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Developmental outcomes of very preterm children with high parental education level

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ABSTRACT

Background: Compared to their term-born peers, children born very preterm are at risk for poorer cognitive, academic and behavioral outcomes, however this finding may have been confounded by lower parental education level in the very preterm children. Studies that compare very preterm and term-born children with comparable (high) parental education level are needed to assess the true effect of very preterm birth on outcomes.

Aims: To compare cognitive, academic and behavioral functioning in very preterm and term-born children of highly educated parents. To examine whether outcomes differ for children of whom one or both parents are highly educated.

Study design: Cross-sectional study with a term-born comparison group.

Subjects: 113 very preterm children and 38 term-born children aged 8–12 years old, with highly educated parents.

Measures: Cognitive functioning (Intelligence Quotient), academic functioning (arithmetic facts and reading) and parent and teacher rated behavioral functioning (attention, executive function, hyperactivity, and emotional, conduct and peer problems). Parental education was considered high when children had two highly educated parents or one highly- and one middle educated parent.

Results: Very preterm children had significantly poorer cognitive (difference of 10 IQ points) and behavioral functioning than their term-born peers, but did not differ on academic functioning. Children with one highly educated parent performed poorer than children with two highly educated parents on most outcome measures.

Conclusions: Performance of very preterm children should be compared to term-born peers with parents having comparable educational levels for accurate assessment of outcomes. The number of highly educated parents also impacts outcomes.

1. Introduction

Children born preterm (< 37 weeks gestational age, GA) and/or with low birthweight (< 2500 g, BW) are at risk for adverse outcomes such as cognitive delay, poor academic achievement and behavioral problems [1–3]. Preterm children perform below term-born peers on cognition, arithmetic, reading and spelling tests and have a two to four times higher risk of being diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD) [1–4]. However, Socio-Economic Status (SES) possibly may act as a moderating or mediating factor.

Preterm children are often born in low SES environments. A systematic review including 109 studies on the subject and carried out between 1999 and 2007, showed that in 17 out of 32 studies conducted in Europe, lower maternal SES is associated with spontaneous preterm birth [5]. As a result, globally, most studies investigating cognitive, academic and behavioral outcomes of preterm birth do so in a group of

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children that have lower parental SES than the general population. Furthermore, cognitive, academic and behavioral outcomes are associated with low SES in the general population [6,7]. Studies reporting on the effects of SES on cognitive development, academic achievement and behavioral problems after preterm birth have yielded inconsistent findings with some studies reporting strong effects of SES on those outcomes and other reporting no effects of SES [8]. A number of studies compared outcomes between preterm and term-born control children whose parental education level was not statistically different. Despite comparable parental education level, preterm children had poorer cognitive and language outcomes than term-born peers [9–11]. Thus far, no studies have directly compared preterm and term children with equal levels of parental education. Research has shown that besides genetic factors, SES can impact developmental outcomes through different mechanisms, including access to resources, the availability of stimulating materials and experiences, parent expectations, parenting styles and teacher attitudes and expectations [7].

SES can be measured in several ways, including index measurements such as the Hollingshead Four Factor Index of Socioeconomic Status [12]. However, studies on developmental outcomes after preterm birth often use parental educational level as an indicator of SES [8]. More importantly, most of these studies only accounted for education level of one of both parents [8], while it is unclear whether maternal and paternal education level impact child outcomes to the same extent [13,14]. Those studies that did take both maternal and paternal education into account, often entered both levels as a separate predictor in a regression model. Therefore it remains unclear whether the combination of parents' education levels matter.

The present study examines cognitive, behavioral, and academic outcomes in a sample of very preterm and/or extremely low birthweight (in short: very preterm) children with highly educated parents and compares results to that of term-born, normal birthweight comparison children with highly educated parents. We also examined whether outcomes differ for children with one or both of their parents having a high education level and whether outcomes differ for children with the mother or the father having a high education level.

