

Fine motor development in children with chronic malnutrition¹

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Abstract: Introduction: Children with chronic malnutrition present several delays that may compromise the development of fine motor skills. Objective: To verify how the fine motor skills is regard to chronological age and the genders in children aged to 24 to 48 months with chronic malnutrition. Method: Descriptive study was carried out in a low-income community in Maceió, Alagoas, Brazil. Malnourished children were recruited in Nutritional and Educational Center and eutrophic children in a local kindergarten, both from the same low-income community. The Rosa Neto Motor Development Scale (EDM) was used for assessed children fine motor skills and weight and height measurements were performed for assessed children nutritional status. Descriptive statistics and the t-test ($p < .05$) were used. Results: Twenty three children (10 girls and 13 boys) composed the study sample. Out of the sample, 11 children formed the cases (malnourished) and 12 the control group (eutrophic). The age for fine motor skill (IM1) was lower among the cases ($M = 26.18$) compared to controls ($M = 47$; $p < 0.001$), and among the girls ($M = 33.6$) in relation to the boys ($M = 39.69$; $p < 0.001$). Conclusion: It is possible that malnutrition has been decisive in lower references in cases, presenting a significant impact on the overall child development, since delays in this area can characterize motor difficulties regarding to learn for reading and writing abilities. As well as associated with numerous motor problems such grip, unsafe trace, and impulsive movements.

Keywords: *Psychomotor Performance, Child Malnutrition, Health Vulnerability.*

Desenvolvimento da motricidade fina em crianças com desnutrição crônica

Resumo: Introdução: Crianças com desnutrição crônica apresentam diversos atrasos que poderão comprometer o desenvolvimento da motricidade fina. Objetivo: Verificar como se apresenta a motricidade fina em relação à idade cronológica e entre os gêneros em crianças de 24 a 48 meses com desnutrição crônica. Método: Realizou-se estudo descritivo em uma comunidade de baixa renda em Maceió e Alagoas, cidades do Nordeste do Brasil. Recrutaram-se crianças desnutridas de um Centro de Recuperação e Educação Nutricional e crianças eutróficas em uma creche, ambos os grupos de uma comunidade periférica da cidade. Aplicou-se a Escala de Desenvolvimento Motor (EDM) de Rosa Neto e medidas de peso e estatura. Utilizou-se a estatística descritiva e o teste t – Student ($p < 0,05$). Resultados: A amostra foi de 23 crianças; 10 meninas e 13 meninos. Da amostra, 11 crianças formaram os casos (desnutridos) e 12 o grupo controle (eutróficos). A idade motora para motricidade fina (IM1) foi inferior entre os casos ($M = 26.18$) em relação aos controles ($M = 47$, $p < 0.001$) e entre as meninas ($M = 33.6$) em relação aos meninos ($M = 39.69$, $p < 0.001$). Conclusão: Pode-se suscitar que a desnutrição tenha sido decisiva nos referenciais inferiores entre os casos, apresentando um impacto significativo sobre o desenvolvimento global da criança, já que atrasos nessa área motora podem caracterizar dificuldades em aprender a ler e escrever, associados aos inúmeros problemas motores como preensão, traçado inseguro e movimentos impulsivos.

Palavras-chave: *Desempenho Psicomotor, Desnutrição Infantil, Vulnerabilidade em Saúde.*

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1 Introduction

The early years of the child's life are important because, during this phase, most processes occur in the spheres of physical and motor development (NOBRE et al., 2012). The entire body of the child undergoes constant changes, and even the development of the brain happens quickly and constantly. Therefore, minimal changes in this process can have great consequences on the child's physical structure and functional capacity (GRANTHAM-MCGREGOR et al., 2007).

In addition to developing the brain, the child exhibits changes in motor behavior, which are influenced in part by the maturational process, but which also suffer marked influences from the environmental context and the various stimuli available (PAPALIA; FELDMAN, 2013).

Connolly (2000) also mentions that motor behavior in early childhood is an important indicator of global child development. Due to such characteristics, Gallahue, Ozmun, and Goodway (2013) highlight that motor development is a process in which the phases and stages of development expected will have these influences as typically among the individuals.

However, in addition to the motor development considered in a global way, some motor aspects have different development periods. According to Meinel (1984), between the different periods, the fine motor takes more time for its refinement, because it works with minimal force, but with great precision and speed because it is an activity of especially small movements.

The fine motor is the ability to control a set of movement activities of certain segments of the body, using minimal force, with the ability to control the small muscles of the body (ROSA NETO, 2002; GALLAHUE; OZMUN; GOODWAY, 2013).

