Developmental Coordination Disorder in Children with a History of Infantile Colic

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Objective To investigate whether children with a history of infantile colic showed impaired motor development at age 7 years compared with unaffected peers.

Study design We studied 27 940 children from the Danish National Birth Cohort (1997-2002), including 1879 (6.8%) with a history of infantile colic. Infantile colic was defined according to the modified Wessel criteria as crying for more than 3 hours per day and more than 3 days per week. We compared the parental Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07) scores in children with and without infantile colic after adjustment for intrauterine exposures, feeding type, parity, maternal age, socioeconomic status, Apgar score, gestational age, and birth weight.

Results Children with a history of infantile colic had an elevated risk of scoring above the predefined cutoff limit of possible or suspected developmental coordination disorder (OR, 1.3; 95% CI, 1.0-1.7; P = .034). The mean total DCDQ'07 score was −0.4 point (95% CI, −0.8 to 0) lower in children with a history of infantile colic. Moreover, they were at higher risk for a low total score (OR for a 10-point decrease, 1.1; 95% CI, 1.0-1.1; P = .006) and a low general coordination score (OR, 1.3; 95% CI, 1.1-1.5, P = .000) in the DCDQ'07. All associations appeared to be stronger among boys, but no statistically significant effect measure modification between infantile colic and sex was found.

Conclusion We found no evidence of a strong association between infantile colic and developmental coordination disorder in this large Danish cohort. *(J Pediatr 2015;167:725-30)*.

Excessive crying during the first months of life, commonly referred to as infantile colic, is rather frequent, troubles parents, and results in numerous contacts with the health care system.[1,2] The first 3 months of life, when the crying episodes reach their peak,[3] is the time when normal infants reach milestones of motor development and coordination that include emergence of sensory acuity, beginnings of muscle control, development of more complex movements, and preliminary stages of hand–eye coordination. Health providers usually consider infantile colic a benign condition, because most infants return to normal levels of crying by age 3-4 months.

Nonetheless, parents may wonder whether their infant will develop normally despite all the time spent crying instead of interacting with the environment. If we assume that the evolution of motor skills is facilitated by environmental stimuli occurring while the infant is in a quiet, alert state,[4] these parental concerns seem justified.

Infants with a history of infantile colic indeed demonstrate transient developmental lags in both fine and gross motor skills, and are less responsive and less able to maintain optimal functioning for months after resolution of the crying.[5] This developmental lag may be the result of suboptimal interaction with the environment during the colicky period, or may reflect inert characteristics of the infant that make learning new skills more challenging. In the latter case, excessive crying may be a marker of underlying conditions, and thus associated with deficits of cognitive and motor development later in life. In follow-up studies, children with infantile colic exhibited emotional and behavioral problems,[6-10] attention deficit and hyperactivity symptoms,[7,11-13] inefficient sensory processing,[12,14,15] cognitive impairment,[16-18] and poorer fine motor skills[17] during preschool and school age; this was more prominent when excessive crying persisted beyond age 3 months or was combined with feeding and sleeping problems.

Minor motor problems in childhood are currently described under the term developmental coordination disorder (DCD), a condition characterized by poor motor function, difficulty learning new motor skills, clumsiness, lack of coordination, and poor spatial perception.[19] DCD affects 1%-5% of all

DCD	Developmental coordination disorder
DCDQ'07	Developmental Coordination Disorder Questionnaire 2007
DNBC	Danish National Birth Cohort

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children[20] and is associated with peer problems, bullying, low self-esteem,[21] inactivity, obesity, and higher risk for cardiovascular diseases.[22,23]

In the present study, we used a large Danish cohort with prospectively collected data to investigate whether a history of infantile colic is associated with an increased occurrence of DCD by age 7 years compared with unaffected peers. We hypothesized that excessive crying may reflect an underlying developmental disorder, and thus that motor development problems may be more frequent in these children.

