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Using the Infant Neurological International Battery (INFANIB) Score to Identify Clinical and Anthropometric Factors Associated with Early Neuromotor Developmental Outcomes in Premature Infants

Eposse Ekoube Charlotte[1,2], Puepi Djike Yolande[3], Mbono Ritha Betoko[1,2], Mandeng Ma Linwa Edgar[3], Noukeu Njinkui Diomède[4], Enyama Dominique[4], Moudze Béatrice[2], Sajida Misse Dicka[2], Épée Patricia[1], Alima Yanda Anastasie Nicole[5], Hassanatou Iyawa[1], Ngo Linwa Esther[6], Calixte Ida Penda[1], Kedy Mangamba Koum Daniele-Christiane[1]

1.Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon
2. Paediatric unit, Douala Laquintinie Hospital, Douala, Cameroon
3. Faculty of Health Sciences, University of Buea, Buea, Cameroon
4. Faculty of Medicine and Pharmaceutical Sciences, University of Dschang, Dschang, Cameroon
5. Centre Mère Enfant Fondation Chantal BIYA, Yaoundé, Cameroun
6. Faculty of Health Sciences, University of Bamenda, Bamenda, Cameroon

Auteur correspondant
Eposse Ekoube Charlotte
Paediatric unit, Douala Laquintinie Hospital, Douala, Cameroon
Email : eposseek@gmail.com
Douala, Cameroun
Tel: +237 699895177

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Mots Clés. INFANIB, Neuromoteur, Anthropométrique, Devenir, Prématuré.

RÉSUMÉ

Introduction. Prematurity increases the likelihood of developmental delay, which refers to a condition where a child fails to meet developmental milestones at the expected age. Through this study, we set out to identify clinical and anthropometric measures that are associated with early neuromotor developmental outcomes in premature infants using the Infant Neurological International Battery (INFANIB) score. **Methodology.** This was a retrospective cohort study carried out at Douala Laquintinie Hospital (DLH) over a period of 3 years from January 2020 to December 2022. Developmental delay was defined as a transient or abnormal INFANIB score at 6 months of corrected age. **Results.** A total of 78 infants were retained for the study. Most infants were females (n=40, 51.28%) and were born through vaginal delivery (n=51, 65.38%). Median gestational age at birth was 32 weeks (Q1-Q3: 27-36). At birth, median weight and head circumference were 1810g (Q1-Q3: 1000-2400) and 30 cm (Q1-Q3: 28-31), respectively. Thirteen patients had icterus on admission (16.7%). INFANIB score at 6 months was abnormal in 42.3% (n=33) of patients. The head circumference at birth [aOR: 1.45 (0.9-2.33), p=0.046, b= -0.54] and the presence of icterus at birth [aOR: 31.41 (2.23-442.34), p=0.001, b= 1.35] were the two factors significantly associated with neuromotor developmental delay. **Conclusion.** Developmental delay was present in 42.3% of patients at 6 months. Head circumference at birth and icterus on admission were associated with developmental delay at 6 months. More robust and multicentric studies are needed to confirm these findings.

