Growth and Neurodevelopment Outcome Among Preterm and Very Low Birth Weight Neonates Given Early Aggressive Amino Acid Therapy Admitted in the NICU of a Tertiary Hospital

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ABSTRACT

Long-term outcomes of preterm and very low birth weight (VLBW) infants have been the focus of published research due to improved neonatal care. One of the long-term morbidities associated with being born too early or VLBW is postnatal growth failure and neurodevelopment delay. Because of this, different strategies were implemented to address this, one of which is initiating early aggressive amino acid therapy at 3 g/kg/day within 24 hours of life with its goal to improve previously mentioned outcomes. This study aims to determine the growth and neurodevelopment outcome among neonates born preterm and VLBW who were given 3 g/kg/day of amino acid. It is important that such delays are detected early on so that appropriate interventions can be initiated to maximize the infant's capabilities. A total of 34 neonates were included in the study where baseline anthropometrics were taken and followed up at the 6th, 9th, and 12th month of corrected age. Results showed 35.2% of the participants were discharged with their anthropometrics below the target range. By the 6th month of corrected age, only 2.94% were below normal and by the 9th month of corrected age, all participants have normal for age anthropometrics. As for the neurodevelopment aspect, 4 of 34 participants (13.8%) were found to be classified as emerging risk and were referred to a neurodevelopment specialist. By the 9th month of corrected age, only 2 were classified as emerging risk and by the 12th month of corrected age, only 1 remained to be at risk for neurodevelopment delay. In conclusion, early aggressive amino acid therapy proves to have a positive effect in the growth and neurodevelopment outcome among preterm and VLBW infants. However, we would like to recommend continued monitoring of neurodevelopment in neonates from this population until 2 years of age, since some delays can be evident later on in life.

INTRODUCTION

There has been an improvement in the survival of preterm infants due to advancements in neonatal care. Preterm birth is defined as being born before 37 weeks of gestation associated with major morbidities which include abnormal neurodevelopment outcome related to inadequate nutrition during the early postnatal period. Therefore, timely nutritional care is important in optimizing neurodevelopment outcome among preterm infants.[1]

Aside from prematurity, postnatal growth failure is extremely common among the very low birth weight (VLBW) infants - birth weight of less than 1500 g and

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related with higher risk of poor neurodevelopment outcome.[2] VLBW infants at times demonstrate difficulties across a wide range of domains: cognitive, language, motor, and behavioral functioning.[1]

The goal of nutritional therapy for both preterm and VLBW infants is the achievement of postnatal growth at a rate that approximates the intrauterine growth in the normal fetus. This goal is best achieved with effective enteral feeding. However, early enteral feeding is commonly limited among this population due to the immaturity of gastrointestinal motor function.[3] Also, even if enteral feeding is being done, the oral feedings given often do not provide the adequate nutrition until full feeds were achieved which might take 7 to 10 days. To address these limitations, early parenteral therapy is initiated soon after birth. Of the major nutritional components, proteins are essential for normal growth and development. Preterm and VLBW infants given intravenous amino acids showed evidence of enhanced growth in the part of the brain responsible for cognition, as proven by an increase in head circumference and brain size.[4] Multiple studies have been done regarding the dose of amino acid therapy to be given to VLBW and preterm infants. With this, the current standard of nutritional therapy is early amino acid therapy, defined as initiating 3.0 g/kg/day of amino acids within the first 24 hours of life. One of the major limitations of the systematic review is the lack of studies that pertain to the long-term effect of nutritional therapy by giving amino acids, particularly the neurodevelopment outcome of preterm and VLBW infants.[5]

METHODOLOGY

This was a prospective cohort study conducted at the High Risk Clinic of the Outpatient Department of a tertiary hospital which included preterm and very low birth weight newborns admitted at the neonatal intensive care unit (NICU). In this study, we want to determine the growth and neurodevelopment outcome of preterm and very low birth weight infants admitted in the NICU who were given early amino acid therapy. Newborns with major congenital or metabolic abnormalities and asphyxiated infants were not included in the study.

All newborn infants who met the inclusion criteria admitted at the NICU were included in the study provided that the informed consent was signed by the parent/caregiver. All subjects were started on parenteral nutrition containing amino acid (6% Aminosteril) at 3 g/kg/day within 24 hours of life, in accordance with the standards of nutritional therapy. Enteral feeding was initiated as soon as possible and tapering down of amino acids was started once the patient could tolerate 70 ml/kg/day of enteral feeds. The subject's weight and length as well as head circumference was measured until upon discharge and plotted against the Fenton Chart. Once discharged, subjects were followed up at the 6th, 9th, and 12th month of corrected age and assessed by the investigator using the Bayley Scales of Infant and Toddler Development – Third Edition (BSID–III) Screening Tool, neurodevelopment parameters were assessed: cognitive, language, motor, social-emotional and adaptive behavior scales while taking note of weight, length and head circumference and plotted against the WHO growth charts. The results gathered underwent statistical analysis and if determined to have neurodevelopment delay, an immediate referral to a specialist was done.

