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ORIGINAL ARTICLE

Evaluation of motor performance of preterm newborns during the first months of life using the Alberta Infant Motor Scale (AIMS)

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Abstract

Objectives: To evaluate the motor performance of premature neonates using the Alberta Infant Motor Scale (AIMS) and to investigate the influence of birth weight on motor acquisition.

Methods: A cross-sectional study was carried out of a prospective cohort of 44 premature newborn infants with gestational ages from 32 to 34 weeks, without neurological disorders, selected from the neonatal intensive care unit at the Pontifícia Universidade Católica's Hospital São Lucas in Rio Grande do Sul, Brazil. The neonates studied were stratified by birth weight and assessed using the AIMS scale at the 40th week of postconceptional age, and at 4 and 8 months of corrected age.

Results: The preterm infants studied exhibited a progressive sequence of motor ability acquisition in all of the positions tested (prone, supine, sitting, standing), which occurred variable manner, expressed by the mean percentile of 43.2 to 45.7%, but within the limits of normality defined by the AIMS. It was observed that there was a clear increase in AIMS scores from the first to the last of the three postnatal observation points. The rate at which these scores increased was similar for both groups, irrespective of birth weight category (<1,750 g or ≥ 1,750 g).

Conclusions: The motor performance of the sample of premature infants studied here was normal according to the AIMS and their scores on that scale were not influenced by birth weight.

J Pediatr (Rio J). 2008;84(1):53-59: Child development, premature infants, birth weight.

Introduction

Premature newborn infants are at greater risk of delayed neuropsychomotor development than those born at full term. Recent methods for the identification and treatment of premature newborn infants with motor dysfunction have put emphasis on assessment and intervention within the first year of life.[1] Very often it is physiotherapists who are the first assessors and care providers in the identification and treatment of these children, in addition to, generally, being responsible for the choice of an infant assessment method that is both practical clinically and effective from a psychometric perspective.

Several different scales have been used over the years to assess development. However, when the choice is being made, the age group to which the assessment is applicable and the areas or aspects of development emphasized by the instrument should be taken into consideration. It is important to point out that many of the instruments that have been proposed originate from studies whose clinical data lacked homogeneity and with questionable reproducibility.[2,3]

The Alberta Infant Motor Scale (AIMS) incorporates the concept of neuromaturation and the theory of dynamic systems, in addition to being used to measure the maturation of the gross motor function of newborns from birth up to the age at which they are able to walk independently.[4] In the AIMS, the impact of neurological components on motor development is reflected in a series of motor abilities, used as the basis

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for assessment. This is a trustworthy scale that is capable of differentiating normal motor performance from abnormal performance and one that is easy to apply. In the observational approach adopted by the AIMS, the principles are based on a focus on integrated spontaneous movements, emphasizing the positive aspects of the motor repertoire, handling the child as little as possible and assessing their movements within their own context and with reference to their age. The scale consists of 58 items (21 observed when the child is in the prone position, nine supine, 12 sitting and 16 standing). At the end of the assessment the child is scored from 0 to 60 points, and this score is converted into a percentile, varying from 5 to 90%.[4,5]

The influence of birth weight on the motor performance of newborns free from neurological disorders has been discussed in the literature with conflicting results, primarily with reference to premature infants. This has happened because many prognosis studies have been based on birth weight and have not taken into account the appropriateness of that weight to the infant's gestational age. It is important to differentiate between transitory and physiological situations that occur during the first year of life of effective developmental delay.[6-8]

The objective of this study was to evaluate the motor performance of premature infants born with gestational ages from 32 to 34 weeks, during the first months of their lives, according to the methodology proposed by the AIMS, and also to investigate whether birth weight has an influence on the acquisition of this development.

Methods

A cross-sectional study was carried out of a prospective cohort of premature neonates born with gestational ages from 32 to 34 weeks, and being treated on the Brazilian National Health Service (SUS - Sistema Único de Saúde) at the Hospital São Lucas, affiliated to the Pontifícia Universidade Católica do Rio Grande do Sul (HSL-PUCRS), in Porto Alegre, RS, Brazil, and followed up by the neurodevelopment clinic at the same institution. The data collection for this study, which was approved by the Ethics Committee at PUCRS, was carried out over a 1-year period.

