Cognitive Development 62 (2022) 101173

Contents lists available at ScienceDirect

Cognitive Development

journal homepage: www.elsevier.com/locate/cogdev

Executive functions, child development and social functioning in premature preschoolers. A multi-method approach

A.M. López Hernández[a], M.D. Lanzarote Fernández[b,c,*], E.M. Padilla Muñoz[b,c]

[a] International Doctoral School, Faculty of Psychology, University of Seville, Camilo José Cela s/n, 41018 Seville, Spain
[b] Departamento de Personalidad, Evaluación y Tratamiento Psicologícos. Facultad de Psicología, Universidad de Sevilla. Avda. Camilo José Cela s/n, 41018 Sevilla, España
[c] Integral Paediatrics and Paediatric Psychology Research Group (CTS-152), Spain

ARTICLE INFO

Keywords:
Degree of prematurity
Development
Executive functions
Preschool
Gender
Birth weight

ABSTRACT

Thirty-six months is a key time to assess executive functions in premature children. Following an observational, cross sectional-comparative design, 57 children were assessed using development tests, parent reporting, and behavioural observation. The scores are in the average range, although greater vulnerability is observed in the motor skills, and in specific executive functions. The risk factors due to prematurity, sex, and behaviour observed during the assessment are related to achievement. The girls achieve better performance in global and fine motor skills. Lower gestational age is associated with poorer motor skills, and lower weight with linguistics. Parents of those born at higher birth weights or with lower prematurity report less Flexibility and Emotional Control. Data derived from functioning social observation support the results obtained using the development test and from the information provided by the parents. The results support a multi-method assessment at an early age be made part of protocol to reduce the impact of prematurity.

1. Introduction

The World Health Organization considers that prematurity continues to be a matter of relevance due to the increasing growth rate in developed countries (WHO, 2018). Recent analyses show that Spain is one of the European countries with the highest incidence of premature births, and there has been a progressive increase over the last decade (Hidalgo-Lopezosa, Jiménez-Ruz, Carmona-Torres, Hidalgo-Maestre, Rodríguez-Borrego & López-Soto, 2019; INE, 2019).

This increase in the number of premature births obliges child-health researchers and professionals to develop intervention strategies to guarantee the survival of the new-born, and to try to make up for or reduce the developmental consequences that might arise as a result of brain immaturity (Gong, Johnson, Livingston, Matula & Duncan, 2015; Nassar et al., 2019).

Neuroimaging techniques reveal brain abnormalities such as a significant reduction in the volume of the periventricular white matter, the corpus callosum, the cerebellum, and the grey matter in premature infants (Alcántara-Canabal, Fernández-Baizán, Solís-Sánchez, Arias & Méndez, 2020; Nassar et al., 2019). For this reason, the cognitive development of the preterm infant, compared to the full-term one, may differ substantially, and lead to an increase in psychological and behavioural problems (Alcántara-Canabal

* Correspondence to: Facultad de Departamento de Personalidad, Evaluación y Tratamiento Psicológicos, Facultad de Psicología. Universidad de Sevilla, Calle Camilo José Cela, s.n., 41018 Sevilla, Spain.

E-mail addresses: alopez.psico@gmail.com (A.M. López Hernández), lanzarote@us.es (M.D.L. Fernández).

https://doi.org/10.1016/j.cogdev.2022.101173
Received 23 November 2021; Received in revised form 4 March 2022; Accepted 11 March 2022
Available online 21 March 2022

et al., 2020; Dai et al., 2021).

It has been pointed out that being born preterm is one of the main causes of neurological development disorders in children, and an inverse relationship with birth weight and, especially, gestational age has been reported (Allotey et al., 2018). Numerous studies have established that being born preterm has a negative effect on achieving milestones in the motor, cognitive and language areas (López-Hernández et al., 2021; O'Meagher, Norris, Kemp & Anderson, 2018; Sastre-Riba, 2009).

With these deficiencies in mind, the possibility of disruption in other domains and functions of baseline development, such as executive functions (EF), may also be anticipated (Wolfe, Vannatta, Nelin & Yeates, 2015). These are essential for coordinating and achieving objectives, in decision-making, in selecting and storing information, as well as in planning action. They begin in the first months of life and are related to the makeup and maturity of the prefrontal cortex (O'Meagher, Kemp, Norris, Anderson & Skilbeck, 2017; O'Meagher et al., 2018; Sastre-Riba, 2009). There is no doubt that the EF's lay the foundations for proper learning and successful performance at school, as well as the transition to later stages of life (O'Meagher et al., 2017; Skranes, 2017).

In recent decades, some research has found that children with a history of prematurity have displayed executive dysfunctions, independently of the intellectual range (Bohm et al., 2004). This dysfunction becomes more evident as the children get older and are exposed to greater cognitive demands (Aarnoudse-Moens, Weisglas-Kuperus, Duivenvoorden, van Goudoever & Oosterlaan, 2013; Aviles et al., 2018; Hodel, Senich, Jokinen, Sasson, Morris & Thomas, 2017; O'Meagher et al., 2017, 2018; Sastre-Riba, 2009; Wehrle et al., 2016). These developmental and EF results differ depending on certain factors, including the sex of the premature infants. There are some works that indicate a worse prognosis for boys when it comes to reaching developmental milestones (Hintz, Kendrick, Vohr, Poole & Higgins, 2006; Kuban et al., 2016; Sierra-García et al., 2018; Thompson et al., 2018; Vu et al., 2017). The results also appear to differ with respect to the different domains involved in the EF's (Aarnoudse-Moens et al., 2013; Anderson, McNamara, Andridge & Keim, 2015; Pauen, Kliegel, Voigt, Pietz & Reuner, 2011; Ritter, Perrig, Steinlin & Everts, 2014) or associated risk factors, such as weight and gestational age (Ritter et al., 2014; van Houdt, Oosterlaan, van Wassenaer-Leemhuis, van Kaam & Aarnoudse-Moens, 2019).

In short, published material reports that premature birth may affect the development of EF's, and this may manifest itself in an increased risk of Attention Deficit Hyperactivity/Impulsivity Disorders (ADHD), Specific Learning Disorders (Aarnoudse-Moens, Smidts, Oosterlaan, Duivenvoorden & Weisglas-Kuperus, 2009; Aarnoudse-Moens et al., 2013; Alcántara-Canabal et al., 2020; Kuban et al., 2016; Sastre-Riba, 2009), and even Autistic Spectrum Disorders (ASD) (Bröring, Oostrom, van Dijk-Lokkart, Lafeber, Brugman & Oosterlaan, 2018). Because of all this, it can be said that premature labour, and associated neonatal experiences, affect early brain development and contribute to higher levels of hyperactivity, attention problems and impulsivity; sensory processing disorders; in other words, poor self-regulation (Aarnoudse-Moens et al., 2013; Andersson, Martin, Strand Brodd & Almqvist, 2017; Machado, Oliveira, Magalhães, Miranda & y Bouzada, 2016). However, most EF studies in preterm infants focus on school ages (from age 6) or are retrospective studies based on reviewing reports.

It is at three years of age that strategies of interpretation, socialisation, imagination and theory of mind begin to develop (Scharf, Scharf, & Stroustrup, 2016). All these skills can be considered as prerequisites for EFs, and they are the prelude to adaptive functions at higher ages (Eickmann, Malkes, de & Lima, 2012). However, there is a lack of consensus about the relationship between EF deficits and behaviour patterns in this at-risk population (O'Meagher, Norris, Kemp & Anderson, 2019).

