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Artigo

Affordances, Motor Development and Quality of Life of Preterm Babies

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Abstract: The present study aimed to analyze the behavior of anthropometric variables; home affordances for motor development; motor development; and quality of life in preterm infants. The study included 18 mothers and their respective infants. Anthropometric measures were analyzed using the Fenton Growth Chart and the WHO Anthro software; affordances were assessed using the *Affordances in the Home Environment for Motor Development – 3 to 18 Months*; motor development was evaluated using the *Alberta Infant Motor Scale*; and quality of life was assessed through the *Pediatric Quality of Life Inventory (PedsQL) – Infant Version*. Descriptive statistics indicated a predominance of adequate home environments, normal physical growth, appropriate nutritional status, and typical motor development. The Generalized Linear Model (GLM) revealed a significant effect only of infant sex on quality of life. It is suggested that when the home environment is favorable, infants tend to align with healthy growth and motor development standards. It appears that families with female infants demonstrate greater concern regarding their infants' quality of life. Future studies with larger samples are needed to confirm this hypothesis.

Keywords: Prematurity*; Affordances*; Motor development; Quality of life.

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Affordances, Desenvolvimento Motor e Qualidade de Vida de Bebês Prematuros

Resumo: O presente estudo teve como objetivo analisar o comportamento de variáveis antropométricas, *affordances* no ambiente doméstico que favorecem o desenvolvimento motor, o próprio desenvolvimento motor e a qualidade de vida de bebês prematuros. O estudo incluiu 18 mães e seus respectivos bebês. As medidas antropométricas foram analisadas utilizando os *Gráficos de Crescimento de Fenton e o software WHO Anthro*; os *affordances* no ambiente doméstico foram avaliadas utilizando o instrumento *Affordances in the Home Environment for Motor Development – 3 to 18 Months*; o desenvolvimento motor foi avaliado utilizando a *Escala Motora Infantil de Alberta*; e a qualidade de vida foi avaliada por meio do *Inventário de Qualidade de Vida Pediátrica* (PedsQL) – *Versão Infantil*. As estatísticas descritivas indicaram uma predominância de ambientes domésticos adequados, crescimento físico normal, estado nutricional apropriado e desenvolvimento motor típico. O Modelo Linear Generalizado (GLM) revelou um efeito significativo apenas do sexo do bebê sobre a qualidade de vida. Sugere-se que, quando o ambiente doméstico é favorável, os bebês tendem a apresentar crescimento e desenvolvimento motor adequados. Parece que as famílias com bebês do sexo feminino demonstram maior preocupação com a qualidade de vida de seus bebês. Estudos futuros com amostras maiores são necessários para confirmar essa hipótese.

Palavras-chave: Prematuridade; *Affordances*; Desenvolvimento motor; Qualidade de Vida.

Posibilidades, Desarrollo Motor y Calidad de Vida de los Bebés Prematuros

Resumen: El presente estudio tuvo como objetivo analizar el comportamiento de variables antropométricas; los *affordances* del entorno domiciliario para la motricidad; el desarrollo motor; y la calidad de vida de bebés prematuros. Participaron en el estudio 18 madres y sus respectivos bebés. Las medidas antropométricas fueron analizadas mediante la Gráfica de Crecimiento de Fenton y el software WHO Anthro; los *affordances* fueron evaluados mediante el *Affordances in the Home Environment for Motor Development – 3 a 18 meses*; el desarrollo motor fue evaluado mediante la *Alberta Infant Motor Scale*; y la calidad de vida fue analizada a través del *Pediatric Quality of Life Inventory (PedsQL) – Versión para Lactantes*. Las estadísticas descriptivas evidenciaron una prevalencia de entornos domiciliarios adecuados, normalidad del crecimiento físico, estado nutricional adecuado y desarrollo motor típico. El Modelo Lineal Generalizado (GLM) reveló un efecto significativo únicamente del sexo del bebé sobre la calidad de vida. Se sugiere que cuando el entorno domiciliario es favorable, el bebé tiende a ajustarse a los estándares de crecimiento y desarrollo motor saludables. Al parecer, las familias con bebés del sexo femenino presentan una mayor preocupación por la calidad de vida de los mismos. Se requieren estudios futuros con muestras más amplias para confirmar esta hipótesis.

