



## Impact of physiotherapy on neuromotor development of premature newborns

### *Impacto da fisioterapia no desenvolvimento neuromotor de recém-nascidos prematuros*

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#### Abstract

**Introduction:** The population of children born prematurely has increased in line with improving the quality of perinatal care. It is essential to ensure to these children a healthy development. **Objective:** We evaluate the neuromotor development of a group of preterm infants regularly assisted by a physiotherapy service in comparison to full-term newborns, checking, so the impact of the service. **Materials and methods:** We randomly assigned preterm and full-term infants that formed two distinct groups. The group of preterm infants was inserted into a monitoring program of physiotherapy while the other infants were taken as a control group not receiving any assistance in physiotherapy. The groups were compared using the Alberta Infant Motor Scale (AIMS) at forty-week, four and six months of corrected gestational age and the scores were compared using Student's t-test, assuming a significance level of 5% ( $p < 0.05$ ). **Results:** The preterm group had significantly lower scores at 40<sup>th</sup> week compared to the control group, but subsequent scores showed no significant differences between the two groups. **Conclusion:** The timely and adequate stimulation was efficient to promote the motor development of premature infants included in a follow up clinic.

**Keywords:** Preterm neonates. Stimulation. Child development.

## Resumo

**Introdução:** A população de crianças nascidas prematuramente tem aumentado em função da melhoria da qualidade da assistência perinatal. É fundamental assegurar a essas crianças um desenvolvimento saudável. **Objetivo:** Avaliou-se o desenvolvimento neuromotor de um grupo de recém-nascidos prematuros regularmente assistidos pelo serviço de fisioterapia em comparação aos recém-nascidos a termo, aferindo, assim o impacto do serviço. **Materias e métodos:** Foram alocadas aleatoriamente crianças prematuras e a termo que constituíram dois grupos distintos. O grupo de crianças prematuras foi inserido em um programa de acompanhamento de fisioterapia infantil enquanto o outro grupo foi tomado como controle, não recebendo qualquer assistência fisioterápica. Os grupos foram comparados por meio da Alberta Infant Motor Scale (AIMS), na quadragésima semana, aos quatro e seis meses de idade gestacional corrigida e os escores foram comparados através do test T de Student, assumindo-se um nível de significância de 5% ( $p < 0,05$ ). **Resultados:** O grupo de prematuros apresentou escores significativamente mais baixos na 40ª semana em relação ao grupo controle, mas os escores subseqüentes não mostraram diferenças significativas entre os dois grupos. **Conclusão:** A estimulação oportuna e adequada mostrou-se eficiente para promover o desenvolvimento motor de crianças prematuras inseridas em um ambulatório de seguimento.

**Palavras-chave:** Recém-nascido prematuro. Estimulação. Desenvolvimento infantil.

## Introduction

The technological improvement in the area of perinatal care has enabled major achievements for the survival of premature newborns. The Neonatal Intensive Care Units (NICU) and early neonatal care assistance have helped in reducing neonatal mortality rates, especially for premature and low birth weight newborns (1, 2, 3). As we know, this group of newborns is more likely to show impairment of motor development (4, 5, 6). Thus, assessment of neuromotor development of preterm infants has assumed greater relevance and intervention measures for these infants can be useful to predict the long-term development (7).

Despite the explicit need for assessment and monitoring of these patients, it seems to be a challenge the early identification of infants with delays and subtle deficits in motor development, as these changes become more evident over time. To assess neurodevelopment one of the most used scales in Brazil is the Alberta Infant Motor Scale (AIMS), which evaluates the motor performance of infants both risk and those with typical development (8, 9, 10).

It should be noted, however, that the appropriate assessment should only be the starting point for early and timely interventions. Several authors suggest that for preterm and low birth weight newborns, the physiotherapy interventions have provided significant

benefits (11). These results justify the inclusion of physiotherapists in the outpatient clinics for high-risk newborns. Such services are consolidated more and more as instances to support NICU, providing a continued care for those received in neonatal period. The coordinated and interdisciplinary actions of outpatient clinics (or "Follow-up outpatient clinics") along with family support may interfere positively to the quality of life for infants born prematurely and their families (12). In this regard, a capable and integrated multidisciplinary team is necessary (13).

Physiotherapeutic actions themselves should be concentrated for postural control and movements coordination, so as to provide to premature infants greater speed in the skill acquisition process so that they reach, as early as possible, the same skills of infants born at term (13). For the success of such actions it is recommended that interventions are developed with participation of families, addressing the social context of them and encouraging the development of skills in addition to meetings with health professionals. This promotes a comprehensive care in order to provide a participatory and co-responsible therapeutic plan. In this sense, the physiotherapist's encounters with families of premature babies should value the interdisciplinary context and should be permeated with a lot of interaction and creativity (14).

