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Motor and Oculomotor Performance Assessment in Infants in Primary Health Care Level: A Cross-Sectional Study

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Method: Twenty six term infants without neonatal risk factors were selected. Infants were six months old when they had their motor and oculomotor performance assessed respectively using the Alberta Infant Motor Scale and the Optokinetic Nystagmus, this latter was assessed using a drum with white and black stripes interspersed with each other. Ratings were recorded on video and motor and oculomotor performances were assessed and scored by two evaluators who have been trained and are blind to the study. For data analysis, X2 for reliability analysis and the Mann Whitney test for correlation of continuous variables. The significance level was 5% for every analysis.

Results: It was found 15% of assessed infants showed motor development abnormalities and only one infant showed no Optokinetic Nystagmus movement.

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Conclusion: Term infants have abnormal motor performance and can present absence of optokinetic nystagmus.

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I. Introduction

Although health has shifted from the biological field to the population living conditions, requiring direct and intersectional public intervention, the essential pursuit of improving life quality with peace, equity and social justice, and citizenship (Teixeira, 2000) the risks and neuromotor development delays evaluation is oriented mostly to a specific group of newborn infants (Carvalho, 2005), (Formiga, 2009) (Pereira, 2011), not being performed as a routine in primary health care.

The lack of surveillance systems, which complicates the identification and monitoring of vulnerable children, may be a possible explanation for this gap and the no use of appropriate tools to screen children at risk for motor neuropsychiatric development (Torburn, 1990). In addition, children living in developing countries often live in unfavorable family environments, where stimulation and social support are inadequate (Halpern, 1996). This sequence of events raises the risk of delay in their cognitive, physical and social development.

Within this perspective, new studies have already interpreted instruments as an alternative to assess the complexity of the child development process, in order to prevent and detect deviations and to establish strategies for early intervention (Gagliardo, 2003). Early detection is the main vehicle to monitor and adjust the physiological and pathophysiological function of various systems, such as the motor system, in all situations.

The Alberta Infant Motor Scale (AIMS) has been used in many studies in children, as it is considered a reliable and valid instrument for measuring motor performance and detect possible changes aiming to establish an early intervention (Syrengelas, 2010) (De Kegel, 2012) (Saccani, 2013).

The oculomotor performance assessment is quite simple, low cost (Ricci, 2008) and the possibility of timely detection of changes in the oculomotor system is connected to a timely diagnosis and prompt attention, thus favoring children and their families' life quality,
since there is a reciprocal relationship between visual and motor function (Pereira, 2011), (Saccani, 2009) (Mancini, 2002) (Halpern, 2000) (Saccani, 2010) (Cassidy, 2000).

The motor-visual reciprocity is represented by a complex set of interdependency between sensory system and ocular motility, and its muscle contraction command is determined by the central nervous system (Gagliardo, 2003) (Gagliardo, 2004) (Costa, 2007) (Mezzalira, 2005).

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This research objective was to assess the visual and motor responses of infants at primary health care level.

II. Method

A cross-sectional study was performed with infants born in Ana Bezerra University Hospital's Maternity (HUAB – Hospital Universitário Ana Bezerra), after the Committee of Ethics in Research approval, an integrant of Onofre Lopes University Hospital, within Federal University of Rio Grande do Norte, under the protocol number 77081/2012.

The sample, which have been drawn for convenience, consisted of six-months-old infants, born at term, weighing less than 2500g, by single delivery, without participating in intervention programs, having the free and enlightened consent by the person responsible (infant mother or guardian), which term was properly signed.

Infants excluded from the study showed neurologic diseases, orthopedic problems, sensory impairments (hearing and/or visual) and infants with Apgar value of less than five in the fifth minute.

In order to select the inclusion criteria, it was initially performed a retrospective analysis of infants medical records, which have been born between September/2011 and February/2012. At this stage, 180 charts were selected and 95 were analyzed. The data gathered included: date and type of delivery, Apgar scores, head circumference, infants' birth weight and length; as well as information relating to the mother (mother's age, marital status and occupation) and obstetric information (gestational age, parity, and gestational problems).

After analyzing the patient charts and approximately six months after the infant date of birth, a prior contact with the infant mother or guardian had been made by phone and/or home visits, to provide them with guidelines to participate in the research and to schedule the neuromotor performance assessment.

