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Impact of birth type on infant development in gross motor, fine motor and language skills

Incidencias del tipo de nacimiento en el desarrollo infantil en la motricidad gruesa, motricidad fina y el lenguaje

Yulmis Rodríguez-Guerrero[1], Pedro Gil-Madrona[1], Luz Marina Méndez-Hinojosa[2], Paz Belén Fernández-Valero[3], Adrián Eduardo Vásquez-Cruz[4], Carlos Montoya-Fernández[1] y Patricia Teea-Gligan[1]

[1]Facultad de Educación de Albacete. Universidad de Castilla-La Mancha, España; [2]Universidad Autónoma de Nuevo León, Monterrey, México; [3]Escuela de Educación Física, Deporte y Recreación. Facultad de Educación. Universidad Bernardo O'Higgins, Chile; [4]Facultad de Psicología. Universidad Autónoma de Nuevo León, México.

Autor de correspondencia: Pedro Gil-Madrona. Pedro.Gil@uclm.es

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Abstract

The mode of birth –normal labor versus caesarean– could affect development and future health. Understanding these possible links could inform future interventions. The aim is to describe and correlate child developmental dimensions of gross and fine motor skills and language, as a function of segmentation by the birth type of normal and caesarean labor. The sample included 300 preschoolers aged 4 to 5 years in the municipality of Soledad, Colombia. The instrument used was the TEPSI. To determine the correlation between type of birth and domains, Pearson's bivariate correlation test with $p \leq 0.01$ was performed using SPPS V25.0 software. This study found that caesarean has significant positive correlations between coordination and language (r = .401; $p = .000$); coordination and motor (r = .577; $p = .000$); and between language and motor (r = .484; $p = .000$). Natural birth segmentation has a significant positive correlation between language and motor skills (r = .410; $p = .000$). The study supports the importance of knowing the mode of labor and its link with psychomotor development, owing to evidence from previous research that warns about the existence of negative effects on preschoolers born by cesarean section.

Keywords: Childhood; psychomotor development; psychomotor skills; Caesarean section; natural birth.

Resumen

El modo de nacimiento –parto normal frente a cesárea– podría afectar el desarrollo y a la salud futura. La comprensión de estos posibles vínculos podría servir de base para las intervenciones venideras. El objetivo es describir y correlacionar las dimensiones del desarrollo infantil en relación con la motricidad gruesa, fina y el lenguaje en función de la segmentación por el tipo de nacimiento de parto normal y parto por cesárea. La muestra incluía 300 preescolares de entre 4 y 5 años del municipio de Soledad, Colombia. El instrumento utilizado es el TEPSI. Para determinar la correlación entre el tipo de nacimiento y los ámbitos se realizó la prueba de correlación Bivariada de Pearson con $p \leq 0{,}01$ usando el software SPPS V25.0. El modo de nacimiento por segmentación de cesárea tiene correlación positiva significativa entre coordinación y lenguaje (r = .401; $p = .000$); coordinación y motricidad (r = .577; $p = .000$); y entre lenguaje y motricidad (r = .484; $p = .000$). El modo de nacimiento por segmentación de parto natural tiene una correlación positiva significativa entre lenguaje y motricidad (r = .410; $p = .000$). El estudio apoya la importancia de conocer el modo de parto y su vinculación con el desarrollo psicomotor, atendiendo a las evidencias de investigaciones previas que alertan de la existencia de efectos negativos para preescolares nacidos por cesárea.

Palabras claves: Infancia; desarrollo psicomotor; psicomotricidad; cesárea; parto natural.

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Introduction

The early years of childhood are a period of significant physical and mental development, as changes occur rapidly, numerous adaptations to the environment take place, and lifestyle habits begin to form (Gil-Madrona, Romero-Martínez, Sáez-Gallego, & Ordóñez-Camacho, 2019; Kim et al., 2020; Rodríguez-Guerrero, Gil-Madrona, Leon, & Vásquez-Cruz, 2023). Therefore, it is of great interest to investigate the various factors that influence this stage, including individual characteristics, interactions with the environment, and mode of birth (Morales-Silvestre and Leguía-Franco, 2018; Zaigham et al., 2020).

Regarding the mode of human birth, it can be divided into four categories: natural childbirth, assisted childbirth, cesarean section for medical reasons, and cesarean section for social reasons (Chen and Tan, 2019). Natural childbirth is a unique, spontaneous, and uncomplicated physiological process with which a woman completes her pregnancy, involving psychological and sociocultural factors (Federation of Associations of Midwives of Spain, 2011). It has positive effects such as establishing mother-child bonding and the psychological development of a child (Macías-Intriago et al., 2018). In fact, previous studies have found that children born through natural childbirth have better sensory integration capacity than children born via cesarean section (Kong et al., 2009; Yuan et al., 2009). However, it has been reported that natural childbirth is associated with a higher risk of neurological developmental delay (Molkenboer et al., 2006).