Palabras clave: Prematuridad; Posibilidades; Desarrollo motor; Calidad de vida.

Introduction

The definition of prematurity involves all newborns with gestational age (GA) below 37 weeks. GA and birth weight are important indicators of biological risk for child development, being considered late preterm those born between 34 and 36 weeks and 6 days and extreme preterm ones born before 28 weeks of GA (Teixeira et al., 2019; Vanin *et al*., 2020).

It is important to say that in the case of preterm newborns, anthropometric references should consider their GA, and for the purpose of screening these variables, the corrected age should be considered, being the weight of the baby considered one of the main references for a healthy child development (Fenton *et al*., 2013; Caçola *et al*., 2010).

Considering the influence that context can exert to minimize problems arising from prematurity, sociocultural conditions may contribute to aggravate or minimize possible sequelae (Caçola *et al*., 2010).Thus, for example, motor *affordances*, that is, the environmental stimuli for motor development of the baby carry a unique importance to reverse the problems of motor delays (Saccani *et al*., 2013).

The home is the primary environment for development, in which the baby is expected to develop molar activities through reciprocal relationships with other people, handling objects and making use of symbols that promote his/her development (Bronfenbrenner *et al*., 2007). It is in the home that the human being has his/her first opportunities to play roles that are fundamental for building emotional ties and autonomy. The interaction between siblings or others present in the family environment, the structure of the architectural space, as well as the type of toy offered to the baby affects positively or negatively the motor development and quality of life (Nobre *et al*., 2009).

Quality of life (QoL) in childhood refers to psychological, physical, social, well-being, autonomy, health and leisure factors, including the individual's perception about his/her state of health and issues that pervade the health-disease process (Prebianchi; Barbarini, 2009). There is evidence that the quality of life of preterm children is less promising than that of their term peers however, it is necessary to investigate how some variables of interest can act as a protective factor of quality of life (Vieira; Linhares, 2011).

Providing adequate conditions for the development of preterm babies should be a priority assumed by the family and the State. It is no less important to identify the supporting factors that can act in protection and ensure a healthy development and a good quality of life. Therefore, the objective of this study was to evaluate how some variables of interest: physical

growth, nutritional status, *affordances* in the home and motor development can explain the quality of life of preterm babies.

Method

The study was conducted with families from two reference municipalities in the Cariri Region, Ceará, Brazil. Data collection occurred in the transition period after the COVID-19 pandemic, which implied the number of participants in the study, consisting of 18 mothers aged between 26 and 42 years (31.8±4.4) and their respective babies. The mothers, predominantly, had higher education, 11 (61.1%) and high school, 4 (22.2%) and 15 (83.3%) lived in nuclear families.

The criterion for the inclusion of babies in the study was that they were chronologically aged between 3 and 18 months at the time of data collection. Report of physical disability, poor congenital formation, neurological, visual and auditory alterations, and newborns who received motor or cognitive intervention outside the home environment were established as exclusion criteria. The babies that met the inclusion criteria presented gestational age between 28 and 36 weeks: ten boys (33.8±1.9) and eight girls (32.1±2.9), the corrected age varied in boys from 3 to 16 months (8.2±4.9) and in girls between 1 and 17 (10.2±6.3) months.

Considering the sample size (n = 18), the test performed (Mann-Whitney U) in the comparison of the average quality of life between the sexes, the significance level of 5% and the effect size observed from the results, a statistical power of 0.99 (99%) was obtained. Calculations performed using G*Power 3.1®.

