

Neonatal Behavioral Assessment of SFD Infants and Longitudinal Study of Their Development

— During the First Postnatal Year —

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Abstract It has constantly been observed that cerebral palsy and/or mental retardation develops among premature and high risk infants. The incidence of mental retardation is particularly high among SFD (small for dates) infants. Assessment using the Neonatal Behavioral Assessment Scale (NBAS) immediately after birth and a longitudinal study on development during the first postnatal year were performed on 18 SFD infants whose development was anticipated to be normal.

In comparison with 21 AFD (appropriate for dates) infants and 21 mature infants, the development indices were lower in SFD infants. Two of the 18 SFD infants at corrected age one showed developmental retardation with mental development index (MDI) or psychomotor development index (PDI) less than 70%. The higher were the stressed signs reflected by NBAS supplementary items 30, 33, 34, 35 and 36, the lower were the development indices.

As in AFD infants¹⁾, MDI and PDI were closely associated with the quality of sleep-waking rhythm at 44 weeks.

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Key Words : SFD, NBAS, Bayley scale, Development, First one year

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Introduction

Brazelton's Neonatal Behavioral Assessment Scale (NBAS)³⁾ is not for a mere assessment of newborns but it is significant in that neonatal behaviors in the process of interaction with environmental factors can be assessed. NBAS is comprised of 37 items of behavioral assessment and 21 items of neurological examination by Prechtl and Beintema. Nine of the former 37 items are identified as supplementary ones for premature or stressed infants.

It is important in the care of and early treatment program for handicapped neonatal infants due to intrauterine or perinatal disorders to provide such environments that would promote 1. regulation for state, 2. autonomy independence, 3. attention (interactive process) and 4. motor performance. In high risk infants for whom support of development from early stage is desirable, it is liable to underestimate these potential normal functions paying too much attention to pathologic abnormal findings. Proper assessment using NBAS should be greatly useful for promotion of the development of high risk infants.

Recent studies⁶⁾ suggest that observing the administration of the NBAS helps sensitize parents to the behavioral capacities of their newborn infants. We conducted NBAS assessment at 44 weeks and 48 weeks by home visit and carried out a longitudinal follow up study of their subsequent development during the first postnatal year.

Subjects and Methods

Subjects were 18 SFD (by the high risk mother-infant care research team of the Ministry of Health and Welfare 1983) infants who received intensive care at the neonatal intensive care unit (NICU) of the Department of Pediatrics, Nagasaki University Hospital, ranging in fetal age from 32 weeks and 5 days to 41 weeks and 6 days with a mean of 36 weeks and 5 days, and in body weight at birth from 1120 to 2300g with a mean of 1675 ± 360 g, and whose Apgar (AP) scores were 1 min/1-9 points (mean 6.5 ± 20.0) and 5 min/7-10 points (mean 8.6 ± 0.9). They had no additional specific risk.

Assessment by NBAS was performed at 40, 44 and 48 weeks. Assessment of development at 6 and 12 months was conducted using the Bayley scale of infant development⁴⁾. Home observation for measurement of the environment⁵⁾ was also carried out concurrently. Assessment at 40 weeks was performed at the NICU and that at 44 weeks, 48 week, 6 months and 12 months by visiting homes.

The control subjects were 21 mature infants who were born in the Goto Islands and showed normal development, and 21 AFD infants who received intensive care at the NICU of the Department of Pediatrics, Nagasaki Univer-

sity Hospital, and showed normal development.

Results

Lester et al³⁾ (1982) devised a cluster system in which NBAS test items are compared after dividing into 1. habituation, 2. orientation, 3. motor performance, 4. range of state, 5. regulation of state, 6. autonomic stability and 7. reflexes. Based on Brazelton's theory that it is undesirable to assign a single summary score to neonates at birth, the maximum score in the NBAS is either 1, 5 or 9. The sequence of scores in some items that is not linear with the optimality of response needs to be recoded so that a higher score may reflect a better performance.