The emergence of new tools to assess these domains using information provided by parents has been a great achievement, especially as they have been shown to have ecological validity (Huamán-Álvarez, 2021). However, the studies are still insufficient, especially in Spanish-speaking countries, due to insufficient adaptations and validation for early ages (Loe, Chatav, & Alduncin, 2015; O'Meagher et al., 2017). Most instruments focus on school age and adolescence (Huamán-Álvarez, 2021). Examples within our context are Alcántara-Canabal et al. (2020) and Sierra-García et al. (2018), but only the first study used assessment instruments adapted to the Spanish population.

Due to the impact of neuropsychological functions in learning and quality of life in general, this work has arisen because of a clinical concern to know what the level of development is, and its relationship with EFs in children with a history of prematurity, at the beginning of the pre-school stage in a Spanish-speaking sample. In addition, an exploration by a multi method assessment, parents, child and evaluator, will allow us to have a broader knowledge of the EF in this at-risk population.

In this regard, our first aim is to assess the development and executive functions in preschoolers because of their preventive value. Also, to consider any differences according to individual factors, such as gender, or risk factors, such as weight or gestational age. The second objective is to assess the relationship between the information obtained by parents, children and evaluator on cognitive competences. This would allow us to assess whether parents provide a realistic and practical description of children's strengths and difficulties in everyday settings.

2. Method

2.1. Participants

The population of new-borns born at less than 37 weeks at the selected tertiary level hospital was 641. A total of 243 met the inclusion criteria: gestational age (<34 weeks) and/or weight (<1500 g). Of these,177 cases were discarded because (a) families could not be contacted; (b) they did not attend the follow-up appointment at 36 months; (c) they had moderate and severe neurologic sequelae that made evaluation difficult. The families of 66 preterm infants were contacted. Neurological disorders were detected in seven children during the evaluation process, and two families who did not complete the FE report were discarded. The final sample was 57 children (33 boys and 24 girls). The number of reporting parents was 51 (there were four couples who had twins and one that had triplets). It is important to note that, currently, the follow-up protocol beyond 24 months has not yet been implemented in our country (SeNeo, 2017). Therefore, access to this sample was particularly complex.

Based on the WHO criteria (2018) for determining the degree of prematurity: 21.1% were extremely preterm (<28 weeks' gestation), 61.4% were very preterm (28 <32 weeks), and the remaining 17.5% were moderate preterm (32 < 34 weeks). See flow chart: Fig. 1. The normative group with which the sample is compared are those extracted directly from the tests, being adapted to the Hispanic population.

2.2. Measures

The Bayley Scale of Infant Development III (Bayley, 2015) was applied. The scale assesses levels of development of Cognitive, Motor (Gross and Fine), and Language (Expressive and Receptive) skills in children from 15 days to 42 months. The average range is between 85 and 115 points for composite figures, and 8–12 for scaled score. The Bayley Scale provide a comprehensive assessment of child development with a high prestige in the field of neurodevelopment (Bode, D'Eugenio, Mettelman & Gross, 2014; Herbón, Garibotti, & Moguilevsky, 2015), with acceptance for preterm populations (García-Martínez, Sánchez-Caravaca, Montealegre-Ramón & Pérez-López, 2019).

The Behaviour Observation Inventory (Bayley, 2015). Bayley-III complementary rating, consisting of 13 items, was completed by the examiner during the test. It scores the frequency (from "never or rarely" to "always or almost always") of behaviours such as: positive affect, enthusiasm, exploration, ease of engagement, cooperation, moderate activity, adaptation to change, alertness, distractibility, motor tone, tactile hypersensitivity, fear/anxiety and negative affect.

Parents completed the preschool version of the Behaviour Rating Inventory of Executive Function, BRIEF-P (Gioia et al., 2016). It allows measurement of the most everyday, behavioural, and observable aspects of executive functions in children aged 2–5 years. It consists of different indexes: Global Executive Composite (GEC), Inhibitory Self-Control Index (ISCI), Flexibility Index (FI), and Emerging Metacognition Index (EMI). There are also different scales related to executive functions: Inhibition (I), Flexibility (F), Emotional Control (EC), Working Memory (WM), and Planning and Organization (PO). T scores (mean 50 and SD 10) are obtained, where higher scores indicate more vulnerability or problems. It has proved to be useful for reaching a clinical diagnosis and assessing the prognosis of various disorders and has displayed a high level of internal consistency (Anderson et al., 2015).

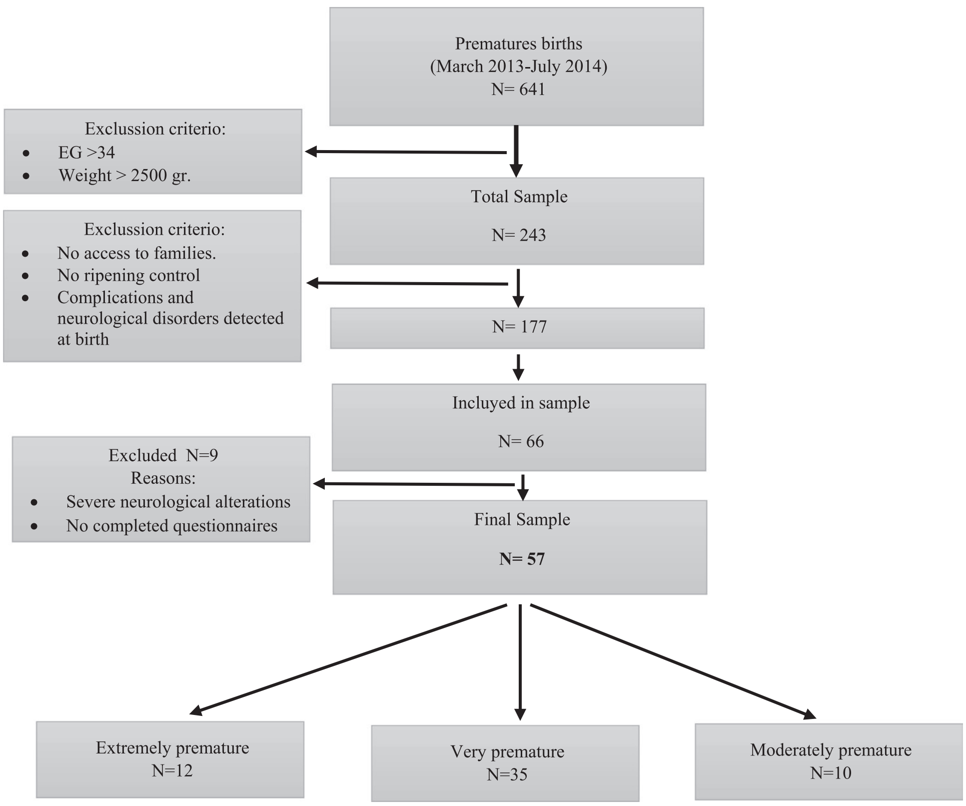

Fig. 1. Flow diagram showing the distribution according to GA at birth.

2.3. Procedure

The research complied with the ethical standards of the Andalusian School of Public Health of the Regional Government (EASP) and the Declaration of Helsinki. This study has also been approved by the Ethics Research Committee of the hospital where the research was conducted (code: 1560-N-18), and parental consent was obtained.