Canfield (1981) states that fine motor have eye-hand coordination and require a high degree of precision in movement for specific skill performance, at a high level of achievement. For example, cutting paper, picking up pencils, brushing teeth, combing hair, opening and closing the zipper, that is, movements that require the ability to control the small muscles of the body to be performed, therefore, a sequence of development from large muscle groups to small ones.

According to Harrow (1988), through these daily tasks, the child begins to have more skill in performing such ordinary movements. However, the child needs stimulation in the exploration of

tasks to experience skills, from the simplest to the most complex.

For Gallahue, Ozmun, and Goodway (2013), the development is influenced in the social and biological environment and may have changes during its process. It is known that favorable environments, which offer adequate spaces, such as the school, are relevant for the motor development of the child since the playful environment characterized by play within the school becomes an effective means for learning and development of the children (PAPALIA; FELDMAN, 2013).

Several factors can influence infant motor development. Despite that obesity in children and adolescents is one of the greatest public health problems today (SILVA et al., 2010), chronic malnutrition deserves to be highlighted due to the indirect effects that the disease causes on health status, especially in the cognitive and neuropsychomotor development in children who had nutritional deprivation during the critical period of development, ranging from 0 to 5 years old, becoming more vulnerable to post-disease sequels (TEIXEIRA; HELLER, 2004).

In recent years, there has been a decline in malnutrition in the world; however, the disease is still considered one of the major public health problems, including its various causes and risk factors (ONIS; FRONGILLO; BLÖSSNER, 2000). This context is also evident in Brazil that despite the reduction of cases in the last decades, some regions of the country have higher prevalence than the national region, which is 5.9% (LIMA et al., 2010).

The study by Ferreira and Luciano (2010) in Alagoas with a probabilistic sample of 1,386 children under five years old, revealed a prevalence of chronic malnutrition in this age group of 10.3%.

Another study in this same state in the capital had a probabilistic sample of 2,075 children aged 4 months old to 6 years old (SILVEIRA et al., 2010), who showed a prevalence of 8.6% for chronic malnutrition, evaluated by the height-age index of the children.

Several studies have approach malnutrition as one of the greatest problems of global public health (TEIXEIRA; HELLER, 2004; ONIS; FRONGILLO; BLÖSSNER, 2000; LIMA et al., 2010; FERREIRA; LUCIANO, 2010; SILVEIRA et al., 2010). However, it is still evident that attempts to combat these problems are still failing. In this way, it is necessary to invest in increasingly comprehensive and multisectoral programs of public health, not only for the fight against malnutrition, but also for

the prevention of the disease, which must be done with adequate education of the means and not only depend on a single individual, but on social groups as well as on government actions to reformulate outdated strategies.

Children suffering from chronic malnutrition have been assisted by non-governmental organizations (NGOs) that seek to minimize the harmful effects of the disease. One of them is the Center for Nutrition Education and Recovery (CREN), a reference NGO in the treatment of children with malnutrition, providing specific meals through semi-boarding and outpatient care with a multi-professional team to attend the children and their mothers.

Such strategies are fundamental to promote the full development of children in situations of social vulnerability since it is imperative that preschool children be stimulated and coexist in enriching environments (RÉ, 2011), minimizing the inherent consequences to the deprivation of such stimuli. Therefore, professionals of Occupational Therapy, Physical Education and Physiotherapy have important tools such as the Motor Development Scale of Rosa Neto (2002), whose purpose is to investigate the motor age of the child according to the test related to their chronological age, that is, after each test establish the developmental age patterns and, consequently, motor profile, to evaluate the motor development of children and to identify possible commitments in this area.

In a preliminary study about children with malnutrition, Costa and Cavalcante Neto (2010) obtained important results for the fine motor, being the component with greater distribution of negative values, presenting a superior percentage of motor deficits in the other batteries of the Motor Development Scale, an instrument developed by Rosa Neto (2002).

Therefore, this study preliminary study and the the scarcity of specific publications on fine motor skills in children with malnutrition in the sources consulted, this study raises the possibility of investigating fine motor function as an important factor in children with malnutrition, and maybe direct future interventions in the area of Occupational Therapy, Physical Education and Physiotherapy, which allow methodological specificities for greater gain in the motor repertoire of these children. Since chronic malnutrition compromises the child's development in a global and specific way, and also due to the lack of research in the literature on the topic, it was hypothesized that children with

chronic malnutrition have motor development lower than chronological age than children with normal nutritional status. The objective of this study was to verify the influence of the nutritional status of children on their motor performance, particularly in their fine motor function, for the 24-48 months age range.