The cluster scores thus obtained for 18 SFD, 21 AFD and 21 mature infants are shown in Table 1 a-c.

Table. 1 Cluster Score

a. 21 mature cases

Cluster	Day 1	Day 3	Day 7	Day 14
Habituation	7.26±0.81	7.32±1.18	7.50±0.83	7.65±0.94
Orientation	6.76±1.53	6.73±1.16	6.22±1.12	6.54±1.41
Motor	4.94±0.81	4.93±0.72	5.14±0.90	5.05±0.73
State Range	3.61±1.10	3.68±0.96	3.30±1.21	3.85±1.10
State Regulation	5.93±1.12	5.46±0.89	5.47±0.99	5.29±1.10
Autonomic Stability	6.30±0.98	6.03±1.01	5.97±1.18	6.05±1.08
Reflexes	0.84±0.69	0.79±0.92	0.91±1.14	0.72±1.53

Mean ± S. D.

b. 21 AFD cases

Cluster	36W	40W	44W
Habituation	7.18±1.05	7.91±0.54	8.05±0.60
Orientation	5.09±1.06	5.42±0.99	6.52±0.99
Motor	5.13±0.69	5.55±0.63	6.11±0.62
State Range	3.94±0.83	3.90±0.69	3.92±0.71
State Regulation	5.61±0.97	5.23±0.99	5.58±1.19
Autonomic Stability	5.46±1.13	6.25±0.83	6.95±0.85
Reflexes	1.00±1.27	0.86±1.30	0.43±0.68

Mean ± S. D.

c. 18 SFD cases

Cluster	40W	44W	48W
Habituation	7.46±1.00	7.89±1.31	8.36±0.47
Orientation	4.93±0.75	4.89±0.91	5.95±0.87
Motor	5.16±0.57	5.18±0.54	5.79±0.63
State Range	3.56±0.63	3.96±0.56	3.79±1.09
State Regulation	5.76±0.96	4.32±1.11	4.91±1.21
Autonomic Stability	5.81±1.15	6.63±0.93	7.55±0.57
Reflexes	0.50±0.85	1.25±1.18	1.47±1.88
Supplement Items	6.53±1.01	6.43±1.04	7.50±1.23

Mean ± S. D.

In comparison of cluster scores among the SFD and AFD groups at converted gestational age of 40 weeks and the mature group at postnatal age of 3 day, orientation and motor performance showed a significant difference. Orientation was significantly higher in the mature group than in the SFD and AFD groups ($p < 0.01$) and motor was higher in AFD than in SFD and mature ($p < 0.01$). In comparison between the SFD and AFD groups at converted gestational age of 44 weeks, orientation, motor, state regulation and reflexes showed a significantly higher score in the AFD group ($p < 0.01$). Moreover, in comparison between the SFD at 48 weeks and the AFD at 44 weeks, these four clusters showed a significantly higher score in AFD ($p < 0.05$).

The development indices by the Bayley scales of the SFD, AFD and mature groups at 6 and 12 months after birth (converted for SFD and AFD) are shown in Table 2. In comparison among the three groups, the SFD group showed significantly lower indices than the mature and AFD groups, and the AFD at 12 months showed lower values only for MDI than the mature group (Fig. 1).

The degree of mother's aggressive interaction as one of the environmental factors of nursing was assessed at the time of home visit for the SFD group. Nursing was aggressive in all cases.

The relationship between the sleep-waking rhythm at 44 weeks and the Bayle development indices at 6 and 12 months after birth was studied for the SFD group. Infants who were markedly irregular in sleep-waking rhythm, drowsy almost all day or sleeping all morning but sometimes waking in the afternoon were classified as "poor" group and those with established

Table 2 Bayley Score

a. 6 Month

	MDI(Chro.)	MDI(Corr.)	PDI(Chro.)	PDI(Corr.)
AFD	71.7±11.9	97.3±6.1	71.4±13.1	101.1±10.5
SFD	77.0±13.1	87.9±10.5	73.9±14.5	86.0±10.7
成熟児	99.3±9.5		100.5±4.9	

b. 12 Month

	MDI(Chro.)	MDI(Corr.)	PDI(Chro.)	PDI(Corr.)
AFD	90.9±8.2	106.5±7.0	90.5±8.0	100.5±7.9
SFD	89.9±13.9	98.0±11.7	85.7±13.4	90.2±12.0
成熟児	118.0±11.5		106.5±18.2	

Mean±S. D.