The children were assessed at 36 months (± 1 months) by the medical team (neonatology and paediatrics) of the tertiary hospital where the follow-up of their maturation development was performed. A qualified psychologist administered the Bayley-III scales in an appropriate and quiet setting, and the father, mother or both were present. The parents completed the EF assessment questionnaire.

2.4. Statistical analyses

A cross-sectional study of a descriptive, comparative and correlational type was carried out. The statistical analyses were performed using IBM SPSS Statistics, version 24.00 for Windows.

The required sample size was calculated with a confidence level of 95% (a= 0.05; Za= 1.96), a precision of 10% and a prevalence value known in the Spanish literature where the percentage of preterm births with sequelae was up to 30% (Alcántara-Canabal et al., 2019; García-Martínez et al., 2019; Gómez, Sánchez, García & Segovia, 2019). In this line, considering the starting population universe (243 cases), 61 was found to be the minimum sample size for an adequate probabilistic estimation. This result was corroborated using the statistical programme Epidat 4.1 of the Galician Health Service (Hervada, Naveira, Santiago, Mujica, Vázquez & Manrique, 2014). Therefore, we can consider that the results obtained will be consistent when analysing the sample as a whole and should be taken with caution when distributing them into subgroups.

The preliminary study of homogeneity of variance determined that there were several parameters with non-normal distribution, and therefore non-parametric tests were used. Means comparisons were performed using the binomial test and Cohen's d effect sizes (0.20 is taken as a null effect; 0.20–0.50, small; 0.50–0.80, medium; and more than 0.80, is a large effect) (Cohen, 1988).

Spearman's Rho test was performed to see the correlation between GA and weight and the dependent variables. Finally, the Mann-Whitney U test was performed for independent samples according to sex, degree of prematurity and weight.

3. Results

The sample consisted of 33 boys and 24 girls with a mean gestational age of 29.26 weeks. The largest group, at 61.4%, is in the "very preterm" category. 54.4% were born with a very low weight (≤ 1500 grs.); the mean weight of the sample being 1237.80 g (Table 1).

The developmental means on the Cognitive, Motor and Language scales obtained through the Bayley-III, are in the average ranges. However, when compared to the standard group, preterm infants have significantly lower results in motor skills, with a small effect size ($p = 0000$; $d = 0.42$). It was observed that 75% of the preterm sample was below the mean in this area (g.1% = 75) (Table 2).

In executive functions (EF), preterm infants fall within the average range, although with higher scores, indicating greater difficulties. All the scores obtained follow this trend, both in the indices and in the scales. Regarding the indices, significant data ($p < .000$) were noted in the Inhibitory Self-Control Index, Emergent Metacognition and the Global Executive Composite, all with a mean effect size. Inhibition, with a high effect size ($d = 0.95$), and Working Memory and Planning-Organization, with medium effect, stand out among the scales (Table 2). In all the indices and scales indicated, over 75% of preterm preschoolers have above-average results, which indicated a higher level of difficulties.

In relation to the variables of sex, gestational age (GA) and birth weight, the data show that preterm girls achieve better outcomes in the areas of development, with significant differences in Global Motor Skills (100.08 vs. 90.42; $p = 0.03$; $d = 0.636$) And in Fine Motor Skills (9.63 vs. 8.03; $p = 0.017$; $d = 0.73$) (Table 3). In contrast, no differences are observed in the EFs.

A positive relationship is observed between weight, GA and development (Tables 4 and 5). Increased GA is significantly associated with motor achievement (global, gross and fine motor), while weight is significantly associated with verbal achievement (global and expressive). However, higher GA and weight are related to more difficulties in EFs as flexibility and emotional control.

Table 1
Characteristics of the premature group.

Distribution	Mean /SD	n (%)
Sex		
Boy		33 (57.9%)
Girl		24 (42.1%)
GA	29.26 /2.30	
Extremely premature < 28		12 (21.1%)
Very premature 28 < 32		35 (61.4%)
Moderately premature 32 < 34		10 (17.5%)
Weight	1237.80 gr /314.17	
Extremely underweight ≤ 1000 gr.		16 (28.1%)
Very underweight ≤ 1500 gr.		31 (54.4%)
Underweight ≤ 2500 gr		10 (17.5%)

Note: GA = Gestational Age; SD = standard deviation.

Table 2
Bayley-III y BRIEF-P: comparison between groups of premature babies and normative group.

Evaluation Instruments	Group of Prematures		Normative Group		Binomial Test: mean of normative group		
	Mean	SD	Mean	SD	g.1%	sig	*d*
Development							
Cognition	9.89	2.498	10.0	2.6	60	.185	0.04
Language	97.30	13.113	99.7	12.3	46	.597	0.19
Motor	94.49	15.747	100.7	13.6	75	**.000**	**0.42**
Executive Function							
Inhibition (I)	56.05	9.909	48.10	6.514	25	**.000**	**0.95**
Flexibility (F)	51.05	10.424	50.64	10.395	56	.427	0.04
Emotional Control (EC)	55.09	11.114	51.93	9.076	40	.185	0.31
Working Memory (WM)	55.46	10.640	49.75	8.563	25	**.000**	**0.59**
Planning and Organization (PO)	56.18	9.955	49.94	8.123	25	**.000**	**0.69**
Inhibitory self-control index (ISCI)	56.23	9.627	49.54	7.471	23	**.000**	**0.78**
Flexibility index (FI)	53.75	10.832	51.64	7.853	44	.427	0.22
Emergent metacognition index (EMI)	56.14	10.307	49.21	8.270	23	**.000**	**0.74**
Global executive composite (GEC)	56.35	9.806	49.55	8.111	23	**.000**	**0.76**

Note: Scalar scores are used for the cognitive scale (mean =10; SD=2), and for language and motor composite scores (mean=100; SD= 15). BRIEF-P standard scores.
SD= Standar Deviation; g.1.%= below the mean of the group of prematuere babies; $p < 0.05$; d = Cohen effect size

Table 3
Results in the Bayley-III and BRIEF-P according to sex.

	Sex			
	Boy	Girl	Sig. ʋ	*d*
Development				
CS. COG	96.85	103.13	.102	0.529
CS. LANG	95.15	100.25	.147	0.400
SS. RC	10.21	10.88	.318	0.268
SS. EC	8.09	9.08	.154	0.457
CS. MOT	90.42	100.08	**.030**	**0.636**
SS. FM	8.03	9.63	**.017**	**0.73**
SS. GM	8.76	10.38	.102	0.506
Ejecutive Function				
I	55.00	57.50	.231	0.288
F	49.48	53.21	.087	0.364
EC	53.12	57.79	.323	0.407
WM	56.03	54.67	.571	0.126
PO	57.15	54.83	.240	0.227
ISCI	54.67	58.38	.149	0.374
FI	51.76	56.50	.147	0.109
EMI	56.97	55.00	.369	0.188
GEC	55.76	57.17	.656	0.139

Note: CS = Composite Scores; SS= Scalar Scores; COG = Cognitive; LANG = Language; MOT = Motor functions; RC= Receptive Communication; EC = Expressive Communication; FM= Fine Motor functions; GM= Gross Motor functions; Inhibition (I), Flexibility (F), Emotional Control (EC), Working Memory (WM), and Planning and Organization (PO, Inhibitory self-control index- (ISCI), Flexibility index (FI), Emergent metacognition index (EMI), Global executive composite (GEC). ʋ =U de Mann-Whitney ($p < 0.05$); d = Cohen effect size

When comparing the groups of preterm infants, there are significant differences between extreme and very preterm infants in developmental scales such as global, expressive and comprehensive language, as well as in global and gross motor skills ($p < 0.05$). There were also differences between extreme and moderate preterm infants in global, fine and gross motor skills ($p < 0.05$). On the other hand, there are no differences between very preterm and moderate preterm infants (Table 4). When the sample is categorised according to weight, no differences are found between the groups (Table 5).