Instruments

Anthropometric assessment

Anthropometric measurements of length, weight and head circumference were recorded from the vaccination record of the babies and measured during visits to families at the date of data collection. For the evaluation of normal physical growth and nutritional status, respectively, the graphs of Fenton *et al*. (2013) and the Who Anthro software, developed by the World Health Organization were used (WHO, 2011).

Neurodevelopmental assessment

To evaluate motor development, the Alberta Infant Motor Scale (AIMS) Piper *et al*. (1992), was used, validated and standardized for the Brazilian population (Valentini; Saccani, 2011). The instrument is intended to evaluate the motor development of term and preterm newborns between 0 and 18 months. The tool includes 58 motor criteria, distributed in 4 subscales: prone (21 items), supine (9 items), sitting (12 items) and standing (16 items), the evaluation is made from the free observation of the child in the four postures, totaling a maximum score of 58 points.

The scale allows the analysis of the performance of babies from the gross score obtained, which is converted into percentile and guides the classification of motor development in which the child is: a) percentile greater than 25 corresponds to typical motor performance; b) between 25 and 5, suspected delay; c) below 5, delays in motor performance (Valentini; Saccani, 2011).

Assessment of environmental stimuli for motor development (affordances)

The term *Affordance* is used to describe the opportunities for stimuli in the environment where the child develops. To evaluate *affordances* in the home to promote motor development, the questionnaire *Affordances* in the Home Environment for Motor Development - AHEMD – 3 to 18 months was used, validated for the Brazilian population (Caçola *et al*., 2015), and used in studies with preterm newborns (Caçola *et al*., 2010; Saccani *et al*., 2013; Defilipo *et al*., 2012).

The questionnaire is intended for parents or caregivers of children from 3 to 18 months, and consists of 48 questions related to the family environment and divided into 5 subscales: (1) outer space; (2) inner space; (3) variety of stimulation; (4) fine motor materials; (5) gross motor materials. The different groupings present answers, including dichotomous choices like yes/no. The statements are presented in a Likert type ranging from 1, low opportunity to 4, excellent (Caçola *et al*., 2015).

Assessment of quality of life

To evaluate the quality of life, the pediatric questionnaire of Quality of Life-PDSQL TM, Brazilian version, was used, being applied to mothers and/or caregivers. The versions for

children aged 1 to 12 months and 13 to 24 months were used. The 1-12 months scale version includes 36 items and covers 5 scales: (1) - Physical functioning (6 items); (2) Physical symptoms (10 items); (3) Emotional functioning (12 items); (4) Social Functioning (4 items); (5) Cognitive Functioning (4 items). The 13-24 months scale includes the same items as the 1-12 months version, with 9 additional items according to age: (1) Physical Functioning (9 items); (2) Physical Symptoms (10 items); (3) Emotional Functioning (12 items); (4) Social Functioning (5 items); (5) Cognitive Functioning (9 items) (Felce *et al*., 1995; Klatchoian *et al.*, 2008).

The instructions ask how much each item was a problem during the last month, and respondents (mothers and/or caregivers) use a 5-point response scale, from 0 to 4, and is transformed into a percentage (0 =never is a problem; 1 = almost never is a problem; 2 = sometimes is a problem; 3 = often is a problem; 4 = almost always is a problem). The items are scored inversely and transformed linearly to a scale of 0-100 (0 = 100; 1 = 75; 2 = 50; 3 = 25; 4 = 0), so that higher scores indicate better quality of life (QoL) (Felce *et al*., 1995; Klatchoian *et al.*, 2008).

Data analysis

Descriptive statistics with measures of central tendency and dispersion were performed to describe the characteristics of the study participants. The Mann-Whitney U test was used to compare the variables of interest between the sexes. To verify the effect of variables: sex, *affordances*, and age-controlled motor development corrected on the quality of life of the babies, the Generalized Linear Model (GLM) was used. The post hoc of Bonferroni was used when necessary and the sizes of the effects were interpreted from the standardized coefficients of Beta (β). The choice for GLM was given in order to be a robust statistical method for small samples, and allow the use of different probability distributions for the parameters of the dependent variable (Field, 2009).

