COMPARISON BETWEEN NINTENDO WII FIT GAME THERAPY AND TASK SPECIFIC TRAINING ON GROSS MOTOR FUNCTION AND BALANCE IN SPASTIC DIPLEGIC CEREBRAL PALSY

A Dissertation Submitted to

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LOVELY PROFESSIONAL UNIVERSITY

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Punjab, 144411 December 2017

CERTIFICATE

This is to certify that the dissertation work entitled " COMPARISON BETWEEN NINTENDO WII FIT GAME THERAPY AND TASK SPECIFIC TRAINING ON GROSS MOTOR FUNCTION AND BALANCE IN SPASTIC DIPLEGIC CEREBRAL PALSY" was carried out by Miss GIDA MONI, Register No.11512752

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CERTIFICATE

This is to certify that Miss GIDA MONI, Register No.11512752 has completed MPT dissertation work entitled entitled " COMPARISON BETWEEN NINTENDO WII FIT GAME THERAPY AND TASK SPECIFIC TRAINING ON GROSS MOTOR FUNCTION AND BALANCE IN SPASTIC DIPLEGIC CEREBRAL PALSY" under my guidance and supervision.To the best of my knowledge, the present work is the result of her originalinvestigation and study. The dissertation is fit for the submissionand the partial fulfilment of the conditions for the award of MPT(Neurology).

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DECLARATION

I hereby declare that dissertation titled "COMPARISON BETWEEN NINTENDO WII FIT GAME THERAPY AND TASK SPECIFIC TRAINING IN GROSS MOTOR FUNCTION AND BALANCE IN SPASTIC DIPLEGIC CEREBRAL PALSY" submitted for the MPT synopsis is entirely my original work.

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ABSTRACT

Background and purpose– Nintendo wii fit game therapy and task specifc training both are based on task activity intervention used as to improves balance and gross motor function in cerebral palsy children.The aim of the study was to examine the comparison between Nintendo wii fit and task specific training on gross motor function and balance in spastic diplegic children

Subjects and methology- A randomized clinical trail was conducted on 10 children daignosed with spastic cerebral palsy,aged 6 to 12 years with gross motor function classification system (edited and revised version) level II,III, manual activity classificationsystem level II,were included in study. Children were excluded if they taking any medication that that could influence functional ability, any orthopaedic procedure of upper and lower limbs, cardiac anomalies, visual and auditory deficits. Group A(Nintendo wii fit) and group B(task specific training). Both the groups underwent 45 minutes of intervention session a day, 5days a week for 5 weeks. Gross motor function measure -88 scales and pedriatric balance scale

Results- post intervention there was a greater improvement in balance and gross motor function in both group A(6.98) and group B(4.775). p value $p<0.5$ in both groups after intevetion. Nintendo wii fit (group A) shows more improvement on gross motor function and balance as compare to task speciif training(group B).

Conclusion- Nintendo wii fit game therapy was more effective then task specific training in improving gross motor function and balance among spastic diplegic cerebral palsy children.

Key words- cerebral palsy, spastic diplegic, nintendo wii fit, balance.

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1.1 INTRODUCTION

Cerebral palsy is defined as a group of neuro developmental disorders which is a affecting the developmental movement and body alignment leading to various limitations such as activity limitation, it is an non progressive disorders. These all occurs in development of brain of an infant. The major disorders of cerebral palsy are often accompanied by sensation disturbances, perception, cognition, communication, seizure and behavioural problems. Incidence of cerebral palsy in worldwide which is approximately 2 cases per 1000 live births and 44% of total incidence of spastic diplegic cerebral palsy[1.] In India ,it is estimated at around 3 cases per 1000 live birth . A study conducted in Jalandhar district of Punjab reported the prevalence of spastic diplegic as 43%[2]. The physical representation of cerebral palsy are neuromuscular dysfunction which causes selected motor functions, abnormal muscle tone that causes the imbalance between agonist and antagonist muscles, coordination impairment , weakness and sensory disturbances[3]

Spastic diplegic cerebral palsy is the most widespread type of cerebral palsy having more motor impairements in the lower extremities than the upper extrimities majorly affecting functional performance, gait [4]. They typically walk slowly and have difficulty in perfoming activities such as walking, climbing or running. The different types of gaits are present - scissoring, crouched and walking gaits which are categories by particular weakness on the trunk with lower extremities spasticity, hyper flexion of knee and hip because of impaired plantar flexors of ankle . Scissoring gait is characterized by significant knee and hip extensors with adductor tightness of lower extremities, crouched and walking gaits are because of weakness in dorsiflexors of foot.[5]

Balance impairment are the main cause for the motor development disorder in cerebral palsy children. These children demonstrate a number of limitations caused by instability on the

performance of static and dynamic tasks[6]. In children with cerebral palsy, Balance impairments because of trunk instability which is marked from the better oscillation of the centre of pressure in the anteroposterior and mediolateral directions [7] Balance control is very essential to make the postural movement of the body and its already proved as a primary source of producing ambulation in cerebral palsy children [6] . Many children with diplegic cerebral palsy have poor balance control and gross motor function skills(1). The contributing factors for the above is poor balance control. Balance control is very essential in initiating to perform the functional movements, which is very useful and benefits for a child to overcome from balance impairments/disorders.

Delayed gross motor function development is very common in cerebral palsy child, it has been related to functional outcomes such as activities of daily living. It involves movement of the large group of muscles in upper and lower limb[6]. Poor walking abilities, movement management skill is common in diplegic child [8].In order to help cerebral palsy children to regain their functional independence, numerous physiotherapy techniques involving traditional and new emerging approaches are practised. Traditional techniques includes stretching exercises, active and passive range of motion exercises, sitting, standing and walking activities[7]. New emerging approaches includes, sensory integration, roods approach , propioceptive neuromuscular facilitation,bobath.

Task oriented training is the most important method used in children with cerebral palsy and has shown to be very effective in improving the performance, promoting intensive, meaningful , and goal oriented training [10]. play activities one of the component of task oriented training. It is very beneficial by the means of recent principles of motor learning training program in task specific is most pertinent. Which involves functional movements practise related to daily living activities. It is shown as the activities of task specific training results a best improvement in functional movement of cerebral palsy. Functional task which

is generally using our daily activities of life like static and lively balancing activities involves sitting, sit to stand and standing.[11]

The present and novel approaches has introduces to evaluate motor which is connected with computer systems, such as virtual reality training which involves numbers of versions and different training devices which make use of video games through a devices like Nintendo wii fit virtual reality rehablitation has been introduced[12]. The motivation with the ability to modify the therapy provide by the contact with the virtual environment[13]. Make virtual reality an significant rehablitation tool which offers sensorimotor experience that are or else unfeasible in common therapies, Nintendo wii fit is low cost, commericially accessible gaming devices for rehabilitation of a children with cerebral palsy. On the other hand, in this study we aspire to use the Nintendo wii which includes balance board and remote both are sensor. The Nintendo wii motion remote and balance board sensor device also allow players to interrelate with what they see on the screen by tracking the body movement. The feasibility of Nintendo wii system obtainable.

The outcomes measures for gross motor function and balance in spastic diplegic cerebral palsy children are gross motor function classification(GMFMCS), pediatric balance scale(PBS) a modified version of berg balance scale(BBS), to test the psychometric properties of world health organization quality of life(WHO QOL-BREF), dynamic balance scale, functional motor performance, FULL-BESTest and Mini-BESTest. And there is numbers of noval approach are also introduced which showed a greater improvement in balance and gross motor function in spastic diplegic cerebral palsy children such as virtual reality game therapy with variety of version like Nintendo wii fit game therapy, partial body weight supportive trademill training (PBWSTT).

The gross motor function classification (GMFMCS) has developed to identify severity of functional limitation,disability of children with cerebral palsy[2]. Studies investigation the profits of balance activities of cerebral palsy children has classify the benefits of balance recovery transform into more effective gross motor function has shown the improvements by gross motor function measure. The gross motor functional measurement is used to assess children with cerebral palsy who are between the ages of 0-18 years[8].

The pediatric balance scale (PBS) which is using from longer period of time to assess balance impairments in motor development disorder of cerebral palsy children which is very reliably used and also very beneficial in neurological problems/disorder[14] .PBS allows evaluation of balance dysfunction in a time dependent manner , including changes with age and treatment[15] . Because pediatric balance scale is easy to use and require minimal equipment, it has been widely applied and therefore, translated into atleast nine languages[16].

1.2 NEED OF THE STUDY-

Nintendo-wii fit and task specific training have been prove to be helpful for getting better gross motor function and balance in children with cerebral palsy. Both interventions contain their own different principles. Task specific Training based on motor learning principle and lively participation training of the child, while Nintendo-wii fit mechanism on the principle of instant visual and sensory feedback which motivates the patient and create a sole environment for exercise. readily available be short of literature to sustain the declaration that one therapy is valuable in excess of the other in Spastic diplegic cerebral palsy children. This study is life form undertake to compare both these approaches so that a improved and effectual treatment for getting better functional aptitude be able to be recognized.

1.3 Significant of the study-

A key constituent of this approaches to use of low, commercially of newly accessible health gaming virtual reality training Nintendo wii fit and task specific training. The thought is to use the recently developed techniques for motor function and balance in spastic cerebral palsy which is a major incidence and prevalence in world. This study resolve compare both these efficacy and approaches of task specific training and Nintendo wii fit game therapy on gross motor function and balance so, that a improved and effectual treatment for getting better functional recognized

1.4 AIMS & OBJECTIVES-

Aim of this study is to compare the effects of Nintendo wii fit and Task Specific Training (TST) in improving the gross motor function and balance in spastic diplegic Cerebral palsy children.

Objectives:

1. To find the effect of Nintendo Wii Game Therapy and Task Specific Training on:

gross motor function;

balance

1.5 RESEARCH HYPOTHESIS

Null Hypothesis:

There is no significant difference between Nintendo Wii fit (N-Wii) and Task Specific Training (TST) on improves gross motor function and balance in spastic diplegic cerebral palsy children.

Alternate Hypothesis:

There is significant difference between Nintendo Wii fit(N-Wii fit) and Task Specific Training (TST)in improving gross motor function and balance in spastic diplegic cerebral palsy children.

