

Original Research Article

To study the anthropometric measurements of the neonates between 28 to 42 weeks of gestational age at tertiary health care center, Bhavnagar, Gujarat.

Abstract:

Background/Introduction (Confine abstract to 350 word)

Objectives

To study the anthropometric measurements of the neonates between 28 to 42 weeks of gestational age. To express them as smoothed percentiles and obtain their correlation with the constant. Comparing the data trend with the Shah Study conducted twelve years ago in the same institute.

Study design and methodology

Cross sectional observational study of 500 live new-borns, 28 to 42 weeks gestational age (confirmed by ballard score) was conducted in NICU and post-natal ward, Sir-T hospital, Bhavnagar.

Infantometer and non-stretchable measuring tape were used for measurements.

Results

Demographic data was female, male: [247 (49.4%), 253 (50.6%)]. The newborns weighing < 2.499 kg were n= 193(38.6%), 2.500- 3.00 kg n=247(49.4%) and > 3.00 kg n= 60(12%). 244

newborns were <37 weeks old (48.8%) and 256 were 37- 42 weeks old (51.2%), with 37 weeks old contributing n=167(33.4%).

The male newborn had higher anthropometric variable than female: Weight, Crown Heel Length, Head Circumference, Chest Circumference, Ponderal Index, Thigh Circumference, Mid Arm Circumference, Foot Length were 2.500, 46.73, 31.65, 29.69, 2.38, 12.06, 8.4, 6.79 (What are these measures? Mean? Standard deviations? Measured in what? Inches? mm? kg?) of female and 2.595, 47.43, 32.08, 29.95, 2.39, 12.19, 8.2, 7.13 of male respectively, except in MAC (Introduce abbreviation in full first).

By comparing the mean of the parameters of 34 to 38 weeker newborn, the mean of TC and MAC of present study was increased than in Shah Study. Similarly, the mean of weight in 34, 36, 37 and 38, CHL in 36 and 38, the HC in 36, 37 and 38, the CC in 34, 35, 36 and 37, the FL in 35 and 37, and the Ponderal Index in 34, 35 and 38 weeker newborns, of present study was increased as compared to Shah Study. (Why do you leave out 38 – 40 weeks, and post-mature when you include premature till 34 weeks?)

By Pearson's correlation, the maximum association was found with TC (r 0.934), followed by PI (0.868) and HC (0.844) in present study and with TC (0.966) in Shah Study.

The intrauterine growth curves were constructed by plotting percentile values of each anthropometric parameter against gestational age in weeks.

Conclusion

The nutrition has been improved in near term and full-term neonates. The percentile charts constructed in accordance to current data trends, thus can be utilised regionally.

INTRODUCTION

Establishment of various physical parameters of newborn helps in predicting the prognosis and managing the subnormal as well as normal newborns.

It is very important to know the status of the intrauterine growth because it affects further growth, complications that may occur in neonatal period and their management. [1] Intrauterine growth curves were first constructed by Lubchenco et al. [2]

Birth weights of the newborns and patterns of intrauterine growth show considerable differences from population to population. Therefore, this study was conducted to construct intrauterine growth curves (anthropometric curve of newborn) based on local data of Bhavnagar, Gujarat. And in addition, various physical parameter measurements of present study were compared with the previous study conducted twelve years back, from same institute to evaluate changes in the data trends.

The correlation of the various anthropometric parameters were made in comparison to weight as a constant. Hence the best predictor of the low birth weight can be made. [3-5]

METHODOLOGY

Study design:

A cross sectional observational study consisting of 500 live newborns was conducted in NICU and post – natal ward, at the department of Pediatrics, in a tertiary care hospital, Sir T G Hospital, Bhavnagar, from January 2018 to April 2018. (figure1) (How was Sample Size arrived at? In case calculated, indicate the formula used, and cite any previous Study used to calculate the Sample Size. Was any Random Sampling done? Indicate method. If not, indicate how Sample was obtained)

Inclusion criteria

All babies between 28 – 42 weeks

Exclusion criteria:

Babies with major congenital malformations e.g. holoprocencephaly

Severely ill babies e.g. babies on non- invasive/ invasive mode of ventilation, oxygen support, sepsis.

Stillborn babies

Guardians not gave consent

Infantometer (briefly describe infantometer including brand, directions in using, whether calibration required and whether calibration done; any precautions necessary) and non-stretchable measuring tape were used, for anthropometric measurements. The gestational age was confirmed by applying new Ballard scoring (define). All the recordings were made between 24 to 48 hours of birth as it is recommended that the head circumference measured after 24 hours of birth have some amount of moldings.

Measurements of anthropometric data were made as follows.

Birth Weight: It was recorded on an electronic weighing machine in a warm room with baby in naked state. The machine was sensitive up to 500 gram (5000 grams?) of weight.

Head Circumference (HC): was measured with the help of measuring tape touching the external occipital protuberance and glabella, above the ears.

Chest Circumference (CC): was measured at the level of nipple with the help of measure tape.

Mid arm Circumference (MAC): was measured at a point midway down the left arm between the tip of acromion and olecranon processes with the help of measure tape.

Crown Heel Length (CHL): was measured on the infantometer with the baby supine with both legs straightened and both feet including the heel resting against the footboard.

Maximum Thigh Circumference (TC): In supine position, the maximum thigh circumference was measured at the level of the lowest furrow in the gluteal region, measure tape being placed perpendicular to the long axis of the lower limb.

