



Master of Public Health

Master de Santé Publique

Measurement and determinants of the early childhood educational environment and support services received in school among children born very preterm across 11 European countries— Results from the EPICE-SHIPS cohort

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Acronyms

ADHD	Attention Deficit Hyperactive Disorder
ASD	Autism Spectrum Disorder
ASQ	Ages and Stages Questionnaire
BW	Birthweight
CP	Cerebral Palsy
ECE	Early Childhood Education
EPICE	Effective Perinatal Intensive Care in Europe
EPT	Extremely Preterm
GA	Gestational Age
ISCED	International Standard Classification of Education
SDQ	Strengths and Difficulties Questionnaire
SEP	Special Educational Provision
SHIPS	Screening for Health in Very Preterm Infants in Europe
UK	United Kingdom
VPT	Very Preterm

Abstract

Background. Early childhood education offers opportunities for stimulation in multiple developmental domains and early identification and support for learning and other difficulties. Its positive impact on long-term outcomes and well-being is well documented. Few studies have focused on early education and the educational environment in children born very preterm (VPT; <32 weeks of gestation) who are at higher risk of neurodevelopmental disorders and poor educational outcomes than children born at term. This study has two objectives: (1) to describe the educational environment at five years using indicators developed from a multinational cohort of children born VPT in Europe and (2) to investigate the social and perinatal determinants of educational environment at five and, in particular, of receiving educational support services. **Methods.** Data come from the population-based EPICE/SHIPS cohort of children born VPT in 2011/2012 in 19 regions from 11 European countries. Perinatal data were collected from medical records and information on education child health and development at five years of age from parental questionnaires. Indicators characterizing early education and school support/services were first harmonized and described across countries. Developmental healthcare services were also analyzed to identify children receiving support services in school only, in the healthcare system only, in both or neither. To explore the second objective, relative risks (RR) with a 95% confidence interval (CI) for any school attendance, full-time attendance and receiving support services in school were estimated using modified Poisson regression modeling with random intercept at the country and the mother levels to account for the clustering structure of the data. **Results.** Among 6,759 eligible children, 3,687 (55%) were followed-up at five years (mean gestational age 28.8 weeks). At five years, almost all VPT children were in school, but educational program (pre-primary/primary) and full-time/part-time attendance differed markedly by country. Almost one in four children received special support at school (country range: 13% to 34%). Classification of parental free-text responses identified 4 main areas of services being received in school: learning assistance, speech and language services, motor assistance and emotional, social and behavioral support. When integrated with developmental services outside of school, 59.2% of children received no services, 3.6% received services in school only, 17.9% in the healthcare system only and 19.4% in both; but variation was high across countries (i.e. developmental services received only in the healthcare system ranged from 7.6% to 28.0%). Determinants of receiving educational support services included motor (RR=5.1; CI 3.5;7.2), sensory (RR=4.9; CI 3.5;7.1), cognitive (RR=6.5; CI 3.8;11.0), and behavioral (RR=3.5; CI 2.2;5.5) moderate-to-severe developmental difficulties as well as low maternal education, (RR=1.4; CI 1.1; 1.6). **Conclusions.** There is marked variation in approaches to early education in Europe. While school type and full/part-time attendance are mostly determined by national policies, multiple sociodemographic and health characteristics were associated with the reception of educational support services. Future research should investigate the strengths and weaknesses of these approaches and their consequences for children's well-being and longer-term educational outcomes.

INTRODUCTION

Background of preterm birth

The World Health Organization defines preterm birth as any birth occurring before 37 completed weeks of gestation.¹ There are multiple causes of preterm birth including multiple pregnancy, infections and maternal pregnancy complications such as gestational hypertension.² The complications of preterm birth are the leading cause of neonatal morbidity and mortality worldwide.³ Children born at lower gestational ages face higher risks of adverse outcomes and preterm births are grouped further into very preterm (VPT, <32 weeks of gestation) and extremely preterm (EPT, <28 weeks of gestation). Over the last few decades, there have been vast improvements in the survival of infants born VPT and EPT resulting from medical advances in the fields of obstetrics and neonatology. Very preterm children constitute 1 to 2% of all births.⁴ With more VPT babies surviving into childhood, there is a growing importance in studying their longer-term outcomes.

Consequences of VPT birth on developmental outcomes in childhood

There is a large body of literature investigating the short- and long-term developmental difficulties of VPT children. With strong evidence then compared with children born at term, these children are at an increased risk for developmental problems that can also carry into adulthood.⁽⁵⁻⁹⁾ Short- and long-term risks include language delays,⁹ sensorial impairment,^{4,5} neurodevelopmental delays,⁵ and impaired cognitive, behavioral, motor, and emotional functioning.^(7,10-15)

These neurodevelopmental problems can have repercussions on various domains of the participation in society of these children, such as school performance and social participation.^{16,17} It is well documented that children born VPT are at an increased risk of difficulties in school.^(16,18,19) In a study assessing educational outcomes in EPT children at 11 years old in the United Kingdom (UK), EPT children were found to have poorer academic attainment and higher rates of learning difficulties when compared to their peers born at term.¹⁶ VPT birth has also been reported as a risk factor for low school readiness, a multi-dimensional construct referring to the child's readiness to start school²⁰, when assessed in children born VPT at 5 years of age.^{21,22}

While school performance and educational outcomes are well documented in children born VPT, less focus has been on the environmental influences and the educational environment is poorly described in this population. Therefore, it is important that more attention

is brought to educational environmental factors that could promote these children's longer-term development.

Early childhood educational (ECE) environment

The period of early childhood is an important phase of life as it is a critical window for both brain development and growth. Children are highly influenced by their environment and the people surrounding them during this time. The family plays a crucial role in influencing children's development and their socioeconomic level can impact this. Lower maternal education level and exposure to social adversity have been associated with developmental language delay and lower cognition in childhood in VPT children.⁽²³⁻²⁵⁾

Early childhood education (ECE) refers to regulated activities that offer educational components for children between the early childhood phase of birth to compulsory school age (first 5/6 years of life in most European countries).²⁶ ECE offers opportunities for stimulation in multiple developmental domains along with early identification and implementation of early intervention or support and services for learning and other difficulties. The ECE environment provides opportunities for children to increase their skills and plays an important role in positively impacting children's academic preparedness, cognitive, and social development.^{27,28} While the definition of ECE in the European union is the same, the structure of these systems is not.²⁶

Early childhood education in Europe

Early childhood practices are diverse across and within countries.²⁶ The age at which children begin participating in ECE activities and the policies regulating their placement in a program varies between countries and over time. Data on children in the general population showed that some countries, including Denmark, the Netherlands, Belgium and France, had ECE participation rates under the age of three between 50-72%, while on the other hand in Germany, Italy and the UK rates were between 29-33%.²⁶ The age children start school also affects the structure or settings they are in, but ECE settings most commonly refer to center-based schoolings such as pre-school and kindergarten.²⁶ ECE programs can range from separate settings to unitary settings. In separate settings, childcare-type settings and education type-settings are separate, while unitary settings may combine both educative and care components.²⁶ The national policies and practices lead to a variation in the structures of ECE across Europe and even within countries which can make it difficult to make meaningful comparisons and to harmonize indicators across countries.

The degree of ECE system and policy integration was classified in the Eurydice²⁶ report, placing countries on a continuum from integrated to split systems. The degree of integration was determined on four quality dimension criteria, whether the system has: 1) unitary or separate

settings; 2) authorities (single or dual); 3) highly qualified staff throughout the entire ECE phase (minimum ISCED level 6); 4) education guidelines applying to all settings.²⁶ **Figure 1**²⁶, displays the heterogeneity of ECE system integration across Europe. This suggests that children in Europe experience and are exposed to different ECE practices and this diversity provides a good opportunity to investigate environmental characteristics that could act as facilitators/obstacles of the children's outcomes, development and school participation, particularly in vulnerable populations, such as children born VPT, who are higher risk of developmental difficulties.

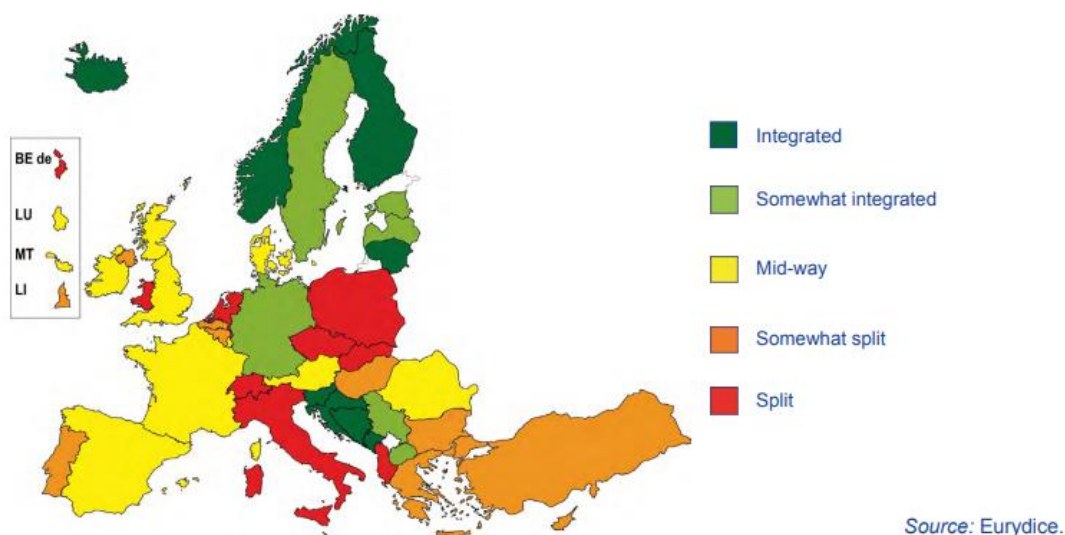


Figure 1. Degree of ECE and care system integration, 2018/2019

Early education of children born very preterm

The educational setting is central to development in all children and may be particularly important for children with health and social vulnerability, such as those born VPT.^{28,29} Inclusive education is an essential principle, which aims to meet the educational needs of all children, regardless of their social or health circumstances, and is recognized as instrumental for full economic and social participation in society.²⁶ For children with impairments, early inclusion in schooling “provides the foundations for lifelong learning and development”.²⁶

One benefit of the educational environment is that it makes it possible to identify learning and other difficulties and opens up opportunities to receive services for these difficulties.²⁹ For VPT children, this is essential, as their prognosis is often unknown once they are discharged from the neonatal unit, making follow-up essential. Since many developmental difficulties may not be detected before school age, the educational environment plays a key role in identifying children having difficulties, assessing needs and providing support services.