Chro. : Chronological Age

Corr. : Corrected Age

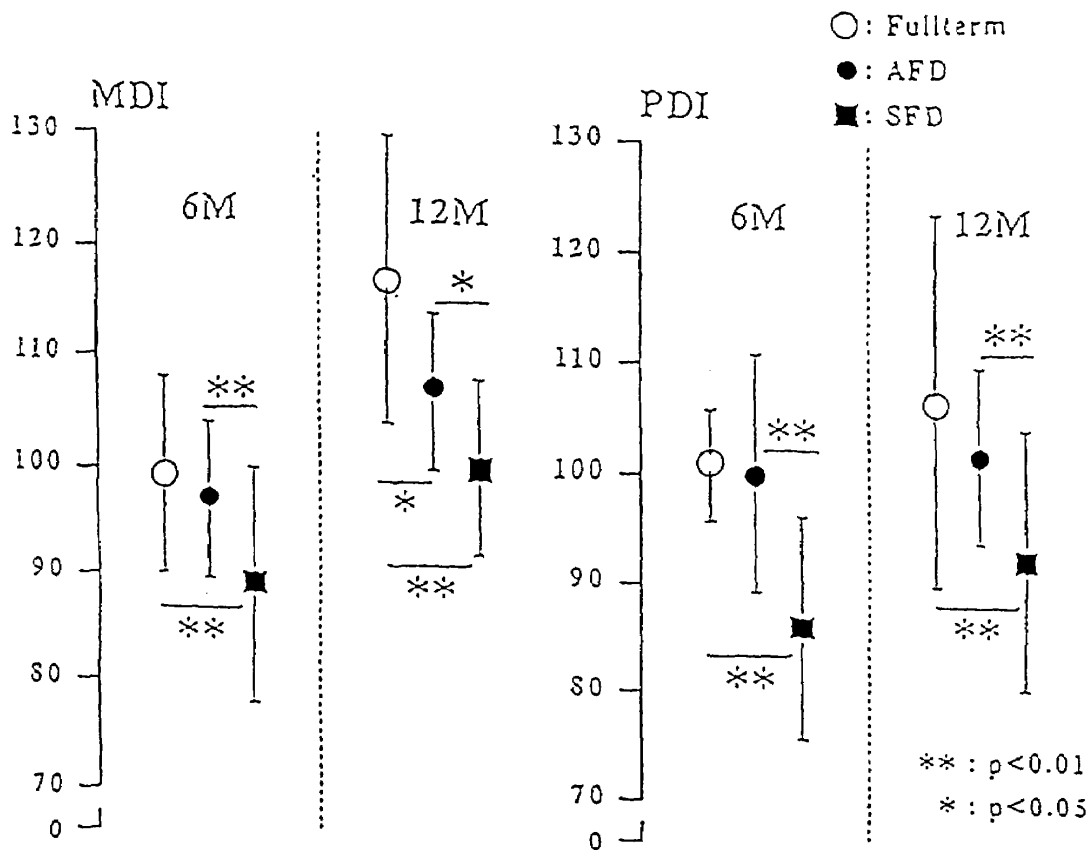


Fig. 1 t-Test of DI (Bayley Scales) in SFD, AFD and mature infants (corrected age)

sleep-waking rhythm at intervals of several hours as "good" group. The development indices were higher in the good sleep-waking rhythm group than in the poor group, like in AFD infants as reported earlier¹⁾. MDI and PDI at 12 months were significantly higher in the "good" group than in the "poor" group (Table 3).