Foot Length (FL): was measured by joining points made from the tip of the great toe to the heel after placing the foot against the vertical board with the help of plastic scale.

Ponderal Index (PI): $\text{Weight in grams} / \text{Length in cms}^3 \times 100$

Gestational Age: The gestational age was calculated by clinical assessment using the New Ballard Score.

Statistical analysis

Microsoft excel was used to plot smoothed percentile charts. SPSS was used for expressing anthropometric measurements in mean and SD, according to their gender. The unpaired t-test was applied to obtain their significant value. Linear regression equation applied for correlation of each

parameter (HC, CC, MAC, CHL, TC and ponderal index) with weight, for gaining maximum association.

Result and Discussion

In present study of 500 newborns there were 247 female (49.4%) and 253 male (50.6%).

193 were weighing less than 2.499 kg (38.6%), 247 were between 2.500 – 3.00 kg (49.4%) and 60 were weighing >3.00 kg (12%). This is the first study to document the anthropometry of neonates from Bhavnagar, Gujarat.

Among these there were 244 newborns were of <37 week (48.8%) and 256 newborns were between 37 – 42 week of gestational age (51.2%). The near full term neonates (37 weeker) were contributing maximum distribution 167 out of 500 (33.4%) and preterm neonates (28 and 29 weeker) contributing minimum distribution 1 and 2 (0.2% and 0.4%) (Table 1).

The demographic distribution of newborns of present and Shah study, according to gestational age and number were plotted. There were maximum 167 newborns of 37 week gestational age in present study. In Shah Study there were maximum 244 newborns of 40 week of gestational age (figure 4).

The mean of every anthropometric measurements : CHL, HC, CC, PI, TC, MAC, FL among female and male were 2.500, 46.73, 31.65, 29.69, 2.38, 12.06, 8.4, 6.79 and 2.595, 47.43, 32.08, 29.95, 2.39, 12.19, 8.2, 7.13 respectively according to gender.

Each mean had gender difference, in which male newborn have higher mean as compared to female except that of, mid arm circumference which is more in female (Table 2). In the study by Sajjadian N of total 500 newborns correlating anthropometry parameters with gender, there were significant differences in birth weight and anthropometric measurements between male and female newborns ($p < 0.05$), the males had higher birth weight and all anthropometric variable except mid arm to head circumference ratio as there is more subcutaneous fat in female as compared to male. [6]

By comparing the mean of the parameters of 34 to 38 weeker newborn, the mean of TC and MAC of present study was increased than in Shah Study. Similarly, the mean of weight in 34, 36, 37 and 38, CHL in 36 and 38, the HC in 36, 37 and 38, the CC in 34, 35, 36 and 37, the FL in 35 and 37, and the Ponderal Index in 34, 35 and 38 weeker newborns, of present study was increased as compared to Shah Study (Table 3).

The association between present study and Shah Study was made; in 34- 38 week gestational age with significant p values (Table 4).

This suggests improvement in nutrition of near term and full term neonates over a period of twelve years from 2006 to 2018.

By Pearson's correlation, the maximum association was found with TC ($r 0.934$), followed by PI (0.868) and HC (0.844) in chronological order in present study and with TC (0.966) in Shah Study (Table 5). In study by P. Sampathkumar, *foot length* was the best surrogate to weight, to evaluate high risk (LBW) newborn, as compared to another physical anthropometric parameters [7], [9].

In a study by Gohil, of foot length measurement in neonates from Ahmedabad, the correlation of foot length was made between length and occipital-frontal circumference [10]. The percent variation in CHL, occipito-frontal circumference (OFC) and FL measurements for preterm babies was 1.8, 1.5, and 1.2 respectively by the same observer and had inter-observer

variation of 1.9, 1.55 and 1.23. The variations for TSGA (term small for gestational age) were: intra-observer- 2.0, 1.8, 1.4 and inter-observer -2.2, 1.84, 1.46; and for TAGA (term appropriate for gestational age) babies intra-observer -2.7, 2.48, 1.56 and inter-observer -2.8, 2.52, 1.6 for CHL, OFC and FL in that order [10].

Another study by Bhat [11], for efficacy of various anthropometric measurements in determining low birth weight babies; had a significant correlation of birth weight with calf circumference ($r = 0.87$), thigh circumference ($r = 0.7$), mid-arm circumference ($r = 0.7$), and chest circumference ($r = 0.40$). Calf circumference accounted for 75.69% of the total variance [11].

Tables of Smoothed Percentile Values and Percentile Charts

Smoothed percentiles (10th, 25th, 50th, 75th and 99th) were obtained of each anthropometric value along with gestational age of present study and are mentioned as chart number 2.1-2.8. (Figure 2) The percentile charts of previous study are mentioned as 3a to 3g (Figure 3).

Both of them observed were different. These percentile values, plotted against gestational age in weeks gave the intrauterine growth curves for each anthropometric parameter. Thus percentile charts of particular regions similar to Lubchenco [2] and Oslen [8] could be created.

Abbreviations

CHL- Crown Heel Length, HC- Head Circumference, CC- Chest Circumference, MAC- Mid Arm Circumference, TC- Thigh Circumference, PI- Ponderal Index and FL- Foot Length, LBW- Low Birth Weight, OFC- Occipito-Frontal Circumference.

What is already known?

Anthropometry of the neonate varies between different genders, regions and gestational age.

What this study adds

This is the first study to document the anthropometry of neonates from Bhavnagar, Gujarat.

Recommendations

Assessment and charting of anthropometry of each local region including newborns delivered in private hospitals should be carried out.

