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Original Article

Comparison of Fenton Vs Intergrowth-21st Charts in Assessing Postnatal Growth In Preterm Babies in a Rural Tertiary Care Hospital

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ABSTRACT

Background: Preterm birth is a major contributor to neonatal morbidity and mortality, especially in rural India where resources are limited. Growth monitoring is essential for timely interventions. The Fenton 2013 growth charts and INTERGROWTH-21st standards differ in methodology and classification, potentially influencing management decisions.
This study aimed to compare both the charts in post-natal assessment of preterm babies.
Methods: A prospective cohort study was conducted from 2022–2024 at a rural tertiary hospital, including 200 preterm infants (28–36 weeks gestation). Anthropometric parameters (weight, length, head circumference) were recorded from birth to 6 months corrected age and converted to Z-scores using both charts. Extrauterine growth restriction (EUGR) was defined as <10th percentile. Concordance was assessed using Kappa statistics.
Results: Most infants (55%) weighed 1.5–2.5 kg at birth; 85% were moderate to late preterm. Fenton charts consistently classified more infants as EUGR compared to INTERGROWTH-21st, particularly in weight. Concordance between charts ranged from moderate to substantial (Kappa 0.45–0.72). Significant discrepancies were observed primarily below the 10th percentile.
Conclusion: Growth chart choice substantially impacts preterm growth classification. Fenton charts may overestimate EUGR, risking overtreatment; INTERGROWTH-21st offers a more conservative approach. In resource limited settings, a balanced application of both charts may optimize clinical care and resource allocation.

Keywords: *Preterm infants; Postnatal growth; Fenton growth chart; INTERGROWTH-21st standards; Extrauterine growth restriction; Rural healthcare.*

INTRODUCTION

Preterm birth (<37 weeks gestation) is a leading global cause of neonatal mortality and long-term morbidity, with India accounting for over one-fifth of cases worldwide. Growth monitoring in preterm infants is essential to guide nutritional and clinical interventions.

There are two main growth charts used for preterm babies: the Fenton charts and the INTERGROWTH-21st standards [1]. The Fenton charts were first made in 2003 and updated in 2013. They cover babies from 22 weeks of pregnancy to 50 weeks postmenstrual age. These charts were based on data from several large studies mostly done in rich countries [2]. They include weight, length, and head size and are designed to match WHO's standards after 50 weeks [3]. The Fenton charts are widely used in newborn intensive care units and have been the main tool for many years [4]. However, these charts are descriptive in nature ,ie, they show how babies grew in real life. The INTERGROWTH-21st standards were published in 2016 and offer a newer method for tracking growth in preterm babies. These standards were part of a large international project to make global growth standards like the WHO ones. Unlike the Fenton charts, the INTERGROWTH-

21st standards followed healthy preterm babies from healthy mothers in different countries using a planned, long-term study approach [15]. They show how babies should grow in the best possible/ideal conditions, ie ,they were prescriptive in nature. [6].

The INTERGROWTH-21st charts are for babies born between 26 and 36 weeks and can be used until 64 weeks postmenstrual age. They fit smoothly with the WHO charts, so doctors can track growth from birth through childhood without switching tools. Choosing between these two charts matters because they might show different results for the same baby. For example, the INTERGROWTH-21st standards usually label fewer babies as having growth problems compared to the Fenton charts.

These differences affect medical decisions, like feeding plans, when to discharge the baby, and follow-up care. In rural Indian hospitals where resources are limited, picking the right chart is even more important.

The choice between INTERGROWTH-21st and Fenton growth charts in NICU settings reflects important differences in methodology, purpose, and clinical philosophy. Fenton charts, based on retrospective birth weight data, serve as population references that include both healthy and compromised infants, thus reflecting typical—but not necessarily optimal—growth patterns. In contrast, the INTERGROWTH-21st charts are international growth standards derived from healthy, low-risk pregnancies, illustrating how infants should grow under ideal conditions. This makes INTERGROWTH-21st particularly valuable for promoting standardized, evidence-based care that aspires to optimal health outcomes, especially in diverse or global populations. While Fenton charts remain relevant for assessing extremely preterm infants and in contexts where local population data differ, the INTERGROWTH-21st standards better support the goal of achieving equitable and optimal growth in neonatal care.

