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Research Article

Hippotherapy and Torso-Weighting For Down Syndrome

Effective of Hippotherapy and Balance-Based Torso-Weighting to Improve Standing Stability and Postural Balance in Children with Down Syndrome

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Abstract: Down syndrome is a genetic disorder caused by an extra abnormal presence of the 21st chromosome. Some abilities related to motor function are extensive, for example, lack of postural control, gait abnormality, and lack of balance and coordination. In addition, postural changes in Down syndrome may occur due to the difficulty of perception of responses, which impairs the feeling of the limb position and limb movements. Hippotherapy (HT) is a physical treatment, and it is defined as equine-assisted treatment in which horse movement promotes physical and physiological improvements. Strategic placement of lightweight on the torso using the balance-based torso-weighting (BBTW) method has improved stability and reduced falls in people with cerebellar ataxia but has not been tested in Down syndrome. Therefore, we examined whether torso-weighting increased standing stability and or functional movement in children with DS. A total of 30 subjects with Down syndrome were taken and grouped into two groups, with group A- 15 subjects treated with hippotherapy and group B-15 subjects treated with balanced-based torso-weighting. The baseline measurement was taken using Berg's balance scale and the time up and test (TUG test). Statistical package for social science (SPSS) version 24. The paired t-test was to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to see the statistical difference between the groups. The procedure is done by performing hippotherapy for 4 times a week for 12 weeks for group A, and balanced-based torso weighting is performed for 4 times a week for 12 weeks for group B. Children medically diagnosed with DS and with IQ less than 50 were excluded from the study. In this study, hippo therapy with conventional treadmill training gives a better improvement in a patient with down syndrome when compared with balance-based torso weighting with conventional treadmill training. Hence, hippo therapy with conventional treadmill training would be the better treatment for down syndrome.

Keywords: Down syndrome, hippo therapy, BBTW, postural control, standing stability.

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1. INTRODUCTION

Down syndrome is a genetic disorder caused by the presence of all or part of the third copy of chromosome 21[1]. This extra genetic material causes the developmental changes and physical features of Down syndrome people[4]. instability of the atlantoaxial joint occurs in about 20% and may lead to spinal cord injury in 1–2%[5,6]. Hip dislocations may occur without trauma[7]. It is common for children with DS to be delayed in reaching common milestones such as sitting with any support, standing, and walking. The delay of these specific milestones is the poor balance due to poor muscle tone. It is well known that DS is often considered floppy, clumsy, uncoordinated, and has irregular movement patterns due to balance issues. These balance changes will occur in children into their teens and sometimes into adulthood[8] Impaired balance is difficult for them. It may also impact the development of other motor abilities and cognitive development. Being not able to maintain balance does not allow for exploration, social interaction, and overall freedom.[9]In this research is necessary for its relevance and is a study of young individuals with Down syndrome compared to hippo therapy. Hippo therapy plays a major role in sensory-motor stimulation (research suggests that 49% of DS experiences sensory processing disorders)and a link between rider and horse; there is a therapeutic method that provides sensory-motor experiences to the disabled practitioner that contributes to the development, maintenance, rehabilitation and improvement of several sensory and motor skills.[10] Hippo therapy (HT) is a therapeutic improvement for individuals with down syndrome and also promotes better biomechanical postural alignment, with more efficient muscle control through appropriate muscle activation and synergy optimizing the balance.[11] The activities of movement of horses developed in contributing to greater control of movement and quality of walking, resulting in improved the walking pattern of Down syndrome children.[12]Although it is similar to the use of therapeutic rehabilitation to improve joint position and balance control, Balance-based torso-weighting (BBTW)[13] in people with down syndrome, they improve in static standing, gait velocity, cadence, and percent of the gait cycle in single-limb support.[14] BBTW is a method of assessment in the five-dimensional direction of perturbation, (i) first to check the balance and alignment in standing, multidirectional trunk perturbations, and transitional movements; (ii) identification of the direction of sway or balance loss; (iii) placement of small amounts of weight on the torso for individuals directional instability to counteract the loss of balance control; (iv) reassessment of abnormalities in balance and postural alignment found in starting initial stage of assessment; (v) change the amounts of weight according to improvement attained in standing balance or reactive response of perturbation. Once improvement is obtained, the individual who wears the weight according to the side usually gets a loss of balance. While a trained clinician manually applies perturbation and resisted rotation at the shoulder and pelvis. The clinician strategically places light weights (objects with designated mass) on the trunk to counter instability; likewise, physical therapy interventions are performed accordingly.[15]TheThe measuring tool for assessing the intervention part is berg balance and TUG (time and test). The berg balance scale determines the ability to balance during any task the therapist gives. This scale is widely used for static and dynamic balance abilities; it was named after Katherine Berg, one of the developers.[1617]. This study evidence indicates that the BBS is also a valid measure of standing balance in DS patients, but only for those who ambulate independently due to the tasks that are required of the patient[18]; the BBS was recently identified as the most commonly used assessment tool across the continuum of stroke rehabilitation and it is considered a sound measure of balance impairment.[19]Time up and go test is used to test the walking speed tests can quantify physical mobility and have been shown to predict future health outcomes and quality of life for down syndromes.[20]This test is typically for developing children and adolescents and to validate its use in individuals. It is a reliable, cost-effective, safe, and time-efficient way to evaluate overall functional mobility.[21] The TUG has a high correlation with other proven tests that measure pure gait speed for longer lengths, such as a 10-m walk.[22]TheThe test can also assess functional mobility in individuals with Down syndrome. The study aims to compare the effectiveness of hippotherapy and balance-based torso weighting to improve standing stability and postural balance in children with DS. Since balance is affected in down syndrome, the need of the study was to analyze the effectiveness of intervention would enhance the change in improving the postural balance and standing stability in children with down syndrome

