Original Article

Analysis of neuropsychomotor development of preterm in multidisciplinary ambulatory: a view of physiotherapy

Análise do desenvolvimento neuropsicomotor de pré-termos em ambulatório multidisciplinar: um olhar da fisioterapia

Nicole Almeida[1]

Daiane Aparecida da Silva[2]

Larissa Rebola Volpi da Silva[3]

Audrin Said Vojciechowski[4]

Arlete Ana Motter[5]

Talita Gianello Gnoato Zotz[6]

[1,2,5]Universidade Federal do Paraná (Curitiba). Paraná, Brazil. nicolealmeida854@gmail.com, daiane.silvaa97@gmail.com, arlete.motter@uol.com.br
, [3]Complexo Hospital de Clínicas da Universidade Federal do Paraná (Curitiba). Paraná, Brazil. larissa_ela@hotmail.com
[4]Universidade Federal do Paraná (Curitiba), Faculdade UniBras (Juazeiro). Paraná, Bahia, Brazil. asaidvoj@gmail.com
[6]Corresponding author. Universidade Federal do Paraná (Curitiba). Paraná, Brazil. talita.gnoato@gmail.com

ABSTRACT | INTRODUCTION: From gestation to birth, neuropsychomotor development is influenced by several biopsychosocial factors. This influence can be even more accentuated in preterm newborns due to their admission to the Neonatal Intensive Care Unit, so preterm babies are more susceptible to these influences. **OBJECTIVE:** To analyze the neuropsychomotor development of preterm babies in a multidisciplinary outpatient clinic of a public hospital. **METHODOLOGY:** Observational and longitudinal, ambispective study of 19 children born prematurely from 0 to 12 months of corrected age, being exclusion criteria children with cognitive and/or genetic alterations or not having signed the consent form. The data were collected through the analysis of medical records between August 2017 and December 2018, the development evaluated through the Denver II Triage Test, in two moments: A1 and A2, on their admission and return to service after discharge from the Neonatal Intensive Care Unit and for analysis of the relationship between mother and baby the Evaluation Mother/Son bond only in A1 was used. The stimulations were carried out employing orientation and educational folder for parents and guardians. The data were analyzed by means of mean, standard deviation, absolute and relative frequency, median, minimum and maximum, and Wilcoxon Test for the domains of Denver II A1 compared to A2, using the SPSS program version 20.0. **RESULTS:** 19 children were accompanied, and 79% of these were classified with normal development in A1. The children who presented deficits in A1 (10.5%), surpassed in A2. However, in the second attendance, some started to present difficulties in new tasks/domains (motor, fine motor, and personal-social), so that 31.5% presented abnormal general development in A2. A significant value was found when comparing the Denver II general classification in A1 with A2 (p=0.02). The mother-child bond was classified as weak (average of 5.8 points). **CONCLUSION:** It was observed that babies overcame the delays identified in the first evaluation, although the results in Denver had variations over time. Thus, it is believed that the family profile identified in this research plus the multi-professional approach may have favored the neuropsychomotor development of premature babies up to 12 months of corrected age.

KEYWORDS: Premature Newborn. Physiotherapy. Child Development. Early Stimulation.

RESUMO | INTRODUÇÃO: Desde a gestação até o nascimento, o desenvolvimento neuropsicomotor é influenciado por diversos fatores biopsicossociais. Tal influência pode ser ainda mais acentuada em recém-nascidos pré-termo devido a internação na Unidade de Terapia Intensiva Neonatal, por isto, bebês pré-termos estão mais susceptíveis a essas influências. **OBJETIVO:** Analisar sob a ótica do fisioterapeuta o desenvolvimento neuropsicomotor de pré-termos em ambulatório multidisciplinar de um hospital público. **METODOLOGIA:** Estudo observacional e longitudinal, ambispectivo, de 19 crianças nascidas prematuras de 0 a 12 meses de idade corrigida, sendo critério de exclusão crianças com alterações cognitivas e/ou genéticas ou não terem assinado o termo de consentimento. Os dados foram coletados por meio da análise de prontuários entre agosto de 2017 e dezembro de 2018, o desenvolvimento avaliado por meio do Teste Triagem Denver II, em dois momentos: A1 e A2, em sua admissão e retorno ao serviço após a alta da Unidade de Terapia Intensiva Neonatal e para análise da relação entre mãe e bebê foi utilizada a Avaliação Vínculo Mãe/filho apenas em A1. As estimulações eram realizadas por meio de orientações e folder educativo para os pais e responsáveis. Os dados foram analisados, por meio de média, desvio-padrão, frequência absoluta e relativa, mediana, mínimo e máximo e Teste de Wilcoxon para os domínios do Teste Denver II A1 em comparação a A2, utilizando o programa SPSS versão 20.0. **RESULTADOS:** Foram acompanhadas 19 crianças, destas 79% foram classificadas com desenvolvimento normal no A1. As crianças que apresentaram déficits no A1 (10,5%), superaram no A2. Porém, no segundo atendimento, algumas passaram a apresentar dificuldade em novas tarefas/domínio (motor, motor fino e pessoal-social), de modo que 31,5% apresentaram desenvolvimento geral anormal em A2. Foi encontrada diferença significativa (p=0,02) ao comparar as classificações gerais de Denver II nos dois momentos de avaliação. O vínculo mãe-filho foi classificado como fraco (média de 5,8 pontos). **CONCLUSÃO:** Observou-se que os bebês superaram os atrasos identificados na primeira avaliação, embora os resultados no Denver tiveram variações ao longo do tempo. Dessa forma, acredita-se que o perfil familiar identificado nesta pesquisa somada a abordagem multiprofissional possa ter favorecido o desenvolvimento neuropsicomotor dos bebês prematuros com até 12 meses de idade corrigida.

