Very Preterm Birth is Associated with Disabilities in Multiple Developmental Domains

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Objective Follow-up studies in very preterm children usually present outcome for separate developmental domains. Presence of disabilities in more than one developmental domain will show a more serious outcome picture for extreme preterm infants and may be related to a different degree of perinatal problems. **Methods** At 5.5 years corrected age, outcome in the neurological, motor, cognitive, and behavioral domain was studied in 157 children born <30 weeks gestation. The children were divided into a normal, a single, or a multiple disability group. Group differences in background, clinical characteristics, and neurodevelopmental outcome at 2 years were evaluated. **Results** Thirty-nine percent had a normal developmental outcome, 17% had a single disability, and 44% had multiple disabilities. Multiple disabilities were associated with lower birth weight, BPD, and difficulties according to neurodevelopmental assessments at 2 years. **Conclusion** Assessments of different developmental domains show that most very preterm children had multiple disabilities.

Key words premature; disabilities; school outcome.

From conception to adulthood, human development is characterized by increasing differentiation and integration of physical and behavioral functioning. It is assumed that development results from maturation and learning processes that built upon existing neurobiological and somatic structures, through complex interactive exchanges between genetic, neurobiological, neurophysiological, psychological, and social systems. With increasing age, self-regulative capacities will also shape development from infancy to adulthood.

As a consequence of premature birth, natural developmental processes are disturbed, especially when infants are born so soon that they need intensive care treatment. Many very preterm children born between 25 and 30 weeks gestation nowadays can survive with this treatment (Richardson et al., 1998). Subsequently, they are at risk of developmental problems for several reasons. First, their premature birth could already have resulted from earlier and longer existing difficulties. Second, being born at such an immature gestation could immediately have damaged the main organs (lungs and brain) or, third, such damage could arise in the neonatal period, for instance from the necessary intrusive treatment. Furthermore, exhaustion resulting from adaptation or stress could damage or disturb development. In addition, the highly stimulating hospital environment and the lack of social interactive experiences with the mother or the abundant interaction with others could add to the risk. In short, many reasons are conceivable that by itself or in different combinations could result in developmental problems of very preterm children. Often it is unclear to what extent an individual child has been affected. The brain of infants between 25 and 40 weeks gestation is still immature but develops rapidly (Hüppi et al., 1998). Disturbances in the early developmental stages of the brain could affect some of the basic building

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blocks that are formed during this period of brain growth, but still need further development. All neuromotor, cognitive, and socioemotional capacities need to develop further into more complex functions after hospital discharge of preterm children. As a consequence, a wide variety of problems are to be expected at older ages. Careful follow-up studies are important to learn about the problems that occur, but also to investigate potential compensative mechanisms.

Studies on developmental outcome of preterm infants can roughly be divided into cohort studies and follow-up studies on specific perinatal interventions. Different outcome measures are used, often focusing either on disabilities or on examinations concerning a specific neurodevelopmental domain. Outcome can be classified according to WHO criteria in impairments, disabilities, or handicaps (World Health Organization, 1989). Many studies have focused on severe handicaps defined as cerebral palsy (CP), mental retardation, and blindness or deafness or a combination (Aylward, Pfeiffer, Wright, & Verhulst, 1988; Hoy, Bill, & Sykes, 1988; Escobar, Littenberg, & Petitti, 1991; McCormick, 1997; Vohr & Msall, 1997). Often such follow-up studies report on separate outcomes in one or more neurodevelopmental domains: neurological, motor, cognitive, or behavioral domain.

In addition, school problems are now frequently reported in very preterm born children, and these are associated with neuromotor problems, developmental delay, speech/language delay, or behavioral problems at early school age (Marlow, Roberts, & Cooke, 1989; Hille et al., 1994; Hall, McLeod, Counsell, Thomson, & Mutch, 1995). School problems are also found in preterm born children without severe handicaps and in a higher rate than in full-term or normal birthweight peers (Horwood, Mogridge, & Darlow, 1998; Hansen, Dinesen, Hoff, & Greisen, 2002). A combination of disabilities, less severe than a handicap, but indicating difficulties in different domains, could reflect either a common underlying developmental problem or more frequent experiences during development of stress and frustration or both. Such combinations of disabilities of any kind might explain the high rate of school problems in very preterm children.