The sample size was calculated using a formula devised by Krejcie and Morgan and yielded a result of 34 participants.

RESULTS

A total of 34 participants were included in the study, but only 29 participants completed the study. The five patients who dropped out were admitted in our institution, but were unable to follow-up. To maintain prognostic balance generated from the original random treatment allocation, the data was canned by using the intention-to-treat (ITT) procedure. Per-protocol population is defined as a subset of the ITT population who completed the study without any major protocol violations, to provide information about the potential effects of treatment policy rather than on the potential effects of specific treatment.

The collected data on demographic profile of the respondents were tabulated and presented in frequency, percentage, and mean ± SD as shown in Table 1. Evidently, the patients were equally distributed in terms of gender. Majority of the subjects were classified as very preterm and very low birth infants with mean birth weight of 1.35 kg. The birth lengths were distributed at a range interval of 30 and above with mean birth length of 40.6 cm. The head circumferences had an average of 28.22 cm.

Table 1: Demographic profile of the respondents included in the study

Profile	Frequency (n = 34)	Percentage (%)	Mean±SD
Gender			
Male	17	50.0	
Female	17	50.0	
Age of Gestation			
Moderate Preterm	12	35.29	
Very Preterm	17	50.00	
Extremely Preterm	5	14.71	
Birth Weight (kg)			1.35±0.35
Low birth weight	12	35.29	
Very low birth weight	20	58.82	
Extremely low birth weight	2	5.88	
Birth Length (cm)			40.60±3.72
33 - 35	2	5.88	
36 - 38	5	14.71	
39 - 41	6	17.65	
42 - 44	7	20.59	
45 and above	14	41.18	
Head Circumference (cm)			28.22±2.47
23 - 25	2	5.88	
26 - 28	7	20.59	
29 - 31	12	35.29	
32 and above	13	38.24	
Hospital Stay (days)			38.59±18.45
15 - 27	11	32.35	
28 - 40	10	29.41	
41 - 53	7	20.59	
54 - 66	3	8.32	
67 and above	3	8.32	

Table 2: Descriptive analysis on weight, linear growth and head circumference

Variables	Frequency beyond normal	Percentage	Mean±SD
Weight Gain			
Discharge Weight	12	35.20	1.98±0.26
6th Month Weight	1	2.94	6.93±0.44
9th Month Weight	0	0.0	8.00±0.45
12th Month Weight	0	0.0	9.065±0.78
Linear Growth			
Discharge Length	7	20.59	44.41±2.33
6th Month Length	3	8.82	65.42±2.00
9th Month Length	0	0.0	69.39±1.97
12th Month Length	0	0.0	73.53±1.46
Head Circumference			
Discharge Circumference	4	11.76	31.50±1.19
6th Month Circumference	0	0.0	42.98±0.97
9th Month Circumference	0	0.0	45.10±1.01
12th Month Circumference	0	0.0	46.10±1.09

Most of the subjects stayed 15 to 40 days in the hospital with an average of 38.59 days.

Table 2 presents the descriptive analysis on weight, linear growth, and head circumference of the subjects. The results showed that there were 12 (35.2%) participants below their normal weight from the target range of 10th to 90th percentile at the time of discharge with the average weight of 1.98 kg. At the 6th month of corrected age, upon follow up, the number of participants with below normal weight

Table 3: Bayley Scales result on neurodevelopment outcome assessed on 6th, 9th, and 12th month of corrected age

Description	Frequency	Percentage
Bayley Scales Result on 6th Month		
At Risk	0	0.0
Emerging Risk	4	13.8
Competent	25	86.2
Bayley Scales Result on 9th Month		
At Risk	0	0.0
Emerging Risk	2	6.9
Competent	27	93.1
Bayley Scales Result on 12th Month		
At Risk	0	0.0
Emerging Risk	1	3.4
Competent	28	96.6

Table 4: Paired T-test analysis on weight, linear growth and head circumference of the respondents from the baseline to 12th month of corrected age

Description	t-value	p-value p = 0.05	Remarks
Weight Gain			
Baseline x Discharge Weight	8.29	0.000	Significant
Baseline x 6th Month Weight	48.30	0.000	Significant
Baseline x 9th Month Weight	57.91	0.000	Significant
Baseline x 12th Month Weight	58.43	0.000	Significant
Linear Growth			
Baseline x Discharge Length	6.13	0.000	Significant
Baseline x 6th Month Length	31.62	0.000	Significant
Baseline x 9th Month Length	36.59	0.000	Significant
Baseline x 12th Month Length	43.31	0.000	Significant
Head Circumference			
Baseline x Discharge Head	7.77	0.000	Significant
Circumference	30.84	0.000	Significant
Baseline x 6th Month Head	33.09	0.000	Significant
Circumference	34.06	0.000	Significant
Baseline x 9th Month Head			
Circumference			
Baseline x 12th Month Head			
Circumference			

