Original Research Article

Post natal growth pattern of very low birth weight infants up to corrected 40 weeks of gestational age

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Abstract

Background: We all know, increase in survival of NICU graduates result in increment in numbers of very low birth weight babies and extremely low birth weight babies. Intra uterine milieu provides unlimited supply of nutrients, protection from hypothermia and microbial invasions, which turns into intermittent supply of nutrients and risk of sepsis when a neonate comes outside.

Aim: To observe the growth parameters in VLBW infants postnataly up to 40 weeks post menstrual age (PMA) by plotting the growth trends on Fenton's postnatal growth curves and on WHO growth charts at 40 weeks PMA.

Materials and methods: Prospective observational study was carried out at Level III NICU in West India. 110 VLBW infants admitted from July 2012 to September 2013 were included in the study. Length, head circumference (HC) and mid arm circumference were measured within 48 hours of birth and then weekly. Growth pattern obtained till 40 weeks PMA and then plotted.

Results: We found that average daily weight gain of this cohort was 17.7(+/-7.8) g/kg/day which was comparable to intrauterine growth velocity. In addition, the average weekly increment in length and HC was 0.52 and 0.39 cm/wk respectively, not comparable to intrauterine growth. On Fenton's 2013 sex specific growth curves, all infants showed significant growth lag and at 40 weeks PMA, on WHO standard growth curves, 2006 they all lie at 3rd centile or below.

Conclusions: We need large multi centric prospective cohort study to explore the growth trends of VLBW babies in India to develop Post natal growth nomograms for VLBW babies. Long term growth of VLBW infants should be monitored as they are at risk of growth failure.

Key words

Very low birth weight, Growth, Fenton, 40 weeks PMA.

Introduction

We all know, increase in survival of NICU graduates result in increment in numbers of very low birth weight babies and extremely low birth weight babies. Intra uterine milieu provides unlimited supply of nutrients, protection from hypothermia and microbial invasions, which turns into intermittent supply of nutrients and risk of sepsis when a neonate comes outside. This discrepancy results in overall lag in the growth of these infants; viz in weight, length, head circumference and mid arm circumference [1-4].

Predicting the growth of very low birth weight has been a mind blender to many neonatologists till recently. Though few growth charts have been described in western literature, very limited studies has been done in India and there is no standard growth chart for Indian very low birth weight infants. Therefore it requires a proper follow up study to monitor the different aspect of growth of very low birth weight newborns. Our study was a small stance in this direction

We reviewed the literature and found that there are generations of post natal growth charts available and nowadays all neonatologists prefer to use Fenton's sex specific growth curves of 2013 [5-16].

Our aim was to observe the serial changes in various growth parameters in VLBW infants postnataly up to 40 weeks post menstrual age (PMA) by plotting the growth trends on Ehrenkranz, Fenton's sex specific postnatal growth curves 2013 and on WHO growth charts at 40 wks Post Menstrual Age (PMA).

We followed all very low birth weight NICU graduates who fulfilled our inclusion criteria. These infants are then followed up daily till discharge and then weekly after the discharge. Then the data obtained were compared with the standard curves already available and inference noted.

Materials and methods

Our study was prospective analytical cohort study, an observational study. Gestational age was calculated from the first day of last menstrual period or by early/first trimester ultra sound noting of gestation wherever available. Cases were taken from the Intramural and Extramural Neonatal Intensive Care Unit (NICU) of Sir Sayaji Rao Gaekwad Hospital, Baroda (SSGH). Selected Very Low Birth Weight Infants admitted to NICU from July 2012 to September 2013 were followed prospectively from birth to completed 40 wks of gestation. This study was approved by the Scientific and Ethical Research Committee (SERC) Medical College and SSGH, Baroda. Parental consent was taken at the time of enrolment. Weight, length, head circumference and mid arm circumference were serially measured from birth till discharge, then up to 40 weeks PMA in High Risk Clinic, at SSGH. All the parameters of growth i.e. weight, length, head circumference and mid upper arm circumference were recorded at birth and then serially.

