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Neurobehavior of mexican newborns in conditions of low perinatal risk

Neurocomportamiento de neonatos mexicanos en condiciones de bajo riesgo perinatal

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Abstract

INTRODUCTION: The first hours of life are still a window of opportunity to identify at-risk newborns, but there are few studies focusing on early neonatal behavior.

OBJECTIVE: Describe in a cross section the behavior of newborns born in conditions of low perinatal risk under 48 hours of extrauterine life and compare it with historical referents.

METHOD: We studied 47 newborns with low perinatal risk, whose behavior was assessed using the Brazelton Neonatal Behavioral Assessment Scale (NBAS). Scores were obtained by item and area, and then were compared with 7 historical referents.

RESULTS: Low scores were found, both by item and by areas in up to 25% of the population. NBAS scores were related primarily with age of newborn, weight, and height. Significant differences were found in relation to referents for which higher scores were reported in the majority of cases.

CONCLUSIONS: A pattern was found of behavior, in which the same areas or items caused greater or lesser difficulty in achieving higher scores or those which required a certain level of adaptation to the environment, which would lead us to believe that our newborns should attain the scores seen in other populations as they advance in age.

KEY WORDS: Pregnancy; Infant, Newborn; Neurobehavioral; NBAS.

Resumen

ANTECEDENTES: Las primeras horas de vida son aún una ventana de oportunidad para identificar a los neonatos en riesgo, pero se cuenta con pocos estudios centrados en el comportamiento neonatal temprano.

OBJETIVO: Describir el comportamiento de neonatos nacidos en condiciones de bajo riesgo perinatal, menores de 48 horas de vida extrauterina y compararlo con referentes históricos.

MATERIALES Y MÉTODO: Neonatos con bajo riesgo perinatal en quienes se evaluó el comportamiento mediante la Escala de evaluación del comportamiento neonatal de Brazelton (NBAS). Se obtuvieron las puntuaciones por ítem y área, posteriormente se compararon con 7 referentes históricos.

RESULTADOS. Se estudiaron 47 neonatos que dieron puntajes bajos por ítem y áreas hasta en 25% de la población. Las puntuaciones NBAS se relacionaron, principalmente, con edad del recién nacido, peso y talla. Se encontraron diferencias significativas en relación con los referentes para los que se informaron puntaciones más altas en la mayoría de los casos.

CONCLUSIONES: Se encontró un patrón de dificultad similar en las mismas áreas o elementos reportados en otros trabajos, especialmente en aquellos que requerían un cierto nivel de adaptación al entorno; lo cual se favorece al ser expuestos adecuadamente al mismo.

PALABRAS CLAVE: Embarazo; infantes, recién nacido; neurocomportamiento, NBAS.

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INTRODUCTION

Development, as an evolutionary process in the relationship the organism-individual maintains with the environment, is expressed by means of behavioral organization, which, in the neonatal period, requires complete structures and nervous system functions, capable of responding properly to its demands; damage or immaturity can affect [the individual's] relationship with the emotional, perceptual, motor, and mental environment and thereby modify neurobehavior.

From the neonatal stage and in low-risk conditions, the higher human nerve centers modulate our spontaneous reactions or behaviors and have the ability to actively respond to various environmental stimuli, giving assessment of such responses an immediate and predictive clinical value of a child's development.

Normal and altered early neonatal neurobehavior has been investigated using the Brazelton Neonatal Behavioral Assessment Scale (NBAS), an evaluation specifically developed to describe the earliest behaviors in newborns which indicate their capacity to adapt to the environment; it has been used worldwide since the 1960s, both as a clinical tool and as a research instrument. It was created in response to the need for a complete profile of the functional organization of the neonate to describe a wide variety of behaviors, and to discover areas of difficulty or deviation, with the aim of identifying and outlining individual differences in neonatal behavior.

