicz KM, Marshall SW, Barr W, Randolph C, Cantu RC, et al. Acute effects and recovery time following concussion in collegiate football players: the NCAA Concussion Study. Jama. 2003;290(19):2556-63.
14. Balatsouras DG, Koukoutsis G, Aspris A, Fassolis A, Moukos A, Economou NC, et al. Benign paroxysmal positional vertigo secondary to mild head trauma. Annals of otology, rhinology & laryngology. 2017;126(1):54-60.

ANNEXURES

Anexure 1: Consent form (English)

Anexure 2: Consent form (Urdu)

Anexure 3: Demographics form & Questionnaires

Anexure 4: Permission Letter

Annexure 5: IRB/ERB Letter

Annexure 6: REC Letter

Anexxure 6: Data Completion Certificate

Anexure 8: Plaiagerism Report