In order to assess neuromotor skills acquisition it was used the AIMS, which had been developed by Piper and Darrah (1992) (Piper, 1992). Based upon the literature, consists of 58 items grouped into four subscales that describe the development of spontaneous movement and neuromotor skills; these subscales are determined by four basic positions: prone, supine, sitting and standing (Carvalho, 2005) (Saccani, 2009) (Vieira, 2009) (Zajonz, 2008) (Mancini, 2004) (Zajonz, 2008) (Lima, 2004).

In each subscales' item, detailed descriptions of weight support, posture and antigravity movements observed in each position are included. At the end of the assessment it was credited a percentile, ranging from 5% to 90%. The percentile presented by summing the four subscales was used to rank neuromotor performance: normal/expected, exceeding 25% in percentile curve; suspect, between 25% and 5%; and abnormal, below 5% (Piper, 1992) (Mancini, 2004) (Zajonz, 2008) (Lima, 2004).

After the motor performance assessment, it was performed the oculomotor performance assessment with the infant sitting comfortably on the mat with his trunk being supported by the researcher.

In order to perform this assessment it was presented, 30 cm away from the infant, a target-shaped drum with interspersed white and black stripes, similar to optokinetic drum from Bárány (El Hassan, 2001). The drum was rotated in front of the infant in an attempt to attract his attention and assess the ocular movement called Optokinetic Nystagmus (Figure 01). The ocular movements promoted vertical measurements as stripes turned left and right, and horizontal measures, as stripes turned up and down. During the assessment the infant was expected to follow the drum movement presenting rhythmic repeated and involuntary oscillations movements of the eyes.

Figure 1

Figure 1 : Optokinetic Nystagmus assessment. The drum (radius 6.5 cm – 12.4° of visual angle and height of 17 cm – 31.6° of visual angle) with horizontal black and white stripes (4 cm each – 7.6 cycles per degree of visual angle was used for evaluation of optokinetic nystagmus. Was performed vertical measurements with the stripes rotating left and right and horizontal measurements, by rotating the stripes up and down. During the assessment it was expected the baby to accompany the drum's movement by presenting repeated and involuntary rhythmic, oscillating motions of the eyes (movements of smooth pursuit and saccadic movements of return).

At the end of the assessment the mother and/or guardian was requested to respond to a closed questionnaire, providing information regarding sociodemographic data. A single examiner, who was well trained to use the scale, has evaluated all children. Ratings were recorded on video and motor performances were reassessed and scored by two evaluators who have been trained and are blind to the study.

The collected data were archived using the Statistical Package for Social Sciences Program for Personal Computer (SPSS-PC) Program, version 17, and grouped according to the studied variables. For data analysis, the Shapiro Wilk test was performed for normality analysis, X2 for reliability analysis and the Mann Whitney test for correlation of continuous variables.

III. Results

Considering the total of 95 infants which were selected for the study: 26 were effectively assessed; 16 were not located, because there were no full address medical record entries; and 53 did not reside at the address identified in the medical record and/or had no telephone number.

All 26 infants were evaluated at six months of age (Median = 6.45 ± 0.37 m), were born with a gestational age between 37 to 41 weeks (Median = 40 weeks ± 1.11), average weight of 3459.42 g ± 382 and head circumference of 34 cm ± 1.27. Table 1 shows the sample characteristics.

Table 1 : Sample characterization

Characteristics	Assessed Group (n = 26)
Perinatal	
Mother's Age (year) – Mean (SD)	29 (±6)
Type Childbirth – f (%)	
Normal	15 (58)
Cesarean	11 (42)
Neonatal	
Sex – f (%)	
Female	15 (58)

Gestational Age (wk) – Mean (SD)	40 (±1,11)
Birth weight (g) – Mean (SD)	3459,42 (±382)
Birth height (in cm) – Mean (SD)	50 (±2)
Head Circumference (in cm) – Mean (SD)	34 (±1)
APGAR at 1 minute (score) – Mean (SD)	8 (±1)
APGAR at 5 minutes (score) – Mean (SD)	9 (0)
Exclusive Breastfeeding	
Yes	17 (65)
No	9 (35)

Caption: SD – standard deviation; f – frequency; % – percentage; wk – weeks; g – grams; cm – centimeters.

Regarding socioeconomic conditions 16 (61%) families presented a monthly income of a minimum wage and owned a home (65%), two families had no income. Fifteen homes presented 4 to 5 residents including the infant, and 19 assessed infants had contact with other children. Mothers were young adults with a mean age of 29 ± 6, with low education (14 presented incomplete primary education); only two mothers were married and five of them had a steady relationship.