2. Methods

2.1. Study design

A multi-center cross-sectional study was conducted in two academic hospitals in the Netherlands (Amsterdam University Medical Centers and University Medical Center Utrecht). The Medical Ethical Committee of Amsterdam UMC (location AMC) approved the study protocol and the execution of the study procedures was according to the Declaration of Helsinki.

2.2. Participants

Parents of surviving 7 to 12 year old (chronological age) very preterm (GA < 30 weeks and/or birthweight < 1000 g) children, born in one of the two academic hospitals and joining the follow-up program, were asked to fill out a questionnaire about their child's behavior. Children of parents who completed this questionnaire were eligible for the study as soon as they reached the chronological age of at least 8 years. For this study, children of whom educational level of both parents was known and who had a high combined parental education level were selected. Exclusion criterion was an estimated intelligence quotient (IQ) < 80. In total, 113 very preterm children with highly educated parents were included. A control group consisting of term-born, normal birthweight (GA > 37 weeks and BW > 2500 g) children was recruited by asking preterm participants to bring a friend or family member, or through schools and through recruitment posters at sports clubs. For term-born controls, children of whom educational level of both parents was known and who had a high combined parental education level were selected and exclusion criteria were an estimated IQ < 80 and no medical complications during delivery or in the neonatal period (such as asphyxia). In total, 38 term-born children with highly educated parents were included. Written informed consent for all participating children was obtained from both parents and, if applicable, from all children aged 12.

2.3. Measures

2.3.1. Parental education

Maternal and paternal education levels were categorized according to the Dutch Central Office of Statistics (CBS) definition and were grouped into low, middle and high. Low was defined as parents who had less than or equal to the lowest type of college (< 6 years post-elementary schooling). Middle was defined as parents who graduated from middle level college (6–8 years post-elementary schooling). High was defined as parents who graduated highest level college or university (> 8 years post-elementary schooling) [15]. The combined measure of parental education was categorized as follows: low if both parents had low education or one parent low and the other middle; middle if both parents had middle level education or one low and the other high; high if both parents had high level education or one high and the other middle [15].

2.3.2. Cognitive development

IQ was estimated using a short version of the Dutch version of the third edition of the Wechsler Intelligence Scale for Children (WISC-III-NL) [16], including the subtests Vocabulary and Block Design. Estimated IQ based on this two-subtest form correlated highly with full scale IQ ($r = 0.90$) [17].

2.3.3. Academic functioning

Arithmetic and technical reading were assessed using the TempoTest Automatiseren (TTA) [18] and the Brus Een Minuut Test (B-EMT) [19]. The TTA measures the degree of memorization of mathematical facts and consists of four pages of 50 arithmetic problems including one page of addition problems, subtraction problems, multiplication problems and one page of division problems. Children get two minutes per page to complete as many arithmetic problems as possible. The outcome measure is the total number of arithmetic problems performed correctly. Reliability for this task is high (0.92) [20]. The B-EMT measures technical reading skills and consists of one page with 116 words divided in four columns. Words are not coherent and differ in length and complexity. Children get one minute to read as many words out loud as possible. The outcome measure is the total number of words read correctly.

2.3.4. Behavior

Behavior was measured with three questionnaires, each filled out by both parents and teachers. Attention was measured with the Strengths and Weaknesses of ADHD-symptoms and Normal Behavior (SWAN) questionnaire [21]. This questionnaire consists of 18 questions on how well a child performs several behaviors compared to peers on a seven-point Likert scale ranging from ‘far below average’ (7 points) to ‘far above average’ (1 point). ‘Average’ corresponds to four points. Scores on all questions were added and the total score was the outcome measure in this study. The higher the score, the more attention problems children experience. The psychometric characteristics of the SWAN are considered appropriate, with high internal consistency (Cronbach's $\alpha = 0.88$) and acceptable test-retest reliability ($r = 0.72$–0.90) [22].