Data collection

Baby's weight was recorded daily till discharge or transfer and then on follow up. Measurements were performed with digital electronic weighing scale for 40 weeks PMA and further in follow up. This machine was calibrated at regular intervals. Length, head circumference and mid arm circumference were measured within 48 hours of birth and then weekly. The length was

recorded with an infantometer to the nearest 0.1 cm with the baby supine, knees fully extended and soles of feet held firmly against and head touching the fixed board. The head circumference was measured at the maximum circumference of the head (i.e. occipito-frontal) with a non-stretchable tape to the nearest 0.1 cm. Mid arm circumference was measured weekly by applying the same around the upper arm at the midpoint of distance from acromian to olecranon. All parameters were measured twice before documenting. An average of the two values was recorded. However if there was large discrepancy between the two readings (defined as >5%) then repeat measurements were taken.

Inclusion criteria

- Infants <1500gms birth weight
- Group A-without morbidities
- Group B-with minor morbidities
- Group C-with major morbidities

Group B included birth asphyxia without multi organ dysfunction, sepsis, mild respiratory distress, NEC grade I. Group C included severe RDS, IVH, mechanical ventilation, Necrotising Enterocolitis grade II or III, exchange transfusion, Retinopathy of prematurity requiring intervention, shock, oxygen dependency, recurrent apnea, Prolong Total Parenteral Nutrition, HIE, Pyogenic Meningitis, seizures, congenital heart disease (except Small Patent foramen Ovale)

Exclusion criteria

- Syndromic infant
- Surgical illness including NEC requiring surgery.
- Major congenital malformations.
- Admission @ or >48 hours of life.
- Death within 7 days of life.
- Lost to follow up within 7 days of enrolment

Data analysis

After collecting the growth parameters the maximum weight loss was calculated, from the difference of minimum weight reached and birth weight. The age at maximum weight loss and time taken to reach weight at discharge were also calculated. Thereby, we calculated daily weight gain during hospital stay and for calculation we used time taken to reach discharge weight from minimum weight in denominator. Similarly, increments in the length and head circumference were calculated at different gestational groups.

Weight gain in g/kg/day = (discharge weight in g – minimum weight in g)/duration to reach the discharge weight in days) x birth weight in kg

Length increment in cm/wk = (discharge length in cm – birth length in cm)/mean duration to reach discharge length in days

Head Circumference increment in cm/wk = (discharge HC in cm – birth HC in cm)/mean duration to reach discharge HC in days

Fluid and Nutrition Policy

Majority of VLBW infants were started on 80 ml/kg/d (60 to 120 ml/kg/d) of fluid on first day of life. Feeds initiation were delayed depending upon the hemodynamic status of the baby. However, enteral feeds were initiated as soon as possible, preferably on first day of life, if hemodynamically stable. Increments of 15 to 20 ml/kg/d were made as tolerated. Expressed breast milk was ensured in all selected infants and once infants reached on full enteral feeds of at least 100 ml/kg/d. Human milk fortifier (Lactodex HMF, manufactured by Raptakos, Brett and Co, with 6.5 Calories, 0.2 g protein and 0.1 g fat in each sachets) to increase the calories, protein and fat intake of the infants. We excluded all those infants who do not reach full enteral feeds by day 10.