2 Method

This study is characterized as a descriptive and comparative study. The research was carried out at the Nutrition Education and Recovery Center (CREN) in Maceió, State of Alagoas, in the northeastern region of Brazil, located in the seventh administrative region of the city, as well as in a municipal nursery near CREN, where data of the control group were collected. The CREN is a place where the children are in semi-boarding school, doing meals and snacks and having pedagogical teaching.

2.1 Sampling

The study population was children between 24 and 48 months old, divided into case groups and control groups. The case groups were malnourished children, moderate to severe, and the control study was eutrophic children assisted in a municipal nursery near CREN.

The study sample was non-probabilistic for convenience, based on the availability of human resources at the places. Thus, there were 23 children participated in the study in total, being 11 children in CREN and 12 children in the municipal daycare center.

2.2 Instruments

In this study, the following instruments were used:

2.2.1 Motor Development Scale (MDS)

The Motor Development Scale (MDS)² was elaborated by Rosa Neto (2002) and aims to evaluate the motor development of children in the group from 2 to 11 years old from specific tasks for each age, performed by some variables, also called of motor ages (MAs): fine motor (MA1), global motricity (MA2), balance (MA3), body schema (MA4), spatial organization (MA5) and temporal organization (MA6). The monitoring of the tests was

done with the help of a Fuji brand digital camera, Finepix series S2500HD/S2700HD, 12-megapixel resolution, 15x digital zoom, for recording information and later analysis.

The research studied a total of 10 (ten) girls and 13 (thirteen) boys between 24 and 48 months old. The classification of the results of the fine motor was established according to Rosa Neto (2002), through the motor quotient as Very high of 130; High 120-129; Normal high as 110-119; Normal average as 90-109; Normal Low as 80-89; Low as 70-79; Very Low as 69 or less.

2.2.2 Anthropometric evaluation

The evaluations regarding the nutritional status of the children were carried out by the nutritionist team of the Nutrition Education and Recovery Center (CREN) in Maceió. This information was provided through the database available at the Institution. The anthropometric evaluation of the children in the control group was carried out by trained undergraduates of the Physical Education Bachelor and Graduation degree of the Federal University of Alagoas, who carried out the measures in the daycare center. A digital scale of Filizola® brand was used to verify body weight and for children's height measurement a TBW® brand stadiometer was used. The cut-off point was the Z score (-2DP), using the height-age index, according to the classification of nutritional status recommended by the World Health Organization (WORLD..., 2006).

2.3 Procedures

At the first moment of the study, interviews were conducted with the parents to consent to their children's participation in the research and selection of the participants from the anthropometric evaluation. Students with chronic malnutrition in the CREN and eutrophic students in the nursery near the CREN were identified. In the second moment, the chronological age (CA) of the children was identified, considering the time in months from the date of their birth, collected secondary form from the enrollment form of the children in the Institutions.

In the third moment, the battery of tests of Rosa Neto (2002) was applied with the purpose of evaluating the motor development. It was possible to evaluate the motor age for fine motor (MA1), calculated by the results obtained in the fine motor tests and the chronological age of the child; and the

motor quotient for fine motor (QM1), calculated by the formula ($QMG = \frac{IMG}{IC} \times 100$). According

to the QMG scores, children can be classified into 7 levels: Very High, High, Normal High, Normal Average, Normal Low, Low, and Very Low.

This study was submitted to the Research Ethics Committee (CEP) of the Federal University of Alagoas (UFAL), approved with protocol number 012090/2009-79. Data collection began after the reading and signing the Informed Consent Form (TCLE) with the children guardian, following all the prerogatives of the Declaration of Helsinki and the Resolution of the National Health Council (CNS, 466/12).

2.4 Statistical analysis

A descriptive statistical analysis was used with frequencies, means, and standard deviation. The t-test was also used to compare the means between the groups, with significance level <0.05 . The analyses were performed in the Statistical Package for Social Sciences (SPSS) software version 20.0.

3 Results and Discussion

According to the literature reports, fine motor is the ability to control a set of movement activities of certain segments of the body using minimal force and able to administer the small muscles of the body (ROSA NETO, 2002; GALLAHUE; OZMUN; GOODWAY, 2013).

Table 1 shows the mean motor age for fine motor (MA1) was lower in the case groups than in the control groups, with a significant difference ($p < 0.001$).

The motor age is obtained through the sum of the positive results obtained in the motor tests, and it may suffer alterations in the results, as in the case of malnutrition, in the graph shows a smaller result among the case groups than the control groups.