Cesarean deliveries were originally a surgical solution to solve the problems associated with difficult childbirth, but nowadays, there are no controls on their use (Chen & Tan, 2019). Currently, it has become an increasingly common mode of delivery, with countries such as Korea, Turkey, Mexico, Colombia, and Chile having rates ranging from 45% to 53% (Organization for Economic Co-operation and Development [OECD], 2019). However, cesarean births have numerous risks: they are associated with an increased risk of respiratory distress syndrome (Loor-Zambrano et al., 2022), the newborn may have an altered gut microbiotic composition (Penders et al., 2006), increased incidence of pneumothorax (García-Muñoz et al., 2014), and infantile-onset type I diabetes (Cardwell et al., 2008). In addition, they have been directly and

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indirectly associated with negative cognitive outcomes (Polidano et al., 2017), obesity (Chu et al., 2018), and lower motor and cognitive development at 9 months (Khalaf et al., 2015). Likewise, people who are born by cesarean section have more emotional disturbances and sleep problems in preschool age (Kelmanson, 2013).

The mode of birth – natural delivery versus cesarean section – could impact neonatal development and future health, so understanding these potential links could serve as a foundation for future interventions (Sandall et al., 2018). Previous studies have shown that adequate language development at one year of age is associated with the occurrence of a natural birth (Farkas and Corthorn, 2012), while children born by cesarean section exhibit lower motor, manipulative, visual, and personal autonomy skills (Rodrigues and Silva, 2018). However, there are few studies to confirm these findings. Therefore, the aim of this study is to describe and correlate dimensions of infant development in relation to gross and fine motor skills and language, based on the segmentation by the type of birth: natural delivery and cesarean section.

Material and method

Design and sample

The present study employs a descriptive correlational design using quantitative methods. It was conducted between the years 2021 and 2022 and includes preschoolers from the department of Atlántico, municipality of Soledad in the Colombian Caribbean. This study was approved by the Ethics and Coexistence Committee of the Jesús Maestro Educational Institution of Colombia (001/2022) in accordance with the Declaration of Helsinki (1961).

Out of the 32 institutions in the municipality of Soledad, two schools (chosen for accessibility to the sample) were invited to participate in the study. The sample was selected through convenience sampling and consisted of 300 preschoolers (4.5 ± 0.50 years) aged between 4 and 5 years (150 boys and 150 girls). In addition to the age requirement, preschoolers included in the study expressed their participation through informed consent provided by the acceptance of their families and/or legal guardians.

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Instruments and variables

The variables included in the study were: gross motor skills (gross motor skills), coordination (fine motor skills), and language (verbal comprehension and expression). These were assessed using the Psychomotor Development Test (TEPSI; Haeussler and Marchant, 2014), which is a screening test that evaluates gross motor skills, fine motor skills, and language. It allows determining the level of performance in psychomotor development of boys and girls aged 2 to 5 years in three areas: Coordination, Language, and Motor Skills. This is done through observation with a record sheet of the child's behavior in situations proposed by the examiner.

Each area or subtest is composed of items or tasks: 16 items for the coordination subtest (skills for grasping and manipulating objects and drawing), 24 items for the language subtest (aspects of language comprehension and expression), and 12 items for the motor skills subtest (skills for handling one's own body), scored with "1" point if the evaluated behavior is approved and "0" points if the evaluated behavior is not approved.

The instrument has demonstrated adequate validity and reliability for the study population (Haeussler and Marchant, 2014; Ishisaka and De la Cruz, 2018; Plazas, 2018). It has highly significant internal consistency, with a Kuder Richardson 20 (K-R 20) index of 0.94 for the total test, equally significant for the subtests (K-R 20 Coordination = 0.89; K-R 20 Language = 0.94; K-R 20 Motor Skills = 0.82).

Procedure and data analysis

The preschoolers completed the TEPSI in the order stipulated by the administration manual and were individually assessed by research personnel in a room provided by the institutions. Each assessment lasted between 30 and 40 minutes. There were no motivational stimuli or additional comments.

The data were analyzed using SPSS V25.0 (Statistical Package for the Social Sciences) with a predetermined significance level of $p \leq 0.01$. To check the normality of the sample, the Kolmogorov-Smirnov (K-S) analysis was conducted with Lilliefors significance correction to assess whether the sample was parametric or non-parametric. This test helps verify if the sample data come from a normal distribution and is used for

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continuous quantitative variables when the sample size is greater than 50 (Romero, 2016).

According to Flores and Flores (2021), the p-value of the K-S test has two parameters to determine the distribution of the sample and to assume or reject the Null Hypothesis:

- H0: The data follow a normal distribution.
- H1: The data do not follow a normal distribution.

If the sample has a p-value > 0.05, it is considered "parametric," and the null hypothesis (H0) is assumed. Conversely, if the sample has a p-value < 0.05, it is considered "non-parametric," and the alternative hypothesis (H1) is assumed. In Table 1, it can be observed that the significance levels are greater than 0.05, so the null hypothesis is assumed, and it is concluded that the data follow a "Normal" distribution.

