



# Higher rates of behavioural and emotional problems at preschool age in children born moderately preterm

Marieke R Potijk,<sup>1</sup> Andrea F de Winter,<sup>1</sup> Arend F Bos,<sup>2</sup> Jorien M Kerstjens,<sup>2</sup> Sijmen A Reijneveld<sup>1</sup>

<sup>1</sup>Department of Health Sciences, Community and Occupational Medicine, University Medical Center Groningen, University of Groningen, The Netherlands  
<sup>2</sup>Department of Paediatrics, Division of Neonatology, University Medical Center Groningen, University of Groningen, The Netherlands

## Correspondence to

Marieke R Potijk, Department of Health Sciences, Community and Occupational Medicine, University Medical Center Groningen, University of Groningen, Antonius Deusinglaan 1, PO Box 196, 9700 AD Groningen, The Netherlands; m.r.potijk01@umcg.nl

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## ABSTRACT

**Objective** To compare preschool children born moderately preterm (MP; 32–35 weeks' gestation) and children born at term (38–41 weeks' gestation) regarding the occurrence of behavioural and emotional problems, overall, for separate types of problems and by gender.

**Design** Prospective cohort study consisting of a community-based sample of MP and a random sample of term-born children in 13 Preventive Child Healthcare centres throughout the Netherlands.

**Patients** 995 MP and 577 term-born children just under age 4 were included.

**Main outcome measures** Behavioural and emotional problems were measured using the Child Behavior Checklist 1.5–5 years. Seven syndrome scales, internalising, externalising and total problems were determined. Higher scores indicate worse outcomes.

**Results** MP children had higher scores on all syndrome scales, internalising, externalising and total problems than term-born controls. The mean difference on total problems was 4.04 (95% CI 2.08 to 6.00). Prevalence rates of elevated externalising problem scores were highest in boys (10.5%) and internalising problems were highest in girls (9.9%). MP children were at greater risk for somatic complaints (OR 1.92, 95% CI 1.09 to 3.38), internalising (OR 2.40, 95% CI 1.48 to 3.87), externalising (OR 1.69, 95% CI 1.07 to 2.67) and total problems (OR 1.84, 95% CI 1.12 to 3.00).

**Conclusions** Moderate preterm birth affects all domains of behavioural and emotional problems, particularly for girls. MP children should be targeted for the prevention of mental health problems as they have a great impact on developmental and social competencies at school and in the community.

## INTRODUCTION

Worldwide, the preterm birth rate in 2005 was an estimated 9.6% (12.9 million births).<sup>1</sup> The highest rates were in Africa (11.9%) and North America (10.6%), and the lowest rates were in Europe (6.2%).<sup>1</sup> In the Netherlands, 7.7% of children were born preterm in 2008.<sup>2</sup> US data show a rise in the preterm birth rate from 9.4% in 1981 to 12.3% in 2003, with the highest increase in the rates of moderately preterm-born children (MP; 32–35 weeks' gestation).<sup>3</sup> The rate of children born very preterm (<32 weeks) remained relatively constant during the same period at 1.8–2.0%. In other words, children born after 32 weeks' gestation comprise more than 85% of all preterm births.<sup>3–5</sup>

Accumulating evidence shows that MP children are at greater risk for developmental and

## What is already known on this topic

- ▶ Children born moderately preterm are at increased risk for neonatal mortality and for short- and long-term health problems.
- ▶ It has been suggested that children born moderately preterm may also be at risk for several types of behavioural and emotional problems.
- ▶ However, large prospective cohort studies are lacking.

## What this study adds

- ▶ The occurrence of behavioural and emotional problems was higher in moderate preterm-born children than in term-born controls, overall and for separate types of problems.
- ▶ In both groups the prevalence of behavioural and emotional problems was higher among boys, but being moderately preterm affected girls more than boys.

health problems than term-born children (38–41 weeks' gestation). Several follow-up studies have reported that MP children are not only at risk for short-term morbidity and mortality,<sup>6–8</sup> but also for numerous developmental and school-related problems in the long term.<sup>9–11</sup>

However, evidence concerning long-term behavioural and emotional problems among MP children is limited.<sup>12–16</sup> One study on 52 late preterm-born children (born at 34–36 weeks) showed no differences in externalising, internalising, aggressive and anxious/depressed problems compared to term-born children.<sup>12</sup> In contrast, van Baar *et al* reported that MP children were more likely to have behavioural and emotional problems at ages 7–9, specifically attention and internalising problems.<sup>13</sup> A recent study by Talge *et al* confirmed the presence of more attention and internalising problems in 6-year-old children born at 34–36 weeks' gestation.<sup>14</sup> Furthermore, Gray *et al* reported that ~20% of MP children with low birth weight had behavioural problems at 3, 5 and 8 years of age, compared to the expected 10% in normative samples when using the same cut-off.<sup>15 17</sup>