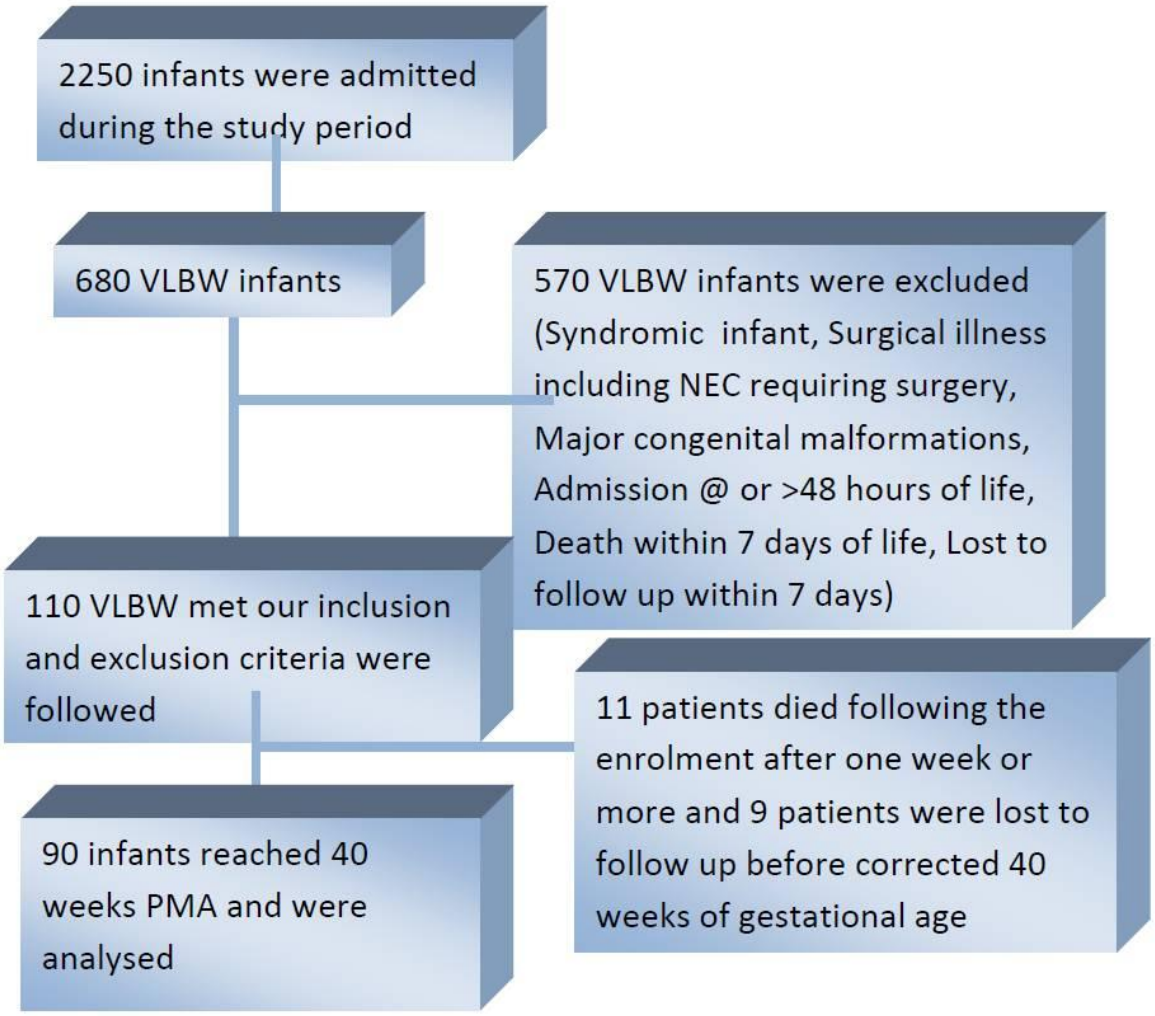
Results

We divided our 110 infants into three major groups according to gestational age, which in turn were divided into AGA (appropriate for gestational age) and SGA (small for gestational age) as per **Flow chart - 1**.

- <32 weeks
- 32-34 weeks

- 34-37 weeks

Flow chart – 1: Results of the study.



For comparison of our data regarding mean age of starting feeds and age of reaching full enteral feeding in days we took data from Ehrenkranz's study [17]. But we found that our data was not comparable with them because the cohort of infants was from developed countries where this cohort was mainly comprised of AGA infants belonging to even less than 28 weeks. Secondly they practice total parenteral nutrition from very first day of life. Our cohort mainly contains SGA infants (55%) and in late preterms percentage goes higher to 80% and also we don't practice total parenteral nutrition so aggressively.

The mean duration of stay at the hospital of <32 weeks infants was between 20-25 days, while the late peterms had hospital stay of 15 to 20 days.(Range - 8 to 49 days). While in Saluja et al study it was 27 days with range of 27-110 days. The mean duration to reach the discharge weight from minimum weight was around 15-25 days, depending upon gestational age.

When we tried to compare our data with Saluja, et al. study (**Table - 1**), we found that our infants had relatively more weight loss, in 30-34 wk AGA group with P value of <0.005. This means the difference was statistically significant with 99% confidence limits. However, data of other two groups had no significant difference in their weight loss.

We found that average daily weight gain of this cohort was 17.7($\pm$7.8) g/kg/day which was

comparable to intrauterine growth velocity. In addition the average weekly increment in length and head circumference was 0.52 and 0.39 cm/wk respectively. This growth velocity of VLBW babies was not comparable to intrauterine growth as far as head circumference increment and length increment was concerned. This may be due to large group of late preterms with additional disadvantage of being SGAs.

Table – 1: Comparison of our data with Saluja, et al. study.