The scale describes the current state of the autonomic and motor systems, state of awareness and social attention, and how those systems interact with one another and are integrated in the neonatal period. It is divided in 7 areas, which evaluate 28 behavioral items graded on a 9-point scale (1 to 9), and 18 items for reflexes, each graded on a 4-point scale (0 to 3).[1]

There are several studies using the NBAS, which have observed that neonatal behavior can be affected by different conditions of biological origin present during gestation and/or birth, in which manifestations of behavioral alteration have been found, such as: indifference, excessive irritability, low ability to regulate response to changes in physical environment (body temperature, breathing, sleep-waking) and exalted reflexes, and at later stages it has been related with low response to emotional stimuli[2] and inferior coefficients of mental and psychomotor development at 6, 12, and 24 months of age.[3]

Beeghly et al,[4,5] found that retarded intrauterine growth results in poor organization of state and motor maturity, as well as an increase in the number of abnormal reflexes, although there are other studies in which such behavior has not been observed; on the contrary, small-for-gestational-age children obtained similar or discretely higher scores than controls.[6,7] In longitudinal studies it has been observed that poor NBAS scores predict retarded development at 3 months.[8,9]

Nugent made a compilation of a majority of research reported up to the time in European, Asian, African, and American countries, and at least 4 meta-analyses have been conducted, which have found that there are not only differences in NBAS areas due to biological and sociodemographic factors, but that they were linked to cultural factors, modes of mother-child interaction,[10] temperament[11,12] presence of postpartum depression,[13] mother's self-esteem,[14] and the father's involvement in childcare.[12,15]

In Mexico, experience with use of the NBAS in the Mexican population dates back to the late 1960s. In the ensuing years, different conditions of perinatal risk have been addressed, such as: maternal lead poisoning,[16] smoking,[17] exposure to DDT,[18,19] maternal mood disorders,[2]

restriction on intrauterine growth[20] or social restriction,[21,22] reporting low regulation and control of alertness and irritability compared with healthy controls. However, the authors remark that even the healthy controls showed scores inferior to other reference populations. [2,23]

The objective of this study was to describe the behavior of newborns in the first 48 hours of extrauterine life (EL) born in conditions of low perinatal risk in relation to their birth conditions and compare it with historical referents.

METHOD

I. Study design. A comparative, transverse, with historical referents.

II. Subjects. We studied 47 newborns under 48 hours EL, male and female in similar proportions, with close perinatal monitoring, born mainly by caesarean section, in good conditions and apparently healthy by pediatric criteria at the time of the assessment. We excluded those newborns with congenital malformations, or neurological, genetic damage, obstetric or health trauma conditions, did not allow manipulation (f. e., oxygen dependence). We studied all newborns born in a 6-month period whose parents agreed to the assessment.

III. Venue. Birth Studies Group Center for Maternal-Child Research (Centro de Investigaciones Materno Infantil del Grupo de Estudios al Nacimiento (CIMI-Gen)), Mexico City.

IV. Measurements. The NBAS was applied by 1 medical investigator, expert in the management of neonates and previously calibrated to 99% reliability with respect to the gold standard, who had no knowledge of the clinical history and birth conditions of the newborns previously evaluated by pediatrics, which determined their low-risk status.

V. Procedure. The assessment was conducted in the presence of one or both parents, in similar conditions for all children in the joint nursing room between feedings, in a room with attenuated daylight and regulated and stable temperature and noise level, starting the assessment in a state of deep sleep according to the clinical criteria of the Scale. The reagents were applied the number of times that each reagent specifically requires to evoke the responses (between 5 and 8 stimuli for the behaviors and maximum 3 for the reflexes) and the maximum response times proposed by the test were given; subsequently, they were classified and grouped into 7 areas (Habituation, Orientation, Motricity, State Variability, State Regulation, SNA Stability and Reflexes), considering as criterion of optimality a score of 7 or higher, except Reflexes, where 0 is considered optimum according to the scores described in the manual$_{(1)}$. In the cases that were required due to the irritability conditions that occurred in the newborns, the assessment was suspended and a new attempt was made 12hrs later (3 cases).

Condition at birth was characterized based on the variables: gestational age (weeks), age (hours EL), weight (grams), height (cm), and cranial perimeter (cm) of the newborn at birth, Apgar 1 and 5 min, and duration of labor; maternal age was also considered.

Choice of studies to be compared. We searched for studies that used the NBAS, in addition, that the neonates evaluated fulfilled characteristics similar to those of our study (low perinatal risk, full-term, APGAR at 5 min greater than 8, weight and height at birth suitable for gestational age) , the ages of evaluation with NBAS in the studies to be compared varied between 1 and 9 days' EL; from this 7 studies were selected seven stud-

ies were chosen with conditions at birth similar to the sample, which offered complete data on populational means by NBAS area, from which 1 (Mexico 1998) was excluded because they were high perinatal neonates and mothers with severe depression, and the rest of the data chosen to describe the population of the study; in the other cases scores of healthy newborns were taken (Spain 2007; Mexico 2005; Texas 2006; China 2006; India 2003; and Washington, DC, 1994).[2, 7, 24-27] Only one study (Spain 2007) had scores by NBAS item.