Daily-life behavioral executive functions were measured with the Behavior Rating Inventory of Executive Function (BRIEF) [23]. This questionnaire consists of 75 questions that are divided into eight subscales (Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan and Organize, Organization of Materials and Monitor). Scores of

all subscales were added to compute a Total Score and were subsequently age- and sex-normed to a T-distribution with a mean of 50 and SD of 10 as the outcome measure. The higher the score, the more problems in daily-life EFs children experience. The total score of the Dutch translation of the BRIEF has high internal consistency (Cronbach's $\alpha = 0.96$) and test-retest reliability (intraclass coefficient, ICC, = 0.86) [24].

Behavioral difficulties in the domains of hyperactivity, emotional problems, conduct problems and peer problems were measured with the Strengths and Difficulties Questionnaire (SDQ) [25]. This questionnaire consists of 25 questions scored on a three-point scale ranging from 'never' (0 points) to 'often' (2 points). A Total Problem Score was computed as the outcome measure by adding scores of all questions. The higher the score, the more behavioral difficulties children experience. The total difficulties score of the English version of the SDQ has high internal consistency (Cronbach's $\alpha = 0.82–0.87$) and test-retest reliability ($r = 0.72–0.80$) for both the parent and teacher versions [26].

2.3.5. Procedure

Very preterm children and term-born controls included in the study were invited to either the Amsterdam UMC location AMC or UMC Utrecht for the assessment. Term-born controls could also be assessed at their home in a separate quiet room. IQ was always assessed first, administration order of the TTA and B-EMT was randomized. The assessment took approximately 45 min. Parents and teachers were asked to fill out behavioral questionnaires. Parents filled out questionnaires while children performed the assessment. Questionnaires for teachers were sent to the parents by mail before the assessment. Teachers could return the questionnaires either via the parents who handed them in at the assessment, or by sending them directly to the investigators by mail.

2.3.6. Statistical analyses

IBM SPSS Statistics version 24 was used for the statistical analyses [27]. Outliers were winsorized at 3 SDs [28]. Three outliers were winsorized: one score on the SDQ teacher (+3.9 SDs above the group mean) and two scores on the BRIEF teacher questionnaire (+4.3 and + 3.4 SDs above the group mean). IQ, TTA and SWAN parent questionnaire were each missing for 2 of 113 (1.8%) very preterm children and for 1 of 38 (2.6%) term-born controls. SDQ parent questionnaires were missing for 2 of 113 (1.8%) very preterm children. IQ and TTA scores were missing due to unavailability test materials. For IQ, vocabulary subtest scores of these children were already sufficiently high to obtain an estimated IQ ≥ 80. SWAN and SDQ parent ratings were missing due to parents not completing the questionnaire. SWAN, BRIEF and SDQ teacher questionnaires were missing for 19 of 113 (16.8%) very preterm children and for 10 of 38 (26.3%) term-born controls due to unavailability of the teacher to complete the questionnaires. Missing values were not imputed.

Independent *t*-tests and chi-square tests were used to compare very preterm and term-born comparison children in terms of GA, BW, age at assessment, age distribution, sex and the number of parents with high educational level.

Mixed model analyses were used for all outcome measures (IQ, TTA, BRUS, SWAN parent, SWAN teacher, SDQ parent, SDQ teacher, BRIEF parent and BRIEF teacher). The model included a random intercept to account for dependency in the data due to family bonds between children within the very preterm group, within the term-born group and between the very preterm and term group. Furthermore, age at assessment was entered as a covariate and sex was entered as a fixed factor to control for differences in age and sex between very preterm and term-born controls. Furthermore, group (very preterm or term control), number of parents in a family attaining a high educational level and the interaction between the two were added as fixed effects. Next, the model was run again twice, once with the interaction between group and age at assessment added as a fixed effect and once with the interaction between group and sex added as a fixed effect. If significant, the model including the significant interaction(s) was used, if not, the model without the interaction terms (group by age at assessment and group and sex) was used. For IQ, age at assessment was not entered as a covariate because IQ-scores were standardized for age. For the BRIEF parent and teacher scores, age at assessment and sex were not entered in the model because scores were standardized for age and sex.