ABSTRACT

Introduction. La prématurité augmente la probabilité d'un retard de développement, c'est-à-dire le fait qu'un enfant n'atteigne pas les étapes de son développement à l'âge prévu. Cette étude a pour but d'identifier les mesures cliniques et anthropométriques qui sont associées aux résultats du développement neuromoteur précoce chez les enfants prématurés en utilisant le score Infant Neurological International Battery (INFANIB). **Méthodologie**. Il s'agit d'une étude de cohorte rétrospective menée à l'hôpital Laquintinie de Douala (DLH) sur une période de 3 ans allant de janvier 2020 à décembre 2022. Le retard de développement a été défini comme un score INFANIB transitoire ou anormal à 6 mois d'âge corrigé. **Résultats**. Au total, 78 nourrissons ont été retenus pour l'étude. La plupart des nourrissons étaient de sexe féminin (n=40, 51,28%) et étaient nés par voie basse (n=51, 65,38%). L'âge gestationnel médian à la naissance était de 32 semaines (Q1-Q3 : 27-36). À la naissance, le poids médian et le périmètre crânien étaient respectivement de 1810 g (Q1-Q3 : 1000-2400) et de 30 cm (Q1-Q3 : 28-31). Treize patients présentaient un ictère à l'admission (16,7 %). Le score INFANIB à 6 mois était anormal chez 42,3 % (n=33) des patients. Le périmètre crânien à la naissance [aOR : 1.45 (0.9-2.33), p=0.046, b= -0.54] et la présence d'un ictère à la naissance [aOR : 31.41 (2.23-442.34), p=0.001, b= 1.35] étaient les deux facteurs significativement associés au retard de développement neuromoteur. **Conclusion**. Un retard de développement était présent chez 42,3 % des patients à 6 mois. Le périmètre crânien à la naissance et l'ictère à l'admission étaient associés à un retard de développement à 6 mois. Des études plus solides et multicentriques sont nécessaires pour confirmer ces résultats.

HIGHLIGHTS

What is already known on this topic

Though black African children are less likely to have neurodevelopmental delays compared to Caucasians, the prompt evaluation of neuromotor development in premature infants is primordial to identify neurological abnormalities such as cerebral palsy.

What question this study addressed

Clinical and anthropometric measures associated with early neuromotor developmental outcomes in premature infants using the Infant Neurological International Battery (INFANIB) score.

What this study adds to our knowledge

1. Developmental delay was present in 42.3% of patients at 6 months.
2. Head circumference at birth and the presence of icterus at birth were the only two factors significantly associated with developmental delay

How this is relevant to practice, policy or further research.

Researchers should conduct further studies to determine the burden of hyperbilirubinemia and determine context-specific thresholds associated with developmental delay.

INTRODUCTION

Low-birth weight (LBW) is a frequent complication of pregnancy, affecting one out of every five babies born in Cameroon [1]. A birth weight of 2600 g or less has previously been described as the cut-off value for LBW in Cameroon [1]. LBW is more common with preterm delivery and it increases the risk of developing neonatal asphyxia, foetal distress, respiratory distress, and neonatal death [1,2]. Because birth weight is a vital indicator of a foetus's health state, it has a significant influence on physical and neurological development within the first three years [3,4]. LBW and prematurity increases the likelihood of being diagnosed with neurodevelopmental delay in gross motor, fine motor, and adaptability in infants aged 1-6 months [3]. Developmental delay is a condition in which children fail to meet developmental milestones at the expected or adjusted age and may be due to many causes, among which premature birth, brain trauma, and encephalitis; severe medical problems after birth; inborn metabolic errors; genetic or chromosomal abnormalities; insufficient stimulation; malnutrition; iron deficiency anaemia; chronic illness; adverse environmental, familial, and psychological states [5]. Due to the limited availability of experts in child health, early identification of neurodevelopmental delays constitutes a significant management gap in the care of premature infants [6]. Although black African children are less likely to have neurodevelopmental delays compared to Caucasians [7,8], the prompt evaluation of neuromotor development in premature infants is primordial to identify neurological abnormalities such as cerebral palsy [9] that may predict problems during the early school years and require both physical and occupational therapy [10]. This study therefore aimed at identifying clinical and anthropometric measures that are associated with early neuromotor developmental outcomes in premature infants using the Infant Neurological International Battery (INFANIB) score.

METHODOLOGY

Study Design and study setting

This was a retrospective cohort study carried out at Douala Laquintinie Hospital (DLH). DLH is a second category reference hospital located in Douala, the economical capital city of Cameroon and provides specialist pediatric care. The pediatric department is divided into 5 units: neonatal unit, emergency unit, general pediatrics unit, sickle cell unit, and the outpatient consultation unit. The department has 6 pediatricians and numerous nurses trained in the care of premature infants by the N.G.O "Fundación Canguro".