decreased to 1 (2.94%) with the average weight of 6.93 kg. All participants had normal weight for age by the 9th month of corrected age. There were 7 (20.59%) participants with below normal linear length at the time of discharge with average length of 44.41 cm. By the 6th month corrected age, it decreased to 3 (2.94%) with average weight of 65.42 cm, and by the 9th month of corrected age, all participants had normal for age linear growth. As for head circumference, there were 4 (11.76%) participants with below normal head circumference at the time of discharge with average measure of 31.50 cm, and by the 6th month of corrected age, all participants had normal measurement of head circumference.

Table 3 presents the neurodevelopment outcome of the respondents assessed on the 6th, 9th, and 12th month of corrected age using the Bayley scale. The results showed that there were no subjects classified as "at risk for developing neurodevelopment delay" on the 6th, 9th, or 12th month of corrected age. There were 4 (13.8%) respondents classified as "emerging risk" while 25 (86.2%) subjects were classified as competent using the Bayley scales on the 6th month. On the 9th month of corrected age, only 2 (6.9%) were classified as "emerging risk" and it decreased to 1 (3.4%) by the 12th month of corrected age.

The paired t-test analysis on weight, linear growth, and head circumference of the respondents from the baseline to the 12th month of corrected age was

assessed and summarized in Table 4. The t-value between baseline and discharge weight was 8.29 with p-value of 0.000 at a level of significance of 0.05. Thus, the result shows that there is significant weight gain of the participants from the time of birth to time of discharge. Consequently, the p-values of comparisons of weight gain from the baseline to 12th month of corrected age was 0.000 with t-values of 8.29, 48.30, 57.91, and 58.43, respectively. Generally, there were significant increases on respondents' weight from baseline weight to the 12th month weight. The p-values between birth lengths compared continuously to discharge date until follow up at the 6th, 9th, and 12th month of corrected age was 0.000 with t-value of 6.13, 31.62, 36.59, and 43.31, respectively. Thus, the results show that there is significant gain on the linear growth of respondents started at the time of discharge and continuously acquired the same results up to the 12-month period. The p-values between head circumference at birth, compared to measurements taken upon discharge up to the 12th month of corrected age was 0.000 with t-value of 7.77, 30.84, 33.09, and 34.06, respectively. Thus, the result showed that there was significant gain on the linear growth of respondents started at the time of discharge and continuously acquired the same results up to the 12-month period.

DISCUSSION

Major developments in neonatal care have resulted in improved survival of preterm infants.[4] Despite this, poor weight gain remains the most frequent morbidity seen in VLBW infants. Another frequently occurring morbidity seen is neurodevelopment impairment. There have been extensive studies that link neurodevelopment impairment and early undernutrition.[1] With these findings, it has been the standard of care to start very preterm and VLBW infants with early aggressive amino acid therapy, that is, giving 3 g/kg/day of amino acid as early as 24 hours of life. This accounts for the 0.3 g/kg/day to mimic intrauterine changes in the body composition, + 2.2 g/kg/day to 2.5 g/kg/day for normal growth + 1 g/kg/day for the obligatory urinary and dermal protein loss. Recent studies have shown that protein delivery of 3 g/kg/day beginning on day 1 of life is safe and associated with plasma amino acid concentrations similar to those of a second and third trimester fetus.[7]

A systematic review which compared early and late administration of amino acids among preterm infants included seven randomized controlled trials that showed safety in administering 3 g/kg/day of amino acid as evidenced by normal blood urea nitrogen levels despite positive nitrogen balance with a variable finding with regard to its effect on head circumference growth.

During the past 10 years, there has been an increasing number of screening tests available to assist physicians in identifying babies who may need further assessment. The Bayley Scales of Infant and Toddler development, Third Edition (BSID–III) Screening Tool was developed to assess the infant using different domains: cognitive, language, fine and gross motor movement among infants aged 0-18 months of corrected age. With minimal training, the test can be administered by the members of health care.[8]

Analysis of the study results showed that the subjects included more of very preterm and VLBW infants who stayed at the NICU for at least 15-27 days as shown in Table 1. Of the 34 respondents, only 29 completed the study. Since our institution is a tertiary and referral hospital, we get patients who live far away from our area, making follow up after discharge difficult.

Of the subjects included, 35.2% had below normal weight, 20.59% had below normal length, and 11.75% had below normal measurement of head circumference upon discharge. This indicates that a majority of the patients were able to have normal anthropometrics by the time of discharge. However, current studies show that it is important for monitoring growth after NICU discharge, and going by the data gathered there is an upward trend in all areas of growth (weight, length, and head circumference) at the 6th, 9th, and 12th month of corrected age.

