EFFECT OF BALANCE TRAINING IN DOWN SYNDROME CHILDREN

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ABSTRACT

BACKGROUND: Down syndrome (Trisomy 21) is a genetic disorder and the commonest chromosomal abnormality. The hallmark features includes muscle hypotonia and joint hyperflexibility. Balance being one of the hardest functions to attain by these children is a major factor which affects the safe and independent skills. Hence contributes to the risk of falls and injuries. The objective of the study was to find the effect of balance training in Down syndrome children.

METHODOLOGY: A Quasi-Experimental study was done on eight children with Down syndrome. Inclusion criteria- both boys and girls of age 6-16 years, Mini Mental State Examination score of 10-23 (Mild-Moderate) and able to stand and walk independently. The children were taught to perform the warm up exercises followed by main exercise session and each session ended with the cool down exercises. Total duration- 6 weeks (3 days alternatively/week). Pre-test and post-test was assessed by using Pediatric Balance Scale.

CONCLUSION: The study concluded that there is improvement in balance in children with Down syndrome after 6 weeks of balance training with 3 sessions per week.

KEY WORDS: Balance training, Children, Down syndrome, Hypotonia, Pediatric Balance Scale (PBS), six weeks

I. INTRODUCTION

Down syndrome is a genetic disorder and the commonest chromosomal abnormality. Incidence in India is 1 per 1150 live birth1. Cause of Down syndrome can be attributed to the non-disjunction. Hence there occurs an extra genetic material in chromosome 21 resulting in 47 numbers. Hence it is also called as Trisomy 211.

The commonest risk factor of Down syndrome is higher maternal age. Others include consanguineous marriage, radiation during pregnancy and socioeconomic factors2. Down syndrome is a common cause of developmental disabilities and mental retardation1. The predominant features of these individuals include muscle hypotonia and joint hypermobility3. Other physical characteristics include increased obesity, flat face, irregular or small shaped ears, slanted eyes, abnormal pattern of fingers and wide gap between 1st and 2nd toes.

Developmental delays being more common in these individuals will further affect the gross motor skills including longer reaction time, balance deficits, poor postural control and lack of coordination. Balance being one of the hardest functions to attain by these children is a major factor which affects the safe and independent skills. It plays an important role in the process of development in children. Hence this affects the quality of movement and participation in activities of daily living.

As previous articles says that normally children with Down syndrome score less in balance subset when compared to normal children4-6. The reason for the poor balance in these children as stated by Connolly and Michael (1985) is due to hypotonia which the researchers define as decreased segmental pool excitability and pathology of stretch reflex mechanism and its effects such as decreased pelvic stability and also that flat foot contributes to balance difficulties that is commonly noted in activities such as single limb stance and tandem
standing. Also studies said that balance difficulties in Down syndrome children are not because of hypotonia but rather occur because of the defects within higher level postural mechanisms⁷,⁸.

Children with Down syndrome normally score mild to moderate level of mental impairment as there is a delay in myelination, degenerative processes and small amount of neurons in CNS⁹,¹⁰. Also hypotonia, restrained primary reflexes and slow reaction times affects the motor and cognitive skills and also balance performance. For an activity to be performed with adequate balance sufficient amount of equilibrium is needed to be attained¹¹. For an equilibrium to be attained the integration of sensory and neuromuscular functions are required. When this gets hindered equilibrium is affected and this in turn leads to inefficient balance.

The aim of the study is to find the effect of balance training in Down syndrome children. The need of the study is that Down syndrome individuals have balance difficulties due to which there are frequent chances of falls and injuries. Also the balance deficit hinders them to perform their functional activities efficiently. Hence balance training in these individuals not only helps to prevent falls by providing a greater stability but also to perform their functional activities with ease. Due to the limited number of studies on balance training in these children, the current study emphasize on the need and planning of appropriate interventions to improve balance.

II. MATERIALS AND METHODS

It is a Quasi-experimental study done on eight Down syndrome children who were selected based on the selection criteria as convenient sampling. The inclusion criteria included both boys and girls of age 6-16 years, Mini Mental State Examination score of 10-23 (Mild-Moderate) and able to stand and walk independently. The exclusion criteria included children with vision and hearing loss, cardiovascular diseases, respiratory diseases and recent injury to lower extremities. Prior to the study, parents of the children were asked to fill the informed consent after being clearly explained about the exercise protocol and the objectives of the study. Also departmental ethical committee clearance was obtained before starting the study. The study was conducted at SRM Medical College Hospital & Research Centre from 2019-2020.

Before starting with the exercise intervention these children were assessed with Paediatric Balance Scale (PBS). Once the Pre-test gets completed, the children were taught to perform the warm up exercises. Later the children were trained to perform the balance exercises. Each session ended with cool down exercises which consisted of exercises similar to the warm up exercises. The total time period for the exercise intervention was 6 weeks (3 days alternatively/week). The duration of each session was 40-45 minutes which includes warm up exercises, main exercises phase and cool down exercises. A rest period of 30 seconds to 1 minute was given between the exercises. Table 1 shows the exercise protocol.
TABLE 1- EXERCISE PROTOCOL

