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Original Article

Is there any difference between high-risk infants with different birth weight and gestational age in neurodevelopmental characters?

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Abstract

Aim: This study is aimed to investigate differences between cognitive, language and motor development of high-risk infants related to birth weight and gestational age.

Material and Methods: One hundred sixty high-risk infants who were born 32 weeks, 1 500 gr and below included in this study. According to corrected age, 58 infants were 1 month, 72 were at 4 months, 82 were at 8 months and 65 were 12 months old. Infants were seperated two groups according to gestational age <30 weeks and 30-32 weeks and birth weight ≤1 000 gr and 1 001-1 500 gr. Infants motor development were assessed with Bayley-III Infant and Toddler Development Motor Scale (Bayley-III) and Neuro Sensory Motor Developmental Scale (NSMDA), cognitif and lanuage development were Bayley-III cognitive and Language scales. Assessments were applied by the same physiotherapist at 1 month, 4 months, 8 months and 12 months old infants in corrected age. Mann-Whitney U Test, 2 x 2 Chi-Square test ve Fisher's exact tests were used to compare group data. Statistical significance was determined $p<0.05$.

Results: Cognitive, motor and language developments were in normal ranges in all infants. There were no statistical differences in cognitive, language and motor development between groups ($p>0.05$).

Conclusion: Results of this study showed that the motor, cognitive and language development were normal in all high risk infants and power gestational age and birth weight did not affect these parametes. (Turk Pediatri Ars 2015; 50: 151-7)

Keywords: Premature infants, assessment, birth weight, gestational age, risk factors.

Introduction

The current literature considers infants with a very low birth weight (<1500 g) and low gestational week (≤32 weeks) "high-risk" infants (1). The American Academy of Pediatrics published instructions for follow-up of preterm infants in 2006. Accordingly, it was reported that age-appropriate neuromotor evaluation should be performed at least two times in the first two years of life in all infants with very low birth weight and in all preterm infants (2). In addition, regular follow-up of babies born below the gestational age of 32 weeks and with a birth weight below 1500 g is recommended (3, 4).

With advancement of prenatal and neonatal care in the last ten years, especially ventilation assisted modern techniques, prenatal steroid therapy and use of exogenous surfactant in tertiary care centers are increasing the survival rate of high risk babies (5, 6).

This study was presented at the 23rd Annual Meeting of European Academy of Childhood Disability, 8-11 June 2011, Roma, Italy.

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Thus, the rate of occurence of motor disorders has also increased in babies born with low birth weight and in preterm babies. These disorders range from developmental mental coordination disorder to cerebral palsy (CP) (7, 8).

In developed countries, long-term neurodevelopmental outcomes of preterm babies have been documented well in the last 40 years and the rate of major disorders in the first year of life is inversely proportional with birth weight and gestational age by 20% and 40%, respectively (9, 10). Vohr et al. (11) reported that gross motor skills, fine motor skills and mental skills were affected in preterm babies with very low birth weight and a gestational age below 32 weeks. In developing countries, there is a very limited number of studies in this area (12). In our country, there is no study investigating the cognitive, language and motor developments of high-risk babies in the first years of life in detail. Therefore, the aim of our study was to examine the differences in cognitive, language and motor developments in high-risk babies by gestational age and birth weight.

Material and Methods

The necessary approval was obtained from Hacettepe University, Medical Faculty, Medical, Surgical and Drug Researches Ethics Committee (LUT 09/168) to conduct this study. The families included in the study were informed about the study and informed consent was obtained from the families by making them sign the consent form.

Participants

160 high-risk babies who were born with a gestational age of 32 weeks and below and a birth weight of 1500 g and below were included in the study. According to the corrected age, 58 infants were at the age of one month, 72 infants were at the age of four months, 82 infants were at the age of eight months and 65 infants were at the age of 12 months. The babies of the families who did not give consent for participation in the study and the babies who had congenital anomaly and genetic syndrome were not included in the study. The babies were divided into two groups in terms of gestational age as <30 weeks and 30-32 weeks. They were divided into two groups as 1000 g and below (extremely low birth weight) and 1 001 g-1 500 g (very low birth weight) by birth weight.