Among the participants 86.2% were deemed competent using the Bayley Scales taken at the 6th month of corrected age, with only 4 of 13.8% classified as emerging risk for delay. All patients classified as emerging risk were referred to a neurodevelopment specialist for further evaluation and early intervention. The four patients who were classified as emerging risk were extremely preterm infants who stayed at the NICU the longest and had a difficult neonatal course. On further followup at the 9th and 12th month of corrected age, we can observe a decrease in the number of infants classified as emerging risk for delay, which could

indicate an improvement in the neurodevelopment aspect of these patients, and only one remained to be in the emerging risk category by the 12th month of corrected age. This patient was already started on occupational therapy as advised by the neurodevelopment specialist.

Lastly, table 4 showed the paired t-test analysis of baseline anthropometrics in comparison to measurements taken upon discharge and follow up and showed significant results.

CONCLUSION AND RECOMMENDATIONS

Very preterm and VLBW infants are considered a high risk population in developing long-term complications related to prematurity such as problems in growth as well as neurodevelopment delay. Early identification of such complications is important for prompt intervention.

The results of this study clearly illustrate the long-term benefits of giving early aggressive amino acid therapy among high risk neonates, specifically in terms of growth and neurodevelopment.

However, one of the limitations of this study is the number of patients who were unable to complete the study. Also, the study, only followed up participants up to 12 months of corrected age, and it would be better if they can be followed up until 2 years of age and longer.

This research only focused on the nutritional intervention, in the form of early amino acid administration, and since neurodevelopment delay can be multifactorial, another recommendation for future studies is to include other factors that may influence the outcome of having neurodevelopment delay such as episodes of hypoglycemia, sepsis, etc.

Acknowledgment

This research would not have been possible if not for the support of the Department of Medical Education and Research, Research Ethics Committee, as well as the Section of Newborn Medicine of the University of Santo Tomas Hospital. The author would also like to acknowledge Mr. Noel Potenciano for the assistance in doing statistical analysis of this study.

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I. PATIENT DATA CHARACTERISTICS UPON BIRTH AND DISCHARGE

CODE	SEX	AOG	BIRTH WEIGHT	BIRTH LENGTH	HEAD CIRCUMFERENCE	DISCHARGE WEIGHT	%	DISCHARGE LENGTH	%	DISCHARGE HEAD CIRCUMFERENCE	%	TOTAL HOSPITAL DAYS
001	F	31-32 wks	1.66 kg	40.5 cm	29 cm	2.2 kg	10TH percentile	41.5 cm	<10th percentile	30.5cm	10TH percentile	35 days
002	F	32-33 wks	1.15 kg	40.5 cm	29 cm	1.84 kg	<10th percentile	42 cm	<10th percentile	31 cm	<10th percentile	34 days
003	F	32 wks	1.76 kg	44 cm	30.5 cm	2 kg	50th percentile	44 cm	50th percentile	31.5 cm	50TH percentile	19 days
004	M	26-27 wks	0.88 kg	35 cm	24.5 cm	2.1 kg	10th percentile	44 cm	10th percentile	32 cm	50th percentile	65 days
005	F	27-28 wks	0.85 kg	35 cm	26 cm	1.75 kg	10th percentile	42 cm	50th percentile	32 cm	50th percentile	58 days
006	F	30-31 wks	1.39 kg	39 cm	27 cm	2.4 kg	10TH percentile	46.5 cm	10th percentile	32 cm	10th percentile	49 days
007	M	31-32 wks	1.43 kg	41.5 cm	29.5 cm	2 kg	<10th percentile	44 cm	10th percentile	31 cm	10th percentile	37 days
008	M	32-33 wks	1.89 kg	45 cm	31 cm	2.09 kg	10th percentile	46 cm	10th percentile	32.5 cm	50th percentile	17 days
009	M	26-27 wks	0.73 kg	33 cm	22.5 cm	2.2 kg	<10th percentile	48 cm	10th percentile	33 cm	50th percentile	80 days
010	M	30-31 wks	1.57 kg	43 cm	29 cm	1.97 kg	<10th percentile	45 cm	10th percentile	32 cm	50th percentile	35 days
011	F	29-30 wks	1.0 kg	45 cm	30 cm	2.18 kg	10th percentile	46 cm	10th percentile	32.5 cm	50TH percentile	50 days
012	M	30-31 wks	1.2 kg	40 cm	27 cm	2.54 kg	10th percentile	46 cm	10th percentile	33 cm	50th percentile	43 days
013	M	29-30 wks	1.25 kg	38 cm	25.5 cm	2.11 kg	<10th percentile	47 cm	10th percentile	31 cm	<10th percentile	65 days
014	F	33-34 wks	1.43 kg	45 cm	30 cm	2.12 kg	<10th percentile	47 cm	50TH percentile	32 cm	10th percentile	22 days
015	M	31-32 wks	1.8 kg	45 cm	30 cm	2 kg	10th percentile	44 cm	10th percentile	32 cm	50th percentile	22 days
016	F	34-35 wks	1.5 kg	40 cm	29.5 cm	1.75kg	<10th percentile	43 cm	<10th percentile	30.5 cm	10th percentile	19 days
017	M	28-29 wks	1.07 kg	38 cm	27 cm	2.06 kg	10th percentile	43 cm	<10th percentile	31 cm	10th percentile	47 days
018	F	30-31 wks	1.61 kg	43 cm	29 cm	2.14 kg	10th percentile	46 cm	50TH percentile	32 cm	50TH percentile	36 days
019	M	32-33 wks	1.66 kg	43 cm	30 cm	1.91 kg	<10th percentile	45 cm	10th percentile	33 cm	50th percentile	27 days
020	M	26 wks	0.93 kg	37 cm	26 cm	2.10 kg	<10th percentile	43.5 cm	<10th percentile	31.5 cm	10th percentile	82 days