The AIMS assessment identified four (15%) infants with a suspected motor development, presenting percentiles below 25%; and only one infant presented no optokinetic nystagmus.

Multivariate analysis showed that the factors which had influenced the development of the four infants who have presented suspected motor development were: not having other children at home ($p = 0.028$, OR = 1.29), not having breastfed until six months of age ($p = 0.011$, OR = 1.69) and low birth weight ($p = 0.06$), Table 02.

Table 2 : Correlation between the groups with and without delay NMD with categorical variables (X2) and numerical variables (Mann Whitney)

Risk Factors	*p*-value	Odds Ratio (IC 95%)
Marital Status	0,32	
Education	0,86	0,83
No of Residents	0,31	
Family Income	0,75	
Other Children	0,028	1,29
E.B.	0,011	1,69
Ocular Movements	0,017	0,75
Type Childbirth	0,73	0,69
Gestational Age	0,40	
Apgar at 1 Minute	2,39	
Apgar at 5 Minutes	0,66	
Birth weight	0,06	
Size at birth (cm)	0,47	
Head Circumference	0,23	

Caption: NMD = normal motor development, No = number; EB = exclusive breastfeeding, cm = centimeters.

IV. Discussion

Although there were no neonatal risk factors, 15% of assessed infants showed some abnormalities of motor development and one infant showed no ocular movements. Moreover, the family dynamics, exclusive breastfeeding until six months, and birth weight influenced the motor ability of infants with suspected development.

The identification of children presenting delays and subtle motor deficits may be a challenge for clinicians and researchers, since the evaluation of infant

motor development may be ineffective when only clinical description is used (Santos, 2008). Motor development is a skill which receives multifactorial influences; this way therapeutic intervention should aim not only biological risks, but also the influence of sociodemographic factors and their relationship with the visual function (Ferreira, 2011).

As for motor response, most infants presented a motor performance within expected levels for the age of six months (mean percentile of 27.46). These data are not similar to Saccani (Saccani, 2013) and Lopes (Lopes, 2004) findings with healthy Brazilian infants, as the values they have found proved to be superior at an average score which was lower to the percentile (Mello, 2004).

By the optokinetic nystagmus movement, we propose in this study an investigation of the oculomotor performance, in an attempt to assess the central processing route and correlate findings between the two instruments. However, this correlation was hampered as only one infant presented abnormal ocular movement; and we believe that motor development and communication skills are impaired in children with visual disabilities, because gestures and social behaviors are learned by visual feedback (Gagliardo, 2004). It is known that not integrating the visual pathway may result in motor impairments (Gagliardo, 2003) (Cassidy, 2000) and our data confirm these findings, since motor development was suspected according to AIMS in only one infant who presented no optokinetic nystagmus.

Previous studies which have assessed motor development in healthy Brazilian infants presented low percentiles; and acquisitions for most tasks occur slowly compared with infants which were assessed in Canadá (Mancini, 2004) (Pilz, 2007) (Santos, 2008). These authors questioned which aspects could justify the presence of the low percentiles presented by Brazilian children and explained that this fact could occur because motor skills acquisition happens in a non-uniform rhythm, is not universal and undergoes cultural changes (Mancini, 2004) (Pilz, 2007) (Santos, 2008).

Although most of the interviewed mothers presented low education level and low income, no correlation was found between these variables and motor development.

This result does not confirm those described in previous studies which have found an association of these variables with socioeconomic status. According to the authors, when income and consumption of goods are low, parents' harmony and the environment well being can be impaired, and may affect the quality of family relationships, as well as disadvantage child development (Saccani, 2009) (Mancini, 2004) (Pilz, 2007). This can be explained by the physical environment limitation, restricting the possibilities for infants' proper exploration and interaction in the environment, thus hampering their global development (Saccani, 2009).

Regarding the fact that low maternal education is a risk factor which causes problems to child growth and development (Pereira, 2011) (Vieira, 2009) (Pilz, 2007), Halpern et al. (Halpern, 2000) found that as maternal education decreases, the risk to present suspect motor development increases; association also mentioned by Moura (Santos, 2008) . In this study, however, despite mothers' low education, these data were not significant.

The monthly family income is crucial to provide families' life quality in accessing health, education, food, housing, among others (Vieira, 2009) (Leone, 2002); and to most survey participants it was lower than the minimum wage, around R$600. Poverty has been considered a constant threat to child welfare, as it promotes limitations to their development opportunities (Zajonz, 2008) (Mancini, 2004). Thus, the lower the family income, the greater children's vulnerability to motor disorders (Halpern, 2000) (Mancini, 2004).