Stressed signs which were reflected by some NBAS supplementary items, 30. cost of attention, 33. robustness and endurance, 34. regulatory capacity, 35. state regulation, and 36. balance of motor tone [on the autonomic (30. 33), state control (34, 35) and motor (36) systems] were studied in relation to the Bayle development indices. Infants with supplementary items score 7 or more were grouped as "good" and those with 6 or less as "poor". In comparison of the two groups for the scores of supplementary items at 44 weeks with the development indices at 6 and 12 months, both MDI and PDI tended to be higher in the "good" group, and PDI at corrected age of 12 months was significantly higher in the "good" group ($p < 0.05$) (Table 4).

Abnormal values of 20 items in reflexes test were significantly higher in the SFD group than in the AFD group. However, there was no significant difference in such values when the SFD group was divided into two subgroups of high and low abnormal values of reflexes and the two subgroups were

Table 3 The relation between sleep-waking rhythm at 44 weeks and PDI and MDI at 6, 12 months.

a. 6 Month

	Chro. MDI	Corr. MDI	Chro. PDI	Corr. PDI
Total	77.0±13.1	87.9±10.5	73.9±14.5	86.0±10.7
Good	82.9±11.6	91.0±9.9	80.3±11.7	90.3±9.1
Poor	66.4±8.4	81.6±9.6	62.4±12.3	77.4±8.3
T-test	2.77 *	1.75 -	2.70 *	2.61 *

b. 12 Month

	Chro. MDI	Corr. MDI	Chro. PDI	Corr. PDI
Total	89.9±13.9	98.0±11.7	85.7±13.4	90.2±12.0
Good	96.8±8.3	103.3±7.1	93.1±8.5	95.9±8.2
Poor	80.0±14.7	89.7±13.0	75.0±12.0	81.1±11.9
T-test	3.02 **	2.87 *	3.66 **	3.13 **

Mean±S. D.

Chro. : Chronological Age Corr. : Corrected Age

* : p<0.05 ** : p<0.01

Table 4 The relation between Supplement Items Scores at 44 weeks and PDI and MDI at 6, 12 months.

a. 6 Month

	Chro. MDI	Corr. MDI	Chro. PDI	Corr. PDI
Total	77.0±13.1	87.9±10.5	73.9±14.5	86.0±10.7
Good	82.0±12.1	90.1±10.5	80.8±11.4	90.1±10.6
Poor	66.5±11.5	86.5±11.5	57.8±8.7	78.0±9.6
T-test	2.17 -	0.54 -	3.59 **	1.96 -

b. 12 Month

	Chro. MDI	Corr. MDI	Chro. PDI	Corr. PDI
Total	89.9±13.9	98.0±11.7	85.7±13.4	90.2±12.0
Good	97.4±8.3	102.5±7.0	92.2±10.0	95.7±9.1
Poor	76.0±15.0	89.0±17.4	73.0±13.4	80.4±14.4
T-test	3.61 **	1.67-	3.15 **	2.55 *

Mean±S. D.

Chro. : Chronological Age Corr. : Corrected Age

* : p<0.05 ** : p<0.01

compared.

Discussion

SFD is regarded as intrauterine growth retardation caused by some factor. The perinatal mortality and morbidity as well as the frequency of brain damage reportedly are higher compared to AFD.

From the results of neonatal behavioral assessment for 18 SFD infants

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without any specific risk after birth and whose normal development was anticipated, and of assessment of their development at 6 and 12 months after birth by the Bayley scales, discussion on the developmental aspects of SFD is made.