Policies and systems in place that regulate educational support and specialist provision are also heterogeneous across countries. Inclusive education continues to develop in Europe,

but countries are at different stages in this development.²⁶ Children born VPT have been shown to require additional support and assistance at school.^(18,19,30) In a population-based cohort study in France (EPIPAGE 1) conducted in 1997, 15% of VPT children were receiving special support at school between the ages of five and eight years old compared to 5% of children born at term, with that number increasing to 23% in children born <28 weeks.¹⁹ This is consistent with a more recent cohort study in France reporting that 15.2% of children born VPT were receiving educational support at 7 years old.³¹ While these studies focused on school age children, the receipt of support services is poorly described in VPT children during the early childhood phase, despite these children being vulnerable to being left behind in school due to their health and developmental challenges, as they often are from families with disadvantaged socioeconomic backgrounds.

Additionally, children born VPT are more likely to receive healthcare in childhood in other settings with developmental benefits. An observational cohort studying investigating healthcare therapies and educational provisions aimed at investigating this and found that a large proportion of children born VPT received healthcare therapies and/or educational support between five and six years of age.³³ High healthcare use at 5 years old in very preterm children was also found in a study looking at healthcare (outpatient/inpatient) use across various specialties and domains.³⁴

Relevance in Public Health

There is a lack of common indicators for describing the educational environment resulting in limited to no research on the early childhood environment among the VPT population and the relative contribution, for instance, of services received within the health system and educational system are poorly described. In a recent priority setting exercise to establish a roadmap for research on the consequences of VPT birth with 64 European clinicians, researchers, policy makers and parents, education was identified as the highest-ranking theme to investigate in future research.³⁴ Expanding research on the educational environment and its influence in this vulnerable population is needed to provide evidence about how early educational intervention support and services contribute to preventing or mitigating difficulties. This knowledge is needed to develop evidence-based healthcare and educational policies and contribute to effective health promotion and prevention actions for children born very preterm.

Aim of the study

Very few studies are available documenting early education environmental characteristics up to the first 5/6 years of life among children born very preterm in Europe, which could optimize their

later development and well-being. This is partially explained by the diversity in national practices and policies regarding early education, and the lack of a harmonized framework allowing to explore this question across countries.

We hypothesized that the child's and family's characteristics, including social, perinatal and child's health, related with the type of early childhood education, in spite of the diversity of European systems in terms of ECE.

The principal aim of the study was to describe and investigate the determinants of the early childhood educational environment in children born VPT at 5 years old across multiple European countries.

We had two specific objectives:

1. To describe the educational environment at five years using indicators developed from a multinational cohort of children born VPT in Europe.
2. To investigate the social, perinatal and other health determinants of the educational environment at five and, in particular, of receiving educational support services.

METHODS

Study design and population

Data come from the Effective Perinatal Intensive Care in Europe (EPICE) – Screening for Health in Very Preterm Infants (SHIPS) cohort, a population-based, prospective cohort study of children born from 22+0 weeks to 31+6 weeks of gestation in 2011/2012 in 19 regions in 11 European countries: Belgium (Flanders); Denmark (the Eastern Region); Estonia (entire country); France (Burgundy, Ile-de-France, and the Northern regions), Germany (Hesse and Saarland); Italy (Emilia-Romagna, Lazio, and Marche regions); the Netherlands (Central and Eastern regions); Poland (Wielkopolska); Portugal (Lisbon and Northern regions); Sweden (Stockholm County) and the UK (East Midlands, Northern and Yorkshire, and Humber regions).³⁴ Perinatal information was abstracted from medical records in obstetric and neonatal units.³⁴ Regions can be visualized in **Figure 2**.³⁵ Children were followed at 2 years corrected age and 5 years of age

using a parental questionnaire. Our study sample included the 3687 participants followed-up at 5 years. The flow chart in **Figure 3** describes attrition due to mortality and loss to follow-up. Out of 10329 total births, 2429 were stillbirths or terminations of pregnancy and 1106 died before discharge home.³⁵ 6759 children were alive at 5 years and eligible for the follow-up; 3072 did not participate, meaning their parents did not return the questionnaires (45.5%). The children who were not followed-up in the cohort have been compared to children included in the follow-up.^{35,36} While the children did not differ in their clinical characteristics (gestational age or severity of morbidities, for instance), there were differences in social and demographic characteristics. At both 2- and 5-year follow-up, children born to younger, multiparous and migrant women were less likely to be included.³⁵



Figure 3. Regions included in EPICE/SHIPS cohort

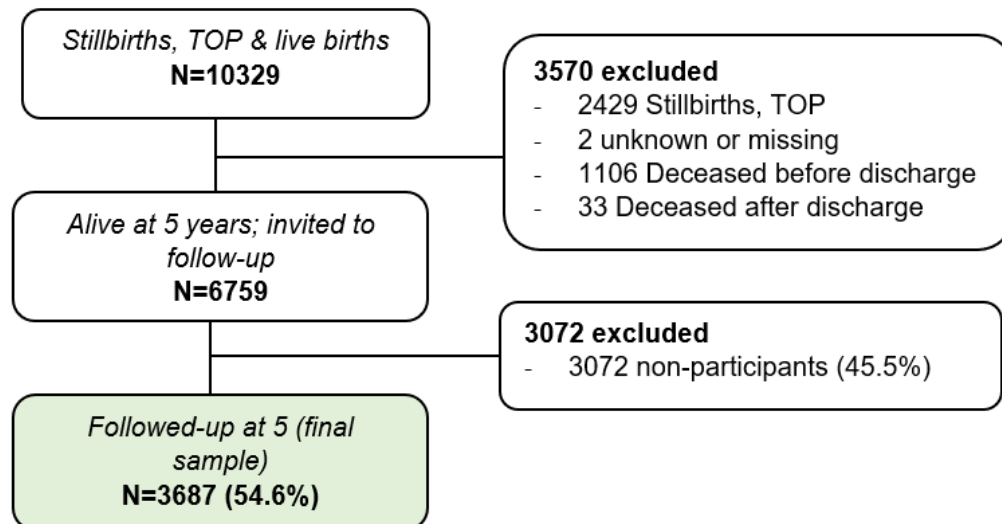


Figure 3. Study sample section
Abbreviation: TOP: Termination of Pregnancy

Measures of ECE environment at 5 years

At the 5-year follow-up, parents were asked if their child was currently participating in any educational program (yes/no). Parents indicating yes were then invited to describe the type of educational program in free-text response for all countries except France and Italy, who had predetermined response options provided. Parents were also asked to provide the intensity of attendance (response options: full-time, part-time), as well as the age their child started the educational program.

Information was also collected from parents on the reception of any educational support services or special educational provision (SEP) in a yes/no question. Those responding yes were invited to provide details on the type of support services being received with a free-text response, except in France where response options were proposed. For more specific details on the questions around schooling, please refer to **Appendix 1** for the extract of the questionnaire at 5 years.

Measures of potential determinants of the ECE environment

The following variables were considered in our analysis as potential factors associated with ECE environment (health care services use, sociodemographic and perinatal characteristics, developmental difficulties and health outcomes) or as potential confounder (child's age).

Health care services use

Data were also collected on the use of health services during the past year through the parental questionnaire at 5 years. Indicators characterizing health services were derived in a previous work.³³ For our study, we selected services that were relevant to development and the educational setting, including motor therapies (occupational therapy and physiotherapy), speech, emotional (psychologist and psychiatrist), early intervention and multidisciplinary services. These were consistent with support services provided at school that were reported in other studies.^(18,31,32) These were derived each into separate indicators along with one composite indicator combining any developmental healthcare service. A four-category indicator was also created to identify children receiving support services in school only, in the healthcare system only, in both or not receiving these services.

Sociodemographic characteristics

The following sociodemographic characteristics were included in our analyses : child sex, child's age at the survey, maternal age at delivery (<25 years/≥25 years old), maternal educational level

at 5 years low (primary/lower secondary); medium (upper secondary/short tertiary); high (bachelor's/higher),^(23,24) maternal cohabitating status, (single versus married/cohabitating), household employment status (employed/at least one parent unemployed) and if the mother was born in the country (European country/non-European country).

Perinatal characteristics

Perinatal information extracted from medical record were included in our analysis were gestational age (GA) (23-24, 25-26, 27-28, 29-30 and 31 weeks), birthweight (≥ 1000 grams versus < 1000 grams), and parity referring to the number of previous deliveries (primiparous/multiparous). Level of perinatal risk was determined using a composite variable deriving from perinatal characteristics (e.g. GA, bronchopulmonary dysplasia, retinopathy of prematurity stages III–V diagnosed before discharge, intraventricular hemorrhage III or IV, cystic periventricular leukomalacia or necrotizing enterocolitis needing surgery, and severe congenital anomaly) to define three levels of risk (low, medium and high). Further details on the composite variable are available in previous study.²³

Developmental difficulties and health outcomes

Data on the child's health conditions and neurodevelopment were extracted from the 5-year parental questionnaires along with clinical assessments with validated instruments to create dichotomous indicators. Motor function was assessed using the Movement Assessment Battery for Children-Second Edition (MABC-2) and parental reported questions when the clinical assessment was missing. Cognitive abilities were measured using the less than 10th percentile scores on the Ages and Stages Questionnaire (ASQ) and emotional/social/behavioral difficulties were measured using the greater than 10th percentile scores on the Strengths and Difficulties Questionnaire (SDQ). Lastly, sensory impairment (hearing/vision), cerebral palsy (CP), attention deficit hyperactive disorder (ADHD) or autism spectrum disorder (ASD) diagnosis were measured based on parent-reported responses on the questionnaire. Dichotomous indicators yes/no indicators were then derived to describe developmental difficulties and parent-reported diagnosis. **Table 1** outlines the subgroups on developmental difficulties that were used in our study. Characteristics by subgroups are also provided in **Appendix 2**.

Table 1. Description of subgroups used in analysis

Development domain	Measurement
Cognitive abilities	ASQ (Ages and Stages Questionnaire)
Motor difficulties	MABC-2 & parent-reported responses
Emotional/Social/Behavioral difficulties	SDQ (Strengths & Difficulties Questionnaire)

Harmonized indicators of the educational environment

Harmonized indicators of the type of education and type of special support services (e.g. type and area of assistance) received at 5 years were derived from parental reported free-text responses across countries. For both type of education and special support, categories were established a priori by consensus between SHIPS partners in each participating country. SHIPS partners were then provided the free-text responses in national language along with categories established a priori. Partner countries returned the free-text responses with English translations along with their classification of the responses into the categories. Regarding education type, we further categorized type of educational program based on the International Standard Classification of Education (ISCED, levels 0 and 1)³⁷. An example of responses and classification for Germany is provided in **Appendix 3**.