To study the extent and the kind of developmental problems of extreme preterm children that gradually appear during infancy and the preschool period, we combined outcome measures from different developmental domains at early school age. The age period at 5.5 years was chosen, as by this time the children must have entered school and need to function fairly independent, to be able to cope with the demands for learning at school in a group with peers. Children experiencing disabilities in any developmental domain by this age may have greater difficulty to cope with such demands. Subsequently, they may experience further school problems, either of a cognitive or of a social nature, which may add to their developmental problems in the long-term.

We studied the proportion with no, a single, or multiple disabilities in a cohort of very preterm born children at 5.5 years of age in relation to their background and perinatal characteristics and their functioning at 2 years of age. Current school performance was also studied in relation to the number of disabilities.

Method

Participants

The original study cohort consisted of 200 very preterm born children (35 children died in the neonatal period, seven children were withdrawn, and the parents of one child moved abroad) (Van Wassenaer et al., 1997). At the corrected age of 5.5 years, developmental outcome was studied in 157 children. All children were born between 25 and 30 weeks gestational age between January 1991 and July 1993. They were enrolled in a randomized, double-blind, placebo-controlled trial of thyroxine supplementation in the neonatal period.

Developmental assessments were done at the corrected age of 6, 12, and 24 months. No effects of thyroxine supplementation were found at 2 and 5 years of age (Van Wassenaer et al., 1997; Briët, Van Wassenaer, van Baar, Dekker, & Kok, 1999; Briët et al., 2001).

This follow-up study was approved by the Committee of Medical Ethics of the Academic Medical Centre of Amsterdam.

Measures

Neurodevelopmental Outcome at the Corrected Age of 5.5 Years Outcome at early school age reflects functioning in different developmental domains. When available, standardized assessments with Dutch norms were preferred.

Neurological development was studied with a qualitative assessment according to Touwen and classified as: normal, minor neurological dysfunction (MND), or CP (Touwen, 1979). MND was diagnosed when one or more abnormalities occurred in posture, muscle tone, muscle power, reflexes, coordination and balance, or in the occurrence of involuntary movements. CP was diagnosed if the complete neurological syndrome with abnormalities in posture, tone, and reflexes was present.

CP was classified according to Hagberg (Hagberg, Hagberg, & Olow, 1975). All children were assessed by the same experienced paediatrician (AvW).

Motor function, competencies of the children in motor performance, was assessed using the Movement Assessment Battery for Children. (Movement ABC) (Henderson & Sugden, 1992). Severity of motor problems can be distinguished by cut-off scores for mild and severe motor problems which are represented by the 15th (≥10.5) and 5th (≥17) percentile, respectively, of the reference population. The scores indicate the extent to which the child falls below the level of his or her peers. Eight tasks have to be completed, which test the level of motor performance of manual dexterity, ball skills, and static and dynamic balance. The total scores can range from 0 to 40, with the 50th percentile of the norm being a score of 3.5. The test–retest reliability coefficient was found to be .64 (Smits-Engelsman, 1998).

Cognitive abilities were assessed with the Revised Amsterdam Children's Intelligence Test (RAKIT, short version) for 4–11 years (Bleichrodt, Drenth, Zaal, & Resing, 1987). The norm score (IQ score) of the test is 100 with an SD of 15. Severity of cognitive problems can be distinguished by cut-off scores representing a mild delay (IQ score ≥70 and <85) and a severe delay (IQ score <70). The test has good psychometric characteristics with an internal consistency coefficient of .92 and a test–retest coefficient of .85. A correlation of .81 was found with a Dutch version of the Wechsler Intelligence Test—revised.

Behavior problems, also reflecting socioemotional functioning, were assessed with the Child Behavior Checklist for ages 4–18 (CBCL 4–18) (Achenbach, 1991a; Verhulst, van der Ende, & Koot, 1996) and the Teacher Report Form (TRF) (Achenbach, 1991b; Verhulst, van der Ende, & Koot, 1997). Severity of behavior problems can be distinguished by the borderline and clinical cut-off point, corresponding with standardized norm scores of 60 and 63, respectively. Reliability coefficients were .91 for the CBCL and .95 for the TRF total problem scores. In a study comparing the Dutch CBCL total score with a psychiatric assessment based on a clinical judgement, a correlation of .63 was found.

Information on early school outcome, i.e., attending a grade appropriate for age, moderate school problems (grade retention and/or the need for special assistance), or attending a school for special education, was obtained from the TRF questionnaire and by interviewing parents.