In neonatal behavioral assessment, SFD infants showed lower values in orientation and state regulation clusters compared to mature infants, and further in motor and reflexes as compared to AFD infants. Low values of

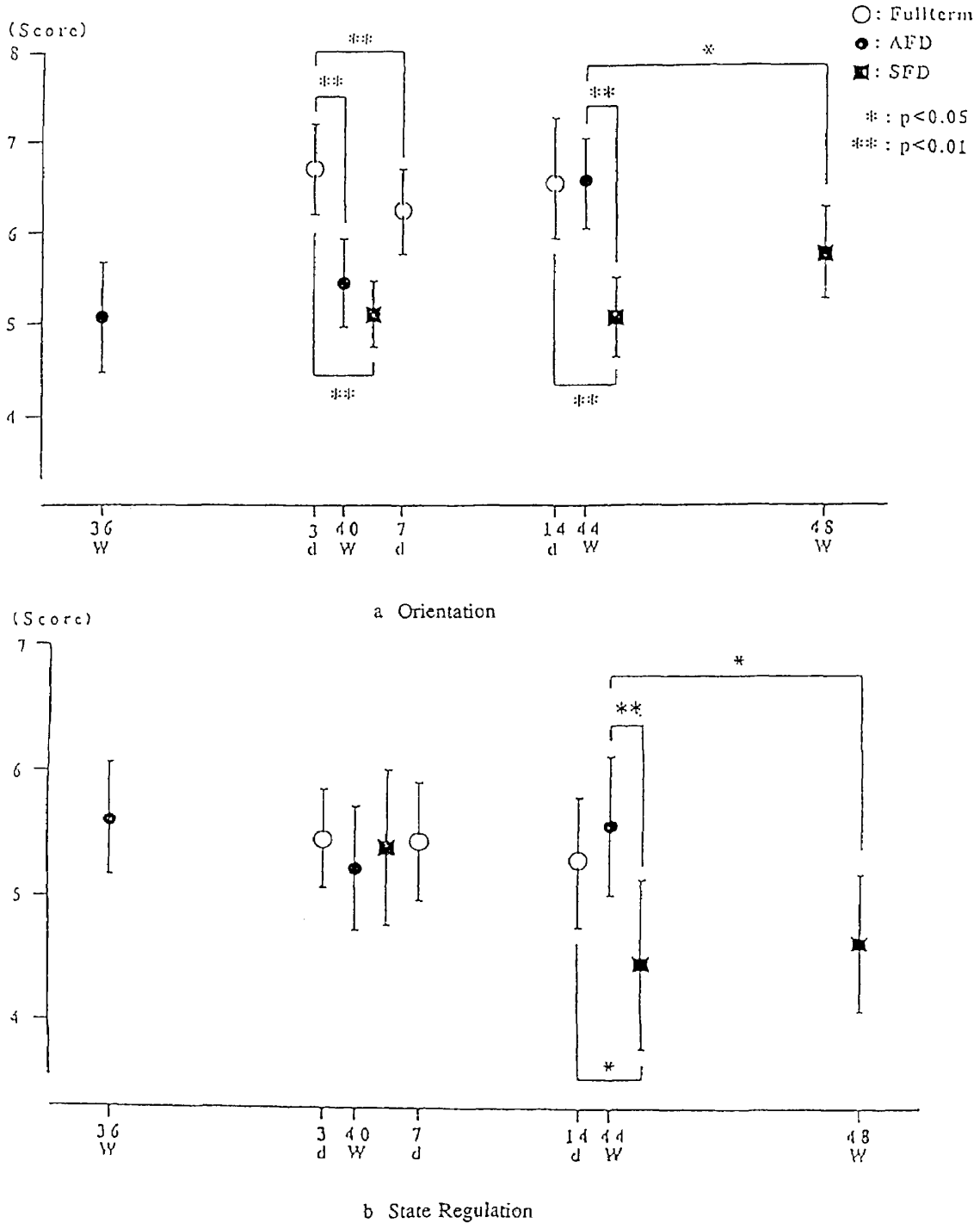


Fig. 2 a-b t-Test of cluster scores in SFD, AFD and mature infants

attention to visual and auditory stimuli, maintenance of sleep state and alert state, state regulation capacity, muscle tone, activity of primitive reflexes, and spontaneous motor performance result in an underestimation of the behavioral capacity of infants and are disadvantageous to mother-infant interaction.

