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Motor development of infants (6–12 months) with low birth weight

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SUMMARY

OBJECTIVE: The aim of this study was to describe the motor development (MD) and growth of infants born with low birth weight (LBW) versus adequate birth weight (ABW) by using the Alberta Infant Motor Scale (AIMS).

METHODS: The cross-sectional study including LBW infants (aged 6–12 months) followed at an outpatient clinic from a University Hospital in Brazil and a group of infants of the same age with ABW. The variables were recorded as maternal, birth, and infant conditions. The infants were assessed for MD using the AIMS.

RESULTS: In total, 98 infants (38 LBW versus 60 ABW) were evaluated and no statistically significant differences were found in demographic characteristics and in the AIMS results. The AIMS results of the total sample were suspicious or abnormal MD in 44 (45%) of total infants. Higher frequency of suspected or abnormal motor behavior was found in the age group between 9 and 12 (54.6%) months.

CONCLUSIONS: A frequency of 45% of suspected or abnormal behavior was observed in the evaluated infants, with a higher frequency of occurrence in those aged 9–12 months (54.6%).

KEYWORDS: Infant, low birth weight. Motor skills.

INTRODUCTION

Low birth weight (LBW) is defined by the World Health Organization as birth weight of <2.500 g, regardless the gestational age (GA), including preterm newborns, those with intrauterine growth restriction or small for GA infants. LBW is considered a global public health problem and is associated with a series of functional consequences[1,2].

In 2019, it was estimated 20.5 million live births with LBW, mostly (91%) in low/middle income countries[2]. In Latin America, the rate observed was 8.7%[2]. In Brazil approximately 8.5% of live births were born LBW[3], and in São Paulo it was 9.5%[3].

Children with LBW was at risk for growth, and motor developmental (MD) delays with a broad spectrum of alterations such as cognitive, behavioral, and learning disabilities[4]. Functional changes usually become more apparent over the years, resulting in difficulties in reading and writing in the school phase[5].

In the first 5 years of life, the motor acquisition of child represents the integrity and functionality of other systems[6]. The early identification of possible MD delay, and timely intervention can lead to a better prognosis for children at risk for developmental disorders[7].

The Alberta Infant Motor Scale (AIMS) is considered a dynamic assessment scale, as it describes the acquisitions achieved by the child and enables the analysis of the components necessary for the acquisition of certain skills. It emphasizes movement patterns and skills in different gravitational situations, as well as weight distribution, posture, and antigravity movement. It is a low cost and easy-to-apply instrument[6,8].

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Although infants with LBW are at higher risk for growth and MD delay and developing short- and long-term diseases[4], a few studies[9-11] evaluated the MD in the first year of life applying AIMS. Thus, the main objective of this study was to evaluate the MD of infants aged 6–12 months with LBW by AIMS.

METHODS

This cross-sectional clinical trial included infants born with LBW (LBW Group) and healthy infants (aged between 6 and 12 months) of the same age and also born at term with adequate birth weight (ABW Group). The study was approved by the Ethics Committee (No. 1.904.715). Infants diagnosed with central or peripheral nervous system malformations, encephalopathy, congenital heart disease, genetic syndromes, or the Apgar score <7 in the fifth minute were excluded.

The variables were noted as follows: information about birth (i.e., type, clinical condition of mother, complications, birth GA, birth weight, height, and head circumference), length of stay in the nursery and neonatal complications, the Apgar score, resuscitation procedures, and maternal conditions (e.g., age, parity, chronic diseases, complications during pregnancy, tobacco/alcohol/drug use, socioeconomic status, and education).

Gestational age and birth weight were used to classify the newborn as appropriate for GA (AGA), small for GA (SGA), or large for GA (LGA)[12]. For MD and nutritional status assessment, all premature infants (GA ≤37 weeks) had their GA corrected to 40 weeks[2]. For anthropometry, at the time of MD evaluation, weight (g), length (cm), and head circumference (cm) measurements were obtained[13]. The indicators shown as *Z*-score for age were weight/age, height/age, body mass index (BMI), and head circumference/age[13].