Ethical and legal aspects

The study strictly complied with the guidelines and determinations set forth in Resolution n. 466 of December 12, 2012. All mothers signed the informed consent form (ICF)

in accordance with the methodological procedures adopted in the study. The research project was submitted and approved by the Human Research Ethics Committee of the home institution.

Results

Anthropometric characteristics

The anthropometric data of preterm newborns should be interpreted using the Z score or reference percentile for gestational age at birth (Fenton *et al*., 2013; Leone, 2014). Fenton *et al*. (2013) graph analysis showed prevalence of adequate weight for gestational age, where 7 (70%) male and 8 (100%) female babies were between the 10th and 90th percentiles, with a tendency to approach or exceed the 50th percentile with advancing age.

The term catch-up is used in health sciences to portray physical growth and nutritional status within the statistical limits of normality for age or maturity during a given period of time. The effect of catch-up is to lead the child to recovery according to the original pre-retarded growth curves (Boersma; Wit, 1997). Figure 1 compares the anthropometric characteristics of preterm newborns with the World Health Organization (WHO) reference curves for children at term, and Figure 2 compares the anthropometric characteristics of the babies throughout the study considering the corrected age. The data show that, at birth, preterm newborns were predominantly below the "Z -2" score in relation to the WHO reference curves for full-term children, however, Figure 2 highlights the catch-up effect (Boersma; Wit, 1997).

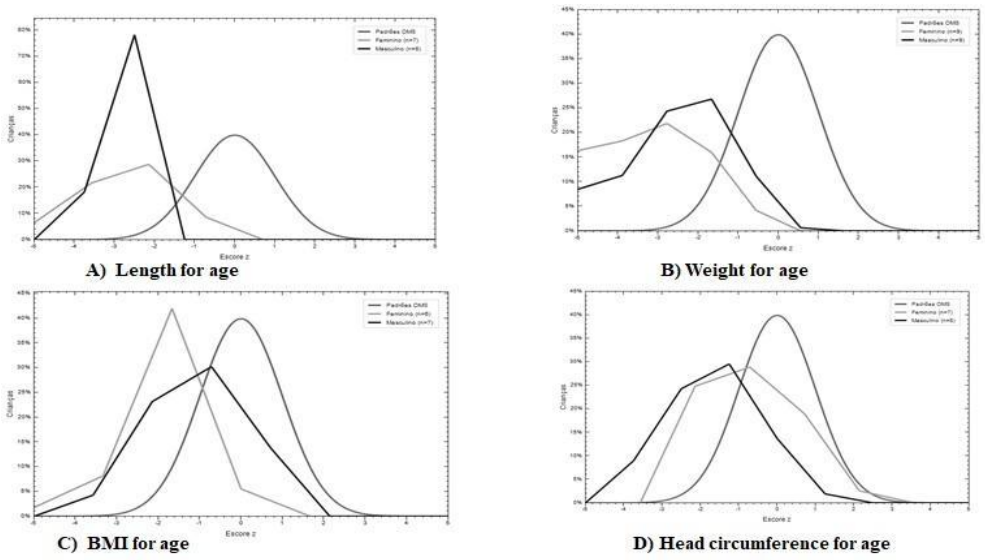

Figure 1: Comparison of Z scores for anthropometric data of preterm newborns according to sex in relation to WHO curves.