Study period

This database study included neonates hospitalised for prematurity at DLH over a period of 3 years from January 2020 to December 2022.

Population selection

We included all premature infants hospitalised at DLH and followed up at the centre from birth to 6 months of corrected age. Patients who died after birth or in the course of follow-up and patients lost to follow-up before 6 months were excluded from the analysis.

Outcome of interest

The main outcome of interest was developmental delay, which was defined as a transient or abnormal INFANIB score at 6 months of corrected age.

Sample size calculation

A Cameroonian study conducted in 2022 [11] had reported the prevalence of neurodevelopmental delay at 6 months to be 7%. A minimum sample size of 101 infants was necessary [12] to discuss the prevalence in this study. As this was not attained, the prevalence of neurodevelopmental delay obtained in the current study has limited statistical power. Nonetheless, the above study did not address factors associated with developmental delay and as such was not adequate for use as reference. A study carried out in Iran [13] identified birth weight as a significant factor associated with developmental delay, with 60% of children with birth weight <=1500g having developmental delay. In children with birth weight >1500g, developmental delay occurred in only 18.18% of the sample. Based on this information, for our study to have 80% power, significance of 5%, and 95% confidence interval, the minimum sample size was calculated using Openepi software [12] and yielded 22 non-exposed participants and 22 exposed participants.

Data collection tools and procedures

We used a pretested survey sheet to collect data on demographics, birthweight, clinical and anthropometric characteristics, and INFANIB scores at 3 months, and 6 months of corrected gestational age. Birth weight was further categorised as <1500 grams, 1501-2000 grams and more than 2000 grams. Patients were part of the Kangaroo Mother Care Program and received daily evaluation by the Kangaroo team during hospitalisation. After discharge, carers of the infants received reminders through calls and

messages of their scheduled follow-up visits. Transport was covered for infants living very far from the centre. A psychologist's consultation was offered to every carer at discharge, at 3 month and at 6 months. This permitted carers to develop coping strategies when faced with difficulties in the care of the infants and permitted better adherence to treatment and follow-up visits.

Infant Neurological International Battery (INFANIB) Score

Several screening tools are available to detect neurodevelopment delays such as the American Speech-Language and Hearing Association, Guide for Monitoring Child Development, Infant Neurological International Battery (INFANIB), New Delhi-Development Screening Questionnaire and Woodside Screening Technique, all reported to have relatively high sensitivity (82.5%–100%) and specificity in low-and-middle income countries [5]. The INFANIB score, although rarely reported in African studies [14], has been used for neurological follow-up of high-risk infants[15] under the "Fundación Canguro" in Colombia and reported to have good discriminating abilities [16]. From 2000-2013, this non-governmental organisation (N.G.O) has supported the training of staff of the Douala Laquintinie Hospital (DLH) on Kangaroo Mother care and on the early identification of neurodevelopmental delays using the INFANIB score [17].

The Infant Neurological International Battery (INFANIB) is a developmental screening instrument designed to evaluate neuromotor development in infants aged one to eighteen months. Ellison and colleagues founded it in 1985 [15]. The original INFANIB battery had 20 items and five factors: Spasticity, Vestibular Function, Head and Trunk, French Angles and Legs. Many of the INFANIB test items were adapted from previous neuromotor tests, such as the Milani-Comparetti and Gidoni scales. It includes the evaluation of posture, extremities and axial tone, primitive reflexes, and postural response. It is simple, saves time, and is simple to learn. The cut points for INFANIB scores were established as described previously [15]. For infants < 4 months old, abnormal ≤48, Transient 49-65, and normal ≥66. For infants 4-8 months, the cut-off points were abnormal ≤56, transient =55-71, and normal ≥72. For infants >8 months old, the cut-off points were abnormal ≤68, transient =69-82, and normal ≥83. Because the first year of an infant's life is essential for brain development due to brain plasticity, the INFANIB score aids in the early detection and correction of neuromotor disorders. Normal INFANIB can be used to comfort parents of high-risk babies. It may be used to compare infant's neuromotor testing earlier with later factors (cerebral palsy, cognitive function, school performance). The INFANIB score has been described to have sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of 76.9%, 57.1%, 35.7%, 88.9% at 3 months and 84.6%, 57.1%, 37.9%, 92.3% at 6 months respectively [18]. INFANIB score is less reliable at birth. INFANIB score has been reported to have good reliability and validity especially at 6 months and above by some authors and has been recommended in low and middle income countries [5,18–20].