Environment/routines of the infant were as follows: use of a walker, habit of placing the child in prone position, and attending in a day care during the period of the evaluation. MD evaluation was performed by using the AIMS[8] applied by two trained physiotherapists. The total score was converted into a percentile curve, and the MD ratings of infant were included[8] as follows:

1. Normal or typical motor performance when >p25 on the scale percentile curve;
2. Suspicious motor performance between p5 and p25; and
3. Abnormal motor performance when <p5.

At the moment of the MD evaluation the infant was positioned in a firm surface, and specific stimuli were provided to apply the tests according to the age range to be evaluated, manipulating the child only when necessary[8].

All evaluations were recorded by filming, with the purpose of performing the disagreement/agreement analysis between the two physiotherapists. In case of disagreement, a third trained physiotherapist analyzed the videos. The children were worn only with diapers, and the evaluations were performed between feedings, as long as they were active and awake (Brazelton Scale at level 4 or 5)[14].

Statistical analysis

The data were recorded in an Excel spreadsheet (Office®) and analyzed using the Statistical Package for Social Sciences for Windows (SPSS, Chicago, IL, USA) 25.0 (IBM®). Qualitative variables were presented as absolute numbers and percentages, compared by using the Pearson's chi-square test. The normality of continuous variables was assessed using the Shapiro-Wilk test. Those that presented parametric distribution were presented as mean±standard deviation, compared by using the Student's *t*-test. Variables with nonparametric distribution were presented as median and 25–75% interquartile range and compared using the Mann-Whitney *U* test. The variables were considered statistically significant when $p \leq 0.05$.

RESULTS

In this study, 69 eligible infants were attended at the LBW outpatient clinic, and 17 infants were excluded due to congenital malformations and 14 due to loss of follow-up, resulting in the inclusion of 38 infants with LBW, and 60 with ABW.

The maternal sociodemographic and gestational characteristics of infants can be observed in Tables 1 and 2. In LBW group, the mothers had a higher percentage of complications during pregnancy (87% versus 45%; $p<0.001$), the most frequent were infectious and specific pregnancy hypertensive disease (Table 1).

Among the evaluated infants, the mean birth weight of LBW and ABW groups were 2.218.0±166.4 and 3.232.8±416.4 g, respectively ($p<0.001$). The LBW group had a higher frequency of SGA infants (42% versus 10%; $p<0.001$), as well as neonatal complications (57% versus 12%; $p<0.001$) (Table 2).

The 66% of LBW infants were born premature (GA: 35.5±1.7 weeks). The average length of stay after birth was <10 (8.9±6.8) days. Four newborns from the LBW group (11%) remained in the intensive care unit, but the hospitalization time was <24 h.

At the time of the AIMS evaluation, the mean real and corrected age of infants were 273.5±77.2 days in LBW group versus 215.6±60.7 days in ABW group. It was observed that 14 (37%) of the LBW group received breast milk versus 49 (82%) in ABW group ($p<0.001$). No statistical differences were observed between the groups concerning their nutritional conditions. There was no correlation between MD assessment and nutritional status in the groups.

Table 1. Maternal sociodemographic and gestational characteristics of infants with low birth weight and adequate birth weight, 2020.

Variables	LBW (n = 38)		ABW (n = 60)		p-value
	n	%	n	%	
Maternal age (years)*	29.9±6.8		26.7±6.4		0.015†
Maternal schooling					
Elementary school	11	28.9	23	38.5	0.219‡
High school	20	52.6	35	58.3	
University education	7	18.4	2	3.2	
ABEP					
A	0	0.0	0	0.0	0.258‡
B	3	7.9	1	1.7	
B1	12	31.6	10	16.7	
C1	16	42.1	35	58.3	
C2	6	15.8	11	18.3	
D–E	1	2.6	3	5.0	
Prenatal initiation (months)*	1.0±0.16		1.13±0.34		0.036†
Number of pregnancies*	1.6±1.3		2.2±0.9		0.024†
Smoking					
Yes	1	2.6	2	3.3	0.649‡
No	37	97.4	58	96.7	
Alcoholism/drugs					
Yes	1	2.6	2	3.3	0.649‡
No	37	97.4	58	96.7	
Gestational complications					
Yes	33	86.8	27	45.0	<0.001‡
No	5	13.2	33	55.0	
Type of complications					
Cardiovascular	13	34.2	3	5.0	<0.001‡
Respiratory	1	2.6	0	0	
Genitourinary	5	13.1	2	3.3	
Hematological	4	10.5	4	6.7	
Infectious	15	42.8	14	23.3	
Metabolic	4	10.5	0	0	
Neurological	1	2.6	0	0	
Others	11	28.9	4	6.7	
Type of delivery					
Vaginal	4	10.0	34	56.7	<0.001‡
Cesarean section	34	89.5	26	43.3	