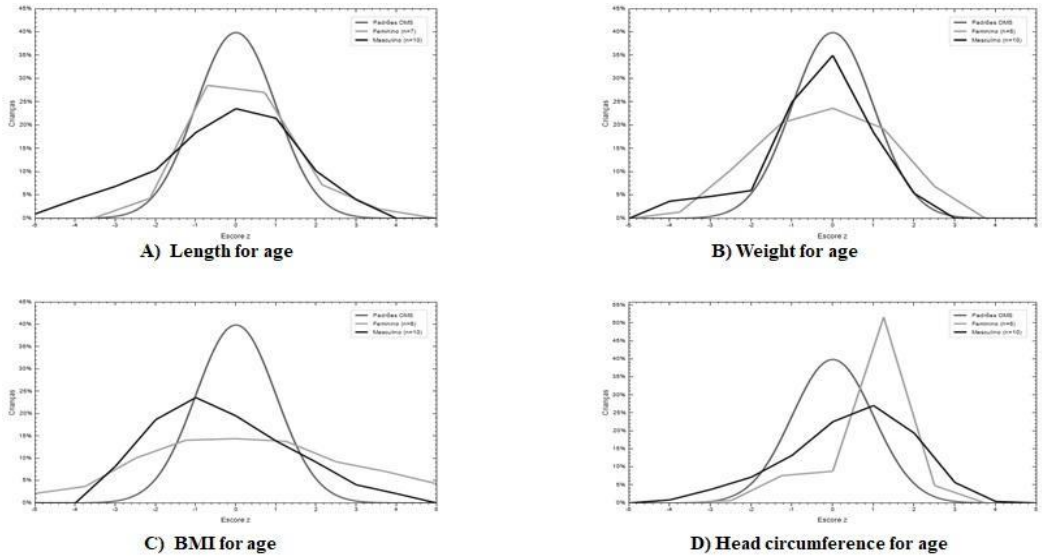

Figure 2: Comparison of Z scores for anthropometric data of preterm newborns using current age corrected according to sex in relation to WHO curves.

Characteristics of opportunities offered in the domestic environment for motor development (affordances)

Hereditary influences and experiences lived by children, as well as the specific demands of the tasks of movements, exert great influence on the rate of acquisition of rudimentary motor skills (Gallahue *et al.*, 2013). Table 1 below presents the characteristics of *affordances* in the domestic environment.

Table 1: Characteristics of opportunities for motor development in the home environment.

Affordances	**Sex**	**Max. Score**	**Mean (CI 95%)**	***p***
AHEMD_PS	Male	7	2.7±1.9 (1.3-4.1)	0.152
	Female	--	4.4± 2.8 (2.0- 6.7)	
AHEMD_VS	Male	20	13.1±4 (10.3-16.0)	0.620
	Female	--	14.1±4.6 (10.3- 18.0)	
AHEMD_GMT	Male	10	5.3±3.4 (2.8- 7.8)	0.632
	Female	--	6.0±2.4 (4.0-8.0)	

AHEMD_FMT	Male	12	4.5±3.0 (2.3-6.7)	0.480
	Female	--	5.8±4.3 (2.2-9.4)	
AHEMD_total	Male	49	25.6±9.5 (18.8-32.4)	0.365
	Female	--	30.3±11.7(20.4-40.1)	

*PS: Physical Space; VS: Variety of Stimulation; GMT: Gross motor toy; FMT: Fine motor toy.

Although there were no statistically significant differences in the stimuli for motor development in the domestic environment between the sexes, more favoring *affordances* were observed in female babies' homes. The lack of adequate toys for the development of babies showed *affordance* less favorable to motor development, especially in homes of male infants.

In terms of prevalence, the results showed that the opportunities for motor development in the domestic environment were: 4 (22.2%) inadequate, 6 (33.3%) moderately adequate, 5 (27.8%) adequate, and 3 (16.7%) excellent. The prevalence of affordances ranging from moderately adequate to excellent according to sex was 70% in male babies' households and 87.5% in female babies' households.

