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To describe the responses of healthy full-term Brazilian neonates in the Neonatal Behavioral Assessment Scale (NBAS), comparing the results to the current literature. Methods: In a cross-sectional study, 36 newborns, aged 1 to 3 days, were assessed using the NBAS. Results: The means of the behavioral items were in accordance with data reported by other studies, except for the Orientation cluster, which presented lower values. Boys presented significantly higher scores than girls in three items (...)

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**NEUROBEHAVIORAL PROFILE OF HEALTHY TERM
NEWBORNS ACCORDING TO THE NEONATAL
BEHAVIORAL ASSESSMENT SCALE**

**PERFIL NEUROCOMPORTAMENTAL DE NEONATOS
SAUDÁVEIS NASCIDOS A TERMO NA ESCALA NEONATAL
BEHAVIORAL ASSESSMENT SCALE**

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This study was conducted in Curitiba, Paraná, Brazil. There is no conflict of interest to declare.

Abstract: Objective: To describe the responses of healthy full-term Brazilian neonates in the Neonatal Behavioral Assessment Scale (NBAS), comparing the results to the current literature.

Methods: In a cross-sectional study, 36 newborns, aged 1 to 3 days, were assessed using the NBAS.

Results: The means of the behavioral items were in accordance with data reported by other studies, except for the Orientation cluster, which presented lower values. Boys presented significantly higher scores than girls in three items (pull-to-sit, hand-to-mouth and rapidity of build-up), which may indicate a better motor control. The NBAS showed good internal consistency regarding Orientation, Habituation and Regulation clusters (Cronbach's alpha 0.94, 0.86 and 0.73, respectively). The reflex items indicate variability in the responses of healthy neonates, with hypoactivity in walking, placing, incurvation, crawling and tonic neck deviation. Conclusion: The present study contributed to an initial description of Brazilian neonates' profile in the NBAS. Researches with larger samples are suggested.

Key-words: Infant, newborn; Infant behavior; Neurologic examination; Neonatal screening; Neuropsychological Tests.

Resumo: Objectivo: Descrever as respostas de neonatos saudáveis nascidos a termo na Neonatal Behavioral Assessment Scale (NBAS), comparando os resultados aos achados da literatura atual.

Método: Em um estudo transversal, 36 neonatos de 1 a 3 dias de vida foram avaliados com a NBAS.

Resultados: As médias dos itens comportamentais foram semelhantes aos dados relatados por outros estudos, com exceção do grupo Orientação, que apresentou médias menores. Os meninos apresentaram escores significativamente maiores que as meninas em três itens (puxar-para-sentar, habilidade mão-boca e rapidez de recomposição), o que pode indicar um melhor controle. Foi identificada boa consistência interna para os grupos Orientação, Habituação e Regulação (alfa de Cronbach de 0,94, 0,86 e 0,73, respectivamente). Os itens de reflexos indicam variabilidade nas respostas, com alguma hipoatividade em marcha reflexa, apoio plantar, encurvatura, engatinhar reflexo e desvio tônico do pescoço. CONCLUSÃO: O estudo contribuiu para uma melhor descrição das repostas de neonatos brasileiros na NBAS. Sugerem-se pesquisas com amostras maiores.

Palavras-chave: Recém-nascido; Comportamento do Lactente; Exame Neurológico; Triagem Neonatal; Testes Neuropsicológicos.

Introduction

A global and comprehensive assessment of the newborn should include neurologic and behavioral examination. This should occur in a ludic and affective environment so that the baby can demonstrate all his potential. In general, the neurobehavioral assessment of the full-term neonate considers the following items: visual orientation and motor reactions, auditory orientation, level of attention, habituation, interaction with the environment, posture, spontaneous and elicited motor activity, muscle tone, trofism, reflexes, sleep, alertness, crying, excitability and skull characteristics (Moura-Ribeiro, 2010).

In terms of neurobehavioral assessment, The Neonatal Behavioral Assessment Scale or NBAS (Brazelton & Nugent, 1995), originally published in 1973 by Terry B. Brazelton, is an interesting instrument for examining infants between birth and two months of life. It is used internationally and it is composed of different clusters, each one assessing a specific aspect of the child development, such as the central nervous system, the motor control, the level of consciousness and the interaction with the environment. It is an appropriate tool for detecting infant's strengths and difficulties, in different areas, being considered a reliable instrument.