Statistical analysis

Data was entered using the SPSS version 20 software. Quantitative variables were presented as medians and interquartile ranges, while qualitative variables were presented as frequencies (counts) and percentages. Since the distribution of anthropometric measures (head circumference, height, and weight at birth, 40 weeks, 3 months, and 6 months) were non-normally distributed, the Mann-Whitney test was used to compare the mean ranks of these values between the two neurodevelopmental outcome measures (Abnormal INFANIB score Yes/No). Multivariable logistic regression analysis was then performed using clinically relevant variables like birth asphyxia, birthweight, etc. that were statistically significant on univariate analysis to identify independent factors associated with abnormal INFANIB score. Statistical significance was set at $p<0.05$.

Ethical considerations

Administrative clearance was obtained from the Directorate of the DLH. The authors decided not to request for ethical committee clearance for their study because all studied data were gathered as part of standard medical diagnosis and care, carried out under an approved programme (Kangaroo Mother care) and patients were diagnosed and treated in accordance with national protocols. The retrospective nature of the study did not require informed consent. Authors ensured there were no breaches of confidentiality.

Operational definitions

- Asphyxia was defined as infants with a 5-minute Apgar score less than 7
- Developmental delay: Patients with abnormal or transient INFANIB score at 6 months of corrected age.
- Abnormal INFANIB: Any infants with scores suggestive of abnormal or transient scores were all considered to have abnormal INFANIB scores.
- Low-birth weight: Considered as any premature infant born with a weight of <2600g
- Head circumference: This corresponds to the occipitofrontal circumference measured using a non-flexible tape, taken from the most prominent part of the forehead around the widest part of the head.
- Length/height: This was measured with the neonate or infant lying down from the top of the head to the soles of the feet.
- Weight: This was measured using a beam balance scale. A thin soft paper was placed on the scale and the unclothed neonate or infant was placed on the scale and allowed to stabilize before recording the displayed value to the nearest grams.

RESULTS

Sociodemographic and clinical characteristics of the study population

A total of 78 infants were retained for the study. Most infants were females (n=40, 51.28%) and were born

through vaginal delivery (n=51, 65.38%) as shown in Table I.

Table I Patient's clinical and sociodemographic characteristics

Patient's clinical and sociodemographic characteristics	No (%)
Year of consultation	
2019-2020	24 (30.7)
2021-2022	54 (69.1)
Young mothers (<21 years)	4 (5.1)
Birth Weight categories	
1000-1500 grams	21 (26.9)
1501-2000 grams	34 (43.6)
2000-2400 grams	2 3 (29.5)
Gestational age at birth categories (weeks)	
28-32 (very preterm)	42 (53.8)
32-34 (moderately preterm)	23 (29.5)
34-37 (late preterm)	13 (16.7)
Mode of delivery	
Caesarian section	27 (34.6)
Vaginal delivery	51 (65.4)
Type of pregnancy	
Monofetal pregnancy	58 (74.4)
Twin pregnancy	20 (25.6)
APGAR score	
0-3	3 (3.9)
4-6	5 (6.4)
≥7	70 (89.7)
Reason for admission	
Infection/sepsis	64 (82.1)
Prematurity	36 (27.3)
Respiratory distress/apnea on admission	9 (11.5)
Birth asphyxia	8 (10.3)