METHODOLOGY

A prospective cohort study was conducted at MVJ Medical College & Research Hospital, Hoskote, from January 2022 to December 2024 after Institutional Ethics Committee approval. Written informed consent was obtained from parents.

Inclusion criteria: All Inborn and Out born preterm between 28 weeks to 36 weeks will be included in this study.

Exclusion criteria: Infants with severe morbidity in neonatal period like Broncho pulmonary dysplasia, major congenital heart disease, chromosomal anomalies, suffering from recurrent illness in early infancy, Preterm in whom follow up visits is less than 80 % of desired follow up.

Methods of collection of data: Weight, length and head circumference were calculated at birth and at each follow up and expressed as Z-score for the 2 references.

Weight was measured using a digital baby scale while length was measured using an infantometer, while Head circumference was obtained with a measuring tape. The same measurement method was followed for all children.

EUGR is defined as weight at discharge below the 10th centile using Fenton & IG-21
Statistical analysis was performed using SPSS v20. Continuous variables were expressed as mean ± SD; categorical variables as frequencies (%). Agreement between charts was assessed using Kappa statistics; $p<0.05$ was considered significant.

RESULTS

A total of 200 preterm infants were enrolled; baseline characteristics are shown in Table 1. Over half (55%) weighed between 1.5–2.5 kg at birth, and 85% were moderate to late preterm (32–36 weeks).

When classified for EUGR (<10th percentile), Fenton charts identified significantly more infants as growth-restricted than INTERGROWTH-21st charts across all parameters ($p<0.05$). Agreement between the two charts was moderate to substantial (Kappa 0.45–0.72). Significant differences occurred primarily for infants below the 10th percentile.

Weight Growth Over Time

Weight Percentile	Fenton	Intergrowth	p value
Week 1	39 ± 29	54 ± 31	<0.001
Week 2	32 ± 26	52 ± 27	<0.001
Week 3	34 ± 26	42 ± 30	0.003
Month 1	37 ± 28	46 ± 30	0.004
Week 6	32 ± 32	41 ± 29	0.008
Month 2	36 ± 35	38 ± 33	0.554
Month 3	45 ± 35	54 ± 34	0.01
Month 4	53 ± 36	55 ± 36	0.525
Month 5	49 ± 33	56 ± 36	0.06
Month 6	61 ± 32	56 ± 32	0.08

