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The prenatal, perinatal and neonatal risk factors for children's developmental coordination disorder: A population study in mainland China

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ABSTRACT

We initially conducted a population-based study on developmental coordination disorder (DCD) in mainland China to explore the prenatal, perinatal and neonatal risk factors on DCD. A total of 4001 children were selected from 160 classes in 15 public nursery schools. The Movement Assessment Battery for Children-Second Edition (MABC-2) was used to assess the children's motor function. Crude and adjusted odds ratios were estimated to determine the strength of association using a multilevel logistic regression model with a random intercept. Three hundred and thirty children out of 4001 subjects met the DSM-IV criteria for DCD, and 3671 children were non-DCD. Maternal age, threatened abortion, fetal distress during labor, preterm birth, chronic lung disease and newborn pathological jaundice were related with DCD (OR = 1.72, 2.72, 9.14, 5.17, 1.43, and 2.54, respectively, each $p < 0.05$). Considered collectively, these risk factors may provide clues to an etiology of DCD. Additionally, the practitioners of maternity and child health care should improve the assessment and monitoring of the prenatal, perinatal and neonatal risk factors for DCD.

1. Introduction

Developmental coordination disorder (DCD) also known as developmental dyspraxia and clumsy child syndrome (Gibbs, Appleton, & Appleton, 2007; Henderson & Henderson, 2003) is listed in the fourth Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) (American Psychiatric Association, 2000) and classified in the fifth revision (DSM-5) as a motor disorder in the category of neurodevelopmental disorders (American Psychiatric Association, 2013). It is a chronic neurological disorder beginning in childhood that can affect planning of movements and co-ordination as a result of brain messages not being accurately transmitted to the body. Motor impairments include marked delays in achieving motor milestones, clumsiness, poor sensorimotor coordination, poor balance and hand-writing (Cermak & Larkin, 2002), poor postural control and difficulties in motor learning (new skills, planning of movement, atomization), strategic planning, timing, sequencing of movement (Geuze, 2005). They also have deficits in processing visual–spatial information (Wilson &

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McKenzie, 1998). Studies have shown that 4–6% of school-aged children have DCD, and most of them experience deep and persistent trouble in daily activities (Piek & Dyck, 2004; Raeymaecker, 2006).

Evidence suggests that DCD was related to central nervous system pathology (Cantin, Polatajko, Thach, & Jaglal, 2007; O'Hare & Khalid, 2002). The morphological and functional development of the human brain involves a complex temporally and spatially ordered sequence of events. Several potential adverse factors acting in the prenatal, perinatal and neonatal period, including hypoxia, ischemia, sepsis and under-nutrition may adversely affect brain development (Hoon, 1995; Rosenbloom & Sullivan, 1996). A few studies have explored possible prenatal, perinatal and neonatal factors which associated with DCD in the premature population. Goyen and Lui (2009) found that prolonged rupture of membranes (an event that occurs during pregnancy when the sac containing the developing baby and the amniotic fluid bursts or develops a hole prior to the start of labor) and retinopathy of prematurity (a disease of the eye affecting prematurely-born babies generally having received intensive neonatal care) were significantly related with DCD in extremely premature or extremely low birth-weight children. Holsti, Grunau, and Whitfield (2002) found no difference in several neonatal variables, including chronic lung disease, patent ductus arteriosus (a congenital disorder in the heart wherein a neonate's ductus arteriosus fails to close after birth), necrotizing enterocolitis (a medical condition primarily seen in premature infants, where portions of the bowel undergo necrosis), duration of ventilation or days on oxygen between children of extremely low birth weight who did and did not develop DCD. In a similar cohort of extremely low birth weight infants at school-age, Davis, Ford, Anderson, and Doyle (2007) found the male sex and postnatal steroid exposure to be associated with DCD, whereas Cooke (2005) found that only low gestational age was associated with poor motor outcomes in a cohort of very premature infants. However, the pattern of perinatal and neonatal factors explaining the relationship of DCD was inconsistent. Most of studies were based on the preterm or low birth weight children. In recent, the researchers (Maimburg, Bech, Vaeth, Møller-Madsen, & Olsen, 2010) have found that brain development may undergo a sensitive period with special vulnerability to harmful exposure (such as bilirubin) at 40 weeks of gestation. Therefore, studies on risk factors of DCD during prenatal, perinatal and neonatal periods should be based on both preterm and term children. Identifying these risk factors of DCD may help generate hypotheses regarding etiology and help identify those children at the highest risk.

Based on our previous study which reported the usefulness of a measurement for screening DCD in mainland China (Hua, Gu, Meng, & Wu, 2013), we conducted an initial population-based study on DCD in mainland China. We aim to explore the prenatal, perinatal and neonatal risk factors on DCD in both term and preterm children in China so as to provide clues to the etiology of DCD.

2. Materials and methods

2.1. Participants

Stratified clustered sampling, using grade and school as stratification variables, was used to select 160 classes (the primary sampling units) from randomly selected 15 public nursery schools distributed throughout the five main districts in Suzhou City of China. A total of 4416 children were recruited in the study. The mothers of these children were asked to fill out a questionnaire concerning their socio-demographic features and risk factors in prenatal, perinatal and neonatal period before the tests for children. Of the 4110 questionnaires that were returned, 105 had to be excluded duo to their missing items. Finally, 4005 children with no missing questionnaires participated in the tests of MABC-2 (Henderson, Sugden, & Barnett, 2007) and Wechsler Primary and Preschool Scale of Intelligence™-Third Edition (WPPSI-III; Wechsler, 1967). However, only 4002 completed the tests because three felt physically uncomfortable during the test and failed to complete the whole tasks. Exclusion criteria of this study were: neurological diseases; intelligence quotient (IQ) bellow 70; general medical condition (e.g. cerebral palsy, hemiplegia, or muscular dystrophy) or a Pervasive Developmental Disorder. According to the criteria, one child was excluded because his global intelligence below 70 according to exclusion criteria. Finally, a total of 4001 children were included in the analysis. The study was approved by the Local Education Board and Ethics Committee of Children's Hospital of Suzhou University. Participation in the study was voluntary. Oral parental consent and students' assent were obtained before the investigation and tests.

2.2. Measures

MABC-2 (Henderson et al., 2007) is a measurement for screening children with developmental coordination disorder and other movement impairment. It is composed of a performance test, a checklist, and a manual. In the present study, only the performance test was applied. The test was designed to identify and describe impairments in motor performance of children and adolescents aged from 3 to 16. The age band 1 of the MABC-2 test which refers only to children aged 3–6 years was used in this study. The test refers to eight items are grouped in the following three motor subtests: (1) manual dexterity, which is composed of posting coins, threading beads and drawing trails; (2) aiming and catching, which consists of catching a beanbag and throwing a beanbag onto a mat; and (3) balance, which includes the one-leg balance, walking heels raised, and jumping on mats. The total score of MABC-2 was the sum of the standard score of all eight items. The datasheets and the guidelines of MABC-2 purchased from the Pearson Assessment Cooperation were translated from English into Chinese. The validity and reliability of the age band 1 of MABC-2 in Chinese population were fair according to our previous study (Hua et al., 2013).