Although it is shown that very preterm and low birthweight children have considerably more behavioural and emotional problems,<sup>18</sup> large prospective cohort studies on moderately and

late preterm-born children are lacking. The few small studies showed conflicting results.<sup>12–14</sup> Therefore, the purpose of this study was to determine the occurrence of behavioural and emotional problems, overall and for separate types of problems, in a large cohort of MP preschool children and to compare the occurrence with term-born controls. In addition, we assessed these problems by gender.

## METHODS

### Study design

The Longitudinal Preterm Outcome Project (Lollypop) is a large prospective cohort study designed to investigate the growth, development and general health of children born preterm, with a special focus on MP children.<sup>19</sup> The Lollypop cohort consists of a community-based sample of MP children (all born between 32 and 36 weeks' gestation) and a random sample of term-born children. When the study was designed, MP children were defined as those born at 32–35 weeks' gestation and so children born at 36<sup>0</sup>–36<sup>6</sup> weeks' gestation were not included. Parents completed a questionnaire on behavioural and emotional problems just before the scheduled Preventive Child Healthcare (PCH) visit at 4 years of age. The study was approved by the local institutional review board.

### Population

The study children were sampled in 13 randomly selected PCH centres, which together monitored 45 446 children (25% of all children of this age monitored by PCH centres). In the Netherlands, 90–95% of children are seen regularly by PCH centres for well child care from birth up to age 4, free of charge.<sup>20</sup> The PCH centres follow the monitoring guidelines of the National Centre for PCH ([www.ncj.nl](http://www.ncj.nl)). Each PCH centre provided a sample of all preterm children born during a single year, either from January 2002 to January 2003, or from June 2002 to June 2003. Term-born children were sampled from the same PCH centres and were in the same age range as the preterm children. After the file of each second preterm child had been selected, the file of the next term-born child served as a control. Children were excluded if they had a congenital malformation or syndrome or if their gestational age could not be verified. For this study children born at less than 32 weeks' gestation were also excluded. Gestational age was calculated by using the last date of menstruation, and confirmed by early ultrasound measurements in >95% of cases. Parents were willing to participate for 995 (86.9%) of the MP and 577 (85.6%) of the term-born children. Behavioural questionnaire response rates were high, with the parents of 93.3% of MP and 95.1% of term-born children returning the questionnaires.

### Measures and procedure

Behavioural and emotional problems were measured using the Child Behavior Checklist (CBCL) for ages 1.5–5.<sup>21 22</sup> The CBCL 1.5–5 has good psychometric properties and is widely used in diverse service settings and in research.<sup>22</sup> The reliability and validity of the problem scales have been confirmed for the Dutch version of the CBCL.<sup>23 24</sup> It consists of 99 problem items and one open-ended item for recording other problems not listed on the form. Each item can be rated by the parent as follows: 0, not true; 1, somewhat or sometimes true; or 2, very true or often true. We constructed seven syndrome scales by summing the ratings for the items comprising each syndrome. Subsequently, problem scores were subdivided into three categories: normal range (<93th percentile), subclinical

or borderline range (93rd to 97th percentile), and clinical or elevated range (>97th percentile). In addition, the scores for two broad groups (internalising and externalising problems), and total problems were calculated. For these scores, cut-offs for subclinical and clinical problems were set at the 84th and 90th percentiles, respectively, following the CBCL manual.<sup>21</sup> Internalising problems consist of syndrome scales for emotionally reactive behaviour, anxious/depressed behaviour, somatic complaints and withdrawn behaviour. Externalising problems consist of syndrome scales for attention problems and aggressive behaviour.

Data on background characteristics were collected using a general parental questionnaire that was sent to the parents simultaneously with the CBCL. The questionnaire consisted of questions about the medical condition of the mother during pregnancy, delivery, developmental and medical conditions of the child, family composition and socioeconomic status. Furthermore, retrospective data files for all children were available from PCH centres, paediatricians, midwives and obstetricians. Thus, it was possible to check some important variables such as gestational age and birth weight by referring to two or more data files. When inconsistencies were found, these were checked against information in discharge letters.