VI. Statistical analysis. For conditions at birth we present distribution of frequencies and measurements of central tendency, as applicable. From the NBAS we obtained mean and standard deviations of scores by item and area.

We conducted analyses of correlation and ANOVA between conditions at birth and NBAS scores by area. Then we compared the NBAS scores obtained by the study population with those taken from the studies by item and by area, conducting analysis of difference in means by student t tests for samples with different variance, using JMP 10 statistical software.

VII. Ethical considerations. The procedures used were approved by the CIMI-Gen Research and Ethics Committee. Informed consent was requested from both parents for participation in the project.

RESULTS

Characteristics of the population: All the newborns were born at term (*M* 39, *SD* 1.0 weeks), principally by caesarean section (0.81), Apgar 5 min of 8 and 9 (0.70 and 0.24 respectively), average weight 3160 SD 332 gr, height 50.5 SD 1.8 cm, and cranial perimeter 34.90 SD 1.30 cm; most were products of first and second gestation (0.49 and 0.32 respectively). Maternal age at birth was 26 SD 5 years, with a range of 15 to 41 years. At the time of the assessment the mean age of the newborns was 23 SD 8.51 hours EL.

Neonatal behavior of the population studied

Description by item: For the population studied the items which presented lower mean scores were in the areas of Orientation: item 7 inanimate visual, item 5 animate visual, and item 8 inanimate visual and auditory; Variability of state: item 18 rapidity of build-up, item 17 Peak of excitement, and item 20 lability of states; and Motricity: item 16 activity level. The items with best response in the newborns were those related to Organization of state: item 23 self-quieting, item 22 consolability, and item 21 cuddliness; Habituation: item 2 response to rattle and item 1 response to light; and ANS stability: item 26 startles.

Description by area: As regards the distribution of scores by area, we observed that, for the areas Habituation, Regulation of state, and ANS stability only between 10 and 25 percent of the population achieve scores of 7 or higher. The area Variability of state showed low scores for the total population. As regards Reflexes, up to 25 percent of the population reported 6 to 13 reflexes with abnormal behavior. **Table 1**

Neonatal Behavior and Conditions at birth: Looking for a relationship between NBAS areas and conditions at birth, we found no differences by gender, gestational age, cranial perimeter, duration of labor, or maternal age. The area Orientation was correlated with Age EL (0.3907, p = 0.01) and weight (0.2716, p = 0.02) and for height a tendency was found without being significant. The behavior of the area Variability of state was modified by the factor weight of newborn (0.2824, p = 0.03). The variables Age EL, APGAR 1 min, and APGAR 5 min were inversely related to Reflexes. **Table 2**

Table 1. Percentile distribution of means achieved by newborns in this study by NBAS area (n=47)

NBAS areas	Min	10%	25%	Median	75%	90%	Max
1. Habituation (4)	1	1.75	3.25	5	7	8	8.75
2. Orientation (7)	1	1.69	2.43	3.71	5	5.77	7
3. Motricity (5)	1	1.6	2.6	3.8	5	5.68	6.2
4. Variability of state (4)	1.25	2	3	3.75	4	4.25	4.75
5. Regulation of state (4)	1.75	2.75	4	5.5	6.25	7.3	8.75
6. ANS stability (3)	2	2.67	3.67	5	6.33	7	7.67
7. Reflexes (18)	0	0.8	2	4	6	8.2	13

Table 2. Coefficients of correlation between scored by NBAS area and conditions at birth

GENERAL (47)	Gestational age	RN Age	Weight	Height	PC	APGAR 1 min	APGAR 5 min	Labor	Maternal age
1. Habituation	-0.1037	-0.1342	-0.0443	-0.0103	0.1155	-0.0561	-0.1656	-0.0527	-0.1681
2. Orientation	-0.1288	0.3907 (0.01)	0.2716 (0.02)	0.2458 (0.08)	0.0625	0.0434	-0.1182	-0.0595	0.1703
3. Motricity	-0.0843	0.1357	0.159	0.0629	0.034	0.0236	-0.0238	-0.2396	0.1108
4. Variability of state	-0.1604	-0.0253	0.2824 (0.03)	0.0096	0.0628	0.2269	-0.0963	-0.1787	-0.0511
5. Regulation of state	-0.1627	0.0639	0.0498	-0.1492	0.1871	0.0529	-0.0934	-0.1092	0.184
6. ANS stability	-0.0196	-0.0017	0.0228	0.1222	-0.0083	-0.0674	-0.2321	0.0456	-0.0833
7. Reflexes	0.1698	-0.2736 (0.06)	-0.0924	0.0096	-0.208	-0.3388 (0.04)	-0.2154 (0.03)	0.2701	-0.0381
(p value)									

