

# 1 Motor and Oculomotor Performance Assessment in Infants in 2 Primary Health Care Level: A Cross-Sectional Study

3 Silvana Alves Pereira<sup>1</sup> and Silvana Alves Pereira<sup>2</sup>

4 <sup>1</sup> Universidade Federal do Rio Grande do Norte

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## 7 **Abstract**

8 Method: Twenty six term infants without neonatal risk factors were selected. Infants were six  
9 months old when they had their motor and oculomotor performance assessed respectively  
10 using the Alberta Infant Motor Scale and the Optokinetic Nystagmus, this latter was assessed  
11 using a drum with white and black stripes interspersed with each other. Ratings were recorded  
12 on video and motor and oculomotor performances were assessed and scored by two evaluators  
13 who have been trained and are blind to the study. For data analysis, X<sub>2</sub> for reliability analysis  
14 and the Mann Whitney test for correlation of continuous variables. The significance level was 5

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16 **Index terms**— infant, child development, risk factors, term birth, ocular movements, optokinetic nystagmus.

## 17 **1 Introduction**

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

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

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

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

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

39 The motor-visual reciprocity is represented by a complex set of interdependency between sensory system and  
40 ocular motility, and its muscle contraction command is determined by the central nervous system (Gagliardo,  
41 2003) (Gagliardo, 2004) (Costa, 2007) (Mezzalira, 2005). This research objective was to assess the visual and  
42 motor responses of infants at primary health care level.

## 9 RESULTS

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### 43 2 II.

### 44 3 Method

45 A cross-sectional study was performed with infants born in Ana Bezerra University Hospital's Maternity (HUAB  
46 -Hospital Universitário Ana Bezerra), after the Committee of Ethics in Research approval, an integrant of  
47 Onofre Lopes University Hospital, within Federal University of Rio Grande do Norte, under the protocol number  
48 77081/2012.

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

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

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

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

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

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

69 In order to perform this assessment it was presented, 30 cm away from the infant, a target-shaped drum with  
70 interspersed white and black stripes, similar to optokinetic drum from Bárány (El Hassan, 2001). The drum  
71 was rotated in front of the infant in an attempt to attract his attention and assess the ocular movement called  
72 Optokinetic Nystagmus (Figure ??1). The ocular movements promoted vertical measurements as stripes turned  
73 left and right, and horizontal measures, as stripes turned up and down. During the assessment the infant was  
74 expected to follow the drum movement presenting rhythmic repeated and involuntary oscillations movements of  
75 the eyes.

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### 78 6 2014

### 79 7 A

80 In order to assess neuromotor skills acquisition it was used the AIMS, which had been developed by ??iper  
81 and Darrah (1992) (Piper, 1992). Based upon the literature, consists of 58 items grouped into four subscales  
82 that describe the development of spontaneous movement and neuromotor skills; these subscales are determined  
83 by four basic positions: prone, supine, sitting and standing ??Carvalho, 2005) (Saccani, 2009) (Vieira, 2009)  
84 (Lima, 2004). At the end of the assessment the mother and/or guardian was requested to respond to a closed  
85 questionnaire, providing information regarding sociodemographic data. A single examiner, who was well trained  
86 to use the scale, has evaluated all children. Ratings were recorded on video and motor performances were  
87 reassessed and scored by two evaluators who have been trained and are blind to the study.

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

### 92 8 III.

### 93 9 Results

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

97 All 26 infants were evaluated at six months of age (Median =  $6.45 \pm 0.37$  m), were born with a gestational age  
98 between 37 to 41 weeks (Median = 40 weeks  $\pm 1.11$ ), average weight of 3459.42 g  $\pm 382$  and head circumference

99 of 34 cm  $\pm$  1.27. Table 1 Regarding socioeconomic conditions 16 (61%) families presented a monthly income of a  
100 minimum wage and owned a home (65%), two families had no income. Fifteen homes presented 4 to 5 residents  
101 including the infant, and 19 assessed infants had contact with other children. Mothers were young adults with  
102 a mean age of 29  $\pm$  6, with low education (14 presented incomplete primary education); only two mothers were  
103 married and five of them had a steady relationship.

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

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

## 110 10 Discussion

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

114 The identification of children presenting delays and subtle motor deficits may be a challenge for clinicians and  
115 researchers, since the evaluation of infant motor development may be ineffective when only clinical description is  
116 used (Santos, 2008). Motor development is a skill which receives multifactorial influences; this way therapeutic  
117 intervention should aim not only biological risks, but also the influence of sociodemographic factors and their  
118 relationship with the visual function (Ferreira, 2011).