Education type classifications derived from this process were then compared with the structure of the educational systems in each country according to the European Commission's Eurydice report on Early Childhood Education and Care in Europe²⁶ to verify consistency and accuracy of categorization. A summary of the final education programs classifications are provided in **Table 2**. A similar process was used for the harmonization of type and area of support and services. **Figure 4** provides a summarization of the final categories along with examples of free-text responses with English translation by country is provided in . Only information on Area of Assistance was used in this study.

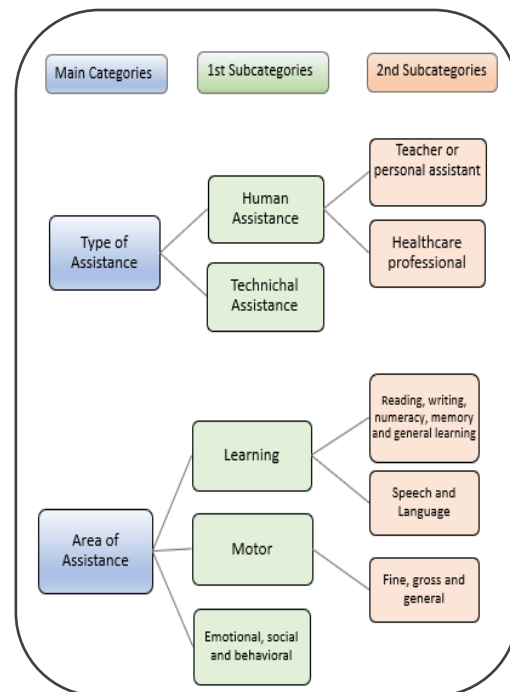


Figure 4. Summarization of categories and subcategories created to classify free text

Table 2. Type of early childhood educational program at 5 years; Common free text responses in national language with English translation

		Belgium	Denmark	Estonia	France*	Germany	Italy*	Netherlands	Poland	Portugal	Sweden	UK-England
Pre-school educational activities (ISCED 0)	Centre-based institutions including educational activities before compulsory school	n/a	3-5 yo Børnehave (Kindergarten; daycare institution)	n/a	n/a	3-6 yo Kindergarten (not a part of the regular public school)	n/a	n/a	n/a	n/a	1-6 yo Förskola Dagis (Pre-school center)	n/a
	School-based programme in school settings before compulsory school age	2 ½-6 yo Kleurterschool Kleuterklas Kleuteronderwijs Maternelle Kleuteronderwijs (Pre-School)	n/a	1 ½ -7 yo Lasteaed Kindergarten (Pre-School)	2-6 yo Ecole Maternelle Maternelle: Petits, Moyens, Grands (Kindergarten)	5-6 yo Vorschule Vorklasse (school-based programme in some landers)	3-6 yo Kindergarten	6-8 weeks - 4 years (Voorschoolse educatie en kinderopvang) (Kindergarten) Peuterspeelzaal Pre-School)	3-7 yo Przedszkole (Kindergarten) Zerówka (Pre-School)	3-6 yo Pré-escola (Pre-School) Jardim de Infância Infantário (Kindergarten)	6-7 yo Förskoleklass (Pre-primary preschool class)	3-4 yo Reception and Nursery classes in schools (Pre-School)
Primary compulsory school (ISCED 1)		6-12 yo Lagere School Basisschool (Primary School)	n/a	7-16 yo Põhikool (Primary School)	6-11 yo Cours Préparatoire de l'école Primaire CP (Primary School)	6-10 yo Grundschule (Primary School) Ganztagsschule (All-day School) Schule (School)	6-11 yo Primary School	4-12 yo Basis onderwijs (Primary School)	7-15 yo Szkoła (Primary School)	6-12 yo Escola Primária (Primary School)	7-16 yo Grundskola (Primary School)	5-11 yo Primary Pre-prep Infant (Primary schools)

Statistical analysis

We first analyzed the missing data and then described the main characteristics of the study sample followed up at 5 years. The distribution of the main ECE indicators was provided stratified by country and by perinatal risk in order to investigate our first objective.

Developmental healthcare services were also described to identify children receiving support services outside of school and by subgroups of children according to developmental difficulties (low cognitive abilities, motor difficulties and emotional/social difficulties). To explore the second objective, relative risk (RR) with 95% confidence interval (CI) for full-time attendance and receiving support services in school were estimated using modified Poisson regression modeling with robust variance³⁸ for sociodemographic, perinatal and other health characteristics. We used random intercepts at both country level and mother level to account for possible clustering effect within countries and mothers with twins or higher births. We also adjusted for the age of the child at the time of survey, as this varied across countries.

All analyses accounted for the effects of potential bias due to selective attrition using inverse probability weighting to assign a higher weight to children non-participant at the 5-year follow-up according to their characteristics. Weights were derived from logistic regression model as the probability of response at 5 years using relevant perinatal, neonatal and sociodemographic variables (after multiple imputation)(e.g. pregnancies complications, gestational age, congenital anomaly, maternal country of birth) .^{35,36} This approach gives higher weights to characteristics that are underrepresented because of non-response, as described elsewhere.^{33,36} A sensitivity analysis was also performed comparing results from weighted and unweighted analyses. Analyses were performed using Stata version 16 (StataCorp LLC, College Station, TX).

RESULTS

Missing data on our study sample was described (**Appendix 4.**). Less than 5% of missing data were reported for all study variables, except for intensity of participation (5.3%) and the free-text response on type of support and services (6.9%). Main characteristics of non-participants at the 5-year follow-up have been described in a previous study,³³ which described children at 5-year follow-up, born to younger, multiparous and migrant women were less likely to response. A description of the main sociodemographic and perinatal characteristics, as well as the developmental difficulties and health outcomes of the entire study sample (n=3687 participants at 5-year follow-up) is provided in **Table 3**. The median age of the child at the time of the survey was 5.5 years old, however this varied across countries depending on the time when the surveys were distributed (age range: 4.3-7.2 years old; median age range: 5.0-5.7).

Table 3. Description of characteristics of children followed-up at 5 years (N=3687)

	Number of children (n)	Unweighted %	Weighted %
Child characteristics			
Child's age (years)	3612	5.5 (4.3-7.2) [†]	
Male	1968	53.4	53.5
Sociodemographic characteristics			
Maternal age at delivery			
Less than 25 years	440	12.0	16.8
25-34 years	2114	57.5	56.7
Greater than 35 years	1123	30.5	26.5
Maternal educational level at 5 years			
Low	611	17.0	18.0
Intermediate	1498	41.6	42.5
High	1493	41.5	39.5
Single Mother	436	12.2	13.5
At least one parent unemployed	399	11.2	11.7
Perinatal characteristics			
Gestational age			
23-24 Weeks	132	3.6	3.6
25-26 Weeks	483	13.1	11.6
27-28 Weeks	847	23.0	22.2
29-30 Weeks	1274	34.6	35.2
31 weeks	951	25.8	27.4
Level of perinatal risk			
Low	922	25.7	27.1
Medium	1362	37.9	37.8
High	1311	36.5	35.2
Birthweight (grams)			
<1000	1099	29.8	27.7
Parity: Multiparous	1448	39.7	43.0
Other impairments or developmental difficulties at 5 years			
Cerebral Palsy	210	5.8	6.1
Motor difficulties	508	13.8	13.9
Sensory Impairment (Hearing or visual)	138	3.8	3.7
Low cognitive abilities ^a	281	9.9	11.6
Emotional/social/behavioral difficulties ^b	370	11.0	11.6
Any developmental difficulty ^c	966	27.7	28.8
Country			
Countries			
Belgium (Flanders)	280	7.6	9.5
Denmark (Eastern)	152	4.1	4.3
Estonia (whole country)	134	3.6	2.1
France (Burgundy, Northern, Ile-de-France)	779	21.1	16.4
Germany (Hesse, Saarland)	280	7.6	10.0
Italy (Emilia, Lazio, Marche)	693	18.8	14.3
Netherlands (East-Central)	155	4.2	4.8
Poland (Wielkopolska)	189	5.1	3.7
Portugal (Lisbon, Northern)	433	11.7	8.9
United Kingdom (East Midlands, Northern, Yorkshire)	448	12.2	22.5
Sweden (Stockholm region)	144	3.9	3.4

[†]Median (Range)^aLow cognitive abilities derived from scores below the 10th percentile on the Ages and Stages Questionnaire (ASQ); Excludes France^bEmotional/social/behavioural difficulties derived from scores above the 10th percentile on the Strengths and Difficulties Questionnaire (SDQ)^cAny child with at least one impairment or difficulty including cerebral palsy, sensory, cognitive, motor or emotional/behavioral

Description of the main indicators of ECE activities and environment at 5 years

Overall, 98.6% of children were participating in an educational program (varied from 90.8% in Poland to 99.8% in Belgium and France) at 5 years (**Table 4**).

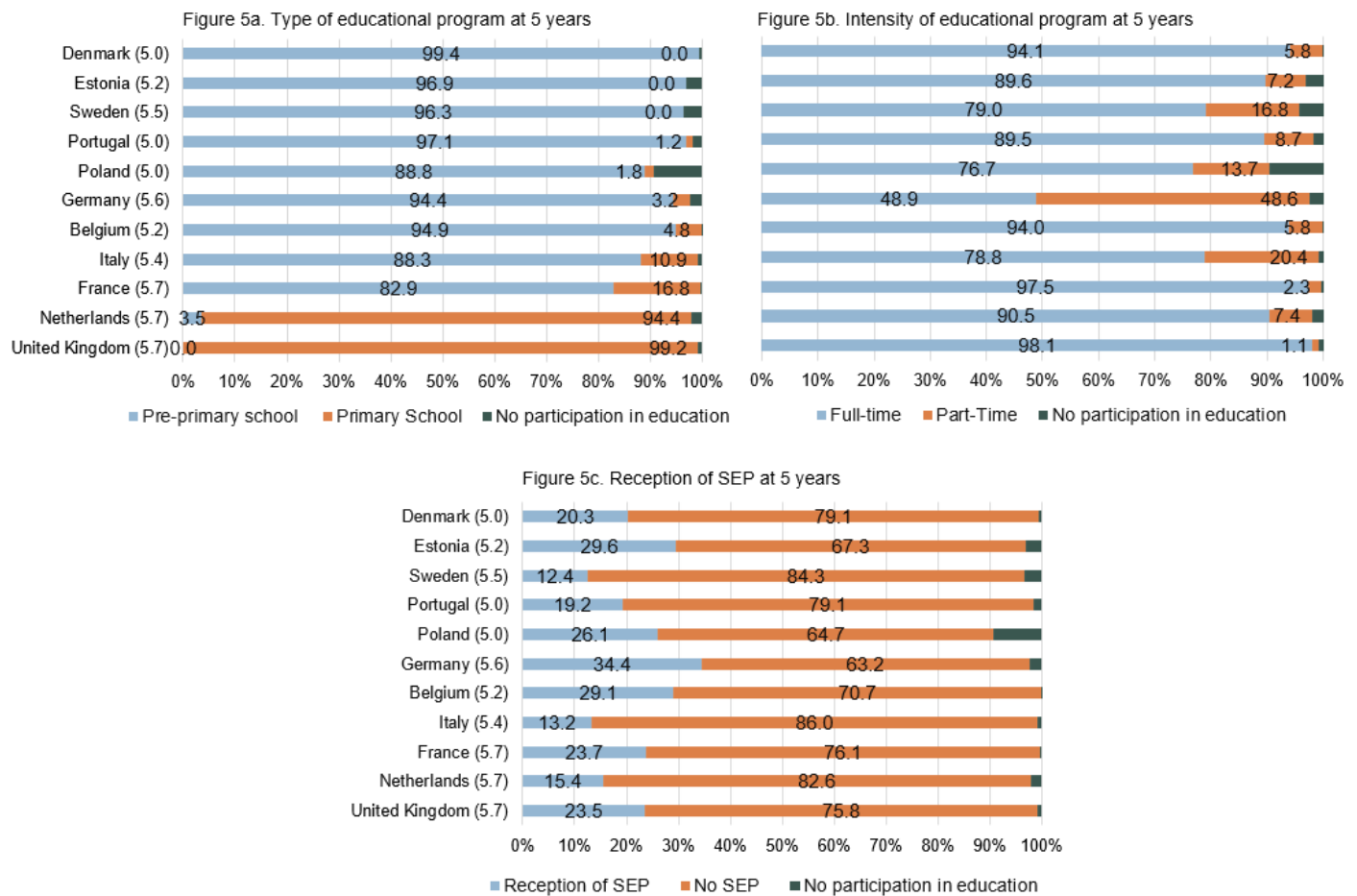
The harmonization of free-text responses identified two main categories of educational program in which children were enrolled (**Table 2**): 1) pre-primary educational activities or programs (corresponding to ISCED level 0; e.g. pre-school, kindergarten, daycare institution); 2) primary education (ISCED 1).