PALAVRAS-CHAVE: Recém-Nascido Prematuro. Fisioterapia. Desenvolvimento infantil. Estimulação precoce.

Introduction

Biological, environmental, social, and cultural factors influence child development. This process is explained by the biopsychosocial approach that takes into account the interaction between health conditions and factors of the biological and environmental context[1]. Associated with this, the Theory of Dynamic Systems is considered, within the different systems present in the organism, whether mechanical or sensory stimuli of the environment, its small parts have determinacy over the whole, and with this, movement can emerge as a result of the interaction between the different elements, without control or pattern coming from the nervous system[2].

Considering this, children born preterm have a higher risk of motor delays because, in addition to physiological immaturity, repetitive pain, mechanical ventilation, invasive procedures, and excessive and inadequate environmental stimuli are also exposed, resulting from their extended stay in Neonatal ICUs (NICU)[3]. In addition to these factors, others such as low birth weight, early and prolonged hospitalization, perinatal asphyxia, apnea, infections, jaundice(icterus), intracranial hemorrhages are risk factors for delays in child development[3].

After hospital discharge, it is also necessary to consider the environmental risks to the motor development that the child encounters, such as the physical space in which the child lives, the parents' schooling, family dynamics, the purchasing power of the family, family relationships and maternal bonds[4]. Concerning the mother-child bond, it is abruptly interrupted, due to premature delivery, because the newborn will need intensive care in a hospital environment[5].

Due to all these factors, it is essential that premature infants are evaluated in the context of motor, neurological and behavioral alterations for the early detection of possible difficulties and, consequently, the physiotherapist will outline an early intervention that contemplates as many biopsychosocial factors as possible.

The early intervention programs for premature babies have a positive influence on cognitive and motor development during childhood. In this sense, the Ministry of Health has set goals for early stimulation, considering both the ambulatorial environment and the family environment, enabling multi-professional action. Besides, it is suggested guidance to parents and the community regarding continuous follow-up from birth to school age[6].

Recent advances in the areas of obstetrics and neonatology are responsible for increasing the survival rate of preterm births[7] so that the city of Curitiba and the metropolitan region concentrate 30% of births in the state of Paraná, of which 9.9% are born before 37 weeks of gestation[8]. In, preterm children who survive have a higher risk of short and long-term morbidities[3].

Therefore, it is necessary to carry out the evaluation of the NPMD (NeuroPsychoMotor Development) and its monitoring to identify potential risks, delays, or improvements to identify strategies to prevent and/or minimize delays in the motor development of these premature infants through family instrumentalization.

Thus, the study aimed to analyze from the perspective of the physiotherapist the neuropsychomotor development over the first 12 months of corrected age of pre-terms followed up in a multidisciplinary ambulatorial clinic.

Methodology

The present study, of an observational overview, ambispective and longitudinal follow-up during the first year being the total period of the study from 2017 to 2019, approved by the HC-UFPR Human Research Ethics Committee, document n°. 2.330.736, CAAE 58865616.7.0000.0096 was performed with premature children after discharge from the Neonatal Intensive Care Unit.

