

## ORIGINAL ARTICLE

# Motor development analysis of three-year-old children born preterm through the Motor Development Scale - Case Report

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## Abstract

**Introduction:** Prematurity and low birth weight are conditions that may compromise the normal development of a child at different stages of development. Considering that these conditions may cause delay in the acquisition of motor skills, it is important to evaluate, detect and prevent possible changes in motor development.

**Objective:** To investigate the influence of prematurity and low birth weight on the motor development of children of three years old relating chronological age to general motor age.

**Methods:** This is an analysis of five cases of preterm children 32.1 ( $\pm$  1.82) weeks and underweight 1704 ( $\pm$  384.41) grams, mean chronological age of 43.2 ( $\pm$  2.59) months, evaluated through the Motor Development Scale (MDS) in the Laboratory of Electromyography and Kinematics (LAELCIN) of the Federal University of Triângulo Mineiro (UFTM), considering general motor age (GMA) and chronological age (CA) as variables.

**Case:** The five preterm and low birth weight children presented a difference between the mean general motor age (37.6  $\pm$  7.40) months and the mean chronological age (43.2  $\pm$  2.59) months, indicating delayed motor development.

**Conclusion:** It was observed the absence of linearity of the variables, indicating delay in the motor development, thus justifying the necessity and importance of the longitudinal monitoring of this population for early detection and intervention.

**Keywords:** child development, motor ability, evaluation.

## What is the purpose of this study?

It is a paper from the Physiotherapy graduation process, derived from the doctoral research "Effect of specific training on manual reaching ability in preterm infants". During the initial research, the infants were evaluated and those who presented some indication of development delay due to prematurity and low birth weight were referred for early intervention.

## What researchers did and found?

After three years of the initial evaluation, the researchers verified the overall motor development of this population. Therefore, the children who attended and whose parents agreed to participate in the present study were re-evaluated through the Motor Development Scale (MDS). It was observed that the three-year-old children still had developmental delays, especially in spatial and temporal organization, and according to the mothers' reports, they had been submitted to early stimulation with physical therapy until the independent gait ability. However, they could not say how long the children were followed, thus justifying the need for longitudinal and multidisciplinary follow-up, even after gait acquisition.

## What do these findings mean?

Such findings are relevant to professionals, parents, caregivers and family members' awareness of the need for early multidisciplinary intervention programs with longitudinal follow-up of preterm and underweight children.

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## INTRODUCTION

With advances in medical science and technology, neonatal care has been increasing and raising the survival of preterm and underweight newborns. However, it is not ruled out the sequelae such conditions can leave, jeopardizing the development of the child<sup>1,2</sup>.

Different neonatal changes have consistently been classified as probable risk factors for abnormal neuromotor and intellectual development<sup>3</sup>. Among these complications, it can be highlighted intracranial hemorrhage, anoxia, apnea or hyaline membrane disease requiring assisted ventilation, hyperbilirubinemia and infections. In addition to these, other complications due to prematurity are present such as altered muscle tone, which may compromise the activation of agonists and antagonists, making it difficult to acquire new motor skills and behaviors. Thus, when compared to full-term children, the exploitation of the environment becomes more difficult for the preterm infant<sup>4,5</sup>. In view of this; the increase in the number of premature infants is an issue that requires caution and monitoring of their development and quality of life<sup>6,7,8</sup>.

Premature birth can change the normal development of these children characterizing risk for neurodevelopment and successive functional disabilities. Such changes may also impair behavioral and cognitive abilities, leading to deficits that continue throughout adolescence and adulthood, causing social and educational consequences<sup>9</sup>.

Tools for assessing motor development in children may be various; however, they may fail to observe some areas of development. Therefore, Rosa Neto<sup>10</sup> proposed the Motor Development Scale (MDS), made up of a battery of tests, aiming to measure the motor development of children with and without alterations, between 2 and 11 years old. The dimensions evaluated are fine motor, global motor, balance, body schema, spatial and temporal organization and laterality.

Studies report that in different stages of development, the preterm presents a greater risk of abnormalities in intellectual, emotional and behavioral areas when compared to full-term children<sup>11</sup>. In this way, studies have been carried out seeking to warn health professionals about possible impairments. Considering

that physiotherapy seeks to be effective in assessing, detecting and early preventing the delays in motor development; this study is aimed at contributing to the production of greater scientific knowledge about infants at risk, clarifying the gaps on the subject matter and the performance of physiotherapy in evaluation, intervention and guidance processes for the child's health promotion and prevention.

Based on the premise that prematurity and low birth weight may delay the acquisition of motor skills, the following question was raised: Does a child with diagnosis of prematurity and low birth weight present motor development compatible to the three-year age group regarding chronological age and general motor age?