Sensitivity analyses were run on a sample of very preterm children that was matched on age, sex and number of parents with high educational level to the term-born comparison children. These analyses used mixed models as described above, with the exception that sex and age were not entered into the models.

Exploratory mixed model analyses were run on all outcome measures for the children with one parent with high education level, with a random intercept to account for dependency in data due to family bonds, fixed effects of group (very preterm or term-born control) and which parent had high education level (father or mother) and the interaction between the two. For all mixed model analyses, Cohen's *d* values were computed. A Cohen's *d* of 0.20 is considered as a small effect, a Cohen's *d* of 0.50 is considered as a medium effect and a Cohen's *d* of 0.80 is considered as a large effect [29].

3. Results

3.1. Participants

Flowcharts of the inclusion of very preterm children and term-born controls are shown in Fig. 1 and Fig. 2, respectively. Reasons to refuse participation for very preterm children were that parents found that incorporation of the training sessions into already busy schedules was too burdensome for the child and/or family, or parents or children had no interest in participating. Demographic characteristics are presented in Table 1. Very preterm children were older than term-born controls at the time of assessment and there was a trend towards less boys in the very preterm group than in the term-born group. The number of children with one or two parents with high education level did not differ between very preterm children and term controls, nor did the number of children with mother high or father high within the 'one parent high' group. There were 16 twin or sibling pairs and one triplet in the very preterm group, 5 sibling pairs in the term-born control group and 3 sibling pairs of which one sibling was in the very preterm group and one was in the term-born control group.

3.2. Cognitive, academic and behavioral outcomes

Results for cognitive, academic and behavioral outcomes for very preterm children and term-born controls are shown in Table 2. IQ was significantly lower for very preterm children than for term-born controls. Groups did not differ for TTA scores. No significant difference on the B-EMT was found between very preterm children and term-born controls. Very preterm children obtained significantly higher scores on both the SWAN parent and teacher questionnaire, indicating more attention problems, than term-born controls. Furthermore, very preterm children obtained significantly higher total scores on both the BRIEF parent and teacher questionnaires, indicating more daily-life EF problems, than term-born controls and had a significantly higher total problem score on the parent and teacher SDQ, indicating more behavioral difficulties, than term-born controls. In sensitivity analyses with a sample of very preterm children matched to term children on age, sex and number of parents with high educational level, effect sizes remained similar. Some *p*-values dropped to non-significant due to loss of power (SWAN teacher, $p = .11$; BRIEF parent, $p = .10$).