(This is an unusual study comparing with just one Study carried out at the same institute 12 years earlier with the attempted aim of proving there is improved nutrition in the pregnant at the ante-natal clinic. First, maternal nutrition is not the only factor deciding the anthropometric measures of new-borns.

Factors affecting birth weight (and, you had discussed how the remaining anthropometric measures correlate with birth-weight)

1. **Genetics** - The mother's weight impacts on the weight of the baby at birth - and the father's weight has an impact too. Some babies are small because it runs in the family.
2. **Age of the Parent** - Evidence shows that women aged 35+ have larger babies, and teenage pregnancies are more likely to result in babies that are underweight.
3. **Twins** - Babies who are twins are born relatively smaller than those without, because the twins share a uterus.
4. **Diet During Pregnancy** - If the mother under-eats, the required nutrients won't be passed to the child and they are more likely to be born underweight.
5. **Early Births** - If the baby is born early, they will not have developed fully in the womb. Babies put on their weight during the latter stages of pregnancy, so this stage is missed.
6. **Gender** - Slight differences between boys and girls can be observed. Generally, boys are slightly heavier.
7. **Parent's Birth Weight** - The parents' birth weights also plays a part in the baby's weight - the mother's weight has more of an influence than the father's.
8. **Smoking and Drinking** - If the mother has smoking and drinking habits, the baby's birth weight can be reduced.

9. **Mother's Medical Issues** - Any medical issue during pregnancy can affect the weight of the infant. Conditions like anemia and diabetes also puts the baby at risk of being born underweight.
10. **Remaining Inherited Medical Conditions** - A baby can also inherit hereditary diseases within the womb which can cause a low birth weight.

Secondly, from Table 1, the manner of the frequency-distribution of the newborns according to gestational-age at birth in this Study is vastly different from that of the Shah-study. Even if the frequency at each age is smaller in this Study, the frequency-distribution should be around the same by ratio such that meaningful comparison can be made. This reviewer suggests that just data on anthropometric-measures be obtained in a suitable sample-size randomly obtained across the gestational-age at birth, and percentile-charts derived on these prior to comparisons made in a discussion with previous studies in your city, state, country and even regionally and globally. The Background/Introduction need be lengthier leading to the Aim of the Study and the need for the Study)

(The Author must state Ethical Clearance in the Study, and declare 'No Conflict of Interest' exist)

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References

- 1) Leitner Y, Fattal-Valevski A, Geva R, et al. Six-year follow-up of children with intrauterine growth retardation: long-term, prospective study. *J Child Neurol* 2000; 15(12):781-786.
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- 4) Gupta V, Hatwal SK, Mathur S, et al. Calf circumference as a predictor of low birth weight babies. *Indian Pediatr* 1996;33:119-21.
- 5) Magzoub MM, Ali TE, Ali AB. A low-cost tool for traditional birth attendants to identify low-birth-weight infants. *Food and Nutrition Bulletin*. 1994 Sep;15(3):1-5.
- 6) Sajjadian N, Shajari H, Rahimi F, Jahadi R, Barakat MG. Anthropometric measurements at birth as predictor of low birth weight. *Health*. 2011 Dec 8;3(12):752.
- 7) Shah AR, Jhala DR. A clinical study of neonatal anthropometry. Dissertation MD Pediatrics. Maharaja Krishnakumarsihji Bhavnagar University; Bhavnagar, Gujarat, India: 2006.
- 8) Oslen I, Groveman S, Lawson M, Clark R, Zemel B. New Intrauterine Growth Curves on United States Data. *Pediatrics* 2010;125(2), pp.e214-e224.

9) Sampathkumar P, Devi SA. A study on new-born foot length measurement to identify high risk neonate. Int J Contemp Pediatr 2018;5:1078-82

10) Gohil JR, Sosi M, Vani SN, Desai AB. Footlength measurement in the neonate. Indian J Pediatr. 1991 Sep;58(5):675-7. doi:10.1007/BF02820189

11) Bhat IA, Dhar GM, Shah GN, Shehzada A. Efficiency of various anthropometric measurements in determining low birth weight babies. Indian Journal of Maternal and Child Health, 1995 Apr-Jun; 6(2):40-2.

Table 1: Demographic distribution according to gestational age.

Gestational Age (weeks)	Present Study n, (%)	Study1 ⁷ n, (%)
28	1, (0.2)	14, (1.6)
29	2, (0.4)	14, (1.6)
30	5, (1.0)	19, (2.2)
31	2, (0.4)	26, (3.1)
32	6, (1.2)	22, (2.5)
33	7, (1.4)	28, (3.2)
34	24, (4.8)	16, (1.8)
35	72, (14.4)	17, (2.0)
36	125, (25.0)	30, (3.5)
37	167, (33.4)	82, (9.6)

38	76, (15.2)	121, (14.2)
39	12, (2.4)	145, (17.1)
40	1, (0.2)	244, (28.7)

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Table 2: Mean difference among gender

Gender (n)	Mean weight (kg)/ SD	Mean CHL (cm)/ SD	Mean HC (cm)/ SD	Mean CC (cm)/ SD	Mean PI/ SD	Mean TC (cm)/ SD	Mean MAC (cm)/ SD	Mean FL (cm)/ SD
Female (247)	2.500*/ 0.464	46.73/ 3.457	31.65/ 1.967	29.69/ 2.022	2.38/ 0.266	12.06/ 0.877	8.4/ 5.276	6.79/ 1.932
Male (253)	2.595*/ 0.489	47.43/ 2.355	32.08/ 1.991	29.95/ 1.786	2.39/ 0.260	12.19/ 0.877	8.2/ 0.997	7.13/ 1.952

*p= 0.017

CHL- Crown Heel Length, HC- Head Circumference, CC- Chest Circumference, FL- Foot Length, PI- Ponderal Index, TC- Thigh Circumference, MAC- Mid Arm Circumference.