1.6 OPERATIONAL DEFINATION-

Cerebral palsy is the group of muscle disorders which is not developing disorder. It is appearing in the early developing brain and result in cluster of disorders depends on the past of brain affected and give different clinical features, it is also called as neurodevlopmental disease.[3]

Spastic cerebral palsy its an upper motor lesion where pre motor cortex is affected mainly planning and control voluntary movements is impaired. Clinical features are lower limb muscle are affected first and it become very tight and stiff muscle which create scissoring and toe walking gaits .[5]

Nintendo wii fit ,this approaches to use of low, economically newly accessible health gaming virtual reality training. Mechanism on the principle of instant visual and sensory feedback which motivates the patient and create sole environment for exercises. Readily available to sustain the decleration that this therapy is valuable in excess of cerebral palsy.[15]

Task specific training based on motor learning principle and lively participation training of the child. It has been shown the perform of task specific activities outcomes is an best improvement in functional movement in spastic cerebral palsy children.[11]

2 LITRATURE REVIEW

1.Yeon et al 2016, studied the effectiveness of task oriented training and highly changeability training programme on GMFM in seven cerebral palsy diplegic children. The group A (con trol group) receives NDT x 40 minutes, group B and group C receives standard physiotherapy

intervention implement a TOT(task oriented training) and group D (highly changeability training) x 60 minutes 2/week x 8 weeks. The study concluded that applied high changeabili ty training in a TOT it might be consider abn effective treatment in improving motor perfor mance skill which enhance the daily living activity through motor performance training and learning of new techniques as well as new skill of learning in a complex environment and same response in high variability practise.

2.Sharma raju et al. 2015 prevalence of cerebral palsy in India, reported that spastic cere bral palsy(83.46%) was the most prevent type of cerebral palsy in jalandhar district of Pun jab. In different forms different forms of spastic type, diplegic had the major presentation. conducted a survey using physical examination of child and schedule interview of parents on 248 children with cerebral palsy of age group 3-13 years. Reported that Spastic cerebral palsy(83.46%) was the most prevalent type of cerebral palsy in jalandhar district of Punjab. In spastic type diplegia has been major presentation (43%), follow by quadriplegia (34%), majority of children fall in level V (57%,) of (GMFCS **) .**

3.Hsui ching chiu et al 2015, studied the evidence for the use of virtual reality in spastic ce rebral palsy on less than 18 years children at whichever level of motor limitation of impair ment. The effects was balanced even after the end of treatment. Randomized control trail in tervention tool was used. Games are used in this study are nintendon wii fit, eyes toys, ex treme play gesture, custom engineer equipments. And they concluded that virtual reality can be helpful as a treatment purpose for the children who's showing interested in playing games and keep in exercise activities particularly to those children having difficulties in real envi ronment because of physical limitation level.

4. Yuping Chen et al 2015 studied the effectiveness of a home based virtual reality inter

vention in 3 children with Cerebral Palsy and children with typical development using super pop virtual reality evaluation metrics. The duration of VR intervention was 30 min x 5 ses sion/wk x 8 wk using commercial eye toy play VR system. Results shows 2/3 participants of cerebral palsy better getting kinematics in pathway measurement lengthwise, progress time, number of activities and shoulder joint range of motion.

5. **Thais Massetti et al 2014** studied the effectiveness of Motor learning through VR in Ce rebral Palsy. Interventions given were virtual reality, Neuromotor intervention. This study suggest the profits and advantages of using virtual reality game therapy in cerebral palsy children improve in GMFM and also benefits in motor learning activities with trained transfer to daily activities of living.

6. Wannisa kumban et al 2012, studied the effectiveness of task specific training with a ran domized Control trail on functional abilities in 21 cerebral palsy children with their impair ment limitation (mild-moderate). controlgroup received conventional therapy and experiment tal group received task specific training, 20min/session x 3 session /wk x 6week. The study concluded an extra activities programes like sit-stand training which improves the functional abilities of cerebral palsy children the results suggested that subjects who showed a good functional balance took less time to achieve the five time sit to stand , while subjects classified as GMFCS-E&R level III, who used Assistive devices and had difficultly doing activities including sit-to-stand movement, showed a lower score on Pediatric Balance Scale.

7. **Kim M. et al 2012 studied** the dependability and sensitivity of the GMFM-88 in 84 in ce rebral palsy children. They concluded that by using of GMFM is excellent (ICC_S=0.952-the results suggested that subjects who showed a good functional balance took less time to achieve the five time sit to stand , while subjects classified as GMFCS-E&R level III, who used Assistive devices and had difficultly doing activities including sit-to-stand movement, showed a lower score on Pediatric Balance Scale.**7.Kim M. et al 2012 studied** the dependability and sensitivity of the GMFM-88 in 84 in cerebral palsy children. They concluded that by using of GMFM is excellent (ICC_S=0.952-1.00), results showed the

reliability relation. Results shows both the reliability and the responsiveness of the GMFM-88 are sensible for measure gross motor function in cerebral palsy children.

8. **Her J. Et al 2012**, they proposed a study to use a reliability paediatric balance scale which is a modified version of burg balance scale, which includes on the basis of literature review with the express aim of extremely reliable scale to use in functional mobility outcome meas ure .The study shows the retest reliability of paediatric balance scale is highly reliable (ICC=0.998) and the inter rater reliability is also satisfactory (ICC=0.9987).

9. Michelle Rang et al 2011 reviewed on virtual reality in Paediatric Neurorehabilitation. This literature review focused on the types of VR systems that are used as treatment tools to address the primary impairments of children with ADHD, Autism and Cerebral Palsy. The review suggested that, the potential of using VR in children with disabilities hopefully stimu lated interest and discussion for continued use and research with virtual technology within the field of Paediatric neurorehabilitation.

10. Munchee choi et al 2011, studied the effectiveness of task oriented training and NDT(neurodevelopmental training) conducted randomized controlled trail. Intervention was in sitting position over 10 children on spastic cerebral palsy caused by premature birth. The study concluded group A(control group) receives neuro developmental training(NDT) and group B(intervention group) receives task oriented training(TOT) for 5 times/week x 6 weeks. The approaches of group A and group B intervention for muscles enhancement and improve sitting, both shows great improvements in cerebral palsy children.

11. Kasturi Agnihotri et al 2010 conducted a cross-sectional study to test the psychometric properties of World Health Organization Quality of Life (WHO QOL-BREF) instrument in 525 Indian adolescents with mean age of 14.04±2.09 yr. The instrument showed good inter nal consistency (Cronbach's a=0.87; p-value<0.01) as well as good content, construct and predictive validity (p values< 0.05). Psychological domain had best predictive validity, whe reas, social relations domain had best content validity. The study concluded that a revised WHO QOL-BREF is a reliable and valid instrument and can be used in Indian adolescents.

12. Yasser Salema et al 2009 conducted a single blinded randomized controlled trial with pre

post training evaluations on ten subjects with cerebral palsy (GMFCS- I-III). Control group

received conventional physiotherapy and experimental group received task oriented strength training for 2/wk x 5 wk. Studied that the effectiveness of task oriented training on cerebral palsy children improved activities in various mobility functions.

13.Denise T Reid et al 2006, studied a pilot randomized study which concluded the efficacy of virtual reality to improves upper limb effectiveness skill in spastic cerebral palsy children of age 8 to 12 years. The intervention consisted of use of desktop virtual reality (mandala gesture xtreme technology) for 1 session/ day x 8 weeks. This study have evaluated the bene fits results in improving upper limb skills which is measure by quality of upper extremity test (QOUET) and Bruininks'oseretsky test of motor proficiency. A correct percentage measure to 4 children of spastic cerebral palsy. Following the 8 session of intervention, children showed varying levels of improvements in aspects of quality of upper extremity skills. The study results suggested the viability of virtual reality based intervention as a part of rehabilitation process for children with cerebral palsy.

14.Gay Review et al 1993 conducted a randomized controlled trial to analyze the effect of 8 intensive training sessions of task specific interventions on 24 children with uncoordinated movements. The training consisted of over arm throw, hopping, target kicking, volleyball bounce and catch tests. The results concluded that its shows great learning activities which is beneficial

for both groups and it improve a significant profits between both groups. Result of the study suggested that task specific interventions improved kicking, throwing, bounce catch tasks for children with poor coordination. Pediatric balance scale.

3.6 PARAMETERS

1.Gross motor function

2.balances

3.7 MATERIALS AND TOOLS:

Armless chair,

rope

Tape measure,

paper,

Stopwatch,

chair ,

marker

Nintendo wii fit game system,

TV screen or doungal

Wooden blocks of various height

Adjustabl

3.MATERIALS AND METHODS :-

3.1 STUDY DESIGN: Comparative study (Single blinded Randomized Clinical Trial)

3.2 STUDY SETTING: Pingla Ghar, phagwara

3.3 POPULATION AND SAMPLING : Spastic diplegic palsy and simple random Sampling

SAMPLE SIZE - 10 subjects

3.4 SELECTION CRITERIA-

3.4.1 INCLUSION CRITERIA:

1. Spastic diplegic Cerebral palsy children

2. Age - 6-12 years[2,6]

3. Gross motor functional classification scale-E&R of levels II or III[5] ;

4. Subjects with MACS(manual activity classification system)- Levels-I, II, III

5. functional range of lower limbs and upper limbs range of motion.

6. can able to follow the comments and communicate.

3.4.2 EXCLUSION CRITERIA:

1. Taking any medication that could influence functional ability.

2. Any orthopaedic disorder of the upper and lower limb.

3. Any cardiac anomalies

4. any chromosomal anomalies

5.Visual and auditory deficits

3.5 OUTCOME MEASURES:

Gross motor function score- basic motor abilitie

GMFM 88 & 66 scale chair

GROUP OF RINGS

FIVE STEPPED STAIR WITH RAMP CONNECTION

ADJUSTABLE CHAIR WITH SIDE ARMS

FOAM ROLLER AND STICK

MARKER PENS

FOOTBALL

MEASURING TAPE

STOPWATCH

FIGURE NO.1-

FIGURE- 2 VITUAL REALITY GAME THERAPY SET UP

FIGURE NO.3-CHAIR AND TABLE

3.8 PROCEDURE:

10 spastic diplegic Cerebral palsy patients with impaired functional ability will be assessed according to the inclusion and exclusion criteria and will be allotted to the groups by simple Random Sampling. Written informed consent was obtained from patients prior to the study. Total of 10 subjects were screened, out of which 10 were included in the study based on inclusion and the exclusion criteria. Prior to allocation

into the groups baseline measures were recorded. Baseline measure included gross motor function measure and pediatric balance scale. Subjects were randomly allocated in group A and group B by lottery method. Subjects were asked to pick a chit from a bowl containing folded chits numbered from 1 to 10 chits with odd number were allocated to group A and chits with even number were allocated to group B. The baseline outcome measure were assessed using gross motor function measure and pediatric balance scale. Group A Nintendo wii fit based on the principle of instant visual and sensory feedback which motivates that and creats a sole environment for exercise and group B task specific training based on motor

learning principle and lively participation training of the child. Duration of treatment for both groups was 45minutes/day 5days a week for 5 weeks. At the end of 5 weeks of intervention, post intervention outcome measures were assessed.