<table>
<thead>
<tr>
<th>WARM UP EXERCISES (WEEK 1-6)</th>
<th>COOL DOWN EXERCISES (WEEK 1-6)</th>
<th>MAIN EXERCISES (WEEK 1-2)</th>
<th>MAIN EXERCISES (WEEK 3-5)</th>
<th>MAIN EXERCISES (WEEK 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm circles, leg swings, knee lifts Mini squats Mild stretching- Hamstrings, Quadriceps and calf muscles</td>
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<td>Walking on a line Reverse walking Two foot ankle hops Double leg hops Tandem standing Zig-zag walking</td>
<td>Walking on a line Reverse walking Two foot ankle hops Double leg hops Tandem standing Zig-zag walking Toe-heel walk Single leg hops Double leg stance with feet together One leg stance</td>
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</tr>
<tr>
<td>5 times on each side 5 times Stretching Hold time-10 seconds 2 times on each side</td>
<td>5 times on each side 5 times Stretching Hold time-10 seconds 2 times on each side</td>
<td>10 steps ; 2 sets 10 steps ; 2 sets 10 hops ; 2 sets 10 hops ; 2 sets 20 seconds with eyes open 10 steps ; 2 sets</td>
<td>10 steps ; 2 sets 10 steps ; 2 sets 10 hops ; 2 sets 10 hops ; 2 sets 20 seconds with eyes closed 10 steps ; 2 sets 10 steps ; 2 sets 5 hops ; 2 sets 20 seconds with eyes open</td>
<td>Day 1-5 hops ; 2 sets 10 steps ; 2 sets Day 2-8 hops ; 2 sets Day 3-10 hops ; 2 sets 20 seconds with eyes closed 20 seconds with eyes closed</td>
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</table>

After completing the exercise intervention for 6 weeks, Post-test was taken for each of the participants in a similar manner as Pre-test by assessing all the 14 components of Paediatric Balance Scale (PBS) and the total balance score was calculated.

**Outcome measure** - By Pediatric Balance Scale which consists of 14 components that assess the daily functional activities of children. The total score of the scale is 56 with each component having a maximum score of 4. It is a highly valid scale with a reliability of ICC 3,1= 0.997.

III. RESULTS AND DISCUSSION

The collected data was tabulated and was analyzed using SPSS software.

TABLE 2- MEAN VALUES OF PRE AND POST TEST OF THE TOTAL BALANCE SCORE OF PAEDIATRICS BALANCE SCALE

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>z – Value</th>
<th>p -value</th>
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</thead>
<tbody>
<tr>
<td>Total</td>
<td>Pre</td>
<td>8</td>
<td>37.63</td>
<td>3.159</td>
<td>-2.524</td>
</tr>
<tr>
<td></td>
<td>Post</td>
<td>8</td>
<td>48.75</td>
<td>.886</td>
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</table>
Table 2 shows the mean, standard deviation, z-value and p-value of pre and post test. The mean value of pre test is 37.63 and post-test is 48.75. There is a significant improvement between the pre and post test values of total balance score with p<0.05.

The present study aimed to improve the balance in Down syndrome children. The statistical analysis shows that there is a significant improvement (p<0.05) in overall balance scoring between the pre and post test when assessed by Paediatric Balance Scale (PBS).

All the children in the study scored mild to moderate in Mini Mental State Examination Score (MMSE). Hence they were able to follow the instructions. The children performed the exercises as per the instructions given as thrice per week and there were no missed out exercises in the protocol. Hence we can state that, the exercises given to the children were feasible.

Also on comparing the pre and post test values of each of the component there is statistical significance in the following components of Paediatric Balance Scale (PBS) transfers, standing unsupported, standing with eyes closed, standing with feet together, standing with one foot in front, standing on one foot, turning 360 degrees, retrieving objects from the floor, placing alternate foot on stool, reaching forward with outstretched arm. There is no significant improvement identified in the components such as sitting unsupported and turning to look behind (p>0.05). The reason for the non significant improvement for turning to look behind could be that none of the interventional exercises involved activities of trunk rotation.

The findings of the current study were in line with the previous studies by Sukriti Gupta et al., (2011) and Vassilios K. Tsimaras,. (2004) which concluded that balance abilities improved after balance training interventions4,5. The result of our study supports the previous study done by Sukriti Gupta et al., (2011) who concluded that following a six weeks intervention there was a significant improvement in balance in children with down syndrome5.

The results of this study is also supported by Samia A. Abdel Rahman et al.,(2010) who concluded that there was improvement in balance abilities in Down syndrome individuals by providing weight-bearing exercises12. The reason for the significant improvement is that weight-bearing exercises helps in enhancing the proprioceptive feedback which in turn provides improved movement control and reaction time.

AzimeNajafiFard et al., (2015) found the effect of a selected local game on dynamic balance of Down syndrome students which predominantly used hopscotch as the exercise intervention and concluded that there was a significant improvement in dynamic balance15. Hopscotch associated with jumping improves proprioception and thereby balance in these individuals. This is in line with our present study which includes two foot ankle hops, double leg hops and single leg hops in the balance training and thereby significant improvement is obtained.

The statistical significance from the current study in static balance components could be because the balance training protocol involved exercises such as tandem standing, double leg stance with feet together and one leg stance. Also these exercises involved a regular practice session with which the child is made to maintain the balance with a small base of support. Hence children who participated in the study showed a significant improvement in balance abilities from the pre-test values which indicated a poor balance. The participants showed significant balance improvement after a training session of 6 weeks with 3 sessions per week.

IV. CONCLUSION
The study concluded that there is improvement in balance in children with Down syndrome after 6 weeks of balance training with 3 sessions per week.

Limitations of the study are the sample size was small and there was a lesser study duration. The recommendations includes same study can be done with longer study duration and increased sample size, since there is no significant improvement in the component of turning to look behind and hence future studies must involve such exercises that will enhance and improve trunk rotation, future studies can be done by providing interventions for both strength and balance training for more effective outcome and also follow-up studies can be done in future to document the long-term effects of such provided interventions.

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Ethical Clearance by College level ethical committee

Funding: Self

Conflict of Interest: Nil

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