Monofetal pregnancies predominated (n=58, 74.4%) and the majority of infants were born between 28-34 weeks (n=62, 79.5%) gestational age. Median gestational age at birth was 32 weeks (Q1-Q3: 27-36). The median birthweight was 1810g (Q1-Q3: 1000-2400) with most patients (n=34, 43.6%) born with weights between 1501-2000g. A total of 8 patients (10.3%) were born with APGAR <7. Icterus (n=13, 16.7%) and respiratory distress (n=9, 11.5%) were present in few patients at birth. At discharge, most infants had a median weight of 1900g (Q1-Q3: 1050-2580). The median gestational age at discharge was 34 weeks (Q1-Q3: 29-51).

INFANIB score at 3 months and 6 months

INFANIB score at 3 months was abnormal in most patients (n=48, 61.5%). INFANIB score at 6 months was normal in 57.7% (n=45) and abnormal in 42.3% (n=33) of patients.

Anthropometric measurements from birth to 6 months

The median weight was 1810g (Q1-Q3: 1500-2067.5), 3037.5 g (Q1-Q3: 2665-3388.8), 5810 g (Q1-Q3: 5282.5-6471.3) and 6810 g (6407.5-7616.3) at birth, 40 weeks, 3 months and 6 months respectively. The median head circumference was 30 cm (Q1-Q3: 28-31), 35 cm (Q1-Q3: 34-36.4), 41 cm (Q1-Q3: 40-42) and 44 cm (Q1-Q3: 43-47.8) at birth, 40 weeks, 3 months and 6 months respectively. The median height (cm) was 41.5 cm (Q1-Q3: 38-44), 49 cm (Q1-Q3: 46-50), 60 cm (Q1-Q3: 56.3-61) and 65.5 cm (Q1-Q3: 62-67) at birth, 40 weeks, 3 months and 6 months respectively as shown in Figure 1.

Factors associated with Abnormal INFANIB score at 6 months.

On univariate analysis, male gender (p=0.026), icterus at admission (p=0.003), median head circumference at birth (*U*=586.5, p=0.049), height at birth (*U*=503, *p*=0.016), abnormal INFANIB score at 3 months (p<0.001), median weight at 6 months (*U*=472, *p*=0.006) and median head circumference at 6 months (*U*=338, *p*=<.001) were associated with abnormal INFANIB score at 6 months as seen in Table II. Birthweight (*U*=577.5, *p*=0.097), weight at discharge (*U*=628.5, *p*=0.252), gestational age at birth (*U*=659.5, *p*=0.405), gestational age at discharge (*U*=706, *p*=0.716), duration of hospitalisation (*U*=726, *p*=0.872), and height at 6 months (*U*=607.5, *p*=0.175) were not associated with abnormal INFANIB score at 6 months. However, on multivariable analysis, only the infant's head circumference at birth [aOR: 1.45 (0.9-2.33), p=0.046, b= **-0.54**] and the presence of icterus at birth [aOR: 31.41 (2.23-442.34), p=0.001, b= **1.35**] were significantly associated with INFANIB score at 6 months in our cohort as seen in Table III.

DISCUSSION

We aimed to identify clinical and anthropometric measures that are associated with early neuromotor developmental outcomes in premature infants using the Infant Neurological International Battery (INFANIB) score. To our knowledge, only few data have been published on neuromotor development in African preterm babies, using the INFANIB score.