Procedure

The assessment was performed on the floor on a large cushion or on a table while the baby was sitting in his/her mother's lap approximately 2 hours after feeding. The baby received no medication which would hinder the assessment at the time of assessment. The original Bayley-III Scales of Infant and Toddler Development (Bayley-III) and the Neuro Sensory Motor Development Assessment Questionnaire (NSMDA) were used for the assessment. Each assessment lasted approximately for 60 minutes. The Bayley-III and NSMDA tests were applied to the infants aged one month, four months, eight months and 12 months old by a physiotherapist who had received education and necessary approval to apply these assessment methods.

Statistical analysis

SPSS 150 analysis program (IBM SPSS Statistics; IBM Corporation, Armonk, NY, USA) was used for statistical analysis of the data. The compatibility of the variables with the normal distribution was examined by Kolmogorov-Smirnov test. The descriptive analyses were expressed as median and minimum-maximum values for the variables which were not compatible with the normal distribution. Since Bayley-III cognitive, language and motor scores and NSMDA scores did not show a normal distribution, they were expressed as median values (minimum, maximum). In comparison of the data of the groups, Mann-Whitney U test was used to evaluate if there was a difference between two distributions. The significance of the difference between two percentages was determined by 2x2 chi-square test and Fisher's exact chi-square test. A p value of <0,05 was considered statistically significant.

Results

Seventy-four (46.25%) of the babies included in the study were female and 86 (53.75%) were male. When the birth characteristics of the babies were examined, it was observed that the mean gestational age was 29.38±2.06 weeks (min:24, max:32). The mean birth weight of the babies was 1195.71±255.36 (min: 600, max:1500) g which was classified as very low birth weight. One hundred and forty-one of the babies (88.1%) were born by cesarean section and 19 (11.9%) were born by normal delivery. Fifty-four of the babies (33.7%) were twins, six (3.7%) were triplets and four (2,5%) were quadruplets. The mean Apgar scores at the 1st, 3rd and 5th minutes were 5.6±2.2, 7.2±1.9 and 8.4±1.3, respectively. Birth characteristics by month and birth weight are shown in Table 1.

Table 1. The characteristics of the babies related with birth

Median (min-max)	Below 30 weeks				30-32 weeks				1 000 g and below				1 001-1 500 g			
	1 month n=35	4 month n=43	8 month n=50	12 month n=44	1 month n=23	4 month n=29	8 month n=32	12 month n=21	1 month n=15	4 month n=25	8 month n=26	12 month n=18	1 month n=43	4 month n=47	8 month n=56	12 month n=47
Gestational age (weeks)	28 (26-29.71)	28 (24-29.85)	28 (25-29.57)	28.35 (26.42-29.57)	31.75 (30-32)	31.28 (30-32)	31.42 (30-32)	32 (30-32)	27.5 (26-31.42)	28.28 (26.42-31.14)	27 (25-31.85)	28.14 (26.42-31.14)	29.57 (26-32)	29.85 (26.43-32)	30 (26-32)	29.14 (26.43-32)
Birth weight (g)	1 110 (710-1 500)	1 120 (620-1 490)	1 125 (600-1 490)	1 135 (710-1 480)	1 460 (810-1 500)	1 430 (750-1 500)	1 460 (880-1 500)	1 430 (1 000-1 500)	950 (710-1 000)	880 (620-1 000)	925 (600-1 000)	955 (710-1 000)	1 360 (1 020-1 500)	1 414 (1 030-1 500)	1 350 (1 030-1 500)	1 340 (1 030-1 500)
Corrected age (days)	32 (25-37)	122 (114-128)	240 (235-247)	360 (355-367)	32 (27-37)	120 (115-128)	240 (236-247)	360 (355-265)	32 (26-37)	120 (114-128)	240 (236-247)	360 (358-366)	32 (25-37)	121 (115-128)	240 (235-247)	360 (355-367)

Table 2. Risk factors belonging to the babies and their mothers by gestational age