Table 3: mean, SD value of present study and Shah Study7

Gestational Age (weeks)	34		35		36		37		38	
	<i>Present study</i>	Shah study	<i>Present study</i>	Shah study	<i>Present study</i>	Shah study	<i>Present study</i>	Shah study	<i>Present study</i>	Shah study
Weight (kg)	2.12, 0.10	1.93, 0.33	2.05, 0.29	<i>2.06,</i> <i>0.29</i>	2.23, 0.30	2.10, 0.25	2.84, 0.21	2.69, 0.31	2.99, 0.25	2.82, 0.27
CHL (cm)	45.47, 1.52	<i>45.55,</i> <i>0.55</i>	47.04, 1.16	<i>47.30,</i> <i>1.42</i>	47.60, 3.86	47.32, 0.94	48.47, 1.50	48.73, 0.70	49.85, 1.07	49.69, 0.69
HC (cm)	30.48, 1.80	<i>30.83,</i> <i>0.74</i>	31.03, 1.42	<i>31.05,</i> <i>0.88</i>	31.96, 1.72	31.91, 0.96	33.94, 1.11	33.40, 0.70	33.61, 1.11	33.56, 0.96
CC (cm)	28.73, 1.97	27.35, 0.85	28.76, 1.41	28.46, 0.98	28.99, 1.76	28.33, 1.06	30.68, 1.47	30.22, 0.85	31.90, 1.09	<i>31.97,</i> <i>1.81</i>
FL (cm)	6.75, 0.56	<i>6.94,</i> <i>0.13</i>	6.52, 0.19	6.25, 0.28	7.43, 0.61	7.55, <i>0.20</i>	7.54, 0.89	7.53, 0.16	7.39, 0.42	<i>7.51,</i> <i>0.15</i>
PI	1.21, 0.71	1.04, 0.29	1.95, 0.23	1.94, 0.24	1.93, 0.24	<i>1.98,</i> <i>0.19</i>	2.45, 0.20	2.88, <i>0.22</i>	2.49, 0.19	2.09, 0.16
TC (cm)	11.32, 0.32	11.10, 0.31	12.56, 0.58	12.27, 0.31	12.28, 0.63	12.26, 0.29	12.60, 0.52	12.52, 0.47	12.88, 0.45	12.86, 0.44
MAC (cm)	7.53, 0.53	7.40, 0.42	8.65, 0.68	8.09, 0.58	8.63, 0.66	8.26, 0.37	8.88, 0.63	8.83, 0.67	8.89, 0.80	8.78, 0.68

CHL- Crown Heel Length, HC- Head Circumference, CC- Chest Circumference, FL- Foot Length, PI- Ponderal Index, TC- Thigh Circumference, MAC- Mid Arm Circumference.

Bold indicates higher value in present study. *Italics* indicate higher value in Shah Study.

Table 4: Association of anthropometry between present study and Shah Study7

Gestational Age (weeks)	34			35			36			37		
	p-value	df	95% CI	p-value	df	95% CI	p-value	df	95% CI	p-value	df	95% CI
Weight (kg)	0.12	36.10	0.437-0.054	0.27	22.61	2.57-0.07	0.03*	51.57	1.29-0.05	0.002*	121.24	0.72-0.58
CHL (cm)	0.86	31.18	0.739-0.880	0.05	20.05	1.21-2.754	0.017*	152.90	1.17-0.71	0.139	247.27	0.08-0.61
HC (cm)	0.17	32.99	1.162-0.311	0.02*	33.30	0.26-1.42	0.88	79.30	0.05-0.23	0.002*	223.90	1.80-1.26
CC (cm)	0.012*	33.75	2.451-0.322	0.47	29.75	0.89-0.34	0.05	72.92	0.66-0.25	0.00*	241.99	2.20-1.51
FL (cm)	0.028*	25.28	1.237-0.500	0.002*	57.15	0.60-0.16	0.001*	145.11	0.37-0.06	0.026*	166.46	2.91-0.18
PI	0.11	34.36	0.489-0.080	0.00*	21.09	0.54-0.25	0.00*	54.91	0.34-0.04	0.00*	152.26	0.62-0.58
TC (cm)	0.05	36.97	0.039-0.667	0.00*	41.20	0.51-0.93	0.001*	98.04	0.68-0.07	0.207	176.59	0.22-0.14
MAC (cm)	0.21	36.63	0.544-1.192	0.002*	44.87	1.16-1.99	0.03*	72.85	1.82-0.08	0.189	166.11	13.88-8.14

*p significant CHL- Crown Heel Length, HC- Head Circumference, CC- Chest Circumference, FL- Foot Length, PI- Ponderal Index, TC- Thigh Circumference, MAC- Mid Arm Circumference, df- degree of freedom

Table 5: Pearson correlation (r value) with Weight

Measurement	CHL	HC	CC	FL	PI	TC*	MAC
Present study	0.796	0.844	0.588	0.800	0.868	0.934	0.640
Shah Study ⁷	0.845	0.860	0.596	0.813	0.882	0.966	0.714

