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Dynamic Balance in Children With Trisomy 21: A Pilot Study*

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At age 5, children with trisomy 21 have roughly 2 years of delayed motor development. We aimed to verify if children with trisomy 21 (AD) (N = 6, 7.67 ± 1.51 years) had a similar performance to children with a typical development (TD) (N = 37, 5.19 ± 0.40 years old), in a playful motor action (to spin on herself until she cannot get more). On average, ADs gave less laps, for less time, spending more time per rotation, but without significant difference. Of the AD, one-third fell and rose to continue to spin; one-third stopped and resumed spinning (with intervals of 2.05 ± 0.86s). Three ADs performed the action counterclockwise and the other three in clockwise direction. The results support the hypothesis that AD can perform the activity of spinning, with DT (significantly) younger, allowing to AD momentary pauses and conditions for their physical security.

Keywords: children, dynamic balance, motor development, trisomy 21

Introduction

Dynamic balance is the maintenance of equilibrium in rapidly changing kinetic condition during a motor action, being an essential component in many fundamental motor skills (DeOreo & Keogh, 1980; Espenschade & Eckert, 1980), particularly for pre-schoolers (B. D. Ulrich & D. A. Ulrich, 1985). Between three and six years of age, they increase the mastery of the base of support (Assaiante, Amblard, & Carblanc, 1988; Brenière, Bril, & Fontaine, 1989; Bril, & Breniere, 1988; Gallahue & Ozmun, 1998), the stabilization of the head in space (Assaiante & Amblard, 1993), and the use of peripheral vision (Assaiante, 1998); with the emergence of new modes of postural synergies (Shumway-Cook & Woollacott, 1985a). This contributes to an attunement of the vestibular-ocular reflex (Casselbrant et al., 2010) and an ability to better detect vestibular somatosensory

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information (Foudriat, Di Fabio, & Anderson, 1993). In studies on dynamic balance control, postural instability is created by action on the child or the support base (Shumway-Cook & Woollacott, 1985a; Forssberg & Nashner, 1982; Woollacott, Debû, & Mowatt, 1987); or, observing sustained, undisturbed spontaneous locomotor control (Valente, 2007), especially in the laboratory setting and in translational displacement; rotational conditions only those by extrinsic constraints (e.g., Amblard, Assaiante, Lekhel, & Marchand, 1994). Few tests run through rotations; for example, Zimmer and Volkamer (1987) include in their MOT 4-6 a test in which the child makes a 180° vertical jump to land on a rim in front of him/her, performing a second jump to starting position with another 180° rotation. Franco et al. (2017) based on solitary functional play, which is common in day care and preschool children (Rubin, Watson, & Jambor, 1978) asked children from three and six years old to spin on their selves until they cannot get more, noticing that 3-year-olds were slower, and that both directions of rotation were equally distributed among all children.

At age 5, Down 21 children have a cumulative delay in motor development of approximately two years (Butterworth & Cicchetti, 1978; Share & French, 1974). Its ability to respond to loss of balance is very slow until age 6, probably not due to its hypotonia (Shumway-Cook & Woollacott, 1985b). Down's syndrome children are hardly able to ride a tricycle at age 7 (Share, 1971). However, three and six years old that performed jumping practice could improve their dynamic balance (Wang & Ju, 2002).

It was intended to verify if children with trisomy 21 had a similar performance to younger typically developing children, in a playful motor action.

Methods

Sample

Six children with trisomy 21 (AD) (7.67 ± 1.51 years, 1 girl) and 37 significantly younger children with typical development (TD) (5.19 ± 0.40 years, 16 girls) ($Z = 4.517$, $p = 0.001$, $r = 0.69$). Written informed consent and assent were obtained.

Procedures and Protocols

According to Franco et al. (2017), it was asked to children to spin around themselves till they could not more or till they stopped definitively and totally unbalanced or fall on the floor, on a gym mat. The activity was presented was a playing one. No restriction of velocity or time was imposed. No feedback was provided. Participants did not receive any reward. It was allowed for child to stop for short moments during the spinning and to continue to spin, a behaviour that was frequent in children with trisomy 21. Direction of rotation, total spinning time, number of turns, and mean time per turn were obtained.

Statistical Analysis

It was used IBM SPSS Statistics for Windows, version 24, for a significance level of 0.05. Normal distribution was obtained through Shapiro-Wilk test. For comparison between groups, Mann-Whitney U test (Z), with Monte Carlo test, was used, and effect size r was estimated when significant difference occurred. Probability error was set at 0.05, two-tailed.

Results

On average, AD rotated less, for less time, spending more time per rotation, but without significant difference (Table 1).

Table 1

Comparison Between AD and DT Groups

Variable	Group	Mean ± SD	Z	p
Number of turns	DT	16.27 ± 12.53	1.475	0.140
	DA	10.33 ± 5.54		
Total time (sec)	DT	36.97 ± 30.73	0.491	0.623
	DA	28.84 ± 17.85		
Time per turn (sec)	DT	2.25 ± 0.47	1.265	0.206
	DA	2.69 ± 0.82		

Of the DA, one third fell and rose to continue spinning; one third stopped and restarted spinning (at intervals of 2.05 ± 0.86s). Three AD performed the action counter clockwise and the other three clockwise.

Discussion

In this fundamental motor skill, these AD children retain slight but not significant limitation of motor performance. The occurrence of falls during activity may be due to their difficulty in efficiently using vestibular somatosensory information (Foudriat et al., 1993) and to readjust to situations of loss of stability (Shumway-Cook & Woollacott, 1985b), unlike children DT (cf. Franco et al., 2017). As in children with TD (Franco et al., 2017), in these AD children there is no evidence of predominance of direction of rotation.

Conclusion

The results support the hypothesis that AD can perform the spinning activity on itself, with (significantly) younger DTs, enabling during the motor action to AD momentary pauses and conditions for their physical safety.

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