Table 5: Difference in weight percentile between two growth charts

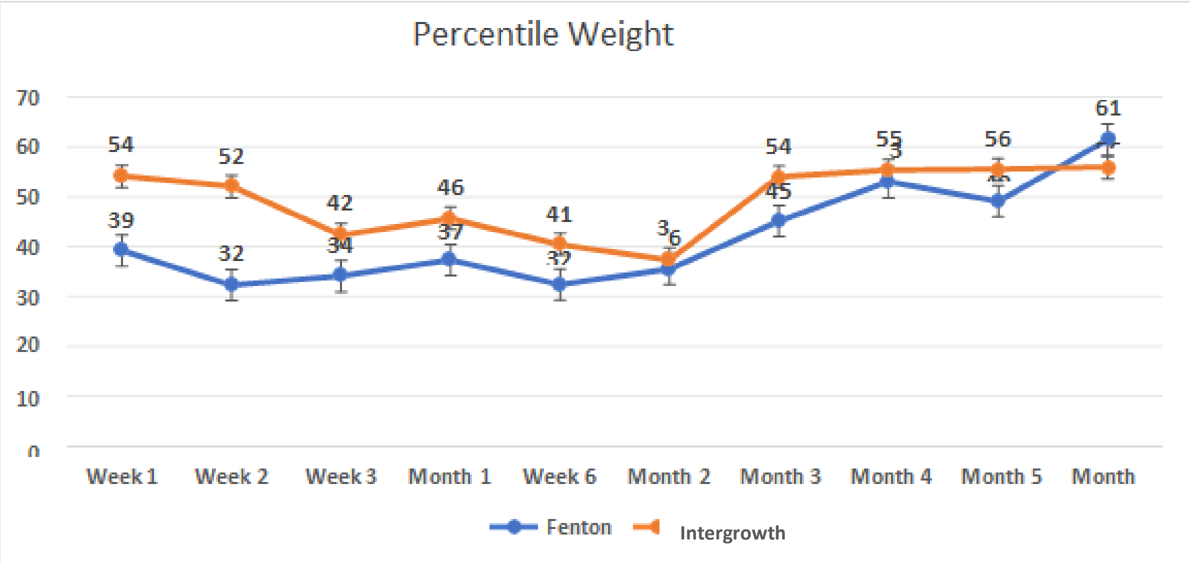


Fig: - 11: Serial Weight percentile distribution among the study participants

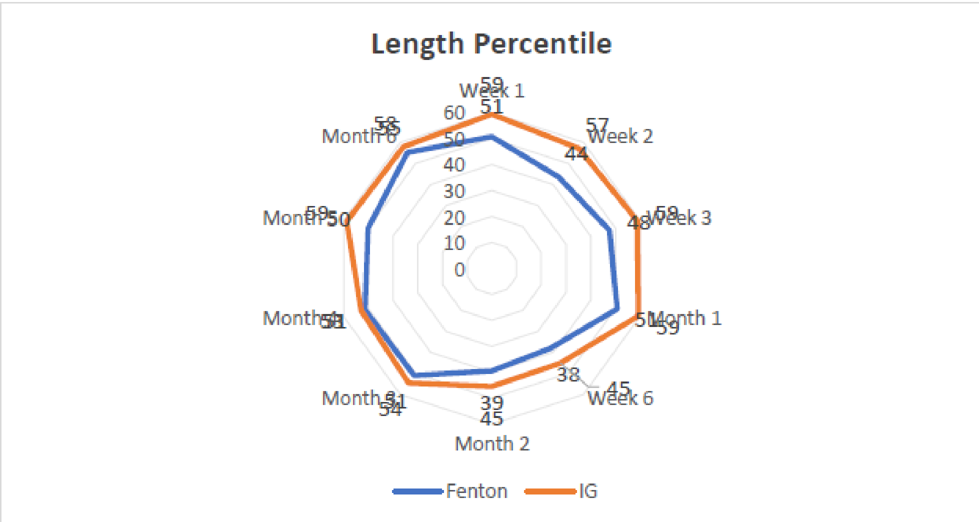
In conclusion, the data indicates that Fenton growth chart infants tend to have lower weight percentiles in the first few months of life compared to those measured with the Intergrowth 21

standard, but by 6 months, the difference diminishes, and the Fenton group even surpasses the Intergrowth group in weight percentiles, though not statistically significant.

Length Growth Over Time

Length Percentile	Fenton	Intergrowth	p value
Week 1	51 ± 31	59 ± 34	0.008
Week 2	44 ± 31	57 ± 31	<0.001
Week 3	48 ± 32	59 ± 33	<0.001
Month 1	51 ± 31	59 ± 34	0.008
Week 6	38 ± 28	45 ± 30	0.01
Month 2	40 ± 29	45 ± 32	0.05
Month 3	51 ± 34	54 ± 36	0.314
Month 4	51 ± 33	53 ± 35	0.672
Month 5	50 ± 30	59 ± 33	0.006
Month 6	55 ± 30	58 ± 31	0.38