From the results observed in Table 1, chronic malnutrition has been decisive factors to justify lower referential between case groups than control groups in their motor age for fine motor. This has a significant impact on the overall development of the child since delays in this motor area can also characterize a certain difficulty in learning to read and write, associated to the numerous motor problems such as gripping, unsafe tracing and

impulsive movements (GALLAHUE; OZMUN; GOODWAY, 2013).

Therefore, Occupational Therapy, Physical Education and Physical Therapy provide safe tools to identify such delays that can trigger future problems.

Regarding the mean motor quotient for fine motor (QM1), Table 2 shows a lower classification, whereas, in the control groups, the classification was normal average.

The motor quotient is obtained through the division between motor age 1 (MA1) and chronological age (CA). The result is multiplied by 100 (ROSA NETO, 2002).

Considering the results found, several factors can interfere in the normal course of motor development. Low birth weight and malnutrition are among the main causes of motor retardation (GALLAHUE; OZMUN; GOODWAY, 2013).

Silveira et al. (2010) and Ré (2011) point out that risk factors increase the probability of deficits in the motor development of children, including when related to environmental conditions such as socioeconomic level, among others.

Although there are few studies in the specialized literature investigating the variables considered in children with malnutrition, a study developed by Sacconi et al. (2007) pointed out a greater delay in the development of fine motor skills in malnourished children, reinforcing the assumptions of this study.

In addition to allowing details to be identified, factors that directly and/or indirectly interfere with motor development during childhood, since the motor development process occurs dynamically, susceptible to being shaped by innumerable external stimuli (NOBRE et al., 2012). Rodrigues (2005) highlights that during the development of the child

in the school context, the activities performed in Physical Education classes play an important role, since games, exercises and playing and other activities develop and improve the cognitive, motor and auditory spheres. Therefore, professionals working in this area have the ability to know their students better and have sensitivity and specific information to detect problems and suggest appropriate interventions to aid in the child's motor development process (OLIVEIRA; OLIVEIRA; VAZ, 2008). One of the roles of the Occupational Therapist is to investigate cases of delays in child development with the aid of developmental assessment tools such as MDS and to promote interventions for the improvement of delayed motor components. Maronesi et al. (2015) found a positive effect on the fine motor skills of a child with motor delay after performing a two-month intervention.

When detected early, the motor delay allows the child to be quickly inserted into a specific activity program, which may help in the future to achieve greater chances of success in specific movements. If not stimulated, the child could have higher delays due to the deprivation of stimuli for the child's development (CEZARIO, 2008).

It is interesting to highlight some limitations of this study, such as the lack of matched chronological age between case and control groups and the small number of the sample. On the other hand, the groups started from the same sociodemographic reality and the motor evaluation instrument selected in the study allows the classification of the motor age for a specific chronological age of the group being studied. Also, the difficulty found in the recruitment of children in this age group, despite the process of recognition and socialization carried out before the collection, hinder to form a larger sample for the study.

Table 1. Indices of Motor age for fine motor (MA1) between case groups and control groups (N=23).

Groups	Average	Standard Deviation	p-value
Case	26.18	10.48	<0.001
Control	102.01	8.02	

Table 2. Average of the motor quotient for fine motor (MA1) between case and control groups (N=23).

Groups	Average	MDS Classification	p-value
Case	79.37	Low	<0.001
Control	107.95	Normal average	

4 Conclusion

The values of motor evaluation were lower in children with chronic malnutrition compared to the eutrophic children. Thus, the data show that malnutrition can directly and/or indirectly affect the growth and development of a child, proving the hypothesis rose in the study.

In this way, specific investigations are necessary for progress in the fine motor component. It is important to emphasize that motor activities directed to these children will be of great gain and enriching since

the stimuli require learning and development of muscular groups that facilitate the daily activities.

Thus, new studies that can expand the motor development theme are recommended, specifically focused on fine motor skills, broadening the referential of the area and promoting interventions in groups at risk.

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Authors' Contributions

Aline Gabrielle dos Santos da Costa conception of the text, organization and data collection and text writing. Jorge Lopes Cavalcante Neto conception of the text, guidance of the work, analyzed the data, carried out the statistical analysis and text writing. Both authors approved the final version of the text.

Notes

- ¹ The research involved human beings, so this study followed all the ethical precepts of human being research based on the Declaration of Helsinki and Resolution 466/12 dealing with human being research in Brazil. The research project of this study was submitted to the Ethics Committee in research with human beings of the Federal University of Alagoas (CEP/UFAL), approved with number 012090/2009-79. They are original results of field research carried out from a project of Graduation Course Conclusion.
- ² We highlight that in this study we used only the component fine motricity in our analyses.