Characteristics of motor development

Although the rudimentary motor phase is considerably influenced by phylogenetic issues, ontogenetic issues cannot be disregarded (Gallahue *et al.*, 2013), particularly when it comes to preterm babies (Toneli *et al*., 2024), where the gains in development related to the process of neurological maturation are somewhat compromised. With relevant information, the study showed that no baby was identified with a percentile below 5 in AIMS (motor delays), the score ranged between 25 and 59 points in boys (49.5±10.3); CI: (42.1-56.9); M_d = 52.5 and, between 5 and 59 points in girls (47.0 ±18.0); CI: (31.9-62.1); M_d = 53.0, therefore there are no significant differences in the percentile obtained for motor development according to sex: W = 39.0; p = 0.964; r_b = -0.025. Only one male and one female baby were classified as having risks for motor delays.

Characteristics of the quality of life of babies

There were also no statistically significant differences in the subscales that make up the instrument of quality of life of infants (PDSQL ™ questionnaire) according to sex. Statistically significant difference was observed only in the total quality of life score in favor of female babies.

Table 2: Classification of children's quality of life according to sex.

Quality of Life	Sex	Maximum Score	Mean/CI 95%	*p*
PDSQL_PC	Male	100	92.8±14.3 (82.6-103.0)	0.955
	Female		94 ±14.6 (81.7-106.3)	
PDSQL_PS	Male	100	85.8 ±11.6 (77.5-94.2)	0.809
	Female		84.3 ±13 (73.6-95.2)	
PDSQL_EA	Male	100	76.1 ±12 (67.5-84.7)	0.884
	Female		75.1 ± 16 (61.8-88.5)	
PDSQL_SI	Male	100	80.2 ± 30.7 (58.2-102.2)	0.855
	Female		78.3 ±29.5 (53.7-103.0)	
PDSQL_Cog	Male	100	75.30 ±37.0 (49.0-101.7)	0.812
	Female		82.8 ±23.7 (63-102.78	
PDSQL_total	Male	100	74.8 ± 17.2 (62.5-87.1)	0.014
	Female		92.1 ± 4.4 (88.3-95.8)	

PC: Physical Capacity; PS: Physical Symptoms; EA: Emotional Aspect;
SI: Social Interaction; COG: Cognition.

For a better understanding of what these values represent, the classification of children's quality of life by sex showed that all female babies, 8 (100%), had a good quality of life rating, as, among male babies, this classification was heterogeneous: 2 (20%) with poor quality of life, 4 (40%) with moderate quality of life and 4 (40%) with good quality of life.

Analysis of Generalized Linear Model – GLM

The study used a Generalized Linear Model (GLM) to verify the effect of sex, *affordances* and age-corrected motor development on the quality of life of infants. The analyses

were performed from an adjusted GLM with normal distribution and identity binding function. This model presented better fit to the data based on the information criterion of Akaike (AIC = 153.7) compared to the adjusted GLM model with gamma distribution and identity binding function (AIC = 159.2). The AIC is interpreted considering that the smaller the better, suggesting that, for this cross-sectional design, the model with normal distribution was the most appropriate.

GLM revealed significant effect of only the sex of the baby on quality of life: [Wald (1.17) = 8.773; p = 0.003, where female babies showed mean scores of quality of life (95.7±5.5) higher than the mean scores obtained by male infants (79.6±5.6); p = *0.003*; β = -16.113).

Discussion

Physical growth and nutritional status are reliable indicators of possible health problems (Leone *et al*., 2014; Boersma, 1997). Anthropometric indices provide nutritional risk information, allowing early intervention if necessary (Leone *et al*., 2014). This study allowed verifying that the preterm newborns (PNB) managed to reach the levels of normality of physical growth and nutritional status over time, corroborating a review study that highlights that, when the environment is favorable, PNB present the ability to adapt healthy anthropometric references after a certain period of time (Vargas *et al*., 2017).

There is evidence that nutritional status can compromise the neurodevelopment of children (Caçola *et al*., 2010; Vargas *et al*., 2017), impacting some domains of human development even after a nutritional improvement. Thus, as important as the recovery of nutritional condition is to ensure that these conditions persist throughout life (Vargas *et al*., 2017).