	Saluja et al study		Our's study		P value
30-34 wks					
AGA	(n=25)	6.8(3.2)	(n=32)	10.9(4.8)	**0.0005**
SGA	(n=31)	6.6(3.7)	(n=13)	8.4(5.7)	0.21
>34 wk					
SGA	(n=16)	5.2(3.0)	(n=47)	6.5(4.9)	0.123

With hitherto NICHD Neonatal Research Network Centre nutritional practices, Ehrenkranz, et al. found that once VLBW infants regain birth weight, their average daily weight gain ranged between 14.4 and 16.1 g/kg/d , a rate similar to the reported intrauterine weight gain of; 1.5%/d or 15 g/kg/d [18]. In addition, their average weekly increments in length (0.9 cm/wk) and HC (0.9 cm/wk) are similar to the rates of intrauterine length and HC increase reported by Lubchenco, et al. [12] between 26 and 36 weeks of gestation (1.1 cm/wk and 0.7 cm/wk, respectively). Also, their average weekly increment in MAC (0.35 cm/wk) is similar to the average weekly intrauterine MAC increase reported by one study [19] for infants between 25 and 36 weeks of gestation (0.34 cm/wk).

The only Indian study which we found comparable to our study was by Saluja, et al. [18]. They found with the nutritional practices used in the study infants experienced a daily weight gain of 15.18 $\pm$ 1.7 g/kg/day, which is comparable to intra uterine growth rate and other reports. However, weekly increments in the length and head circumference were almost half of the intrauterine growth expectations and other reports [17].

We found that all the three parameter of growth were numerically less as compared to the Saluja, et al. study. However, on statistical analysis these differences are insignificant (P >0.05).

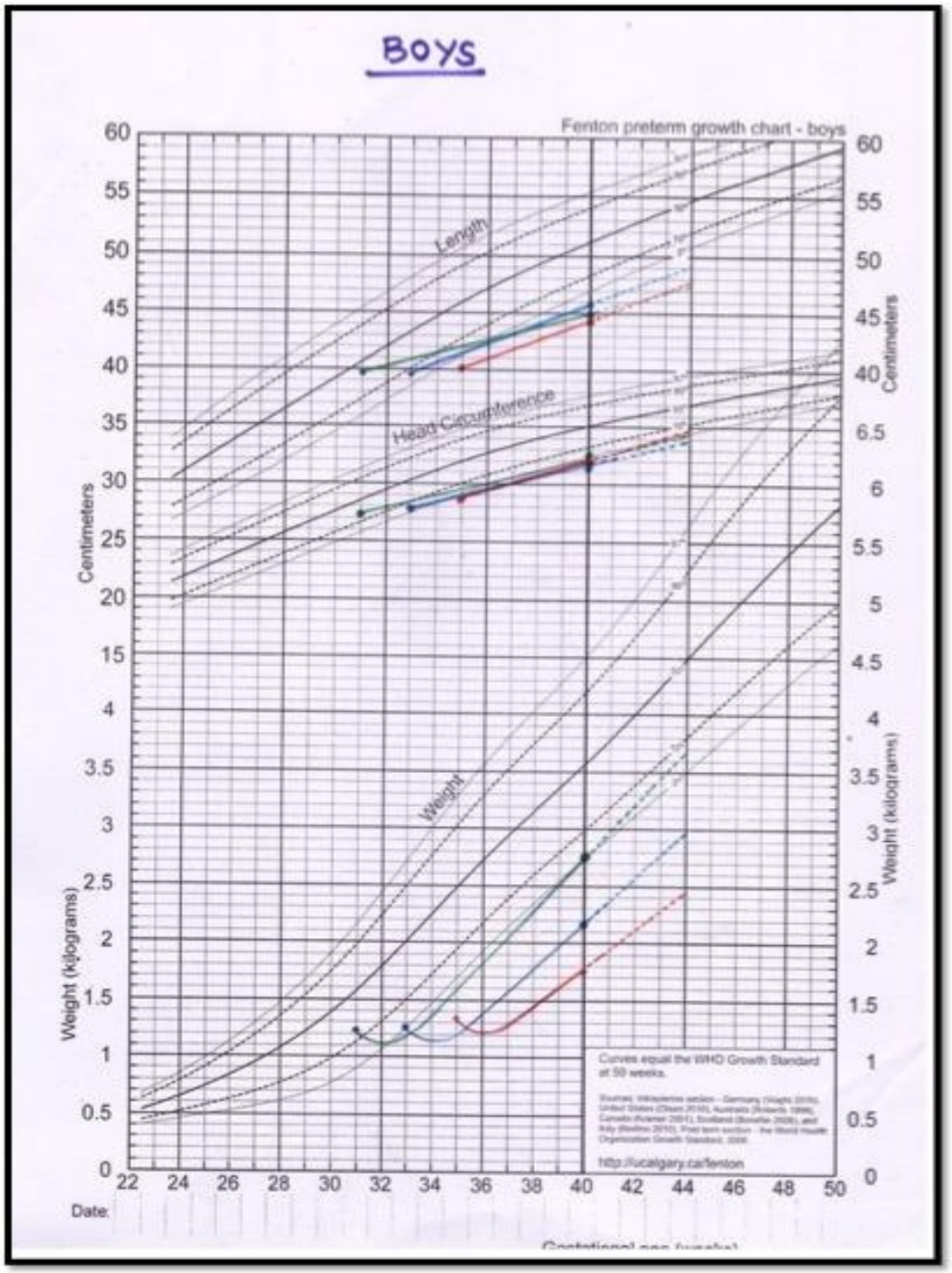
When we plotted our growth trends on Ehrenkranz's growth charts and we found that our cohort's growth velocity lags in all the parameters like weight gain, head circumference and length increment as compare to infants of Western countries.

