Early Human Development (2007) **83**, 521–525

available at www.sciencedirect.com

ScienceDirect

www.elsevier.com/locate/earlhumdev

Are abnormal fidgety movements an early marker for complex minor neurological dysfunction at puberty?

Christa Einspieler [a,*], Peter B. Marschik [a], Styliani Milioti [b], Yayohi Nakajima [c,1], Arend F. Bos [d], Heinz F.R. Prechtl [a]

[a] *Institute of Physiology, Center for Physiological Medicine, Medical University of Graz, Harrachgasse 21/5, A-8010 Graz, Austria*
[b] *Department of Physiotherapy, Technological Educational Institute Thessaloniki, Greece*
[c] *Department of Infant's Brain and Cognitive Development, Tokyo Women's Medical University, Japan*
[d] *Department of Paediatrics, Division of Neonatology, Beatrix Children's Hospital, University Medical Centre Groningen, The Netherlands*

Accepted 7 October 2006

KEYWORDS
Fine manipulation;
Follow-up;
General movements (GMs);
Infant;
MND

Abstract

Background: Prechtl's method on the qualitative assessment of general movements (GMs) is a powerful tool for early and specific prediction of cerebral palsy. However, it is uncertain whether the GM assessment can be used to predict mild neurological impairment.
Aims: To determine whether the quality of general movements (GMs) from the age of 3 to 5 months, i.e. fidgety movements, is related to the presence of complex minor neurological dysfunctions (MND) 13 to 15 years later.
Study design: Prospectively collected data on the quality of GMs during infancy were retrospectively analysed on the basis of MND at puberty.
Subjects: Twenty-eight participants (14 girls and 14 boys) with a median gestational age of 40 weeks (range: 35 to 42 weeks) and an appropriate birth weight (median 3390 g; range 1900 to 4200 g).
Outcome measures: Touwen's neurological examination.
Results and conclusions: Abnormal fidgety movements were not related to later complex MND, but to fine manipulative disabilities ($p<0.05$). Normal fidgety movements, which are continually present in the whole body, might be required for optimal calibration of the proprioceptive system.

1. Introduction

Prechtl's method on the qualitative assessment of general movements (GMs) is a powerful tool for early and specific prediction of cerebral palsy [1,2]. However, it is uncertain

* Corresponding author. Tel.: +43 316 380 4266; fax: +43 316 380 69 4266.
E-mail address: christa.einspieler@meduni-graz.at (C. Einspieler).
[1] At present: Japanese Red Cross Medical Center Tokyo, Japan.

0378-3782/$ - see front matter © 2006 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.earlhumdev.2006.10.001

whether the GM assessment can be used to predict mild neurological impairment [3]. GMs emerge in the fetus at the postmenstrual age of 9 to 10 weeks and persist until the age of 6 months [2]. Normal GMs involve the whole body in a variable sequence of arm, leg, neck and trunk movements. They wax and wane in terms of intensity, force and speed; they also commence and end gradually. Rotations along the axis of the limbs and slight changes in the direction of movements make them fluent and elegant, and create an impression of complexity and variability [1,3]. At the end of the second month of life GMs change their character from a writhing to a fidgety appearance [4]. Fidgety movements are small movements of the neck, trunk and limbs, of moderate speed and variable acceleration, and executed in all directions. They occur continually in the awake infant, except when the infant frets or cries [5]. The absence of fidgety movements is a specific predictor of cerebral palsy [2,3,5].

As a neurological sign, fidgety movements may have an abnormal quality. Abnormal fidgety movements look like normal ones, but their amplitude, speed and jerkiness are exaggerated [3,5]. They are less predictive of the neurological outcome than is the absence of fidgety movements [5], but have been discussed in the context of the development of mild neurological impairments at two to three years of age [3,6–8]. Similar results were obtained by Hadders-Algra et al. [9–11], although their methodological approach differs from Prechtl's GM assessment [3]. According to Hadders-Algra [12,13], the so-called mildly abnormal GMs – irrespective of whether they are of a writhing or fidgety character – lack fluency but are still complex and variable. Mildly abnormal GMs indicate an increased risk for the development of minor neurological dysfunctions (MND) in 18-month-olds [10], and also in 4- to 12-year-old children [9–11].