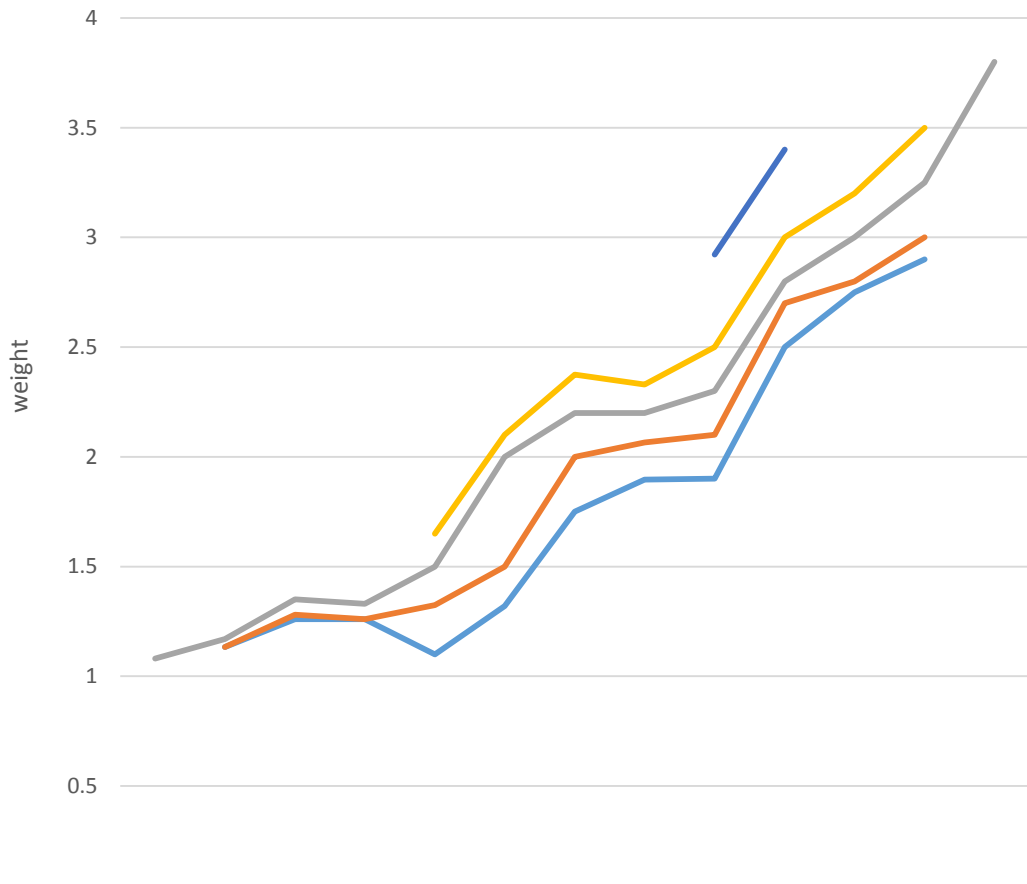
CHL- Crown Heel Length, HC- Head Circumference, CC- Chest Circumference, FL- Foot Length, PI- Ponderal Index, TC- Thigh Circumference, MAC- Mid Arm Circumference.

*In both this study, the maximum association with weight is that of thigh circumference (TC) (r is near to 1), followed by ponderal index (PI), head circumference (HC) and foot length (FL).