Neonates were included consecutively, as long as parents consented and they met the following inclusion criteria: gestational age between 32 and 34 weeks, 5 min Apgar ≥ 7, cerebral ultrasound normal, without clinical evidence of neurological disturbances and whose parents were willing for them to take part in all three stages. Newborn infants were excluded from the study if their participation was not authorized, they were put on mechanical ventilation during the neonatal period, they had neurological conditions or congenital heart disease or were receiving motor stimulation/treatment.

The sample size calculation indicated that a minimum of 42 patients would be necessary after calculating the estimated clinical relevancy and in order to test a difference of at least one standard deviation, respecting a proportion between study groups of 1:2, $\alpha = 0.05$ and statistical power > 90% ($\beta = 0.10$).

The NEWBORN were selected by the researcher (SM) at the neonatal intensive care unit (PICU) at the HSL-PUCRS if they met the inclusion criteria and were stratified into one of two groups by birth weight (group 1: NEWBORN with birth weight < 1,750 g and group 2: NEWBORN with birth weight ≥ 1,750 g).

The parents were contacted at the unit or by telephone and requested to attend the follow-up clinic at the 40th week of postconceptional age, if their children had already been discharged from the PICU and again at the fourth and eighth months of corrected age. The choice of this cutoff point was suggested by the authors of the AIMS table, since they take in the largest number of items.[5,9]

In order to fill out the data collection instruments an interview was conducted with a parent of each newborn and data collected on identification, socioeconomic aspects, characteristics of the pregnancy and delivery and the Apgar score. Parents who did not attend the clinical appointment that had been made for them were contacted by telephone or a home visit was made.

With relation to applying the AIMS to the sample; this was always carried out by the same assessor (SM), the duration of each assessment varied from 20 to 30 minutes, a part of which time was taken up by the patient adapting to the assessment situation. Normally, once the NEWBORN had begun to move, the series of items was observed over a brief period in the four positions (prone, supine, sitting and standing).

According to the AIMS methodology, it is not necessary to follow a standardized sequence, completing all items in one position before moving on to observe another. If an assessment cannot be completed in a single session, the remaining items can be administered within 1 week of the original assessment, and it is not necessary to repeat the entire scale for each neonate, testing just those items that are most appropriate to their developmental level.

All of the newborns included in this study were also assessed by means of neurological examination and with the Denver II neuropsychomotor developments screening test. The neurological assessment, including the Denver, was carried out by the child neurology team as part of the neurodevelopment clinic's routine, and was supervised by the same assessor.

For the statistical analysis, results were described using mean AIMS scores and their standard deviations, with the points obtained inserted into the AIMS methodology standard curve. Analysis of variance (ANOVA) for repeated measures was used to assess the variation in AIMS scores over the observation period and its behavior between < 1,750 g vs. ≥ 1,750 g. Data were analyzed with the aid of the software program SPSS version 11.5.

Results

This study assessed a total of 44 newborns, 14 with birth weight < 1,750 g and 30 with birth weight ≥ 1,750 g, on three different dates: during the 40th week of postconceptional age and at the fourth and eighth months of corrected age. None of the patients were lost to follow-up after initial enrollment, since any who did not attend the appointment were paid a home visit, at which the assessment was carried out. All of the patients were assessed during a single session for each assessment date.

There were no significant differences between the groups studied in terms of the distribution of sex, 1 minute Apgar score (means of 7.6±1.7 in the group < 1,750 g and 7.3±1.8 in the ≥ 1,750 g group) or 5 minute Apgar score (means of 8.6±0.9 and 8.4±1.3 respectively). Mean gestational age was older in the group with weight ≥ 1,750 g ($p < 0.01$). Relating birth weight with gestational age, we observed that there was a significantly higher proportion of small for gestational age (SGA) infants in group < 1,750 g than in group ≥ 1,750 g (Table 1).