Table 8: Difference in Length percentile between two growth charts

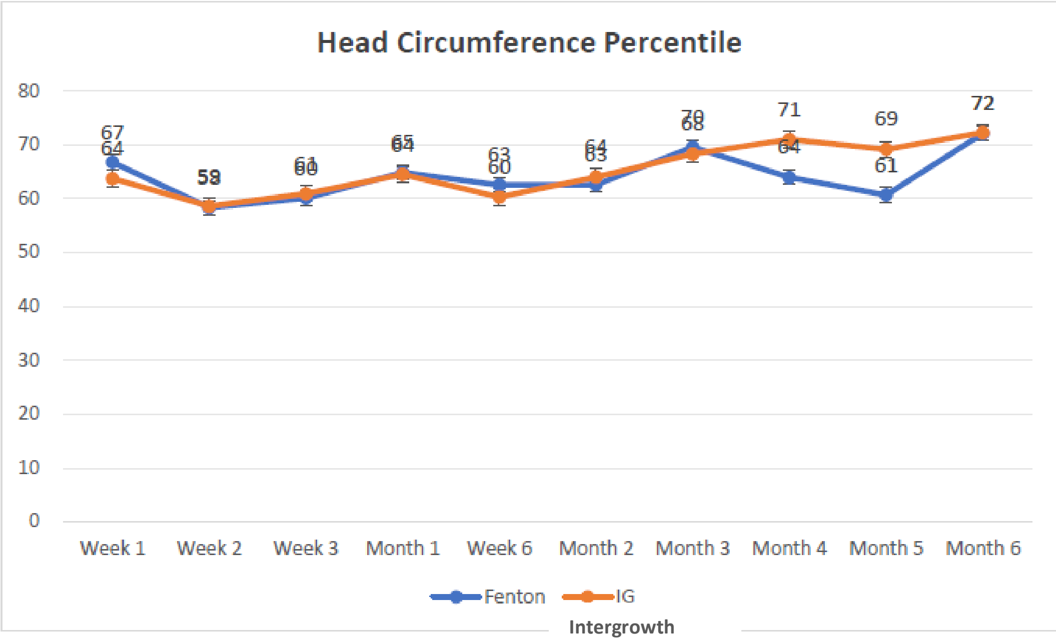


Intergrowth

Fig:- 13: Serial length percentile distribution among the study participants

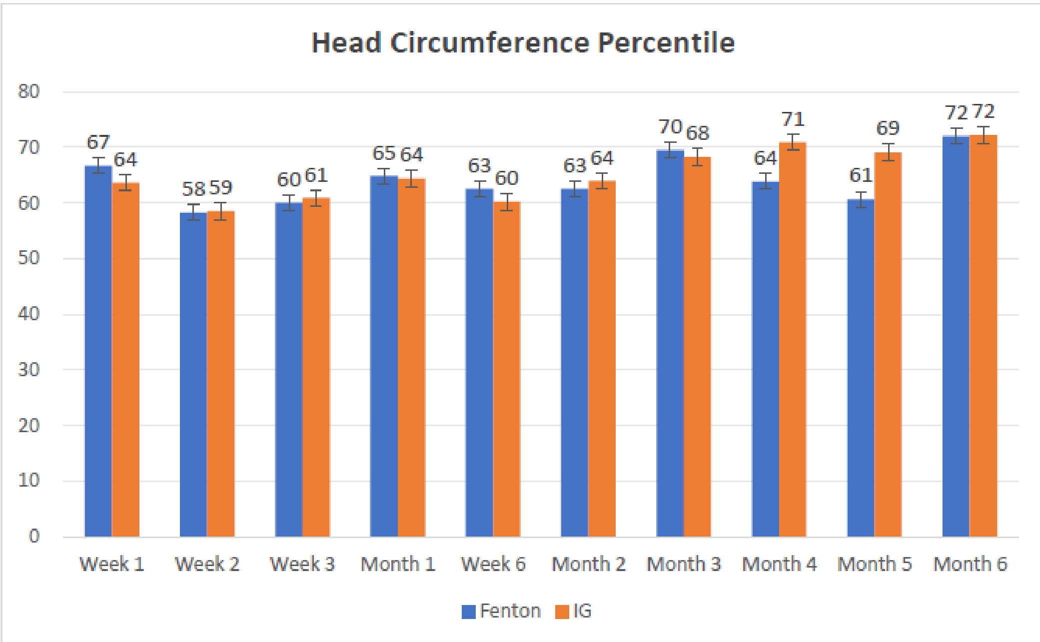
In conclusion, the data indicates that the Fenton group consistently shows lower length percentiles compared to the Intergrowth group during the first few months. However, as the infants grow older, the gap narrows, and by 6 months, the difference becomes less pronounced, with no significant difference between the groups at this stage.

