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Determination Of The Effectiveness Of Task-Oriented Training To Improve Balance Among Children With Down Syndrome

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Abstract: The purpose of the study is to determine the effectiveness of Task-Oriented Training to improve balance among children with Down syndrome. **Method:** A Quasi-experimental (Single group pretest-posttest) design and Convenience sampling was used for the study. 14 children aged 5 to 12 years with Down syndrome were included in the study. The balance of the participants was assessed (pre-test) using the Pediatric Balance Scale. Participants underwent 45 minutes of Task-Oriented Training sessions, 3 times a week for 12 weeks. The balance was reassessed (post-test) using the Pediatric Balance scale. The pre-test and post-test scores of the balance were analyzed and interpreted. **Results:** The data analysis was carried out using the paired t-test. Based on the analysis, there is a significant improvement in the post-test scores of the balance (p value<0.05) compared to the pre-test scores. **Conclusion:** The study concluded that there was a significant improvement in balance after providing Task-Oriented Training among children with Down syndrome.

Keywords: Down syndrome, Balance, Pediatric Balance Scale, and Task-Oriented Training.

I. INTRODUCTION

DOWN SYNDROME

Down syndrome (Trisomy 21), is a common chromosomal condition caused by the presence of all or part of an extra chromosome 21[(1)]. A syndrome is a disorder defined by a group of features that occur together. A congenital syndrome, such as Down syndrome, is present from birth and is due to the abnormal development of the fetus[(2)]. John Langdon Down, a British physician, discovered Down syndrome in 1866, and the cause of the condition is chromosomal aberration, discovered by French human geneticist Dr. Jerome Lejeune in 1994[(3)]. This condition affects about 1 in every 700 to 1 in every 800 babies born worldwide; in India, the incidence is 1 per 850-900 live births[(4)]. It affects both genders equally[(5)]. Individuals with Down syndrome have a distinct collection of symptoms and manifestations that impair numerous bodily functions, in particular the musculoskeletal, neurological, and cardiovascular systems. They are generally smaller in size, with short fingers, hypotonia, and atlantoaxial instability, epicanthic folds, a flat nasal bridge and occiput, a small mouth and ears, and up-slanting palpebral fissures are the characteristics of the face. Down syndrome children have significantly delayed development when compared to typically developing children. The delay is caused by anatomical changes in the brain, such as decreased amounts of grey and white matter in the cerebellum, frontal and parietal lobes, corpus callosum, and hippocampus, as well as a delay in central and peripheral neuronal myelination. They have a variety of neuromuscular and musculoskeletal abnormalities as a result of these structural changes. Hypoplasia of the cerebellum and corpus callosum is the

main cause of muscle hypotonia, impaired fluency of movement and axial control, incoordination, abnormal laterality, and balance abilities[6].

BALANCE AND DOWN SYNDROME

Balance is the process of maintaining the Center of Gravity within the base of support of the body[7]. The capacity to maintain balance in sitting and standing is an important determinant of an individual's safety, independence, and quality of life. Static and dynamic balance are essential for maintaining a stable posture and carrying out many daily activities[8]. Children with Down syndrome's safety and independence skills are significantly impacted by balance, which is the most challenging skill to develop[9]. The challenges in balance can affect various aspects of motor skill development. This might be a significant factor, in addition to Hypotonia, and limited strength, causing delays in motor development in Down syndrome[10]. Impaired balance not only impacts an individual's ability to perform an occupation, but it is also a leading cause of falling[11].

TASK-ORIENTED TRAINING

Task-Oriented Training involves repeatedly practicing significant, functional activities or elements to develop well-organized and effective motor abilities. It is employed as a rehabilitation strategy to improve motor skills and as a rehabilitation program for improving muscle strength, balance, and function. Task-Oriented Training includes specific tasks to improve function as an effective treatment for functional improvement of patients with central nervous system problems. It is a type of motor learning in which skills are acquired while doing a specified functional activity. A skill is the ability to achieve a goal with consistency, flexibility, and efficiency. This training improves motor performance, motor control strategies, balance, and daily function more than traditional treatment[12]. It often uses real or daily tasks as a therapeutic medium in rehabilitation. When combined with repetitive practice, this aims to improve optimal function, enabling the patient/client to carry out everyday activities[13]. Tasks used in Task-Oriented Training should be repetitive, functional, task practice, task specific, and client-centered[14].

II. AIM AND OBJECTIVES

Aim:

- To determine the effectiveness of Task-Oriented Training to improve balance among children with Down syndrome.

Objectives:

- To assess (pre-test) balance in children with Down syndrome using the Pediatric balance scale.
- To provide intervention using Task-Oriented Training in children with Down syndrome.
- To reassess (post-test) balance in children with Down syndrome using the Pediatric balance scale.
- To compare the pre-test & post-test scores of the Balance to determine the effectiveness of Task-Oriented Training.