In controversy to the majority of studies, despite of the low family income, it was found that infants presented motor performance considered within normal limits; this can be explained because in low-income homes located in developing countries such as Brazil, the head of the family is usually the one who works, thus the role of child care gets diluted among the several residents of that home. Results show that other 4-5 people also live in 62% of households where assessed children live, including children; 81% of the assessed children lived together with other children. It is believed that early contact with these children has contributed to good motor performance. These data corroborate to Formiga (Vieira, 2009), Magalhães (Magalhães, 2003) and Souza (Souza, 2010) findings. However, the relation between the number of residents in the child's residence and the motor performance is still poorly investigated .

Another point that can be discussed in this perspective is the presence of a stable union between most participants' parents; in his study Formiga (Vieira, 2009), considered this marital status as a potentially protective factor, neutralizing the adversity effect on the child motor development. This author also reported that when parents are in a stable union, family shows greater support for infant care, favoring interactions, emotional balance and proper development.

Breastfeeding can also configure itself as a possible factor which may favor the development; by questioning mothers regarding feeding the infant only with breast milk it was found that 65% of infants have been exclusively breastfed up to six months old. In Zanjonz (Zanjonz, 2008) study it was noted that the longer breastfeeding duration the best assessed children motor performance was, according to his study. Another study found out that children who have never

been breastfed presented a 88% higher chance of having a test resulting in suspected motor development, when compared to those who had exclusive breastfeeding up to six months old (Albuquerque , 2009). The breastfeeding period provides a daily approach, which works as a facilitator of child development. This approach also promotes physical contact with the mother, making it a rich source of stimuli, leading to increased motor stimulation, which triggers appropriate responses for this age group (Zajonz , 2008).

Other studies investigating the influence of birth weight on child development (David, 2012), corroborate to our data (Lima, 2004) (Santos, 2008) (Pilz, 2007), as they demonstrated that the lower the birth weight, the greater the chance of infants to present developmental delay . Although assessed infants are facing social factors that may negatively influence the process of motor skill acquisition, they remain within normal limits. The participants in this study presented an average birth weight of 3459g and gestational age of 40 weeks. The effect of social risk factors on the relationship between biological risk and child development can be understood as a moderating effect. According to Souza & Magalhães (Souza, 2010), since biological factors have great influence on the development in the first year of life, from the second year on, however, it was seen that environmental factors were more relevant (Lima, 2004). Some factors may possibly justify the good development that children presented in this study, although they present no statistically significant relationship; as, for example, the average maternal age of 29 years. To Zajonz (Zajonz, 2008) the higher the maternal age, the better motor performance is shown by children.

There are some limitations in the present study, as the limited sample size and the fact that this is a transversal study. Future researches shall be stimulated using the same population with a more representative sample size, as well as the longitudinal assessment of infant motor development. This study, however, provides important information on infant motor development, demonstrating that even term infants without neonatal risk factors, may exhibit abnormal motor performance and present no optokinetic nystagmus. We note that studies aiming to associate oculomotor development with motor development of children using reliable scales with proven sensitivity and specificity shall be encouraged. Although we do not use a validated visual analogue scale, an object placed in the visual field awakens the child's interest and desire to touch it, stimulating his vision and enhancing ocular movements. These stimuli cause these structures to develop their cell contacts and synapses are realized by neural cells, promoting visual function and making it permanent (Gagliardo, 2003) (Mezzalira, 2005), allowing interaction with the external environment, fostering communication and controlling movements and actions (Pereira, 2011) (Carvalho, 2005) (Costa, 2007) (Mezzalira, 2005) (Bicas, 2003).

These study's practical implications reinforce that knowledge, assessment and the spontaneous observation of visual behavior during the first months of life allows not only to verify how the infant uses his vision to build his sensorimotor universe , but also constitutes a procedure able to detect possible changes in motor and neurological development, for the vision integrates other systems and senses. One of these infants' possible visual apparatus deficits is in their ability to achieve and maintain a normal motor activity. The environmental experiences occurred during the neonatal period influence the neurological maturation, which justifies the proper visual pathways development and motor performance found in our research.

V. Conclusion

Infants without neonatal risk factors may have delayed visual and motor performance, since 15% of our sample presented suspected motor development and one infant showed no optokinetic nystagmus.

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