The follow-ups were carried out in a pediatric ambulatory in a Public Hospital in Curitiba. Data collection took place between August 2017 and December 2018. Families performed multidisciplinary monitoring every 3 months, in which the baby's development was evaluated/reassessed by a team of neuropediatric doctors, physiotherapists, social workers, occupational therapists, and psychologists.

The sample consisted of premature babies, corrected aged from 0 to 12 months, preterm, after discharge from the NICU. The sample excluded: babies who presented lesions in the central nervous system, genetic alterations, who had undergone abdominal surgical procedures, and/or those responsible for having refused to sign the Informed Consent Form. Those responsible also needed to be committed to the dynamics of the service provided, since they needed to spend the whole afternoon in care and also carry out the guidelines given by the health team. If there was no possibility/interest in continuing, the family was referred to another pediatric ambulatory (Figure 1).

Figure 1. Study diagram
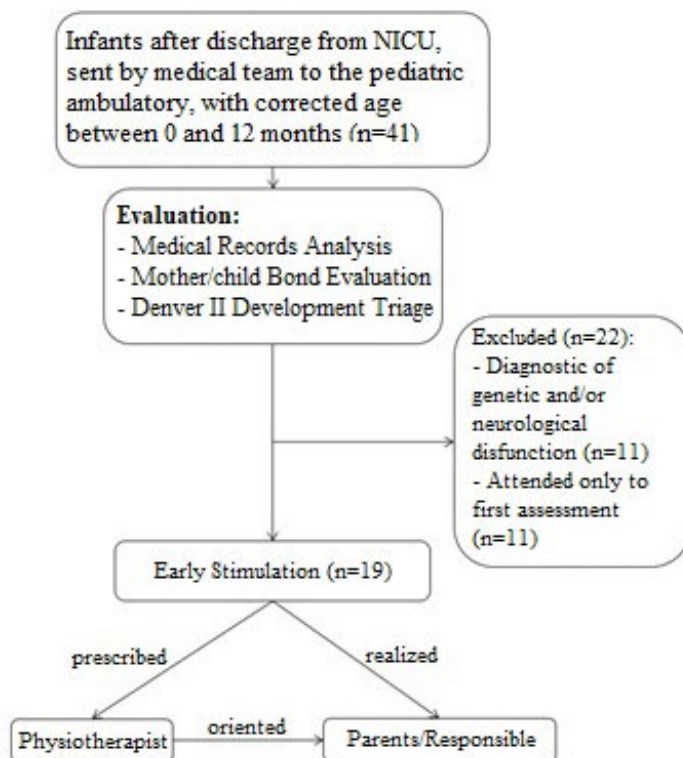
The care provided by the multidisciplinary team and observed in the present study was guided by the collection of data from the medical records regarding the hospitalization period and the family's sociodemographic considerations, also, some protocols were applied to assess neuropsychomotor, bio psychic development, and maternal bonding. Thus, the following tests were performed: Denver II Triage Test (TTDII)[9], Assessment of the mother/child bond[10].

The newborns' characterization variables were: gestational age, type of birth delivery, Apgar score in the first and fifth minutes of life, weight and height at birth, hospitalized duration in the NICU, days of use of mechanical ventilation, pressure continuous positive airway (PCPA), intermittent positive nasal pressure ventilation (IPNPV) and/or oxygen mask and presence of jaundice, sepsis, apnea, hypotonia, metabolic acidosis, respiratory distress syndrome, urinary tract infection and bad general state at birth (BGS). Maternal and paternal data were also collected, such as age, education, main occupation, marital status, address.

Newborns with low weight, to classify birth weight, were considered those weighing less than 2500g, very low weight, those who had a birth weight less than 1500g, and extremely low weight those with a birth weight below 1000g[11].

The Denver II9 Developmental Triage Test assesses children aged zero to six with a total of 125 items divided into four aspects: personal-social - focusing on the child's socialization; fine motor skills - encompassing eye-hand coordination; wide motor skills - which includes body motor control; and language-comprising the ability to recognize, understand and use language. The evaluated items were categorized individually, considering the chronological age and the corrected age of each child. The result can be expressed in three ways: with delay - when an item is intersected by the age line after the 90th percentile and this is not performed by the child. Caution or attention - when the child does not fulfill an item that the age line is between 75 and 90%, or else passed - when the child successfully performed the test. The final performance was classified according to the number of overdue items and/or caution. Development was considered: abnormal - when there were two or more delays regardless of the area; questionable - if a delay or two or more cautions are presented; and normal - if there is no delay or at most caution[9].