LBW: low birth weight; ABW: adequate birth weight; n: number; %: absolute percentage; ABEP: Associação Brasileira de Empresas de Pesquisa; *data in averaged±standard deviation of the mean; †student's *t*-test significance level; ‡Chi-square test significance level.

Table 2. Conditions at birth and anthropometry at the date of motor assessment of infants with low birth weight and adequate birth weight, 2020.

Variables	LBW (n=38)		ABW (n=60)		p-value
	n	%	n	%	
Gender					
Male	19	50.0	34	56.7	0.540†
Female	19	50.0	26	43.3	
Birth weight (g)*	2218±166.4		3232.8±416.4		<0.001‡
Adequate for gestational age					
SGA	16	42.1	6	10.0	<0.001†
AGA	22	57.9	42	70.0	
LGA	0	0.0	12	20.0	
Neonatal complications					
Yes	21	57.5	7	11.7	<0.001†
No	17	42.5	53	88.3	
Type of complications					
Infectious	4	11.4	0	0	<0.001†
Respiratory	12	31.6	0	0	
Metabolic	5	13.1	0	0	
Icterus	7	18.4	8	13.3	
Others	5	13.1	0	0	
Z-score height					
Short stature	7	18.4	2	3.4	0.026†
Adequate height	31	81.6	57	96.6	
Z-score BMI					
Thinness	1	2.6	1	1.7	0.897†
Eutrophic	31	81.6	48	80	
Overweight/obesity	6	15.8	11	18.3	
Z-score HP					
Adequate	38	100	60	100	

LBW: low birth weight; ABW: adequate birth weight; n: number; %:absolute percentage; SGA: small for gestational age; AGA: adequate for gestational age; LGA: large for gestational age; BMI: body mass index; HP: head perimeter; * data in averaged±standard deviation of the mean; †Chi-square test significance level; ‡Student's *t*-test significance level.

Through the interview with parents/legal guardians of the infants, it was obtained that 82% of the LBW group and 90% of the ABW group were under the parental care and did not attend at a day care.

The AIMS results observed were suspicious or abnormal in 18 (47%) in the LBW group versus 26 (43%) in the ABW group (p=0.522). There were no statistically significant difference between the groups, regarding total score and test components (Table 3). However, the median score of the seated position was lower in the LBW group versus the ABW group [i.e., 7.0 (3.0–11.2) versus 9.5 (5.0–12.0)] (p=0.087).

It was observed that at the age of 6–9 months, 44.4% of the infants in the LBW group had suspicious or abnormal/atypical motor behavior, and in the ABW group the frequency was 37.2%. Infants aged 9–12 months had a higher frequency of suspicious or abnormal behavior (i.e., 54.6% in the LBW group).

Table 3. Total and component score of Alberta Infant Motor Scale in children with low birth weight and adequate birth weight, 2020.

AIMS	LBW (n=38)	ABW (n=60)	p-value
Total score	27.5 (19.0;43.0)	31.5 (22.2;42.7)	0.233*
Classification			
Normal	20 (52.6)	34 (56.7)	0.522†
Suspicious	12 (31.6)	21 (35.0)	
Abnormal	6 (15.8)	5 (8.3)	
Prone			
Score	10.5 (7.0,17.0)	12.0 (7.0,17.7)	0.483*
Supine			
Score	8.0 (6.0,9.0)	7.5 (6.0,9.0)	0.888*
Seated			
Score	7.0 (3.0,11.2)	9.5 (5.0,12.0)	0.087*
Standing			
Score	3.0 (2.7,6.3)	3.0 (3.0,5.0)	0.553*

AIS: Alberta Infant Motor Scale; LBW: low birth weight; ABW: adequate birth weight; n: number, and data expressed as median and interquartile range; *Mann-Whitney *U* test significance level; †Chi-square test significance level.