It can be observed from Table 2, that for all positions studied (prone, supine, sitting, standing) there was a clear increase in AIMS scores over the 3 months of postnatal observation. The rate of increase was similar for both groups, as illustrated graphically in Figure 1. The same tendency can be observed in the total AIMS scores, where the percentiles varied from 10 to 90% in both groups and where the means of group < 1,750 were 43.2% at the 40th week, 42.9% at the fourth month and 43.9% at the eighth month, and for the group ≥ 1,750 g these were 47, 47.8 and 45.7% respectively. This means that motor ability development did not differ over the observation period since there was no significant oscillation between values. It can be stated that the distribution of the AIMS score percentiles observed at baseline (40 weeks) did not exhibit any substantial change over time, remaining stable up to the eighth month of observation (Table 2).

Discussion

The objective of this study was to assess motor ability development and the influence of birth weight on the motor development of neonates during their first year of life using the AIMS instrument.[5] This scale, despite not having been validated for use with the Brazilian population, has been widely used by services that monitor premature newborn, due to its practicality.[10]

This study followed a selected population of premature infants with minimal intercurrent conditions, free from acute clinical or neurological disease and meeting rigid inclusion/exclusion criteria and did not observe any influence from birth weight on the motor abilities assessed by AIMS. One possible limitation may be the choice of cutoff point for stratifying the groups, at less than 1,750 g, rather than 1,500 g, as is habitually employed. The reason for this choice, made when the study variables were defined, was that, at that time, mortality of neonates with birth weights of < 1,500 g was elevated at our unit, which would have made it impossible to complete the research protocol within the time available.

Earlier studies using motor scales with premature infants have found evidence of some degree of birth weight influence on motor performance.[6-8] It was starting from this premise that we raised the hypothesis upon which this study is based.

Table 1 - Clinical characteristics of the neonates, stratified by birth weight

	< 1,750 g	≥ 1,750 g	
Characteristics	**n = 14**	**n = 30**	**p**
Gestational age, weeks	32.4±0.7	33.2±0.8	< 0.01
Sex M:F, %	36:64	53:47	0.34
1 min Apgar, n (%)			0.62
≤ 3	0 (0.0)	1 (3.3)	
4 to 6	4 (28.6)	5 (16.7)	
≥ 7	10 (71.4)	24 (80.0)	
Birth weight, g	1,417±292	2,090±278	< 0.01
Proportion of SGA, n (%)	8 (57.1)	3 (10.0)	< 0.01

M:F = male:female; SGA = small for gestational age.

Table 2 - Alberta Infant Motor Scale scores for the positions assessed, comparing the two birth weight groups < 1,750 g vs. ≥ 1,750 g

	< 1,750 g	≥ 1,750 g	ANOVA for repeated measures		
	n = 14	n = 30	P_{time}	$P_{interaction}$	P_{group}
Prone			< 0.001	0.30	0.60
40 weeks	2.3±0.6	2.4±0.9			
4th month	4.9±1.3	4.9±1.4			
8th month	14.1±2.9	13.13±3.0			
Supine			< 0.001	0.72	0.99
40 weeks	2.4±0.9	2.6±1.0			
4th month	4.7±0.6	4.6±0.9			
8th month	8.6±0.5	8.5±0.9			
Sitting			< 0.001	0.50	0.45
40 weeks	1.1±0.7	1.0±0.6			
4th month	2.8±0.6	2.9±1.0			
8th month	9.2±2.1	9.7±1.9			
Standing			< 0.001	0.48	0.45
40 weeks	1.4±0,5	1.6±0.5			
4th month	2.2±0.4	2.3±0.5			
8th month	3.6±0.6	3.5±0.6			
Total AIMS			< 0.001	0.61	0.39
40 weeks	7.2±2.4	7.6±2.5			
4th month	14.6±2.1	14.7±2.9			
8th month	33.1±10.6	34.8±5.1			
Total AIMS – as percentile			0.86	0.71	0.40
40 weeks	43.2±17.3	47.0±24.2			
4th month	42.9±15.3	47.8±21.9			
8th month	43.9±22.7	45.7±22.9			

Comparing the results obtained with previously published data, we conclude that any motor involvement is early and transitory, not being detected by more extended follow-up periods. Furthermore, the studies cited above evaluated muscle tone exclusively, in contrast with the AIMS which assesses a wider range of motor functions.