### Analysis

We compared behavioural and emotional problems as measured by the CBCL for MP and term-born children at preschool age. First, characteristics (ie, small for gestational age, gender, age of the child at completing the CBCL, family composition, number of siblings, maternal age, educational level and ethnicity) between MP and term-born children were compared using  $\chi^2$  tests. Second, mean scores were computed for all CBCL scales to identify behavioural problems associated with moderate prematurity. In addition, differences in mean CBCL scores by gender between MP and term-born children were examined using t tests. All t tests were confirmed by non-parametric Mann–Whitney U tests because of the non-Gaussian distribution of the CBCL scores. Third, we computed the risk for clinical CBCL problem scores in MP versus term-born children, using logistic regression analyses. In a multivariate logistic regression model, results were adjusted for differences in characteristics between the samples. For all statistical analyses SPSS for Windows 16.0 was used. A p value of less than 0.05 was considered to be statistically significant. A Bonferroni correction for multiple t tests in our gender subgroup adjusted the cut-off for statistical significance to be 0.005.

## RESULTS

Differences in the background characteristics of the preterm and term groups were highly statistically significant as regards gender, family composition and number of siblings, and marginally so for maternal age and educational level (table 1).

Table 2 shows that MP children had higher mean scores on internalising (mean difference (MD) 1.33, 95% CI 0.67 to 1.98), externalising (MD 1.41, 95% CI 0.59 to 2.23) and total problems (MD 4.04, 95% CI 2.08 to 6.00) than term-born children. In the syndrome scales, the greatest differences were seen regarding withdrawn behaviour (MD 0.29, 95% CI 0.13 to 0.44) and attention problems (MD 0.59, 95% CI 0.39 to 0.79). Non-parametric testing produced similar results.

Differences in mean CBCL scores between groups tended to be greater in boys than in girls, as presented in table 3. However, the gender-by-group interaction was not statistically

**Table 1** Characteristics of moderately preterm and term-born children

	Preterm (n=916)		Term (n=543)		p Value
	Mean	SD	Mean	SD	
Mean gestational age (weeks)	34.0	(SD 1.0)	39.6	(SD 1.0)	
Mean birth weight (g)	2244	(SD 465)	3553	(SD 488)	
	% (n)		% (n)		
Gestational age (weeks)					
32	11.5	(105)			
33	20.1	(184)			
34	27.8	(255)			
35	40.6	(372)			
38			17.1	(93)	
39			26.2	(142)	
40			35.9	(195)	
41			20.8	(113)	
SGA*	9.2	(84/916)	7.7	(42/543)	0.4
Gender (male)	57.2	(524/916)	49.2	(267/543)	0.003
Age of child (months)†					0.6
<43	0.9	(7/768)	0.6	(3/467)	
43–47	89.6	(688/768)	91.4	(427/467)	
>47	9.5	(73/768)	7.9	(37/467)	
Family composition					0.005
Two-parent family	92.7	(845/912)	96.3	(517/537)	
One-parent family	7.3	(67/912)	3.7	(20/537)	
Number of siblings					0.006
0	18.6	(170/916)	12.5	(68/543)	
1	54.5	(499/916)	55.2	(300/543)	
2	20.7	(190/916)	23.2	(126/543)	
≥3	6.2	(57/916)	9.0	(49/543)	
Maternal age (years)					0.05
<25	8.5	(75/885)	6.1	(32/526)	
25–34	73.6	(651/885)	71.5	(376/526)	
>34	18.0	(159/885)	22.4	(118/526)	
Maternal educational level‡					0.08
Low	30.5	(278/912)	25.6	(138/539)	
Medium	43.0	(392/912)	43.6	(235/539)	
High	26.5	(242/912)	30.8	(166/539)	
Maternal ethnicity					0.6
Netherlands	94.2	(856/909)	95.1	(507/533)	
Europe	1.8	(16/909)	1.9	(10/533)	
Outside Europe	4.1	(37/909)	3.0	(16/533)	

\*SGA, small for gestational age, that is, birth weight below the 10th percentile of the Dutch Kloosterman growth charts.

†Age at completing the Child Behavior Checklist.

‡Low, primary school or less and/or low-level technical and vocational training; medium, high school or medium-level technical and vocational training for 12–16 years; high, university or high-level technical and vocational training for >16 years.

