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Assessment of balance in ambulatory children with downs syndrome

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Abstract

Background: Balance is an ability that keeps the center of gravity within the base of support with a limited amount of sway, thus it is essential for postural control and activity^[15]. The clinical ability to control equilibrium is crucial for children. Neuromuscular abnormalities in children with Down syndrome, which have been observed to be coincident with developmental delays, include generalized muscular hypotonia, the persistence of primitive reflexes beyond their normal disappearance with age, and slowed reaction times during voluntary movement^[10, 11]. The gross motor skills of Down syndrome children are consistently low compared to those of normal children, and balance shows the largest difference. It can affect cognition, sociality, and complicated motor abilities such as running and jumping^[19].

Procedure: Ethical approval was taken from the ethical committee. The participants were selected from the special school according to inclusion & exclusion criteria by purposive sampling method. The selected participants were informed & written consent was taken from either school / parents. The students were assessed according to the Pediatric balance scale on different components. The data was then analyzed.

Result: 37 children with Down's syndrome are at moderate risk of fall (92.50%) and rest 3 of them (7.25%), are at low risk. No ambulatory child with Down's syndrome was found to be at high risk. The relation between the Age of the children and the risk of fall, correlation coefficient was calculated and the value obtained was; $r = 0.17$. Since the r value obtained is minimal, the correlation between Age and Risk of fall is insignificant.

Conclusion: Maximum number of children were reported to be at moderate fall risk as compared to low fall risk which had fewer children. Children with downs syndrome had minimal difficulty in performing sitting to standing while standing on one leg was affected the maximum. While comparing the age of children and risk of fall it was clinically proven that the risk of fall reduces as age increases, but statistically r value was insignificant.

Keywords: Balance, downs syndrome, pediatric balance scale

1. Introduction

Down syndrome, also known as trisomy 21, is a genetic disorder caused by the presence of all or part of a third copy of chromosome 21^[1]. It is typically associated with physical growth delays, characteristic facial features, and mild to moderate intellectual disability^[2]. The average IQ of a young adult with Down syndrome is 50, equivalent to the mental ability of an 8 or 9-year-old child, but this can vary widely^[3].

Down syndrome is one of the most common chromosome abnormalities in humans. It occurs in about one per 1,000 babies born each year^[1]. Those with Down syndrome nearly always have physical and intellectual disabilities^[1]. They also typically have poor immune function^[4] and generally reach developmental milestones at a later age^[5]. It is known that children with Down syndrome learn to walk independently at an average age of 19 months. Yet children with typical motor development walk, on average, at 12 months of age^[6].

When motor development of a child with Down syndrome is compared with that of a developmentally normal child, a consistent delay is observed in the acquisition of both postural and voluntary components of motor control^[7, 8]. General movements in children with DS are characterised by low—low/moderate speed, large—large/moderate amplitude, partially creating impression of fluency, smoothness and complexity, abrupt beginning and end, few other concurrent gross movements^[9].

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Neuromuscular abnormalities in children with Down syndrome, which have been observed to be coincident with developmental delays, include generalized muscular hypotonia, the persistence of primitive reflexes beyond their normal disappearance with age, and slowed reaction times during voluntary movement^[10, 11].

In particular, disabilities related to motor function are extensive, for example abnormal gait patterns and postural control, dilatory response to environment alteration, lack of coordination, and concurrent contraction of agonists and antagonists^[12]. Juvenile motor development is delayed because muscle activation patterns are unstable and not well-organized and thus, motor dysfunction leads to muscle dystonia^[13, 14].

2. Methodology

- Study Design – Observational
- Study type – Cross-sectional
- Sampling – Purposive Sampling
- Sample Size – 40
- Study duration – 6 months
- Study set up – Special schools. (In and around PCMC and Pune).

3. Procedure

Ethical approval was taken from the ethical committee. The participants were selected from the special school according to inclusion & exclusion criteria by purposive sampling

method. The selected participants were informed & written consent was taken from either school / parents. The students were assessed according to the Pediatric balance scale on different components. The data was then analyzed.