3.3. Effect of number of parents with high education level

Results for cognitive, academic and behavioral outcomes for

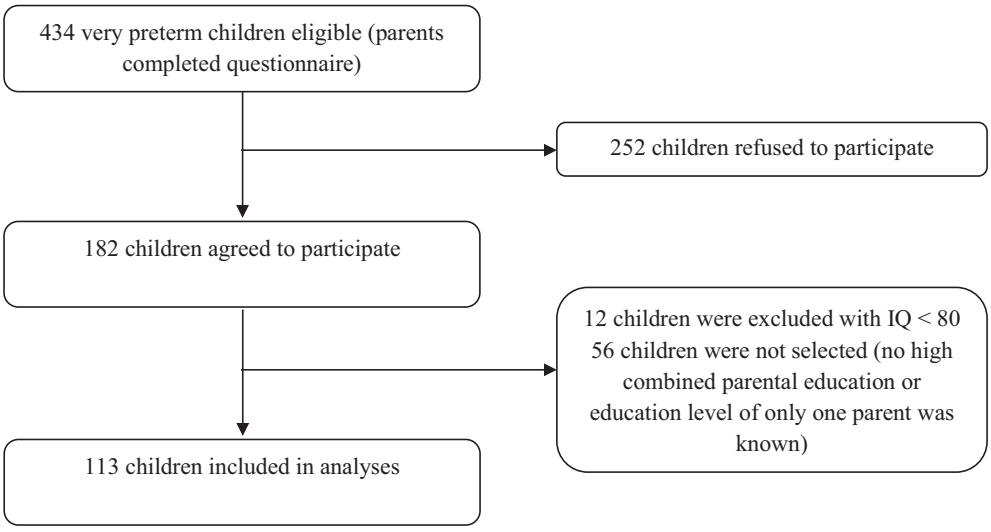

Fig. 1. Flowchart of inclusion of very preterm children.

children with one and two parents with high educational level are shown in Table 3. IQ was significantly lower for children with one highly educated parent than for children with two highly educated parents. Scores on the TTA were significantly lower for children with one highly educated parent, indicating poorer arithmetic skills, than for children with two highly educated parents. There was a trend towards lower B-EMT scores for children with one highly educated parent, indicating poorer reading skills, than for children with two highly educated parents. Children with one highly educated parent had significantly higher SWAN scores, higher total scores on the BRIEF and a higher total problem score on the SDQ according to parents, all indicating more problems, as compared to children with two highly educated parents. According to teachers, children with one highly educated parent had higher SWAN scores and there was a trend for children with one highly educated parent to have higher BRIEF scores and higher SDQ total problem scores, all indicating more problems, as compared to children with two highly educated parents. The interaction between group and number of highly educated parents was significant for the TTA (p = .011), indicating that the difference between having one or two highly educated parents is more profound in term-born controls than in very preterm children (very preterm children, 1 parent high: M = 107.4, SE = 5.7; very preterm children, 2 parents high: M = 114.7, SE = 5.1; term-born controls, 1 parent high: M = 100.6, SE = 10.8; term-born controls, 2 parents high: M = 147.3, SE = 8.4). All other interactions between group and number of highly educated parents were not significant (all p's > 0.149). In sensitivity analyses, effect sizes remained similar, except for SWAN and SDQ teacher scores (from Cohen's d = 0.40 to Cohen's d = 0.03 and from Cohen's d = 0.70 to Cohen's d = 0.09, respectively). Some p-values dropped to non-significant due to loss of power (IQ, p = .11; TTA, p = .19; SWAN parent, p = .11; SDQ parent, p = .06).

3.4. Effect of mother high education or father high education

Exploratory analyses indicated that outcomes in children with one highly educated parent did not differ for those children with a highly educated father and those children with a highly educated mother (see Table 4). Furthermore, there were no significant interactions between group (very preterm or term-born comparison children) and which parent was highly educated (all p's > 0.21).

4. Discussion

The current study examined whether cognitive, academic and behavioral functioning of very preterm children with highly educated parents differs from term-born, normal birthweight children with highly educated parents. Results show that both IQ and behavioral functioning were significantly poorer in very preterm children than in