**Table 2** Differences in mean Child Behavior Checklist (CBCL) scores between moderately preterm and term-born children

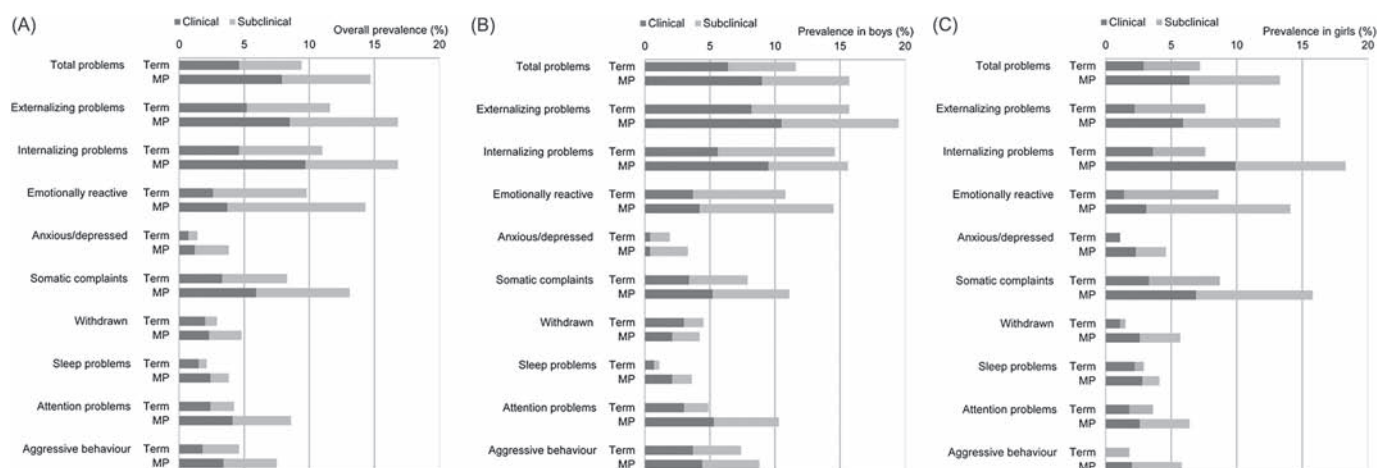
CBCL problems scale	Preterm (n=916)		Term (n=543)		Difference (95% CI)	p Value*
	Mean	SD	Mean	SD		
Total problems	30.40	19.41	26.36	17.80	4.04 (2.08 to 6.00)	<0.001
Externalising problems	12.44	8.12	11.03	7.50	1.41 (0.59 to 2.23)	<0.01
Internalising problems	7.93	6.71	6.60	5.85	1.33 (0.67 to 1.98)	<0.001
Emotionally reactive	2.75	2.67	2.34	2.31	0.41 (0.15 to 0.67)	<0.01
Anxious/depressed	1.78	2.06	1.43	1.74	0.35 (0.15 to 0.55)	<0.01
Somatic complaints	2.05	2.22	1.77	1.96	0.28 (0.06 to 0.50)	<0.01
Withdrawn	1.35	1.52	1.07	1.38	0.29 (0.13 to 0.44)	<0.001
Sleep problems	2.03	2.34	1.62	2.11	0.41 (0.18 to 0.65)	<0.01
Attention problems	2.40	2.02	1.81	1.84	0.59 (0.39 to 0.79)	<0.001
Aggressive behaviour	10.04	6.75	9.22	6.17	0.82 (0.14 to 1.50)	<0.05

\*p Values calculated by t tests; non-parametric testing provided p values of the same significance for all differences, except for somatic complaints (p=0.051) and aggressive behaviour (p=0.054).

**Table 3** Differences in mean Child Behavior Checklist (CBCL) scores between moderately preterm and term-born children by gender

