Parental questionnaire as a screening instrument for motor function at age five

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ABSTRACT

INTRODUCTION: No standardised method is used to determine motor function in children in general practice in Denmark. Our aim was to evaluate the correlation between a parental questionnaire assessing motor function at the age of five years and the clinical test Movement Assessment Battery for Children (M-ABC), and to assess whether one or more questions could be used to screen for motor problems at the age of five years.

METHODS: This study was based on a parental questionnaire containing ten questions. The M-ABC was used as the gold standard. n = 755 children. The Mann-Whitney rank sum test, Pearson's χ^2-test, logistic regression analyses and sensitivity and specificity were used to assess the correlation between the questionnaire and the M-ABC test.

RESULTS: The best screening tool was six questions in combination: sensitivity 39.8%, specificity 87.1%. Asking if a health professional ever expressed concern about the child's motor development had a sensitivity of 17.0% and a specificity of 93.9%.

CONCLUSION: A parental questionnaire used as a screening instrument to identify children with motor problems has a reasonable specificity, but a low sensitivity. The six questions can be used to identify children who do not have motor function difficulties with a relatively high certainty, and it can fairly well identify children with motor function problems.

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Some children have difficulties with everyday activities, which make great demands on their motor function abilities. For instance, the children experience difficulties when jumping, riding a bike, drawing or throwing and catching a ball [1]. Such problems often cannot be explained by a physical handicap, neurological disease or intellectual impairment [2]. Children with minor motor function disabilities were first described by Dupre in 1911 [3]. In 1987, the American Psychiatric Association described the first diagnostic criteria for this target group in the Diagnostic Manual of Mental Disorders-Revised (DSM III-R) using the overall term Developmental Coordination Disorder (DCD) [4].

Motor problems appeared in 6-10% of Norwegian 7-10-year-old children and in 13.5% of 7-year-old Swedish children [5, 6]. In a Danish study assessing motor function in children during the first and second years of school, 15% of the children performed poorer than expected for their age, 0.9-1.3% being classified as very immature [7]. In accordance with Danish health legislation, recommendations about preventive measures for children and youngsters have been developed [8]. Children under school age are offered seven preventive health checks by their general practitioner (GP). All health checks include an examination and assessment of the child's motor and physical function as well as a general health check and vaccinations. At the five-year examination, the focus is primarily on motor function and language [9]. There is no overall account of the number of children identified with motor function delays by the preventive health-care scheme in Denmark; and no systematic method is used to determine motor function in general practice, although nurses and sometimes doctors see preschool children in the community.

Some studies have shown an association between motor function and physical fitness [10]. Children diagnosed with DCD are less active and as a result of inactivity, the risk of developing a lifestyle disease such as type 2 diabetes and cardiovascular disease is increased [10-12]. Although physical inactivity is not as eye-catching as e.g. overweight, it can pose a greater threat to public health than overweight does [10, 13].

Two meta-analyses concluded that a significant effect is achieved when treating children diagnosed with DCD; it was emphasised that early identification of DCD is necessary with a view to treatment [14, 15]. The aim

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TABLE 1

Characteristics and answers on single questions from parental questionnaire after coding into three groups and prevalence "Normal" and "Motor function delay" estimated using M-ABC test towards each single question (N = 755).

Questions from parental questionnaire	Single question, n			Prevalence using M-ABC test[a], %	
	normal motor function	motor function delay	missing/ don't know[b]	normal motor function	motor function delay
1) … received support in institution?	657	90	8	87.02	11.92
2) … when did child walk?	744	4	7	98.54	0.53
3) … motor development in general?	721	24	10	95.5	3.18
4) … gross motor development?	721	25	9	95.5	3.31
5) … fine motor development?	715	28	12	94.7	3.71
6) … concern about motor development?	694	56	5	91.92	7.42
7) … biking without support?	422	316	17	55.89	41.85
8) … one leg standing, without support?	741	7	7	98.15	0.93
9) … catch a small ball with two hands?	654	43	58	86.62	5.7
10) … throw small ball and catch again?	517	8	160	68.48	10.33

M-ABC test = Movement Assessment Battery for Children, motor test.
a) Prevalence on: "Normal motor function" and "Motor function delay", group: "Missing/don't know" were left out from this analysis.
b) Agreed to participate, filled in questionnaire, and completed the M-ABC test, but did not answer question.

of the present study was to assess whether one or more questions to parents could be used for screening for motor function problems in children at the age of five years.

METHODS

Design and population

Participants were recruited from the Danish National Birth Cohort (DNBC) to participate in the Lifestyle During Pregnancy Study (LDPS) [16, 17]. Briefly, the DNBC consists of 101,042 women and their offspring, recruited from 1997 to 2003. A total of 3,478 women who were sampled on alcohol drinking patterns during pregnancy were invited to participate in the LDPS between 2003 and 2008. The exclusion criteria were the child´s inability to speak Danish, impaired hearing or vision to the extent that the test session could not be performed, multiple pregnancies, and congenital diseases likely to cause mental retardation.