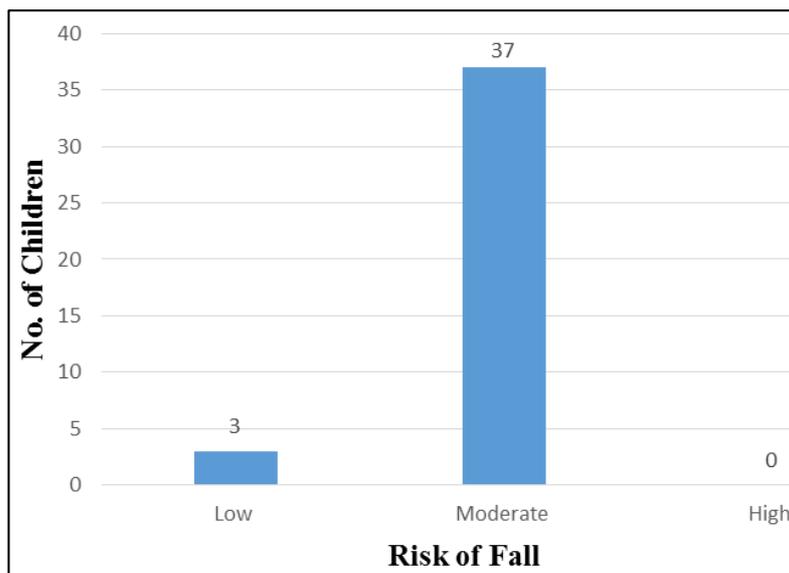
4. Data analysis and results

- In this study, 40 children of both genders were included.
- There were 22 boys and 18 girls.
- The mean and standard deviation of the total scores was calculated and interpreted in relation with age and gender of the children.
- The mean age of children with downs syndrome was 9.1.

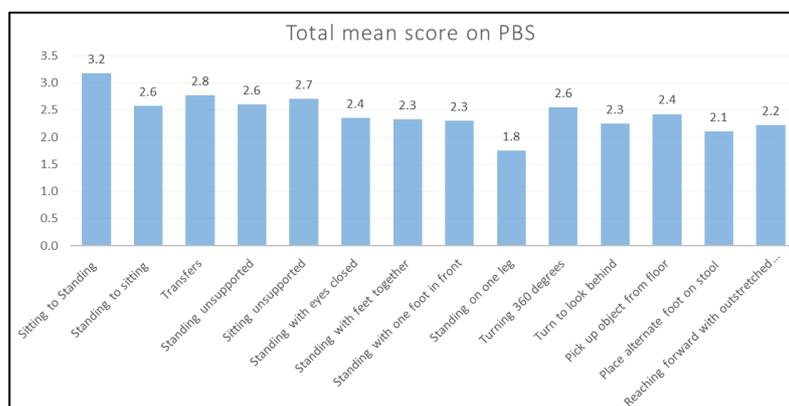
Table 1: Distribution of children according total score of PBS

| Risk of Fall | No. of Children | Percent |
|---------------|-----------------|---------|
| Low Risk | 3 | 7.50% |
| Moderate Risk | 37 | 92.50% |
| High Risk | 0 | 0 |
| Total | 40 | 100.00% |

- The above table shows the distribution of children with downs syndrome according to the total score of PBS.
- Maximum number of children were reported to be at moderate fall risk as compared to low fall risk which had fewer children.

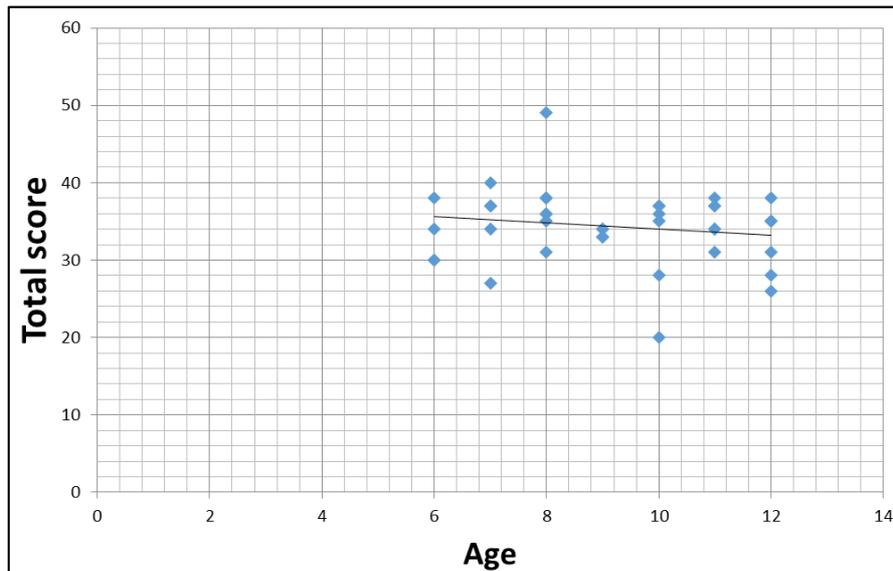


Graph 1: Distribution of children according total score of PBS



Graph 2: Total mean score on PBS

- The above graph shows the mean total score of children with downs syndrome on Pediatric balance scale.
- Children with downs syndrome had minimal difficulty in performing sitting to standing while standing on one leg was affected the maximum.