The Mother/Child Bond Assessment was used to assess the child-caregiver bond, consisting of 13 questions with yes/no answers, with "yes" being a positive response to the presence of a weak bond attribute or indicator. Adding the answers "yes", the score that can be obtained can vary from 1 to 13. The positive classification for the weak link is given with the number of positive responses ≥5[10].

The initial assessment (A1) of the child consisted of the analysis of the medical record, application of the Mother/Child Bond Assessment[10], and the first assessment of the Denver II Triage Test[9]. After 3 months, this child returned to the service for a reassessment (A2), composed only by the Denver II Triage Test; on this day, new guidelines were given to the family, according to the corrected age at which the child was.

The child was evaluated and then demonstrated to the parents which stimuli should be performed at home according to age (stimuli for cervical control, rolling, sitting, cat position, or standing/walking), and folders were delivered built by the physiotherapy team with these same guidelines to provide support.

The sample power was calculated for the number of 19 children in the G*Power3.1.3 program, considering the following criteria: effect size: 0.50; α error: 0.05, resulting in the power (1-β) of 0.85. The data were analyzed using the mean, standard deviation, absolute and relative frequency, median, minimum, and maximum. Through the Wilcoxon test, a comparison was made between the General Classification of the Denver II Test on A1 with A2. For this, the SPSS program (Statistical Package for Social 18 Sciences) version 20.0 was used.

Results

There were 41 children born preterm, with corrected age between 0 to 12 months, after discharge from the Neonatal Intensive Care Unit eligible for the study. Considering the exclusion criteria, 22 children did not enter the study, due to the non-follow-up of families to the clinic (n = 11) and due to neurological and/or genetic disorders (n = 11), so the final sample was 19 children.

Table 1 presents sample characterization on neonatal data. The average length of stay in the NICU was 48.7 days, 84.2% of the children needed PCPA and 63.1% had jaundice. Maternal and child complications were: premature labor for no reason, gestational diabetes mellitus (21%; n = 4), Gestational Hypertensive Syndrome (63.1%; n = 12), postoperative bariatric surgery (10.5% ; n = 2), placental abruption (10.5%; n = 2), fetal centralization (5.25%; n = 1), maternal congenital syphilis (5.25%; n = 1), restriction of intrauterine growth (10.5%; n = 2), reduction of amniotic fluid (5.25%; n = 1), uterine fibroids (5.25%; n = 1), premature rupture of membranes (5.25% ; n = 1), ruptured pouch (5.25%; n = 1), urinary infection (5.25%; n = 1), total previous placenta (5.25%; n = 1).

Table 1. Data on the neonatal period of premature children (n = 19) (2019)

Gestation time (weeks)	29,9±2,47
Type of delivery	
Normal	31,6% (n=6)
Cesarean	68,4% (n=13)
Apgar 1`	
Under 7	42,2% (n=8)
Equal or Above 7	57,8% (n=11)
Apgar 5`	
Under 7	10,6% (n=2)
Equal or Above 7	89,4% (n=17)
Apgar 10`	
Under 7	-
Equal or Above 7	10,5% (n=2)
Birth weight (grams)	1251,5±506,5
Classification	
Low weight	15,7% (n=3)
Very Low Weight	57,8% (n=11)
Extreme Low Weight	21% (n=4)
Height at birth (cm)	37,7±4,7
Head circumference (cm)	27,3±2,9
NICU stay time (days)	48,7±30,5
Mechanical Ventilation (SIMV)	36,8% (n=7)
PCPA	84,2% (n=16)
IPNPV	10,6% (n=2)
Oxygen mask	36,8% (n=7)
Jaundice	63,1% (n=12)
Respiratory Distress Syndrome	10,5% (n=2)
Neonatal sepsis	15,8% (n=3)
Apnea of prematurity	36,8% (n=7)
Poor general condition at birth	31,5% (n=6)
Metabolic Acidosis	10,5% (n=2)
Urinary tract infection	5,2% (n=1)
Hypotonia at birth	10,5% (n=2)
Cyanotic	15,8% (n=3)

Table 2 shows the classification of each aspect of the Denver II Test.