In our study, the INFANIB score was abnormal in 61.5% of infants at 3 months and in 42.3% of them at 6 months, suggesting an improvement in the gross motor outcome at 6 months. The same trend was also reported by Chiabi in the North-West region of Cameroon, with lower abnormal scores (15.5% at 3 months and 7.0% at 6 months) [14]. This discrepancy can be explained by the fact that their sample was made of almost a quarter of full-term infants and only 19.7% very preterm, compared to our sample with 53.8% very preterm and no full-term infants. Many authors report that preterm infants have a higher risk of neurodevelopmental delay, especially early in their life, and that the smaller the gestational age, the higher the incidence of neurodevelopmental disability [21–26]. A different trend was described by Liao in China and Charpak in Columbia who reported higher proportions of abnormal scores, respectively, 50.9% and 62.1% at 3 months; 52.9% and 77.5% at 6 months [18,19]. This can be due to the fact that they reported more critical status at birth than us, needing more admission in neonatal intensive care units (NICU), such as neonatal asphyxia, respiratory distress, mechanical ventilation and neonatal resuscitation. It is effectively reported that perinatal factors may increase the risk of neurodevelopmental impairment [27]. There also exist racial and ethnic variations in motor development. Compared to other ethnicities, black infants have more rapid motor development during the first two years of life [7]. Cultural factors such as child handling practices can also explain why infants in Africa attain motor milestones faster than the documented norm in the western world [28].

The INFANIB score was assessed by both trained pediatricians and general practitioners in our study. At the start of the Kangaroo Mother Care programme at Laquintinie, some pediatricians were trained on the Kangaroo Care and the use of INFANIB scale by the Columbia Kangaroo Foundation and these pediatricians later trained the entire team. But over time, the system of rotation of general practitioners in the unit every three months could have reduced the inter-rater reliability which refers to the degree of agreement among independent observers who rate a phenomenon [29]. Further studies are necessary to validate the use of this score in Cameroon since the evaluation of the validity and reliability of this score was beyond the scope of the current study.

The factor greatly associated with developmental delay in our study was icterus on admission (b= 1.35). Bilirubin-induced neurological impairment, also known as kernicterus, occurs in the early days of life when the unconjugated bilirubin (indirect bilirubin) levels in the blood exceed 25 mg/dL and gets deposited in the basal ganglia as a result of any circumstance that causes less bilirubin to be eliminated and more to be produced [30]. Data on bilirubin levels in our sample patients would have comforted this hypothesis. Premature newborns with unconjugated hyperbilirubinemia/icterus at birth need to be managed rapidly through modalities such as phototherapy and exchange transfusion to reduce the occurrence of kernicterus and subsequent developmental delay or even death [31–33].

Head circumference at birth (b=-0.54) was associated with developmental delay in a negative manner. This means that the higher the head circumference value, the lower the odds of having a developmental delay. Small head circumference for gestational age, referred to as microcephaly, has been described previously as a significant factor associated with development delay [34,35]. A nationwide cohort study in Denmark [36] revealed that an increased risk of Attention Deficit Hyperactive Disorder (ADHD) was related with head circumference at the lower limit of normocephaly compared to a head circumference at the upper limit (HR 1.52, 95% CI 1.43, 1.63). Monitoring head circumference at birth may be beneficial in early identification of neurodevelopmental delays, but this requires validated and standardised growth curves. Growth curves commonly used internationally to evaluate growth in premature neonates include the Fenton and the Intergrowth-21 curves [37–39]. These tools are not validated in Cameroon and some authors have reported controversial results in Lebanon [40].

Our study was mono-centric and handled a very small cohort of patients because of the high volume of patients who died or were lost to follow-up, making the generalisation of this study results mitigated. Despite these limitations, we are one of the few studies in Africa that investigated on the potential associations between clinical and anthropometric measures and developmental delay using the INFANIB score. Despite the fact that we found preliminary results associating icterus at admission and head circumference at birth with developmental delay at 6 months, we recommend that researchers conduct further studies to determine the burden of hyperbilirubinemia and determine context-specific thresholds associated with developmental delay. Moreover, local growth curves need to be developed and standardised so that they can be used to establish cut-off values for microcephaly in our context. Lastly, a prospective cohort should be conducted from birth till at least 18 months corrected age to detailly investigate other reported factors such as sepsis, necrotizing enterocolitis, and neonatal asphyxia [41,42] and compare INFANIB scores with more standardised assessment tools like the Standardized Infant NeuroDevelopmental Assessment (SINDA), brain imaging or clinical evaluation by experienced neuro-pediatricians [43,44].