Methods

We used data from the Danish National Birth Cohort (DNBC), a cohort of pregnant women and their offspring recruited by their general practitioner between 1997 and 2002. The original cohort recruited 101 042 women, 30% of the pregnant population in Denmark. One-half of the nonparticipants were never invited (nonparticipation at the general practitioner level) and the other one-half denied participation, most commonly claiming lack of time.[24] The DNBC is approved by the Committee on Biomedical Ethics under case no. (KF) 01-471/94 and by the Danish Data Protection Agency under case no. 2008-54-0431 and 2004-41-4078 (7-year follow-up).

The **Figure** (available at www.jpeds.com) shows the number of participants at each stage of the DNBC. In the present study, we used data from 3 time points: (1) information on exposures during early pregnancy, maternal health, and sociodemographic data from a computer-assisted telephone interview around gestational week 16-17; (2) data on the duration of crying from a computer-assisted telephone interview at 6 months postpartum; and (3) the parent-administered Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07) from the 7-year follow-up.

For the 7-year follow-up, invitations were sent every week to the primary caregiver of all DNBC children turning age 7 during that particular week (n = 91 256). Two reminders, at 4-week intervals, were sent to nonresponders. This led to 57 282 caregivers (57% of the original cohort and 63% of the invitees) completing either the online or the paper version of the questionnaire between November 2005 and July 2010. The 7-year follow-up consisted of a self-administered parental questionnaire assessing several aspects of the child's health and development. The DCDQ'07 was not included in the first versions of the follow-up questionnaire; only questionnaires completed after November 2006 (n = 40 197) were available for this study.

We included singletons with data on pregnancy exposures, infantile colic assessment, and complete DCDQ'07 data; we excluded younger DNBC siblings, to avoid dependency of observations. This resulted in a study sample of 27 940 children. Questionnaires, information on the procedures, and participation rates are available at the DNBC home page.[25]

Infantile Colic

At the 6-month interview, the caregiver (usually the mother) reported hours of crying and fussing per day, number of days per week in which crying and fussing exceeded 3 hours, and age when the infant had unexplained crying bouts lasting longer than 30 minutes. We defined infantile colic according to the modified Wessel criteria as crying and fussing for more than 3 hours a day and for more than 3 days a week. The 30-minute crying bouts had to start before age 3 months for infants born at term and before 3 months corrected age for preterm infants, in accordance with literature findings.[26] Within the group of children with a history of infantile colic, we also identified a group of prolonged criers—infants with 30-minute crying bouts persisting beyond age 3 months.

DCDQ'07

The parent-administered DCD questionnaire is a screening tool for evaluating motor skills in children aged 5-15 years. The DCDQ'07, the current version of the questionnaire, consists of 15 items evaluating the child's motor performance in a range of everyday activities, grouped into 3 subscales evaluating distinct areas of motor skills: control during movement, fine motor/handwriting, and general coordination. For each question, parents grade their child's performance on a 5-point Likert scale compared with peers, and all items are added to calculate the total score (range, 15-75). A total score of 46 or lower indicates probable or suspected DCD for children under age 8 years, and a higher score suggests no DCD. The test has shown high internal consistency, high discriminant function, and satisfactory agreement with clinical assessments by occupational therapists and tests of motor impairment, such as the Movement Assessment Battery for Children. Brenda Wilson, MD, who developed and tested the original questionnaire, approved the back-translation of the Danish version of the questionnaire used in this study.

Statistical Analyses

DCDQ'07 total scores and subscores for children with and without a history of infantile colic were compared using the nonparametric Wilcoxon Mann-Whitney rank-sum test, because the distribution of neither original nor log-transformed scores was symmetrical. We investigated the association between infantile colic and motor skills by fitting 3 different regression models. Initially, we compared the risk (odds) for probable or suspected DCD (total DCDQ'07 score $\leq$46) in children with and without a history of infantile colic using logistic regression. We used the same model to compare 3 distinct groups: children whose 30-minute crying bouts stopped by age 3 months, children whose crying bouts continued beyond this time (prolonged criers), and children with no history of infantile colic. In a linear regression model, we compared total DCDQ'07 scores of children with and without a history of infantile colic. Finally, in a logistic model, history of infantile colic (binary dependent variable) was regressed toward total DCDQ'07 scores (continuous explanatory variable), and we estimated the odds for a