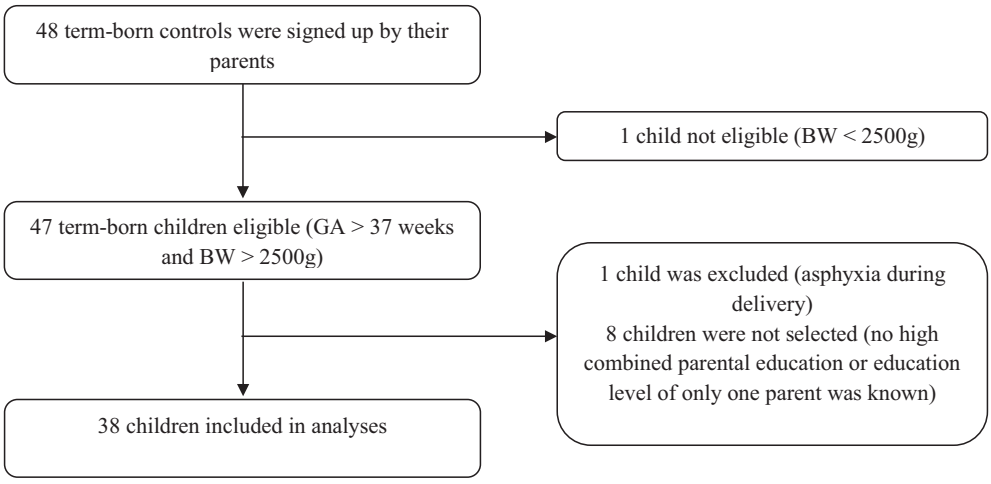

Fig. 2. Flowchart of inclusion of term-born controls.

Table 1
Demographic characteristics.

	Very preterm (n = 113)	Term (n = 38)	p-value
GA (M, SD)	28.13 (1.4)	40.11 (1.4)	< .001[a]
BW (M, SD)	1080.05 (259.5)	3640.69 (512.0)	.000[a]*
Age (M, SD)	10.72 (1.2)	10.20 (1.3)	.022[a]*
Age distribution			.260[b]
8 years	11 (9.7%)	7 (18.4%)	
9 years	22 (19.5%)	10 (26.3%)	
10 years	29 (25.7%)	9 (23.7%)	
11 years	32 (28.3%)	10 (26.3%)	
12 years	19 (16.8%)	2 (5.3%)	
Sex (n boys, %)	56 (49.6%)	26 (68.4%)	.059[b]
One parent high (n, %)	48 (42.5%)	12 (31.6%)	.256[b]
Of one parent high, that parent being mother (n, %)	21 (43.8%)	6 (50.0%)	.754[b]
SGA (n, %)	17 (15.0%)		
Ventilator support (n, %)	76 (67.3%)		
BPD at 36wks PMA (n, %)	15 (13.3%)		
IVH I or II	17 (15.0%)		
IVH III or IV	3 (2.7%)		
PVL I	8 (7.1%)		
PVL II, III or IV	0 (0.0%)		
Open Ductus Botalli treated	40 (35.4%)		
Sepsis[a]	73 (64.6%)		

[a]Defined as either ≥5 days treated with antibiotics or bacteriologically proven. * = significant at $p < .05$ level. [a] t-test, [b] Chi-square test. GA = Gestational Age; BW = Birthweight; SGA = Small for Gestational Age (< p10); wks = weeks; PMA = Post Menstrual Age; IVH = Intraventricular Hemorrhage; PVL = Periventricular Hemmorhage.

Table 2
Performance of very preterm and term-born comparison children on all cognitive, academic and behavioral measures.

	Very preterm (n = 113)	Term (n = 38)	p-value	Cohen's d
IQ	104.14 (1.30)	114.81 (2.28)	< .001*	.77
TTA	111.08 (3.80)	123.94 (6.78)	.097	.32
B-EMT	68.39 (1.62)	71.77 (2.85)	.299	.19
SWAN parent	68.06 (1.58)	58.12 (2.91)	.003*	.58
SWAN teacher	62.05 (2.02)	52.12 (3.76)	.021*	.50
BRIEF parent	45.41 (0.89)	40.12 (1.57)	.004*	.55
BRIEF teacher	49.22 (1.01)	42.88 (1.80)	.002*	.66
SDQ parent	8.13 (0.53)	3.76 (0.92)	< .001*	.79
SDQ teacher	6.18 (0.48)	2.96 (0.83)	.001*	.70

* = significant at $p < .05$ level. Depicted are Means (Standard Errors). IQ = Intelligence Quotient; TTA = TempoTest Automatiseren; B-EMT = Brus Een Minuut Test; SWAN = Strengths and Weaknessess of ADHD-symptoms and Normal Behavior; BRIEF = Behavior Rating Inventory of Executive Functions; SDQ = Strengths and Difficulty Questionnaire.

term-born children, but academic functioning was not. In addition, for most measures, both very preterm and term-born children with only one highly educated parent performed poorer than children with two highly educated parents.