The present study aimed to assess the neuromotor development of a preterm infants group, followed

by physiotherapy in an outpatient follow-up clinic (Follow-up of preterm and high-risk infants) compared to full-terms newborns and so, gauging the impact of this service.

## Material and methods

This is an intervention study, prospective, controlled, involving preterm infants with gestational ages from 32 to 34 weeks (experimental group) and full-term newborns (control group). The infants were selected in NICU, nurseries and rooming from the only two hospitals with high-risk maternity services and NICU of a midsize city in northern Minas Gerais, Brazil. Random allocation of the newborns were carried out through weekly visits to the institutions and "in loco" check of the occurrence of newborns who fit the study proposal and subsequent invitation to families to insert the clinic visits to participate in the research. Newborns with perinatal asphyxia (Apgar score < 5) were excluded. For each premature selected, we identified a full-term newborn, in the same day, to consolidate the control group. Whenever possible allocation of the full-term newborn was performed according to the same type of delivery, so that, this variable did not present significant difference between groups at the end of the study.

The sample size calculation for the study was defined to identify a difference of at least two units in total AIMS score among preterm and full-term newborns groups, with an estimated standard deviation of 2.5 units (from the total score of the AIMS) and respecting a ratio of 1:1.5 study groups, alpha error of 5% ( $\alpha = 0.05$ ) and statistical power > 90%. In that sense, the sample size was defined by, at least, 70 newborns (28 in the preterm group and 42 in the full-term group).

All newborns were followed up using the AIMS to assessment of neuromotor development at 40<sup>th</sup> week of conceptional age, defined by last menstrual period (LMP) associated with ultrasound. This assessment was also carried out at four and six months of corrected gestational age.

The Alberta Infant Motor Scale (AIMS) assesses the motor performance of infants as at risk as with typical development, being a validated scale that assesses the axial motor skills from birth through the acquisition of independent walking. The exam takes about 15-20 minutes and involves the observation of 58 items, which illustrate the development of postural

control in four positions: prone (21 items) supine (9 items), sitting (12 items) and standing (16 items). For implementation of AIMS, the examiner observes the movement of the infant in those positions, pay attention to aspects of motor performance (weight bearing, posture, antigravity movements, among others). Scoring is done dichotomously (present = 1, absent = 0) and the result of the application of the scale is a final score that records normal or delayed development of evaluated infant. The successive application of the scale gradually allows quantifying the development, since it increases the number of items evaluated as the infant grows (15). The AIMS has been validated in Brazil in a population of infant of Rio Grande do Sul (16).

Premature newborns were included in the intervention group and were systematically submitted to the therapeutic method of stimulating the nearest normal muscle pattern with approaches postures reflex inhibition or stimulation of the tone control, suppressing abnormal patterns before they may appear, based on the neuroevolutive concept of Bobath and constant guidance to parents and/or caregivers. The sessions for this group were performed according to the definition of need, weekly, fortnightly or monthly.

The full-term newborns group was used as control and received only guidance to parents so they could encourage their babies in age-appropriate postures, according recommendations of Child Health Handbook.

Data were analyzed using the SPSS for Windows software (version 18.0). The comparison of the mean scores of the domains the AIMS was performed using Student's t-test, considering the data normality checked by Kolmogorov-Smirnov test, assuming a significance level of 5% ( $p < 0.05$ ). The "control" groups and "intervention" were also compared according to sex, type of delivery, birth weight, duration of maternity stay in days, Apgar score (1 and 5 minutes), maternal age and maternal education, assuming the same level of significance.

This study was approved by the Research Ethics Committee of the State University of Montes Claros (Unimontes), under protocol number 1069/2008. All participating families signed an informed consent.

## Results

We completely followed up 31 preterm and 43 full-term infants, registering the abandonment of the

study for two preterm and six full-term infants. The main features of the group are shown in Table 1.

The mean gestational age was 32.8 weeks for the premature group and 39.4 weeks for full-term group. The average weight of the full-term infants was approximately twice the average weight of infants who received the intervention. We registered slight male predominance and high percentage of mothers undergoing cesarean deliveries. The group of preterm infants had the highest percentage of teenage mothers in relation to the group of full-term newborns (22.6% and 13.9%, respectively), but the distribution of age ranges

showed no difference between groups ( $p = 0.569$ ). Maternal education was also similar between groups.

