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ORIGINAL ARTICLE

Impact of Body Weight Supported Treadmill Training on Balance and Gross Motor Function of Children with Cerebral Palsy and Developmental Delay

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ABSTRACT

Objective: To evaluate the effects of body weight supported treadmill training on balance and gross motor function in patients with cerebral palsy and developmental delay.

Study Design: Quasi experimental pre and post study with convenient based sampling technique.

Place and Duration of Study: Pediatrics Rehabilitation Unit, Department of Physiotherapy, Liaquat National Hospital, Karachi. from 1st January 2019 to 31st December 2019.(remove this duration please)

Material and Methods: Total 50 participants fulfilled eligibility using inclusion criteria of age 5-15 years, Gross motor function classification score (GMFCS) level more than II, known case of Developmental Delay and Cerebral Palsy. Body Weight Support Treadmill was performed for total 14 days. Baseline assesment was done through Gross motor function classificaton score. Gross Motor functioning measurement (GMFM-66) and Pediatric Balance Scale (PBS) were used as pre and post-test assessment tool for measuring gross motor and balance respectively.

Results: The mean age of participants was 4.90 ± 1.129 with 32 (64%) males and 18 (36%) female population. Paired t-test was used to find pre and post effects of body weight supported treadmill on Pediatric Balance Scale (PBS) and Gross Motor Function Measurement (GMFM)-66 and the results were significant with 0.001 and 0.002 P-values respectively. Frequency of GMFM-66 and PBS were also compared. PBS results showed that balance was improved in 20% participants whereas GMFM-66 results showed that gross motor functioning was improved in 63% of participants.

Conclusion: Body weight supported treadmill helped in improving gross motor as well as balance.

Key Words: *Balance, Cerebral palsy, Developmental delay, Gross motor function, Treadmill*

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INTRODUCTION

Around the world each year globally 52.9 million

child under age 5 years failed to achieve proper development according to their age and about 90% cases are reported from the child living in low

income and middle income countries.¹ Estimated prevalence of developmental delay in Pakistan was found to be around 15% which increased to 30% in poor population.²

Developmental delay is the umbrella term used for children having significant delay in developmental domains including gross motor, fine motor, cognitive or intellect, social activities, speech, and many more.³ Common example of developmental disabilities are Down Syndrome, Cerebral Palsy, Autism, Microcephaly, Epilepsy, Brain Malformations, Spina Bifida, Behavioral Disorders, injury to brain and many more.⁴

Cerebral palsy by definition is the disorder of movement and posture due to lesion in brain.⁵ It is a static encephalopathy with various motor impairment including abnormal muscle tone, movement and posture that are often accompanied by disturbances of sensation, balance, perception, cognition, communication, behavior and secondary musculoskeletal problems with non progressive disturbances that occurred in developing fetal or early infancy and persist throughout the life span.⁵ Cerebral palsy was first reported in the historical document of Hippocrates.^{5,6}

Cerebral palsy has been classified into spastic CP including quadriplegic, hemiplegic or diplegic; Dyskinetic CP including athetosis, choreoathetosis, dystonia and ataxic or mixed cerebral Palsy.⁷ Working with pediatric population is not a single person work but it requires team work. The team of neurologist, paramedical staff, physical therapist, occupational therapist, speech therapist, and orthotist work together for the betterment of cerebral palsy and developmental delay.⁸

The types and functional limitation of cerebral palsy and development delay varies from patient to patient, that is why assessment tools has been designed to understand the limitation and provide the treatment as per the need and targetted goal designed for each individual.⁹ The two most common limitation in the cerebral palsy population are balance and gross motor functioning.¹⁰

Tools widely used in assessment of balance in cerebral palsy involve functional reach test, Pediatric balance scale, and early child clinical assessment of balance.¹¹⁻¹³ Pediatric Balance

scale (PBS) has been used widely with good validity and reliability for age group between 5 to 15 years old with reliability (ICC=0.927).¹² It is considered as easy and least expensive in predicting balance and to detect changes in functional balance.¹⁴ In contrast, to measure gross motor functioning most common assesment tool is Gross Motor Function Classification Score (GMFCS) on an ordinal scale with scoring I-V and reliability 0.77 and Gross Motor Function Measurement (GMFM) on a ordinal scale with scoring based on 66 points.¹⁵

To improvise the walking pattern, and gait training in cerebral palsy and developmental delay, treadmill is occassionally used.¹⁶ Treadmill allows multiple repetitions of steps involved in gait cycle with control between antagonist and agonist muscles in improving static and dynamic balance.¹⁷

Previous studies has been conducted related to effect of treadmill on endurance, dynamic control, functional activities ,gross motor control, cardiopulmonary endurance.^{18,19}

Romero et al. conducted a study on the effect of treadmill training with partial body weight support on spine geometry and gross motor functions in child with diplegic Cerebral palsy. 31 children spastic with age 5 to 7 years were selected. Results showed that there was significant improvemnet in trunk mobility but not in gross motor functioning.²⁰ Another study was conducted by Bıyık et al., to evaluate effectiveness of treadmill in improving ambulatory status of spastic cerebral palsy in these treated with Botox, showed that treadmill was effective in improving ambulatory status.¹⁸

Previous studies have been conducted regarding effectiveness of body weight supported treadmill in cerebral palsy but there was insignificant data regarding the effectiveness of treadmill in improving gross motor and balance among cerebral palsy and developmental delay population so this study was conducted to find the efficacy of body weight supported treadmill concerning gross motor and balance training.