Figure 1: percentile charts present study

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1.1)weight percentile chart

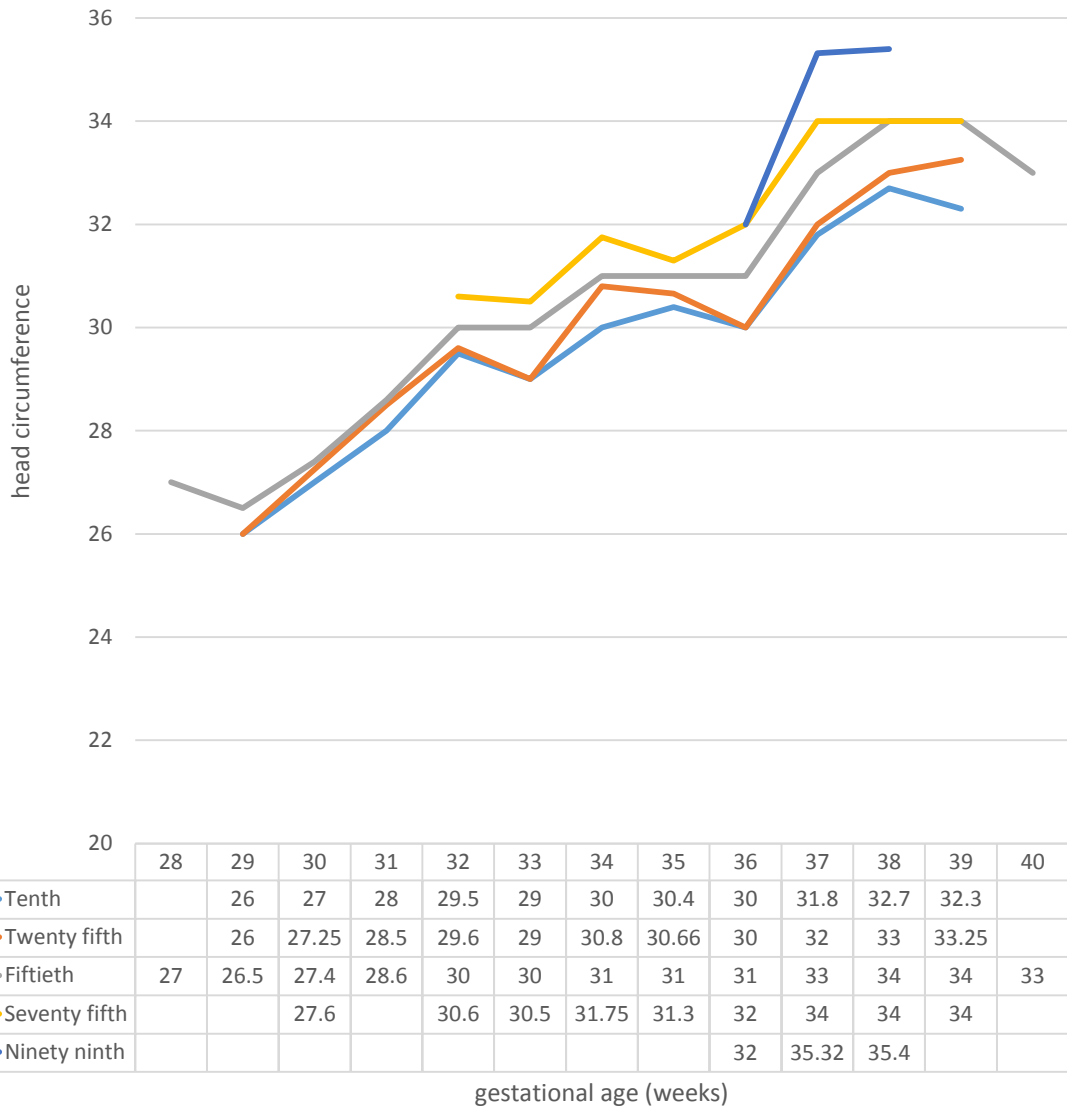


	28	29	30	31	32	33	34	35	36	37	38	39	40
Tenth		1.133	1.26	1.26	1.1	1.32	1.75	1.8965	1.9	2.5	2.75	2.9	
Twenty fifth		1.133	1.28	1.26	1.325	1.5	2	2.065	2.1	2.7	2.8	3	
Fiftieth	1.08	1.1695	1.35	1.33	1.5	2	2.2	2.2	2.3	2.8	3	3.25	3.8
Seventy fifth			1.7		1.65	2.1	2.375	2.33	2.5	3	3.2	3.5	
Ninety ninth									2.922	3.4			

gestational age (weeks)