III. NEED OF THE STUDY

Balance is important for safely carrying out regular motor tasks. Deficits in these areas in children with Down syndrome can cause motor delays, increase the risk of instability, falls, and associated injuries, and lead to restrictions in activities and participation. Task-Oriented Training, which focuses on practicing functional and goal directed activities, has been shown to improve motor performance and balance in various populations, but evidence supporting its effectiveness specifically for children with Down syndrome remains limited. Therefore, this study is conducted to determine the effectiveness of Task-Oriented Training to improve balance among children with Down syndrome.

IV. METHODOLOGY

Research Design:

The Quasi-experimental (Single group pretest-posttest) design.

Study Setting:

The study was conducted at Occupational Therapy, Department of Therapeutics, and Department of Cross Disability Early Intervention Centre (CDEIC), NIEPMD, Tamil Nadu.

Sampling Technique:

Convenience Sampling.

Sample Population:

Children diagnosed with Down syndrome.

Sample Size:

14

Duration of the study:

The duration of the study was 6 months. The intervention was given for 12 weeks. Each session was for 45 minutes, and 3 sessions were given in a week.

VARIABLES

• *Independent Variable:* Intervention given using Task-Oriented Training.

• *Dependent Variable:* Balance.

SELECTION CRITERIA

Inclusion Criteria:

• Children diagnosed with Down syndrome.

• Both gender.

• Age group from 5 to 12 years.

• Children with Balance Problems. (Children who score 0-3 in Pediatric Balance Scale)

Exclusion Criteria:

• Children with Cardiac conditions.

• Children with vision impairment.

• Seizure disorder.

• Orthopedics conditions (recent fractures)

TOOL USED

PEDAITRIC BALANCE SCALE

The Pediatric Balance Scale (PBS), a modified version of the Berg Balance Scale, was developed as a balance assessment tool for school-aged children with mild to moderate motor impairment. It contains 14 items which are sitting to standing, standing to sitting, Transfers, standing unsupported, Sitting with Back unsupported and Feet supported on the floor, Standing unsupported with eyes closed, Standing unsupported with feet together, Standing unsupported one foot in front, Standing on one leg, Turn 360 degrees, Turning to look behind Left and Right shoulders with Standing still, Pick up object from the floor from a standing position, Placing alternate foot on step stool while standing unsupported, Reaching forward with outstretched arm while standing. Each item is assigned a score ranging from 0 (the lowest function) to 4, (the highest function), with a maximum of 56 points[15].

INTERVENTION PROTOCOL

Children in this study participated in 45-minutes of Task-Oriented Training program weekly thrice for 12 weeks, with 4 to 5 minutes breaks between tasks.

1) Reaching activities

2) Sit-to-stand activities

3) Ball-kicking activities

4) Walking activities (Forward, backward, sideways)

5) Jumping activities

6) Standing on one limb activities

7) Up and down stairs training

8) Stepping activities (Forward, backward, sideways onto blocks of various heights)

9) Raising and lowering heel while maintaining a standing posture.

Each activity was performed in three sets of ten repetitions, with the difficulty level gradually increased by reducing the seat height for sit-to-stand tasks, raising the stepper height, decreasing the assistance provided, and increasing the duration for the standing on one leg activity.

V. PROCEDURE

This study is a Quasi-experimental (Single group pretest-posttest) design, Convenience sampling was adopted for the study. The study was conducted at Occupational Therapy, Department of Therapeutics, and Department of Cross Disability Early Intervention Centre (CDEIC), NIEPMD, Tamil Nadu. The participants of the study included 14 children with Down syndrome between the ages of 5-12 years who fulfilled the inclusion and exclusion criteria. The purpose and procedure of the study were priorly explained to the parents of the participants. Then the written consent was obtained from the parents of the participants. The children's balance was assessed using the Pediatric Balance Scale for the Pre-test. Children in this study underwent 45-minutes Task-Oriented Training program weekly thrice for 12 weeks, with 4 to 5-minutes breaks between tasks. Then using the Pediatric Balance Scale reassessment was done for all 14 participants. The collected data were statistically analyzed by comparing the pre-test and post-test scores to determine the effectiveness of Task-oriented Training to improve balance among children with Down syndrome.

VI. RESULT

Statistical analyses: The data was obtained and subjected to statistical analysis. All analyses were carried out using Statistical Package for Social Sciences (version 26, IBM, Chicago, USA). Continuous variables, such as pre and post-test scores of the Pediatric Balance Scale were expressed as mean ± standard deviation (SD), and categorical variables, such as age and gender were expressed as n and %. The normal distribution of the data was checked using Shapiro Wilk test. As data followed normal distribution, parametric test of significance was used. The level of significance was set at 5%. Paired t-test was used to compare pre and post-test scores after the intervention Task-Oriented Training (TOT).