2. MATERIALS AND METHODS:

A total of 30 subjects with down syndrome were taken and grouped into two groups, with group A-15 subjects receiving the hippo therapy technique and group B-15 subjects receiving BBTW (Balanced based torso weighting) technique. According to inclusion criteria, the issues included in the study are developmental children according to age group 4-12 years, ability to walk 20 meters without assistance, ability to comply communicate with guardians and therapist instructions, Permission and informed consent from parents for the study, lack of postural control/standing stability and exclusion criteria like visual or auditory impairment and significant history of disease or surgery. As mentioned in the exclusion criteria, children with visual, hearing and Iq problems will not be included in the study. Hippo therapy and balance-based torso weighting are used for different needs, body parts, and intensities before the onset of the treatment protocol. The technique was explained to the parents, and information was taken. The baseline measurement was taken using the berg balance scale, rating scale questionnaire, and TUG scale. The procedure was done by performing hippo therapy weekly 4 times for 6 weeks for group A, and BBTW was performed weekly 4 times for 6 weeks for group B. After the study of 6 weeks, the post-test measurement was taken and compared using the berg balance test and rating scale questionnaire and time up and go test scale. Treadmill training was a conventional technique for both groups A & B.

Fig 1: BBTW Garment

Fig: 2 Hippotherapy Model

2.1 Hippotherapy Techniques

The children, who participated in the study, were checked with proper medical records and assessment of data such as age, gender, medicine in use, and therapies applied to individuals with the consent of parents or guardians who did not have previous experience with hippo therapy was done. Initially, the therapy was composed of 24 sessions for down syndrome children, performed four times a week for 30 minutes each; this evaluation is specified, and the route sequence was standardized during the 30-minute attendance with two types, based on the use in clinical practice as follows, Pressure sway in open and closed eyes, with Medio-lateral and anterior-posterior velocity oscillation for improving step length and velocity (Figure 2) along with this treadmill training also included. The therapist held their child upright so that feet were flat on the treadmill belt. When the treadmill was turned on, the belt moved the infant's legs backward and tended to cause infants to produce forward stepping patterns. If the infants did not step or allow their feet to drag, parents were trained to reposition their children near the front of the belt to maximize their response to the dynamics of the moving support surface. Parents administered the treadmill intervention 8 minutes per day, 4 days per week until their children demonstrated the ability to walk independently. The treadmill belt speed was set at 2 meters per second (.46 miles per hour). During the initial training sessions, infants were on the treadmill for a 1-minute interval followed by a minute of rest. Parents were encouraged to gradually increase the length of the treadmill training interval until they achieved 8 consecutive minutes of practice.