Although this study was not designed as a diagnostic test, our results suggest that the AIMS is a reliable instrument for this population, providing very homogenous scores with low standard deviations. In addition to the reliability of the data, in a cross sectional analysis over three points during the first year of life, AIMS was also able to measure in a clear manner the progressive motor development of these neonates. Finally, the validity of AIMS for this type of measurement can be confirmed by the stability of the distribution of the mean scores over the observation period.[11,12] The reliability of an instrument that measures a variable which evolves progressively,

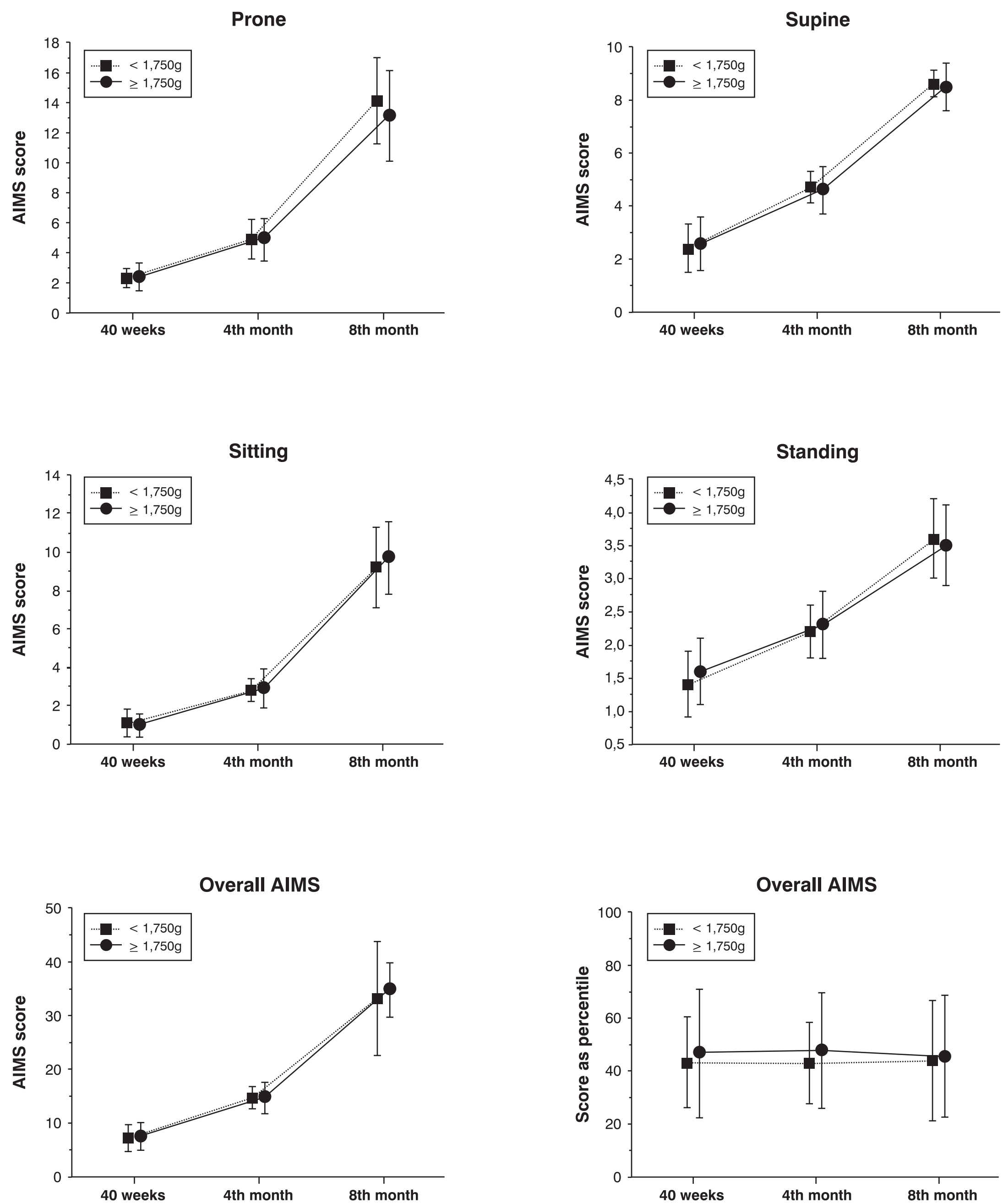

Figure 1 - Graphs of means and standard deviations illustrating the variation in AIMS score over the three assessments for the different positions studied, comparing the two groups stratified by birth weight. The neurological assessment and result of the Denver tests applied during the first year of life were normal

such as motor development, is based, among other aspects, on the stability of the scores with relation to the mean of the scores considered normal for a given chronological age. The scores recorded in this study remained within ± 1 SD, offering greater precision. In studies similar to this one, scores have varied from the mean by up to ± 2 SD and were also considered to be representative of normal developmental stages for each point in time.[13]

Fleuren et al.,[14] used the AIMS to assess 100 Dutch infants, observing a mean percentile of around 28, lower than in the original study, and also lower than our result. One hypothesis for this difference is the Dutch habit of using the supine position to sleep, which was related to the delay in development of motor benchmarks. In the Canadian study, the change in sleeping position customs took place later, and, in Brazil, there is no unanimity on this guideline; on the contrary, there is a strong voice in favor of the lateral position.[15-17] Another difference between this study and that carried out in Holland was age group. The Dutch children were assessed at various ages during the first year of life, whereas, in our study, we carried out assessments at the ages suggested by the original study.[4]

There are around 15 studies in the literature in which the AIMS has been used to monitor the motor development of premature and full term newborns.