GROUP A[4]: group A received Nintendo wii fit game therapy for 45 min session.

The session included activities are Boxing ,tennis, golf, so that subject will try to reach for, transfers activity, taking the object and trying to move the arm in whole session. Each of these activities were performed for 10 minutes with 2-3 minutes rest in between each activity for a total duration of 45 minutes 5days/week for 5weeks. A performance score and graph is shown to the participants after finishing of each activity (win or loose).

FIGURE NO.4-CHILD PLAYING NINTENDO WII FIT GAME THERAPY

GROUP B[16] : group B received task specific training based on motor learning principle. The activities included daily activity of living such as walk,sit-stand activities and climbing up and down to stairs.

Activities in sitting:-

-getting up from a chair

-therapist facilitated the subjects by handling the subjects pelvis

-the subject was asked to grasp a wooden stick with both hands held in front of them

-the subject was asked to reach forward to hit the ball held by subject parents in both frontal and transverse planes.

Activities in standing:-

Position of the therapist-therapist stood behind the subject and facilitated by handling the pelvis.

-activities in walking such as walk forward, backward, side way and also walk over an obstacles.

-walk up and down on the ramps and stairs(ascending and decending from stair and ramps)

-step forward ,backward and sideways

-stand on one leg stance

-kicking a plastic ball

Each activities were performed for 45minutes with 2-3 minutes rest in between .

each activity for a total duration og 45 minutes 5 days/week for 5 weeks.

starting position reaching activities from left to right(transverse plane)

ending position reaching activities in(sagital plane)

Grasping a wooden stick

Standing on one leg stance

Sitting on chair

FIGURE NO.5-
starting positionreaching activities from left to right(transverse plane)

FIGURE NO.6-
ending position reaching activities in(sagital plane)

FIGURE NO.7-
Grasping a wooden stick

FIGURE NO.8- STANDING ON ONE LEG STANCE

FIGURE 9-SIITING ON CHAIR

Figure NO.9-STANDING FROM CHAIR

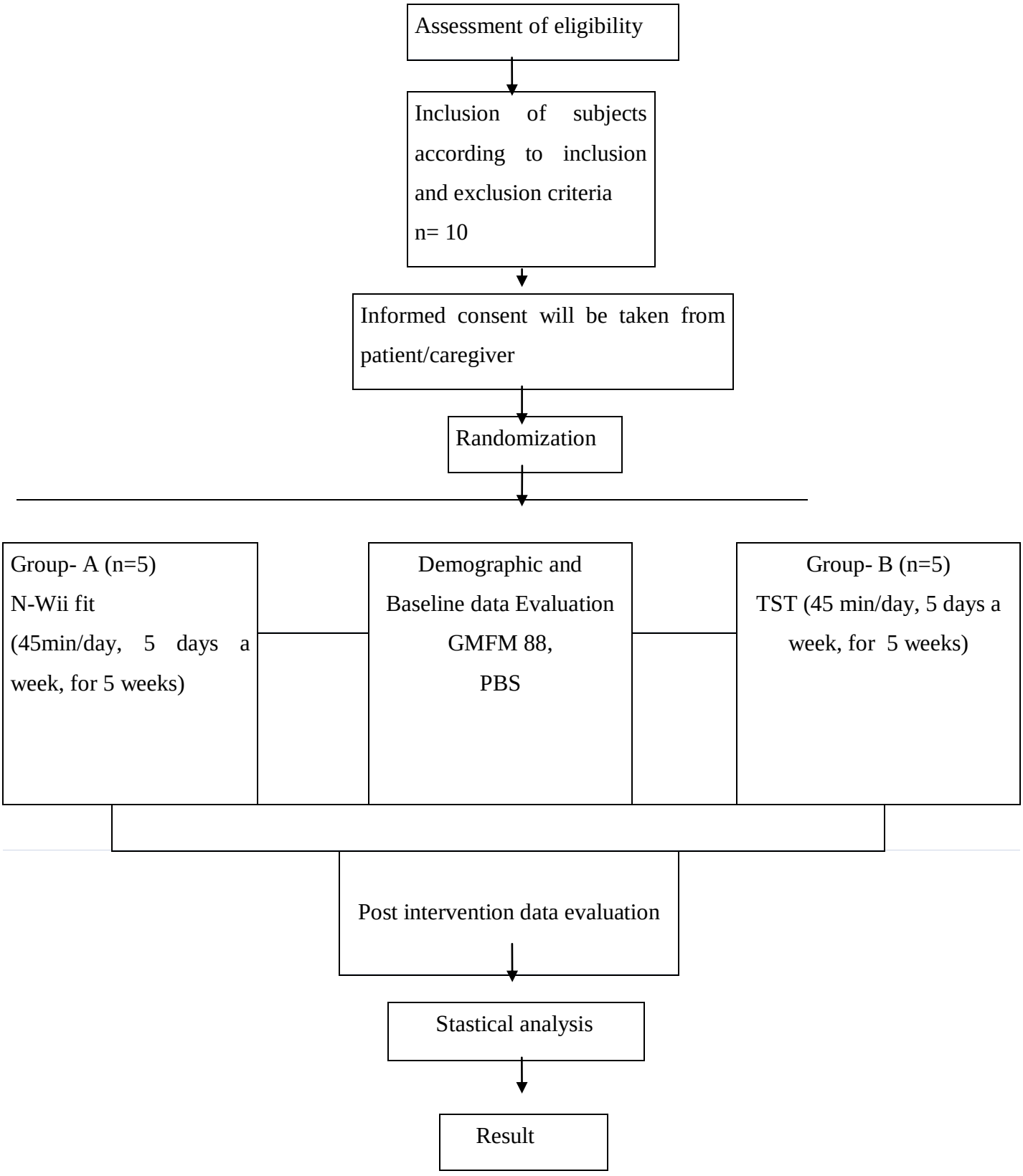
Ascending

Figure NO .10-ASCENDING TO STAIRS

Figure NO.11-DECENDING FROM STAIRS

Figure NO.12- CLEARING AN OBSTACLE

DATA COLLECTION PROCESS (FLOW CHART)



3.8 STATISTICAL TOOL

Data were analyzed using SPSS version 16. Demographic variables were evaluated by student unpaired t test for continuous measures and chi-square test for dichotomous measures. The equality of variance for continuous variable were evaluated by Levene's test. Statistical tests used to analyze the within group and between group comparison were Paired sample T test and Independent T test respectively. The results were concluded to be statistically significant with $p < 0.05$ and highly significant with $p < 0.01$. The effect size index (d) was calculated for each outcome measures using the formula $M_A – M_B/SD$ where M_A and M_B are the means of experiment and Control group respectively and SD is pooled standard deviation. *d*wasdefined by using the Cohen's classification of effect size index, where d = 0.2 considered as small effect size, *d* = 0.5 considered as medium effect size and *d* = 0.8 considered as large effect size.

RESULTS-

DATA ANALYSIS AND GRAPHICAL REPRESENTATION

. Ten subjects with mean (SD) age of 9 and 12 age were recruited to Group A and Group B respectively. Baseline demographic and clinical characteristics are shown in Table 1. A greater part of the study subjects were males with 60% and females with 40 % in both group A and B. The mean age of group A was 7.36 and that of group B was 8.74 and there was no significant difference in the age of both the groups as P<0.5. As seen in the table 3, the study included the patients with scissoring gait and crouching gait of 60% and 40 % respectively.

Table No:1 This table Shows the percentage of males and females in the study

Group	Group A	Group B
Male(%)	60.0	60.0
Female(%)	40.0	40.0
Male(f)	3	3
Female(f)	2	2

Figure No:1 Shows the percentage of males and females in the study

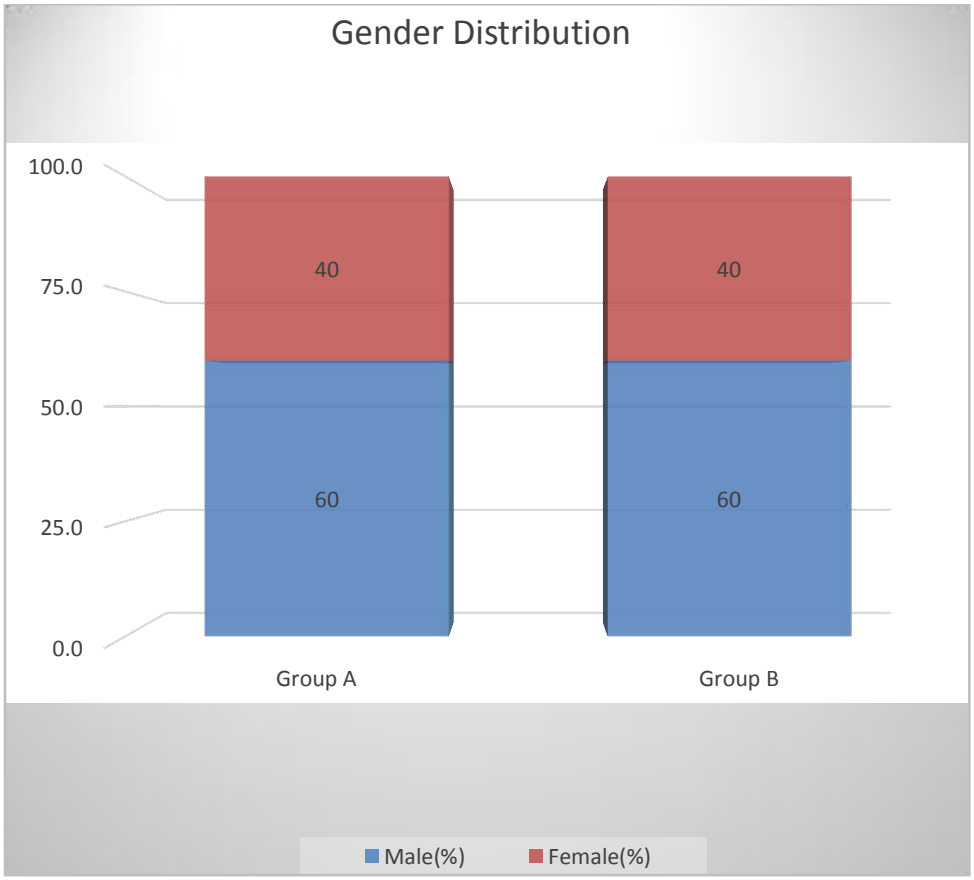


Table No:2 shows the comparison of age in both group A and group B

Comparison of Age	Age	
	Group A	Group B
Mean	7.36	8.74
S.D.	1.189	1.006
Mean Difference	1.38	
Unpaired T Test	1.981	
P value	0.0829	
Table Value at 0.05	2.31	
Result	Not-Significant	