The Apgar scores at the first and fifth minutes were greater for full-term newborns, but the differences were also not statistically significant.

Scores set by AIMS during the 40<sup>th</sup> week, four and six months are presented in Table 2. For the first evaluation, performed at 40 weeks' corrected gestational age (CGA), there was statistically significant difference between the groups with better performance among full-term newborns ( $p = 0.002$ ). In subsequent assessments, no differences were observed.

**Table 1** - Characteristics of newborns allocated to evaluating the neuromotor development; Montes Claros (MG), 2009-2010

Variables	Intervention Group		Control Group		p-value*
	(n)	(%)	(n)	(%)	
<b>Sex</b>					0.903
Male	14	45.2	20	46.5	
Female	17	54.8	23	53.5	
<b>Type of Delivery</b>					0.964
Cesarean	13	41.9	19	44.2	
Normal	18	58.1	24	55.8	
<b>Mother age (years)</b>					0.569
< 20	07	22.6	06	13.9	
20 – 34	22	70.9	35	81.4	
≥ 35	02	6.5	02	4.6	
<b>Mother schooling (years)</b>					0.395
< 8	05	16.1	10	23.3	
9 – 11	21	67.7	30	69.8	
≥ 12	05	16.1	03	6.9	
<b>Gestational age</b>					< 0.001**
Mean (SD)	32.8 (0.69)		39.4 (0.98)		
<b>1<sup>st</sup> minute Apgar score</b>					0.063
Mean (SD)	5.9 (2.17)		7.6 (0.84)		
<b>5<sup>th</sup> minute Apgar score</b>					0.070
Mean (SD)	8.1 (1.22)		9.0 (0.44)		
<b>Birth weight (grs)</b>					< 0.001**
Mean (SD)	1,653.35 (331.30)		3,378.94 (390.19)		
<b>Length of hospital stay (in days)</b>					< 0.001**
Mean (SD)	8.41 (5.05)		1.65 (0.81)		

Note: (\*) Chi-square test for categorical variables and Student t-test to compare means; (\*\*) Statistically significant values.

Source: Research data.

**Table 2** - Scores for assessment of neuromotor development by AIMS in preterm and full-term newborns; Montes Claros (MG), 2009-2010

Assessment time (CGA)*	Intervention Group (Preterms - n = 31) Mean (SD)	Control Group (Full-terms - n = 43) Mean (SD)	P-value (Student t-test)
40 <sup>th</sup> week	3.77 (0.72)	4.30 (0.71)	0.002**
4 months	15.26 (2.41)	15.28 (1.68)	0.965
6 months	26.81(2.21)	26.40 (1.95)	0.401

Note: (\*) CGA: Corrected Gestational Age; (\*\*) Statistically significant value.

Source: Research data.

## Discussion

Several studies have been conducted to investigate the development of preterm infants, and the motor aspects are the most evaluated, possibly because the detection of motor problems in the first year of life means earlier and timely interventions (17, 18, 19, 20). In the present study the assessment of neuromotor development of preterm infants who attended an outpatient follow-up clinic was compared with full-term newborns without special monitoring, revealing similar performance for both groups at four and six months of corrected gestational age. The results are particularly relevant considering that the group of preterm infants presented, at birth, a difference of average of gestational age greater than six weeks in relation the group of full-term newborns.

Early physiotherapy intervention has been recommended for years as a strategy to mitigate or eliminate motor sequelae especially in premature infants, in whom such an event is inversely proportional to gestational age and birth weight (21). In this sense, the inclusion of the physiotherapy team at outpatient clinics has the potential to promote positive outcomes and better quality of life for infants and their families. A recent review of literature on the subject revealed that, despite the different factors involved in the neuromotor development of preterm process, appropriate interventions can prevent, minimize and even reverse the delay in the development of these children (22).

In this study, interventions were personalized and accompanied by their families, who were also oriented to stimulate the infant at home, reinforcing the activities learned. Certainly, programs that enhance family involvement tend to be more effective

(13, 14). Surely, an important factor for the development is the environment in which the infant lives. So the caregiver should always seek to create diverse and appropriate scenarios to the infant's motor behavior, which facilitates and enables interaction and exploration of the environment.

The role of the caregiver for infant motor development has been well discussed in the paper of Moreira and colleagues (23). While the authors have worked specifically for institutionalized infants, they sought to emphasize the importance of early intervention. The study highlighted the importance of the physiotherapist's actions for infants and also for training of caregivers (23). The study included 246 babies between 4 and 18 months of age, among whom, 59 (24%) showed delay in basic motor skills, demonstrating the importance of early intervention through physiotherapy and orientation and training of caregivers.