In SFD infants, the lower were the scores of NBAS supplementary items on which stressed signs were reflected, the lower were the development indices at 6 and 12 months after birth. In the neonatal period, infants consume enormous energy for physiological adjustment to cope with the extrauterine environment. In immature or high risk infants, visual and auditory stimuli often become an overload and are apt to induce stressed signs. Stressed signs are reflected on the physiological, motor and state²⁾ systems, and orientation response is even more oppressed. In our data also, the score of orientation cluster was low for SFD and AFD infants compared to mature infants, and the low value persisted in SFD infants (Fig. 2 a).

The sleep-waking rhythm and the development indices were significantly correlated. In SFD infants compared to mature and AFD infants, the value of state regulation cluster was also low, suggesting a difficulty in state regulation from the neonatal period (Fig. 2 b).

The aggressive mother-infant interaction seems to have resulted from conduct of NBAS by visiting homes. Whereas the development of SFD infants was relatively satisfactory the indices at 12 months were significantly lower compared to mature and AFD infants. It is advisable to conduct the NBAS in the presence of parents from the time of NBAS assessment at the NICU in order to strengthen the mother-infant interaction and to promote the development.

It is also advisable to give consideration to helping state regulation, avoiding overload to the infants to a possible extent with the cooperation of the NICU staff. Association of P. T. and O. T. is necessary for the instruction of positioning, handling and more appropriate sensory stimulation.

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References

1. Akiyama T., Kawasaki C., Tsurusaki T., Ogi S., Kusano M., Tanigawa M., Oshima Y., Senju H., Goto Y., Kawaguchi T. and Brazelton T.B.: Neonatal behavioral assessment of AFD infants and longitudinal study of their development -- During one postnatal year --. Bull. Sch. Allied Med. Sci., Nagasaki Univ. 1989, 3 : 1-12.

2. Als H., Lester B.M., Tronick E.Z. and Brazelton T.B.: Manual for the assessment of preterm infant's behavior (APIB). In Theory and Research in Behavioral Pediatrics, I (Appendix): 1982, 65-132.
3. Brazelton T.B.: Neonatal behavioral assessment scale. Clinics in Developmental Medicine No.88, Blackwell Scientific Publication Ltd., London, 1984, 1-104.
4. Bayley N.: Manual for the Bayley scales of infant development. The Psychological Corporation, New York, 1969, 1-176.
5. Caldwell B.M. and Bradley R.H.: Home observation for measurement of the environment (Administration manual). University of Arkansas at Little Rock, Little Rock, 1984, 1-38.
6. Nugent J.K.: Using the NBAS with infants and their families. March of Dimes Birth Defects Foundation, White Plains, New York, 1985, 5-13.

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SFD の新生児行動評価と縦断的発達研究

— 生後一年間 —

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要 旨 長崎大学附属病院小児科未熟児室で集中管理を受けた在胎31週から41週、平均36週、生下時体重1120gから2300g、平均1675gのSFD18例を研究対象とした。

NBAS評価は40, 44, 48週の計3回施行し、6カ月、12カ月時点での発達評価はBayley乳幼児発達検査を実施し、併せて、生活環境調査もおこなった。さきに調査した成熟児、AFDとも比較検討した。

1. SFDの12カ月時の発達指数はMDI, PDIとも成熟児、AFDと比較して有意に低値を示した。
2. NBAS補足項目中30, 33, 34, 35, 36項に反映されるストレス徴候と発達指数との関連性では、ストレス徴候が顕著なほど発達指数は低い傾向にあった。44週時の補足項目では、12カ月時のPDIは5%の危険率でストレス徴候Good群がPoor群より有意に高値を示した。
3. AFD同様、SFD6カ月、1才時のMDI, PDIに、44週時の睡眠-覚醒リズムの良、不良が深く関与していた。

長大医短紀要5:41-50, 1991