Figure: 2 shows the comparison of age in both group A and group B

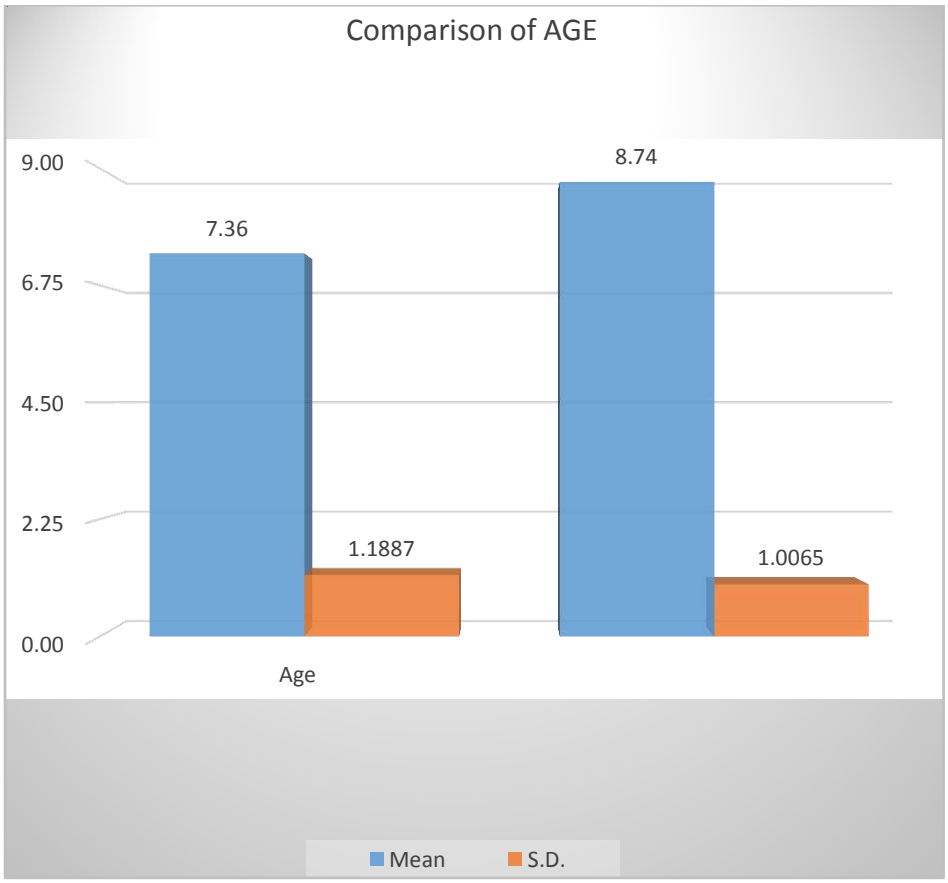


Table No:3 shows the percentage of gait with scissoring and crouch.

Variables	Opts	NINTENDO WII FIT (%)	TASK SPECIFIC TRAINING (%)	NINTENDO WII FIT (F)	TASK SPECIFIC TRAINING (F)
GAIT	SCISSORING	60	60	3	3
	CROUCH	40	40	2	2

Figure No:3 shows the percentage of gait with scissoring and crouch.

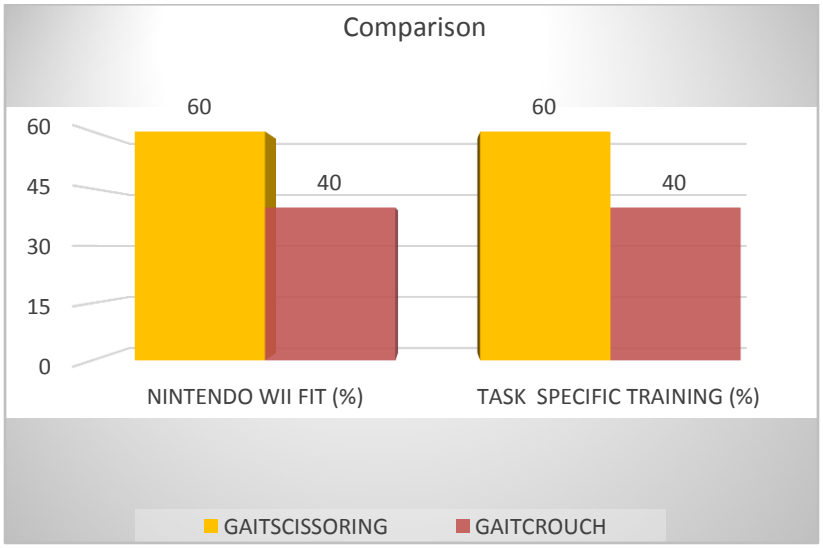


Table No:4 show comparisons of pre and post test of GMFM in Group A

Paired T Test	Group A	
	GMFM	
	PRE	POST
Mean	81.34	90.31
S.D.	8.508	3.796
Mean Difference	8.96	
Paired T Test	3.114	
P value	0.0357	
Table Value at 0.05	2.78	
Result	Significant	

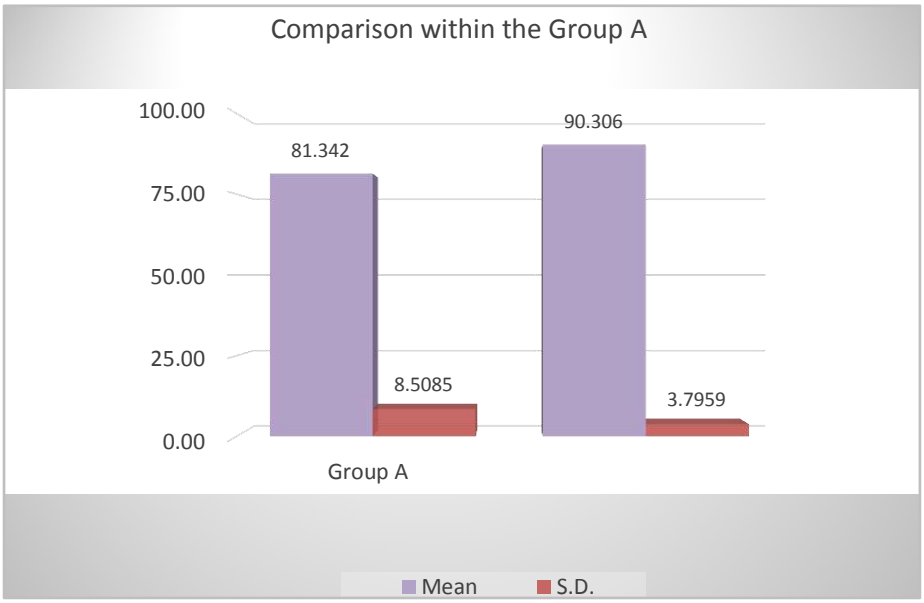


Figure No:4 show comparisons of pre and post test of GMFM in Group A

Paired T Test	Group B	
	GMFM	
	PRE	POST
Mean	82.63	83.86
S.D.	4.366	4.058
Mean Difference	1.24	
Paired T Test	3.674	
P value	0.0213	
Table Value at 0.05	2.78	
Result	Significant	

Table No:5 show comparisons of pre and post test of GMFM in Group B

Figure No:5 show comparisons of pre and post test of GMFM in Group B

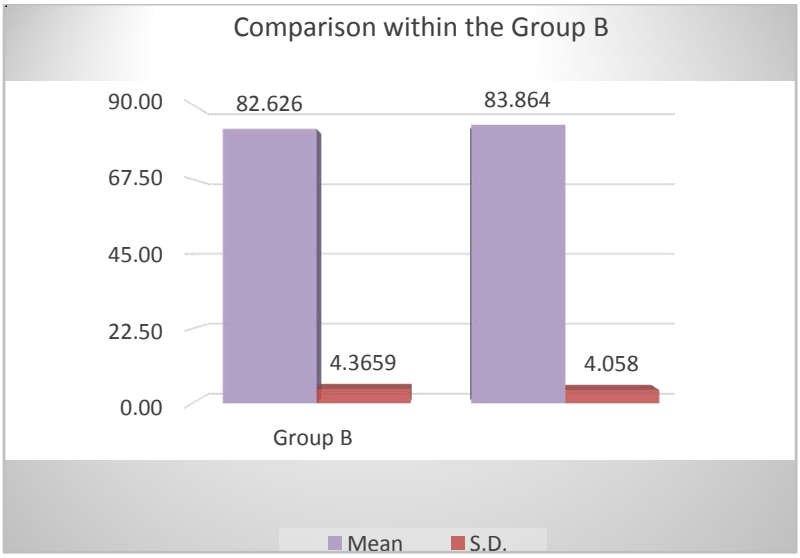
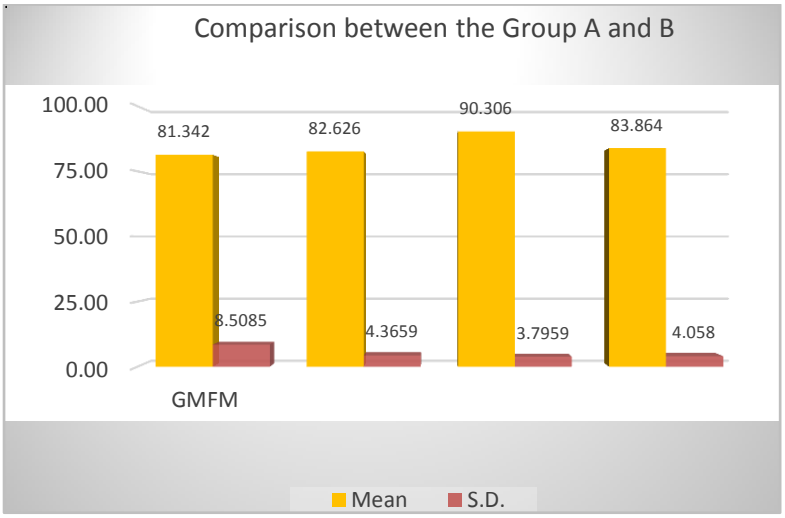