2.2 Balanced Based Torso Weighting (Bbtw)

Balanced-based torso weighting is the procedure to rehabilitate standing balance and gait. The therapist started the balance assessment by observing the relative amount and direction of sway while the children stood quietly. Then the therapist applied anterior, posterior, and lateral perturbations at the shoulder and pelvis to observe the participants' response and direction of balance loss. Next, rotational forces were applied manually through the shoulder and pelvis to determine asymmetries in the participant's ability to maximally resist while maintaining a good balance. Loss of balance during perturbations and rotational forces was scored on a 0–4 scale developed to facilitate the application of weights in the BBTW procedure. Responses were scored: (0) No balance loss, fast response to perturbation; (1) Minimal balance loss, delayed onset of return to upright, (2) Moderate balance loss, significant trunk movement or parachute reaction with no foot movement; (3) Moderate–severe balance loss, significant trunk movement with foot movement or takes a small step; (4) Severe balance loss, manual contact by the researcher required to prevent a fall. The scale has shown good to excellent interrater agreement indicating that other therapists can observe balance loss similarly. Weights (0.06, 0.11, or 0.23 kg) were placed using Velcro on a size-adjustable vest-like garment (Figure 1) (Balance Wear, Motion Therapeutics). Weight location was customized to counter the individual's direction of balance loss, asymmetry of resistance, and latency of response to perturbations. Balance was reassessed with weights to confirm that more excellent stability and/or quicker response were demonstrated. The reduction of balance loss scores indicated a better answer of 0 or 1 with reassessment. Along with this, treadmill training is also included. The therapist held the child upright, so the child's feet were flat on the treadmill belt. When the treadmill was turned on, the belt moved the infant's legs backward and tended to cause infants to produce forward stepping patterns. If the infants did not step or allow their feet to drag, parents were trained to reposition their children near the front of the belt to maximize their response to the dynamics of the moving support surface. Parents administered the treadmill intervention 8 minutes per day, 4 days per week until their children demonstrated the

ability to walk independently. The treadmill belt speed was set at 2 meters per second (46 miles per hour). During the initial training sessions, infants were on the treadmill for a 1-minute interval followed by a minute of rest. Parents were encouraged to gradually increase the length of the treadmill training interval until they achieved 8 consecutive minutes of practice.

3. STATISTICAL ANALYSIS

The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using the statistical package for social science (SPSS) version 24. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to see the statistical difference between the groups.

4. RESULTS

On comparing the mean values of Group A & Group B on the Berg Balance Scale Score, it shows a significant increase in the post-test mean values, but (Group A - Hippo Therapy) 49.53, which has the higher mean value is more(yes) effective than (Group B -Balance Based Torso Weighting) 38.60 at P ≤ 0.001. Hence the Null Hypothesis is rejected. On comparing the mean values of Group A & Group B on Time Up and Go Test Score, it shows a significant decrease in the post-test mean values, but (Group A - Hippo Therapy) 9.46, which has the higher mean value, is more effective than (Group B -Balance Based Torso Weighting) 14.53 at P ≤ 0.001. Hence the Null Hypothesis is rejected. Comparing the Pre-test and Post-test within Group A & Group B on Berg Balance Scale and Timed Up and Got Test Scores shows a highly significant difference in Mean values at P ≤ 0.001

Table 1: Comparison of Berg Balance Scale Score Between Group – A and Group - B in Pre And Post Test

#Test	Group - A		Group - B		T - Test	Df	Significance
	Mean	S.D	Mean	S.D			
Pre Test	32.53	1.45	32.46	2.41	.092	28	.928*
Post Test	49.53	1.84	38.60	2.26	14.50	28	.000***

(- P > 0.05), (**- P ≤ 0.001)*

The above table 1 reveals the Mean, Standard Deviation (S.D), t-test, degree of freedom(df), and p-value between (Group A) & (Group B) in the pre-test and post-test weeks. Table 1 shows no significant difference in pre-test values between Group A& Group B (*P > 0.05). table1 shows that statistically highly significant difference in post-test values between Group A& Group B (***- P ≤ 0.001)

