

Individual differences in postural control and cognitive development in preterm infants

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Abstract

This study was aimed to examine whether individual differences in postural control at 6 months of age could predict cognitive development and attention in relatively healthy preterm infants 6–18 months later. Three groups of infants were identified on the basis of a behavioral observation during an exploration task: infants with an adequate postural control ($N = 33$), infants who showed extension of the elbows consistently ($N = 23$), and infants who demonstrated clear signs of hyperextension of neck and trunk ($N = 9$). In contrast to infants with an adequate postural control, infants who showed signs of hyperextension or elbow extension scored significantly lower on several cognitive measures (Bayley mental scale and tasks for problem solving) and were significantly more often not attending to a task, 6–18 months later. This study showed that individual differences in postural control could predict later cognitive development and inattention of infants who were born prematurely.

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1. Introduction

During infancy, many preterm infants show problems in the regulation of muscle tone. A disturbed muscle tone regulation particularly affects the axial muscles and may result in the characteristic hyperextension of the neck and trunk in these infants (De Groot, van der Hoek, Hopkins, & Touwen, 1992, 1993; Drillien, 1972; Drillien, Thomson, & Burgoyne, 1980; Georgieff, Bernbaum, Hoffman-Williamson, & Daft, 1986; Gorga, Stern, Ross, & Nagler, 1988; Touwen & Hadders-Algra, 1983). The underlying mechanisms of muscle tone

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dysregulation are not well understood, but it is possibly caused by a maladjusted balance between the activity of extensor and flexor muscles (De Groot et al., 1992; Gorga et al., 1988; Touwen & Hadders-Algra, 1983). A hyperextended posture can sometimes be a precursor of cerebral palsy, but in general the phenomenon of trunk hyperextension has been regarded in literature as a “transient dystonia” (Drillien, 1972; Touwen & Hadders-Algra, 1983). Because of this transient nature, there is hardly any data available of follow-up studies investigating this particular problem. However, a few recent studies have shown that a lack of postural control may interfere with the development of arm and hand function (Plantinga, Perdock, & de Groot, 1997), the emergence of successful reaching (Van Beek, Hopkins, Hoeksma, & Samson, 1994), the development of social interaction and communication in the first half of first year (Van Beek et al., 1994), and the development of attachment relationship (Wijnroks & Kalverboer, 1997). Little is known about the possible implications of hyperextension for the development of cognitive functions and attention.

An adequate postural control in sitting and head control, i.e., a good coordination between agonist and antagonists, is a necessary prerequisite for learning and goal-oriented behavior in infancy, such as visual exploration and reaching (see e.g., Rochat & Bullinger, 1994). Studies on infants between 4 and 10 months of age showed that the quality of the reaching movements improves when infants master postural skills, such as sitting without support (Rochat & Goubet, 1995). Moreover, learning and goal-oriented behavior is thought to be an important precursor for later cognitive development (Fogel, 1992; Fogel, Dedo, & McEwen, 1992; Van Wulfften Palthe & Hopkins, 1984). Through exploration, infants learn about the object’s properties and characteristics, and about the effects they have on objects, all of which contribute directly to infants cognitive development (Piaget, 1952; Ruff, McCarton, Kurtzberg, & Vaughan, 1984). Cognitive development comes about as a result of the infant’s spontaneous exploratory behavior and the knowledge acquired from this exploration of the environment. Postural dysfunctions may therefore interfere with prolonged and detailed exploration and manipulation of objects, which in turn, give the infant less opportunity to learn about the properties of objects, hence knowledge of the object world. This hypothesis was indirectly supported by a study of Plantinga et al. (1997), who found a significant correlation between the quality of hand function at the age of 39 weeks and hyperextension of the trunk at 18 weeks. Ruff (1986) argued that examining, or clearly focused and concentrated looking during object manipulation, reflects focused attention and involves the active intake of information. Recently, investigators have become interested in infants’ attention during their exploration of objects (Oakes & Tellinghuisen, 1994). One might speculate that, when infants frequently over-stretch while exploring objects, they will have difficulties learning to focus and sustain their attention (Ruff & Rothbart, 1996).

The aim of the present study was to examine the relationship between individual differences in postural control, on the one hand, and current and subsequent cognitive development and attention, on the other. This study was part of longitudinal project which was designed to identify environmental factors and factors within the infant which contribute to the development of infants at risk. It was not specially arranged to investigate individual differences in postural control in preterm infants. For this reason, we used data from an video-observation made during an exploration task. A sample of 65 relatively healthy preterm infants were observed during this 15-min exploration task at the corrected age of 6 months in order to score signs of hyperextension during object-exploration. At this age, postural control in healthy full-term

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