Classification of the Three Outcome Groups We divided children into three groups based on their functioning in all four developmental domains (cognitive, behavior, motor, and neurological) at early school age. For assessment of a disability in a developmental domain, cut-off scores referring to mild developmental delay were used. Only available data were used to classify whether or not the child had a disability. Missing data were treated as having no disability in that specific domain. The normal group consisted of children with scores in the normal range. The single disability group consisted of children who showed mild or severe delay in one developmental domain. Children diagnosed with MND but with normal scores on all other domains were classified as normal, as reduced neurological quality does not necessarily interfere with a child's functioning. However, MND accompanied by a delay in another domain might add to further problems and was then considered a disability. Children with only high scores on the CBCL or the TRF or both were considered to have a disability in a single domain. The multiple disabilities group consisted of children who received a score reflecting a disability for at least two developmental domains.

Perinatal characteristics, developmental outcome at 2 years, and early school outcome were compared between the three groups.

Neurodevelopmental Outcome Measured at 2 Years of Corrected Age Neurodevelopmental outcome at the age of 2 years included a neurological examination, mental and psychomotor development, and behavioral outcome. A neurological examination was done according to the method of Hempel and classified as normal, mildly abnormal, or abnormal (Hempel, 1993; Van Wassenaer et al., 1997). Outcome on the mental and motor domain was represented by the Bayley Mental (MDI) and Psychomotor (PDI) Developmental Index scores (Van der Meulen & Smrkovsky, 1983). Behavioral outcome was assessed using the CBCL 2/3 questionnaires (Achenbach, Edelbrock, & Howell, 1987; Koot, 1993). Scoring procedure was similar to the CBCL for 4 to 18 years, for details see earlier reports (Briët et al., 1999).

Statistical Analysis

Univariate analyses were carried out to study differences in baseline characteristics, clinical data, and 2 years' neurodevelopmental outcome between the three groups. Categorical data were analyzed with the χ^2 test for 3×2 tables. Continuous data were analyzed using one-way ANOVA. When the overall comparison of the three groups was significant, post-hoc analyses were carried out to study differences between the individual groups.

Results

At the corrected age of 5.5 years, cognitive, motor, and neurological outcome was assessed in 156 children (99%). The parents of one child refused cooperation. Parents' and teachers' behavior questionnaires were completed for 144 (92%) and 147 (94%) children, respectively. Compared with the respondent groups, non-respondents on CBCL and TRF consisted of more children of non-Caucasian background and of more children who had suffered from chronic lung disease or ischemic brain lesions.

Table I shows the proportion of children with disabilities in the different developmental domains and the proportion of children included in each of the three outcome groups. If outcome was examined per domain separately, disabilities were found for approximately 25% of the children in each domain, except for the neurological domain. A relatively greater proportion of children (45%) were diagnosed with MND or cerebral palsy. Six children (4%) needed a wheelchair for continuous or intermittent use, and one child (1%) needed hearing aids.

Table I. Prevalence of Disabilities at the Age of 5.5 Years

Examination	Categories	*n*	*M* ± *SD*	Frequencies	%
IQ		156	95 ± 18		
	≥85			111	71
	≥70 <85			33	21
	<70			12	8
CBCL		144	27 ± 22		
	<60			111	77
	≥60 ≤63			9	6
	>63			24	17
TRF		147	29 ± 25		
	<60			109	74
	≥60 ≤63			11	8
	>63			27	18
Movement ABC		156	8.5 ± 10		
	<10.5			116	74
	≥10.5 <17			16	10
	≥17			24	16
Neurological examination		156			
	Normal			86	55
	MND			54	35
	CP			16	10
Disabilities		156			
	No disabilities			61	39
	In a single domain			27	17
	In multiple domains			68	44

CBCL = child behavior check list; CP = cerebral palsy; IQ = intelligence quotient; MND = minor neurological dysfunction; TRF = teacher report form. Data are presented as *n* (%) or as *M* ± *SD*.

Less than half of the group of children (61/156: 39%) were found to obtain normal scores on all domains combined: the normal group. One child was included in this group, of whom both parents' and teachers' behavior questionnaires were missing. Thirteen children (21%) were diagnosed with only MND.