It is important to point out that the development of instruments for neonatal neurobehavioral examination is relatively recent (El-Dib, Massaro, & Glass, 2011) and that Brazilian literature lacks researches about the neurobehavioral patterns of the newborn. In this context, the aim of this study was to describe the performance of full-term neonates in the first week of life using the NBAS, to compare the responses of boys and girls in relation to behavioral aspects and to analyze the internal consistency of the scale concerning the behavioral items. Finally, the study aimed to compare the results to the findings reported by researches of similar methods.

Methods

Participants

The sample consisted of 36 healthy full-term (37 to 42 weeks of gestational age) neonates within days 1 and 3 of life, recruited in the maternity Victor Ferreira do Amaral (Curitiba, Paraná), which is part of Federal University of Paraná. Inclusion criteria were adequate weight and length of gestational age according to curves of the native population, requirement of routine post natal care only and consent of the parents. The following conditions were exclusion criteria: any neonatal pathology, high-risk pregnancy or Apgar score lower than 7 at 5 minutes. Participants were recruited by convenience sampling, according to the examiner's availability to carry out the evaluations.

Instruments

Medical records were used to obtain information about pregnancy, labor, mother's health and child's health. A structured questionnaire was used to conduct an interview with each mother in order to collect data about family income and education.

All newborns were evaluated with the third edition of the NBAS (Brazelton & Nugent, 1995), which is composed of 27 behavioral items and 18 reflex items.

The behavioral items are grouped into 6 clusters: Habituation (response decrement to light, response decrement to rattle, response decrement to bell; response decrement to tactile stimulation of the foot); Orientation (orientation inanimate visual, orientation inanimate auditory, orientation inanimate visual and auditory, orientation animate visual, orientation animate auditory, orientation animate visual and auditory, alertness); Motor System (general tonus, motor maturity, pull-to-sit, defensive movements; activity level); Autonomic Stability (tremulousness, startles, lability of skin color); Range of State (peak of excitement, rapidity of build-up, irritability and lability of State); and Regulation of State (cuddliness, consolability, self-quieting and hand-to-mouth). These items are scored in a linear scale, from one to nine. There are, however, nine items that are first scored in a curvilinear scale and then are recoded as linear on a 5, 6 or 8 point-scale. This way, a higher score always indicates a better performance.

The reflex items are graded in a four-point scale, from 0 to 3 (meaning absence of response, hypoactive response, normal response and hyperactive response, in this sequence). For some items (ankle clonus, tonic neck reflex and nystagmus) scores 0 and 1 are considered normal.

The manual offers a detailed description for scoring each behavioral and reflex item.

Procedures

This was an observational cross-sectional study approved by the Ethics Committee of Federal University of Paraná and by the director of the Maternity. Written consent was obtained from the parents after they were informed about the objectives and the procedures of the study. They were also invited to observe the examination and received a verbal feedback about the infant's behavior.

Each subject was assessed individually according to the standard conditions recommended by the NBAS's manual: the newborn had to be between two feedings, in a calm room, and without any recent invasive procedure. One of the authors received a specific training for administering the scale.

For the administration of some items the neonate must be in a specific state, such as sleep. Therefore, not all subjects were evaluated in every item of the scale.

Statistical analysis was carried out using SPSS program (Statistical Package for the Social Sciences). Three of the 27 behavioral items (alertness, irritability and lability of states) were excluded from the analysis because they could only be administered for

few subjects.

The participants received a score for each behavioral item and also received a general score for each cluster. This general score was calculated using the arithmetic mean of the items. Measures of mean, median and standard deviation were calculated for the behavioral items individually and for the clusters. The means for boys and girls were compared using the non-parametric test Mann-Whitey U. Difference was considered statistically significant if p was $< \text{or} = 0.05$.

The internal consistency of the behavioral items was measured using the Cronbach's alpha coefficient. The analysis was made for the clusters in order to establish a better understanding of each area of the scale.

Considering that some items were not included in the analysis and having the objective of not creating inappropriate interpretation, the measures of general score and/ or Cronbach's alpha coefficient were not calculated for some of the clusters.

The reflex items were analyzed as categorical variables. The sample was distributed according to the score (0, 1, 2 or 3) for each item.