Comparison with other populations

Comparison by item. We found significant differences between the means obtained by the population studied compared with those found for Spain (2007), on 19 of the 23 items, being lower even by more than 3 points; the greatest differences were seen on items pertaining mainly to the areas Orientation, Habituation and ANS stability. **Table 3**

Comparison by area. 1. HABITUATION: we found significant differences between the population studied with Spain, China, and Washington, for which mean scores were up to 2.37 points higher than ours. 2. ORIENTATION, the population studied presented lower means than all the studies with which it was compared; the scores from India were closest. 3. MOTRICITY, the population studied presented significant differences with all the other studies, except India; Spain, China, and Washington showed differences in means of more than one point. 4. VARIABILITY OF STATE, again, there were significant differences with all the populations compared, the most significant with India, with a mean 2.42 points above that found in Mexican newborns. 5. REGULATION OF STATE; we found significant differences with 2 of the studies compared (India and Washington) in favor of those populations; for those conducted in Mexico (2005) and Texas,

Table 3. Mean and SD of behavioral items shown by newborns by NBAS area in this study compared with other studies

Area	ITEM	Population studied (n = 47) x / sd	Spain 2007 (n = 220) x / sd	t+
Habituation	1. Response to light	**5.04 / 2.55**	**7.33 / 1.80**	*
	2. Response to rattle	**5.60 / 2.71**	**7.38 / 2.01**	*
	3. Response to bell	**4.64 / 2.81**	**7.46 / 1.76**	*
	4. Response to stimulation	4.85 / 2.57	6.53 / 2.01	*
Orientation	5. Animate visual	3.30 / 1.85	5.78 / 2.06	*
	6. Animate visual-auditory	3.81 / 1.64	6.28 / 2.02	*
	7. Inanimate visual	2.70 / 1.60	5.81 / 2.01	*
	8. Inanimate visual-auditory	3.51 / 1.72	6.16 / 2.09	*
	9. Animate auditory	4.51 / 2.11	6.82 / 1.88	*
	10. Inanimate auditory	3.94 / 1.77	6.41 / 1.92	*
	11. Alertness	4.40 / 2.41	6.37 / 1.90	*
Motricity	12. General tone	3.81 / 1.71	5.25 / 1.11	*
	13. Motor maturity	3.62 / 2.02	6.05 / 1.54	*
	14. Pull-to-sit	3.70 / 2.06	5.57 / 2.07	*
	15. Defensive	4.55 / 2.44	6.06 / 1.84	*
	16. Activity level	3.19 / 1.24	4.27 / 0.80	*
Variability of state	17. Peak of excitement	3.17 / 0.92	3.64 / 0.82	*
	18. Rapidity of build-up	2.81 / 1.28	3.30 / 1.55	*
	19. Irritability	4.43 / 1.99	4.78 / 1.70	
	20. Lability of states	3.47 / 1.36	3.58 / 1.25	
Organization of state	21. Cuddliness	**5.36 / 2.06**	**6.39 / 1.64**	*
	22. Consolability	5.40 / 2.33	**6.23 / 1.83**	*
	23. Self-quieting	6.00 / 2.12	5.55 / 2.41	
	24. Hand-to-mouth	4.04 / 2.56	4.47 / 2.84	
Autonomic Nervous System	25. Tremulousness	**4.98 / 2.97**	**7.02 / 2.22**	*
	26. Startles	**5.55 / 2.28**	**8.15 / 1.11**	*
	27. Lability of skin color	4.19 / 1.33	5.36 / 1.10	*

+ Statistical difference between the study population and referents with a .95 probability, student t test for comparison of means in populations with different variance.

our population presented the higher mean, with significant results for Mexico 2005 only. 6. ANS STABILITY, all the populations obtained means above 6 points, whereas our population achieved a mean of 4.91 points, with all the differences being statistically significant. 7. REFLEXES, only 4 of the studies provided data for this area, and in all cases the population studied presented higher mean scores (from 1 to 4 points' difference) equivalent to a higher number of altered reflexes, observing significant differences with China and India. **Table 4**