In a longitudinal study in Taiwan,[18] the AIMS was compared with the Bayley Scales Of Infant Development and the Peabody Developmental Motor Scales[11,12] for measurement of the motor development or premature children at 6 and 12 months of corrected age. The results indicated that the AIMS offers reliable and valid measurements for this population. The results of this study, with methodology and age at assessments are similar to ours, confirmed the findings of the authors of the AIMS, demonstrating that it has transcultural validity.[4]

In neonates, maturation of the motor system is not linear and can exhibit individual variations within the pattern of normality. In reality, the results published by Darrah[19] suggest that uncertainty with relation to predicting motor development has much more to do with the inadequacy of measurement scales than with the nature (normal variation) of motor development. This impression finds support in the fact that the psychometric properties of the AIMS were assessed and no pattern of instability became evident among the babies. The data from that study corroborate the findings of our research, i.e., that mean motor development is progressive and that birth weight does not interfere with the progression of that development.

Campbell et al.[20] observed a tendency for the motor performance of infants to improve over the first year of life, since the number classified as delayed according to the AIMS at 6 months had reduced to half by 12 months. In our study, all of the children assessed exhibited normal motor development according to the AIMS scale during their first year of life, which was later confirmed by the neurological assessment and Denver test.

In a study undertaken in the state of São Paulo, the AIMS was utilized and compared with the Bayley scale, and the authors found good agreement at 6 months of age, considering the Bayley motor classification and the AIMS fifth percentile, (sensitivity = 100%, specificity = 78.37%, accuracy = 81.39%, kappa index = 0.50 and $p < 0.001$).[10]

In conclusion, the premature infants enrolled on this study exhibited a normal progressive sequence of motor ability acquisition, within the mean percentile of normality on the AIMS (43.2 to 45.7%), irrespective of birth weight. No neuropsychomotor development abnormalities were observed in this population during the first year of life AIMS which suggests that the aims can be used with similar populations to this one as a motor development assessment test.

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