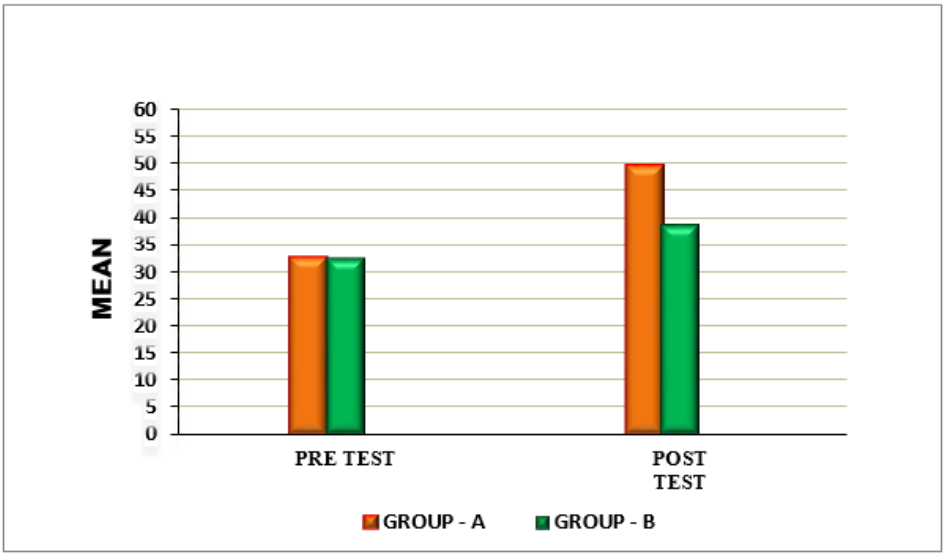

Fig I: Comparison of Berg Balance Scale Score Between Group – A and Group - B in Pre and Post Test

Table-2Comparison of Time Up and Go Test Between Group – A and Group - B in Pre and Post Test

#Test	#GROUP - A		#GROUP – B		T-TEST	Df	Significance
	Mean	S.D	Mean	S.D			
Pre Test	16.74	1.42	16.73	1.86	.011	28	.991*
Post Test	9.46	.990	14.53	1.64	-10.23	28	.000***

(- P > 0.05), (***- P ≤ 0.001)*

The above table2 reveals the Mean, Standard Deviation (S.D), t-test, degree of freedom(df), and p-value between (Group A) & (Group B) in pre-test and post-test weeks. Table 2 shows no significant difference in pre-test values between Group A& Group B (*P > 0.05). Table2 shows that statistically significant difference in post-test values between Group A& Group B (***- P ≤ 0.001).

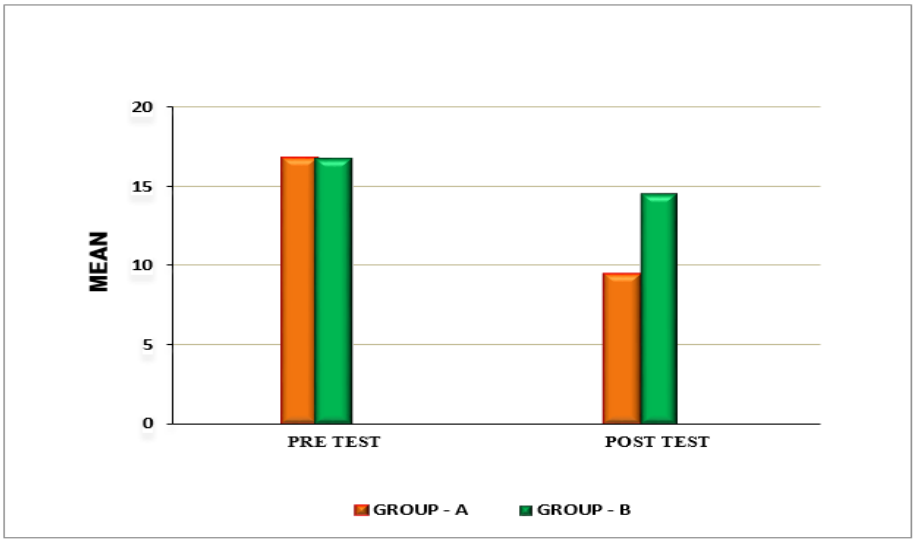

Fig 2: Comparison of Time Up and Go Test Between Group – A and Group - B in Pre and Post Test

Table 3: Comparison of Berg Balance Scale Score Within Group A & Group B Between Pre & Post Test Values

#BBS	Pre Test		Post Test		T-TEST	Significance
	Mean	S.D	Mean	S.D		
GROUP- A	32.53	1.45	49.53	1.84	-31.28	.000***
GROUP-B	32.46	2.41	38.60	2.26	-11.96	.000***

(- P ≤ 0.001)***

The above table 3 reveals the Mean, Standard Deviation (S.D), t-value, and p-value between the pre-test and post-test within Group – A &Group – There is a statistically highly significant difference between the pre-test and post-test values within Group A and Group B (***- P ≤ 0.001).