		n (%)			
		Below 30 weeks	30-32 weeks	z	p
Prenatal	Oligohydramniosis*	5 (5.6)	3 (4.3)	0.134	1.000
	Prolactinoma*	-	1 (1.4)	1.294	0.437
	IUGR	5 (5.6)	9 (12.9)	2.629	0.105
	Preeclampsia	12 (13.3)	13 (18.6)	0.819	0.365
	Placenta previa*	-	4 (5.7)	5.275	0.035
	Maternal diabetes*	2 (2.2)	5 (7.1)	2.279	0.241
	Maternal goitre*	1 (1.1)	4 (5.7)	2.756	0.169
	Maternal infection*	-	2 (2.9)	2.604	0.190
	Consanguinity*	3 (3.3)	3 (4.3)	0.99	1.000
Perinatal	Breech presentation*	4 (4.4)	-	3.191	0.132
	Perinatal asphyxia*	1 (1.1)	3 (4.3)	1.628	0.319
	PDA*	7 (7.8)	4 (5.7)	0.262	0.757
	RDS	24 (26.7)	10 (14.3)	3.607	0.058
	ROP	10 (11.1)	3 (4.3)	2.457	0.117
	BPD*	3 (3.3)	-	2.378	0.257
Postnatal	Hyperbiluribinemia	14 (15.6)	13 (18.6)	0.255	0.613
	Hypoglycemia*	-	2 (2.9)	2.604	0.190
	Brain hemorrhage	27 (30)	17 (24.3)	0.645	0.422
	Hydrocephalus	9 (10)	4 (5.7)	0.969	0.325
	Bradycardia	10 (11.1)	6 (8.6)	0.282	0.595
	Intubated	20 (22.2)	8 (11.4)	3.177	0.075

*Fisher's Exact Chi-square test results
BPD: Bronchopulmonary dysplasia; IUGR: intrauterine growth retardation; PDA: patent ductus arteriosus; RDS: respiratory Distress Syndrome; ROP: Retinopathy of prematurity

Risk factors belonging to the babies and their mothers by gestational age

The group with the gestational age <30th week included 90 babies (56.25%) and the group with the gestational age of 30-32 weeks included 70 babies (43.75%). In the group with a corrected age below one month who were born below the gestational age of 30 weeks, only the rate of placenta previa was significantly high (p=0.035). There was no significant difference between the groups in terms of prenatal, natal and postnatal risk factors (p>0.05). The risk factors belonging to the babies and mothers by gestational age are shown in Table 2.

The risk factors belonging to the babies and their mothers by gestational age

The group with excessively low birth weight included 49 (30.62%) babies and the group with very low birth

Table 3. Risk factors belonging to the babies and their mothers by birth weight

		n (%)			
		1 000 g and below	1 001-1 500 g	z	p
Prenatal	Oligohydramniosis*	6 (12.2)	2 (1.8)	7.805	0.011
	Prolactinoma*	1 (2)		2.280	0.306
	IUGR	8 (16.3)	6 (5.4)	5.078	0.034
	Preeclampsia	8 (16.3)	17 (15.3)	0.026	0.871
	Placenta previa*	–	4 (3.6)	1.811	0.314
	Maternal diabetes*	1 (2)	6 (5.4)	0.920	0.677
	Maternal goitre*	2 (4.1)	3 (2.7)	0.214	0.642
	Maternal Infection*	-	2 (1.9)	0.894	1.000
	Consanguinity*	1 (2)	5 (4.5)	0.572	0.668
Perinatal	Breech presentation*	3 (6.1)	1 (0.9)	3.802	0.086
	Perinatal asphyxia*	–	4 (3.6)	1.811	0.314
Postnatal	PDA*	4 (8.2)	7 (6.3)	0.183	0.738
	RDS	13 (26.5)	21 (18.9)	1.777	0.278
	ROP*	7 (14.3)	6 (5.4)	3.591	0.112
	BPD*	2 (4.1)	1 (0.9)	1.869	0.222
	Hyperbiluribinemia	5 (10.2)	22 (19.8)	2.241	0.134
	Hypoglycemia*	-	2 (1.8)	0.894	1.000
	Brain hemorrhage	11 (22.4)	33 (29.7)	0.904	0.342
	Hydrocephalus*	4 (8.2)	9 (8.1)	0.00	1.000
	Bradycardia	7 (11.3)	9 (8.1)	1.441	0.258
	Intubated	12 (24.5)	16 (14.4)	2.390	0.122

*Fisher's Exact Chi-square test results

BPD: Bronchopulmonary dysplasia; IUGR: intrauterine growth retardation; PDA: patent ductus arteriosus; RDS: respiratory Distress Syndrome; ROP: Retinopathy of prematurity

weight included 111 (69.37%) babies. In the group with excessively low birth weight, the rates of oligohydramniosis and intrauterine growth retardation (IUGR) were significantly high (p=0.011, p=0.034; respectively). There was no significant difference between the groups in terms of other prenatal, natal and postnatal risk factors (p>0.05) (Table 3).