It is important to notice that in this study the scores observed for the preterm group was lower than in the full-term group at the fortieth week of corrected gestational age. It is possible that this result is due the fact that several of preterm infants remained in the hospital after birth to reach the minimum weight for discharge. Without physiotherapy and timely stimulation, the preterm group did not reach the potential of the period. Influence of hospitalization on the development of preterm infants has been evaluated previously and the authors concluded that the greater the hospitalization time of the infant, the greater the impairment of motor development (24).

This result could be different if there was stimulation still in the hospital. A study conducted in São Paulo (17) showed that preterm infants showed motor developmental pattern similar to typical as to the

sequence of acquired skill and faster pace during the newborn to one month age. Although the assessment tool used was different - Test of Infant Motor Performance (TIMP) - the most important idea is that stimulation could and should be initiated in hospital prior to discharge.

Infant development depends on many factors such as environment, behavior, maturation of the nervous system, age, posture and movements of the infant. Early intervention for preterm infants is critical to normalization of muscle tone. It should be noted that the acquisition of motor skills during the first year of life is extremely important for the future development of the infant, because in this period there are rapid and constant changes in motor development, which facilitate the acquisition of skills. The actions of the physiotherapist in outpatient clinic for follow-up of preterm infants should always be aimed at correcting possible dystonia associated with prematurity. Families should be involved in monitoring and encouraged to allow longer duration of stimuli so the sensations are absorbed and retained for longer periods (22), (25).

In their study, Volpi and colleagues followed in a physiotherapy service 143 preterm infants discharged from the intensive care unit, from which obtained the ages of all motor skills (20). In general, all motor skills were within predicted for corrected age, and even in chronological age, many skills were present within the expected range. The skills achieved in this study highlight the importance of early intervention actions, but there is the limitation that this study lacked a control group of full-term newborns.

It is important to notify that there are different results reported by other authors and those indicate the need for standardization and more accurate assessment of early motor stimulation. A randomized controlled trial was used to investigate the effects of physiotherapy as an intervention on the movement of very premature infants with very low birth weight. Seventy-two very premature newborns were randomly allocated to a control group ( $n = 38$ ) and treatment group ( $n = 34$ ). Both groups were evaluated at four months corrected age using the AIMS and a control group of 14 full-term infants. To the authors, the physiotherapy intervention had no significant effect on performance of the motor treatment. However, no patient in this group had abnormal motor development at four months compared to the untreated group (16%) and control group (14%). In

their conclusions the authors highlight that preliminary evidence suggests that early neonatal physiotherapy can reduce the incidence of motor delay in infants born very preterm and with very low birth weight and monitoring of this group is recommended to verify the benefits of early stimulation (26).

The search for similar studies in national databases revealed that there are several studies with very small sample of children, hindering the comparative analysis of the data. However, all these studies indicate the importance of early stimulation activities for preterm and low birth weight newborns (27, 28, 29).

In this study there are limitations to consider. The limits proposed for allocation of premature, although it is a recommendation from the used scale (AIMS) does not allow the results to be extended to newborns with higher degree of prematurity because only newborns from 32 weeks of gestational age were assessed. There was also a methodological restriction for inclusion in the study on the conditions of birth, not inserting children with perinatal asphyxia. It is also possible that the voluntary allocation of newborns at term has influenced the creation of the control group. The losses occurred (two for the group of preterm infants and six for the group of children born at term) should also be considered, but may have occurred because of the long follow up time. The greatest number of losses among mothers of at term infants may be due to the fact they did not perceive the need for clinic visits only for the motor assessment of their infants. It is also important to consider that the results can not be directly and/or exclusively attributed to the intervention because motor development is a multifactorial process and it was not possible to determine in this study the role of the socioeconomic and home environment variables.

## Conclusion

This study provides important information on how early intervention is critical to the development of motor function for at-risk infants. It is worth mentioning the importance of parents and/or caregivers, that when properly oriented, play a fundamental role in constant stimulation of these infants. It is necessary therefore that the role of physiotherapists is encouraged and fostered in outpatient clinics so that they can encourage, facilitate and enhance the skills of premature infants so these can functionally develop

the best way possible. Similarly, other professionals should add to the team of premature newborns care, providing interdisciplinary care and improving the quality of life to these infants and their families.

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Received: 04/26/2013

Recebido: 26/04/2013

Approved: 12/17/2013

Aprovado: 17/12/2013