Considering the subgroups of prematurity and weight, differences in EF were found between those with lower GA and weight in Global Executive Composite (GEC), Flexibility Index and Emotional Control. Also, between extreme and moderate preterm infants in the same EFs. Differences in Flexibility are also found between very preterm and moderate preterm (Tables 4 and 5).

By correlating development achievements and executive functions, the Spearman rho reveals that the higher the level of child development (Cognitive, Language, and Motor), the less difficulties there are in Working Memory, Planning-Organization, and the Emerging Metacognition Index. The highest correlation coefficient is found in the Cognitive area (Table 6).

On the other hand, there is a significant relationship between Cognition, Language and Motor Skills and different behaviours observed during the assessment. Positive observation parameters, such as ease of engagement, cooperation, moderate activity, adaptation to change, alert and motor tone, show a positive relationship with the three development areas. Conversely, distractibility

Table 4
Correlation, means and comparatives in the Bayley-III and BRIEF-P according to GA.

	GA						
	š	< 28 (1) Mean	28 < 32 (2) Mean	32 < 34 (3) Mean	1–2 ʋ	1–3 ʋ	2–3 ʋ
Development							
CS. COG	ns	96.25	100.31	100.50	ns	ns	ns
CS. LANG	ns	91.50	99.57	96.30	**.012**	ns	ns
SS. RC	ns	9.42	11.06	9.80	**.023**	ns	ns
SS. EC	ns	7.67	8.74	8.70	**.019**	ns	ns
CS. MOT	**.370****	86.08	96.06	99.10	**.032**	**.022**	ns
SS. FM	**.285***	7.67	8.86	9.40	ns	**.048**	ns
SS. GM	**.374****	7.67	9.80	10.30	**.032**	**.025**	ns
Ejecutive Function							
I	ns	54.25	56.29	57.40	ns	ns	ns
F	**.282***	48.42	50.06	57.70	ns	**.014**	**.009**
EC	**.327***	47.67	56.63	58.60	**.008**	**.008**	ns
WM	ns	53.17	56.54	54.40	ns	ns	ns
PO	ns	54.17	56.34	58.00	ns	ns	ns
ISCI	ns	52.00	57.06	58.40	ns	ns	ns
FI	**.357****	47.58	54.11	59.90	**.003**	**.003**	**.049**
EMI	ns	53.83	56.94	56.10	ns	ns	ns
GEC	ns	52.42	56.97	58.90	**.043**	**.043**	ns

Note: CS= Composite Scores; SS= Scalar Scores; COG= Cognitive; LANG= Language; MOT = Motor functions; RC= Receptive Communication; EC = Expressive Communication; FM= Fine Motor functions; GM= Gross Motor functions; Inhibition (I), Flexibility (F), Emotional Control (EC), Working Memory (WM), and Planning and Organization (PO, Inhibitory self-control index- (ISCI), Flexibility index (FI), Emergent metacognition index (EMI), Global executive composite (GEC). š =Sperman's coefficient * * $p < 0.01$; * $p < 0.05$. ʋ =U de Mann-Whitney; $p < 0.01$; $p < 0.05$.

Table 5
Correlation, means and comparatives in the Bayley-III and BRIEF-P according to weight.

	Weight						
	š	**≤ 1000 (1) Mean**	**≤ 1500 (2) Mean**	**≤ 2500 (3) Mean**	**1–2 ʋ**	**1–3 ʋ**	**2–3 ʋ**
Development							
CS. COG	ns	98.19	99.52	101.50	ns	ns	ns
CS. LANG	**.311***	93.19	98.13	101.30	ns	ns	ns
SS. RC	ns	9.63	10.65	11.40	ns	ns	ns
SS. EC	**.277***	8.00	8.61	9.00	ns	ns	ns
CS. MOT	ns	89.81	96.45	95.90	ns	ns	ns
SS. FM	ns	8.31	8.97	8.50	ns	ns	ns
SS. GM	ns	8.25	9.84	10.10	ns	ns	ns
Ejecutive Function							
I	ns	56.06	56.13	55.80	ns	ns	ns
F	ns	45.88	53.19	52.70	ns	ns	ns
EC	**.297***	48.81	58.19	55.50	**.001**	ns	ns
WM	ns	52.81	56.03	57.90	ns	ns	ns
PO	ns	52.63	57.52	57.70	ns	ns	ns
ISCI	ns	53.69	57.52	56.30	ns	ns	ns
FI	**.305***	46.94	56.94	54.80	**.000**	ns	ns
EMI	ns	52.94	57.13	58.20	ns	ns	ns
GEC	ns	52.38	57.94	57.80	**.050**	ns	ns

Note: CS= Composite Scores; SS = Scalar Scores; COG = Cognitive; LANG = Language; MOT = Motor functions; RC = Receptive Communication; EC = Expressive Communication; FM= Fine Motor functions; GM= Gross Motor functions; Inhibition (I), Flexibility (F), Emotional Control (EC), Working Memory (WM), and Planning and Organization (PO, Inhibitory self-control index- (ISCI), Flexibility index (FI), Emergent metacognition index (EMI), Global executive composite (GEC). š =Sperman's coefficient ** $p < 0.01$; * $p < 0.05$. ʋ =U de Mann-Whitney; $p < 0.01$; $p < 0.05$

Table 6
Association between Bayley-III and BRIEF-P.

		I	**F**	**EC**	**WM**	**PO**	**ISCI**	**FI**	**EMI**	**GEC**
Development	Cognition	-.210	.089	.100	**-.399***	**-.371****	-.082	.108	**-.421****	-.222
	Language	-.254	.093	.161	**-.328***	**-.277***	-.084	.160	**-.326***	-.160
	Motor	-.168	.215	.176	**-.311***	**-.298***	-.036	.249	**-.333***	-.109

Note: Inhibition (I), Flexibility (F), Emotional Control (EC), Working Memory (WM), and Planning and Organization (PO), Inhibitory self-control index- (ISCI), Flexibility index (FI), Emergent metacognition index (EMI), Global executive composite (GEC); Sperman's coefficient * * $p < 0.01$; * $p < 0.05$.

and negative affect, two parameters which indicate the presence of deficits, are inversely related to development (first part of Table 7).

Finally, about the EF's, it is observed that cooperation is inversely related to the Global Executive Composite. In other words, the greater the difficulties in collaborating during the assessment process, the greater the risk of difficulties with EFs in general ($p < 0.05$). A direct relationship between cooperation and the Inhibition, Working Memory and Emergent Metacognition Indices ($p < 0.01$) and the Inhibitory Self-Control Index ($p < 0.05$) is also evident. The negative affect expressed is related to deficits in the Working Memory and Emerging Metacognition Index ($p < 0.01$). This latter index, in addition to co-operation and negative affect, is inversely related to enthusiasm and easy of engagement ($p < 0.05$). Also, the latter two types of conduct show an inverse relationship with Planning-Organization ($p < 0.05$). And the alert level has been positively related to the indices of Flexibility and Flexibility Index, while moderate activity is negatively related to Inhibition ($p < 0.05$) (second part of Table 7).