Table 1: Demographic details of study participants

Demographic characteristic	Stratification	n (%)
Age	5-8 years	7 (50)
	9-10 years	4 (28.57)
	11-12 years	3 (21.43)
Gender	Male	9 (64.2)
	Female	5 (35.8)

The age group of the children ranges from 5 to 12 years. A total of 14 children participated in the study including 9 males and 5 females.

Table 2: Comparison of Pre and post-test scores of balance after TOT

n=14	Mean	S.D.	P value
Pre-test	19.64	8.07	0.001*
Post-test	30.93	9.33	

-Paired t-test; *p-value<0.05 – statistically significant.

The paired "t" test was used for testing the pre and post-test scores of the balance (p-value<0.05-statistically significant)

Table 3: Comparison of pre and post-test scores of balance among study participants after TOT

	Pre-test scores	Post-test scores	p-value
Sitting to standing	2±0.67	3±0.67	0.001*
Standing to sitting	2±0.67	3±0.67	0.001*
Transfers	1.93±0.61	2.93±0.61	0.001*
Standing unsupported	1.71±0.61	2.64±0.63	0.001*
Sitting unsupported	1.86±0.77	2.71±0.61	0.001*
Standing with eyes closed	1.07±0.61	1.93±0.6	0.001*

Standing with feet together	0.5±0.76	1.21±0.12	0.001*
Standing with one foot in front	0.86±0.66	1.29±0.72	0.001*
Standing on one foot	0.71±0.72	1.64±0.74	0.001*
Turning 360 degrees	1.07±0.61	2.0±0.67	0.001*
Turning to look behind	1.64±0.63	2.36±0.84	0.001*
Retrieving object from the floor	1.71±0.72	2.57±0.93	0.001*
Placing alternate foot on stool	1.0±0.67	1.21±0.8	NS
Reaching forward with outstretched arm	1.5±0.65	2.43±0.75	0.001*

-Paired t-test; *p-value<0.05 – statistically significant

The paired t-test was used for testing the pre and post-test score of balance among study participants after TOT.

VII. DISCUSSION

Table 1 presents the Demographic characteristics of the study participants. A total of 14 children with Down syndrome participated, with 9 being male and the remaining 5 being female. Regarding age distribution, 7 children were in the 5–8 years age group, while 4 and 3 children were in the 9– 10 years and 11–12 years age groups, respectively.

Table 2 present the comparison of pre and post-test scores of the Balance for all participants. The mean pre-test score was 19.64 (±8.07), which increased to 30.93 (±9.33) in the post-test assessment, which could be due to the effects of Task-Oriented activities. The paired t-test showed a p-value of 0.001 (<0.05), indicating statistical significance.

Table 3 demonstrates significant improvements across various items of the Pediatric Balance Scale (PBS). Notably, tasks such as “Sitting to standing”, “Standing to sitting”, “Transfer”, and “Retrieving object from the floor” showed significant improvement. This improvement could be because these tasks directly relate to the functional movements targeted during the intervention. For example, intervention involved, sit-to-stand transitions from various chair heights, walking forward and sideways, and stepping forward onto blocks of various heights. Improvements in “Standing unsupported” and “Sitting unsupported” highlight the participants increased stability in maintaining static positions. The components, such as “Reaching forward with outstretched arm” and “Turning to look behind” also showed marked improvements. This improvement could be attributed to everyday tasks in which children naturally engage in reaching and turning activities. Similarly, more challenging components like “Standing on one foot” and “Standing with one foot in front” demonstrated significant improvement. This improvement could be because during the activity most of the children showed more interest in performing tasks like kicking the ball, and collecting beads with their toes while standing on one leg.

However, the component “Placing alternate foot on stool” showed limited improvement with no statistical significance. This could be due to the complexity of the task, as it demands not only balance but also the ability to coordinate leg movements, suggesting that a longer intervention period or specific training might be necessary to achieve improvements in this specific component. Hewa et al., concluded that among the dynamic component of the Pediatric balance scale, placing alternate foot on stool was highly affected in children with Down syndrome [16].

VIII. CONCLUSION

The study aimed to determine the Effectiveness of Task-Oriented Training to improve balance among children with Down syndrome. The study findings revealed statistically significant improvement in balance, demonstrating the effectiveness of Task-Oriented Training.

LIMITATIONS:

- The study was conducted only at one place – NIEPMD.
- The study population had unequal gender distribution.

RECOMMENDATIONS:

- Future studies could be evaluated on the adult population with Down syndrome.
- Future research can investigate the potential benefits of Task-Oriented Training in other Dependent variables such as Gross motor development in Down syndrome.
- Future research could employ a randomized controlled trial (RCT) design to provide more strong evidence regarding the impact and efficacy of Task-Oriented Training interventions.

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