Results

Description of the sample

With regard to the sample, 69.4% of the 36 infants were girls and 61.1% were born of vaginal delivery. In relation to the Apgar, 94.4% scored 9 or 10 at minute 1, whereas all of the subjects had one of these scores at minute 5.

With respect to the mothers, 47.7% were primipara, 36.1% initiated the elementary school and 25% completed it. Thirty three point three percent started or completed the secondary school. Among the fathers, 42.9% initiated or completed the elementary school and 54.3% the secondary school.

The description of postnatal age, birth weight, birth length, head circumference, gestational age, mother's and father's age and family income are presented in table 01.

Table 1. Description of the sample

Description of the sample			
Variable	Mean	Standard deviation	Median
Age (hours)	45,53	7,06	44,00
Birth weight (grams)	3.104,44	506,85	3.185,00
Length (cm)	48,59	2,25	48,75
Head circumference (cm)	34,07	1,38	34,00
Gestational age - ultrasound (weeks)	39,51	1,02	40,00
Mother's age (years)	22,25	5,72	21,50
Father's age (years)	25,18	6,21	24,00
Family income (reais)	1.295,15	697,97	1000,00

Behavioral items

The results of each cluster (mean and standard deviation of the general score) and of the individual items are presented in table 02.

Table 2. Means, standard deviations and medians of the sample in the behavioral items of the NBAS

Means, standard deviations and medians of the sample in the behavioral items of the NBAS					
Cluster	Item	n	Mean	Standard deviation	Median
Habituation M=7,53 / SD = 1,66**	Response decrement to light	28	7,39	1,73	8,00
	Response decrement to rattle	28	6,71	2,42	7,50
	Response decrement to bell	26	7,35	2,23	8,00
	Response decrement to tactile stimulation – foot	21	7,33	2,27	8,00
Orientation	Orientation inanimate visual	21	4,86	1,88	5,00
	Orientation inanimate auditory	21	5,43	1,57	5,00
	Orientation inanimate visual and auditory	21	4,76	1,76	5,00
	Orientation animate visual	21	4,86	1,59	5,00
	Orientation animate auditory	21	4,81	1,03	4,00
	Orientation animate visual and auditory	21	4,86	1,65	5,00
Motor System M=5,20/ SD=0,52	General tonus*	24	5,79	0,51	5,00
	Motor maturity	23	5,35	0,57	5,00
	Pull-to-sit	22	5,09	1,19	5,00
	Defensive movements	24	5,71	2,01	7,00
	Activity level*	21	3,9	0,94	4,00
Range of State	Peak of excitement*	26	3,46	0,99	4,00
	Rapidity of Build-up*	26	4,46	1,65	4,00
Regulation of state M=6,24/ SD=1,27	Cuddliness	23	6,83	1,37	7,00
	Consolability	28	4,93	1,86	5,00
	Self-quieting	28	5,57	2,25	6,00
	Hand-to-mouth	28	6,61	1,78	7,00
Autonomic Stability M=5,88/ SD=1,27	Tremulousness *	24	6,58	2,81	8,00
	Startles*	25	5,46	1,74	5,50
	Lability of skin color*	29	5,55	0,83	6,00

*recoded item, ** M= Median, SD = Standard deviation

In relation to the internal consistency of the scale, the Cronbach's alpha coefficient for the Habituation, Orientation, Motor system, Regulation of State and Autonomic Stability clusters are summarized in table 03.

Table 3. Cronbach's alpha coefficient of the behavioral clusters of the NBAS

Cronbach's alpha coefficient of the behavioral clusters of the NBAS			
	Number of items	Cronbach's alpha	Cronbach's alpha with standardized items
Habituation	4	0,86	0,87
Orientation*	6	0,94	0,95
Motor System	5	0,07	0,08
Regulation of State	4	0,73	0,72
Autonomic Stability	3	0,26	0,30

*Excluded the item Alertness

Gender differences in the behavioral items were identified in three items. In pull-to-sit, boys presented higher mean ($n=8$; Mean=6.00; SD = 0.19; Median = 6.00) when compared to girls ($n=14$; Mean=4.57, SD = 0.309, Median = 5.00). This difference was statistically significant ($U=14.5$; $Z=-2.974$; $p < 0.005$).

In hand-to-mouth, boys also performed better ($n=9$; Mean=7.67, SD = 0.17, Median = 8.00) than girls ($n=19$, Mean=6.11, SD = 0.45; Median = 7.00), with significant difference ($U=42$; $Z= -2.232$; $p<0.05$).