Comparison of NSMDA and Bayley-III findings of the babies born below the gestational age of 30 weeks and at the gestational age of 30-32 weeks

The developments of the babies at the ages of 1, 4, 8 and 12 months were within the normal limits according to Bayley-III and NSMDA assessment scales. No statistically significant difference was found between the Bayley-III cognitive, language, motor and NSMDA scores of the two groups (p>0.05) (Table 4).

Comparison of NSMDA and Bayley-III findings of the babies born with a birth weight of 1000 g and below and with a birth weight of 1 001-1 500 g

The developments of the babies included in the study at the age of 1, 4, 8 and 12 months were within the normal limits according to Bayley-III and NSMDA assessment scales. No statistically significant difference was found between the two groups in terms of Bayley-III cognitive, language, motor and NSMDA scores (p>0.05) (Table 5).

Discussion

This study is important because it investigated the difference in cognitive, language and motor developments by gestational age and birth weight in high-risk babies. In our study, it was shown that cognitive, language and motor developments of high-risk babies might not be affected as the birth weight and gestational age decreased.

In our study in which we compared the developments of high-risk babies by gestational age, no statistically significant difference was found between the two groups in terms of Bayley-III cognitive, language, motor and NSMDA measurement results. In the literature, generally, the developments of the groups of babies born prematurely and at term have been compared. In these studies, no significant difference has been found between preterm and term babies in terms of development and the results of preterm babies have been reported to be within the normal limits (13, 14). Kieviet e tal. (15) evaluated 24 studies which used Bayley-II motor scale to investigate motor development in babies born very prematurely (≤32 weeks) and with a very low birth weight (≤1 500 g) in their comprehensive review and found that these babies had lower motor scores compared to the normal sample group. Anderson et al. (13) compared 221 children who were born with a birth weight below 1 000 g and with a gestational age below 28 weeks at the age of 2 years with age-matched healthy controls using Bayley-III assessment scale. It was observed that the mean scores of the high-risk group were statistically significantly lower compared to the control group. However, it was stated that the mean scores of the high-risk group were still within the normal limits (13). In our study, the median values of the Bayley-III cognitive, language and motor scores in the babies with corrected ages of one, four, eight and twelve months were within the average limits. The motor developments of the babies were classified to be normal

Table 4. Comparison of Bayley-III and NSMDA scores by gestational week

	Month	Median (min-max) Below 30 weeks	30-32 weeks	z	p
BAYLEY-III COGNITIVE	1	95 (65-110)	95 (85-110)	-2.050	0.40
	4	100 (55-115)	100 (55-115)	-0.296	0.767
	8	95 (55-120)	95 (55-120)	-1.918	0.55
	12	94 (47-109)	100 (55-112)	-0.587	0.557
BAYLEY-III LANGUAGE	1	94 (86-109)	97 (59-112)	-0.233	0.816
	4	97 (42-112)	100 (47-112)	-0.935	0.350
	8	91 (47-118)	94 (47-115)	-1.819	0.69
	12	97 (47-109)	97 (47-118)	-0.676	0.499
BAYLEY-III MOTOR	1	100 (70-118)	103 (85-115)	-0.941	0.347
	4	100 (55-115)	107 (70-124)	-0.835	0.404
	8	91 (46-118)	97 (46-127)	-1.858	0.63
	12	92.5 (46-115)	91 (46-127)	-0.528	0.598
NSMDA	1	6 (5-25)	5 (5-14)	-2.215	0.27
	4	6 (6-27)	7 (6-21)	-0.830	0.406
	8	8 (6-30)	7 (6-29)	-1.167	0.243
	12	8 (7-34)	8 (7-35)	0.00	1.000

BAYLEY-III: Bayley Infant and Toddler Assessment scale- third version;
NSMDA: neuro sensory motor assessment scale