CONCLUSION

Developmental delay was present in 42.3% of patients at 6 months. Head circumference at birth and the presence of icterus at birth were the only two factors significantly associated with developmental delay.

Conflict of interest

The authors declare no conflict of interest in the current study.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, CEE.

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Authors contributions

EEC conceived and wrote the protocol for this study. EEC, PNY, and SMD did data collection. CIP and KMKDC supervised the study. MMLE did data analysis for this study. EEC and MMLE wrote the draft manuscript. EEC, PNY, MMLE, MRB, NND, ED, MB, SMD, EP, AYAN, HI, NLEE, CIP, KMKDC revised the manuscript for scientific input. All authors agreed to submit the current manuscript as the final version.

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Table II Univariate analysis comparing selected variables with INFANIB score at 6 months

	Normal INFANIB (n=45)	Abnormal INFANIB (n=33)	Overall	P-value
	N (%)			
Male Gender	17 (37.8)	21 (63.6)	38 (48.7)	**0.026**
Twin pregnancy	8 (17.8)	12 (36.4)	20 (25.6)	0.068
Birth asphyxia	2 (4.4)	6 (18.2)	8 (10.3)	0.067
Icterus at admission	1 (2.2)	12 (36.4)	13 (16.7)	**0.003**
Received oxygen	11 (24.4)	9 (27.3)	20 (25.6)	0.777
Abnormal INFANIB at 3 months	17 (37.8)	31 (93.9)	48 (61.5)	**<0.001**
	Median (Interquartile range: Q1-Q3)			
HC at birth (cm)	30 (28-34)	29 (20-33)	30 (20-34)	**0.049**
Height at birth (cm)	40 (32-48)	43 (32-48)	41.5 (32-48)	**0.016**
Birthweight (g)	1890 (1100-2380)	1770 (1000-2400)	1810 (1000-2400)	0.097
Weight at discharge	1915 (1130-2580)	1820 (1050-2400)	1900 (1050-2580)	0.252
Gestational age at birth (weeks)	32 (27-36)	32 (27-36)	32 (27-36)	0.405
Gestational age at discharge (weeks)	35 (30-51)	34 (29-42)	34 (29-51)	0.716
Duration of hospitalisation (days)	13 (2-132)	12 (2-83)	13 (2-132)	0.872
Median INFANIB score at 3 months	66 (48-80)	1 (0-68)	62 (0-80)	**<0.001**
Median Weight (g) at 6 months	7225 (5575-9980)	6600 (5100-8975)	6810 (5100-9980)	**0.006**
Median head circumference (cm) at 6 months	44 (41-46)	66.6 (10.7-89.4)	44 (10.7-89.4)	**<0.001**
Median height (cm) at 6 months	66 (58-71)	65 (50-85)	65.5 (50-85)	0.175

Bold values represent statistical significance p<0.05 to be included in the multivariable analysis model.

Table III Multivariable logistic regression analysis comparing selected variables with INFANIB score at 6 months