MATERIAL AND METHODS

This was a quasi experimental pre and post study design with convenient based sampling technique,

that included fifty participants who fulfilled eligibility using inclusion criteria that included age 5 to 15 years, GMFCS level greater than 2, diagnosed with developmental delay or Global Developmental Delay and Cerebral Palsy while those with Spinal Cord Injury, history of trauma, malignancy, fracture, genetic degenerative diseases, cardiopulmonary problems, seizures, audiovisual impairments, orthopedic deformity with surgery indication were excluded from the study.

Informed consent form was signed by parents of child and informed consent form consisted of all the main objectives of the study. Participants were allowed to withdraw the study if they felt unswce. All risk and benefits were explained in the detail.

Baseline assessment was done which included past medical history including perinatal, prenatal and post natal history, Gross Motor function Classification scoring [GMFCS] Level and domain of delay.

All 50 participants underwent body weight supported treadmill program at comfortable speed of 0.5 KPH (at initial phase) for 10 minutes for 14 days. Physiotherapist supported child's feet and assisted them in walking. Speed was gradually increased on the basis of child's degree of tolerance. Orthosis were given to those children who were unable to walk without them on ground and with poor walking pattern. Environment was made playful by using toys and cartoons. Session was stopped if child complained of shortness of breath, fatigue, severe pain and chance of falling out. Parents were guided and instructed that they could continue other activities and therapy session of their child.

Study completed in 14 days with pre and post treatment assessment of balance and gross motor functioning on PBS and GMFM-66 respectively.

All the data was entered and analyzed using

TABLE 2: Descriptive statistics of gross motor functioning measurement (GMFM-66) and pediatric balance scale (PBS) scales

Variable	Pre-Mean \pm SD	Post Mean \pm SD	p-value
GMFM-66	38.100 \pm 5.826	40.42 \pm 6.996	0.001
PBS	26.480 \pm 5.686	23.66 \pm 5.200	0.002

Frequency of GMFM-66 and Pediatric Balance Scale were compared. PBS results showed that balance was improved in 12(20%) population.

SPSS 22.0 Version. frequency percentage were calculated of gender, domains of developmental delay, gmfcs levels and mean were calculated for age, height, and weight. Paired sample t-test was applied to analyze pre and post effect of treadmill.

RESULTS

Fifty children were selected on the basis of inclusion and exclusion criteria. Baseline assessment was done shown in table 1. Total 64% patients were males and 36% were females. Patients were delay in multiple domains for instance motor, communication, fine skills and global developmental delay with percentages of 98%, 4%, 4% and 94% respectively. Majority of the patients, about 44% were on level III of Gross Motor Function Classification System (GMFCS), 36% were on level IV and only 20% patients were on V. Mean age of the children was 5.90 \pm 1.129 years. Mean height and weight were 106.42 \pm 10.369 cm and 17.032 \pm 3.69 kg respectively.

TABLE 1: Characteristics of 50 children with developmental delay and CP

Category	Frequency (%)
Gender	
Male	32 (64.0)
Female	18 (36.0)
Domain of delay	
Motor	49 (98.0)
Communication	2 (4.0)
Fine skills	2 (4.0)
Global	47 (94.0)
Developmental Delay	
GMFCS	
Level III	22 (44.0)
Level IV	18 (36.0)
Level V	10 (20.0)
Age (years)	5.90 \pm 1.129
Height (cm)	106.42 \pm 10.369
Weight (kg)	17.032 \pm 3.69

Paired t-test was used to find pre and post-test effect of treadmill on balance and gross motor functioning and the results were significant as shown in table 2.

While GMFM-66 results showed that gross motor functioning was improved in 38(63%) population.

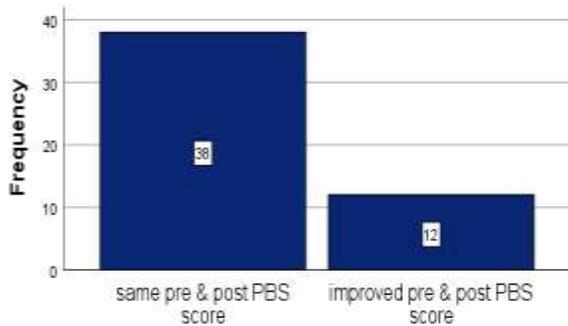


Fig 1: Illustrated the number of patients with improved and same Pediatric Balance Scale (PBS) score after treadmill session (n=50)

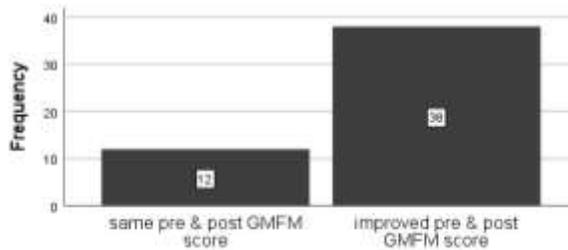


Fig 2: Illustrated the number of patients with improved and same Gross Motor Function Measurement-66 (GMFM-66) score after treadmill session (n=50)

Although both gross motor function and balance was improved after treadmill training in children with cerebral palsy and developmental delay but treadmill was statistically more significant in improving gross motor function (0.001) in comparison to balance.