4. Discussion

When assessing development, behaviour, and executive function (EF) at three years of age in preterm infants, developmental levels are obtained within the average range, in the basic areas of Cognition, Language, and Motor skills and in EF's.

However, preterm infants achieve significantly lower performance on the Motor scale when compared to the contrast sample by the normative group, and it is below the population mean by a high percentage. Thus, we observed that a lower GA is related to lower achievement in the motor area and a lower weight to worse language skills. These results support data found in other research where motor development and, to a lesser extent, language skills show greater vulnerability in children with a history of prematurity (Eickmann et al., 2012; López-Hernández, Padilla-Muñoz, Duque-Sánchez & Lanzarote-Fernández, 2021; Sierra-García et al., 2018).

Also, the results reported by the parents for EF's are within the mean range. Nevertheless, premature children show more difficulties in most subscales than the general population do. The areas most affected were those related to Inhibition, Working Memory, Planning-Organization, Inhibitory Self-Control Index, Emerging Metacognition Index and Global Executive Composite (GEC).

Thus, lower developmental and EF achievements in preterm infants are consistent with the results of previous studies (Machado et al., 2016; O'Meagher et al., 2019; Ritter et al., 2014; Skranes, 2017). Most of them point out that factors such as sex, gestational age and birth weight may be influencing the results in the acquisition and development of brain functions. Nevertheless, more difficulties in EF are found in children with higher birth weight or higher GA. This may be consistent with the presence of low intensity sequelae reported by Spanish Neonatology Society (SeNeo, 2017). Thus, a lower perception of risk makes it possible that they are not referred to early care. This intervention can facilitate the acquisition of EF within the guidelines and dynamics of therapy.

The literature states that girls show better performance in standardised assessment procedures (Hintz et al., 2006; Vu et al., 2017) and more favourable brain development, which means that the prevalence of deficits is much lower (Kuban et al., 2016). The results in the areas of development in girls support this positive trend, and are more evident in Motor Skills, both Global and Fine. These findings are consistent with other research that shows a higher risk during early childhood for preterm boys (Kuban et al., 2016; Sierra-García et al., 2018). In short, a certain slowing down in the rate of acquisition of developmental milestones is evident, which could be related to differences in brain development (Alcántara-Canabal et al., 2020; Nassar et al., 2019).

Regarding the relationship between sex and the development of EF's in preterms, the data are different from the Nagy, Kalmár, Beke, Gráf, and Horváth (2021) for higher ages. They suggest that EFs are more susceptible to biological risk in premature boys. As for Pauen et al. (2011), they hypothesized that sex might make a difference in self-regulation response, although they did not manage to prove it. Nor have more recent studies (Anderson et al., 2015; Ritter et al., 2014) or the meta-analysis by van Houdt et al. (2019) been able to prove it. In Spanish population, there is also no evidence of a relationship between EF development and sex. Although it is observed that preterm boys show higher levels of hyperactivity and behavioral problems, and girls more attention problems (Alcántara-Canabal et al., 2020).

Secondly, gestational age (GA) and birth weight are relevant in this population due to the associated perinatal complications and the impact on neurodevelopmental outcomes (Nassar et al., 2019; Thompson et al., 2018). The results obtained lend support to previous studies where the degree of prematurity is related to differences in development, but not with those who suggest that weight is not relevant (Aviles et al., 2018; Machado et al., 2016; Nassar et al., 2019; Ream & Lehwald, 2018; Wehrle et al., 2016).

Thus, regarding the groups of preterm infants, it is the extremely preterm infants who show the most developmental difficulties in motor skills. No differences are found between very preterm and moderate preterm infants. On the other hand, a lower weight is related to lower performance in Global Language and the field of Expressive. Language is one of the functions with the most prominent role at this age. However, expressive language is a function that is still in the process of being consolidated, so there may be more variability between groups. These discrepancies between language areas would be evidence of variable development, with greater vulnerability in groups with extreme prematurity (Ream & Lehwald, 2018).

Our data show that the degree of prematurity and birth weight have an influence on tasks related to the Flexibility Index (FI) such as: changing behaviour and showing flexibility in order to solve problems; and regulating emotional reactions according to the context. A longitudinal study with babies with moderate prematurity showed an executive pattern from the age of one and a half to two years, with some dysfunctional responses such as perseverance (Sastre-Riba, 2009). In the same way, others point out that premature babies have two to three times more difficulty initiating activities, and lower flexibility, inhibition and emotional control (Ares & Diaz, 2014).

On the other hand, research with preschoolers born preterm indicated a connection between EF's and more misadjusted behaviours in everyday environments, with variable and inconsistent results (Anderson et al., 2015; Arpi & Ferrari, 2013). We observe that extreme preterm children have lower scores in some functions, which are indicative of lesser difficulties. Thus, more difficulties are observed in children with higher birth weight or higher GA. This supports Arpi and Ferrari (2013), when they state that there is no direct relationship between the prevalence of self-regulation and behavioural problems and low gestational age. This could also relate

Table 7
Association between Observational Scale with Bayley-III and BRIEF-P.

	1	2	3	4	5	6	7	8	9	10	11
Development											
Cognition	ns	ns	ns	.421 **	.513 **	.444**	.503**	.281*	-.528**	.363 **	-.392 **
Language	ns	ns	ns	.365 **	.562 **	.516**	.477**	.413**	-.448**	.483 **	-.350 **
Motor	ns	ns	ns	ns	.310 *	.348**	.362**	.292*	-.264*	.440 **	-.314 *
Ejecutive Function											
Inhibition	ns	ns	ns	ns	-.465 **	-.291*	ns	ns	ns	ns	ns
Flexibility	ns	ns	ns	ns	ns	ns	ns	.365 *	ns	ns	ns
Emot. Control	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Work. Memory	ns	ns	ns	ns	-.408 **	ns	ns	ns	ns	ns	.395 **
Planning and Organization	ns	-.280 *	ns	-.299 *	ns	ns	ns	ns	ns	ns	ns
ISCI	ns	ns	ns	ns	-.278 *	ns	ns	ns	ns	ns	ns
FI	ns	ns	ns	ns	ns	ns	ns	.347 *	ns	ns	ns
EMI	ns	-.268 *	ns	-.279 *	-.365 **	ns	ns	ns	ns	ns	.344 **
GEC	ns	ns	ns	ns	-.287 *	ns	ns	ns	ns	ns	ns

Note: 1 Positive affect; 2 Enthusiam; 3 Exploration; 4 Easy of engagement: 5 Cooperation; 6 Moderate activity; 7 Adaptation to change; 8 Alertness; 9 Distraction; 10 Motor tone; 11 Negative affectivity;. Inhibitory self-control index- (ISCI), Flexibility index (FI), Emergent metacognition index (EMI), Global executive composite (GEC). Sperman's coefficient * * $p < 0.01$; *$p < 0.05$. Non-significant measures are indicated as "ns".

to the findings of O'Meagher et al. (2019), where parents, in contrast to teachers, provided more optimistic results. However, comparisons with other studies are complex due to variability in sample characteristics and assessment procedures, as well as lack of consensus in the conceptualization of EFs.

With regard to weight, a study conducted in Cuba with low-weight schoolchildren and their peers with standard weight at birth, showed lower development in Planning, Inhibitory Control, Working Memory and Mental Flexibility (Guerra, 2012). The results obtained partially coincide with them, as that weight is related to Flexibility and Emotional Control at 3 years of age. More difficulties may be experienced with EF's at an older age (Loe et al., 2019).