Continues

CODE	SEX	AOG	BIRTH WEIGHT	BIRTH LENGTH	HEAD CIRCUMFERENCE	DISCHARGE WEIGHT	%	DISCHARGE LENGTH	%	DISCHARGE HEAD CIRCUMFERENCE	%	TOTAL HOSPITAL DAYS
021	M	32-33 wks	1.79 kg	43 cm	30.5 cm	NA	NA	NA	NA	NA	NA	NA
022	M	32 wks	1.8 kg	44 cm	29 cm	2.29 kg	50th percentile	45 cm	50th percentile	30.5 cm	50th percentile	18 days
023	M	32 wks	1.56 kg	44cm	31cm	1.93 kg	10th percentile	46 cm	50th percentile	32 cm	50th percentile	22 days
024	M	33-34 wks	1.45kg	42 cm	30 cm	1.64 kg	<10th percentile	45 cm	10th percentile	33 cm	50th percentile	16 days
025	F	29-30 wks	1.06 kg	35 cm	25.5 cm	1.79 kg	10th percentile	39.5 cm	<10th percentile	29 cm	10th percentile	43 days
026	M	32-33 wks	1.45 kg	43 cm	32 cm	1.99 kg	<10th percentile	46 cm	50th percentile	32 cm	50th percentile	35 days
027	F	28-29 wks	980 g	34.5 cm	25 cm	1.88 kg	10th percentile	42 cm	10TH percentile	30 cm	10th percentile	53 days
028	F	31-32 wks	1.75kg	45 cm	30 cm	1.87 kg	10TH percentile	47 cm	10th percentile	31.5 cm	50th percentile	32 days
029	F	33-34 wks	1.48 kg	43 cm	31.5 cm	1.83kg	10th percentile	45 cm	50th percentile	32.5 cm	50th percentile	18 days
030	M	32-33 wks	2 kg	45.5 cm	31.5 cm	2.22 kg	10th percentile	46 cm	10th percentile	33 cm	50th percentile	21 days
031	F	26-27 wks	0.92 kG	35 cm	24 cm	1.82	10th percentile	38 cm	<10th percentile	28 cm	<10th percentile	50 days
032	F	31-32 wks	1.8KG	44cm	29 cm	1.94 kg	50th percentile	46 cm	50th percentile	31 cm	50th percentile	15 days
033	F	31-32 wks	1.17 KG	40 cm	27 cm	2.1 kg	<10th percentile	44 cm	<10th percentile	30 cm	<10th percentile	46 days
034	F	28-29 wks	1.19 KG	38 cm	27 cm	1.89 kg	<10th percentile	42 cm	10th percentile	31.5 cm	50th percentile	42 days

