



## The motor repertoire in 3- to 5-month old infants with Down syndrome



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### ARTICLE INFO

#### Keywords:

Down syndrome  
Fidgety movements  
General movements  
Infant  
Motor optimality score

### ABSTRACT

**Background:** Even though Down syndrome is the most common chromosomal cause of intellectual disability, studies on early development are scarce.

**Aim:** To describe movements and postures in 3- to 5-month-old infants with Down syndrome and assess the relation between pre- and perinatal risk factors and the eventual motor performance.

**Methods and procedures:** Exploratory study; 47 infants with Down syndrome (26 males, 27 infants born preterm, 22 infants with congenital heart disease) were videoed at 10–19 weeks post-term (median = 14 weeks). We assessed their Motor Optimality Score (MOS) based on postures and movements (including fidgety movements) and compared it to that of 47 infants later diagnosed with cerebral palsy and 47 infants with a normal neurological outcome, matched for gestational and recording ages.

**Outcomes and results:** The MOS (median = 13, range 10–28) was significantly lower than in infants with a normal neurological outcome (median = 26), but higher than in infants later diagnosed with cerebral palsy (median = 6). Fourteen infants with Down syndrome showed normal fidgety movements, 13 no fidgety movements, and 20 exaggerated, too fast or too slow fidgety movements. A lack of movements to the midline and several atypical postures were observed. Neither preterm birth nor congenital heart disease was related to aberrant fidgety movements or reduced MOS.

**Conclusions and implications:** The heterogeneity in fidgety movements and MOS add to an understanding of the large variability of the early phenotype of Down syndrome. Studies on the predictive values of the early spontaneous motor repertoire, especially for the cognitive outcome, are warranted.

**What this paper adds:** The significance of this exploratory study lies in its minute description of

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the motor repertoire of infants with Down syndrome aged 3–5 months. Thirty percent of infants with Down syndrome showed age-specific normal fidgety movements. The rate of abnormal fidgety movements (large amplitude, high/slow speed) or a lack of fidgety movements was exceedingly high. The motor optimality score of infants with Down syndrome was lower than in infants with normal neurological outcome but higher than in infants who were later diagnosed with cerebral palsy. Neither preterm birth nor congenital heart disease were related to the motor performance at 3–5 months.

## 1. Introduction

Even though Down syndrome is the most common chromosomal cause of intellectual disability, with 20–22 individuals per 10,000 births affected (e.g., Kurtovic-Kozaric et al., 2016; Loane et al., 2013), studies on early development are scarce. Infants with Down syndrome are known to be socially competent but show a delay in the acquisition of motor milestones and deficits in early gesture production (Grieco, Pulsifer, Seligsohn, Skotko, & Schwartz, 2015; Özcaliskan, Adamson, Dimitrova, Bailey, & Schmuck, 2016; Saito & Watanabe, 2016). As early as the first months of life they scored lower than typically developing infants on both the Test of Infant Motor Performance (Cardoso, Campos, Santos, Santos, & Rocha, 2015) and the Alberta Infant Motor Scale (Tudella, Pereira, Pedrolongo Basso, & Savelsbergh, 2011). They kicked less often (Ulrich & Ulrich, 1995) and their arm movements were less accurate when reaching for objects of different sizes (de Campos, Cerra, Silva, & Rocha, 2014). Repeated assessments of their spontaneous general movements revealed a heterogeneous movement quality, although the fluency and complexity tended to improve between 1 and 6 months of age (Mazzone, Mugno, & Mazzone, 2004).

Initially designed for infants with acquired brain injuries, the Precht assessment of general movements (Einspieler & Precht, 2005; Precht et al., 1997) has recently also been applied to infants with genetic syndromes (Einspieler, Hirota, Yuge, Deijima, & Marschik, 2012; Einspieler, Kerr, & Precht, 2005; Einspieler et al., 2014; Marschik, Soloveichick, Windpassinger, & Einspieler, 2015; Mazzone et al., 2004) and infants later diagnosed with autism spectrum disorders (Einspieler et al., 2014; Zappella et al., 2015). The assessment is based on visual Gestalt perception of normal vs. abnormal movements in the entire body (i.e. general movements). It is applied in foetuses, preterm infants, and newborn infants from term to 5 months post-term (Einspieler, Precht, Bos, Ferrari, & Cioni, 2004; Precht & Einspieler, 1997). The excellent predictive power of general movement assessments (Bosanquet, Copeland, Ware, & Boyd, 2013; Einspieler et al., 2004) is mainly attributable to fidgety general movements, which occur from 3 to 5 months post-term age (Einspieler & Precht, 2005; Precht et al., 1997). Infants with normal fidgety movements are very likely to develop normally in neurological terms, whereas infants who never develop fidgety movements have a high risk for neurological impairment (Einspieler & Precht, 2005; Precht et al., 1997). Adding a detailed assessment of concurrent movements and postures to the assessment of fidgety movements, for example, showed a reduced motor optimality score (MOS) to be associated with a limited activity in children who were later diagnosed with cerebral palsy (Yang et al., 2012), or with lower intelligent quotients during school age (Butcher et al., 2009). We therefore assumed that determining the MOS (Einspieler et al., 2004, p. 26) by assessing fidgety movements as well as concurrent movement and postural patterns would enable us to systematically

**Table 1**  
Clinical characteristics of 47 infants with Down syndrome.

	Median, Interquartile (P <sub>25</sub> , P <sub>75</sub> ) and Range; or N (%)
Maternal age	Median = 35 years P <sub>25</sub> = 31 years; P <sub>75</sub> = 39 years; range: 17–45 years
Paternal age	Median = 37 years P <sub>25</sub> = 32 years; P <sub>75</sub> = 42 years; range: 23–50 years
Parity	Median = 2 P <sub>25</sub> = 1; P <sub>75</sub> = 3; range: 1–5
Pregnancy complications	22 (47%)
Preterm birth	27 (57%)
Caesarean section	31 (66%)
Birth weight	Median = 2585 g P <sub>25</sub> = 2000 g; P <sub>75</sub> = 2980 g; range: 1400–3680 g
Apgar Score at 1 min	Median = 8 P <sub>25</sub> = 7; P <sub>75</sub> = 8; range: 6–10
Apgar Score at 5 min	Median = 9 P <sub>25</sub> = 8; P <sub>75</sub> = 9; range: 8–10
Hyperbilirubinaemia	26 (55%)
CHD: (Atrio)ventricular septal defects and/or patent ductus arteriosus	22 (47%)
Duration of mechanical ventilation	Median = 0 days P <sub>25</sub> = 0 days; P <sub>75</sub> = 3 days; range: 0–19 days
Age at discharge from the hospital	Median = 12 days P <sub>25</sub> = 4 days; P <sub>75</sub> = 30 days; range: 3–90 days

Key: CHD, congenital heart disease.

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