119 As for motor response, most infants presented a motor performance within expected levels for the age of six  
120 months (mean percentile of 27.46). These data are not similar to Saccani (Saccani, 2013) and Lopes (Lopes,  
121 2004) findings with healthy Brazilian infants, as the values they have found proved to be superior at an average  
122 score which was lower to the percentile (Mello, 2004).

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

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

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

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

144 Regarding the fact that low maternal education is a risk factor which causes problems to child growth and  
145 development ??Pereira, 2011) (Vieira, 2009) , Halpern et al. (Halpern, 2000) found that as maternal education  
146 decreases, the risk to present suspect motor development increases; association also mentioned by Moura (Santos,  
147 2008) . In this study, however, despite mothers' low education, these data were not significant.

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

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

## 11 CONCLUSION

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160 However, the relation between the number of residents in the child's residence and the motor performance is still  
161 poorly investigated .

162 Another point that can be discussed in this perspective is the presence of a stable union between most  
163 participants' parents; in his study Formiga (Vieira, 2009), considered this marital status as a potentially protective  
164 factor, neutralizing the adversity effect on the child motor development. This author also reported that when  
165 parents are in a stable union, family shows greater Breastfeeding can also configure itself as a possible factor  
166 which may favor the development; by questioning mothers regarding feeding the infant only with breast milk  
167 it was found that 65% of infants have been exclusively breastfed up to six months old. In Zanjonz (Zanjonz,  
168 2008) study it was noted that the longer breastfeeding duration the best assessed children motor performance  
169 was, according to his study. Another study found out that children who have never been breastfed presented a  
170 88% higher chance of having a test resulting in suspected motor development, when compared to those who had  
171 exclusive breastfeeding up to six months old (Albuquerque , 2009). The breastfeeding period provides a daily  
172 approach, which works as a facilitator of child development. This approach also promotes physical contact with  
173 the mother, making it a rich source of stimuli, leading to increased motor stimulation, which triggers appropriate  
174 responses for this age group .

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

186 There are some limitations in the present study, as the limited sample size and the fact that this is a transversal  
187 study. Future researches shall be stimulated using the same population with a more representative sample size,  
188 as well as the longitudinal assessment of infant motor development. This study, however, provides important  
189 information on infant motor development, demonstrating that even term infants without neonatal risk factors,  
190 may exhibit abnormal motor performance and present no optokinetic nystagmus. We note that studies aiming to  
191 associate oculomotor development with motor development of children using reliable scales with proven sensitivity  
192 and specificity shall be encouraged. Although we do not use a validated visual analogue scale, an object placed  
193 in the visual field awakens the child's interest and desire to touch it, stimulating his vision and enhancing ocular  
194 movements. These stimuli cause these structures to develop their cell contacts and synapses are realized by  
195 neural cells, promoting visual function and making it permanent (Gagliardo, 2003) (Mezzalira, 2005), allowing  
196 interaction with the external environment, fostering communication and controlling movements and actions  
197 ??Pereira, 2011) ??Carvalho, 2005) (Costa, 2007) (Mezzalira, 2005) (Bicas, 2003). These study's practical  
198 implications reinforce that knowledge, assessment and the spontaneous observation of visual behavior during the  
199 first months of life allows not only to verify how the infant uses his vision to build his sensorimotor universe , but  
200 also constitutes a procedure able to detect possible changes in motor and neurological development, for the vision  
201 integrates other systems and senses. One of these infants' possible visual apparatus deficits is in their ability  
202 to achieve and maintain a normal motor activity. The environmental experiences occurred during the neonatal  
203 period influence the neurological maturation, which justifies the proper visual pathways development and motor  
204 performance found in our research.

205 V.

## 206 11 Conclusion

207 Infants without neonatal risk factors may have delayed visual and motor performance, since 15% of our sample  
208 presented suspected motor development and one infant showed no optokinetic nystagmus. <sup>1 2</sup>



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Figure 1: Figure 1 Figure 1 :



Figure 2: A

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Figure 3: Table 1 :

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<sup>2</sup>(58) 11 (42) Neonatal Sex -f (%) Female

## 11 CONCLUSION

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	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)
Year	Caption: SD -standard deviation; f -frequency; % -percentage; wk -weeks; g -grams; cm -centimeters.	
2014		
Volum	Risk Factors	p- value
XIV		Odds Ratio (IC 95%)
Is-		
sue		
I		
Ver-		
sion		
I		
A (	Marital Status Education	0,32 0,83
)		0,86
	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.		

Figure 4: Table 2 :

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