The same pattern was found in rapidity of build-up, in which male participants showed higher scores ($n=8$; Mean=5.125; SD = 0.35; Median =5.50) in comparison to female subjects ($n=18$; Mean=4.17; SD = 0.44; Median = 4.00). In this case, the p value was also significant ($U = 34,5$; $Z=-2,157$; $p < 0,05$).

Reflex items

Table 04 shows the distribution of the sample according to the scores for each reflex item.

Table 4. Percentage distribution of the sample according to the categorized scores of the reflex items

Percentage distribution of the sample according to the categorized scores of the reflex items				
	Score 0	Score 1	Score 2	Score 3
Plantar grasp ($n=32$)	0	0	100	0
Babinski ($n=32$)	0	100	100	0
Ankle clonus ($n=23$)	76,7	6,7	16,7	0
Passive movements - legs ($n=31$)	0	0	100	0
Passive movements - arms ($n=31$)	0	0	100	0
Rooting ($n=31$)	0	6,5	93,5	0
Sucking ($n=31$)	0	0	100	0

Glabella (n=30)	0	0	100	0
Palmar grasp (n=31)	0	3,2	96,8	0
Placing (n=27)	0	11,1	88,9	0
Standing (n=26)	3,8	15,4	80,8	0
Walking (n=26)	19,2	34,6	46,2	0
Crawling (n=26)	7,7	23,1	69,2	0
Incurvation (n=25)	4	16	80	0
Tonic Deviation of head and eyes (n=22)	0	0	100	0
Nystagmus (n=24)	95,8	0	4,2	0
Tonic neck reflex (n=22)	0	50	50	0
Moro (n=25)	0	4	96	0

Discussion

In the Habituation cluster, most of the items showed mean higher than 7. These values are similar to the data described by a Spanish study (Moragas, Deu, Mussons, Boatella Costa, & Zurita, 2007) and are higher than the results found in an American (McCollam, Embretson, Mitchell, & Horowitz, 1997) and in a Korean (Shin, Borzzette, Kenner, & Kim, 2004) research. A noticeable finding was that, in the present study, the response decrement to rattle was the item with the lowest mean score, whereas in the other three cited publications the lowest score was for decrement to tactile stimulation. The cluster's general score was in accordance with those found in the literature (Canals, Fernandez-Ballart, & Esparo, 2003; Canals, Hernandez-Martinez, & Esparo, 2011; Hernández-Martínez, Canals, Aranda, Ribot, Escribano, & Arijá, 2011; Moragas et al., 2007; Oyemade, Cole, & Johnson, 1994; Pressler, Hepworth, LaMontagne, Sevcik, & Hesselink, 1999).

The means of the Orientation items were lower than the results described in other studies, which are normally higher than 6 or 7 (McCollam et al., 1997; Saraiva, 2002). However, Shin et al. (2004) also demonstrated poorer performance in their sample - composed of Korean newborns - with means ranging from 4.7 to 5.9. The authors suggest that this could be related to the use of anesthetic medication by the mothers and to maternal extra-uterine experiences. There is also recent evidence that the mother's educational level is associated to the full term's performance in the orientation cluster (Perez-Pereira et al., 2013). It is important to point out that these variables were not controlled in the present study and that they could explain, in part, the inferior scores shown by the neonates.

In the Motor System cluster, the means of the individual items were similar to what was described in other studies (Costa et al., 2010; McCollam et al., 1997;

Moragas et al., 2007; Shin et al., 2004). The mean of the general score was also in accordance with studies from other cultural contexts, such as United States (Oyemade et al., 1994), Spain (Moragas et al., 2007; Canals et al., 2003) and China (Loo, Ohgi, Zhu, Woward, & Chen, 2005).

With regard to the Range of the State cluster, the participants had a performance similar to the data provided by Spanish (Moragas et al., 2007) and Korean (Shin et al., 2004) studies. However, in rapidity of build-up the subjects presented a mean score slightly lower than these two researches.

In the Regulation of State cluster, other studies have reported similar means for cuddliness (Moragas et al., 2007; Costa et al., 2010), consolability (Shin et al., 2004), self-quieting (Moragas et al., 2007; Shin et al., 2004); and hand-to-mouth (Shin et al., 2004). Concerning the general score, the participants showed a similar profile to Portuguese (Costa et al., 2010), Spanish (Canals et al., 2003) and American (Oyemade et al., 1994) neonates.