II. GROWTH AND NEURODEVELOPMENTAL SCORES AT 6TH MONTH CORRECTED AGE

CODE	AOG	WEIGHT	Z SCORE	LENGTH	Z SCORE	HEAD CIRCUMFERENCE	Z SCORE	BSID SCORE					REMARKS
								Cognitive	Receptive Communication	Expressive Communication	Fine Motor	Gross Motor	
001	31-32 wks	6.9 kg	Z = 0	66cm	Z = 0	43.5 cm	Z = 0	8	6	7	8	9	COMPETENT
002	32-33 wks	6.8 kg	Z = 0	69 cm	Z = 0	43 cm	Z = 0	11	6	7	7	10	COMPETENT
003	32 wks	6.4 kg	Z = 0	67 cm	Z = 0	42.5 cm	Z = 0	8	6	7	8	8	COMPETENT
004	26-27 wks	7.2 kg	Z = 0	64.5 cm	Z = 0	42 cm	Z = 0	9	7	6	7	8	COMPETENT
005	27-28 wks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
006	30-31 wks	6.5 kg	Z = 0	65 cm	Z = 0	41.5 cm	Z = 0	9	6	6	7	8	COMPETENT
007	31-32 wks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
008	32-33 wks	7 kg	Z = 0	63.8 cm	Z = 0	41.5 cm	Z = 0	7	7	5	7	7	COMPETENT
009	26-27 wks	7.3 kg	Z = 0	64 cm	Z = 0	43 cm	Z = 0	8	7	8	6	9	EMERGING RISK
010	30-31 wks	7.83 kg	Z = 0	67 cm	Z = 0	44.5 cm	Z = 0	9	6	8	7	9	COMPETENT
011	29-30 wks	7.31 kg	Z = 0	64 cm	Z = 0	42 cm	Z = 0	8	7	7	8	9	COMPETENT
012	30-31 wks	6.87kg	Z = 0	67 cm	Z = 0	43.8 cm	Z = 0	9	5	6	7	9	EMERGING RISK
013	29-30 wks	8 kg	Z = 0	66 cm	Z = 0	44.6 cm	Z = 0	10	8	7	9	13	COMPETENT
014	33-34 wks	7.5	Z = 0	67 cm	Z = 0	43 cm	Z = 0	10	7	7	8	11	COMPETENT
015	31-32 wks	6.6 kg	Z = 0	66 cm	Z = 0	42 cm	Z = 0	11	7	8	9	9	COMPETENT
016	34-35 wks	6.1 kg	Z = 0	68 cm	Z = 0	43 cm	Z = 0	8	7	6	9	10	COMPETENT
017	28-29 wks	6.8 kg	Z = 0	68.8 cm	Z = 0	44 cm	Z = 0	8	6	6	7	9	COMPETENT
018	30-31 wks	6.4 kg	Z = 0	65 cm	Z = 0	43.5 cm	Z = 0	7	6	6	7	9	COMPETENT
019	32-33 wks	6.2 kg	Z <-2	66 cm	Z = 0	42 cm	Z = 0	7	6	8	7	8	COMPETENT
020	26 wks	7.4 kg	Z = 0	67 cm	Z = 0	43 cm	Z = 0	8	8	7	8	8	COMPETENT
021	32-33 wks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
022	32 wks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
023	32 wks	6.8 kg	Z = 0	64 cm	Z = 0	44 cm	Z = 0	7	8	8	9	8	COMPETENT
024	33-34 wks	7.2 kg	Z = 0	65 cm	Z = 0	45 cm	Z = 0	8	7	6	8	8	COMPETENT
025	29-30 wks	7 kg	Z = 0	62 cm	z<-2	42 cm	Z = 0	8	7	8	8	10	COMPETENT
026	32-33 wks	6.8 kg	Z = 0	63 cm	Z<-2	42 cm	Z = 0	7	8	7	8	9	COMPETENT
027	28-29 wks	7.1 kg	Z = 0	66 cm	Z = 0	43 cm	Z = 0	7	8	8	7	9	COMPETENT
028	31-32 wks	7 kg	Z = 0	64 cm	Z = 0	44 cm	Z = 0	8	8	7	8	8	COMPETENT
029	33-34 wks	7.2 kg	Z = 0	66 cm	Z = 0	44 cm	Z = 0	8	8	7	9	9	COMPETENT
030	32-33 wks	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
031	26-27 wks	6.6 kg	Z = 0	68 cm	Z = 0	42 cm	Z = 0	8	7	5	8	9	COMPETENT
032	31-32 WKS	7.2 kg	Z = 0	65 cm	Z = 0	43 cm	Z = 0	7	8	6	8	11	COMPETENT
033	31-32 WKS	7.2 kg	Z = 0	62 cm	Z = 0	43 cm	Z = 0	8	7	6	7	7	COMPETENT
034	28-29 WKS	6.3 kg	Z = 0	61 cm	Z<-2	42 cm	Z = 0	8	8	7	7	8	COMPETENT