When the child was between 60 and 64 months old, a three-hour assessment of neuropsychological development was carried out in one of four test sites in Copenhagen, Aarhus, Odense and Aalborg.

Between 2003 and 2006, the tests included the clinical motor test Movement Assessment Battery for Children (M-ABC). Physiotherapists who were familiar with testing children performed the test, and they were blinded to alcohol exposure and other prenatal information.

Questionnaire completed by parents

The selected parents were sent an invitation to participate in the study approximately 8-12 weeks before the child turned five. A self-administered questionnaire was mailed to participating parents. Subsequently, this was to be handed in on the test day. The questionnaire was developed within the LDPS project [16].

The questionnaire had 158 questions on: A) Family and home, B) Development, C) Activity and friends, D) Health, E) Strengths and weaknesses, and F) Parents. In the present study, we used the ten questions in sections A) and B) that all concern the child's motor function during the first 5 years of life. These were: 1) Has the child received support during institutional placement? 2) At which age did the child learn to walk? 3) How has the child's general motor function development been? 4) How would you characterise the child's gross motor function? 5) How would you characterise the child's fine motor control? 6) Has a health professional ever expressed any concern regarding the child's motor development? 7) Is the child able to ride a two-wheeled bicycle? 8) Is the child able to stand with bare feet on one leg without support? 9) Is the child able to catch a small ball with both hands? 10) Is the child able to throw a small ball towards the ground and catch it again with both hands? (**Table 1**).

Movement Assessment Battery for Children

The M-ABC was used to objectively test the children's motor function. The test examines combined functions at activity level (according to the International Classification of Function) and is used to identify difficulties and for screening, clinical examination, planning and evaluation of treatment and research. By considering hand motor function, ball skills and static-dynamic balance in four different age groups; 4-6, 7-8, 9-10 and 11-12 years, children are given scores for the different tasks. The total score of the child's performance is used to assess the child's abilities in relation to the age norm. The scores are converted into a scale score from 0 to 5 points. The higher the score,

TABLE 2

Questions from parental questionnaire	Crude OR (95% CI)	Crude p-value	Adjusted OR (95% CI)	Adjusted p-value
1) … received support in institution?	2.31 (1.31-4.06)	0.00	1.55 (0.80-2.97)	0.19
2)… when did child walk?	7.7 (1.07-55.60)	0.04	2.80 (0.23-34.16)	0.41
3) … motor development in general?	8.61 (3.74-19.85)	0.00	1.65 (0.48-5.59)	0.42
4) … gross motor development?	7.94 (3.49-18.03)	0.00	4.11 (1.37-12.32)	0.01
5) … fine motor development?	5.46 (2.46-12.08)	0.00	4.07 (1.66-9.98)	0.02
6) … concern about motor development?	3.13 (1.65-5.94)	0.00	0.96 (0.39-2.39)	0.94
7) … biking without support?	2.59 (1.63-4.10)	0.00	2.06 (1.27-3.36)	0.00
8) … one leg standing, without support?	20.03 (3.82-104.88)	0.00	6.21 (0.79-48.64)	0.08
9) … catch a small ball with two hands?	5.26 (2.70-10.23)	0.00	3.46 (1.44-8.34)	0.00
10) … throw small ball and catch again?	2.60 (1.45-4.65)	0.00	0.93 (0.41-2.08)	0.86

CI = confidence interval; M-ABC = Movement Assessment Battery for Children; OR = odds ratio.

Association between total score on the M-ABC test and single-item questions from the parental questionnaire. Odds ratio for total score under the 5th percentile from unadjusted and adjusted logistic regression analyses showing crude odds ratios and adjusted odds ratios, and p-values (N = 755).

the poorer the child's performance. In our study, the Total Motor Impairment Score was converted into a percentile via the norm tables. According to the percentile score, the children were divided into three groups: 1) percentile ≤ 5: poor motor function, 2) percentile > 5-15: in the risk zone of poor motor function and 3) percentile > 15: age appropriate/normal [18]. A number of qualitative descriptions can be given. However, these were not used in this study. Furthermore, the instructions for the children are not standardised; instead, the project group developed instructions in cases where this was necessary.

Standardisation and interrater reliability

Interrater reliability was evaluated, and the results confirmed that there were no statistically significant differences between the physiotherapists and whether they had undertaken fewer or more than 20 tests in the study (Pearson's χ^2-test, p = 0.954).