Table No:6 shows the comparison of pre and post test values of GMFM between Group A and Group B

Unpaired T Test	GMFM			
	PRE		POST	
	Group A	Group B	Group A	Group B
Mean	81.34	82.63	90.31	83.86
S.D.	8.508	4.366	3.796	4.058
Mean Difference	1.28		6.44	
Unpaired T Test	0.300		2.592	
P value	0.7717		0.0320	
Table Value at 0.05	2.31		2.31	
Result	Not-Significant		Significant	

Figure No:6 shows the comparison of pre and post test values of GMFM between Group A and Group B



GMFM scores

In this study Group 1 received Nintendo wii game therapy and Group 2 received Task specific training. In the Nintendo group we found that there is an difference in the pretest and poest values of GMFM suggesting nintendo wii fit training is beneficial in improving the GMFM scores of spastic diplegia cerebral palsy children. Like wise we found that there is an difference in the pretest and post-test value of GMFM in the Task specific training group which also suggest that task specific training is helpful in improving the GMFM of spastic diplegia cerebral palsy children. But when we compare the effect of Nintendo group and Task specific training group, the base line values of pretest of both groups has no statistically significant difference but the post test values of GMFM of both groups were found statistically significant difference suggesting there is a difference in the effect of both the treatments. The study found that Nintendo wii game therapy was better than Task specific training treatment in improving the GMFM scores of spastic diplegia cerebral palsy children.

Table No:7 show comparisons of pre and post test of PBS in Group A

Paired T Test	Group A	
	PBS	
	PRE	POST
Mean	37.20	46.40
S.D.	6.611	6.986
Mean Difference	9.20	
Paired T Test	9.489	
P value	0.0007	
Table Value at 0.05	2.78	
Result	Significant	

Figure No: 7 shows comparisons of pre and post test of PBS in Group

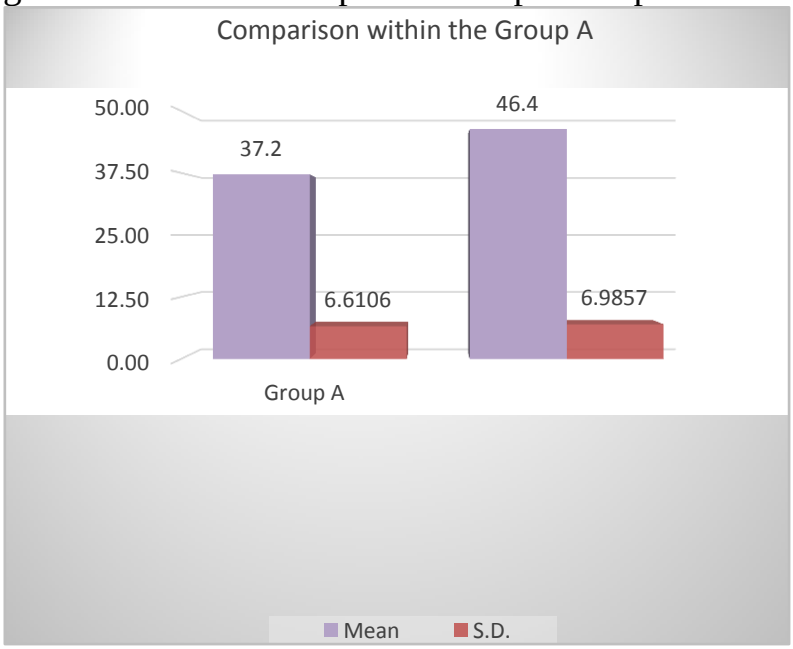


Table No:8 shows comparisons of pre and post test of PBS in Group B

Paired T Test	Group B	
	PBS	
	PRE	POST
Mean	36.60	37.60
S.D.	4.506	4.775
Mean Difference	1.00	
Paired T Test	3.162	
P value	0.0341	
Table Value at 0.05	2.78	
Result	Significant	

Figure No: 8 show comparisons of pre and post test of PBS in Group B

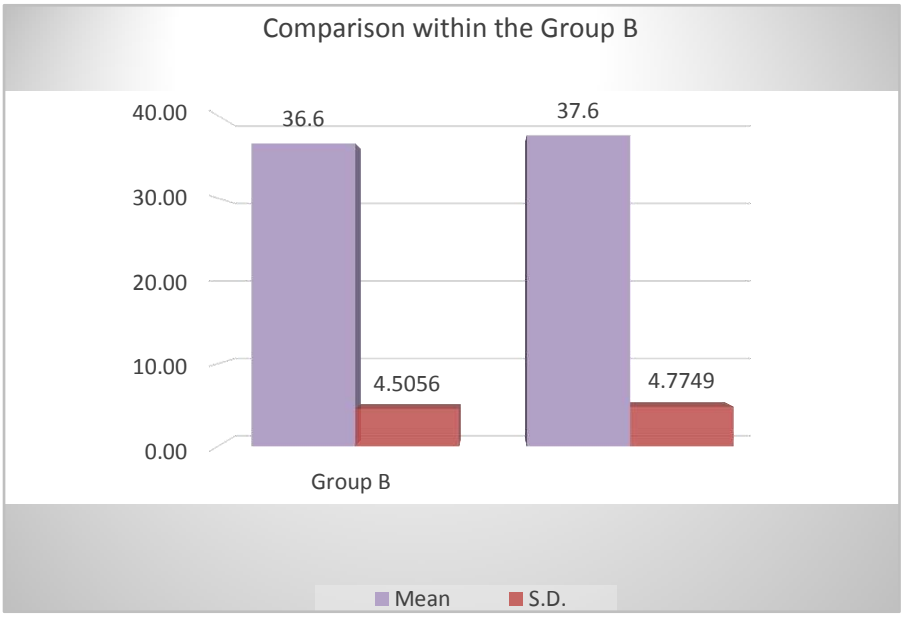
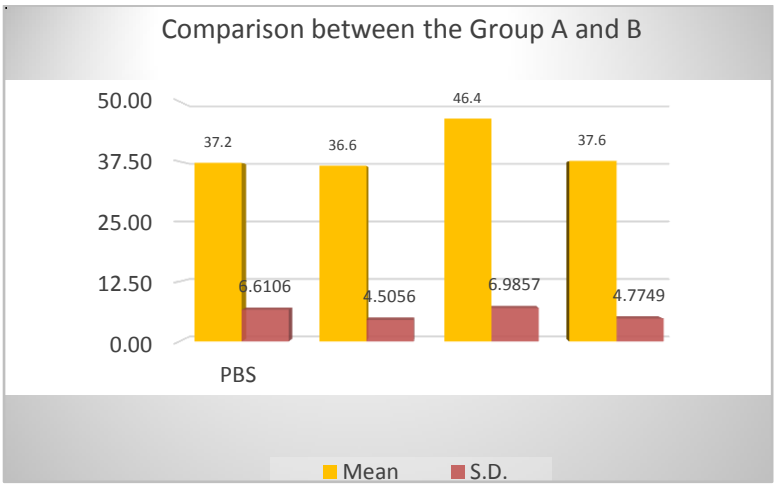


Table No:9 shows the comparison of pre and post test values of PBS between Group A and Group B

Unpaired T Test	PBS			
	PRE		POST	
	Group A	Group B	Group A	Group B
Mean	37.20	36.60	46.40	37.60
S.D.	6.611	4.506	6.986	4.775
Mean Difference	0.60		8.80	
Unpaired T Test	0.168		2.325	
P value	0.8710		0.0485	
Table Value at 0.05	2.31		2.31	
Result	Not-Significant		Significant	

Figure No:9 shows the comparison of pre and post test values of PBS between Group A and Group B



PBS scores

In this study Group 1 received Nintendo wii game therapy and Group 2 received Task specific training. In the Nintendo group we found that there is an difference in the pretest and post-test values of PBS suggesting nintendo wii fit training is beneficial in improving the PBS scores of spastic diplegia cerebral palsy children. Like wise we found that there is an difference in the pretest and post-test value of PBS in the Task specific training group which also suggest that task specific training is helpful in improving the PBS of spastic diplegia cerebral palsy children. But when we compare the effect of Nintendo group and Task specific training group, the base line values of pretest of both groups has no statistically significant difference but the post test values of PBS of both groups were found statistically significant difference suggesting there is a difference in the effect of both the treatments. The study found that Nintendo wii game therapy was better than Task specific training treatment in improving the PBS scores of spastic diplegia cerebral palsy children.

.DISCUSSION

The main aim of this study was to determine the comparative between Nintendo wii fit game therapy and task specific training on gross motor function and balance in spastic diplegic cerebral palsy. In this study results showed a greater improvement on gross motor function and balance in between group comparison .. Both interventions contain their own different principles. The task specific training based on motor learning principle and lively participant training of the child, while Nintendo wii fit game mechanism on the principle of instant visual and sensory feedback which motivates the patient and create a sole environment for exercises. Hence, the present study was aimed to evaluate the efficacy to compare both these approaches so that an improved and effectual treatment for getting better functional aptitude be able to be recognised. The results – ten subjects with mean (SD) age of 9 and 12 age were recruited to group A (Nintendo wii fit game therapy) and group B (task specific training) respectively. Baseline demographic and clinical characteristics are shown in statiscal raphical representation along with tables. Group A part of the study subject were male with 60% and female with 40% in both group A and B . the mean age of group A was 7.36 and that of group B was 8.74 and there no significant difference in the age of both groups as $P<0.5$. as seen in table 3, the study included the patient with scissoring and crouching gait of 60% and 40% respectively.