Despite the adverse condition of prematurity, the catch-up effect [18] identified for anthropometric references seems to have worked as a protective factor for adequate motor development. In particular, children with low birth weight and preterm infants have a delay in motor development when compared to their peers at term and with ideal weight (Caçola *et al*., 2010).

The prevalence of motor development considered normal corroborates previous studies that adopted the corrected age to monitor the prevalence of motor delays (Formiga *et al*., 2015; Borba *et al*., 2013). As suggested by Teixeira et al. (2019), preterm infants with a mean

corrected age of approximately 9 months, as observed in the present study, may already demonstrate sufficient autonomy to ensure gains in specific motor skills.

These results attest to the ability of PNB also presenting a catch-up effect for motor development with advancing age. Apparently, the adequacy to the normal growth and motor development references occurs mainly after six months of life (Borba *et al*., 2013), but it is necessary to consider the corrected age, because chronological age overestimates the motor delays (Formiga *et al*., 2015). Moreover, as verified in this study, extreme preterm patients present a later catch-up for anthropometric references (Vargas *et al*., 2017) and motor development (Formiga *et al*., 2015).

Affordances (opportunities for motor development) with classification ranging from moderately adequate to excellent, especially in female baby's homes, also seem to have worked as a protective factor for proper motor development. There is concern, however, about the lack of material to develop gross and fine motor skills. This concern is shared with other authors cited in a review study (Ferreira *et al*., 2021).

The quality of the home environment is fundamental for the development of the baby in the first year of life. Factors such as socioeconomic level, variety of stimuli and availability of toys are the main factors that attest to the quality of the environment. It is important to highlight, however, that even in environments of high socioeconomic level, there may be *affordances* that are not conducive to motor development, such as inadequate architectural structures and mainly lack of sufficient materials for the development of gross and fine motor skills (Nobre *et al*., 2009; Defilipo *et al*., 2012; Ferreira *et al*., 2021). The fact is that, 15 years after the first publication on the subject in Brazil (Nobre *et al*., 2009), this problem persists, highlighting the need for advertising campaigns that inform the population about the importance of these material resources to promote child development.

Apparently, the prevalence of high maternal education identified in this study was the main *affordance* to promote motor development of children. This variable has been recognized as an important predictor of child development (Defilipo *et al*., 2012; Toneli *et al*., 2024; Ferreira *et al*., 2021), particularly when it comes to homes with preterm babies. Parents of preterm children tend to be insecure and overprotective, delaying the stimulation needed to compensate for prematurity (Raniero *et al*., 2010).

Our data analysis showed that, in general, female babies presented better results than their male counterparts. However, it is not consensual with what was identified in a previous

study (Silva *et al*., 2017). Studies with larger samples and or with longitudinal approach are important for a better understanding of this phenomenon.

For example, our generalized linear model highlighted the significant effect of females on quality of life, but only in the overall score. Recent study conducted with large samples, 882 parents and 581 children and adolescents from developed countries (Hijkoop *et al*., 2021), found that only from the age of 8 years old, female children tend to have a lower quality of life, mainly for physical functioning and emotional functioning.

Additionally, despite the prevalence of good quality of life in infants, this variable was not correlated with motor development. Similar results were observed in the study by Mélo *et al*. (2020), in Paraná, where 64% of babies had a good quality of life, but the correlation with motor development was low ($r = -0.221$, $p = 0.039$). These authors found that the quality of life of preterm babies was associated with motor development only for physical and cognitive functioning.

Last but not least, prematurity is a stressor for parents who are constantly concerned about the health and survival of their baby. Mothers of preterm babies tend to perceive their quality of life as inferior when compared to mothers of full-term infants because they are in a shaken state of mental health (Eiser *et al*., 2005). The prevalence of good quality of life in babies in this study is reassuring for the family members who participated in the study, as it demonstrates resilience of mothers to the vulnerability situation of their children. We assume the lack of control of this variable as another limitation of this study and suggest that additional studies consider investigating the quality of life of family members.

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