Finally, in the Autonomic Stability cluster, the results of tremulousness and lability of skin color were congruent with the values described by Spanish researchers (Moragas et al., 2007). On the other hand, the mean of startles was similar to Korean newborns' score (Shin et al., 2004). The mean general score supports the data reported by other authors (Canals et al., 2003; Canals et al., 2011; Shin et al., 2004).

In relation to the comparison between boys and girls in the behavioral items, the detected differences were not in accordance to the data provided by previous studies. In the present sample, boys scored higher in pull-to-sit, hand-to-mouth and rapidity of build-up, which may indicate better motor control in the first days of life. In contrast to these findings, it has been reported that girls have a greater capacity of Orientation and of State Regulation than male babies. (Boatella-Costa, Costas-Moragas, Botet-Mussons, Fornieles-Deu, & De Caceres-Zurita, 2007; Lundqvist & Sabel, 2000). However, it is worth noting that, as far as gender differences are concerned, there is no great consensus in the literature (Shin et al., 2004; Canals et al., 2003).

In order to make a more detailed analysis of the internal consistency of the scale, the Cronbach's alpha was calculated for each behavioral cluster individually. It was expected that Orientation (even when excluded alertness) and Habituation would have the highest coefficients as they both present a strong theoretical background to form a group of items (Costa et al., 2010). The results confirmed this hypothesis and also were congruent to data from another study (Moragas et al., 2007). On the other hand, the results for Motor System and Autonomic Stability were lower than the coefficients provided by other authors (Costa et al., 2010; McCollam et al., 1997; Moragas et al., 2007). In fact, there is evidence of poor internal consistency in the Motor System cluster and for weak correlation among items in the Autonomic Stability, Motor System and Regulation of State clusters (Pressler & Hepworth, 1997).

In the reflex items all participants showed modulated responses for plantar

grasp, Babinski, passive movements of the arms and legs, sucking, glabella and tonic deviation of head and eyes. No hyperactive responses were observed.

With regard to the percentages of weakened or atypical responses, the profile of the sample was similar to the characteristics of Korean newborns in relation to placing, walking and palmar grasp reflexes (Shin et al., 2004) and it was similar to other Brazilian neonates concerning walking and crawling reflexes (Nogueira, 2001). In comparison to our sample, this same Brazilian study reported higher percentages of hypoactive responses for tonic neck reflex and similar values for the absence of ankle clonus and nystagmus and for modulated responses in Moro reflex.

In relation to the percentage of diminished responses in the incurvation reflex and in relation to the percentage of modulated response in the stepping reflex, the subjects were in an intermediate level between the values reported by other authors (Nogueira, 2001; Shin et al., 2004).

It is possible to state that the results of the reflex items are in the same direction of other studies, from similar and different cultural contexts. As previously discussed by Catarrala and Moya (2002), it was possible to identify the existence of variability in healthy neonates' responses. It has been reported by other authors that primitive reflexes tend to be less intense at earlier post natal ages (Pedroso & Rotta, 2003) and our findings suggests that the weaker responses occur for walking, placing, incurvation, crawling and tonic neck reflexes.

The small sample size and the fact that not all of the subjects were evaluated in all items of the scale were important limitations of the study. That being the case, the findings should not be generalized to a large extent, as this sample may not be representative of all Brazilian newborns.

Conclusion

In the studied sample, the behavioral items – individually and organized in clusters – showed means in accordance to the data reported by the current literature. The only exception was for the Orientation items, which presented lower means than what has been described by other authors. It is possible to infer that this discrepancy was due to maternal characteristics and physiological and environmental variables not controlled in this study. In the gender comparison, boys presented higher scores in three items, which may indicate a better motor control. Still regarding the behavioral items, NBAS presented a good internal consistency for Orientation, Habituation and Regulation of state clusters. The findings of the reflex items indicate the existence of variability in the responses of healthy neonates, with some hypoactivity in the first days of life.

This study contributed to an initial description and comprehension of Brazilian neonates' neurobehavioral profile using a specific instrument – the Neonatal Behavioral Assessment Scale. Finally, the authors intend to develop

future researches with the NBAS considering the use of larger samples and the comparison between healthy and at risk newborns.

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