Graph 3: Correlation Coefficient

- To understand the relation between the Age of the children and the risk of fall, correlation coefficient was calculated and the value obtained was; $r = 0.17$.
- Since the r value obtained is minimal, the correlation between Age and Risk of fall is insignificant.

5. Discussion

Balance is an ability that keeps the center of gravity within the base of support with a limited amount of sway, thus it is essential for postural control and activity. Sway is the horizontal movement of the centre of gravity even when a person is standing still. A certain amount of sway is essential and inevitable due to small perturbations within the body.

The ability to describe the extent to which a child demonstrates righting reactions, protective responses, and equilibrium reactions in response to a therapist generated perturbation formed the foundation of the “classic” balance assessment [1, 2].

Functional balance, for the purpose of this study, has been defined as the element(s) of postural control that allow a child to safely perform everyday tasks. A child of school age is expected to function independently within his/her home and school environment when performing self-help (Basic activities of daily living), locomotor (Mobility), and gross motor activities, including recreational activities/play (instrumental activities of daily living).

Down's syndrome is accompanied by growth deficiency, delayed motor development, and a varying number of morphological anomalies which encompass most organs or systems. 'Hyper flexibility' of the joints is one of the most typical physical abnormalities in downs syndrome children (Beckman, Gustavson & Akesson, 1962). An important factor contributing to excessive postural instability is undoubtedly generalized muscular hypotonia, which is the most frequently mentioned anomaly of the neuromuscular system in DS babies.

A two-factor (age, gender) analysis of variance was computed to determine the significance of differences in risk

of fall with advancing age, between boys and girls, and between the age groups.

The Down syndrome children demonstrated the most minimal reduction in risk of fall between 6 and 12 years. This finding might reflect the presence of hypotonia which could be anticipated during this time in the Downs syndrome children (Levinson *et ai*, 1955; Morris *et al.*, 1982). Investigations of boys and girls (Hupprich & Sigersteth, 1950) aged from 6 to 18 years showed that flexibility increased in most joint motions from 6 to 12 years, and then progressively decreased. The timing of the decrease in flexibility coincides with the period of rapid growth associated with puberty.

Another explanation for the apparent variation in the risk of fall of the Downs syndrome children may be found in the growth patterns commonly associated with the syndrome. Some growth parameters in Downs syndrome children such as height (Rarick & Scefeldt, 1975), skeletal maturation (Rarick, Rapaport & Seefeldt, 1964; Roche, 1964), tibial length (Rarick *et al.*, 1964) and length of the metatarsals and phalanges (Chumlea *et al.*) [15]

The gross motor skills of Down syndrome children are consistently low compared to those of normal children, and balance shows the largest difference. In particular, disabilities related to motor function are extensive, for example abnormal gait patterns and postural control, dilatory response to environment alteration, lack of coordination, and concurrent contraction of agonists and antagonists [12].

With this study we found out that balance was affected maximum in children with Down syndrome while attaining one leg stance. Children with Down Syndrome oscillate more than children with no neuromotor impairment during static posture control, which is attributed to difficulty capturing the sensory information that determines the position of the body in space [1, 2]. The children with Down syndrome analyzed in the study exhibited greater anteroposterior oscillation with and without visual information. In other studies, when compared to unaffected

subjects, Down syndrome patients show lower levels of strength [12]; this is probably partly due to the action of factors such as number and type of muscle fibers, because the percentage of fast fibers in DS individuals is smaller than in people without disabilities [13].

Another reason which justifies that one leg standing is affected the maximum could be that the motor function in individuals with Down syndrome is characterized by hypotonia [7] and hyper flexibility, which results in an increased risk of joint dislocation and retarded motor skills. Hypotonia, decreased muscle tone, has a negative effect on the proprioceptive feedback from muscle and joint sensory structures and can have a detrimental effect on the efficiency of co-contractions and postural reactions.

6. Conclusion

- Our finding suggests that most of the children with Down Syndrome are at moderate risk of fall (92.50%) and rest (7.25%) are at low risk.
- No ambulatory child with Down's syndrome was found to be at high risk.
- In our study, the most affected component found in Down syndrome was 'One leg standing' and the minimally affected component was 'Sitting to standing'.
- While comparing the age of children and risk of fall it was clinically proven that the risk of fall reduces as age increases, but statistically r value was insignificant.

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