The single disability group comprised 27 children (27/156: 17%). Information on behavioral outcome was missing for four children (CBCL + TRF, $n = 2$; CBCL, $n = 1$; TRF, $n = 1$). Two children (2/27: 7%) had a disability (CP) in the neurological domain, 12 children (12/27: 44%) a mild disability in the cognitive domain (IQ ≥70 and <85), and 13 children (13/27: 48%) a disability in the behavioral domain [CBCL ($n = 5$), TRF ($n = 5$), both ($n = 3$)]. None of the 156 children studied had a single disability in the motor domain.

Sixty-eight children were included in the multiple disability group (68/156: 44%). Information on behavioral outcome was missing in 10 children (CBCL + TRF, $n = 3$; CBCL, $n = 5$; TRF, $n = 2$). Disabilities in two or three developmental domains were found in most children. Four children (4/68: 6%) showed disabilities in all domains. Twenty-five children (25/68: 37%) had a disability in one developmental domain accompanied by MND. All children with motor disabilities (40/68: 59%) also showed disabilities in at least one other domain of whom 10 showed MND.

Characteristics of the Three Groups

In Table II, it is presented that a few differences between the three groups were found in background factors, birth characteristics, and clinical outcome. Mean birth weight was lower in the multiple disability group than in the normal group. In addition, more cases of BPD were found in the multiple disability group than in the single disability group [$\chi^2(1) = 7.9$, $p < .01$] and in a lesser extent compared with the normal group [$\chi^2(1) = 3.7$, $p = .06$]. Outcome at the age of 2 years differed between the multiple disability group and the two other outcome groups, but not between the single disability group and normal group. More children in the multiple disability group already had a disability in one of the four developmental domains compared with the normal group and (except for the behavioral domain) the single disability group. The occurrence of problems in two or more developmental domains at the age of 2 years was much higher in the multiple disability group than in the two other outcome groups (normal group: 9/61,15%; one disability group: 4/27, 15%; multiple disability group: 38/68, 56%). None of the children in the normal group,

Table II. Characteristics of the Normal Group, the Single Disability Group, and the Multiple Disability Group

	Normal Group		Single Disability Group		Multiple Disability Group		
	n = 61	39%	*n* = 27	17%	*n* = 68	44%	$\chi^2(df)$ or F(*df*)
At birth							
Sex: male	26	43%	14	52%	33	49%	$\chi^2(2) = .78$
Ethnic background non-Caucasian	7	11%	7	26%	10	15%	$\chi^2(2) = 3.04$
Educational level of mother:							
Low	19	31%	10	37%	25	37%	$\chi^2(6) = 10.80$
Middle	30	49%	12	44%	31	46%	
High	12	20%	3	11%	12	17%	
Missing			2	8%			
Gestational age (weeks ± days)	28 2/7	±8	28 4/7	±7	28 0/7	±7	$F(2,153) = 4.63$*
Weeks of gestation							
25/26	12	20%	1	4%	18	26%	$\chi^2(6) = 9.79$
27	8	13%	8	30%	13	19%	
28	21	34%	7	26%	16	24%	
29	20	33%	11	40%	21	31%	
Birth weight (g)	1151	±238	1081	±241	1048	±210	$F(2,153) = 3.37$*
Antenatal steroids	33	54%	15	56%	37	54%	$\chi^2(2) = .02$
Intra-uterine infection	30	49%	9	33%	23	34%	$\chi^2(2) = 3.73$
Prom[a]	20	33%	12	44%	24	35%	$\chi^2(2) = 1.12$
Apgar score 5 min	8.4	±1.6	8.7	±1.3	8.5	±1.6	$F(2,153) = .40$
The neonatal period							
T4 supplementation	29	48%	15	56%	37	54%	$\chi^2(2) = .78$
RDS grade 3 + 4[b]	18	30%	5	19%	18	26%	$\chi^2(2) = 1.17$
Bronchopulmonary dysplasia	24	39%	5	19%	34	50%	$\chi^2(2) = 8.00$*
O_2 at 36 weeks pma[c]	8	13%	3	11%	18	26%	$\chi^2(2) = 4.99$
Ultrasound findings[d]:							
Normal	32	52%	16	59%	31	45%	$\chi^2(4) = 4.26$
Mildly abnormal	25	41%	10	37%	27	40%	
Abnormal	4	7%	1	4%	10	15%	
At 2 years of age							
MDI[e] < 84	7	11%	5	19%	33	49%	$\chi^2(2) = 23.20$***
PDI[f] < 84	15	25%	6	22%	39	57%	$\chi^2(2) = 18.22$***
Neurological outcome:							
Mildly abnormal	7	11%	0	0%	18	26%	$\chi^2(4) = 30.81$***
Abnormal	0	0%	1	4%	13	19%	
Behavior problems above borderline range	7	11%	6	22%	18	26%	$\chi^2(2) = 4.65$
Developmental problems on ≥2 domains at 2 years[g]	9	15%	4	15%	38	56%	$\chi^2(2) = 24.46$***
At 5 years of age							
School performance							
At age level, no assistance	39	64%	15	56%	15	22%	$\chi^2(4) = 31.44$***
Moderate school problems[h]	21	34%	9	33%	34	50%	
In special education	1	2%	3	11%	19	28%	