HEAD CIRCUMFERENCE GROWTH OVER TIME



Intergrowth

Fig:- 15: Serial Head circumference among the study participants



Intergrowth

Fig:- 16: Head circumference distribution among the study participants

The head circumference percentiles for the Fenton group are generally higher than the IG group at Week 1 but are not significantly different (p-value = 0.254). However, significant differences are observed in Month 4 (p-value = 0.046) and Month 5 (p-value = 0.011), with the IG group showing higher percentiles. By Month 6, the percentiles for both groups are nearly identical (p-value = 0.96), indicating no significant difference at this stage.

DISCUSSION

Our study was aimed to assess the growth patterns in a 200 preterm and low birth weight infant's cohort during the first six months of life, using the Fenton 2013 and INTERGROWTH- 21 (IG) standards. This was done by systematically comparing weight, length, and head circumference percentiles at sequential time points. We have also evaluated the consistency and variability between the two growth charts. As there is a high prevalence of growth restriction among preterm neonates, this comparison provides valuable insights into the clinical utility of each chart in accurately monitoring growth and help us in guiding early intervention strategies. In our study majority of the neonates were moderate to late preterm (170 infants, 85%), while very preterm infants (<32 weeks) were comprised of 15% (30 infants). Similar observations were made by Mathew et al. studied VLBW and preterm neonates and found predominant representation of moderate-late preterm births in their study population. Tuzun et al. [7] focused on neonates <32-weeks and also reported that many growth classification systems do not adequately differentiate between very and moderate-late preterm neonates. Out of the 200 neonates, 58.5% were male (n = 117) and 41.5% were female (n = 83), resulting in a male-to-female ratio of approximately 1.4:1. Kim et al. [8] in their observation they have also reported male predominance in their cohort of extremely preterm infants, and they highlighted male gender as an independent predictor of extrauterine growth restriction when using INTERGROWTH-21st standards (adjusted OR 1.77). Chan et al. [9] in their article observed there is gender-related classification discrepancies between Fenton and IG charts, with Fenton underestimating LGA prevalence among female neonates. The study population reported a high incidence of low birth weight, with 55% of neonates weighing between 1.5–2.5 kg followed by 19% between 1.0–1.5 kg, 16% were 69 extremely low birth weight, and only 10% of them were >2.5 kg. This distribution shows us the weight profile of preterm neonates in Indian NICUs and highlights the public health challenge of intrauterine growth restriction and preterm birth in India. Similar findings were made by studies such as Reddy et al. [9] and Deepthi et al. in which they have reported a similar high prevalence of infants <2.5 kg. Moreover, Singamala et al. [10] reported that birth weight classification varied significantly depending on the chart used, with Fenton overestimating SGA infants compared to IG and regional South Indian growth standards.

In our study, both Fenton and IG growth charts revealed that there is a consistent increase in infant weight from Week 1 (1.64 ± 0.54 kg) to Month 6 (5.89 ± 1.41 kg) which indicated a healthy postnatal growth. Yet significant differences were observed in percentiles, especially in the early weeks. At Week 1, the Fenton chart showed a mean weight percentile of 39 ± 29, significantly lower than the IG chart (54 ± 31; $p < 0.001$). This difference remained statistically significant till Month 1 and reappeared again at Month 3 ($p = 0.01$), aligning with findings from Tuzun et al. [11] observed a higher EUGR rate using Fenton charts compared to INTERGROWTH-21st (40.2% vs. 31.5%) and greater early underestimation of weight percentiles using Fenton standards. Kim et al. demonstrated that EUGR prevalence based on weight was significantly higher using Fenton charts (73.8%) than INTERGROWTH (55.7%), suggesting a possible overestimation of growth failure using Fenton. Patel et al. (2021) further reported higher rates of IUGR and EUGR using Fenton (42.9% and 92.9%) than IG-21 (36.9% and 73%). By Month 6, the difference in weight percentiles between the charts reduced and became statistically nonsignificant (Fenton: 61 ± 32 vs. IG: 56 ± 32, $p = 0.08$), supporting observations by Deepthi et al. noted that there is better convergence of growth patterns in later infancy.