CBCL problems scale	Boys				Girls			
	Preterm (n=524)	Term (n=267)	Difference (95% CI)	p Value*	Preterm (n=392)	Term (n=276)	Difference (95% CI)	p Value*
Total problems	30.99	28.52	2.47 (−0.36 to 5.30)	0.08	29.60	24.26	5.34 (2.59 to 8.09)	<0.001
Externalising problems	13.09	12.57	0.53 (−0.69 to 1.74)	0.39	11.56	9.54	2.03 (0.92 to 3.13)	<0.001
Internalising problems	7.64	6.95	0.69 (−0.24 to 1.61)	0.14	8.32	6.26	2.05 (1.08 to 3.03)	<0.001
Emotionally reactive	2.77	2.54	0.23 (−0.15 to 0.62)	0.22	2.71	2.14	0.58 (0.21 to 0.94)	<0.01
Anxious/depressed	1.65	1.48	0.17 (−0.09 to 0.43)	0.22	1.95	1.38	0.57 (0.26 to 0.88)	<0.001
Somatic complaints	1.93	1.75	0.18 (−0.13 to 0.49)	0.25	2.21	1.79	0.42 (0.10 to 0.75)	<0.05
Withdrawn	1.29	1.18	0.11 (−0.11 to 0.33)	0.35	1.44	0.96	0.48 (0.27 to 0.69)	<0.001
Sleep problems	2.01	1.55	0.46 (0.13 to 0.79)	<0.01	2.07	1.69	0.38 (0.03 to 0.73)	<0.05
Attention problems	2.56	2.05	0.51 (0.21 to 0.81)	<0.01	2.19	1.58	0.61 (0.33 to 0.89)	<0.001
Aggressive behaviour	10.53	10.52	0.02 (−0.99 to 1.02)	0.98	9.38	7.96	1.42 (0.51 to 2.32)	<0.01

\*p Values calculated by t tests; non-parametric testing provided p values of the same significance for all differences except for aggressive behaviour (p=0.016) and externalising behaviour (p=0.002) in girls, and attention problems (p=0.001) in boys.



**Figure 1** (A) Prevalence rates of behavioural and emotional problems in moderately preterm (MP) and term-born children. For total, externalising and internalising problems, 'clinical' indicates scores >90th percentile and 'subclinical' indicates scores >84th and <90th percentiles. For the syndrome scales, 'clinical' indicates scores >97th percentile and 'subclinical' indicates scores >93th and <97th percentiles. (A) Overall prevalence. (B) Prevalence in boys. (C) Prevalence in girls.

significant. Among boys, mean scores on two syndrome scales, sleep problems and attention problems, were significantly higher in MP than in term-born children. Among MP girls, mean scores on all seven syndrome scales, as well as on internalising, externalising and total problems, were significantly higher than among term-born girls (table 3).

The prevalence rates of subclinical and clinical CBCL problem scores are presented in figure 1A–C. Among all MP children, 6.8% had a total problems score in the subclinical range and 7.9% had a score in the clinical range (combined 14.7%). For term-born children, these figures were 4.8%, and 4.6%, respectively (combined 9.4%) (figure 1A). Total problem scores in the clinical range were more prevalent in MP boys than in MP girls (9.0% vs 6.4%) (figure 1B,C). The risk for a clinical total problems score compared with term-born peers was lower for MP boys (OR 1.52, 95% CI 0.84 to 2.75) than for MP girls (OR 2.62, 95% CI 1.09 to 6.26). MP boys had the highest prevalence rates of elevated externalising problem scores (9.0% subclinical and 10.5% clinical), while MP girls had the highest prevalence rates of elevated internalising problem scores (8.4% subclinical and 9.9% clinical).

Finally, ORs of the risk of clinical CBCL problem scores in MP children are given in table 4. Compared with term-born children, MP children were at significantly higher risk for clinical CBCL scores for total problems (OR 1.84, 95% CI 1.12 to 3.00), internalising problems (OR 2.40, 95% CI 1.48 to 3.87), externalising problems (OR 1.69, 95% CI 1.07 to 2.67) and somatic complaints (OR 1.92, 95% CI 1.09 to 3.38).

## DISCUSSION

In this study, we have provided evidence that behavioural and emotional problems occur more frequently in MP than in term-born children at preschool age. The syndrome scales emotionally reactive, anxious/depressed, somatic complaints, withdrawn behaviour, sleep problems, attention problems and aggressive behaviour were all associated with moderate prematurity. Furthermore, we found that MP children were at greater risk for clinical CBCL scores on total problems, internalising and externalising problems, and on somatic complaints.

Our finding that MP children have more behavioural and emotional problems confirms the findings of most previous studies, but in a much larger sample, and at a different age.<sup>12–16</sup>

**Table 4** Risk for clinical problem scores on the Child Behavior Checklist (CBCL) in moderately preterm versus term-born children

