

## **Spatiotemporal Gait Measures in Children with Cerebral Palsy and in Non-Disabled Children: Test-Retest Reliability**

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**Introduction:** The purpose of this study was to determine the intersession reliability of spatiotemporal gait measures and to assess these stride characteristics in children with cerebral palsy (CP) compared to age and gender matched non-disabled children.

**Statement of Clinical Significance:** The intersession reliability of spatiotemporal walking parameters in children with CP are not well established. Determining test-retest reliability will help identify measures that can be used to evaluate gait and to assess the effects of surgical and other therapeutic intervention for children with CP.

**Methodology:** Twenty children, age 5-15 years, participated in this prospective study of intersession repeated measures. Data were collected on two testing days held one to two weeks apart. Ten children with spastic CP (mean age = 7.4, SD = 3.6) and 10 age and gender matched, non-disabled children (mean age = 7.5, SD = 3.2) participated in this study. On each of the two testing days, the child was fitted with compression-closing footswitches (B & L Engineering) and asked to walk how he/she normally walks for three trials of 30 feet. The stride characteristics of velocity (m/min), cadence (steps/min), stride length (cm), and single limb support as a percentage of the gait cycle (SLS) for both limbs were recorded. The Spearman correlation coefficient ( $\rho$ ) was used to assess intersession reliability of the measures. Reliability was assessed by comparing the average of three trials taken on testing day 1 to the average of three trials taken on testing day 2. A correlation of  $> .8$  was defined as high reliability, a correlation of  $.8$  to  $.6$  was defined as substantial reliability, a correlation of  $.6$  to  $.4$  was moderate reliability, a correlation of  $.4$  to  $.2$  was low reliability, and below  $.2$  is unacceptable reliability. In order to assess the level of walking impairment in children with CP relative to children with normal walking ability, the stride characteristics of the children with CP were compared to the values for 10 age and gender matched, non-disabled children.

**Results:** Table 1 shows reliability coefficients for the 10 children with CP and the 10 controls for the six stride characteristics assessed. Three stride characteristics—velocity, cadence, and stride length—had substantial to high intersession reliability ( $\rho > .6$  to  $.8$ ) for children with CP. SLS for both limbs in children with CP had low to unacceptable reliability ( $\rho < .3$ ). For controls, there was substantial intersession reliability for cadence, stride length, and SLS for both limbs. Velocity had low reliability ( $\rho < .3$ ) in the controls. The mean, standard deviation, and range of values for the stride characteristics are also reported in Table 1. Results of the two-tailed t-test indicate that velocity was significantly slower for children with CP than for controls ( $p < .01$ ). Stride length was significantly shorter in children with CP ( $p < .01$ ). Mean cadence was not significantly different between the groups. SLS for the right limb was significantly less for children with CP ( $p < .01$ ), and SLS for the left limb was not significantly different at a level of  $p < .01$ .

**Table 1:** Mean stride characteristics  $\pm$  SD (range) and intersession reliability ( $\rho$ ) of measures for children with cerebral palsy and non-disabled children

Group	N	Velocity (m/min)	Cadence (steps/min)	Stride Length (m)	SLS (%GC)
CP	10	42.2* $\pm$ 11.3	126.1 $\pm$ 15.8	.7* $\pm$ .2	34.0* $\pm$ 3.2 <sup>R</sup> 37.9 $\pm$ 5.0 <sup>L</sup>
(range)		(21.2 - 58.3)	(106.5 - 151.4)	(.39 - 1.1)	(30.7 - 40.8) <sup>R</sup> (32.1 $\pm$ 45.5) <sup>L</sup>
Intersession ( $\rho$ )		.66*	.88*	.81*	.29 <sup>R</sup> , .07 <sup>L</sup>
Control	10	65.1 $\pm$ 10.0	126.3 $\pm$ 12.1	1.03 $\pm$ .18	37.7 $\pm$ 2.2 <sup>R</sup> 37.1 $\pm$ 2.2 <sup>L</sup>
(range)		(53.2 - 83.4)	(107.2 - 148.4)	(.85-1.36)	(33.4 - 41.8) <sup>R</sup> (34.5 - 41.7) <sup>L</sup>
Intersession ( $\rho$ )		.31	.66*	.89*	.75 <sup>R*</sup> , .61 <sup>L</sup>

<sup>R</sup> Right Leg, <sup>L</sup> Left Leg; SLS, Single Limb Support as Percentage of Gait Cycle; \*  $p < .01$ .

**Discussion:** The results of this study indicate that the stride characteristics of velocity ( $\rho = .66$ ), cadence ( $\rho = .88$ ), and stride length ( $\rho = .81$ ) had substantial to high intersession reliability for children with CP. This suggests that these measures can be used to assess gait and to evaluate the effect of therapeutic intervention. SLS showed low to unacceptable reliability for children with CP. This may be in part explained by how normal SLS is approximately 30 percent of the gait cycle<sup>1</sup>. Thus, for these measures to be reliable, the values must be stable within a narrow range. For non-disabled children, cadence and stride length had substantial to high intersession reliability. However, velocity ( $\rho = .31$ ) showed low reliability for non-disabled children. Similarly, Stolze et al. (1998) found low reliability of gait velocity in 6-7 year old non-disabled children<sup>2</sup>. They found moderate reliability for cadence and substantial reliability for stride length. The velocity of children with CP may be more reliable than for controls because children with CP have restrictions on their movement and a higher energy expenditure that does not allow them to vary their gait velocity as easily<sup>3</sup>. This study indicates that gait velocity was slower as a result of shorter stride in children with CP. Cadence was similar for children with CP and non-disabled children as has been reported previously<sup>4</sup>.

#### References:

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