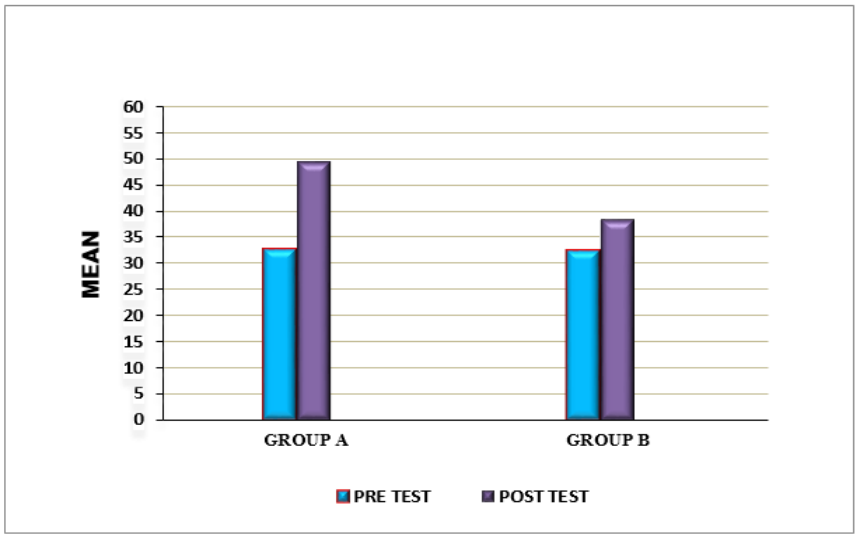

Fig 3: Comparison of Berg Balance Scale Score Within Group A & Group B Between Pre & Post Test Values

Table 4: Comparisonof Time Up and Go Test Within Group – A&Group – B Between Pre & Post Test Values

#Tugt	Pre Test		Post Test		T - Test	Significance
	Mean	S.D	Mean	S.D		
Group- A	16.74	1.42	9.46	.990	18.84	.000***
Group-B	16.73	1.86	14.53	1.64	20.57	.000***

(- P ≤ 0.001)***

The above table 4 reveals the Mean, Standard Deviation (S.D), t-value, and p-value between the pre-test and post-test within Group – A &Group – There is a statistically highly significant difference between the pre-test and post-test values within Group A and Group B(***- P ≤ 0.001).

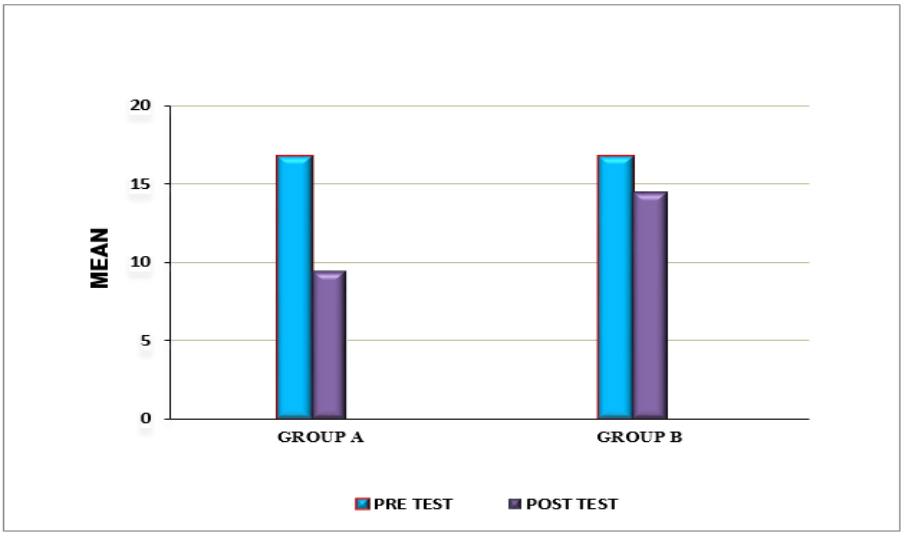

Fig 4: Comparison of Time Up and Go Test Within Group – A & Group – B Between Pre & Post Test Values