— Tenth
 — Twenty fifth
 — Fiftieth
 — Seventy fifth
 — Ninety ninth

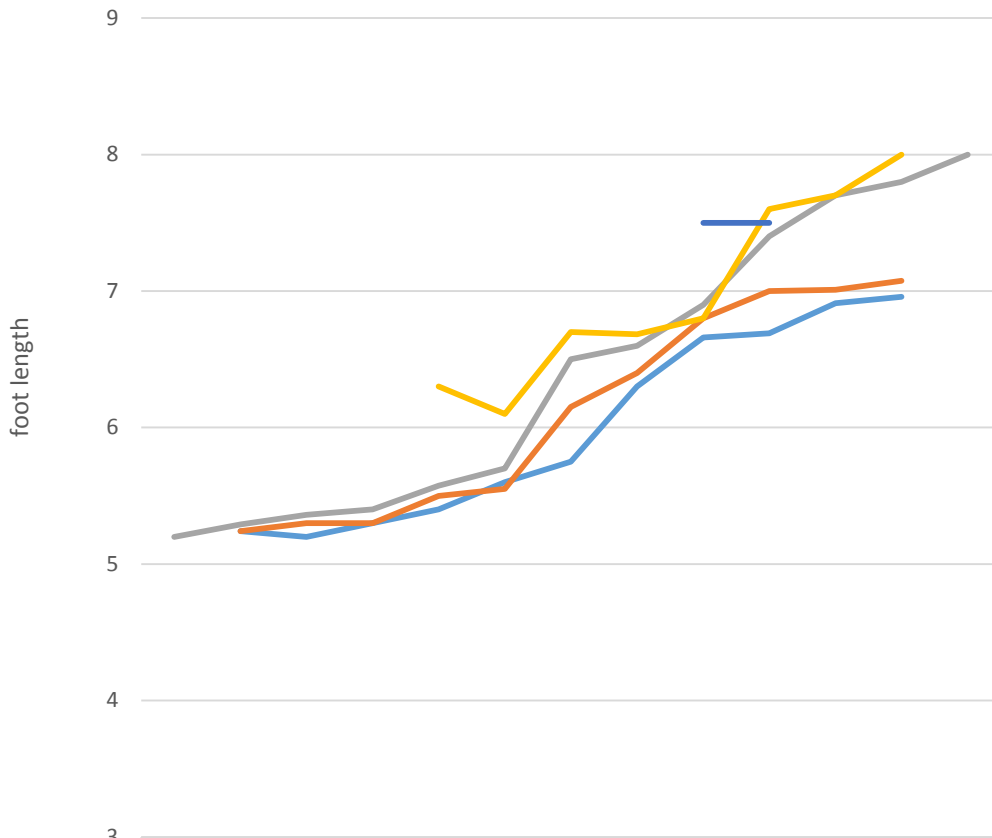
1.2) HC percentile chart



— Tenth — Twenty fifth — Fiftieth — Seventy fifth — Ninety ninth

UM

1.3)FL percentile chart

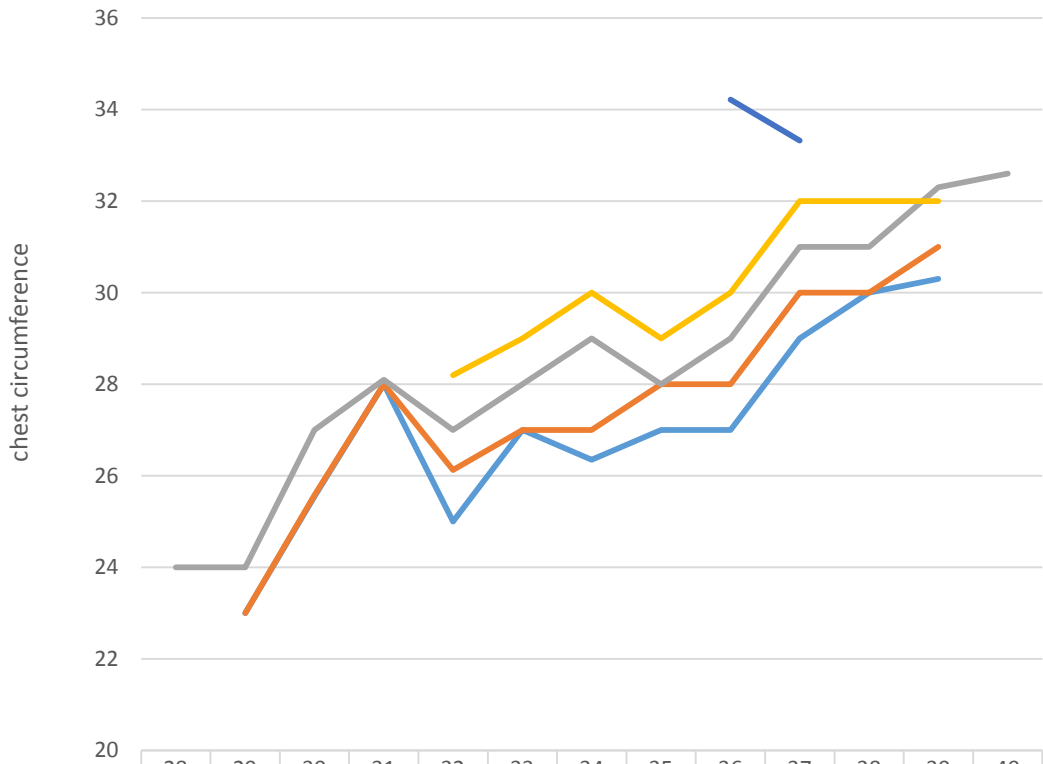


	28	29	30	31	32	33	34	35	36	37	38	39	40
Tenth		5.24	5.2	5.3	5.4	5.6	5.75	6.3	6.66	6.69	6.91	6.958	
Twenty fifth		5.24	5.3	5.3	5.5	5.55	6.15	6.4	6.8	7	7.01	7.075	
Fiftieth	5.2	5.29	5.36	5.4	5.575	5.7	6.5	6.6	6.9	7.4	7.7	7.8	8
Seventy fifth			5.765		6.3	6.1	6.7	6.6825	6.8	7.6	7.7	8	
Ninety ninth									7.5	7.5			

gestational age (weeks)

— Tenth
 — Twenty fifth
 — Fiftieth
 — Seventy fifth
 — Ninety ninth
 —

1.4)CC percentile chart



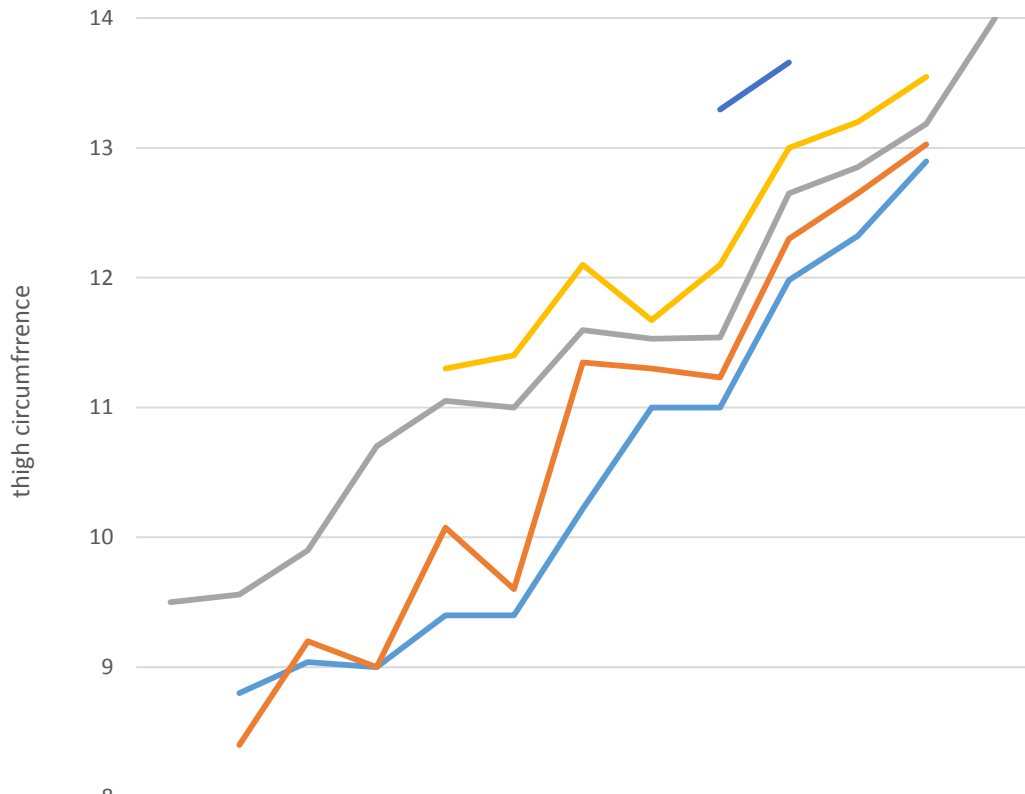
	28	29	30	31	32	33	34	35	36	37	38	39	40
Tenth		23	25.55	28	25	27	26.35	27	27	29	30	30.3	
Twenty fifth		23	25.575	28	26.125	27	27	28	28	30	30	31	
Fiftieth	24	24	27	28.1	27	28	29	28	29	31	31	32.3	32.6
Seventy fifth			29		28.2	29	30	29	30	32	32	32	
Ninety ninth									34.22	33.32			