Considering that prematurity and low birth weight influence the motor development of the child at three, per the incompatibility between chronological age and general motor age it is possible to reinforce the awareness not only of health professionals, but also of society about the risk factors of delay in premature infants. Thus, secondary prevention that aims to prevent the evolution of possible sequelae in individuals already exposed to the condition of risk for development can be implemented among other possibilities, by evaluation and early detection, as well as by the conduction of intervention programs. In addition, once changes have been detected, guidelines can be given to parents for home stimulation.

Thus, the present report describes the possible influence of prematurity and low birth weight on the motor development of children of three comparing the chronological age with the general motor age, showing the degree of linearity of these variables.

## CASE REPORT

Five children, two girls and three boys, with gestational age less than or equal to 33 weeks, birth weight less than 2500 grams, Apgar score greater than or equal to seven in the first and fifth minutes, hospitalization longer than maternal discharge, without clinical diagnosis of motor and sensorineural diseases or alterations, and current chronological age of three, were part of the study (Table 1).

**Table 1:** Characterization of the participants according to the birth data.

Participants	Sex	GA	BW	Apgar1	Apgar5	Photo	Inc.	CA	ECC
1	M	33.5	1480	9	9	8	26	44	32
2	M	32	1405	8	9	0	21	40	22
3	M	33	2025	8	10	0	3	47	16
4	F	29	1400	7	8	3	39	43	16
5	F	33	2210	9	9	5	12	42	23

Legend: M - male; F - female; GA - gestational age (weeks); BW - birth weight (grams); Photo - phototherapy (days); Inc - incubator (days); CA - chronological age (months); ECC - Economic Classification Criteria.

All were evaluated in the Electromyography and Kinematics Laboratory (LAELCIN) of the Department of Applied Physiotherapy of the Federal University of Triângulo Mineiro (DfisioApl/UFTM), through the Motor Development Scale (MDS) performed in an individualized room, with the necessary conditions for the study, whose

environment was free from external interference and furniture. The children were attended and evaluated individually, by the same researcher, in the presence of their parents/guardians.

The motor development was considered according to the classification of the results of the general motor

quotient (Table 2), with responses obtained during the evaluations of fine motor, global motor, balance, body schema, spatial organization, temporal organization, laterality, and chronological age of the child. Thus, the

**Table 2: GMQ Classification according to the MDS.**

130 or more	Much higher
120-129	Higher
110-119	Normal High
90-109	Normal Medium
80 - 89	Normal Low
70-79	Lower
69 or less	Much lower

Source: Rosa Neto.10

In the evaluation of motor skills, it was observed variability in the linearity between chronological age and motor age of the participants, characterizing a distinct

general motor quotient reached the average normal score in two children and lower in three, indicating delay in motor development of the participants, as observed in Table 3.

**Table 3: Classification of participants according to GMQ.**

Participants	GMQ	Ranking
1	109.09	Normal medium
2	75.00	Lower
3	76.59	Lower
4	74.41	Lower
5	100	Normal medium

Legend: GMQ - general motor quotient.

motor profile among them, indicating alteration in motor development, especially in spatial and temporal organization (Figure 1).



**Figure 1: Representation of children’s motor age according to MDS**

**Legend:** P – participant; GMA – general motor age; MA1 – fine motor; MA2 – global motor; MA3 – balance; MA4 - body schema; MA5 – spatial organization; MA6 – temporal organization

**DISCUSSION**

It is observed that prematurity and low birth weight may influence the motor development of children at the age of three through MDS evaluation, indicating general motor age lower than chronological age.

Prematurity and low birth weight, besides other possible risk factors such as hospital admission, neonatal jaundice and incubator, allow us to characterize the risks of delayed motor development.

Halpern *et al.*<sup>12</sup> found that children born below 2500g present a greater risk for developmental delays, compared to those with birth weight equal to or greater than 2500g, corroborating the findings of Jiménez *et al.*<sup>13</sup> and Oliveira, Siqueira, Abreu<sup>14</sup> who also concluded that prematurity associated with low weight causes greater damage, mainly to motor development.

Research<sup>2,15,16,17,18</sup> emphasizes that preterm children

with a higher risk of motor development deficits are of a lower economic class. In the present study, case 1 represented the highest economic classification in level B1. Cases 2 and 5 were classified as level C1 and B2 respectively. Cases 3 and 4 presented the same socioeconomic level (C2), therefore the lowest among all according to the Brazilian Association of Research Companies (ABEP)<sup>19</sup>, showing possible aggravating factor for developmental delay in most cases.