III. GROWTH AND NEURODEVELOPMENT SCORES AT 9TH MONTH CORRECTED AGE

CODE	WEIGHT	Z SCORE	LENGTH	Z SCORE	HEAD CIRCUMFERENCE	Z SCORE	BSID SCORE					REMARKS
							Cognitive	Receptive Communication	Expressive Communication	Fine Motor	Gross Motor	
001	7.3 kg	Z = 0	73 CM	Z = 0	45 cm	Z = 0	10	6	6	9	10	EMERGING RISK
002	8 kg	Z = 0	70 CM	Z = 0	46 cm	Z = 0	12	8	7	9	12	COMPETENT
003	7.5 kg	Z = 0	66 cm	Z = 0	46 cm	Z = 0	11	8	6	9	12	COMPETENT
004	8 kg	Z = 0	68.5 cm	Z = 0	45 cm	Z = 0	10	7	7	8	10	COMPETENT
005	NA	N A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
006	7.8 kg	Z = 0	70 cm	Z = 0	45 cm	Z = 0	12	8	7	9	10	COMPETENT
007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
008	7.6 kg	Z = 0	70 cm	Z = 0	44 cm	Z = 0	11	9	8	8	12	COMPETENT
009	8.2 kg	Z = 0	69 cm	Z = 0	45 cm	Z = 0	14	9	9	7	12	EMERGING RISK
010	8.6 kg	Z = 0	72cm	Z = 0	46cm	Z = 0	14	8	9	9	12	COMPETENT
011	7.6 kg	Z = 0	70 cm	Z = 0	44 cm	Z = 0	11	9	9	8	11	COMPETENT
012	7.4 kg	Z = 0	68 cm	Z = 0	45 cm	Z = 0	11	12	9	13	13	COMPETENT
013	8 kg	Z = 0	72 cm	Z = 0	45.5 cm	Z = 0	15	10	10	12	14	COMPETENT
014	8.1 kg	Z = 0	67 cm	Z = 0	43 cm	Z = 0	14	9	8	11	13	COMPETENT
015	8.2 kg	Z = 0	69 cm	Z = 0	46 cm	Z = 0	11	8	11	10	13	COMPETENT
016	7.45 kg	Z = 0	70 cm	Z = 0	45 cm	Z = 0	15	8	8	12	11	COMPETENT
017	7.8 kg	Z = 0	72 cm	Z = 0	47 cm	Z = 0	12	10	12	13	12	COMPETENT
018	7kg	Z = 0	70 cm	Z = 0	45 cm	Z = 0	15	10	8	12	12	COMPETENT
019	7.6 kg	Z = 0	69 cm	Z = 0	44.5 cm	Z = 0	13	11	9	12	12	COMPETENT
020	9 kg	Z = 0	72 cm	Z = 0	46 cm	Z = 0	13	10	12	11	13	COMPETENT
021	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
022	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
023	7.8 kg	Z = 0	69 cm	Z = 0	45 cm	Z = 0	12	10	11	10	11	COMPETENT
024	8.1 kg	Z = 0	70 cm	Z = 0	47 cm	Z = 0	13	11	12	10	12	COMPETENT
025	8.2 kg	Z = 0	65 cm	Z = 0	45 cm	Z = 0	14	9	12	9	12	COMPETENT
026	8.2 kg	Z = 0	68 cm	Z = 0	43 cm	Z = 0	11	10	11	9	11	COMPETENT
027	8 kg	Z = 0	70 cm	Z = 0	46 cm	Z = 0	15	11	13	13	13	COMPETENT
028	8.6 kg	Z = 0	69 cm	Z = 0	46 cm	Z = 0	14	12	12	13	12	COMPETENT

Continues

CODE	WEIGHT	Z SCORE	LENGTH	Z SCORE	HEAD CIRCUMFERENCE	Z SCORE	BSID SCORE					REMARKS
							Cognitive	Receptive Communication	Expressive Communication	Fine Motor	Gross Motor	
029	8.6 kg	Z = 0	70 cm	Z = 0	46.5 cm	Z = 0	13	11	12	12	11	COMPETENT
030	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
031	8.4 kg	Z = 0	70 cm	Z = 0	44 cm	Z = 0	13	8	6	8	10	EMERGING RISK
032	8.4 kg	Z = 0	71 cm	Z = 0	45 cm	Z = 0	14	13	13	12	12	COMPETENT
033	8.3 kg	Z = 0	65 cm	Z = 0	44.5 cm	Z = 0	7	8	7	7	9	EMERGING RISK
034	8.3 kg	Z = 0	68 cm	Z = 0	45 cm	Z = 0	12	12	11	10	12	COMPETENT