Data are presented as *n* (%) or as *M* ± *SD*. Differences in mean scores and proportions between the three groups are analyzed using ANOVA or χ^2 test.

[a]Premature rupture of membranes.

[b]Respiratory distress syndrome.

[c]Oxygen requirement at 36 weeks postmenstrual age.

[d]Ultrasound findings were classified according to severity of brain damage [for details see earlier reports (Briët et al., 2001)].

[e]Mental Developmental Index.

[f]Psychomotor Developmental Index.

[g]Developmental problems at 2 years were identified as neurological problems such as moderate or severe abnormality of tone or posture and movement leading to (minor) functional impairment and/or to a minor delay in motor development and/or a MDI Score <84 and/or a PDI Score <84 and/or a total behavior problem score ≥60.

[h]Moderate school problems: in a grade at appropriate age level with special assistance or in a grade below age level.

*$p < .05$.

**$p < .01$.

***$p < .001$.

and only one in the single disability group, was diagnosed as neurologically abnormal at the age of 2 years.

School Outcome

In the total group, 87 children (56%) were not in a grade appropriate for their age or they needed some form of educational assistance. Twenty-three children (15%) attended a school for special education.

Within the normal group, about one-third of the children had moderate school problems (grade retention and/or need for special assistance). One child was in a special education program for speech and language problems. A comparable proportion of children in the single disability group had moderate school problems, whereas the percentage of children in special education was somewhat higher in this group (one child for speech and language problems and two children for behavior problems). Within the multiple disability group, half the group had moderate school problems, whereas the proportion of children in special education was much higher.

Discussion

Our study shows a clear association between very preterm birth and multiple disabilities in different developmental domains in children born at <30 weeks gestational age at 5.5 years of age. At this age, 61% showed one or more different disabilities. Already 56% of the children were in special education, repeated a grade or needed special assistance at school. Only 39 children, 25%, showed no disabilities and no school problems.

Our follow-up percentage was very high (99%). All children were divided in one of the three groups based on the available outcome measurements. Three outcome measures (intelligence test, motor performance test, and neurological assessment) were obtained for all 156 children (100%). Behavior questionnaires by parents or teachers were completed for at least 90% of the children. The missing data were treated as no disability in the behavioral domain to prevent overestimation. This influenced the classification of the children only slightly because behavior questionnaires were more often not completed for children who were included in the multiple disability group (10/15: 67%). In the normal group, only one child (1/15: 7%) was included, of whom information on behavioral outcome was missing.

Looking at different developmental problems separately, it is found that the proportion of premature born children in this study diagnosed with cerebral palsy (10%), performing poorly on cognitive (8%) or motor tests (16%), or showing a serious amount of problem behaviors according to their parents (17%) and teachers (18%) is similar to the proportions found in other outcome studies (Aylward et al., 1988; Hoy et al., 1988; Escobar et al., 1991; McCormick, 1997). The fact that 80–90% of the children received scores in the normal range for each domain separately could easily lead to the conclusion that the majority of these high-risk children are functioning at the same level as their full-term born peers.

However, our results show that only 39% of the children obtained scores in the normal range on all four developmental domains. Moreover, almost half of the group (44%) obtained scores below the age norm in two or more developmental domains.