Statistics

The Mann-Whitney rank sum test and Pearson's χ^2-test were used to test the association between the questionnaire results and the M-ABC test. Sensitivity analyses were performed applying different values to the categories "Missing/no opinion". Sensitivity and specificity were calculated and the receiver operating characteristic (ROC) area determined. Finally, logistic regression analyses between questions one by one and in combination and the total M-ABC score were performed, and multivariate analyses adjusted for other questions were carried out. Statistical analyses were done in STATA 10.

Trial registration: Approved by the Danish National Birth Cohort (DNBC) Board of Directors, the DNBC Steering Committee, the Regional Ethics Committee, the Danish Data Protection Agency and the CDC Institutional Review Board.

RESULTS

Of the 1,446 invited to the LDPS during the period when motor tests were performed, 816 mothers and children agreed to participate, three of whom failed to complete the required questionnaire and 58 of whom did not participate in the M-ABC test, bringing the total number of participants down to n = 755. No substantial or significant differences were observed between participants and non-participants [19]. The mean age was 5.2 years (standard deviation (SD) = 0.07), mean IQ was 106 (SD = 12.9), and median M-ABC score 7.5 (range 0-38), mean 8.6 (SD = 6.4). Among the 755 participating children, the prevalence of a poor motor function M-ABC total score was 12% at the ≤ 5th percentile and 34% at the > 5-15th percentile. In bivariate analyses, each of the questions from the questionnaire was statistically significantly associated with the results from the M-ABC test showing prevalence (Table 1) and odds ratio (OR) (**Table 2**). However, only three questions remained individually associated with the M-ABC in adjusted analyses (Table 2). Six of the questionnaire questions (2-6 and 9) were collectively the best "*joint indicator*" of motor function

Balance is an important measure of motor function.

TABLE 3

Sensitivity and specificity to single questions from parental questionnaire, used as a predictor of motor function at the age of five years (N = 755).

Questions from parental questionnaire	p-value[a]	Sensitivity (95% CI), %	Specificity (95% CI), %	ROC	PPV/NPV
1) … received support in institution?	0.003	21.6 (13.5-31.6)	89.4 (86.8-91.6)	0.555	21.1/89.6
2)… when did child walk?	0.017	2.27 (0.27-7.97)	99.7 (98.9-100)	0.51	50/88.5
3) … motor development in general?	0.00	13.6 (7.25-22.6)	98.2 (96.9-99.1)	0.559	50/89.6
4) … gross motor development?	0.00	13.6 (7.25-22.6)	98.1 (96.7-99)	0.558	48/89.6
5) … fine motor development?	0.00	12.5 (6.41-21.3)	97.5 (96-985)	0.55	39.3/89.4
6) … concern about motor development?	0.00	17 (9.87-26.6)	93.9 (91.8-95.6)	0.554	26.8/89.6
7) … biking without support?	0.00	62.5 (51.5-72.6)	60.9 (57-64.6)	0.617	17.4/92.5
8) … one leg standing, without support?	0.00	5.68 (1.87-12.8)	99.7 (98.9-100)	0.527	71.4/88.9
9) … catch a small ball with two hands?	0.00	18.2 (10.8-27.8)	96 (94.2-97.3)	0.571	37.2/89.9
10) … throw small ball and catch again?	0.001	20.5 (12.6-30.4)	91 (88.6-93.1)	0.557	23.1/89.7
9, 10) …"ball game"	0.00	27.3 (18.3-37.8)	89.7 (87.1-91.9)	0.585	25.8/90.3
5, 8, 9) ... fine motor, bike + catch ball	0.00	70.5 (59.8-79.7)	57.4 (53.6-61.2)	0.639	17.9/93.6
1-10) All 10 questions	0.00	86.4 (77.4-92.8)	46.9 (43.1-50.8)	0.666	17.7/96.3
2, 3-5, 9 and 10)	0.00	39.8 (29.5-50.8)	85.6 (82.7-88.2)	0.627	26.7/91.5
2, 3-6, 9) "Joint indicator"[b]	0.00	39.8 (29.5-50.8)	87.1 (84.3-89.6)	0.634	28.9/91.6

CI = confidence interval; M-ABC test = Movement Assessment Battery for Children, motor test; NPV = negative predictive value; PPV = positive predictive value; ROC = receiver operating characteristic.
a) Pearson's χ^2-test, M-ABC test at 5th percentile as cut-off level, p-value > 0.05.
b) The 6 questions in combination: walk, motor function + gross-fine motor function + concern + catch ball.

screening at the age of 5 years. Thus, the sensitivity and specificity tests of the "joint indicator" were 39.8% and 87.1%, respectively, at the 5th percentile (**Table 3**). The ROC area is shown in **Figure 1**. In addition to this, two hypotheses were tested in combination, with questions nine and ten from the questionnaire as the parameter "*ball game*", showing a statistically significant result (Table 3). Sensitivity was 27.3% and the specificity 89.7% at the 5th percentile. Question six was also significantly associated with the M-ABC test, the sensitivity being 17% and the specificity 93.9% at the 5th percentile (Table 3).

