Locomotor trajectory of very preterm toddlers: does it differ from full-term peers?

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Summary

This work aims at investigating gait differences between very-preterm (VPT) and full-term (FT) children at 18 and 24 months, considering both corrected age and walking experience. Seventy-one children (51 VPT and 19 FT) walked along a corridor while wearing 3 inertial sensors on the lower back and on the ankles. Gait temporal parameters, their variability, and nonlinear trunk kinematics (i.e., harmonic ratio, recurrence quantification analysis, and multiscale entropy) were extracted. Results showed VPT children had longer stance and double-support phases, greater gait variability, and lower medio-lateral motor complexity compared to FT peers, independently from the analyzed age and walking experience. By highlighting persistent motor differences in early development, these results emphasize the need for early and continued monitoring of preterm children's motor trajectory.

Introduction

Preterm children have a high risk of motor impairment, with very-preterm (VPT, i.e., gestational-age <32weeks) being at higher risk of motor delay [1]. Sensor-based gait analysis resulted effective in distinguishing gait performance between 24-month-old preterm and full-term (FT) toddlers, and among preterm at varying risks of motor delay [2]. However, to implement effective longitudinal monitoring of motor development and identify deviations from typical path, it is essential to understand how motor differences evolve during the early years. Using the approach described in [2], this study aimed to compare VPT and FT children at 18 and 24 months (18m and 24m), considering both their corrected age and walking experience (WE).

Methods

Fifty-two VPTs and nineteen (12 18-month-old and 7 24-month-old) FTs participated in the study. VPT data were collected longitudinally resulting in fifty-two tests at 18m and thirty-one at 24m. Children walked along a corridor while wearing 3 inertial sensors (MMR, mBient, USA) on the lower back and on the ankles [1]. Gait temporal parameters, their variability, and nonlinear metrics of trunk kinematics (i.e. harmonic ratio, recurrence quantification analysis, multiscale entropy) were extracted. Children were divided based on corrected age (18m and 24m) and on WE (0-2months, 3-5months, >5months). As the relatively low sample size did not allow multi-factorial analysis, results were compared among age/WE groups separately (Wilcoxon-rank-sum test, 0.05).

Results and Discussion

No difference was found in normalized stride-time among groups. VPT exhibited longer double-support and stance than FT at 18m, 24m, and with a WE > 5 months. VPT also showed higher variability in temporal parameters across all comparisons, including at WE < 5 months. At 24m, VPT showed lower medio-lateral (ML) harmonic-ratio, while no difference was found at 18m or when analyzed with respect to WE. VPT showed lower multiscale entropy values in ML direction across all comparisons, with no difference observed in antero-posterior and vertical one. Regardless of age and WE, VPT recurrence parameters were lower in the sagittal plane, and the recurrence-rate higher in ML direction.

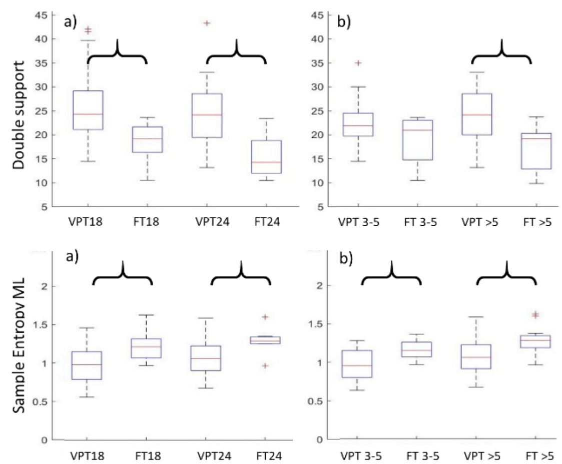

Figure 1: Double support, and Sample Entropy in ML for VPT and FT children divided per age (a) and per WE (b). Brackets indicate significant differences.

Conclusions

VPT children exhibited less mature motor performance during gait, characterized by lower stability (i.e., longer support phases) and higher variability. However, this variability did not indicate a structured exploration of more complex movements, as evidenced by lower recurrence in the sagittal plane and lower entropy in ML. The ongoing longitudinal data collection for both VPT and FT participants will increase the sample size and provide an effective means to monitor early locomotor development to support possible early rehabilitative intervention.

References

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