DISCUSSION

This study observed that MD of infants with LBW (i.e., between 6 and 12 months of corrected age) assessed by AIMS was similar to the group of healthy infants born at term with ABW in São Paulo, Brazil. In both groups, there was a high percentage of suspicious or abnormal MD performance.

There are several standardized tests and scales that help identifying children at risk for MD delay, which can be used for screening and diagnosis and for therapeutic planning if any abnormality is detected[15]. Choosing the best test for assessing MD in infants remains a challenge[15,16]. The detection of changes in MD in the first year of life has a high predictive value for the medium and the long-term global developmental changes[16].

During the evaluation of the MD in children from 1 month to 2 years old, it was identified that the motor domain was the first to present a delay, starting around 10 months of age, followed by the language domain[17]. Those minor deviations in MD between 9 and 15 weeks of age are associated with receptive and expressive language delay at 1.5 and 2.5 years, concluding that motor function delays may precede delays in other domains[17,18].

In this study, the results of MD assessment by AIMS were similar in both groups. It is noteworthy that the characteristics that represent risk factors for MD delay such as the Apgar score, socioeconomic status, and maternal education were similar in all evaluated infants. In both groups, more than 40% of infants were classified by AIMS as having suspicious or abnormal MD.

Some studies[19-21] suggest that the poorer performance of Brazilian children could be related to the fact that instruments suffer interference from cross-cultural adaptation. Other possible elements involved could be the distinct socioeconomic, ethnic, and cultural factors and the greater daily exposure of Brazilian children to biological and environmental risk factors[19,21].

The maternal practices, such as the preference for the supine position due to the concern with the sudden infant death syndrome, could be another factor associated with the observed differences[18]. The lack of habit of Brazilian parents in leaving their children in prone position, even when they are awake, may be a risk factor[22]. Another study[23] verified the influence of maternal practices on the MD of healthy infants between 6 and 12 months of age, suggesting that practices that encourage the adoption of four-support posture and the use of the floor have a positive influence in the MD.

In this study, when infants were stratified in trimesters of age, there was a higher percentage of suspected or abnormal MD between 9 and 12 months (54.6%) than between 6 and 9 months (44.4%). These results are similar to other studies[24] using the AIMS and concluded that in the first 3 months and from 13 months of life, the AIMS curve is not as sensitive for detecting MD delays between 4 and 12 months of age.

Independent sitting is a posture that a child acquires between 6th and 7th month of life that is not a locomotion posture such as crawling and walking, but it is a stabilizing posture necessary for the development of balance, coordination, and motor control, requiring static and dynamic muscle control, which may occur later in children with LBW[22]. The acquisition of postures in MD in the early years of life is influenced by the environment of the child and by the sociocultural context[19-23].

This study has some limitations. It is a cross-sectional study including a convenience sample. The validation proposed of a version of AIMS for the Brazilian population not yet normative for the analysis of motor performance in this population[20]. Previous studies[19-21] observed that the MD of Brazilian children were lower than those observed in Canada, except at 18 months. The reference values for AIMS are still the values determined by the Canadian study[16-21].

CONCLUSIONS

The motor development of LBW infants assessed by AIMS was similar to that of ABW infants, and approximately 60% of the sample was of premature newborns. A frequency of 45% of suspected or abnormal behavior was observed in the evaluated infants, with a higher frequency of occurrence in those aged 9–12 (54.6%) months.

AUTHORS' CONTRIBUTIONS

VCWPG: Investigation, Methodology, Project administration, Writing – original draft. FISS: Formal analysis, Statistical analysis, Writing – review & editing. CJ: Methodology, Validation. MWLS: Formal analysis, Methodology, Validation, Writing – review & editing.

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