Table n.º 1. *Normality Test of Psychomotor Development (TEPSI) Variables Segmented by Type of Birth (Cesarean and Natural)*

Type of birth		Kolmogorov-Smirnov[a]		
		Statistic	gl	Sig.
Coordination (TEPSI)	Caesarean	0.227	169	0.819
	Natural	0.184	131	0.871
Language (TEPSI)	Caesarean	0.225	169	0.779
	Natural	0.205	131	0.835
Motor (TEPSI)	Caesarean	0.187	169	0.857
	Natural	0.209	131	0.855

a. Lilliefors significance correction

Finally, to determine the correlation between the studied dimensions of child development segmented by the type of birth, and having verified the normal distribution of the sample, the bivariate Pearson correlation test was conducted.

Results

Table n.º 2 displays the descriptive characteristics of the study participants based on gender and type of birth.

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Table n.º 2. *descriptive characteristics of participants*

	SEX		
	All (n=300)	*Boys (n=150)*	*Girls (n=150)*
Caesarean	169	85	84
Natural birth	131	65	66

The analysis of psychomotor development and segmentation by the type of birth is presented in Table No. 3, where the mode of birth segmented by cesarean section shows a significant positive correlation between coordination and language (r = .401; p = .000); coordination and motor skills (r = .577; p = .000); and between language and motor skills (r = .484; p = .000). The Pearson correlation shows that the mode of birth segmented by natural delivery has a significant positive correlation between language and motor skills (r = .410; p = .000).

Table n.º 3. *Bivariate Pearson Correlation Test between Psychomotor Development (TEPSI) Segmented by Type of Birth (Cesarean and Natural).*

Tipo de Nacimiento			Coordination (TEPSI)	Language (TEPSI)	Motor (TEPSI)
Caesarean	Coordination (TEPSI)	Pearson Correlation	1	.401**	.577**
		Sig. (bilateral)		.000	.000
		N	169	169	169
	Language (TEPSI)	Pearson Correlation	.401**	1	.484**
		Sig. (bilateral)	.000		.000
		N	169	169	169
	Motor (TEPSI)	Pearson Correlation	.577**	.484**	1
		Sig. (bilateral)	.000	.000	
		N	169	169	169
Natural	Coordination (TEPSI)	Pearson Correlation	1	.142	.117
		Sig. (bilateral)		.105	.185
		N	131	131	131
	Language (TEPSI)	Pearson Correlation	.142	1	.410**

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	Sig. (bilateral)	.105		.000
	N	131	131	131
Motor (TEPSI)	Pearson Correlation	.117	.410**	1
	Sig. (bilateral)	.185	.000	
	N	131	131	131

TEPSI: Test of Psychomotor Development; $p \leq 0,01$.

Discussion

The objective of this study was to describe and correlate the dimensions of child development in relation to gross motor skills, fine motor skills, and language based on the segmentation by the type of birth (natural delivery and cesarean section). We found that boys and girls born by cesarean section showed a positive correlation with coordination and language, coordination, and motor skills, and between language and motor skills, compared to preschoolers born by natural delivery, who correlated between language and motor skills.

The influence of cesarean section on motor development outcomes has been previously reported, although its findings and explanations are still not entirely clear. However, previous studies have found that those born by cesarean section have a lower rate of locomotor skills, manipulative skills, visual skills, speech, and language compared to children born by natural delivery (Rodrigues and Silva, 2018). Similarly, it has been observed that children born by cesarean section has a risk factor for delayed gross motor development at the age of 9 months and again at 3 years (Khalaf et al., 2015). However, both studies assessed motor development in infants, which differs from our study focused on preschool age (4 to 5 years).

Various early events have been identified as potential risk factors for motor development outcomes in both boys and girls, with the mode of delivery being one of them (Grace et al., 2016), and gender being a determinant higher risk. Gender differences have been observed in other studies, in which girls scoring lower in the domain of gross motor skills if born by cesarean section, which did not occur with boys (Grace et al., 2016; Li et al., 2013). However, a previous study (Grace et al., 2016) reported that both girls and boys were at a higher risk of experiencing worse motor development outcomes in childhood and adolescence if born by cesarean section

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compared to natural delivery. It is important to note that our studies did not conduct analyses separated by gender.

Conclusion

In conclusion, this study found that preschoolers born by cesarean section showed a positive correlation with coordination and language, coordination and motor skills, and between language and motor skills. Boys and girls born by natural delivery correlated with language and motor skills. We recommend conducting additional studies to confirm the impact of gender on this correlation.

Our study supports the importance of understanding the mode of delivery and its connection to psychomotor development, considering the negative effects for boys and girls born by cesarean section. Furthermore, considering the evidence presented in the literature, it is evident how crucial the attention and awareness of society are in general. Therefore, it is important to improve the quality of information and its dissemination.

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