Risk variables	Normal INFANIB (n=45)	Abnormal INFANIB (n=33)	OR (95% CI)	OR p-value	aOR	aOR p-value	b
Male Gender	17 (37.8)	21 (63.6)	2.88 (1.14-7.31)	**0.026**	2.44 (0.4-14.69)	0.331	0.92
Icterus at admission	1 (2.2)	12 (36.4)	25.14 (3.06-206.4)	**0.003**	31.41 (2.23-442.34)	**0.011**	**1.35**
HC at birth (cm)	30 (28-34)	29 (20-33)	0.8 (0.65-1)	**0.049**	1.45(0.9-2.33)	**0.046**	**-0.54**
Height at birth (cm)	40 (32-48)	43 (32-48)	1.16 (1.02-1.31)	**0.016**	1.45 (0.9-2.33)	0.132	0.24
Abnormal INFANIB at 3 months	17 (37.8)	31 (93.9)	25.53 (5.41-120.49)	**<0.001**	9.11 (0.93-88.94)	0.057	1.16
Weight (g) at 6 months	7225 (5575-9980)	6600 (5100-8975)	1 (1-1)	**0.006**	1 (1-1)	0.150	0
Head circumference (cm) at 6 months	44 (41-46)	66.6 (10.7-89.4)	1.13 (1.05-1.21)	**<0.001**	1.13 (1-1.29)	0.058	0

p-value < 0.05 was considered significant. OR= Odds Ratio. CI=Confidence Interval. aOR= adjusted Odds Ratio. b= standardised coefficient

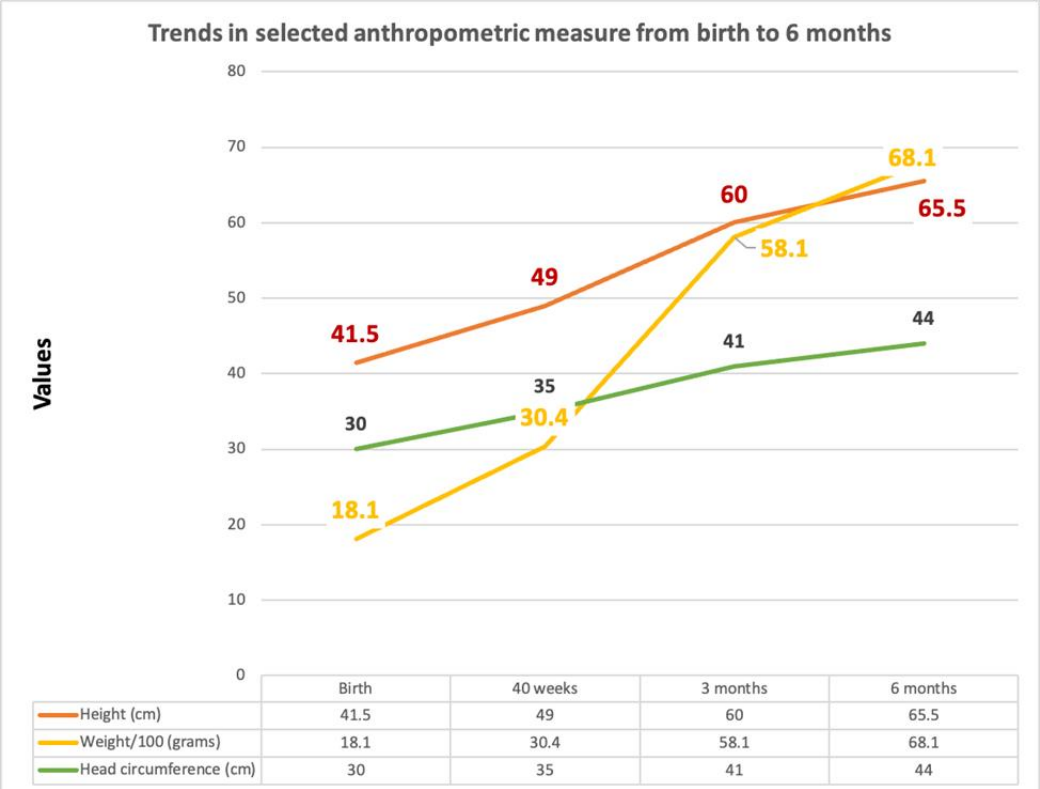

Figure 1 Trends in selected anthropometric measure from birth to 6 months