Multiple disabilities might indeed reflect a more general underlying developmental problem, either a common cause or as sequelae of earlier, perinatal, difficulties. Lower birth weight, even within this preterm group, and BPD were the perinatal characteristics found to be associated with disabilities in multiple domains. Major brain damage (like periventricular leukomalacia, subcortical leukomalacia, and grade III hemorrhage) is predictive in preterm children for later outcome, whereas minor neurological signs have been found in many children with normal ultrasound scans (Jongmans, Mercuri, de Vries, Dubowitz, & Henderson, 1997). A high proportion (45%) of the children in our multiple disability group, however, had normal cerebral ultrasound findings, whereas 48% of the children in the normal group had mildly abnormal or abnormal ultrasound findings. This finding demonstrates that there is no simple relation between early visualized brain damage and later outcome. Further development, including recovery or plasticity concerning brain development, is also important. The neurodevelopmental outcome scores at 2 years were found to be clearly related to later disabilities in multiple domains. This finding shows that developmental difficulties found at a young age in a group with serious perinatal risk factors increase the risk of problems at an older age. A repeated finding of developmental delay, possibly reflecting insufficient recovery from perinatal difficulties, seems an important predictor of serious difficulties in daily functioning.

In our study group, disabilities were found more often in the neurological domain (45%) than in the other three domains (23–29%). Disabilities in the neurological domain were not accompanied by motor problems in all cases and vice versa. This indicates that both methods measure different aspects of functioning and both examinations are needed to obtain a full picture of a child's neuromotor (dis)abilities (Jongmans et al.,

1997). The finding that motor disabilities always occurred together with disabilities in other domains illustrates the presence of comorbidity most clearly and emphasizes the need for multidisciplinary assessments (Polatajko, 1999). Twenty-five percent of our study group showed motor disabilities, and for this group, evaluation of other domains seems to be obligatory.

We have studied outcome in four developmental domains, which included most aspects of functioning of children. However, the fact that 34% of the children in the normal group had moderate school problems (special assistance or in a grade below age level) might indicate that our instruments were not comprehensive or sensitive enough. Language development, for example, was probably not measured sufficiently as is demonstrated by the child included in the normal group that still needed special education for speech and language problems. In addition, no assessments were made of social emotional functioning of the children among a group of peers, which could affect judgment of teachers about school functioning. Another explanation for this finding might be the use of corrected scores for prematurity, which influenced the IQ scores especially. Children were also included in the normal group when their IQ scores were just above the lower limit of the normal range.

Age correction in the Netherlands is usually not applied when school starts at 4 years of age since birth. Grade retention should therefore not always be considered a sign of school failure in all children, as it is often recommended in children who are considered too playful and not yet ready for learning (pre-) academic skills. It is also possible that parents and teachers of preterm born children recommend grade retention easier than parents and teachers of full-term born children. Very preterm children are often *a priori* seen as vulnerable children and overprotectiveness of parents and teachers may play a role in their expectancies regarding age appropriate functioning or their decisions concerning extra educational attention.

However, our finding that already 15% of the children were in special education at 5.5 years of age, which is much higher than the 1.3% of the 5-year olds in the normal population (Central Bureau of Statistics [CBS], 1990), indicates that school problems are indeed often present. Most of these children were referred to schools for moderate learning disabilities such as mild mental retardation or behavioral problems. The finding that many children experienced disabilities in multiple domains suggests that referral to special education will further increase when basic education is continued and children learn academic skills, such as writing, reading, and arithmetic. We intend to evaluate school outcome in our study group at older ages too. For preterm children at 7–8 years, it was reported that 24% of children with birth weight <1,500 g needed special education assistance (Horwood et al., 1998). In a nation-wide cohort of very premature and very low birth weight children born in 1983 in the Netherlands, the proportion of children in special education increased from 12% at the age of 5 years to 19% at the age of 9 years (vs. 7% of 9-year olds in the normal population) and up to 27% at the age of 14 years (vs. 5% 14-year olds in the normal population) (CBS, 1990; Walther, den Ouden, & Verloove-Vanhorick, 2000). In this cohort, children were included with older gestational ages (<32 weeks and/or <1,500 g birthweight) than in our cohort (gestational age between 25 and 30 weeks). In a study on 18–20-year olds, 42% of children with birth weight <1,500 g was found to have experienced school difficulties (Hansen et al., 2002).

Our findings indicate that follow-up studies aiming to evaluate outcome should examine children's performances in multiple developmental domains and present an overall outcome picture. Outcome results based on separate developmental domains are an underestimation of the children's problems. Disabilities in two or more domains are associated with early school problems. These findings also emphasize the need for a longitudinal multidisciplinary follow-up program for very preterm born children to identify children with disabilities in several developmental domains. Signs that might reflect recovery potential after serious perinatal injuries or risk factors should be studied in greater detail. In addition, more specific design and evaluation of intervention programs directed at alleviation of the developmental problems of very preterm children is necessary.

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