DISCUSSION

This study showed that among 755 children, the best questions for screening motor function at the age of five were a "joint indicator". While "best" usually means both a high sensitivity and specificity, both may not be high (Table 2). In order to minimise the potential harm caused by false positive tests and subsequent costs of follow-up test to screen positives, we aimed for a high specificity and a reasonable sensitivity.

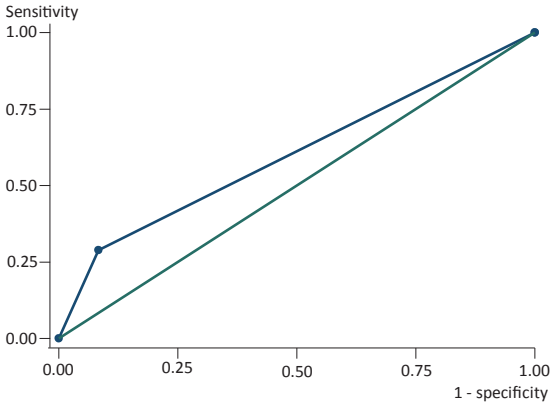
The study results showed a prevalence of 12% with motor delay, identified with the M-ABC test. The proportion is higher than expected from the norm tables. Participants in the DNBC were somewhat healthier than average pregnant women during the enrolment period for the DNBC, and hence one might have expected a lower rather than a higher prevalence of disorders in the children, but most likely the American cut-offs used may not apply in a Danish setting. In Australia 2008, Civetta et al compared a parent questionnaire with the M-ABC test. They stressed the absence of an accepted "gold standard" in assessing children with DCD, the lack of reliability and validity of the M-ABC, and concluded that alternative cut-offs for tests have to be investigated.

It is not known whether Danish children with motor function difficulties at the age of five or before are discovered by the GP or by other professionals within the existing preventive follow-up programme. On the basis of the WHO's programme of principles and Danish health legislation from June 2005, it can be assumed that the existing preventive health programme meets the purpose of the health legislation. Question six in the present study suggests that it is debatable whether the existing practice in the field is sufficient. Furthermore, it indicates that the existing practice to a great extent seems to identify children without motor function problems, but only 17% of those who have motor delay before or at the age of five.

The Danish Health and Medicines Authority's survey of the preventive health-care scheme in Denmark from 2000-2004 showed a rather big difference between the number of local health visits in the individual municipalities, and only half of these municipalities have specified guidelines for the local health service nurses. A third of the GPs asked for further training, and it was suggested that a questionnaire to be filed in by parents before the health visitor checkup be developed [20]. Others called for more operational guidelines and the use of tests. The parents' answers were characterised by uncertainty towards the purpose of the health checks. If a method for screening that identifies children with motor function problems before or at the age of five is to be developed, studies must be done on a larger group of children. It is

FIGURE 1

ROC curve and area under the ROC curve based on six questions used as a "joint indicator" of motor function problems in five-year-old children in Denmark.



ROC area = 0.6028.
Questions 2, 3-6, 9) "joint indicator: sensitivity = 39.8% (95% CI: 29.5-50.8%); specificity = 87.1% (95% CI: 84.3-89.6%).
CI = confidence interval; ROC = receiver operating characteristic.

crucial that the practice in the preventive field is adjusted and systematised according to the existing knowledge about motor function problems. The current practice for follow-up on overweight children may be used as a frame.

The strengths of our study are the prospective collection of data, the size of the sample and the use of the M-ABC test, which is considered the best national and international clinical test in the field both with regard to clinical practice and research. However, Danish norm tables do not exist for the M-ABC or for the second version, the M-ABC-2, from 2007.

A limitation is that we do not know if the answers parents have given to this questionnaire are in accordance with what is actually identified in practice.

CONCLUSION

This study showed that the best screening of motor function at the age of five was performed with a combination of six questions used as a "joint indicator". The six questions can be used to help identify those children who do not have any motor function difficulties with a rather high certainty, and it fairly well identifies children with motor function problems; this may potentially help GPs to focus on those children who have actual problems. If the Danish Health and Medicines Authority were to adjust the guidelines and/or wishes to distribute questionnaires to parents, supplementary to the GP´s preventive health check-up at age five, the "joint indicator" could be taken into consideration. The results of the "joint indicator" of the six questions in the study proved to give a better result for screening of motor function than the single question "Has a health professional ever expressed any concern regarding the child's motor function development?" Nevertheless, it is uncertain whether the outcome of the question reflects the existing practice in the preventive health checks and the local health service in Denmark. The results of this study can be taken into consideration when discussing the possibilities of achieving a better practice in the field, in which, according to current health legislation, a general health improving and disease preventing effort is needed in the future.

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