Table 4. Participation in any educational program at 5 years by country; Sample weighted

Country (region)	Participation in any educational program	
	n	%
Belgium (Flanders)	272	99.8
Denmark (Eastern)	149	99.4
Estonia (whole country)	128	97.0
France (Burgundy, Northern, Ile-de-France)	765	99.8
Germany (Hesse, Saarland)	272	97.7
Italy (Emilia, Lazio, Marche)	687	99.2
Netherlands (East-Central)	144	98.0
Poland (Wielkopolska)	171	90.8
Portugal (Lisbon, Northern)	424	98.4
United Kingdom (East Midlands, Northern, Yorkshire)	418	99.2
Sweden (Stockholm region)	135	96.7
Total	3565	98.6

As shown in **Figure 5**, the majority of children were attending pre-primary educational activities/programs in most countries (from 83% in France to 99% in Denmark), except in the United Kingdom and Netherlands where the majority of children were enrolled in primary school (respectively, 94% and 99%) (**Figure 5a**). Moreover, the majority of children were enrolled full-time in an educational program in all countries (from 77% in Poland to 98% in the UK) except in Germany (49%) (**Figure 5b**). Most children were not receiving SEP (22.8% overall), however it varied across countries (13% in Italy and Sweden and 34% in Germany) (**Figure 5c**).

Figure 5. Distribution of main early childhood indicators (%) at 5 years old by country



Note: Median age of child at time of survey in brackets after country
 Abbreviation: SEP: Special educational provision

The ECE indicators (participation, intensity and educational support services) were also described by level of perinatal risk and by country. Regarding the participation in any educational program at 5 years, no patterns were shown according to the level of perinatal risk, except in Poland and Sweden, where this proportion tended to be lower in subgroups of children with higher level of perinatal risk increases (**Appendix 5**). The proportion of children attending full time and the proportion of children receiving educational support services tended to vary according to the level of perinatal risk, with contrasting patterns according to the country (**Table 5**). In some countries, children with high perinatal risk were more likely to participate full time than those with low perinatal risk (e.g. Estonia: 97.8% vs 80.7% respectively), while the inverse situation was observed in other countries (e.g. Poland: 78.5% vs 92.8%). For the most part, the reception of support services increased as the level of perinatal risk increased (**Table 5**).

Table 5. Distribution of main early childhood indicators at 5 years according to level of perinatal risk and country; samples calculated using weighted percentages; missing values are not included in the calculations

Level of Perinatal risk	Intensity of Attendance (n/% Full time participation)			Special Support (n/% Receives support)		
	Among Low	Among Medium	Among High	Among Low	Among Medium	Among High
Country	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Belgium	83 (95.1)	70 (93.2)	59 (91.9)	15 (17.9)	29 (32.3)	31 (46.3)
Denmark	30 (94.7)	45 (96.0)	51 (92.5)	5 (14.5)	10 (18.8)	16 (29.4)
Estonia	25 (80.7)	41 (95.4)	45 (97.8)	8 (26.9)	14 (30.6)	15 (32.8)
France	166 (98.6)	303 (99.3)	219 (94.4)	33 (19.9)	67 (22.3)	68 (29.4)
Germany	32 (46.1)	51 (56.6)	43 (46.0)	15 (22.2)	29 (32.7)	44 (48.4)
Italy	159 (83.9)	225 (83.2)	150 (70.4)	13 (6.9)	21 (3.7)	56 (27.3)
Netherlands	21 (89.0)	40 (90.0)	67 (95.6)	0 (0.0)	5 (13.8)	13 (23.3)
Poland	43 (92.8)	46 (85.5)	50 (78.5)	4 (9.2)	12 (21.1)	33 (48.4)
Portugal	89 (93.4)	154 (94.2)	107 (85.3)	15 (15.9)	26 (14.9)	40 (28.8)
United Kingdom	107 (100)	120 (98.0)	150 (98.5)	12 (11.7)	26 (20.3)	61 (38.1)
Sweden	23 (100)	38 (89.1)	23 (69.0)	2 (5.4)	2 (3.0)	16 (33.3)
TOTAL	778 (89.5)	1133 (89.5)	964 (84.3)	122 (14.0)	241 (19.6)	393 (35.0)

Note: Number of children with complete data on intensity variable with low (n=872), medium (n=1266) and high (n=1266) perinatal risk and on special support variable with low (n=895), medium (n=1316) and high (n=1218) perinatal risk

Description of the area of special educational support services received at 5 years

Classification of parental free-text responses on type/area of support services identified 4 main areas of educational support being received at school with a variation in the proportion of children receiving these different services. A table with the proportion of children receiving these areas of assistance along with common free-text responses in national language with English translations is provided in **Table 6**. These 4 categories included learning assistance (received by 48.6% of all children), speech and language services (37.8%), motor assistance (37.7%) and emotional, social and behavioral support (16.9%).

Table 6. Area of support and services at 5 years; Common free text responses in national language with English translations¹

Area of assistance provided ²	n (%)	Type of assistance	Examples of free-text responses from 5-year survey in national Languages	English Translation
Learning Assistance	263 (48.6)	Support Teacher Personal Assistant	Geïntegreerd Onderwijs (GON) Insegnante di Sostegno Assistente Educativo e Culturale (AEC) En resursperson Resurs i form av egen pedagog Apoio do docente de Educação Especial One to one support Teacher assistant Small group work	Integrated education Support teacher Personal school assistant Personal assistant Personal teacher Special education support teacher
Speech and Language Services	218 (37.8)	Healthcare professional	Logopodie(a) Logopeed Terapia da fala Speech Therapist Speech & Language Therapy	Speech therapist Speech therapy
Motor Assistance and services	219 (37.7)	Personal assistant Technical assistance Healthcare professional	Fysioterapi Fysiotherapie Füsioteraapia Physiotherapy	Physiotherapy
			Ergotherapie Terapia ocupacional Occupational therapy	Occupational Therapy
			Rehabilitacja ruchowa Egen resurs: hjälp med att ta sig fram, mat, hygien, lek Grob- und feinmotorik Needs physical support e.g. when doing PE, carrying tray, using equipment	Physical rehabilitation Needs help from an assisting person in order to move, eat, personal hygien etc Gross and fine motor skills
Emotional, Social and Behavioral Support	108 (16.9)	Personal assistant Healthcare professional	Psycholog Psicologia Assistente Educativo e Culturale (AEC) IBT (intensiv beteendeträning) Assistenza alla comunicazione Social skills classes, additional support in class	Psychologist Psychologist Personal school assistant Intensive Behavioral Training Communication assistance

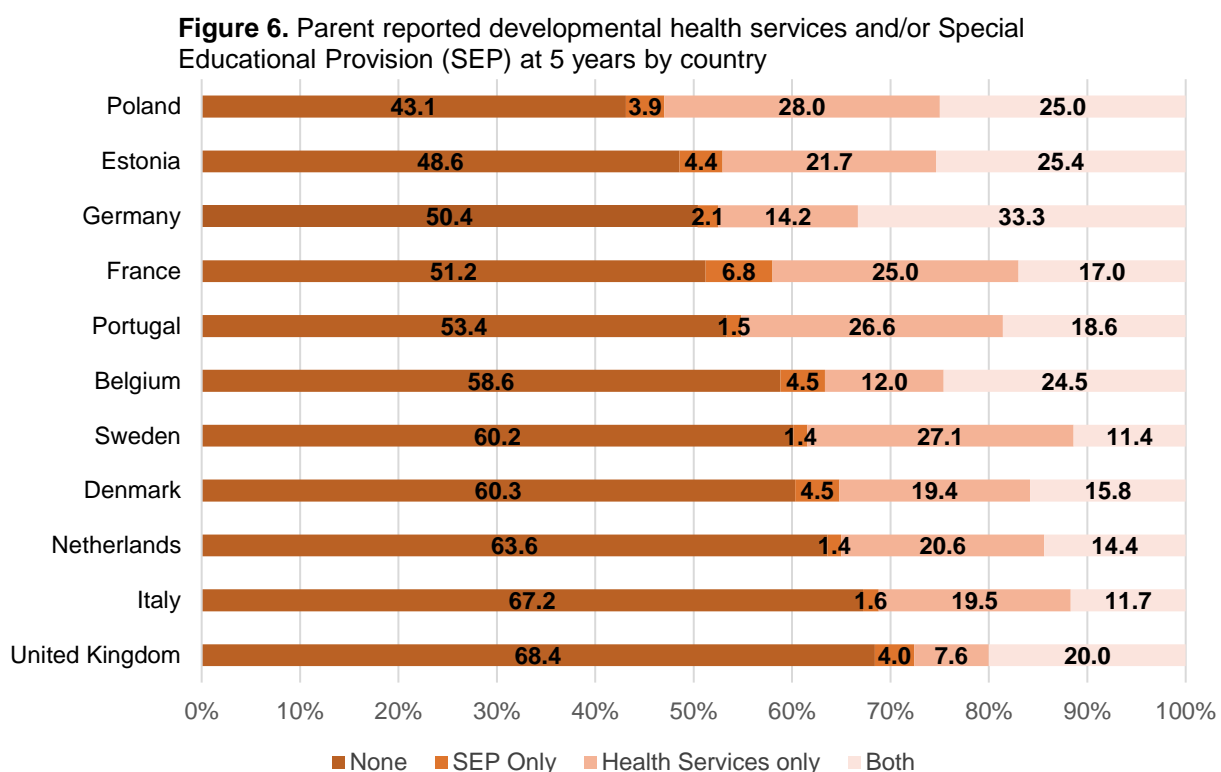
Note:

¹Includes all countries except France; survey didn't ask in free text responses

²Classification of area and type of assistance is visually displayed in **Figure 4**

Description of special educational support and other developmental healthcare services used at 5 years

To provide a complete vision of support and services received by these children, developmental healthcare services were also analyzed to identify children receiving educational support in school only, developmental support in the healthcare system only, both educational support in school and developmental support in other setting, or neither. This was described in the total population, in subgroups according to nature of developmental difficulty (i.e. cognitive, motor, emotional/behavioral) and by country.



