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Changes in infant segment inertias during the first three months of independent walking

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Abstract

Background: During infancy, rapid changes in physical growth affect the size and shape of the body segments. To understand the effects of growth on movement, it is first necessary to quantify rates of development during the acquisition of important motor milestones. The goal of this longitudinal study was to quantify the physical growth of infant body segments during the initial stages of independent walking.

Methods: Ten infants (N = 10) aged between 28 and 55 weeks at the beginning of the study were tested biweekly (every two weeks) for three months. A 13-segment mathematical model of the human body was used to estimate the inertial parameters of the infant body segments at each session. An analysis of variance was used to test for significant differences in segment masses between biweekly measures. Polynomial contrasts were used to test for linear trends in the growth data.

Results: Significant differences between biweekly measures of segment mass were found only for the head/neck ($F(5,45) = 3.42$, $p < 0.05$), upper trunk ($F(5,45) = 4.04$, $p < 0.01$), and lower trunk ($F(5,45) = 3.49$, $p < 0.01$). The lower trunk demonstrated a linear increase in mass ($F(1,9) = 4.56$, $p < 0.05$). However, the upper trunk demonstrated a quadratic trend in growth ($F(1,9) = 9.13$, $p < 0.01$), while the head/neck segment showed a cubic trend in growth ($F(1,9) = 3.80$, $p < 0.05$). Significant differences in axial segment masses were also found between subjects ($F(9,45) = 5.92$, $p < 0.001$).

Conclusion: Given that postural control proceeds in a cephalocaudal manner, the lower trunk segment would be brought under control last, in terms of the axial segments. Increases in the mass of this segment could constrain the system, thereby acting as a control parameter for the onset and development of motor patterns.

Background

Current views of infant motor development consider movement to be the result of the collective and cooperative influence of both neural and non-neural elements, including physical growth, neuromaturation, arousal level, and environmental contexts. A principled account of motor development from this perspective can be found in dynamic systems theory [1-3]. In this theory, changes in