Regarding motor development, it was observed that cases 1 and 5 showed general motor age greater than chronological age. In case 3, the general motor age was compatible with chronological age. Cases 2 and 4 showed general motor age lower than chronological age, indicating a delay in motor development, which may be associated with risk factors such as prematurity, low weight, birth conditions, and socioeconomic aspect. Research<sup>20,21,22,23</sup> shows that preterm and low weight

children may present impairment of visuospatial and perceptual-motor skills, writing difficulty, inadequate postural control, balance deficit and impairment of gross and fine motor development.

Regarding fine motor (MA1), all cases presented motor age higher than chronological age, presenting no difficulty / delay in this ability, as opposed to the studies cited above. In addition, case 1 excelled in global motor skills (MA2) and balance (MA3) with the highest score. However, no similar studies were found with three-year-old children to support empirically such outcome. It is important to highlight the possible limitations of the instrument, since it uses only one activity at each age to assess specific skills.

Case 3 scored zero for spatial organization ability (MA5) and also cases 2 and 4 for temporal organization ability (MA6), corroborating the studies that demonstrated impairment of visuospatial, perceptual-motor and balance deficits<sup>22,23</sup>. This difficulty can be explained even by the lack of stimuli, lower socioeconomic condition, poorly or inadequately stimulating environment for the age. According to the literature, other factors such as cognitive, social, affective, cultural and economic can interfere with motor development<sup>2,17,18</sup>.

Considering the interference of the intervention, as well as the early stimulation, research evidences an improvement in the acquisition of motor skills in children who received stimulation precociously, especially in the first 12 to 18 months, a period of greater cerebral plasticity, favoring the gain of motor skills<sup>24,25,26,27,28</sup>. In the present study, considering that the mothers stated that the children were submitted to therapeutic stimulation, such stimulation does not appear to have been sufficient to adjust the general motor age to the chronological age of the children, indicating delayed motor development in three of the accompanied cases. However, we cannot make assertive inferences on the influence of the therapeutic stimulation, since the mothers did not know to report accurately the time and the type of stimulation the child

was submitted to.

The results also indicated an absence of linearity between the variables (Figure 1). In according to Rosa Neto<sup>10</sup> it is expected that as the chronological age increases, motor age also increases, characterizing evolution of the development. However, only case 1 was highlighted in the motor profile when compared to its chronological age for showing MA1, MA2, MA3 and MA5 higher than its chronological age. Thus, the nonlinearity between the variables indicating general motor age lower than chronological age confirms the delay of motor development in the cases studied, allowing to consider that prematurity and low weight may cause delay in the first years of life, reinforcing the need for longitudinal follow-up.

Regarding the GMQ obtained in each case, it was found that its development was classified as low, being lower in cases 2, 3 and 4, indicating a limited development, and normal medium development in cases 1 and 5. It is important to emphasize that this result is worrying, justifying the need for longitudinal follow-up programs for preterm children, seeking to detect and intervene in possible alterations.

Therefore, further studies on the subject are necessary in order to promote the early diagnosis of motor development delay and to allow better guidance to parents/guardians on early intervention and stimulation, avoiding and/or minimizing possible difficulties and delays in school period, as well as difficulties in social interaction in their adult life.

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## Resumo

**Introdução:** A prematuridade e o baixo peso ao nascimento são condições que podem comprometer o desenvolvimento normal da criança nas diferentes etapas evolutivas. Considerando que estas condições podem acarretar atraso na aquisição de habilidades motoras, é importante avaliar, detectar e prevenir as possíveis alterações no desenvolvimento motor.

**Objetivo:** Analisar a influência da prematuridade e do baixo peso ao nascimento no desenvolvimento motor de crianças na faixa etária de três anos de idade, relacionando a idade cronológica com a idade motora geral.

**Método:** Trata-se de uma análise com cinco casos de crianças nascidas pré-termo 32,1 ( $\pm 1,82$ ) semanas e com baixo peso 1704 ( $\pm 384,41$ ) gramas, idade cronológica média de 43,2 ( $\pm 2,59$ ) meses, avaliadas por meio da Escala de Desenvolvimento Motor (EDM) no Laboratório de Eletromiografia e Cinemática (LAELCIN) da Universidade Federal do Triângulo Mineiro (UFTM), considerando as variáveis idade motora geral (IMG) e idade cronológica (IC).

**Relato:** As cinco crianças nascidas pré-termo e com baixo peso apresentaram diferença entre a idade motora geral média (37,6,  $\pm 7,40$ ) meses e a idade cronológica média (43,2,  $\pm 2,59$ ) meses, indicando atraso no desenvolvimento motor.

**Conclusão:** Observou-se ausência de linearidade das variáveis, indicando atraso no desenvolvimento motor, justificando assim, a necessidade e importância do acompanhamento longitudinal dessa população para detecção e intervenção precoce.

**Palavras-chave:** desenvolvimento infantil, habilidade motora, avaliação.

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