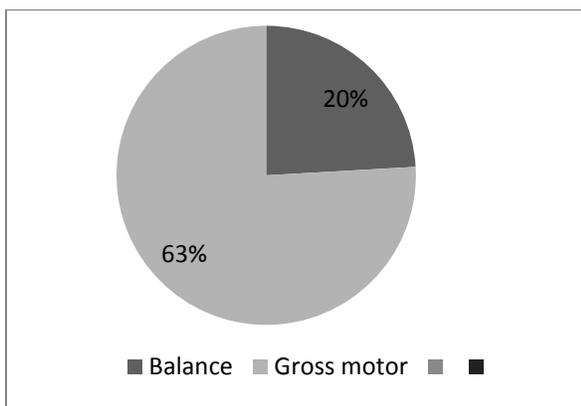


Fig 3: Illustrated the number of children with improved balance and Gross Motor Function after body weight supported treadmill session (n=50).

DISCUSSION

Cerebral Palsy and developmental delay has been the major concern with regards to the disabilities that pediatric population has been facing, globally 59 million cases are reported with more incidence in the under developing and developing country with poor socioeconomic status.¹ Pakistan reports higher rate of disability with pediatric morbidity and mortality due to lack of resources, and facilities.¹⁹ To prevent the incidence of disability in the cerebral palsy and developmental delay children, it is crucial to initiate emerging approaches that can promote mobility, reduce pain, and promote independent walking.

This study was conducted to find the effectiveness of treadmill in improving Gross Motor Functioning and Balance. Total 50 participants were selected as per the inclusion criteria that included age 5 to 15 years, GMFCS level greater than 2, diagnosed with developmental delay or Global Developmental Delay and Cerebral Palsy. Out of 50 participants, 64% were of male gender and 36% were females. One study by Okenwa & Edeh also reported 64% male patients enrolled for cerebral palsy physical rehabilitation.²⁰ The mean age of the participants in our study was 5.90 ± 1.129 . A study conducted by Biyuk et al., included 45 cerebral palsy children for checking the effect of treadmill in promoting early ambulation, the mean age of participants were 5.63 ± 2.07 quite similar to our study.¹⁸

The outcome measures used to assess the effectiveness of treadmill for improving motor function and balance were GMFCS, GMFM-66, and PBS. Each scale has strong reliability and validity.²¹ One study conducted on the effect of treadmill in improving endurance and ambulatory status of cerebral palsy children also used GMFF-66 and PBS along with six-minute walk test as their main focus was on checking cardiopulmonary endurance which can be accurately measured through six -minute walk test, along with this body supported treadmill was used to prevent chances of fall similar to our study.²²

Another study provided brief about the forward and backward strategy of treadmill used in cerebral palsy for improving mobility and balance

among spastic cerebral palsy, GMFM-66, PBS, and timed up and go scale was used as focus to measure functional mobility skill.²³

The data was analyzed using SPSS 22.0 version. The results of this study showed that both balance and gross motor activities were improved after 14 days session of treadmill but gross motor function was statistically more significant with regards to treadmill training (0.001).

One meta-analysis conducted by Han & Yun²⁴ showed that treadmill was effective in improving gross motor functioning which is similar to our study along with this it was found that the gait speed and gait endurance was also improved after 14 days session of treadmill in the children with cerebral palsy.

Al Shemy²⁵ conducted research to evaluate the effect of treadmill with eye open and closed strategy on proprioception and balance in spastic diplegic, result showed that blocked vision treadmill was more effective in improving balance and proprioception of spastic cerebral palsy, same outcome measure PBS was used similar to our study and results were much alike as in our study too treadmill was effective in improving balance.

From the previous findings^{18,25}, it has been analyzed that the research has been conducted previously with regards to the efficacy of treadmill in improving gross motor activities and balance separately or with involvement of gait endurance but there was little data in analyzing the effect of treadmill for providing combined improvement in balance and gross motor functioning, so this study was conducted to evaluate the efficacy of treadmill in improving motor function and balance.

CONCLUSION

From this study one can conclude that body weight supported treadmill was effective in improving balance and gross motor function in children with cerebral palsy and developmental delay. The limitation of this study was that it was conducted in only one tertiary care hospital of Karachi, Pakistan. More studies in terms of large sample size are required to validate the results in more detailed manner. Furthermore this research has paved a way for physiotherapist to provide emerging evidence based rehabilitation strategies to the cerebral palsy and developmental delay

children and reduce the incidence of disability by promoting and supporting mobility status.

Conflict of interest: Nil

Authors' affiliation

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