GMFM as in the table 4 and table5, we found that there is a statically significant different ($p<0.5$) in the pre test and post test values of GMFM scores in both group A and group B. When we compare the pretest values of GMFM of group A and B group we found that there is no statistical significant different($p>0.5$) as in the table 8. But when we compare the post test values of GMFM of group A and group B we found that there is statistically significant difference ($p<0.5$) as in the table 8. Similarly in PBS scores,in table no 6 and 7,we found that there is statically significant difference ($p<0.5$) in the pretest and post test values of PBS scores in the both groups A and B groups. When w compare the pretest values of PBS scores group A and B group B we found that there is no statistically significant difference ($p>0.5$) as in the table 9. But when we compare the post test values of PBS scores of group A and group B we found that there is statistically significant difference ($p<0.5$) as in the table 9.

Greater improvement of gross motor function and balance in Nintendo wii fit game training group compare to task specific training group after post intervention .The present study concluded that there is significant improvement in the outcome measure in group of Nintendo wii fit game therapy. To the best of our knowledge the present study examining the

effectiveness of the Nintendo wii fit game therapy versus task specific training on balance and GMF in spastic diplegic cerebral palsy childrens age 6 to12 years and this is the frist study of comparison between Nintendo wii based and TST with an outcomes of GMFM and PBS in spastic diplegic cerebral palsy child.Golomb et al,2010 this study gave evidence to our finding on great improvement in gross motor function and functional performance with balance capacities by Nintendo wii fit ,the benefits of virtual game which motivates with safe and secure environment which decrease the risk of mistakes. Evidence has been shown in previous studies that reflecting the skill transfer from real environment to virtual world, it provided different learning environment like a public places eg-a café, virtual home and transportation area to support children who is difficulty/problem in learning. Activity of daily living is improved by virtual reality treatment studied by Luna Olive Luara et al where gave evidence the use of virtual reality shown a longer time improvement was maintained after intervenetion of virtual reality hand performances in cerebral palsy by telerehablitation system can be used under the home based programe.Huber et al 2009, studied the effectiveness of home based virtual reality game system –nintendo wii fit game therapy on improvement in daily activity of living and gross motor performances in children with cerebral palsy. Few researches have shown marked modification in the emotional feeling aspect of behavior in individual with physical disabilities and social experiences (Broida, German,Hovek,2000). Ketelar et al 2001 , the peadiatric balance scale , daily living activity of motor function performance where great improvements was noticed differently. The reason for the above seen changes in the present could be due to the fact that the subjects who underwent wii fit training participated in games that focused on gross range movements of the upper andlower limb where as in the task specific training , normal range, daily activities were performed. There distinctions in the systems for training may provide the key to the differences in results.

Significant improvement in balance and gross motor function was observed in both the treatment groups having greater improvement in Nintendo wii fit group. Similarly findings were stated by Thais Massetti et al 2014. This could be due to the active movements of upper and lower limb in treatment tasks such as reaching or transferring objects in multiplaner activities following trunk movements. The current study also observed significant improvement in the lower limb between both groups, virtual reality training and NDT(task specific training) which was also observed by Kilink. This may be due to specific lower limb associated activities in the NDT (task specific training) group with cueing and facilitation of

the lower limb where as such specific lower limb movements were not performed during the virtual reality game therapy session. When we compare the pretest values of GMFM and PBS scores in both group A and group B we found that there is no significant difference ($p>0.5$). but when we compare the post test values of GMFM and PBS of both group A and B dhows a significant difference.

Similarly findings were reported by Veerbeet et al. this is very significant but cannot exclude that with a longer period of rehabilitation this recovery could change since recovery of balance and gross motor function can be in selected cases, more complicated than balance and GMFM.

The challenges faced in this study were when applying these games for the rehabilitation of the subjects. Frequent calibrations were needed, especially when the sensor image signals were disrupted by the physical presence of the therapist due to which the therapist could not manually correct or assist the subjects while performing. During such interruption, the subjects were asked to sit down and rest while the therapist recalibrated the game.Harris and Raid (2005) read virtual reality games appropriately encourage cerebral palsy children and therefore signify a beneficial process with aim of to assist rehabilitation training. These study proved better outcome results in Nintendo wii fit game therapy than task specific training on gross motor function and balance.

5.1 Limitation of the study

First, these results should not be generalized to all cerebral palsy survivors as only diplegic cerebral palsy and age group between 6-12 were included. if study would have been double blinded, there would not be any bias. These limitations should be addressed in future studies

5.2 Strength of the study

To the best of my knowledge there has not been any study investigating the compression between Nintendo wii fit game therapy and task specific training on gross motor function and balance in spastic cerebral palsy between the age 6- 12. There has not any study based on comparison between Nintendo wii fit and task specific training showed result on gross motor function and pedrietric balance scale among children with spastic diplegic CP based on ICF framework. In addition, the present results provide a new perspective for the physical therapists working with CP patients. Given that CP rehabilitation is a long-term process, this

system provides a good alternative for CP evaluation and treatment planning. Group A Nintendo wii shown higher improvement in gross motor function and balance than group B.

5.3 SUGGESTION FOR FURTHER STUDY

As in this study, the compression of Nintendo wii fit game therapy and task specific training on gross motor function and balance was observed only in the spastic diplegic CP subjects, similarly, studies involving different types of CP such as monoplegic and hemiplegic should also be addressed in the future. Also, study can be conducted in lower age groups and upper age groups which were not addressed in the present study. Randomized controlled trial with blinding should be incorporated for further future research.

6. CONCLUSION

This 5 weeks study result showed that Nintendo wii fit game therapy has higher mprovement than task specific training in gross motor function and balance among spastic diplegic Cerebral Palsy children aged 6- 12 years.

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8. APPENDICES

APPENDIX-I

CONSENT FORM

TITLE OF THE STUDY: COMPARISON BETWEEN NINTENDO WII FIT GAME THERAPY AND TASK SPECIFIC TRAINING ON GRO MOTOR FUNCTION AND BALANCE IN SPASTIC DIPLEGIC CEREBRAL PALSY.

I have been informed by Ms. Gida Moni pursuing MPT in Neurological Physiotherapy Department, is conducting the above mentioned study under the guide Dr. Immanuel Jeyasingraj , HOD of Physiotherapy, LPU, Phagwara. I understand that my child will be one of the subjects of the study. I have no objection and my child will be part of that group and will be regular in the sessions designed and described to us. I also understand that the study does not contain any object which has negative implications in his/her health. I understand that medical information produced by the study will become the part of institute record and will be treated as per confidentiality regulations of the institute. I have been informed that the data if used for medical literature and teaching purposes; names and other identifiers (e.g., photographs, audiotapes) will not be used without my written permission. I further understand that they may demand to see his/her photographs and videotapes before giving this permission.

I understand that I may ask more questions about the study at any time of the study and Ms. Gida Moni will be available to answer my questions or concerns at 09888909853. If

during the study or later, I wish to discuss our participations and concerns regarding this study with a person not directly involved. I am aware that I can contact Guide/Head, Department of Physiotherapy, LPU, Phagwara. I understand that my assent is voluntary and I reserve the right to withdraw it and discontinue the participation from the study at any point of the time during the study.

I have explained to Ms/Mr/Mrs._____ the purpose of the research, the procedure required in the language she could understand to the best of my ability.

---------- ----------

(Investigator) (Date)

I confirm that Ms. Gida Moni(Investigator) has explained to me in the language I understand the purpose of the study and the procedure. Therefore, I agree to give my consent for the participation of my child as a subject and I will be accountable for the decision.

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(Guardian) (Date)

APPENDIX –II

PERFORMA

PERFORMA

Name:

Age:

Gender:

Address

Date of assessment:

Place of assessment:

Dominance:

Chief complain:

Present History:

Past History:

Family/Surgical History:

Observation

Built

Posture

Gait

Attitude of limb

APPENDIX-III

ASSESSMENT TOOLS

GROSS MOTOR FUNCTION MEASURE (GMFM)
SCORE SHEET (GMFM-88 and GMFM-66 scoring)

Child's Name: _____ ID#: _____

Assessment Date: _____ year / month / day

GMFCS Level[1]: ☐ I ☐ II ☐ III ☐ IV ☐ V

Date of Birth: _____ year / month / day

Chronological Age: _____ year / month / day

Evaluator's Name: _____

Check (✓) the appropriate score. If an item is not tested (NT), circle the item number on the right column.

	Item	A: LYING & ROLLING	SCORE				NT
	1.	SUP, HEAD IN MIDLINE: TURNS HEAD WITH EXTREMITIES SYMMETRICAL	0☐	1☐	2☐	3☐	1.
*	2.	SUP: BRINGS HANDS TO MIDLINE, FINGERS ONE WITH THE OTHER	0☐	1☐	2☐	3☐	2.
	3.	SUP: LIFTS HEAD 45°	0☐	1☐	2☐	3☐	3.
	4.	SUP: FLEXES R HIP & KNEE THROUGH FULL RANGE	0☐	1☐	2☐	3☐	4.
	5.	SUP: FLEXES L HIP & KNEE THROUGH FULL RANGE	0☐	1☐	2☐	3☐	5.
*	6.	SUP: REACHES OUT WITH R ARM, HAND CROSSES MIDLINE TOWARD TOY	0☐	1☐	2☐	3☐	6.
*	7.	SUP: REACHES OUT WITH L ARM, HAND CROSSES MIDLINE TOWARD TOY	0☐	1☐	2☐	3☐	7.
	8.	SUP: ROLLS TO PR OVER R SIDE	0☐	1☐	2☐	3☐	8.
	9.	SUP: ROLLS TO PR OVER L SIDE	0☐	1☐	2☐	3☐	9.
*	10.	PR: LIFTS HEAD UPRIGHT	0☐	1☐	2☐	3☐	10.
	11.	PR ON FOREARMS: LIFTS HEAD UPRIGHT, ELBOWS EXT., CHEST RAISED	0☐	1☐	2☐	3☐	11.
	12.	PR ON FOREARMS: WEIGHT ON R FOREARM, FULLY EXTENDS OPPOSITE ARM FORWARD	0☐	1☐	2☐	3☐	12.
	13.	PR ON FOREARMS: WEIGHT ON L FOREARM, FULLY EXTENDS OPPOSITE ARM FORWARD	0☐	1☐	2☐	3☐	13.
	14.	PR: ROLLS TO SUP OVER R SIDE	0☐	1☐	2☐	3☐	14.
	15.	PR: ROLLS TO SUP OVER L SIDE	0☐	1☐	2☐	3☐	15.
	16.	PR: PIVOTS TO R 90° USING EXTREMITIES	0☐	1☐	2☐	3☐	16.
	17.	PR: PIVOTS TO L 90° USING EXTREMITIES	0☐	1☐	2☐	3☐	17.