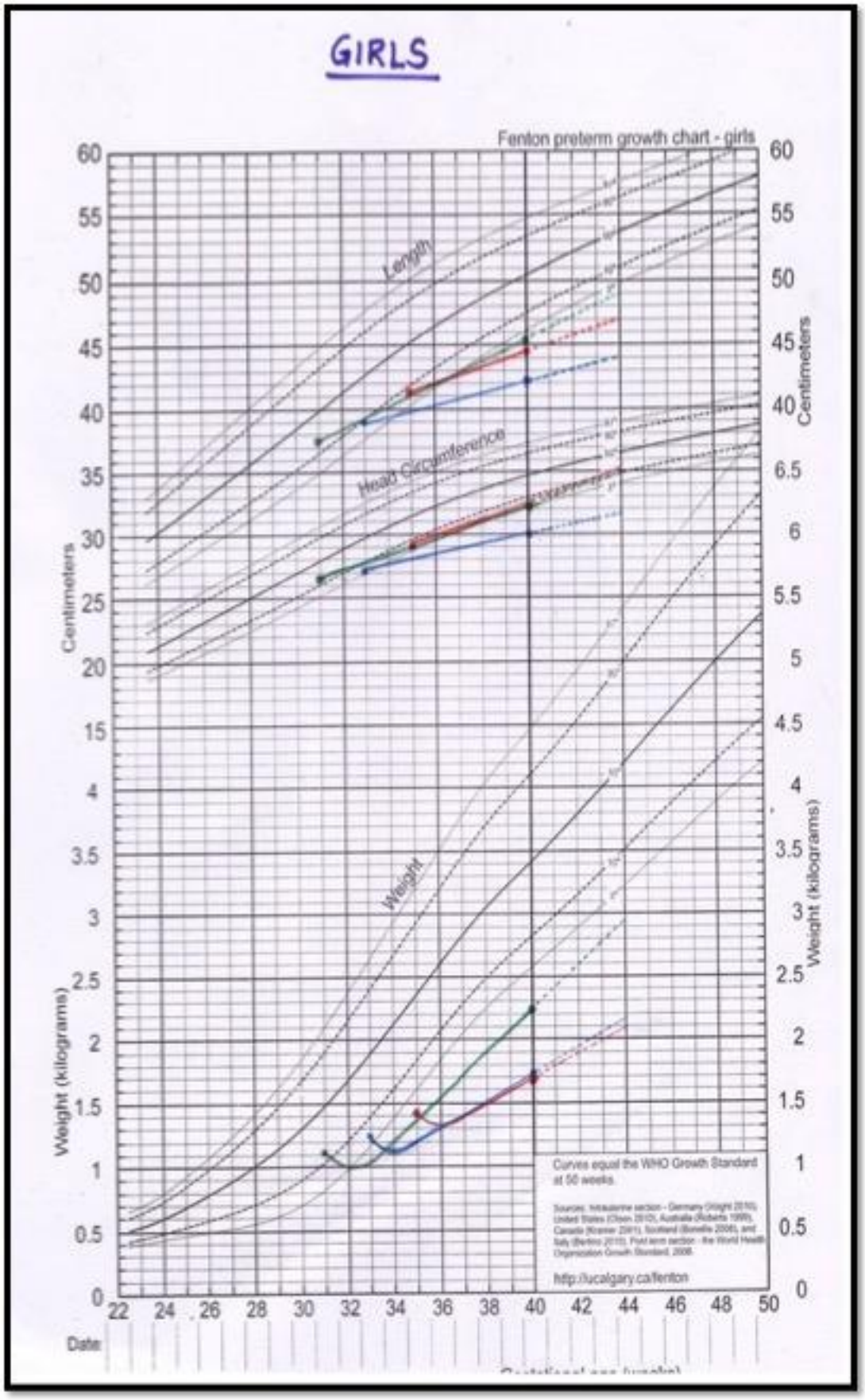
Plotting these growth trends of Fenton's 2013 sex specific growth curves (**Figure – 1 and 2**)