In general, it follows that the differences found with respect to the general population would be in connection with alterations in specific subprocesses rather than to generalized alteration of EF's. However, based on the results, variables such as gestational age, weight and the developmental stage of the child play an important modulatory role as suggested by García-Martínez et al. (2019) and Nagy et al. (2021). This reveals that, regardless of country, the acquisition of developmental milestones may be affected by these variables. Furthermore, there is agreement on the main risk criteria and on the need to monitor the entire preterm population (García-Martínez et al., 2019; Gong et al., 2015). Furthermore, there is a suggestion to extend the age-correction period in the assessment of preterm infants to at least 36 months, rather than 24 months as at present (Gong et al., 2015).

With respect to the information provided by parents on EF's and performance in the areas of development, we observed a negative relationship. In particular, when children reach higher levels of cognitive, linguistic, and motor functioning, parents perceive less difficulty in initiating, planning, organising, implementing, and evoking a response. All are basic competences in the three areas and information from parents seems to be reliable.

On the other hand, when we bear in mind the behaviour of the infant during the assessment, it can be seen that the negative characteristics are associated with worse developmental scores. Distractibility and negative affect would indicate greater vulnerability, especially in the cognitive and language areas. Similarly, behaviours such as ease of engagement, cooperation, moderate activity, adaptation to change, alert, and motor tone are associated with better achievements. Some of these observational parameters correspond to social functioning. In this sense, we might find similarities with studies that report a close relationship between EF's and social skills at school ages (Wolfe et al., 2015).

When connecting EFs to behaviour during assessment, it is Metacognition that has the closest relationship. Thus, greater vulnerability in the Emerging Metacognition Index is related to a low level of enthusiasm for the task, difficulty of engagement, low cooperation and a greater tendency to externalize negative affect. These results correlate with the "process skills" hypothesis described by Andersson et al. (2017), where children with limited skills to initiating and organising their conduct experience difficulties in participation. It is possible that this may lead to greater difficulties in everyday life (Anderson et al., 2015).

If we look further at the relationship between information from different informants (parents vs. assessors), we also find a positive relationship between the presence of negative affect during the assessment, and the parents' perception that there are difficulties in the Working Memory and Emergent Metacognitive Index. In this regard, Loe et al. (2019) point out that there is greater withdrawal during pre-school premature screening. Furthermore, a recent study of preterm babies at the age of seven reports that performance-based EF's and parent questionnaires relate difficulties with behaviour at home (Dai et al., 2021).

All of this suggests that, from early childhood, less effective regulatory strategies could be identified, which would pose a greater risk of problems or difficulties (Bröring et al., 2018).

However, we find some factors that may be indicative of improvement in development. Those children with ease of engagement, cooperation in the assessment process, adaptation to change and tasks, a continuous and adapted alert system, as well as an acceptable motor tone, display better adjustment in the different development areas. This relationship is also observed with regard to the self-regulation functions. These findings are of interest, as they would permit screening of this at-risk population, by their behaviour in various assessment or intervention settings.

In short, these results, which are consistent with those of Loe et al. (2019) emphasise the importance of using diverse complementary assessment methods. They provide a guide for professionals in their work of detecting risks or protective factors that may influence the functional results of the children in the medium term. The BRIEF-P scales are sensitive to executive deficits, and parental information and professional observation are related. As reported by Sherman and Brooks (2010), these measures would be appropriate in the neuropsychological study of preschool children. This would facilitate assessment from an everyday context through parental information, and from the structured context with clinical assessment.

However, this study has some limitations. The first limitation is the entire group belongs to the same environment and there is no contrast group. The second limitation is the sample size. However, we found previous research with similar sampling (Caravale, Tozzi, Albino & Vicari, 2005; Loe et al., 2019), and the sample analysis supports the results when all preterm children are considered. With respect to GA, the limitation lies in the proportion of moderate preterm infants. In our country, follow-up protocols usually include those born before 32 GA, exceptions are made when neurological sequelae or low weight for gestational age are detected.

As a future study strategy, the proposal is to expand the size of the sample to enhance and generalise the findings obtained. It would also be interesting to explore the perception of teachers or educators of children. On finding themselves in another context, they may be able to help uncover potential deficits or development markers and EF's.

Furthermore, it is essential to continue the work of assessing this at-risk population, and to extend these controls until the age of 6, or even later. It has been pointed out that the follow-up of very preterm or very low birth weight infants is not equitable in our context as in others (Pallás-Alonso et al., 2019). The findings found at this pre-school stage may indicate a characteristic vulnerability profile in premature infants, with consistent results among the different informants. Moreover, without proper intervention, such a profile might become consolidated in later stages; where demand levels are higher and could lead to limitations in day-to-day life.

5. Conclusions

Pre-school children born prematurely, whilst they reach average achievement outcomes, both in general development and in executive functions, are at increased risk of difficulties based on certain personal variables. Thus, male children and those with lower GA have a higher risk of presenting motor skill deficits, and those with lower birth weight in language.

Thus, boys have a higher risk of motor skill deficits, those with a lower GA of motor development difficulties and those with a lower birth weight in language. Conversely, higher weight or GA is associated with more difficulties in EF's. When it comes to gestational age, it influences performance in the language area and flexibility. In addition, numerous correlations have been found between development, EF's and the indicators observed during the assessment, which will need to be investigated further in future research.

The information obtained from this work may prove useful for paediatricians, education professionals and families. In all these areas, early detection of maladjustment and observation of interaction behaviour would allow for optimisation of referrals to intervene in the most deficient functions and to reduce adverse effects in later stages.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data Availability

The data presented in this study are available on request from the corresponding author.

Acknowledgements

We gratefully acknowledge both Jennifer Palomo Osuna for her collaboration in the collection of the sample and evaluation. We would also like to thank the collaboration of pediatricians Anabel Garrido Ocaña and Cristina Duque Sánchez and all the staff of the Neonatology Unit of the Virgen del Rocío Children's Hospital in Seville (Spain).

Formatting of funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or non-for-profit sectors.

Conflict of interest

The authors report no conflicts of interest.

References

Aarnoudse-Moens, Cornelieke Sandrine Hanan, Weisglas-Kuperus, N., Duivenvoorden, H. J., van Goudoever, J. B., & Oosterlaan, J. (2013). Executive function and iq predict mathematical and attention problems in very preterm children. *PLoS One, 8*(2), Article e55994. https://doi.org/10.1371/journal.pone.0055994

Aarnoudse-Moens, Cornelieke S. H., Smidts, D. P., Oosterlaan, J., Duivenvoorden, H. J., & Weisglas-Kuperus, N. (2009). Executive function in very preterm children at early school age. *Journal of Abnormal Child Psychology, 37*(7), 981–993. https://doi.org/10.1007/s10802-009-9327-z

Alcántara-Canabal, L., Fernández-Baizán, C., Solís-Sánchez, G., Arias, J. L., & Méndez, M. (2020). Identification of behavioural and emotional problems in premature children in the primary care setting. *Atencion Primaria, 52*(2), 104–111. https://doi.org/10.1016/j.aprim.2018.11.005

Allotey, J., Zamora, J., Cheong-See, F., Kalidindi, M., Arroyo-Manzano, D., Asztalos, E., & Thangaratinam, S. (2018). 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 and Gynaecology, 125*(1), 16–25. https://doi.org/10.1111/1471-0528.14832

Anderson, S. E., McNamara, K., Andridge, R., & Keim, S. A. (2015). Executive function and mealtime behavior among preschool-aged children born very preterm. *Eating Behaviors, 19*, 110–114. https://doi.org/10.1016/j.eatbeh.2015.07.006

Andersson, A. K., Martin, L., Strand Brodd, K., & Almqvist, L. (2017). Patterns of everyday functioning in preschool children born preterm and at term. *Research in Developmental Disabilities, 67*, 82–93. https://doi.org/10.1016/j.ridd.2017.06.005

Ares & Diaz. (2014). Seguimiento del recién nacido prematuro y del niño de alto riesgo biológico. *Programa de Formación Continuada En Pediatría Extrahospitalaria, XVIII*(6), 344–355.