TOTAL DIMENSION A

	Item	B: SITTING	SCORE				NT
*	18.	SUP, HANDS GRASPED BY EXAMINER: PULLS SELF TO SITTING WITH HEAD CONTROL	0☐	1☐	2☐	3☐	18.
	19.	SUP: ROLLS TO R SIDE, ATTAINS SITTING	0☐	1☐	2☐	3☐	19.
	20.	SUP: ROLLS TO L SIDE, ATTAINS SITTING	0☐	1☐	2☐	3☐	20.
*	21.	SIT ON MAT, SUPPORTED AT THORAX BY THERAPIST: LIFTS HEAD UPRIGHT, MAINTAINS 3 SECONDS	0☐	1☐	2☐	3☐	21.
*	22.	SIT ON MAT, SUPPORTED AT THORAX BY THERAPIST: LIFTS HEAD MIDLINE, MAINTAINS 10 SECONDS	0☐	1☐	2☐	3☐	22.
*	23.	SIT ON MAT, ARM(S) PROPPING: MAINTAINS, 5 SECONDS	0☐	1☐	2☐	3☐	23.
*	24.	SIT ON MAT: MAINTAIN, ARMS FREE, 3 SECONDS	0☐	1☐	2☐	3☐	24.
*	25.	SIT ON MAT WITH SMALL TOY IN FRONT: LEANS FORWARD, TOUCHESTOY, RE-ERECTS WITHOUT ARM PROPPING	0☐	1☐	2☐	3☐	25.
*	26.	SIT ON MAT: TOUCHES TOY PLACED 45° BEHIND CHILD'S R SIDE, RETURNS TO START	0☐	1☐	2☐	3☐	26.
*	27.	SIT ON MAT: TOUCHES TOY PLACED 45° BEHIND CHILD'S L SIDE, RETURNS TO START	0☐	1☐	2☐	3☐	27.
	28.	R SIDE SIT: MAINTAINS, ARMS FREE, 5 SECONDS	0☐	1☐	2☐	3☐	28.
	29.	L SIDE SIT: MAINTAINS, ARMS FREE, 5 SECONDS	0☐	1☐	2☐	3☐	29.
*	30.	SIT ON MAT: LOWERS TO PR WITH CONTROL	0☐	1☐	2☐	3☐	30.
*	31.	SIT ON MAT WITH FEET IN FRONT: ATTAINS 4 POINT OVER R SIDE	0☐	1☐	2☐	3☐	31.
*	32.	SIT ON MAT WITH FEET IN FRONT: ATTAINS 4 POINT OVER L SIDE	0☐	1☐	2☐	3☐	32.
	33.	SIT ON MAT: PIVOTS 90°, WITHOUT ARMS ASSISTING	0☐	1☐	2☐	3☐	33.
*	34.	SIT ON BENCH: MAINTAINS, ARMS AND FEET FREE, 10 SECONDS	0☐	1☐	2☐	3☐	34.
*	35.	STD: ATTAINS SIT ON SMALL BENCH	0☐	1☐	2☐	3☐	35.
*	36.	ON THE FLOOR: ATTAINS SIT ON SMALL BENCH	0☐	1☐	2☐	3☐	36.
*	37.	ON THE FLOOR: ATTAINS SIT ON LARGE BENCH	0☐	1☐	2☐	3☐	37.

TOTAL DIMENSION B ☐

Item		C: CRAWLING & KNEELING	SCORE				NT
	38.	PR: CREEPS FORWARD 1.8m (6')	0☐	1☐	2☐	3☐	38.
*	39.	4 POINT: MAINTAINS, WEIGHT ON HANDS AND KNEES, 10 SECONDS	0☐	1☐	2☐	3☐	39.
*	40.	4 POINT: ATTAINS SIT ARMS FREE	0☐	1☐	2☐	3☐	40.
*	41.	PR: ATTAINS 4 POINT, WEIGHT ON HANDS AND KNEES	0☐	1☐	2☐	3☐	41.
*	42.	4 POINT: REACHES FORWARD WITH R ARM, HAND ABOVE SHOULDER LEVEL	0☐	1☐	2☐	3☐	42.
*	43.	4 POINT: REACHES FORWARD WITH L ARM, HAND ABOVE SHOULDER LEVEL	0☐	1☐	2☐	3☐	43.
*	44.	4 POINT: CRAWLS OR HITCHES FORWARD 1.8m(6')	0☐	1☐	2☐	3☐	44.
*	45.	4 POINT: CRAWLS RECIPROCALLY FORWARD1.8m (6')	0☐	1☐	2☐	3☐	45.
*	46.	4 POINT: CRAWLS UP 4 STEPS ON HANDS AND KNEES/FEET	0☐	1☐	2☐	3☐	46.
	47.	4 POINT: CRAWLS BACKWARDS DOWN 4 STEPS ON HANDS AND KNEES/FEET	0☐	1☐	2☐	3☐	47.
*	48.	SIT ON MAT: ATTAINS HIGH KN USING ARMS, MAINTAINS, ARMS FREE, 10 SECONDS	0☐	1☐	2☐	3☐	48.
	49.	HIGH KN: ATTAINS HALF KN ON R KNEE USING ARMS, MAINTAINS, ARMS FREE, 10 SECONDS	0☐	1☐	2☐	3☐	49.
	50.	HIGH KN: ATTAINS HALF KN ON L KNEE USING ARMS, MAINTAINS, ARMS FREE, 10 SECONDS	0☐	1☐	2☐	3☐	50.
*	51.	HIGH KN: KN WALKS FORWARD 10 STEPS, ARMS FREE	0☐	1☐	2☐	3☐	51.

TOTAL DIMENSION C ☐

Item		D: STANDING	SCORE				NT
*	52.	ON THE FLOOR: PULLS TO STD AT LARGE BENCH	0☐	1☐	2☐	3☐	52.
*	53.	STD: MAINTAINS, ARMS FREE, 3 SECONDS	0☐	1☐	2☐	3☐	53.
*	54.	STD: HOLDING ON TO LARGE BENCH WITH ONE HAND, LIFTS R FOOT, 3 SECONDS	0☐	1☐	2☐	3☐	54.
*	55.	STD: HOLDING ON TO LARGE BENCH WITH ONE HAND, LIFTS L FOOT, 3 SECONDS	0☐	1☐	2☐	3☐	55.
*	56.	STD: MAINTAINS, ARMS FREE, 20 SECONDS	0☐	1☐	2☐	3☐	56.
*	57.	STD: LIFTS L FOOT, ARMS FREE, 10 SECONDS	0☐	1☐	2☐	3☐	57.
*	58.	STD: LIFTS R FOOT, ARMS FREE, 10 SECONDS	0☐	1☐	2☐	3☐	58.
*	59.	SIT ON SMALL BENCH: ATTAINS STD WITHOUT USING ARMS	0☐	1☐	2☐	3☐	59.
*	60.	HIGH KN: ATTAINS STD THROUGH HALF KN ON R KNEE, WITHOUT USING ARMS	0☐	1☐	2☐	3☐	60.
*	61.	HIGH KN: ATTAINS STD THROUGH HALF KN ON L KNEE, WITHOUT USING ARMS	0☐	1☐	2☐	3☐	61.
*	62.	STD: LOWERS TO SIT ON FLOOR WITH CONTROL, ARMS FREE	0☐	1☐	2☐	3☐	62.
*	63.	STD: ATTAINS SQUAT, ARMS FREE	0☐	1☐	2☐	3☐	63.
*	64.	STD: PICKS UP OBJECT FROM FLOOR, ARMS FREE, RETURNS TO STAND	0☐	1☐	2☐	3☐	64.

TOTAL DIMENSION D ☐

Item		E: WALKING, RUNNING & JUMPING	SCORE				NT
*	65.	STD, 2 HANDS ON LARGE BENCH: CRUISES 5 STEPS TO R	0☐	1☐	2☐	3☐	65.
*	66.	STD, 2 HANDS ON LARGE BENCH: CRUISES 5 STEPS TO L	0☐	1☐	2☐	3☐	66.
*	67.	STD, 2 HANDS HELD: WALKS FORWARD 10 STEPS	0☐	1☐	2☐	3☐	67.
*	68.	STD, 1 HAND HELD: WALKS FORWARD 10 STEPS	0☐	1☐	2☐	3☐	68.
*	69.	STD: WALKS FORWARD 10 STEPS	0☐	1☐	2☐	3☐	69.
*	70.	STD: WALKS FORWARD 10 STEPS, STOPS, TURNS 180°, RETURNS	0☐	1☐	2☐	3☐	70.
*	71.	STD: WALKS BACKWARD 10 STEPS	0☐	1☐	2☐	3☐	71.
*	72.	STD: WALKS FORWARD 10 STEPS, CARRYING A LARGE OBJECT WITH 2 HANDS	0☐	1☐	2☐	3☐	72.
*	73.	STD: WALKS FORWARD 10 CONSECUTIVE STEPS BETWEEN PARALLEL LINES 20cm (8")APART	0☐	1☐	2☐	3☐	73.
*	74.	STD: WALKS FORWARD 10 CONSECUTIVE STEPS ON A STRAIGHT LINE 2cm (3/4") WIDE	0☐	1☐	2☐	3☐	74.
*	75.	STD: STEPS OVER STICK AT KNEE LEVEL, R FOOT LEADING	0☐	1☐	2☐	3☐	75.
*	76.	STD: STEPS OVER STICK AT KNEE LEVEL, L FOOT LEADING	0☐	1☐	2☐	3☐	76.
*	77.	STD: RUNS 4.5m (15'), STOPS & RETURNS	0☐	1☐	2☐	3☐	77.
*	78.	STD: KICKS BALL WITH R FOOT	0☐	1☐	2☐	3☐	78.
*	79.	STD: KICKS BALL WITH L FOOT	0☐	1☐	2☐	3☐	79.
*	80.	STD: JUMPS 30cm (12") HIGH, BOTH FEET SIMULTANEOUSLY	0☐	1☐	2☐	3☐	80.
*	81.	STD: JUMPS FORWARD 30 cm (12"), BOTH FEET SIMULTANEOUSLY	0☐	1☐	2☐	3☐	81.
*	82.	STD ON R FOOT: HOPS ON R FOOT 10 TIMES WITHIN A 60cm (24") CIRCLE	0☐	1☐	2☐	3☐	82.
*	83.	STD ON L FOOT: HOPS ON L FOOT 10 TIMES WITHIN A 60cm (24") CIRCLE	0☐	1☐	2☐	3☐	83.
*	84.	STD, HOLDING 1 RAIL: WALKS UP 4 STEPS, HOLDING 1 RAIL, ALTERNATING FEET	0☐	1☐	2☐	3☐	84.
*	85.	STD, HOLDING 1 RAIL: WALKS DOWN 4 STEPS, HOLDING 1 RAIL, ALTERNATING FEET	0☐	1☐	2☐	3☐	85.
*	86.	STD: WALKS UP 4 STEPS, ALTERNATING FEET	0☐	1☐	2☐	3☐	86.
*	87.	STD: WALKS DOWN 4 STEPS, ALTERNATING FEET	0☐	1☐	2☐	3☐	87.
*	88.	STD ON 15cm (6") STEP: JUMPS OFF, BOTH FEET SIMULTANEOUSLY	0☐	1☐	2☐	3☐	88.