Our findings are in line with previous literature showing that cognitive and behavioral functioning is generally poorer in very preterm children than in term-born peers [1,4] and that cognitive functioning is poorer in very preterm children than in term-born peers with parents with comparable education level [9,10]. Our findings indicate that very preterm children with highly educated parents do not reach the same performance level as term-born children with highly educated parents, most likely due to the sequelae resulting from very preterm birth and fetal growth restriction, such as compromised brain white matter [30–33]. However, in our sample, academic functioning was not impaired, which contrasts with what is generally found [1,2]. It has been shown that parental education level influences the access to resources, such as access to healthcare and cognitively stimulating materials and experiences [7]. Thus the absence of differences between very preterm children with highly educated parents and term-born children with highly educated parents on our academic outcomes, might be explained by the access that children had to educational services including schools with high yields and educational support services. Arithmetic, especially memorization of arithmetic facts as assessed in the present study, can be practiced, while IQ or behavior cannot. Better access to resources may thus have helped to organize additional extra practice which facilitated mastery of arithmetic skills, but not higher IQ or better behavior.

Although very preterm children with highly educated parents perform below their term-born peers on IQ and measures behavioral functioning, they did not perform below normative means or average scores usually described for typically developing children [34–38]. This phenomenon implies that if not compared to term-born children with highly educated parents but with the general population, the problems that these very preterm children may encounter in their highly educated families may be overlooked or underestimated, since these problems do not reach levels of significance according to normative reference values.

Most studies that compared developmental outcomes in very preterm children to term-born children, did so in a sample in which lower SES was relatively overrepresented in very preterm children whereas higher SES was relatively overrepresented in term-born children. Studies solve this problem by either accounting for educational level of one parent or investigating the influence of each parents' education level [8]. Some studies did compare developmental outcomes in very preterm children to term-born children whose maternal education level was not statistically different [9–11], but they did not directly compare children of the exact same parental education level or incorporate a combined measure of parental education level. Some studies do take into account a combined parental education level in the analyses [15], but that seems insufficient, given our results. We here demonstrate that parental education is best taken into account in a dimensional way ranging from both parents with low to both parents with high education. Our findings indicate that children with two highly educated parents perform better than children with one highly educated parent. Earlier differences found in cognitive, academic and behavioral functioning between very preterm and term-born children may have been biased by an unequal distribution of parental educational backgrounds between the compared groups. Future research should investigate cognitive, academic and behavioral outcomes after very preterm birth stratified according to low, middle and high educational level.

The result that having two highly educated parents as compared to one highly educated parent and one middle educated parent matters for IQ, arithmetic performance, parent- and teacher rated attention and parent rated daily-life EF and behavioral difficulties, might be due to both parents' education level influencing child outcomes through different pathways. For example, education level of fathers may impact child outcomes mostly through access to resources, while education level of mothers may impact child outcomes mostly through parenting skills [13,14]. In this way, there is an additive effect of each parents' education level on the child's outcomes. However, there is much debate on whether maternal and paternal education levels differ in the mechanisms through which they impact child outcomes [13,14], so more in-depth research is necessary to draw robust conclusions on why it matters if one or both parents are highly educated.

4.1. Strengths & limitations

Strengths of the study are the assessment of a comprehensive range of outcome measures on cognitive, academic and behavioral functioning and inclusion of a large sample of very preterm children with highly educated parents. Limitations are (1) the relatively small number of term-born controls included in the study, although, for most analyses we do not expect that different results would have been obtained with a

Table 3
Performance for children with one and two parents with high education level on all cognitive, academic and behavioral measures.