5. DISCUSSION

Down syndrome (DS) was found in large numbers and is popularly known as chromosomal abnormalities and is regarded as one of the everyday occurrences of autosomal chromosomes [23]The purpose of this study is to find the effectiveness of hippo therapy and BBTW as an intervention in standing stability and postural control in patient with Down syndrome. After the intervention of hippo therapy, statistical analysis shows improvement in standing balance and postural control observed from the patient who participated in the study, which was concluded in japan. Increased occurrence of a change in posture of the children at school age can be back to normal during the natural process of body growth [24]. At the same time, a patient with Down syndrome shows muscle wasting, ligamentous laxity, and muscular weakness, which slow down the process of motor development and uneven posture alignment. These changes promote the process of acquiring deviation of body pattern and abnormality in structural, morphological, and body axes, which gives stability to the skeletal system, capable of radiating misalignment in the body and disorders during physical maturity.[25]The effect of hippo therapy shows significant changes in the motor function of the children with chronic non-progressive encephalopathy [26]. Drastic improvement in the postural changes in functional movement like walking due to the impact of hippo therapy.[27] Many case studies have been conducted since 2000, proving that hippotherapy is effective in DS and other neurological conditions. They have recommended conducting the study with a large study sample. The rhythmic movements of the horse produce repeated vestibular feedback, leading to accommodation to the [28]After the hippo therapy session, he shows an increase in an upright posture and less anterior trunk involvement along the neck. Properly aligned shoulder increases postural control creating an impact on muscles of the trunk and extremities found in the study of Grazziotin (study conducted in portugal)[29] Balance control and also increased range of motion is the sign of report showed after the practice of hippo therapy.[30,31]The hippo therapy gives justification to the goals of improving as a whole and promoting neuro-motor function. It plays a significant role in the growth and development of an individual who participates in the progress of rehabilitation[32]This study concluded in Australia shows changes in postural alignment and control of head and trunk balance which showed improvement in quality of life and daily activities such as climbing stairs, strength, and balance[33]. Hippo therapy shows a drastic change in head and trunk stability, reaching and focus off target, and also efficiency after the 12 weeks of treatment sessions [34]These studies gave information about the effect of hippo therapy will increase functional activities and fine motor functions [35]Therapeutic riding, and hippo therapy gave better effects on motor function, and balance which has done in the meta-analysis showed changes in berg balance and gross motor function measure[36] Some of the limitations of this study which is concluded in portugal were understanding of the children. They are not co-operative for the research and thus with low number of subjects at the end of the study. However, the study findings support the conclusion that hippo therapy favors a change in standing stability and postural control. The values of the Berg Balance scale and Timed Up & Go test pre-test and post-test were compared by the mean difference. When the inter-group mean values of Berg Balance scale was analyzed (Table-1 and Table-3) Group-A pre-test meant Berg Balance scale (32.53) and post-test meant Berg Balance scale (49.53). The mean values of Group-B pre-test mean Berg Balance scale (32.46) and post-test mean (38.60). When the inter-group mean values of the Timed up & Go test was analyzed (Table-2 and Table-4) Group A pre-test mean Timed up & Go test (16.74) and post-test mean Timed up & Go test (9.46). The mean values of Group-B pre-test mean Timed up & Go test (16.73) and post-test mean (14.53). From the data analysis it showed that there was improvement in standing balance and postural balance in the Group- A (Hippo therapy).The result of this study proves that there is a significant difference between hippo therapy and Balance Based Torso Weighting (BBTW) on patient with Down syndrome. Hence the Null hypothesis is rejected and an alternate hypothesis accepted.

6. CONCLUSION

Results of this study showed that hippo therapy shows better improvement when compared with BBTW on patients with Down syndrome. Hence hippo therapy would be a better choice of treatment for patients with Down syndrome.Motor impairment is a major issue faced by DS This result suggested that hippo therapy shows more effectiveness in standing stability and postural balance in children with Down syndrome.

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8. ETHICAL CONSIDERATION

The institutional review board - Faculty of physiotherapy approves this study vide ref number 015/PHYSIO/IRB/2020-2021. All the procedures were performed following the ethical standard of the responsible ethics committee both (Institutional and national) on human experimentation and the Helsinki Declaration study of 1964 (as revised in 2008).

9. AUTHORS CONTRIBUTION STATEMENT

All the authors read and approved the final version of the manuscript. K.Kamatchiand V.Shalini conceived the idea and design of the study. K.Kamatchi,V.Shalini,N.Kaviraja performed experiment/data collections. G.Tharani,G.Vaishnavi, G.Yuvaranidata interpretation/Data analysis. K.Kamatchi drafted the whole paper. J.CarlinJersha Rachel, K.Cgayathri, revision of the scientific content of the manuscript. G.Tharani,N.Kaviraja grammatical revision to the manuscript

10. CONFLICT OF INTEREST

Conflict of interest declared none

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