Table 2. Comparison of performance on the Denver II A1 test with A2 (n = 19)

	A1 (n=19)	A2 (n=19)
Age in months		
Average, DV	3,6±1,4	7,7±1,9
Median (min; max)	3,1 (2,3; 8,3)	7,4 (5,1; 11,3)
Motor domain		
Normal	89,5% (n=17)	63,2% (n=12)
Questionable	5,2% (n=1)	21% (n=4)
Not normal	5,2% (n=1)	15,8% (n=3)
Language domain		
Normal	100% (n=19)	89,5% (n=17)
Questionable	0	10,5% (n=2)
Not normal	0	0
Fine motor domain		
Normal	89,5% (n=17)	89,5% (n=17)
Questionable	10,5% (n=2)	0
Not normal	0	10,5% (n=2)
Personal-social domain		
Normal	94,8% (n=18)	84,3% (n=16)
Questionable	5,2% (n=1)	10,5% (n=2)
Not normal	0	5,2% (n=1)
Denver Classification		
Normal	79% (n=15)	42,2% (n=8)
Questionable	10,5% (n=2)	26,3% (n=5)*
Not normal	10,5% (n=2)	31,5% (n=6)*

A1 = Follow-up 1; A2 = Follow-up 2; * significant value when compared to Denver Classification A1 and A2 (p = 0.02, Wilcoxon).

Table 3 presents socioeconomic data and family profile of the sample. From the sociodemographic data, it can be noted that mothers have an average age of 27.3 years, showing a profile of young mothers, in 89.4% of families the parents have a married marital status. Of the mothers, 52.6% had completed high school while the fathers, 63.1% had completed high school, 52.6% had their own home, 78.9% lived in Curitiba and 84.2% in the urban area.

Table 3. Sociodemographic data of parents of premature babies (n = 19)

	median±DP; %(n)
Mother Son Bond	5,8±2,8
Maternal Age	27,3±5,5
Maternal marital status	
Single	10,5% (n=2)
Married	89,5% (n=17)
Maternal Education	
Illiterate	0% (n=0)
Incomplete Fundamental	0% (n=0)
Complete Elementary	5,2% (n=1)
Under High School	21% (n=4)
High School	52,6% (n=10)
Under Graduation	5,2% (n=1)
Graduated	15,8% (n=3)
Prenatal	52,6% (n=10)
Father's Age	30,3±8,1
Paternal marital status	
Single	10,5% (n=2)
Married	89,5% (n=17)
Father's Education	
Illiterate	0% (n=0)
Incomplete Fundamental	5,2% (n=1)
Complete Elementary	5,2% (n=1)
Under High School	0% (n=0)
High School	63,1% (n=12)
Under Graduation	5,2% (n=1)
Graduated	21% (n=4)

Discussion

Analyzing the neuropsychomotor development from the perspective of the physiotherapist over the first 12 months of corrected age of preterm infants monitored at the ambulatorial clinic, it was found that there was a prevalence of children with accentuated prematurity. Concerning legal guardians, most participating families were composed of father and mother, who had completed high school.

In the present study, associated with parental guidance, educational guides developed by the physiotherapeutic team were used as educational support, guiding the work to be performed at home. It is essential to the guardians' instrumentalization, since the adequate guidance so that they know the difficulties, limitations, and personal differences of rhythm and potential of the child to be stimulated so that there is a synchronism between parents and therapist[12]. A study[13] that also used this type of support instrument for parents showed a positive result throughout child development. It is noteworthy that, even with the use of these, the stimulations were defined according to the needs of each child.

Despite all the stimuli guided by the physiotherapist being of a motor character, and considering that in the multi-professional group there was no speech therapist, it was possible to verify that, children with delay in the language and personal-social domain overcame the deficits. It is believed that parents, when performing motor stimuli in their children, also provided stimuli to this domain, whether through songs, speeches, conversations, or even maintaining eye contact with the child.

The fact that some children have fluctuations in the classification of development can be attributed to the fact that the plasticity of the developing brain may be limited due to prematurity, bringing consequences to the acquisition of skills. For Giacchini and collaborators[12], the early identification of situations that lead to brain damage, the proper prescription of the conduct in each case, and the use of neuronal protection factors can positively influence each case, which reinforces the early use of therapeutic openings, enabling greater results related to brain plasticity. It is observed that all children who presented questions or delays in items from Denver in one of the follow-ups exceeded these in the following evaluation. This fluctuation in the classification emphasizes the need for continuous monitoring of this population, corroborating with Araujo and collaborators[13].

Although the sample number in this study was small, it was possible to observe that the early stimulation performed by the parents, who were previously guided and helped with printed material, made the neuropsychomotor development evolve positively. The need to periodically monitor the motor development of premature babies is emphasized.