To our knowledge, it is not known whether the quality of fidgety movements is also related to the neurological performance of young adolescents at puberty, an age at which the prevalence of MND seems to decline according to the data of the Groningen Perinatal Project [14,15]. Due to the age-specific nature of the nervous system, Hadders-Algra [16] made a distinction between complex MND before and after the onset of puberty. Young adolescents with complex MND exhibit mild coordination problems as well as mild fine manipulative disabilities [16]. The aim of the present study was to assess whether the quality of GMs from 3 to 5 months (i.e. the period of fidgety movements) is related to the presence of complex MND 13 to 15 years later.

2. Methods

2.1. Participants

The study group consisted of 28 participants (14 girls and 14 boys), born in Graz (Austria) from 1985 to 1990. All participants were born at term with an appropriate birth weight. Eighteen children were considered to be at high risk for sudden infant death due to infantile apnoea or an apparent life-threatening event. The relationship between infantile respiratory data and neurological outcome has been described elsewhere [17]. A further ten subjects were recruited from the Department of Paediatrics, Medical University of Graz, and were considered to be at low risk for sudden infant death (Table 1). Brain ultrasound examinations were carried out in five participants and were considered to be normal. All children had participated in previous studies concerning normal and abnormal GMs [5,18,19].

From 2000 to 2005 all participants were examined neurologically between the ages of 13 and 15 years. All subjects had reached puberty according to the criteria applied by Lunsing et al. [14], which are based on the signs of puberty given by Marshall and Tanner [20]. The assessments were carried out with the written informed consent of the parents and the children, and were in conformance with the standards prescribed by the ethics committee of Austria. The study was approved by the Austrian Ethics Commission.

2.2. Assessment of fidgety movements

At a median age of 15 weeks (range 9 to 20 weeks), all participants were videoed during active wakefulness while lying supine. The assessment was carried out by the work group for developmental physiology and developmental neurology at the Institute of Physiology, Medical University of Graz. The recordings had a duration of 6 to 14 min (median 10 min) and were performed according to the procedure described by Einspieler et al. [21]. Fidgety movements were scored normal or abnormal according to Prechtl et al. [3,5] (as described above, in the Introduction). In addition, the temporal organization of normal fidgety movements was scored as continual (occurring frequently but interspersed with short pauses; score++) or intermittent (the pauses between fidgety movements were prolonged, giving the impression that fidgety movements were present for only a half of the observation period; score+) [3]. A score of P = D was assigned when fidgety movements were equally present in the proximal and the distal portions of the body. A score of D > P indicated that fidgety activity occurred more frequently in the wrists and the ankles than in the trunk and the proximal joints. Children with more prominent fidgety movements in the neck, trunk, shoulders and hips were scored P > D [3]. The videos were coded and re-assessed by CE with a 13- to 15-year reliability of $r = 0.81$. In addition, PBM, YN, and AFB assessed the videos without being aware of the outcome of the neurological examination at puberty. The inter-scorer agreement was excellent (Cohen's Kappa = 0.84).

2.3. Neurological outcome

Between the ages of 13 and 15 years (median 13 years and 8 months) the subjects underwent a standardized age-specific neurological examination according to Touwen [22]. The purpose of this assessment was to detect minor deviations in neural functions. It consists of the observation of the child's motor behaviour and tests for specific neural functions. Touwen had based his interpretation on ten subsystems [22]. Currently six clusters of dysfunctional signs are used: dysfunctional muscle tone regulation, reflex abnormalities, choreiform dyskinesia, coordination problems, dysfunction in fine manipulative ability, and rare