CBCL problems scale	Preterm, n (%) (n=916)	Term, n (%) (n=543)	uOR*	aOR (95% CI)†
Total problems	72 (7.9)	25 (4.6)	1.77	1.84 (1.12 to 3.00)‡
Externalising problems	87 (8.5)	28 (5.2)	1.71	1.69 (1.07 to 2.67)‡
Internalising problems	89 (9.7)	25 (4.6)	2.23	2.40 (1.48 to 3.87)‡
Emotionally reactive	34 (3.7)	14 (2.6)	1.46	1.70 (0.86 to 3.34)
Anxious/depressed	11 (1.2)	4 (0.7)	1.64	2.50 (0.68 to 9.19)
Somatic complaints	54 (5.9)	18 (3.3)	1.83	1.92 (1.09 to 3.38)‡
Withdrawn	21 (2.3)	11 (2.0)	1.14	1.38 (0.62 to 3.09)
Sleep problems	22 (2.4)	8 (1.5)	1.65	1.88 (0.79 to 4.49)
Attention problems	38 (4.1)	13 (2.3)	1.76	1.80 (0.90 to 3.59)
Aggressive behaviour	31 (3.4)	10 (1.8)	1.87	2.03 (0.95 to 4.36)

\*Unadjusted OR.

†Adjusted OR with 95% CI; adjustment for gender, family composition, number of siblings, maternal age and maternal educational level.

‡Significant differences ( $p < 0.05$ ).

In this study, MP children had significantly worse scores than term-born children on all subscales, internalising, externalising and total problems. Two previous studies also reported more internalising behaviour problems in MP children,<sup>13 14</sup> and three studies reported more problems in the hyperactivity spectrum such as attention problems.<sup>13 14 16</sup> In addition, we found significantly more externalising behaviour problems in MP children, in contrast to the findings of van Baar *et al* in 7–9-year-old Dutch children, and we also found more withdrawn behaviour problems.<sup>13</sup> These differences may have gone unnoticed in those earlier studies because much smaller samples were investigated. However, the reported differences seem to have clinical relevance, as ORs for MP children compared to term-born children were in a range similar to that previously reported for very preterm and very low birth-weight (VP/VLBW) children.<sup>26</sup> Only one study reported no differences between children born at 34–36 weeks and children born at term for externalising, internalising, aggressive and anxious/depressed problems.<sup>12</sup> This may be because that study was restricted to relatively healthy children from high-income families. The deleterious effects of preterm birth may be stronger among children born to poor families.<sup>25</sup>

Differences in behavioural and emotional problems by gender have previously been reported in studies on VP/VLBW children. Overall, VP/VLBW girls seem to have more internalising problems, such as withdrawn behaviour, while VP/VLBW boys seem to be more susceptible to externalising behaviour problems, especially attention problems.<sup>26–29</sup> We found the same pattern of internalising and externalising problems in MP girls and boys but not in term-born children. Among term-born children, both internalising and externalising problems were more prevalent in boys than in girls. On most syndrome scales, prevalence rates were also higher in term-born boys, except for anxious/depressed and sleep problems. To summarise, moderate preterm birth seems to have a greater effect on behavioural and emotional outcomes in girls than in boys. However, the prevalence rates of total problems among MP girls did not particularly differ compared to rates among term-born boys; additional research is required to investigate why prematurity affects behavioural and emotional outcomes more in girls than in boys. Currently, we have no proper explanation and differences in background characteristics do not explain these findings.

Important strengths of this study were its large community based sample, the same method of data collection among MP

and term-born children, and its high response rate. Moreover, this is the first study investigating the full range of behavioural and emotional problems in MP children just before they enter school. A valid and widely used questionnaire, the CBCL,<sup>21</sup> was used to measure behavioural and emotional problems. A large number of parents returned the CBCL questionnaires.

One potential limitation of this study is the fact that we did not obtain professional assessment of behavioural and emotional problems. If the observations of professionals could have been compared with parents' reports, the results of this study would have provided a more complete picture of the behavioural and emotional problems in MP children. However, parent-reported problems can accurately identify psychosocial problems.<sup>30</sup> Another limitation of this study is the lack of information on some early risk factors for behavioural and emotional problems, such as maternal depression and preschool educational experience. Further research is needed to determine the joint effects of maternal psychological, obstetric and environmental factors on behavioural and emotional problems.

## CONCLUSION

Our results demonstrate that MP children are more likely to already have behavioural and emotional problems before they enter school. Therefore, MP children could be a potential target group for the prevention of mental health problems, as behavioural and emotional problems in early childhood tend to persist in later childhood and adolescence.<sup>31–33</sup> Moreover, mental health problems have a great impact on the developmental and social competencies at school and in the community.<sup>31–33</sup> Interventions at early school age might, for example, include extra support at school or even specialised school services, along with psychological assistance. Our findings need to be confirmed by other studies, as we were the first to assess the full range of behavioural and emotional problems in MP children just before they enter school.

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