Length increased steadily from 41.32 ± 4.66 cm at Week 1 to 58.55 ± 4.43 cm at Month 6. Length percentiles, however, varied significantly between Fenton and IG charts in the first few months. At Week 2, the Fenton percentile was 44 ± 31, while IG showed 57 ± 31 ($p < 0.001$). These differences persisted significantly through Week 3 and Month 1. Such discrepancies are consistent with observations made by Samarani et al. and reported that the INTERGROWTH-21st chart better predicted length at 2 weeks of life ($R^2 = 0.650$ vs. 0.585 for Fenton). By Month 3 to Month 6, differences in length percentiles were less pronounced and mostly nonsignificant ($p = 0.314$ at Month 3, $p = 0.38$ at Month 6). Similar findings were reported by Lan et al. that both charts showed comparable predictive ability for long-term height outcomes at 3–5 years of age. At Month 5, there was a re-emergence of significant difference (Fenton: 50 ± 30 vs. IG: 59 ± 33, $p = 0.006$). This variability has been attributed to inherent differences in reference populations used for IG vs. Fenton charts, as noted by Yazici et al.

The study shows a progressive increase in head circumference from 30.23 ± 2.63 cm at Week 1 to 40.30 ± 2.35 cm at Month 6. Early differences in percentiles between charts were not statistically significant (e.g., Week 1: $p = 0.254$), these observations align with that made by from Kim et al. where head circumference-based EUGR rates were similar between charts. Significant differences were observed at Month 4 (Fenton: 64 ± 35 vs. IG: 71 ± 35, $p = 0.046$) and Month 5 ($p = 0.011$), consistent with the trends in Cheikh Ismail et al. who reported a discrepancy in discharge classifications for head circumference between the two charts. By Month 6, both charts showed identical percentiles (72 ± 33), with no statistical difference ($p = 0.96$), corroborating Starc et al. suggested that long-term concordance improves as growth trajectories stabilize. The findings in our study demonstrated that both charts show comparable growth trends over six months, initial months require careful chart selection, especially in preterm infants, as growth discrepancies are more pronounced during this time. At the end of Month 6, both charts converge in classification outcomes, suggesting either can be used for longitudinal monitoring with reasonable reliability.

The findings suggest that while Fenton charts may be more sensitive in identifying early extrauterine growth restriction (EUGR), they may also over estimate growth faltering, especially during initial follow up. Conversely, the IG 21 chart, derived from postnatal growth of healthy preterm infants, may offer a more physiologically appropriate standard for tracking optimal growth, particularly beyond the neonatal period.

A consistent pattern observed is that Fenton chart tends to overestimate the incidence of growth restriction, particularly in the early neonatal period. In contrast, the IG 21 st chart, developed using postnatal growth data from healthy neonates, may under identify some cases of growth restriction, but is argued to be more appropriate for infants growing under ideal conditions.

CONCLUSION

This prospective cohort study included 200 preterm neonates, predominantly moderate to late preterm and low birth weight. In conclusion, both charts are useful in evaluating growth in preterm infants, but their application must be context-specific. The IG-21 chart may be better suited for assessing sustained postnatal growth, while the Fenton chart remains useful for identifying early deviations requiring intervention. Further research is warranted to evaluate their predictive value in relation to neurodevelopmental and metabolic outcomes in Indian populations.

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