	One parent high (n = 60)	Two parents high (n = 91)	p-value	Cohen's d
IQ	106.20 (2.12)	112.75 (1.70)	.020*	.40
TTA	104.02 (6.24)	130.99 (4.99)	.001*	.57
B-EMT	67.07 (2.65)	73.10 (2.07)	.080	.30
SWAN parent	69.29 (2.68)	56.89 (2.01)	< .001*	.63
SWAN teacher	61.91 (3.30)	52.26 (2.86)	.033*	.40
BRIEF parent	45.79 (1.46)	39.74 (1.08)	.001*	.56
BRIEF teacher	47.96 (1.58)	44.15 (1.39)	.072	.33
SDQ parent	7.67 (0.86)	4.22 (0.67)	.002*	.55
SDQ teacher	5.45 (0.76)	3.69 (0.65)	.087	.32

* = significant at $p < .05$ level. Depicted are Means (Standard Errors). IQ = Intelligence Quotient; TTA = TempoTest Automatiseren; B-EMT = Brus Een Minuut Test; SWAN = Strengths and Weaknessess of ADHD-symptoms and Normal Behavior; BRIEF = Behavior Rating Inventory of Executive Functions; SDQ = Strengths and Difficulty Questionnaire.

Table 4
Performancefor children with highly educated father and children with highly educated mother on all cognitive, academic and behavioral measures.

	Father high (n = 27)	Mother high (n = 33)	p-value	Cohen's d
IQ	106.10 (2.83)	107.70 (2.87)	0.69	0.10
TTA	102.83 (9.89)	102.83 (10.03)	1.00	< 0.01
B-EMT	64.07 (3.66)	70.59 (3.82)	0.22	0.32
SWAN parent	72.25 (3.99)	67.78 (4.12)	0.43	0.21
SWAN teacher	61.60 (4.32)	63.23 (4.65)	0.80	0.07
BRIEF parent	45.99 (2.24)	45.41 (2.34)	0.89	0.05
BRIEF teacher	50.25 (2.30)	45.63 (2.63)	0.19	0.37
SDQ parent	8.67 (1.45)	7.20 (1.47)	0.47	0.19
SDQ teacher	6.05 (1.14)	5.15 (1.23)	0.59	0.15

Depicted are Means (Standard Errors). IQ = Intelligence Quotient; TTA = TempoTest Automatiseren; B-EMT = Brus Een Minuut Test; SWAN = Strengths and Weaknessess of ADHD-symptoms and Normal Behavior; BRIEF = Behavior Rating Inventory of Executive Functions; SDQ = Strengths and Difficulty Questionnaire.

larger control group. For the difference in arithmetic performance between very preterm and term-born children and the difference in reading performance and teacher rated daily-life EF and behavioral functioning between children with one and children with two highly educated parents, p-values were approaching significance and may possibly have been statistically significant with a larger control group. (2) the relatively high number of missing teacher questionnaires for the term-born controls, which warrants caution interpreting results comparing very preterm and term-born controls on those measures and (3) that our cohort lacks very preterm children with low and middle educated parents, which hindered us to investigate the impact of parental education of very preterm children's functioning across the full spectrum of parental educational level.

4.2. Future directions

Our results suggest that it is important to include educational level of both parents when carrying out research on cognitive, academic and behavioral functioning after very preterm birth. Furthermore, future studies are necessary to investigate how maternal and paternal education influence child outcomes after prematurity.

5. Conclusion

In conclusion, we demonstrate that very preterm children with highly educated parents perform significantly below term-born children with highly educated parents in terms of cognitive and behavioral functioning, but do not differ in terms of academic functioning. Very preterm children's performance was not impaired if compared to normative data. We further demonstrated that both parents' educational level matters for cognitive, academic and behavioral functioning of both very preterm and term-born children and that the combination of both parents' education level matters more than which parent has highest education.

Conflict of interest

None declared.

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