Table 5. Comparison of Bayley-III and NSMDA scores by birth weight

	Month	Median (min-max) 1 000 g and below	1 001-1 500 g	z	p
BAYLEY-III COGNITIVE	1	100 (90-110)	95 (65-110)	-1.872	0.61
	4	95 (55-115)	100 (60-115)	-1.951	0.051
	8	90 (55-115)	95 (55-120)	-1.712	0.87
	12	95 (55-110)	95 (55-112)	-0.599	0.549
BAYLEY-III LANGUAGE	1	100 (89-112)	94 (59-112)	-2.082	0.37
	4	94 (47-112)	100 (47-112)	-2.224	0.26
	8	90 (47-112)	94 (47-118)	-2.172	0.30
	12	92.5 (50-115)	97 (47-118)	-0.272	0.786
BAYLEY-III MOTOR	1	100 (85-112)	103 (70-118)	-0.196	0.845
	4	97 (46-121)	103 (52-130)	-2.176	0.30
	8	95 (46-127)	97 (46-127)	-1.628	0.105
	12	91 (46-127)	94 (46-127)	-0.235	0.814
NSMDA	1	7 (5-9)	6 (5-25)	-0.391	0.696
	4	7 (6-27)	6 (6-24)	-1.498	0.134
	8	8.5 (6-30)	7 (6-29)	-1.584	0.113
	12	8 (7-29)	8 (7-35)	-0.18	0.853

BAYLEY-III: Bayley Infant and Toddler Assessment scale- third version;
NSMDA: neuro sensory motor assessment scale

according to the NSMDA assessment. This might have arisen from the fact that prematurity and low birth weight are among the significant risk factors, but not the only factor in developmental delay of babies.

When the developments of the babies who were born with excessively low birth weight (≤1 000 g) and very low birth weight (1 001-1 500 g) were compared in our study, it was observed that there was no significant difference between the Bayley-III cognitive, language, motor subscales and NSMDA scores in both groups. This shows that the development of the baby is not affected negatively as the birth weight decreases. These results are compatible with similar studies in the literature. Kohlendorfer et al. (16) evaluated the effect of smoking during pregnancy on motor and intelligence development at the corrected age of 2 years in 142 babies who were born at the gestational age of ≤32 weeks using Bayley-II scale. The babies of the smoker mothers were divided into 3 groups according to birth weight: ≤1 000 g, 1 001-1 500 g, >1 500 g. No statistically significant difference was found between the Bayley-II motor and mental scores in the groups formed according to birth weight (16). Constantinou et al. (17) divided a total of 77 babies into two groups by birth weight as excessively low birth weight (n=43, <1 000 g) and very low birth weight (n=34, 1 000-1 500 g) and evaluated neurobehavioral development at the corrected age of 18 months and 30 months using Bayley-II motor and mental scale. No statistically significant difference was found between the two groups in terms of motor and mental development. However, Connors et al. (18) reported that subsequent increase in weight was a significant factor which affected development. In this study, they evaluated motor development using NSMDA and cognitive development using Griffhts Mental Development Scale in 197 babies. They showed that low body mass index of the babies born with a very low birth weight (<1 000 g) at the age of two years was related with low cognitive and motor skills (18). In another study in which the relation between early minor motor difficulties in babies born with a very low birth weight and attention difficulties in the school period was examined, a strong relation was found between attention in the school period and motor development at the age of 24 months according to NSMDA scores independent of biological and social factors in very low birth weight babies (19). These results support the relation between development in motor function and attention. However, this does not mean that early motor assessments can be substituted for cognitive tests. These results

demonstrate the importance of identification of neurodevelopmental disorder in the early period in high-risk babies.

Lack of a homogenous distribution between the groups is one of the limitations of our study. Long-term follow-up studies including a higher number of babies are needed to show the changes in neurodevelopmental characteristics of high-risk babies in the future.

In preterm babies, cognitive, language and motor development may be retarded compared to normal peers as the gestational age gets younger and the birth weight gets lower. The fact that no significant difference was found between the groups formed by gestational age and birth weight in terms of cognitive, language and motor development is satisfactory. The reason of this may be recent developments in perinatal care in our country as well as the fact that our study group included a very low number of excessively low gestational age (<25 weeks) babies. In addition, familial socio-economical status and cultural level and the environmental conditions which the child grows up under also have effects on cognitive, language and motor development. Our study included babies of families with similar socioeconomical level. This may be one of the reasons for the fact that no difference was observed between the groups. In the future, studies examining the effects of familial factors and enviromental conditions on development in preterm babies should be conducted.

Ethics Committee Approval: Ethics committee approval was received for this study.

Informed Consent: Written informed consent was obtained from the parent of the patient who participated in this study.

Peer-review: Externally peer-reviewed.

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