Arpi, E., & Ferrari, F. (2013). Preterm birth and behaviour problems in infants and preschool-age children: A review of the recent literature. *Developmental Medicine and Child Neurology, 55*(9), 788–796. https://doi.org/10.1111/dmcn.12142

Aviles, C., Madariaga, P., & Hoffman, K. R. (2018). Comparative study of neupsychological functions in preterm and term childrens at eight years old. *Revista Chilena de Pediatria, 89*(4), 471–476. https://doi.org/10.4067/S0370-41062018005000602

Bayley N. (2015). *Bayley Scales of Infantil & Toddler Development, Third Edition* (Bayley III). Adaptación española CDIAP Parc Taulí, Universidad de Murcia y el Dpto. I+D Pearson Clinical & Talent Assessment.

Bode, M. M., D'Eugenio, D. B., Mettelman, B. B., & Gross, S. J. (2014). Predictive validity of the bayley, third edition at 2 years for intelligence quotient at 4 years in preterm infants. *Journal of Developmental and Behavioral Pediatrics, 35*(9), 570–575. https://doi.org/10.1097/DBP.0000000000000110

Bohm, B., Smedler, A. C., & Forssberg, H. (2004). Impulse control, working memory and other executive functions in preterm children when starting school. *Acta Paediatric, 93*(*10*), 1363–1371. https://doi.org/10.1080/08035250410021379

Bröring, T., Oostrom, K. J., van Dijk-Lokkart, E. M., Lafeber, H. N., Brugman, A., & Oosterlaan, J. (2018). Attention deficit hyperactivity disorder and autism spectrum disorder symptoms in school-age children born very preterm. *Research in Developmental Disabilities, 74*, 103–112. https://doi.org/10.1016/j.ridd.2018.01.001

Caravale, B., Tozzi, C., Albino, G., & Vicari, S. (2005). Desarrollo cognitivo en prematuros de bajo riesgo a los 3-4 años de vida. *Archivos de enfermedades en la infancia. Edición fetal y neonatal, 90*(6), F474–F479. https://doi.org/10.1136/adc.2004.070284

Cohen, J. (1988). *Statistical power analysis for the behavioral science*. In N. J. Hillsdale (Ed.) (second ed.). Lawrence Erlbaum Associates.

Dai, D., Franke, N., Wouldes, T. A., Brown, G., Tottman, A. C., Harding, J. E., & P. S. G. (2021). The contributions of intelligence and executive function on behaviour problems in school-age children born very preterm. *Acta Paediatrica. Advance Online Publication, 110*(6), 1827–1834. https://doi.org/10.1111/apa.15763

Eickmann, S. H., Malkes, N. F. de A., & Lima, M. de C. (2012). Psychomotor development of preterm infants aged 6 to 12 months. *Sao Paulo Medical Journal, 130*(5), 299–306. https://doi.org/10.1590/s1516-31802012000500006

García-Martínez, M. de la P., Sánchez-Caravaca, J., Montealegre-Ramón, M. del P., & Pérez-López, J. (2019). Valor predictivo de las escalas Bayley aplicadas a un grupo de niños nacidos pretérmino, sobre sus resultados en las Escalas Wechsler a los 10 años. *Anales de Psicología, 35*(1), 95–105. https://doi.org/10.6018/analesps.35.1.335071

Gioia, G.A., Espy, K.A. and Isquith, P.K. (2016). *BRIEF-P. Evaluación Conductual de la Función Ejecutiva-Versión Infantil. (E. Bausela y T. Luque, adaptadoras)*. Madrid: TEA Ediciones.

Gómez, E. C., Sánchez, C. J., García, S. F., & Segovia, G. M. (2019). Morbilidades del neurodesarrollo asociadas con el nacimiento pretérmino con peso ≤1500 gramos entre 1993 y 2011 en España: estudio de una muestra de 1200 casos. *Revista Española de Discapacidad, 7*(I), 29–47. https://doi.org/10.5569/2340-5104.07.01.02

Gong, A., Johnson, Y. R., Livingston, J., Matula, K., & Duncan, A. F. (2015). Newborn intensive care survivors: a review and a plan for collaboration in Texas. *Maternal health, neonatology and perinatology, 1*, 24. https://doi.org/10.1186/s40748-015-0025-2

Guerra, L.A. (2012). *Caracterización de las funciones ejecutivas en escolares con muy bajo y normo peso al nacer en la provincia de Camagüey.* [Tesis doctoral, Universidad Central Marta Abreu de las Villas. República de Cuba] ⟨https://dspace.uclv.edu.cu/handle/123456789/8264⟩.

Herbón, F., Garibotti, G., & Moguilevsky, J. (2015). Predicción temprana del resultado neurológico a los 12 meses en neonatos de riesgo en Bariloche. *Anales de Pediatria, 83*(2), 123–129. https://doi.org/10.1016/j.anpedi.2014.10.009

Hervada, X., Naveira, G., Santiago, M.I., Mujica, O.J., Vázquez, E., Manrique, R. et al. (2014). *Epidat: programa para análisis epidemiológico de datos*. (Versión 4.1). [Software de computador]. Xunta de Galicia. ⟨www.sergas.gal/Saude-publica/EPIDAT⟩.

Hidalgo-Lopezosa, P., Jiménez-Ruz, A., Carmona-Torres, J. M., Hidalgo-Maestre, M., Rodríguez-Borrego, M. A., & López-Soto, P. J. (2019). Sociodemographic factors associated with preterm birth and low birth weight: A cross-sectional study. *Women and Birth, 32*(6), e538–e543. https://doi.org/10.1016/j.wombi.2019.03.014

Hintz, S. R., Kendrick, D. E., Vohr, B. R., Poole, W. K., & Higgins, R. D. (2006). Gender differences in neurodevelopmental outcomes among extremely preterm, extremely-low-birthweight infants. *Acta Paediatrica, International Journal of Paediatrics, 95*(10), 1239–1248. https://doi.org/10.1080/08035250600599727

Hodel, A. S., Senich, K. L., Jokinen, C., Sasson, O., Morris, A. R., & Thomas, K. M. (2017). Early executive function differences in infants born moderate-to-late preterm. *Early Human Development, 113*, 23–30. https://doi.org/10.1016/j.earlhumdev.2017.07.007

van Houdt, C. A., Oosterlaan, J., van Wassenaer-Leemhuis, A. G., van Kaam, A. H., & Aarnoudse-Moens, C. S. H. (2019). Executive function deficits in children born preterm or at low birthweight: a meta-analysis. *Developmental Medicine and Child Neurology, 61*(9), 1015–1024. https://doi.org/10.1111/dmcn.14213

Huamán-Álvarez, M.E. (2021). Comparación del perfil ejecutivo de niños pre- escolares con y sin antecedentes de prematuridad moderada en un hospital de Lima metropolitana. [Tesis para optar el Grado de Maestría en Psicología Clínica, Universidad Peruana Cayetano Heredia] ⟨https://repositorio.upch.edu.pe/handle/20.500.12866/8982⟩.