Table 4. Average score achieved by newborns by NBAS area in this study compared with historical referents

Population	Population studied	Spain 2007[27]		Mexico 2005[2]		Texas 2006[28]		China 2006[29]		India 2003[7]		Washington, DC, 1994[30]	
n	47	220		25		20		40		48+		323	
AREA	x / sd	x / sd	t	x / sd	t	x / sd	t	x / sd	t	x / sd	t	x / sd	t
1. Habituation (4)	5.03 / 2.22	7.07 / 1.45	*	5.4 / 2.1		4.75 / 3.05		6.37 / 2.18	*	5.65 / 0.66		7.4 / 1.06	*
2. Orientation (7)	3.73 / 1.59	6.33 / 1.65	*	4.2 / 2.1	*	5.17 / 2.12	*	6.25 / 1.66	*	4.28 / 0.33	*	6.02 / 0.55	*
3. Motricity (5)	3.77 / 1.41	5.43 / 1.03	*	4.0 / 0.9	*	4.67 / 0.69	*	5.62 / 0.83	*	3.46 / 0.56		5.33 / 0.74	*
4. Variability of state (4)	3.47 / 0.82	3.83 / 0.78	*	4.0 / 0.9		4.07 / 0.61	*	4 / 0.57	*	5.89 / 0.62	*	3.83 / 0.74	*
5. Regulation of state (4)	5.20 / 1.67	5.66 / 1.41		**4.8 / 1.5**	*	**4.48 / 1.34**		5.14 / 1.66		5.91 / 1	*	5.9 / 1.26	*
6. ANS stability (3)	4.91 / 1.56	6.82 / 1.15	*	5.9 / 1.1	*	6.63 / 1.01	*	6.5 / 1.05	*	6.5 / 1.1	*	6.92 / 1.16	*
7. Reflexes (18)	4.53 / 3.09	-		1.5 / 1.5	*	3.45 / 2.06		0.45 / 0.64	*	1.87 / 0.28	*	-	

* Statistical difference between the study population and referents with a .95 probability, student t test for comparison of means in populations with different variance.
+ Newborn with weight / height appropriate for gestational age

DISCUSSION AND CONCLUSION

The NBAS is a test which has been used as the standard for assessing neonatal behavior since the 1960s, and to date is considered accurate in characterizing newborns and suggesting management strategies by considering the wide variety of behaviors which an infant may present when performance is expedited to help her achieve her highest degree of organization and response to the environment; however, it has also been concluded with increasing frequency that it needs to be accompanied by other tests to build a more complete profile of the newborn and his surrounding environment to ensure a better approach to detection of future problems of development.[10,13,28-30]

In Mexico, the first hours of a newborn's life remain an important window for observation, evaluation, and care given that, due to various sociocultural conditions, in many cases future doctor visits will be limited only to times of illness.

In this study we observed that in general newborns obtained lower scores by item and areas than the populations with which they were compared; however, it is important to mention that although those populations were chosen because they presented conditions at birth similar to those of the Mexican population and complete scores, they varied on points which should be considered. In first place, weight at birth, our newborns presented an average weight below that of 4 populations (Spain, Mexico 2005, Univ. of Texas, and China), by up to 343 grams, equivalent to 10.9% of weight; it has been reported[4,8,9] given that NBAS scores may be altered by subtle variations in weight, height, and/or cranial perimeter, tending to show a directly proportional relationship between weight and NBAS score. We observed such a relationship of weight with the items for Orientation and Variability of state.

Another factor which has been reported in the literature[2,15,25,30] and probably contributes to the weight of the results in this study is the proportional relationship between age (EL hours) and NBAS score; newborns in this study were assessed in the first 24 to 48 hours of life, whereas in the populations compared ages ranged from 48 hours (Washington, China) to 9 days EL, and even in the other study in Mexican population (2005) the ages at assessment were up to 1 week greater; Even so, the scores obtained in this study are not particularly distant and there are even areas in which they match or exceed the scores of certain populations without yet being statistically significant, as in the case of Habituation for Mexico 2005 and Texas and Regulation of state for Mexico 2005, Texas, and China.

We also found a similar pattern of behavior, in which the same areas or items caused greater or lesser difficulty in achieving higher scores or those which required a certain level of adaptation to the environment, which would lead us to believe that our newborns should attain the scores seen in other populations as they advance in age.

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