Premature birth brings vulnerability, dependence, and need for protection of the premature, interfering in the mother-child bond5 since the abrupt separation of this dyad creates fear and insecurity for the mother. This early separation delays maternal responsibility for the child's care, thus generating a feeling of "not feeling maternal", increasing the negative influence on the bond of this dyad[5]. Also, studies have found a significant relationship between motor development and mother-child interaction[14]. Through the Mother-Child Link Assessment, it can be seen that there was a weak link between the studied dyads. It is worth mentioning that this fact can be explained because the average number of weeks of delivery was 29.9 weeks.

As well as the maternal bond, the paternal presence has its importance in child development, since the father has a protective role for the child, in addition to providing financial and psychological support to the mother[4]. Pilz and Schermann[1] found, through the Denver II Test, that children whose mothers did not have paternal support were seven times more likely to have a suspected delay in neuropsychomotor development.

The level of maternal education is another factor that can interfere with neuropsychomotor development. In a Brazilian epidemiological study[15], between 2007 and 2016, the highest rates of prematurity were related to shorter maternal education (up to three years of study). In addition, studies indicate that this sociodemographic data is an indicator of recognition and access to health services, so the higher the education, the better the understanding of the need for special care during pregnancy, and the greater the protective factor for development[16].

In addition to the environmental and gestational factors, mentioned above, which present a risk to neuropsychomotor development, it is also necessary to consider neonatal events. The Health Ministry[17] considers that a newborn at risk is every child who presents at least one of the following criteria: residing in a risk area; birth weight less than 2,500g; newborn with less than 37 weeks of gestation; Apgar <7 in the 5th minute of life; hospitalization or complication in the maternity or newborn care unit; the need for special guidance on discharge from maternity; son of a teenage mother (<18 years); a mother with low education (≤8 years of study); the history of the death of a child under 5 years old in the family. Therefore, the sample studied has at least two risk indicators, namely prematurity and the need for assistance after birth.

Concerning neonatal characteristics at birth, the data from the present study corroborate with Oliveira and collaborators[7], pointing out that most preterm infants have a score greater than 7 in the 5th minute Apgar assessment, with no neurological risk. Still considering the risk criteria for newborns, the low weight associated with prematurity is directly proportional to the risk of morbidity[18]. In addition, it is known that preterm infants with low weight have a higher risk of delayed motor development in the first year of life, and may extend to more advanced ages[19]. A study[7] points out a strong association between birth weight and premature births, corroborating the present study, in which 94.7% of the sample was born weighing less than 2.500g.

The average length of stay in the NICU that influences neuropsychomotor development must also be considered[3,19]. In a study carried out in the city of São Paulo, in which the babies were separated into two groups with a length of stay above or below 34 days of stay, it was found that the group with the

longest stay in the NICU showed delayed motor development, while another group was suitable for the corrected age.

The literature often relates prematurity to only some risk factors for neuropsychomotor development, such as low birth weight, length of hospital stay, maternal characteristics. However, it is necessary to consider the Theory of Dynamic Systems[2]. Thus, the present study did not isolate biological and/or environmental factors, considering that many factors will influence neuropsychomotor development.

The Early Stimulation Guidelines for Children from 0 to 3 years old with Neuropsychomotor Development Delay[6] recommend that the teams that will perform the early stimulation develop, together with the child and his/her family, an exclusive intervention taking into account multidisciplinary evaluations aiming at autonomy and user independence, as well as their social inclusion.

The early motor intervention provides a large number of new stimuli for the child. The quality of the baby's day-to-day life, how it is cared for, and the influences generated by its environment will also be very important for the quality and success of the child's development, as well as guidelines for parents, which are also necessary. The physiotherapist has the role of conducting the initial and continuous assessment of the child, developing goals and objectives through the use of methods appropriate to their needs, such as the instrumentalization of the family[20].

The sample number, the follow-up time, the large number of factors that influence motor development are intrinsic limitations to research that studies the development of preterm babies.

Conclusion

About the neuropsychomotor development of the monitored babies, it was observed that they overcame the delays identified in the first assessment. Thus, it is believed that the family profile identified in this research plus the clinical implications related to the multi-professional approach and orientation booklets for motor development elaborated by the physiotherapy team may have favored the neuropsychomotor development of premature babies up to 12 months of corrected age, however further studies on the subject are suggested.

Author contributions

Almeida N, Silva DA, Silva LRV, Vojciechowski AS, Motter AA and Zotz TGG participated in the conception, design, search and statistical analysis of the research data, interpretation of results and redaction of the scientific article.

Competing interests

No financial, legal or political conflicts involving third parties (government, companies and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to, grants and funding, participation in advisory council, study design, preparation of the manuscript, statistical analysis, etc.).

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