INE, Instituto Nacional de Estadística (2019). *Nacimientos ocurridos en España 2019*. www.ine.es.

Kuban, K. C. K., Joseph, R. M., O'Shea, T. M., Allred, E. N., Heeren, T., Douglass, L., & Vogt, K. (2016). Girls and boys born before 28 weeks gestation: Risks of cognitive, behavioral, and neurologic outcomes at age 10 years. *Journal of Pediatrics, 173*. https://doi.org/10.1016/j.jpeds.2016.02.048, 69-75.e1.

Loe, I. M., Chatav, M., & Alduncin, N. (2015). Complementary assessments of executive function in preterm and full-term preschoolers. *Child Neuropsychology, 21*(3), 331–353. https://doi.org/10.1080/09297049.2014.906568

Loe, I. M., Heller, N. A., & Chatav, M. (2019). Behavior problems and executive function impairments in preterm compared to full term preschoolers. *Early Human Development, 130*, 87–95. https://doi.org/10.1016/j.earlhumdev.2019.01.014

López-Hernández, Á. M., Padilla-Muñoz, E. M., Duque-Sánchez, C., & Lanzarote-Fernández, M. D. (2021). Influence of perinatal complications on the development of a sample of 36-month-old premature infants. *Infant Behavior and Development, 62*, Article 101507. https://doi.org/10.1016/j.infbeh.2020.101507

Machado, A. C., Oliveira, S., Magalhães, L., Miranda, D. M., & y Bouzada, M. (2016). Sensory processing during childhood in preterm infants: A systematic review. *Revista Paulista de Pediatria, 35*(1), 92–101. https://doi.org/10.1590/1984-0462/;2017;35;1;00008

Nagy, A., Kalmár, M., Beke, A. M., Gráf, R., & Horváth, E. (2021). Intelligence and executive function of school-age preterm children in function of birth weight and perinatal complication. *Applied Neuropsychology: Child, 0*(0), 1–12. https://doi.org/10.1080/21622965.2020.1866571

Nassar, R., Kaczkurkin, A. N., Xia, C. H., Sotiras, A., Pehlivanova, M., Moore, T. M., & Satterthwaite, T. D. (2019). Gestational age is dimensionally associated with structural brain network abnormalities across development. *Cerebral Cortex, 29*(5), 2102–2114. https://doi.org/10.1093/cercor/bhy091

O'Meagher, S., Kemp, N., Norris, K., Anderson, P., & Skilbeck, C. (2017). Risk factors for executive function difficulties in preschool and early school-age preterm children. *Acta Paediatrica, International Journal of Paediatrics, 106*(9), 1468–1473. https://doi.org/10.1111/apa.13915

O'Meagher, S., Norris, K., Kemp, N., & Anderson, P. (2018). Examining the relationship between performance-based and questionnaire assessments of executive function in young preterm children: Implications for clinical practice. *Child Neuropsychology, 25*(7), 899–913. https://doi.org/10.1080/09297049.2018.1531981

O'Meagher, S., Norris, K., Kemp, N., & Anderson, P. (2019). Parent and teacher reporting of executive function and behavioral difficulties in preterm and term children at kindergarten. *Applied Neuropsychology: Child, 9*(2), 153–164. https://doi.org/10.1080/21622965.2018.1550404

Pallás-Alonso, C. R., Loureiro, B., De la Cruz Bértolo, J., García, P., Ginovart, G., Jiménez, A., & Vento, M. (2019). Spanish survey on follow-up programmes for children born very preterm. *Acta paediatrica, 108*(6), 1042–1048. https://doi.org/10.1111/apa.14647

Pauen, S., Kliegel, M., Voigt, B., Pietz, J., & Reuner, G. (2011). Cognitive development in very vs. moderately to late preterm and full-term children: Can effortful control account for group differences in toddlerhood? *Early Human Development, 88*(5), 307–313. https://doi.org/10.1016/j.earlhumdev.2011.09.001

Ream, M. A., & Lehwald, L. (2018). Neurologic consequences of preterm birth. *Current Neurology and Neuroscience Reports, 18*, 48. https://doi.org/10.1007/s11910-018-0862-2

Ritter, B. C., Perrig, W., Steinlin, M., & Everts, R. (2014). Cognitive and behavioral aspects of executive functions in children born very preterm. *Child Neuropsychology, 20*(2), 129–144. https://doi.org/10.1080/09297049.2013.773968
Sastre-Riba, S. (2009). Prematurity: longitudinal analysis of executive functions TT - Prematuridad: Analisis y seguimiento de las funciones ejecutivas. *Revista de Neurologia, 48*(supl.2), S113–S118.
Scharf, R. J., Scharf, G. J., & Stroustrup, A. (2016). Developmental milestones surveillance and screening. *Pediatrics in Review, 37*(1), 25–38. https://doi.org/10.1542/pir.2014-0103
SeNeo (Spanish Neonatology Society) (2017). *Protocolo de seguimiento para el recién nacido menor de 1500 g o menor de 32 semanas de gestación*. Lúa Ediciones 3.0., S.L.
Sherman, E. M. S., & Brooks, B. L. (2010). Behavior rating inventory of executive function - Preschool version (BRIEF-P): Test review and clinical guidelines for use. *Child Neuropsychology, 16*(5), 503–519. https://doi.org/10.1080/09297041003679344
Sierra-García, P., López-Maestro, M., Torres-Valdivieso, M. J., Díaz-González, C., Carrasco, M., Ares-Segura, S., & Pallás-Alonso, C. (2018). Developmental outcomes, attachment and parenting: Study of a sample of spanish premature children. *Spanish Journal of Psychology, 21*, Article E20. https://doi.org/10.1017/sjp.2018.22
Skranes, J. (2017). Executive function deficits in preterm subjects are a combination of social risk factors and brain maldevelopment. *Acta Paediatrica, International Journal of Paediatrics, 106*(9), 1380–1382. https://doi.org/10.1111/apa.13955
Thompson, D. K., Kelly, C. E., Chen, J., Beare, R., Alexander, B., Seal, M. L., … Cheong, J. L. Y. (2018). Early life predictors of brain development at term-equivalent age in infants born across the gestational age spectrum. *NeuroImage, 185*, 813–824. https://doi.org/10.1016/j.neuroimage.2018.04.031
Vu, H., Dickinson, C., & Kandasamy, Y. (2017). Gender difference in urvival for premature and low birth weight babies: A systematic review. *Journal of Paediatrics and Child Health, 53*(S2), 108–109. https://doi.org/10.1111/jpc.13494_320
Wehrle, F. M., Kaufmann, L., Benz, L. D., Huber, R., O'Gorman, R. L., Latal, B., & Hagmann, C. F. (2016). Very preterm adolescents show impaired performance with increasing demands in executive function tasks. *Early Human Development, 92*, 37–43. https://doi.org/10.1016/j.earlhumdev.2015.10.021
Wolfe, K. R., Vannatta, K., Nelin, M. A., & Yeates, K. O. (2015). Executive functions, social information processing, and social adjustment in young children born with very low birth weight. *Child Neuropsychology, 21*(1), 41–54. https://doi.org/10.1080/09297049.2013.866217
World Health Organization, WHO (2018, Marzo). Nacimientos Prematuros. ⟨https://www.who.int/es/news-room/fact-sheets/detail/preterm-birth⟩.