The Moves-UP Project: Integrating coordination variability and trajectory analyses to detect children with Developmental Coordination Disorder

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Summary

This study examined coordination variability (CV) during walking in children with different motor competency (MC) trajectories. MC trajectory significantly influenced foot-shank and shank-thigh CV. No MC improvement over 7 months was associated with high CV. These results may help identify children who require additional support in developing MC, such as those with Developmental Coordination Disorder.

Introduction

Poor motor competencies (MC) in school-age children can hinder physical, cognitive, and social development [1]. School-based interventions can improve MC in children needing extra support. Developmental Coordination Disorder (DCD) is a neurodevelopmental condition characterised by persistent coordination impairment despite opportunities to develop motor skills [2]. Coordination variability (CV) enables adaptations to environmental demands. However, excessive CV may indicate underlying impairments and poor MC. This study examined walking CV in children with different MC trajectories.

Methods

The Moves-UP project involved 100 children from four schools in a 7-month intervention. Suspected DCD (sDCD) cases were identified using the DCDQ. The Short Form Dragon Challenge (SFDC) [3] monitored MC trajectories at 0, 3, and 7 months. Forty-five children (aged 8.7 ± 1.3 years, height 1.4 ± 0.1 m, mass 33.8 ± 8.7 kg) attended a walking assessment at 0 and 7 months. Kinematic data (12 Vicon MX cameras, 250 Hz) were collected, with sagittal thigh, shank, and foot angles calculated using a 6DoF model (Visual3D, C-Motion). CV of the foot-shank and shank-thigh coupling angles was calculated [4] in Matlab (R2024a). Mean variability across the gait cycle was determined. Latent class linear mixed models of SFDC scores (N=46) identified MC trajectories subgroups. Average Posterior Probability of Assignment (APPA) above 70% in all classes was considered acceptable for model selection. Linear mixed models compared mean variability between classes and time points, with participants as random effects. All analyses were run in RStudio (R Core Team 2022).

Results and Discussion

Three MC trajectories subgroups (Figure 1) were identified as consistently good (class 1, N=18, APPA 96%), improvers (class 2, N=11, APPA 86%), and non-improvers (class 3, N=17, APPA 96%).

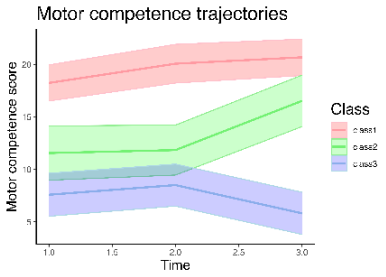

Figure 1: Motor competency trajectories

MC trajectory was associated with both foot-shank (β=0.669, p=.004) and shank-thigh (β=0.562, p=.001) CV. No significant interaction was found for class or time point, nor main effect for time points (Table 1). These findings suggest MC progression is associated with lower limb CV during walking. Children with no improvement in MC over 7 months – with only two-thirds identified as sDCD - had higher lower limb CV. Since DCD is associated with strength and balance deficits [2], these factors likely contributed to increased CV.

Conclusions

MC trajectories are associated with lower limb CV during walking. Assessing CV may offer insights into how children with different trajectories navigate their environment, helping identify those needing additional support. Future research should explore the influence of MC trajectory on more demanding tasks such as running.

Acknowledgements

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References

[1] Brian A et al. (2018). *J Mot Learn Dev*. **6:** S320-336.
[2] Smith M et al (2021). *Gait Posture*. **83:** 177-184.
[3] Barker H et al. (2024). *ISRA-DCD.* 193.
[4] Stock H et al. (2018). *Gait Posture*.**65:** 51-56.

Table 1: Mean variability across the gait cycle for each class

	N (%sDCD)		Mean foot-shank variability (°²)		Mean shank-thigh variability (°²)	
	0 month	7 months	0 month	7 months	0 month	7 months
Class 1	17 (11.1)	17 (17.6)	3.96 (0.94)	3.40 (0.75)	2.68 (0.60)	2.40 (0.49)
Class 2	9 (33.3)	11 (45.5)	4.31 (1.55)	4.19 (1.18)	3.06 (1.14)	3.04 (0.89)
Class 3	14 (57.1)	14 (64.3)	5.36 (2.04)	4.51 (1.34)	3.83 (1.67)	3.16 (0.81)