Development of a new screening tool for neuromotor development in children aged two – the neuromotor 5 min exam 2-year-old version (N5E2)

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Abstract

Objective: As a new screening tool for neuromotor development in children aged two, we developed the Neuromotor 5 min Exam 2-year-old version (N5E2), which can be easily administered by pediatricians or primary care physicians. In this study, as an initial attempt to examine the utility of the N5E2, the inter-rater reliability on scoring for the individual items in this scale was assessed.

Methods: The participants of the study were 29 children (aged 1–5 years, mean age = 2.79) diagnosed with a variety of neuromotor/developmental disorders/high-risk conditions. Inter-rater reliability was examined on the following 11 items in the N5E2: (1) Retrieving a rolling ball, (2) Gait, (3) Toe-walking, (4) Asymmetries of posture and/or movement, (5) Age at unsupported walking, (6) Speaking in two-word understandable sentences, (7) Hypotonus, (8) Hypertonus, (9) Eye movement, (10) Vision problem, (11) Hearing problem. The items were administered to children by two pediatricians with different expertise and clinical experience, separately.

Results: The results showed that among the eleven items in the N5E2 examined, a high level of agreement (κ ≥ 0.60) was found on 4 items, and a moderate level of agreement (0.40 ≤ κ < 0.60) was found on 5 items. The level of agreement somewhat improved after the dichotomization of the score; using this format, a high level of rater agreement (κ ≥ 0.60) was found on 6 out of 11 items. The analyses also revealed high inter-rater reliability on the sum score of the 11 items (r = 0.84).

Conclusions: The results suggest the possibility that this brief screening tool could be feasible in settings where clinicians’ experience varies, based on its inter-rater reliability on individual items between the clinicians with different expertise and amount of clinical experiences.

Keywords: Neuromotor development; Developmental disabilities; Screening; Inter-rater reliability; Japan Environment and Children’s Study (JECS); Young children

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1. Background

For children with developmental disability, early identification and intervention are important, which is now recognized by many clinical professional organizations. For example, in 2006, the American Academy of Pediatrics (AAP) distributed a revised policy statement that recommends all pediatricians to routinely administer a developmental screening test at 9, 18, 24 and 30 month visits [1], providing a list of various general developmental screening tools with reasonable specificity and sensitivity [2,3,4]. Despite this, according to the Periodic Survey conducted in 2009, only 43% of pediatricians (US AAP members) reportedly used recommended formal tests for developmental screening with patients younger than 36 months, and many still depended on informal checklists that are not standardized [5]. The authors of the report inferred that the many screening instruments might not be practicable for use due to their administration time and cost. Therefore, it is desirable to develop a reliable and valid developmental screening tool that can be easily administered by clinicians in their daily work.

Meanwhile, experts also recently pointed out that development and validation of screening and surveillance tools for neuromotor development has lagged behind those for social and language development [6]. According to Health for All Children, the authors mentioned that there is no reliable, valid, and useful screening tool of neuromotor development in early childhood [7]. However, neuromotor difficulty is not uncommon among young children. For example, according to the Centers for Disease Control and Prevention, estimated world-wide prevalence rate of cerebral palsy was 1.5 to more than 4 per 1000 [8]. Developmental coordination disorder (DCD) is also a common disorder causing motor difficulty; 5–6% of children aged 5–11 are affected [9]. Furthermore, researchers found that neuromotor difficulty/abnormality tends to be experienced by children with developmental disabilities other than DCD, such as autism [10,11], attention-deficit/ hyperactivity disorder [12,13], and learning disability [14]. Taking account of the paucity of screening tools for neuromotor development and of the prevalence of neuromotor difficulties among young children, specifically, those with developmental disability, it is desirable to develop a new screening tool for neuromotor problems.

In response to this need, our research group developed a screening tool that can be utilized by clinicians to identify neuromotor abnormality among young children. The new screening tool was named Neuromotor 5-min Exam (N5E) as the screening can be completed within 5 minutes. We first developed a 2-year-old version of the N5E (N5E2), which we were planning to administer in a large-scale birth cohort survey, the Japan Environment and Children’s Study (JECS), when the participants would become two year old. To develop items in the N5E2, we referred to Noritz et al.’s proposal published in 2013 [6] while reflecting clinical and research experiences of the authors who consist of neurologists, pediatricians, psychiatrists, psychologists, and epidemiologists. Among the items coming up in our mind, we selected the items that meet the following criteria: (1) The item indicates neuromotor abnormality of children aged 2, (2) The tool can be administered after receiving minimal training, and (3) Scoring criteria for the item can be so clear that the examinees are scored in the same manner regardless of the examiner’s expertise and clinical experiences. As a result, the selected items were (1) Retrieving a rolling ball, (2) Gait, (3) Toe-walking, (4) Asymmetries of posture and/or movement, (5) Age at unsupported walking, (6) Building a block tower, (7) Pointing out body parts, (8) Speaking in two-word understandable sentences, (9) Hypotonus, (10) Hypertonus, (11) Head circumference, (12) Weight, (13) Height, (14) Eye movement, (15) Vision problem, and (16) Hearing problem. The selected items not only cover motor problems, tone abnormality, and physical characteristics, but also broader aspects of development, such as language, cognition, and perception, because examination of these areas are recommended by American Academy of Pediatrics to identify children with motor delay [6]. Moreover, as abnormality of such areas can be an early sign of neurodevelopmental difficulties [15], inclusion of these items would increase clinical utility of the N5E2.

As an initial attempt to examine the utility of the N5E2, we assessed the inter-rater reliability for the items in this scale. Since the primary purpose of this examination at this point was to validate the N5E2 before using the tool in the JECS, data were collected only for the items which would actually be administered in the JECS. As a result, we did not collect data for five items (building a block tower, pointing out body parts, head circumference, weight, and height) because for the JECS, these variables would be measured as a part of other tests/exams. Therefore, we investigated inter-rater reliability between pediatricians for the remaining 11 items. The more extended psychometric property of this scale will be examined in other studies with more participants.

2. Methods

2.1. Participants

The participants of this study were 29 children (18 boys and 11 girls), who visited the orthotic and prosthetic outpatient service and developmental evaluation center in the National Center for Child Health and Development (NCCHD) in Tokyo, Japan. The reason for collecting data from this group of children was that the N5E2 is a developmental screening tool and so planned to be administered to at-risk individuals who
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