



# The reliability and validity of the Developmental Coordination Disorder Questionnaire'07 for children aged 4–6 years in mainland China



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## ABSTRACT

An effective population-based screening tool is needed to identify possible cases of Developmental Coordination Disorder (DCD) among preschool children in mainland China. We examined the psychometric properties of the DCD questionnaire'07 (DCDQ'07) in Chinese children aged 4–6. A total of 3316 children from 10 nursery schools were involved in the study. Internal consistency and test–retest reliability of the DCDQ'07 were estimated using Cronbach's alpha, item–total correlation and intraclass correlation coefficient (ICC). The construct validity was evaluated using the exploratory and confirmatory factor analysis. Receiver operating characteristic (ROC) analysis was used to measure the accuracy of the DCDQ'07. The results showed that both internal consistency (Cronbach's alpha value of all items were above 0.85) and test–retest reliability (ICCs of 13 items and subscales were above 0.9) were excellent. Confirmatory factor analysis showed that each goodness-of-fit indices of the 3-factor model was above 0.9, indicating a satisfactory fit of the data to the model. Area under the ROC curve was comparatively small (0.641). With the exception of construct validity in younger children (4 years old) and discriminative validity, the Chinese version of the DCDQ'07 achieves satisfactory reliability and construct validity in mainland China. Nevertheless, the questionnaire should be not used in younger children, and further studies are needed to explore the use of Little DCD-Q in Chinese preschool children.

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## 1. Introduction

Developmental Coordination Disorder (DCD) is a neurodevelopmental disorder characterized by an evident impairment in the development of motor coordination. The condition affects approximately 1.8–6% of school-aged children (American Psychiatry Association, 2000; Lingam, Hunt, Golding, Jongmans, & Emond, 2009). Poor coordination and difficulties in

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performing motor based activities leads to decreased motivation to participate in physical activity (Haga, 2009; Li, Su, Fu, & Pickett, 2015; Rivilis et al., 2011), and reduced confidence in their ability to play with other children (Rodger & Mandich, 2005). DCD is also associated with higher body mass (Joshi et al., 2015) and pediatric obesity (Zhu, Wu, & Cairney, 2011), both significant risk factors for cardiovascular disease, type 2 diabetes, psychological problems and other health conditions (Cairney, Hay, Faught, Flouris, & Klentrou, 2007; Cairney, Hay, Veldhuizen, & Faught, 2010; Faught, Hay, Cairney, & Flouris, 2005). The potential development of life-long disabilities underlines the necessity for an early identification of the disorder in order for timely intervention with specific programs.

An effective population-based screening tool is needed to identify possible cases of DCD. This tool would enable children who could potentially have the condition to be identified and referred to clinicians for further evaluation (Schoemaker & Wilson, 2013; Wang, Su, & Su, 2012). Standard administration of a motor test (e.g. movement assessment battery for children, a widely used measurement for diagnosis of DCD) is too time consuming and expensive for population screening. Developmental Coordination Disorder Questionnaire is a 15-item questionnaire, designed as a quick motor screening tool for children. It has been used a popular screening tool for identifying possible incidences of DCD in children aged 5–15 years old. (Loh, Piek, & Barrett, 2009; Pannekoek, Rigoli, Piek, Barrett, & Schoemaker, 2012; Wilson et al., 2009). Several studies have reported that DCDQ was closely associated with the test and checklist of MABC-2 (Capistrano, Souza, & Maxim, 2015; Junaid, Harris, Fulmer, & Carswell, 2000; Schoemaker, Niemeijer, Flapper, & Smits-Engelsman, 2012). Unfortunately, DCDQ has not traditionally been used with population-based studies. Further studies are needed to better establish DCDQ as an effective population-based screening tool.

Additionally, earlier diagnosis of DCD has important implications for providing interventions targeted at younger children (Missiuna, Rivard, & Bartlett, 2003; Rihtman, Wilson, & Parush, 2011). Earlier recognition can facilitate the development and implementation of targeted interventions aimed at promoting skill development and participation in age-appropriate activities (Missiuna et al., 2003; Wilson et al., 2015), as well as alleviation of anxiety (Fox & Lent, 1996). The new edition of DCDQ (DCDQ'07) has extended its age range (4–15 years old) to younger children (Rivard, Missiuna, McCauley, & Cairney 2014). It would be interesting to see if the DCDQ'07 can be used as a validated screening tool for younger children (4 years old). However, current research on the validity of the DCDQ'07 in younger children is seemingly inadequate (Parmar, Kwan, Rodriguez, Missiuna, & John, 2014).

To our knowledge, few studies have reported the psychometric properties of the DCDQ'07 when used in mainland China. Here, we conducted a population-based study aimed at examining the psychometric properties (internal consistency, test-retest reliability, content validity, construct validity, and discriminative validity) of the DCDQ'07 when used in children aged 4–6 years in mainland China, especially in exploring its usefulness in younger children (4 years old).

## 2. Methods

### 2.1. Participants

This study was a part of a cross-sectional investigation for exploring motor development in Chinese children. There are a total of 5 districts in the urban area of Suzhou city. In order to enhance the representativeness of the population, we randomly selected 10 public nursery schools from these districts in the urban areas of Suzhou City (district as stratification variable). All students aged 4–6 years old (3693) with no physical disabilities (according the physical examinations before and after taking part in the nursery school) were recruited in the study during the spring of 2010. A total of 3316 children aged 4–6 years from the 10 public nursery schools and their parents were included in the final analysis (Fig. 1). There were no difference of children's age, sex and their parents' education and family income between the children whose parents did not complete the DCDQ'07 or who had missing items (377) and those included in the final analysis ( $P > 0.05$ ). The study received ethical approval from the Local Committee of Fudan University (#09-03-0160), China. Written informed consent was obtained from the parents or legal guardians of all participants before the investigation.

### 2.2. Measures

The DCDQ'07 (Wilson, Kaplan, Crawford, & Roberts, 2007) is composed of 15 items that are grouped into three subscales: control during movement, fine motor/hand writing and general coordination (Wilson et al., 2009). Parents are asked to report their responses to a series of positive statements on their child's motor abilities. The questionnaire is on a 5-point scale ranging from 1 = does not portray your child to 5 = perfectly portrays your child. Children scoring below 46 (total score) are considered likely to have been diagnosed with DCD (Wilson et al., 2009). The translation of the DCDQ'07 was conducted according to guidelines for cross-cultural adaptation of instruments (Beaton, Bombardier, Guillemin, & Feraz, 2000). The Chinese version of the DCDQ'07 was translated by a Chinese native speaking professional who adapted each item to its proper context and culture, which was then back translated by two English native speaking professionals blinded to the original version. Finally, an expert committee of three faculty members took care to ensure the conceptual and cultural equivalence by comparing the original and back-translation versions.

MABC-2 (Henderson, Sugden, & Barnett, 2007) is a motor test for assessing children with impairments in motor coordination. We used the age band 1 of MABC-2 to assess children's motor performance. Its items and scoring criteria are specific to children aged 3–6 years. It is composed of eight motor tasks in three categories: (1) manual dexterity, which is

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