The distribution of the 4 groups (school, healthcare, both or neither) is provided in the total population (**Table 7**) and by country (**Figure 6**) ordered by the lowest percentage of children receiving either service up to the highest percentage of children receiving neither. We observed a large variation across countries in where children were receiving support (i.e. developmental services received only in the healthcare system ranged from 7.6% to 28.0% and when received in both settings ranged from 11.7% to 33.3%). It can also be noted that the country range for children not receiving any support ranged from 43.1% (Poland) to 68.4% (UK).

Table 7. Description of developmental health and educational services according to the nature of developmental difficulty among children enrolled in an educational program (n=3565); sample weighted

	Total sample+	Low cognitive abilities ^a	Motor difficulties ^b	Emotional/behavioral/social difficulties ^c
	n=3565	n= 219	n = 468	n= 362
Developmental services in healthcare settings				
Any developmental healthcare service use	1364 (37.3)	182 (87.7)	347 (75.7)	256 (69.6)
Type of developmental healthcare services				
Motor Developmental Therapies (Physio, OT)	665 (18.7)	121 (56.5)	254 (55.4)	149 (39.7)
Speech or language therapist	863 (23.6)	147 (73.3)	246 (54.0)	172 (47.4)
Emotional/Social/Behavioral (Psychologist, Psychiatrist)	510 (12.7)	81 (33.6)	149 (30.1)	151 (38.2)
Early intervention and Multidisciplinary Services	357 (11.7)	62 (31.0)	129 (30.0)	91 (27.9)
Educational support and services in school settings				
Any Special educational service use (yes)	766 (22.9)	156 (77.1)	282 (64.7)	196 (58.8)
Type of special educational services*				
Motor	219 (8.1)	61 (29.3)	100 (29.0)	58 (20.9)
Speech	218 (8.1)	57 (29.2)	72 (19.9)	55 (23.5)
Emotional/social	109 (3.6)	34 (14.2)	47 (10.9)	46 (15.7)
Learning	266 (10.5)	76 (39.6)	100 (30.8)	75 (31.2)
Developmental healthcare and/or educational support/services				
No services	1972 (59.2)	18 (6.6)	92 (20.4)	80 (22.6)
School support only	119 (3.6)	12 (5.8)	18 (3.9)	20 (7.2)
Specific health care services	716 (17.9)	41 (14.7)	88 (15.6)	79 (18.2)
Both	631 (19.4)	140 (72.9)	257 (60.2)	173 (51.8)

Note:

+Total sample is among those in school (excluding 52 not enrolled)

^aCognitive abilities derived from scores below the 10th percentile on the Ages and Stages Questionnaire (ASQ); Excludes france

^bChildren with moderate to severe motor deficit

^cChildren with scores below the 10th percentile on the Strengths and Difficulties Questionnaire (SDQ) or with parent reported child diagnosis of Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactive Disorder (ADHD)

*France excluded: Total sample (France n=765): n=2800; cognitive deficit: n=219; motor impair (France n=97): n=371;

Emotional/behavioral impair(France n=85): n=277

The distribution of this indicator in the overall sample (regardless of country) and in subgroups of children defined according to the nature of difficulties encountered is provided in **Table 7**. In the overall sample, 59.2% of children received no services, 3.6% received services in school only, 17.9% in the healthcare system only and 19.4% in both. Notably, in the total population and in different subgroups, children were receiving more developmental support services in healthcare settings when compared to in educational settings.

Lastly, when comparing subgroups by nature of difficulties, children with low cognitive abilities were more likely to being receiving support (regardless of the setting) than children in the other subgroup categories (**Table 7**). Among children with low cognitive abilities, 87.7% were receiving any developmental healthcare service compared to 75.7% among those with motor difficulties and 69.6% among those with emotional/social difficulties. Regarding support services in school, 77.1% of children with low cognitive abilities were receiving support compared to 64.7% of children with motor difficulties and 58.8% of children with emotional/social difficulties.

Determinants of the educational environment received by children born VPT at 5 years

To achieve our second objective of investigating factors associated with the educational environment of children born VPT in Europe, we focused on two indicators: the intensity of attendance and reception of special support in school (**Table 8**). After adjusting for child's age and taking into account the possible clustering effect at the country and mother level, there was no evidence for associations of sociodemographic, perinatal and health characteristics with full/part time participation of schooling (**Table 8**). Regarding the receipt of school support services, males were more likely to receive special educational support, $RR=1.79$ (95%CI 1.38-2.33) as well as children with mothers having low educational level $RR=1.35$ (95%CI 1.14-1.60) compared to those with mothers having high educational level. There was also evidence of an association with perinatal characteristics (GA, birth weight and perinatal risk) along with strong evidence for an association with the severity of all health conditions studied such as children with Autism Spectrum Disorder $RR=7.41$ (95%CI 4.05-13.6), low cognitive abilities $RR=6.45$ (95%CI 3.78-11.01), moderate-to-severe motor difficulties $RR=5.06$ (95%CI 3.53-7.20) and cerebral palsy $RR=6.13$ (95%CI 4.04-9.31).

Table 8. Distribution of sociodemographic, perinatal and health characteristics according to main early childhood educational activities at 5 years among children participating in any ECE program (n=3565); sample weighted; missing values are not included in the calculations

		Early childhood educational activity					
		Intensity in Attendance			Special support		
	n	Full-time n=2960	RR adjusted child age	95% CI	Receiving support n= 766	RR adjusted child age	95% CI
		%			%		
Sociodemographic characteristics							
Child sex							
Female	1661	87.6	ref		17.6	ref	
Male	1904	88.6	1.01	[0.96 ; 1.05]	27.5	1.79	[1.38 ; 2.33]
Maternal age at delivery							
25-34 years	2048	89.2	ref		21.7	ref	
Less than 25 years	417	89.0	0.96	[0.90 ; 1.03]	29.4	1.25	[0.88 ; 1.77]
Greater than 35 years	1091	85.5	0.99	[0.96 ; 1.01]	21.2	1.11	[0.84 ; 1.49]
Maternal educational level at 5 years							
High	1465	91.0	ref		19.2	ref	
Intermediate	1458	90.0	0.98	[0.96 ; 0.99]	23.8	1.27	[1.09 ; 1.46]
Low	584	76.6	0.93	[0.89 ; 0.97]	27.3	1.35	[1.14 ; 1.60]
Maternal cohabiting status							
Married/couple/cohabiting	3087	87.7	ref		22.0	ref	
Single	430	91.1	1.02	[0.97 ; 1.08]	27.9	1.34	[1.10 ; 1.62]
Household employment status							
Employed	3110	87.9	ref		21.8	ref	
Parent unemployed	390	90.1	1.01	[0.97 ; 1.05]	30.2	1.38	[0.95 ; 2.01]
Mother born in the country							
Country born	2844	87.9	ref		22.7	ref	
European born	238	86.9	1.10	[0.97 ; 1.23]	21.0	1.04	[0.95 ; 2.01]
Non-European born	467	89.2	1.02	[0.95 ; 1.09]	24.1	0.98	[0.78 ; 1.22]
Perinatal characteristics							
Gestational age							
31 weeks	936	90.1	ref		16.8	ref	
29-30 Weeks	1250	89.0	0.99	[0.97 ; 1.01]	20.8	1.24	[0.97 ; 1.58]
27-28 Weeks	808	87.5	0.96	[0.93 ; 0.99]	24.5	1.63	[1.25 ; 2.14]
25-26 Weeks	455	83.4	0.92	[0.84 ; 1.00]	33.2	2.37	[1.70 ; 3.31]
23-24 Weeks	116	79.4	0.91	[0.81 ; 1.02]	51.9	4.03	[2.36 ; 6.86]
Level of perinatal risk							
Low	911	89.5	ref		14.0	ref	
Medium	1331	89.5	1.01	[0.98 ; 1.04]	19.6	1.32	[1.12 ; 1.57]
High	1231	84.3	0.94	[0.90 ; 0.99]	35.0	2.71	[1.90 ; 3.85]

Table 8. Continued

	n	Intensity			Special Support		
		Full-time	RR Adjusted child age	95% CI	Receiving Support	RR Adjusted child age	95% CI
		%			%		
Birthweight (grams)							
≥ 1000	2532	90.0	ref		19.2	ref	
<1000	1033	82.7	0.93	[0.88 ; 1.0]	32.9	1.98	[1.59 ; 2.47]
Parity							
Primiparous	2145	86.8	ref		21.8	ref	
Multiparous	1380	89.8	1.02	[0.99 ; 1.05]	24.6	1.09	[0.98 ; 1.21]
Other impairments or difficulties at 5 years							
Cerebral Palsy							
No	3343	88.2	ref		19.0	ref	
Yes	202	84.5	0.98	[0.92 ; 1.04]	81.0	6.13	[4.04 ; 9.31]
Motor difficulties							
Mild/None	3084	88.6	ref		16.4	ref	
Moderate/Severe	468	84.7	0.96	[0.89 ; 1.05]	64.7	5.06	[3.53 ; 7.20]
Low cognitive abilities^a							
≥10th percentile	2512	86.7	ref		16.8	ref	
<10th percentile ASQ	219	81.2	0.94	[0.85 ; 1.04]	77.1	6.45	[3.78 ; 11.01]
Sensory Impairment (Hearing or visual)							
Mild/None	3423	88.5	ref		20.8	ref	
Moderate/Severe	134	77.9	0.88	[0.81 ; 0.96]	76.2	4.98	[3.48 ; 7.14]
Any difficulty^b							
No	2485	89.1	ref		9.9	ref	
1 or more	891	84.5	0.94	[0.90 ; 0.99]	58.3	6.39	[3.94 ; 10.36]
Emotional/social/behavioral difficulties^c							
≤10th Percentile	2958	88.8	ref		16.9	ref	
>10th percentile SDQ	362	83.6	0.93	[0.86 ; 1.02]	58.8	3.45	[2.15 ; 5.53]
Parent reported ASD diagnosis*							
No	3348	88.7	ref		19.3	ref	
Yes	75	79.6	1.17	[0.99 ; 1.38]	89.1	7.41	[4.05 ; 13.6]
Parent reported ADHD diagnosis*							
No	2631	86.6	ref		19.8	ref	
Yes	63	80.0	0.92	[0.81 ; 1.05]	67.8	6.24	[4.06 ; 9.60]