- <32 weeks infants belong to 10th centile of birth weight according to gestational age and by the time they reach 40 weeks PMA they drop down to 3rd centile.
- 32-34 wek infants belong to 3rd centile of birth weight according to gestational age and by the time they reach 40 weeks PMA they drop down to even less than 3rd centile.
- 34-37 weeks group infants which mainly comprised of SGA babies belong to < 3rd centile of birth weight according to gestational age and by the time they reach 40wks they continue to grow below 3rd centile for long time.

- At birth the length of < 32 weeks infants were just more than 10th centile, 32-34 weeks were at 10th centile and 32-34 weeks less than 3rd centile. By the time they reach 40 weeks PMA they all drop down or continue to grow at less than 3rd centile.
- At birth the head circumference of < 32 weeks infants were just at the 10th centile, 32-34 weeks were at 3rd centile and 32-34 weeks less than 3rd centile. By the time they reach 40 weeks PMA they all drop down or continue to grow at less than 3rd centile.

Figure - 1 and 2: Growth Trends plotted on Fenton's 2013 sex specific growth chart.




GIRLS
Fenton preterm growth chart - girls
Length
Head Circumference
Weight
Centimeters
Weight (kilograms)
Curves equal the WHO Growth Standard at 50 weeks
http://ucalgary.ca/fenton
Date

These differences are postulated to occur due to ethnic or racial factors or due to large no. of SGA infants in our study, 55% in total cohort and nearly 80% in late preterms. Secondly maternal morbidities like malnutrition anemia, gestational hypertension do affect fetal and post natal growth and also 65 % of our infants had culture positive sepsis during neonatal period.

Discussion

These differences are postulated to occur due to ethnic or racial factors or due to large no. of SGA infants in our study nearly 50% in total cohort and nearly 85-90% in late preterms. Secondly maternal morbidities like malnutrition anemia, gestational hypertension do affect fetal and post natal growth. Iilliteracy, ignorance, less birth spacing and poverty in the society also play a role.

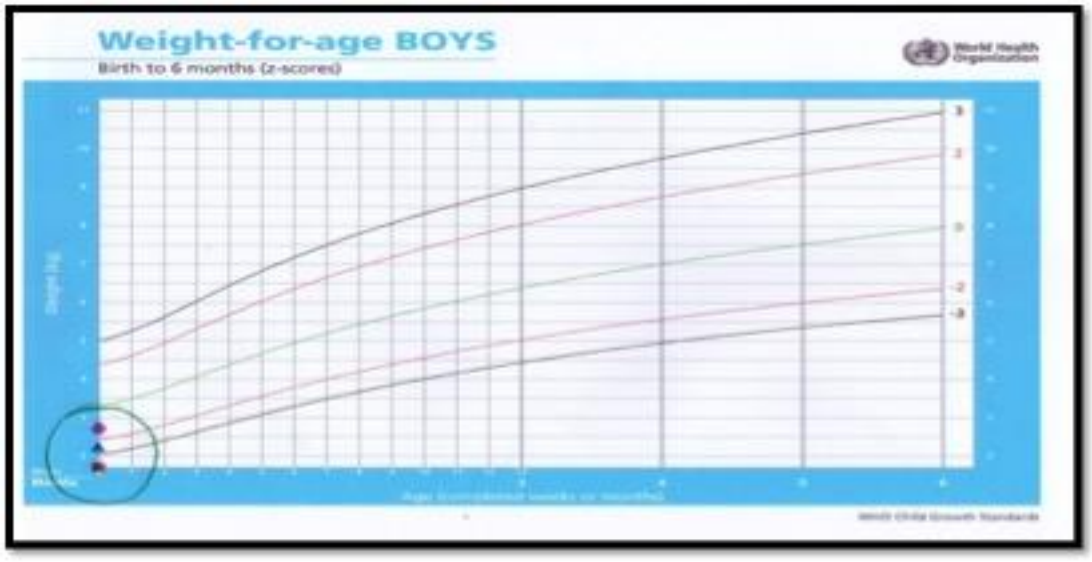
According to NICHD reports [19], 97% of all VLBW babies and 99% of ELBW babies had weights <10th centile at 36 weeks PMA. These babies subsequently also continue to grow poorly throughout the childhood. This growth restriction is believed to persist in adult life as shown by some researchers and they found VLBW infants are twice as likely to have a height < 3rd centile at 20 years of age than that of normal weight controls.