TOTAL DIMENSION E ☐

GMFM-88 SUMMARY SCORE

DIMENSION	CALCULATION OF DIMENSION % SCORES	GOAL AREA (indicated with ✓ check)
A. Lying & Rolling	$\frac{\text{Total Dimension A}}{51} = \frac{\quad}{51} \times 100 = \quad\%$	A. ☐
B. Sitting	$\frac{\text{Total Dimension B}}{60} = \frac{\quad}{60} \times 100 = \quad\%$	B. ☐
C. Crawling & Kneeling	$\frac{\text{Total Dimension C}}{42} = \frac{\quad}{42} \times 100 = \quad\%$	C. ☐
D. Standing	$\frac{\text{Total Dimension D}}{39} = \frac{\quad}{39} \times 100 = \quad\%$	D. ☐
E. Walking, Running & Jumping	$\frac{\text{Total Dimension E}}{72} = \frac{\quad}{72} \times 100 = \quad\%$	E. ☐

TOTAL SCORE = $\frac{\%A + \%B + \%C + \%D + \%E}{\text{Total \# of Dimensions}}$

$= \frac{\quad}{5} = \quad = \quad\%$

GOAL TOTAL SCORE = $\frac{\text{Sum of \%scores for each dimension identified as a goal area}}{\text{\# of Goal areas}}$

$= \quad = \quad\%$

APPENDIX IV

PEDIATRIC BALANCE SCALE TEST SCORE

PEDIATRIC BALANCE SCALE

Name:
Location:
Examiner:

		Date:	Date:	Date:
		Score 0-4 (time- optional)	Score 0-4 (time- optional)	Score 0-4 (time- optional)
1.	Sitting to standing **" Hold your arms up and stand up"** 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 assist to stand or to stabilize 0- needs moderate or maximal assist to stand			
2.	Standing to sitting **"Sit down slowly without using your hands"** 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 assistance to sit			
3.	Transfers 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 (spotting) 1- needs one person to assist 0- needs two people to assist or supervise (close guard) to be safe			
4.	Standing unsupported 4- able to stand safely 30	(___ sec.)	(___ sec.)	(___ sec.)

	seconds 3- able to stand 30 seconds with supervision (spotting) 2- able to stand 15 seconds unsupported 1- needs several tries to stand 10 seconds unsupported 0- unable to stand 10 seconds unassisted			

5.	Sitting unsupported **"Sit with your arms folded on your chest for 30 seconds"** 4- able to sit safely and securely 30 seconds 3- able to sit 30 seconds under supervision (spotting) or may require definite use of upper extremities to maintain sitting position 2- able to sit 15 seconds 1- able to sit 10 seconds 0- unable to sit 10 seconds without support	(___ sec.)	(___ sec.)	(___ sec.)
6.	Standing with eyes closed **"When I say close your eyes, I want you to stand still, close your eyes, and keep them closed until I say open"** 4- able to stand 10 seconds safely 3- able to stand 10 seconds with supervision (spotting) 2- able to stand 3 seconds 1-unable to keep eyes closed 3 seconds but stays steady 0- needs help to keep from falling	(___ sec.)	(___ sec.)	(___ sec.)
7.	Standing with feet together 4- able to place feet together independently and stand 30 seconds safely 3- able to place feet together independently and stand for 30 seconds with supervision (spotting) 2- able to place feet together independently but unable to hold for 30 seconds 1- needs help to attain position but able to stand 30 seconds with feet together 0- needs help to attain position and/or unable to hold for 30 seconds	(___ sec.)	(___ sec.)	(___ sec.)
8.	Standing with one foot in front 4- able to place feet tandem	(___ sec.)	(___ sec.)	(___ sec.)

	independently and hold 30 seconds 3- able to place foot ahead of other independently and hold 30 seconds 2- able to take small step independently and hold 30 seconds, or required assistance to place foot in front, but can stand for 30 seconds 1- needs help to step, but can hold 15 seconds 0- loses balance while stepping or standing			

9.	Standing on one foot 4- able to lift leg independently and hold 10 seconds 3- able to lift leg independently and hold 5-9 seconds 2- able to lift leg independently and hold 3-4 seconds 1- tries to lift leg; unable to hold 3 seconds but remains standing 0- unable to try or needs assist to prevent fall	(___ sec.)	(___ sec.)	(___ sec.)
10.	Turning 360 degrees **" Turn completely around in a full circle, STOP, and then turn a full circle in the other direction"** 4- able to turn 360 degrees safely in 4 seconds or less each way 3- able to turn 360 degrees safely in one direction only in 4 seconds or less 2- able to turn 360 degrees safely but slowly 1- needs close supervision (spotting) or constant verbal cuing 0- needs assistance while turning	(___ sec.)	(___ sec.)	(___ sec.)
11.	Turning to look behind **" Follow this object as I move it. Keep watching it as I move it, but don't move your feet."** 4- looks behind/over each shoulder; weight shifts include trunk rotation 3- looks behind/over one shoulder with trunk rotation 2- turns head to look to level of shoulders, no trunk rotation 1- needs supervision (spotting) when turning; the chin moves greater than half the distance to the shoulder 0- needs assistance to keep from losing balance or falling; movement of the chin is less than half the distance to the shoulder			
12	Retrieving object from floor			

.	4- able to pick up chalk board eraser safely and easily 3- able to pick up eraser but needs supervision (spotting) 2- unable to pick up eraser but reaches 1-2 inches from eraser and keeps balance independently 1- unable to pick up eraser; needs spotting while attempting 0- unable to try, needs assist to keep from losing balance or falling			
13.	Placing alternate foot on stool 4- stands independently and safely and completes 8 steps in 20 seconds 3- able to stand independently and complete 8 steps >20 seconds 2- able to complete 4 steps without assistance, but requires close supervision (spotting)	(___ sec.)	(___ sec.)	(___ sec.)

	1- needs close supervision (spotting) or constant verbal cuing 0- needs assistance while turning			
11.	Turning to look behind **" Follow this object as I move it. Keep watching it as I move it, but don't move your feet."** 4- looks behind/over each shoulder; weight shifts include trunk rotation 3- looks behind/over one shoulder with trunk rotation 2- turns head to look to level of shoulders, no trunk rotation 1- needs supervision (spotting) when turning; the chin moves greater than half the distance to the shoulder 0- needs assistance to keep from losing balance or falling; movement of the chin is less than half the distance to the shoulder			
12	Retrieving object from floor			

.	4- able to pick up chalk board eraser safely and easily 3- able to pick up eraser but needs supervision (spotting) 2- unable to pick up eraser but reaches 1-2 inches from eraser and keeps balance independently 1- unable to pick up eraser; needs spotting while attempting 0- unable to try, needs assist to keep from losing balance or falling			
13.	Placing alternate foot on stool 4- stands independently and safely and completes 8 steps in 20 seconds 3- able to stand independently and complete 8 steps >20 seconds 2- able to complete 4 steps without assistance, but requires close supervision (spotting) 1- able to complete 2 steps; needs minimal assistance 0- needs assistance to maintain balance or keep from falling, unable to try	(___ sec.)	(___ sec.)	(___ sec.)
14.	Reaching forward with outstretched arm **" Stretch out your fingers, make a fist, and reach forward as far as you can without moving your feet"** 4- reaches forward confidently >10 inches 3- reaches forward >5 inches, safely 2- reaches forward >2 inches, safely 1- reaches forward but needs supervision (spotting) 0- loses balance while trying, requires external support	(___ in.)	(___ in.)	(___ in.)
	TOTAL SCORE			

APPENDIX V
MASTER CHART

	NAME	AGE	GENDER	GAIT	MAS	GMFCS	MACS	GROUP	GMFMPRE	GMFMPOST	PBSPRE	PBSPOST
1	MANPREET	6.00	1.00	1.00	1.00	2.00	1.00	1.00	93.05	95.55	47.00	53.00
2	AJAY	6.70	2.00	2.00	2.00	2.00	1.00	1.00	77.97	85.14	36.00	42.00
3	NEHA	7.00	1.00	2.00	2.00	1.00	1.00	1.00	79.99	91.64	30.00	35.00
4	DEEPIKA	9.00	1.00	1.00	2.00	1.00	1.00	1.00	70.27	89.02	33.00	39.00
5	MAANIT	8.10	2.00	1.00	1.00	2.00	1.00	1.00	85.43	90.18	40.00	48.00
6	SUKHDEEP	7.10	2.00	1.00	1.00	2.00	2.00	2.00	70.60	74.13	40.00	44.00
7	KULWIND...	8.50	1.00	1.00	2.00	1.00	1.00	2.00	84.93	91.98	39.00	42.00
8	MANJEET ...	6.30	1.00	1.00	2.00	2.00	1.00	2.00	86.50	89.10	36.00	39.00
9	ANUSHKA	7.20	1.00	2.00	1.00	2.00	2.00	2.00	83.00	88.00	29.00	32.00
10	ARAHV	8.60	2.00	2.00	1.00	1.00	1.00	2.00	85.00	90.00	39.00	41.00