Note: Abbreviations: Attention Deficit Hyperactive Disorder (ADHD); Autism Spectrum Disorder (ASD)

^aCognitive abilities derived from scores below the 10th percentile on the Ages and Stages Questionnaire (ASQ); Excludes France

^bAny child with at least one impairment or difficulty including cerebral palsy, sensory impairment, low cognitive abilities or motor or emotional/behavioral difficulties

^cEmotional/social/behavioral difficulties derived from scores above the 10th percentile on the Strengths and difficulties Questionnaire

DISCUSSION

This study offers a previously unavailable overview of the early childhood educational environment among children born VPT in European regions. Most children born VPT were enrolled in an ECE program at 5 years old (98.6% of the overall sample) and were participating full-time in school in the countries included in the study ($\geq 77\%$), except in Germany (48.9%) and Poland (76.6%). The majority of children were enrolled in pre-primary activities at 5 years, however this varied across countries and by the age the child was at the time of the survey. There was a variation in the proportion of VPT children receiving support and services at school across countries from 12.4% in Sweden to 34.4% in Germany. The intensity of attendance (part/full time) was mostly determined by country and age of the child, however, the probability of receiving services was higher for males and children with perinatal risk factors and all developmental health problems/difficulties. Disadvantaged socioeconomic circumstances, as measured by maternal education, and having a single mother, were related with a higher likelihood of receiving services.

Strengths

Strengths of this study are the large population-based prospective cohort design with geographic diversity and use of a standardized and pre-tested questionnaire. For our English translations, analysis and interpretation of the multilingual free-text parental responses, we benefited from the active participation of SHIPS team members from the countries who were familiar with the cohort and the educational system. The classifications were further refined based on the International Standard Classification of Education (ISCED)³⁷ to allow standardized classification on type of educational program. Attrition bias could be present, however we used inverse probability weights³⁶ based on baseline information available for all children to account for loss to follow-up in the cohort. Sensitivity analysis showed that the results from the weighted and unweighted analyses were similar.

Limitations

There were also some limitations. The variation in educational policies across countries²⁶ and lack of common indicators on education create challenges in comparing across countries. Another limitation was the measurement of developmental difficulties (e.g., cognitive, motor, emotional) which were based on parental report. Full clinical assessments were performed only

among children less than 28 weeks in this cohort. Our measurements of cognitive abilities and emotional/social/behavioral difficulties were determined based on percentiles from scores within the sample and did not use cut offs predefined from prior literature. This decision is due in part to a lack of control population of term children for EPICE/SHIPS cohort. Additionally, the children included in our study were at the end of the ECE phase (5/6 years of age) and for the children receiving educational support services, we were unable to determine how long these children had been receiving this support. Lastly, we were unable to harmonize information on the age the children entered school or whether or not it was a special education setting. This is valuable information to include in future studies as it could help understand the schooling process and there is very little information on this in the VPT population.

Comparison with the literature

To our knowledge, no studies have compared the types of educational systems and the proportions of children born VPT attending school between countries in Europe. Additionally, policies regulating educational practices and special educational provision vary between countries²⁶ making it difficult to directly compare between studies. However, there are single country studies which have investigated special educational provision. Previous studies have described the type of educational support services among VPT children, covering speech therapy, learning support (support groups), motor therapies and psychological/behavioral support.^(18,31,32) These categories were consistent with our findings from free-text responses provided by parents.

National studies investigating the determinants of receiving special educational support among children born EPT/VPT also support our findings, showing that the need and reception for receiving special educational support is associated with perinatal characteristics including gestational age and low birth weight,^(19,30,31,39-41) child characteristics (male gender)^{18,31} and developmental disabilities.^{31,42} For instance, a study performed in the Netherlands on children with very low birth weight, found that impaired motor coordination at 3 ½ years of age was strongly associated with the need for learning support at 5 years of age, and children having multiple difficulties were more likely to have learning support.⁴² In a population-based cohort study in France, more children born VPT were receiving special educational support (15%) between the ages of five and eight years old than children born at term (5%) and receiving support increased with lower gestational age.¹⁹ Lastly, in the UK, academic attainment and special education needs were assessed in children born at <27 weeks of gestation at 11 years

old age, and boys were more likely to use special educational provision (boys: 74%; girls: 51%; RR= 2.7 (CI 95%, 1.5 – 4.8).¹⁸ This corroborates the findings in our study and were expected given already documented higher neurodevelopmental and behavioral risks in boys.⁴³

We found that children with mothers with a lower educational level were more likely to receive support services at school compared to those with mothers with high education. This may be due the association of maternal education level with cognitive and developmental outcomes, as displayed in prior studies.^(23,24,43,44) Lower maternal education was found to be associated with more expressive language delay at 2 years of age in VPT children²³ and more notably, low maternal education²⁴ and unfavorable social living was associated with lower cognition and risk of cognitive impairment. Additionally, higher maternal education was associated with higher cognitive, motor and language scores in children born preterm.⁴⁴

Our findings on disadvantaged socioeconomic circumstances, (maternal education, and single mothers) being related to higher likelihood of receiving services in school offer an interesting comparison to a study in this same cohort assessing high health care use³³ and specialist care service use at 2 and 5 years.⁴⁶ Children from disadvantaged socioeconomic circumstances face poorer developmental outcomes.^{23,29} Despite this, social risk factors, including low maternal education level, were not a factor in receiving more specialist care.³³ Additionally, at two years of age, children with mothers with higher educational level were more likely to see a specialist in some of the regions.⁴⁶ The contrast with our results may suggest that the educational environment is one conduit for children from disadvantaged backgrounds to receive the developmental support services and follow-up care that they need. There are various factors influencing poorer healthcare access in children from disadvantaged backgrounds, including parental work schedules and inadequate recourses.⁴⁸ The educational setting could facilitate access to early intervention and follow-up care as education is mandatory typically by the age of 6 years old and children receive the same developmental screenings at school.²⁶ This could provide an opportunity to identify problems possibly missed by the parents or because of a lack of specialist/health care use.

We found a wide variation in the proportion of children receiving support services in school across Europe. This may be explained by local resources or approaches to detecting problems²⁶ or to the broader organization of health services indicating that children could be receiving these services through the healthcare system. However, our results comparing where children were receiving services (school or health system) pointed to a variety of approaches that adds to, rather than explains, the diversity in support service provision. By describing this variability, our study raises new questions about the organizational and policy determinants and the

advantages and disadvantages of current approaches. The existence of multiple models in countries with similar standards of living and educational and health system resources provides an opportunity to investigate their advantages and disadvantages in future research.

Perspective and Future Research

Research and the description of the educational environment is limited, relating to a lack of common indicators available for describing the educational setting, particularly in multiple countries. This study aimed to describe the ECE setting using indicators from a multinational cohort and these findings emphasize the diversity in schooling practices and procedures across countries. Our findings also identified that children may be receiving support services outside of the educational setting, including healthcare settings, which VPT children have already been showed to have high healthcare use.³³ These findings lead to remaining questions around the educational setting including: 1) Further investigation and explanations for social differences in children receiving educational support services; 2) Potential geographical and social inequalities across countries and/or within countries; 3) Whether these approaches of diverse educational practices have consequences for children's well-being and longer-term educational outcomes; 4) Comparison of children in reception of educational support in other settings, such as healthcare settings. Lastly, our findings indicate social patterns in the receipt of special support services at school, which may indicate that school is a better place for children from disadvantaged families to be receiving support and provide an opportunity to further investigate this.

In future studies, we plan to investigate geographic and social inequalities in the reception of support services at school in various national and international contexts, and whether early childhood educational characteristics affect school performance and child well-being in later childhood.

CONCLUSION

There is marked variation in approaches to early education in Europe. The educational environment is mostly determined by the policies and practices across countries. However, there are notable sociodemographic and health characteristics associated with the reception of educational support services. Moreover, there is a variation in where children receive developmental support services (educational or healthcare setting), indicating the importance of considering both, however services received within the health system and/or educational system

are poorly described. There is a need for further research on description and measurement of the educational environment and its impact on children born VPT in order to have further implications on the structure and deliverance of ECE in the VPT population. While developmental outcomes in children born VPT are well documented, our study emphasizes the importance of furthering investigating domains that can influence and impact developmental outcomes, such as the educational environment, in order to meet the long-term developmental and educational needs of children born VPT.