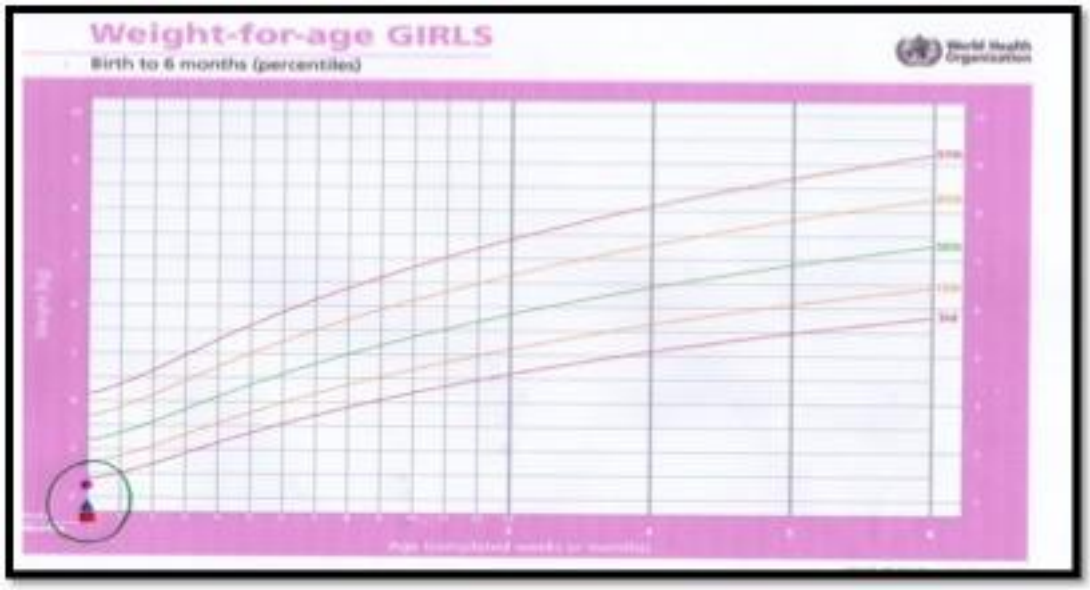
Data regarding post discharge growth of VLBW infants is scanty in our country. In a follow up study done at PGI Chandigarh (abstract presented in Pedicon 2008) [20], they found similar trend of growth failure till corrected age (CA) of one year. At 40 wks CA, 85 % of VLBW babies were <10th centile. They showed some catch up growth by 6 months but again by CA one year 78 % were <10th centile probably due to delayed weaning.

The growth failure is more marked in SGA babies as described in various studies. Report from Hongkong [21] observed in a cohort of their LBW babies that 1/3rd of their babies were SGA who were term or near term. At 6-12 months 33-35% babies were still short as compared to 7-12% of SGA babies.

Lastly when we plot all the growth parameters i.e. weight, head circumference and length separately for girls and boys at 40 wks PMA, on WHO standard growth curves of 2006 we found that they all lie at -2 SD (3rd centile) or below. This means that when these infants reach 40 wks PMA they are already lagging at 3rd centile or below as compared to full term AGA infants (**Figure – 3 and 4**).

Figure - 3 and 4: Growth Trends plotted on WHO 2006 weight for age sex specific standard growth curve.





Conclusion

We need large multi centric prospective cohort study to explore the growth trends of VLBW babies in India to develop Post natal growth nomograms for VLBW babies. Long term growth of VLBW infants should be monitored as they are at risk of growth failure.

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