IV. GROWTH AND NEURODEVELOPMENT SCORES AT 12TH MONTH CORRECTED AGE

CODE	WEIGHT	Z SCORE	LENGTH	Z SCORE	HEAD CIRCUMFERENCE	Z SCORE	BSID SCORE					REMARKS
							Cognitive	Receptive Communication	Expressive Communication	Fine Motor	Gross Motor	
001	7.8 kg	Z = 0	75.5 cm	Z = 0	47 cm	Z = 0	14	11	9	11	14	COMPETENT
002	8.1 kg	Z = 0	75 cm	Z = 0	45.5 cm	Z = 0	16	12	11	14	16	COMPETENT
003	7.9 kg	Z = 0	72 cm	Z = 0	45 cm	Z = 0	17	13	13	14	16	COMPETENT
004	9.6 kg	Z = 0	74 cm	Z = 0	47 cm	Z = 0	17	12	12	13	14	COMPETENT
005	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
006	8.3 kg	Z = 0	73 cm	Z = 0	46 cm	Z = 0	17	13	14	14	15	COMPETENT
007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
008	8.8 kg	Z = 0	73 cm	Z = 0	46 cm	Z = 0	16	12	12	14	15	COMPETENT
009	9 kg	Z = 0	74 cm	Z = 0	46 cm	Z = 0	16	11	13	14	17	COMPETENT
010	9.4 kg	Z = 0	75 cm	Z = 0	45 cm	Z = 0	15	12	14	15	18	COMPETENT
011	8.6 kg	Z = 0	74 cm	Z = 0	44 cm	Z = 0	15	11	12	14	14	COMPETENT
012	8.2 kg	Z = 0	72.5 cm	Z = 0	48 cm	Z = 0	19	13	14	17	15	COMPETENT
013	9.2 kg	Z = 0	75cm	Z = 0	47.8 cm	Z = 0	18	14	15	17	17	COMPETENT
014	9.5 kg	Z = 0	72 cm	Z = 0	45 cm	Z = 0	17	12	14	14	18	COMPETENT
015	9 kg	Z = 0	73.5 cm	Z = 0	48 cm	Z = 0	18	13	15	16	18	COMPETENT
016	9.58 kg	Z = 0	73 cm	Z = 0	47cm	Z = 0	18	14	14	13	16	COMPETENT
017	9kg	Z = 0	75 cm	Z = 0	48 cm	Z = 0	15	12	13	14	16	COMPETENT
018	8.8 kg	Z = 0	74 cm	Z = 0	47 cm	Z = 0	17	12	13	12	15	COMPETENT
019	8.6 kg	Z = 0	73 cm	Z = 0	46 cm	Z = 0	17	14	14	16	16	COMPETENT
020	11 kg	Z = 0	74.5 cm	Z = 0	46.8 cm	Z = 0	17	10	9	11	13	COMPETENT
021	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
022	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
023	9 kg	Z = 0	73.5 cm	Z = 0	48 cm	Z = 0	16	14	15	14	15	COMPETENT
024	9.4 kg	Z = 0	74 cm	Z = 0	48 cm	Z = 0	15	12	12	16	16	COMPETENT
025	9.3 kg	Z = 0	69 cm	Z = 0	47 cm	Z = 0	14	11	11	11	13	COMPETENT
026	9.5 kg	Z = 0	73 cm	Z = 0	47 cm	Z = 0	18	13	12	14	15	COMPETENT
027	8 kg	Z = 0	74 cm	Z = 0	48 cm	Z = 0	17	11	13	13	14	COMPETENT
028	10 kg	Z = 0	74 cm	Z = 0	47 cm	Z = 0	17	15	15	14	16	COMPETENT

Continues

CODE	WEIGHT	Z SCORE	LENGTH	Z SCORE	HEAD CIRCUMFERENCE	Z SCORE	BSID SCORE					REMARKS
							Cognitive	Receptive Communication	Expressive Communication	Fine Motor	Gross Motor	
029	9.6 kg	Z = 0	73 cm	Z = 0	46 cm	Z = 0	16	15	14	15	15	COMPETENT
030	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
031	9.8 kg	Z = 0	75 cm	Z = 0	46 cm	Z = 0	15	11	11	12	13	COMPETENT
032	10.8 kg	Z = 0	74 cm	Z = 0	47 cm	Z = 0	17	14	14	13	14	COMPETENT
033	8.8 kg	Z = 0	70 cm	Z = 0	47 cm	Z = 0	11	11	12	10	12	EMERGING RISK
034	8.3 kg	Z = 0	75 cm	Z = 0	47 cm	Z = 0	14	13	12	13	13	COMPETENT

BSID SCORES: ACCORDING TO SCALE 3 MONTHS AND 16 DAYS TO 6 MONTHS AND 15 DAYS

	TOTAL RAW SCORES		
SUBTEST	AT RISK	EMERGING RISK	COMPETENT
Cognitive	0-3	4-6	7-33
Receptive Communication	0-3	4-5	6-24
Expressive Communication	0-2	3-4	5-24
Fine Motor	0-3	4-6	7-27
Gross Motor	0-4	5-6	7-28

BSID SCORES: ACCORDING TO SCALE 6 MONTHS AND 16 DAYS TO 9 MONTHS AND 15 DAYS

	TOTAL RAW SCORES		
SUBTEST	AT RISK	EMERGING RISK	COMPETENT
Cognitive	0-6	7-9	10-33
Receptive Communication	0-5	6-7	8-24
Expressive Communication	0-3	4-5	6-24
Fine Motor	0-6	7-8	9-27
Gross Motor	0-7	8-10	11-28

BSID SCORES: ACCORDING TO SCALE 9 MONTHS AND 16 DAYS TO 12 MONTHS AND 15 DAYS

	TOTAL RAW SCORES		
SUBTEST	AT RISK	EMERGING RISK	COMPETENT
Cognitive	0-9	10-13	14-33
Receptive Communication	0-6	7-9	10-24
Expressive Communication	0-4	5-8	9-24
Fine Motor	0-8	9-10	11-27
Gross Motor	0-10	11-12	13-28