REFERENCES

1. World Health Organization. Preterm birth [Internet]. 2018. Available from <https://www.who.int/news-room/fact-sheets/detail/preterm-birth>
2. Delorme P, Goffinet F, Ancel PY, et al. Cause of Preterm Birth as a Prognostic Factor for Mortality. *Obstet Gynecol*. 2016;127(1):40-48. doi:10.1097/AOG.0000000000001179
3. Lawn JE, Cousens S, Zupan J. 4 million neonatal deaths: When? Where? Why? *The Lancet*. 2005;365(9462):891-900.
4. Euro-Peristat Project. European Perinatal Health Report. Core indicators of the health and care of pregnant women and babies in Europe in 2015. 2018. <http://www.europeristat.com/index.php/reports/european-perinatal-health-report-2015.html>.
5. Pierrat V, Marchand-Martin L, Marret S, Arnaud C, Benhammou V, Cambonie G, et al. Neurodevelopmental outcomes at age 5 among children born preterm: EPIPAGE-2 cohort study. *BMJ*. 2021;n741.
6. Marlow N, Wolke D, Bracewell MA, Samara M. Neurologic and Developmental Disability at Six Years of Age after Extremely Preterm Birth. *New England Journal of Medicine*. 2005;352(1):9-19.
7. Johnson S, Marlow N. Early and long-term outcome of infants born extremely preterm. *Archives of Disease in Childhood*. 2017;102(1):97-102.
8. Robert E, Marina M, Nicole BY, Ni, Brian A. D, John H, Lianne WL, Doyle, et al. Association of Very Preterm Birth or Very Low Birth Weight with Intelligence in Adulthood: An Individual Participant Data Meta-analysis. *JAMA Pediatrics*. 2021;175(8):1-10.
9. Gilkerson J, Richards JA, Warren SF, Oller DK, Russo R, Vohr B. Language Experience in the Second Year of Life and Language Outcomes in Late Childhood. *Pediatrics*. 2018;142(4):e20174276. doi:10.1542/peds.2017-4276
10. Twilhaar ES, Wade RM, De Kieviet JF, Van Goudoever JB, Van Elburg RM, Oosterlaan J. Cognitive Outcomes of Children Born Extremely or Very Preterm Since the 1990s and Associated Risk Factors. *JAMA Pediatrics*. 2018;172(4):361.
11. Elena A, D'Amico R, Lucaccion L, Bedetti L, Berardi A, Ferrari F. Worse global intellectual and worse neuropsychological functioning in preterm-born children at preschool age: a meta-analysis. *Acta Paediatrica*. 2019;108:1567–79.
12. Brydges CR, Landes JK, Reid CL, Campbell C, French N, Anderson M. Cognitive outcomes in children and adolescents born very preterm: a meta-analysis. *Developmental Medicine & Child Neurology*. 2018;60(5):452-68.
13. Allotey J, Zamora J, Cheong-See F, Kalidindi M, Arroyo-Manzano D, Asztalos E, et al. Cognitive, motor, behavioural and academic performances of children born preterm: a meta-analysis and systematic review involving 64 061 children. *BJOG: An International Journal of Obstetrics & Gynaecology*. 2018;125(1):16-25.
14. Evensen KAI, Ustad T, Tikanmäki M, Haaramo P, Kajantie E. Long-term motor outcomes of very preterm and/or very low birth weight individuals without cerebral palsy: A review of the current evidence. *Seminars in Fetal and Neonatal Medicine*. 2020;25(3):101116.
15. Linsell L, Johnson S, Wolke D, Morris J, Kurinczuk JJ, Marlow N. Trajectories of behavior, attention, social and emotional problems from childhood to early adulthood following extremely

- preterm birth: a prospective cohort study. *European Child & Adolescent Psychiatry*. 2019;28(4):531-42.
16. Johnson S, Wolke D, Hennessy E, Marlow N. Educational Outcomes in Extremely Preterm Children: Neuropsychological Correlates and Predictors of Attainment. *Developmental Neuropsychology*. 2011;36(1):74-95.
 17. Ritchie K, Bora S, Woodward LJ. Social development of children born very preterm: a systematic review. *Developmental Medicine & Child Neurology*. 2015;57(10):899-918.
 18. Johnson S, Hennessy E, Smith R, Trikić R, Wolke D, Marlow N. Academic attainment and special educational needs in extremely preterm children at 11 years of age: the EPICure study. *Archives of Disease in Childhood - Fetal and Neonatal Edition*. 2009;94(4):F283-F9.
 19. Larroque B, Ancel P-Y, Marchand-Martin L, Cambonie G, Fresson J, Pierrat V, et al. Special Care and School Difficulties in 8-Year-Old Very Preterm Children: The Epipage Cohort Study. *PLoS ONE*. 2011;6(7):e21361.
 20. Williams PG, Lerner MA, Sells J, Alderman SL, Hashikawa A, Mendelsohn A, et al. School Readiness. *Pediatrics*. 2019;144(2):e20191766.
 21. Agarwal PK, Zheng Q, Yang PH, Shi L, Rajadurai VS, Khoo PC, et al. Academic school readiness in children born very preterm and associated risk factors. *Early Human Development*. 2021;155:105325.
 22. Roberts G, Lim J, Doyle LW, Anderson PJ. High Rates of School Readiness Difficulties at 5 Years of Age in Very Preterm Infants Compared with Term Controls. *Journal of Developmental and Behavioral Pediatrics*. JDBP. 2011;32(2):117–124.
 23. Sentenac M, Johnson S, Charkaluk M-L, Sjöpanen A-V, Aden U, Cuttini M, et al. Maternal education and language development at 2 years corrected age in children born very preterm: results from a European population-based cohort study. *Journal of Epidemiology and Community Health*. 2020;74(4):346-53.
 24. Sentenac M, Benhammou V, Aden U, Ancel P-Y, Bakker LA, Bakoy H, et al.. Maternal education and cognitive development in 15 European very preterm birth cohorts from the RECAP Preterm platform [Internet]. *Int J Epidemiol*. 2021;dyab170.
 25. Lean RE, Paul RA, Smyser TA, Smyser CD, Rogers CE. Social Adversity and Cognitive, Language, and Motor Development of Very Preterm Children from 2 to 5 Years of Age. *The Journal of pediatrics*. 2018;203:177-84.e1.
 26. European Commission. Key data on early childhood education and care in Europe. –[Internet]. 2019. Available from https://eacea.ec.europa.eu/national-policies/eurydice/sites/default/files/ec0319375enn_0.pdf
 27. Gomajee R, El-Khoury F, Côté S, Van Der Waerden J, Pryor L, Melchior M. Early childcare type predicts children’s emotional and behavioural trajectories into middle childhood. Data from the EDEN mother–child cohort study. *Journal of Epidemiology and Community Health*. 2018;72(11):1033-43.
 28. Côté SM, Mongeau C, Japel C, Xu Q, Séguin JR, Tremblay RE. Child Care Quality and Cognitive Development: Trajectories Leading to Better Preacademic Skills. *Child Development*. 2013;84(2):752-66.
 29. Dall’oglio AM, Rossiello B, Coletti MF, et al. Do healthy preterm children need neuropsychological follow-up? Preschool outcomes compared with term peers. *Dev Med Child Neurol*. 2010;52(10):955-961. doi:10.1111/j.1469-8749.2010.03730.x

30. van Beek PE, van de Par K, van der Horst IE, van Baar AL, Vugs B, Andriessen P. The Need for Special Education Among ELBW and SGA Preterm Children: A Cohort Study. *Front Pediatr*. 2021;9:719048. Published 2021 Oct 20. doi:10.3389/fped.2021.719048
31. Muller J-B, Olivier M, Guimard P, Gascoin G, Roze J-C, Flamant C, et al. Predictive Value of the Global School Adaptation Questionnaire at 5 Years of Age and Educational Support at 7 Years of Age in Very Preterm Children. *The Journal of pediatrics*. 2020;226:129-34.e1.
32. Van Veen S, Aarnoudse-Moens CSH, Oosterlaan J, et al. Very preterm born children at early school age: Healthcare therapies and educational provisions. *Early Hum Dev*. 2018;117:39-43.
33. Seppänen AV, Draper ES, Petrou S, Barros H, Aubert AM, Andronis L, Kim SW, Maier RF, Pedersen P, Gadzinowski J, Lebeer J, Ådén U, Toome L, van Heijst A, Cuttini M, Zeitlin J; SHIPS Research Group. High Healthcare Use at Age 5 Years in a European Cohort of Children Born Very Preterm. *J Pediatr*. 2021 Dec 16:S0022-3476(21)01177-X. doi: 10.1016/j.jpeds.2021.12.006. Epub ahead of print. PMID: 34921871.
34. Zeitlin J, Sentenac M, Morgan AS, Ancel PY, Barros H, Cuttini M, Draper E, Johnson S, Lebeer J, Maier RF, Norman M, Varendi H; RECAP Preterm child cohort research group. Priorities for collaborative research using very preterm birth cohorts. *Arch Dis Child Fetal Neonatal Ed*. 2020 Sep;105(5):538-544. doi: 10.1136/archdischild-2019-317991. Epub 2020 Feb 6. PMID: 32029530; PMCID: PMC7547907.
35. Zeitlin J, Maier RF, Cuttini M, Aden U, Boerch K, Gadzinowski J, et al. Cohort Profile: Effective Perinatal Intensive Care in Europe (EPICE) very preterm birth cohort. *International Journal of Epidemiology*. 2020;49(2):372-86.
36. Piedvache, A., van Buuren, S., Barros, H. et al. Strategies for assessing the impact of loss to follow-up on estimates of neurodevelopmental impairment in a very preterm cohort at 2 years of age. *BMC Med Res Methodol*. 2021;118(21)
37. UNESCO Institute for Statistics. International standard classification of education: ISCED 2011: UNESCO Institute for Statistics Montreal; 2012.
38. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol*. 2004 Apr 1;159(7):702-6. doi: 10.1093/aje/kwh090. PMID: 15033648.
39. Mackay DF, Smith GCS, Dobbie R, Pell JP. Gestational Age at Delivery and Special Educational Need: Retrospective Cohort Study of 407,503 School children. *PLoS Medicine*. 2010;7(6):e1000289.
40. Pinto-Martin J, Whitaker A, Feldman J, et al. Special education services and school performance in a regional cohort of low-birthweight infants at age nine [published correction appears in *Paediatr Perinat Epidemiol*. 2004 Nov;18(6):467. Rosen-Bloch, Joan [corrected to Bloch, Joan Rosen]]. *Paediatr Perinat Epidemiol*. 2004;18(2):120-129. doi:10.1111/j.1365-3016.2003.00541.x
41. Bettge S, Oberwöhrmann S, Brockstedt M, Bühner C. Birth weight and special educational needs: results of a population-based study in Berlin. *Dtsch Arztebl Int*. 2014;111(19):337-344. doi:10.3238/arztebl.2014.0337
42. Verkerk G, Jeukens-Visser M, van Wassenaeer-Leemhuis A, Kok J, Nollet F. The relationship between multiple developmental difficulties in very low birth weight children at 3½ years of age and the need for learning support at 5 years of age. *Res Dev Disabil*. 2014;35(1):185-191.
43. Johnson S. Cognitive and behavioural outcomes following very preterm birth. *Semin Fetal Neonatal Med*. 2007;12(5):363-373. doi:10.1016/j.siny.2007.05.004

44. Patra K, Greene MM, Patel AL, Meier P. Maternal Education Level Predicts Cognitive, Language, and Motor Outcome in Preterm Infants in the Second Year of Life. *Am J Perinatol*. 2016;33(8):738-744. doi:10.1055/s-0036-1572532
45. Benavente-Fernández I, Synnes A, Grunau RE et al. Association of socioeconomic status and brain injury with neurodevelopmental outcomes of very preterm children. *JAMA Netw Open* 2019;2:e192914.
46. Seppänen AV, Bodeau-Livinec F, Boyle EM, et al. Specialist health care services use in a European cohort of infants born very preterm. *Dev Med Child Neurol*. 2019;61(7):832-839. doi:10.1111/dmcn.14112
47. Woolfenden S, Galea C, Badland H, et al. Use of health services by preschool-aged children who are developmentally vulnerable and socioeconomically disadvantaged: testing the inverse care law [published correction appears in *J Epidemiol Community Health*. 2020 Aug;74(8):680]. *J Epidemiol Community Health*. 2020;74(6):495-501. doi:10.1136/jech-2019-213384
49. Ballantyne M, Benzies K, Rosenbaum P, Lodha A. Mothers' and health care providers' perspectives of the barriers and facilitators to attendance at Canadian neonatal follow-up programs. *Child Care Health Dev*. 2015;41(5):722-733. doi:10.1111/cch.12202

Résumé

Introduction. L'éducation de la petite enfance offre des possibilités de stimulation dans de multiples domaines de développement et d'identification précoce et de soutien pour l'apprentissage et d'autres difficultés. Son impact positif sur les résultats à long terme et le bien-être est bien documenté. Cependant, peu d'études se sont intéressées à l'éducation précoce et à l'environnement éducatif des enfants nés Très PréMaturés (TPM ; <32 semaines de gestation) qui présentent un risque plus élevé de troubles du développement neurologique et de mauvais résultats scolaires que les enfants nés à terme. Cette étude a deux objectifs : (1) décrire l'environnement éducatif à cinq ans à l'aide d'indicateurs élaborés à partir d'une cohorte multinationale d'enfants nés VPT en Europe et (2) étudier les déterminants sociaux et périnataux de l'environnement éducatif à cinq ans et, en particulier, de la réception de services de soutien éducatif. **Méthodes.** Les données proviennent de la cohorte EPICE/SHIPS basée sur une population d'enfants nés TPM en 2011/2012 dans 19 régions de 11 pays européens. Les données périnatales ont été recueillies à partir de dossiers médicaux et les informations sur l'éducation à la santé et le développement de l'enfant à cinq ans, à partir de questionnaires parentaux. Les indicateurs caractérisant l'éducation précoce et le soutien/services scolaires ont d'abord été harmonisés et décrits pour chaque pays. Les services de santé liés au développement ont également été analysés afin d'identifier les enfants bénéficiant de services de soutien à l'école uniquement, dans le système de santé uniquement, dans les deux ou dans aucun des deux. Afin d'explorer le second objectif, les risques relatifs à toute fréquentation scolaire, la fréquentation à temps partiel et le fait de recevoir des services de soutien à l'école ont été estimés en utilisant un modèle de régression de Poisson modifié avec une interception aléatoire au niveau du pays et de la mère afin de tenir compte de la structure en cluster des données. **Résultats.** Parmi 6 759 enfants éligibles, 3 687 (55%) ont été suivis à cinq ans (âge gestationnel moyen de 28,8 semaines). A cinq ans, presque tous les enfants TPM étaient scolarisés, mais le programme éducatif (pré-primaire/primaire) et la fréquentation à temps plein/partiel différaient considérablement selon les pays. Près d'un enfant sur quatre recevait un soutien spécial à l'école (fourchette de pays : 13% à 34%). La classification des réponses libres des parents a permis d'identifier quatre domaines principaux de services reçus à l'école : l'aide à l'apprentissage, les services d'orthophonie, l'assistance motrice et le soutien émotionnel, social et comportemental. Lorsqu'ils sont intégrés aux services de développement en dehors de l'école, 59,2 % des enfants ne reçoivent aucun service, 3,6 % reçoivent des services à l'école uniquement, 17,9 % dans le système de santé uniquement et 19,4 % dans les deux ; mais les variations sont importantes d'un pays à l'autre (les services de développement reçus uniquement dans le système de santé vont de 7,6 % à 28,0 %). Les déterminants pour l'obtention de services de soutien éducatif étaient les difficultés de développement moteur, sensoriel, cognitif et comportemental (RR compris entre 3,45 et 7,41) ainsi que le faible niveau d'éducation de la mère, le sexe masculin et le fait d'avoir une mère célibataire. **Conclusions.** Les approches de l'éducation précoce varient considérablement en Europe. Alors que le type d'école et la fréquentation à plein temps ou à temps partiel sont principalement déterminés par les politiques nationales, de multiples caractéristiques sociodémographiques et de santé ont été associées à la réception de services de soutien éducatif. Les recherches futures devraient étudier les forces et les faiblesses de ces approches et leurs conséquences sur le bien-être des enfants et les résultats scolaires à plus long terme.

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Appendix 1. Page of the parental questionnaire at 5 years displaying the questions used to derive indicators on education

SHIPS ID (for office use)

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Childcare

In this section we ask some questions about who cares for your child and whether your child attends [standard educational program in country at this age]. We need this background information to tell us about the kinds of everyday experiences your child has.

1.1 What is your relationship to the child?

- ☐ Mother
 ☐ Father
 ☐ Other relative or family member
 ☐ Other caregiver

1.2 Please tell us who your child lives with. Please tick only one box.

- | | |
|--|---|
| <input type="checkbox"/> Both parents | <input type="checkbox"/> Mother only |
| <input type="checkbox"/> Father only | <input type="checkbox"/> Alternates between mother and father |
| <input type="checkbox"/> Other relative or family member | <input type="checkbox"/> With someone else, please specify: |
-

1.3a Is your child currently in preschool (for example, nursery or kindergarten), school or other educational programme? ☐ Yes ☐ No

If your child is not in any educational programme, please go to **question 2.1**.

1.3b If you answered yes, please specify the type of preschool, school or other educational programme your child currently attends. If your child attends more than one, please tell us about each one:

Type of educational programme For example nursery, kindergarten, school, special education or regular education.	Age when your child started		Does your child attend full or part-time?	
	Years	Months	Full-time	Part-time
			<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>

.....

1.3c Do you feel your child needs special educational support or services? ☐ Yes ☐ No

1.3d Does your child have special educational support or services? ☐ Yes ☐ No

1.3e If yes, please describe what type of support/service your child has:

.....

Appendix 2. Characteristics of children according to nature of developmental difficulties sub groups

	Low cognitive abilities ^a	Motor difficulties	Emotional/social/behavioral difficulties ^c
	n=219	n=468	n=362
Sociodemographic characteristics			
Male (%)	60.2	61.3	64.8
Maternal age at delivery (%)			
Less than 25 years	25.2	20.5	25.5
25-34 years	51.9	53.8	49.3
Greater than 35 years	22.9	25.7	25.2
Maternal educational level at 5 years (%)			
Low	32.6	24.8	24.9
Intermediate	48.0	44.1	49.7
High	19.4	31.2	25.4
Single Mother (%)	17.1	14.1	17.0
At least one parent unemployed (%)	22.9	17.2	18.0
Mother born in the country (%)			
Country born	68.9	70.6	74.1
European born	5.3	5.5	5.6
Non-European born	25.8	23.9	20.3
Perinatal characteristics			
Gestational age (%)			
23-24 Weeks	11.9	13.3	5.4
25-26 Weeks	15.3	30.6	15.8
27-28 Weeks	25.0	24.5	22.8
29-30 Weeks	32.0	21.4	28.3
31 weeks	15.8	10.1	27.7
Level of perinatal risk (%)			
Low	11.8	7.2	21.9
Medium	23.5	17.4	33.9
High	64.8	75.4	44.2
Birthweight (grams) (%)			
<1000	40.5	59.3	36.2
Parity	51.3	42.7	38.2
Moderate to severe health conditions at 5 years			
Motor difficulties (%)	54.0	100	27.9
Cerebral Palsy (%)	26.0	29.1	10.7
Sensory Impairment (Hearing or visual) (%)	20.3	14.8	9.0
Low cognitive abilities^{ab} (%)	100	37.4	34.5
Emotional/social/behavioral difficulties	44.6	25.9	100

Appendix 3. Example of the categories of education type agreed on by authors and distributed to partners in respective countries; Selected responses and categorization for Germany provided

School Type	Approximate English translation if possible	Day care/creche	Pre-school	Primary school	Special Education Settings
Betriebs-Kindergarten	company kindergarten	X			
Französischer Kindergarten	french kindergarten	X			
Ganztagsschule	all-day school			X	
Grundschule	primary school			X	
Integrationskindergarten	integrative kindergarten	X			X
Integrative Kindertagesstätte	integrative day care center	X			X
Integrativer kindergarten	integrative kindergarten	X			X
Kindergarten	kindergarten	X			
Kindergarten 8 - 14 Uhr	kindergarten	X			
Kindergarten mit Integration	integrative kindergarten	X			X
Kindergarten, Tagesmutter	kindergarten, day care mother	X			
Kinderkrippe	nursery	X			
Kindertagesstätte	day care center	X			
Kindertagesstätte	day care center	X			
Krippe	nursery	X			
Vorklasse	pre-school		X		
Vorschule	pre-school		X		

Appendix 4. Percentages of missing data of main variables of participants followed at 5 years and enrolled in an educational program

	n of missing	% of missing
Percentages on 3565 participants		
Educational environment characteristics		
Type of education	119	3.3
Reception of special education provision	46	1.3
Intensity of program	190	5.3
*Type of support services	41	6.9
Any developmental healthcare use	86	2.4
Socioeconomic and demographic characteristics		
Maternal Education	58	1.7
Maternal Cohabiting status	46	1.3
Household employment status	60	1.7
Child sex	0	0.0
Child age at survey	75	2.0
Maternal country of birth	16	0.5
Maternal age at birth	9	0.3
Perinatal characteristics		
Gestational age	0	0.0
Perinatal risk	90	2.6
Birthweight	0	0.0
Parity	40	1.1
Other Conditions		
CP at 5 years	20	0.6
Sensory Impairment	8	0.2
Motor Difficulties	13	0.4
Low Cognitive Abilities	69	2.5
Emotional/Social/Behavioral difficulties	245	6.9
Any difficulty or impairment	25	0.7

Note:

**Among those receiving support (n=591); excludes France*

Appendix 5. Distribution of children participating in an educational program at 5 years according to level of perinatal risk and country;
samples calculated using weighted percentages; missing values are not included in the calculations

Level of Perinatal Risk	Educational program participation (% Participating)		
	Among Low	Among Medium	Among High
Country	%	%	%
Belgium (Flanders)	100.0	100.0	99.2
Denmark (Eastern)	97.5	100.0	100.0
Estonia (whole country)	100.0	94.1	97.9
France (Burgundy, Northern, Ile-de-France)	100.0	99.4	100.0
Germany (Hesse, Saarland)	98.8	96.4	98.4
Italy (Emilia, Lazio, Marche)	99.6	98.7	99.4
Netherlands (East-Central)	100.0	97.1	98.0
Poland (Wielkopolska)	96.3	91.9	86.4
Portugal (Lisbon, Northern)	100.0	97.1	98.7
United Kingdom (East Midlands, Northern, Yorkshire)	100.0	98.5	99.2
Sweden (Stockholm region)	100.0	98.5	92.1
TOTAL	99.6	98.1	98.3

Note: Children with low (n=922), medium (n=1362) and high (n=1311) perinatal risk have complete data on the participation variable