gestational age (weeks)

— Tenth — Twenty fifth — Fiftieth — Seventy fifth — Ninety ninth

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1.5)TC percentile chart

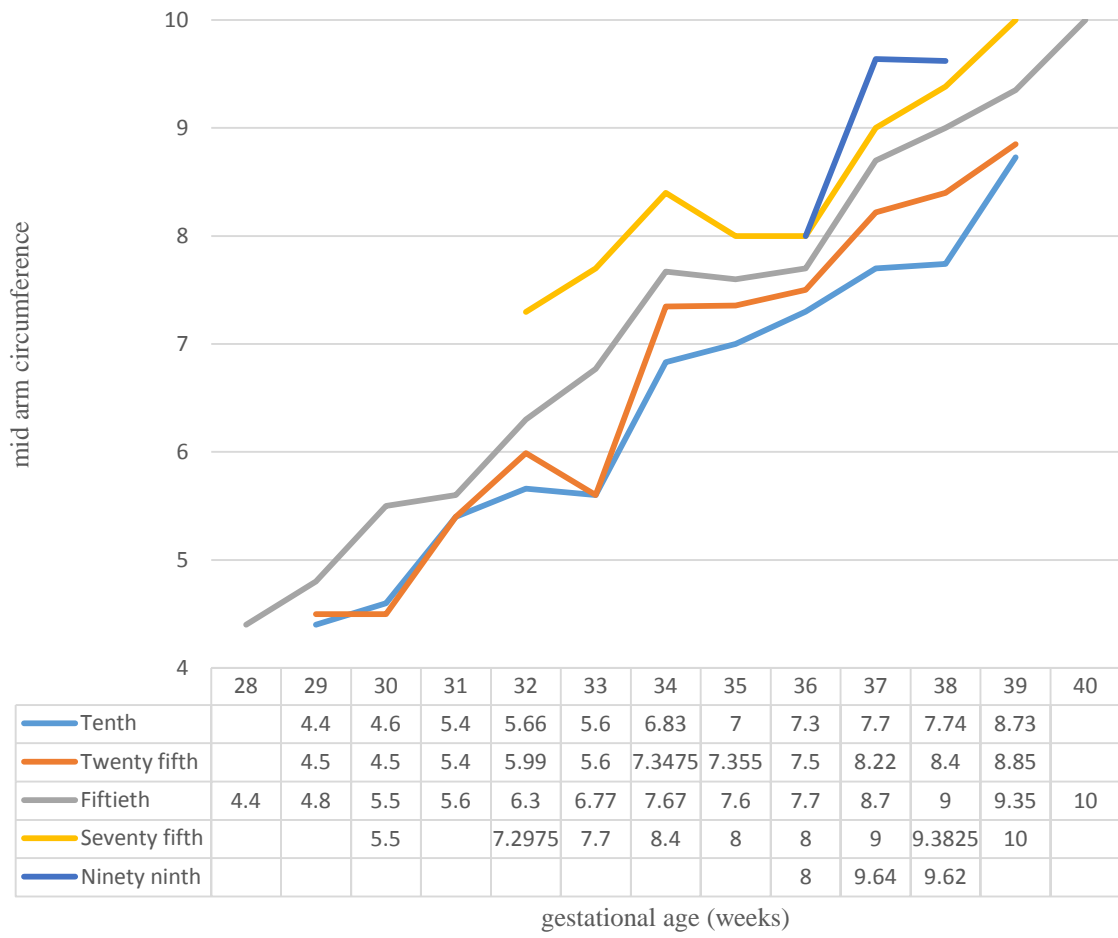


	28	29	30	31	32	33	34	35	36	37	38	39	40
Tenth		8.8	9.04	9	9.4	9.4	10.22	11	11	11.98	12.321	12.895	
Twenty fifth		8.4	9.2	9	10.075	9.6	11.348	11.3	11.23	12.3	12.65	13.025	
Fiftieth	9.5	9.56	9.9	10.7	11.05	11	11.595	11.53	11.54	12.65	12.85	13.185	14
Seventy fifth			10.5		11.3	11.4	12.1	11.673	12.1	13	13.2	13.548	
Ninety ninth									13.296	13.656			

gestational age (weeks)

— Tenth
 — Twenty fifth
 — Fiftieth
 — Seventy fifth
 — Ninety ninth

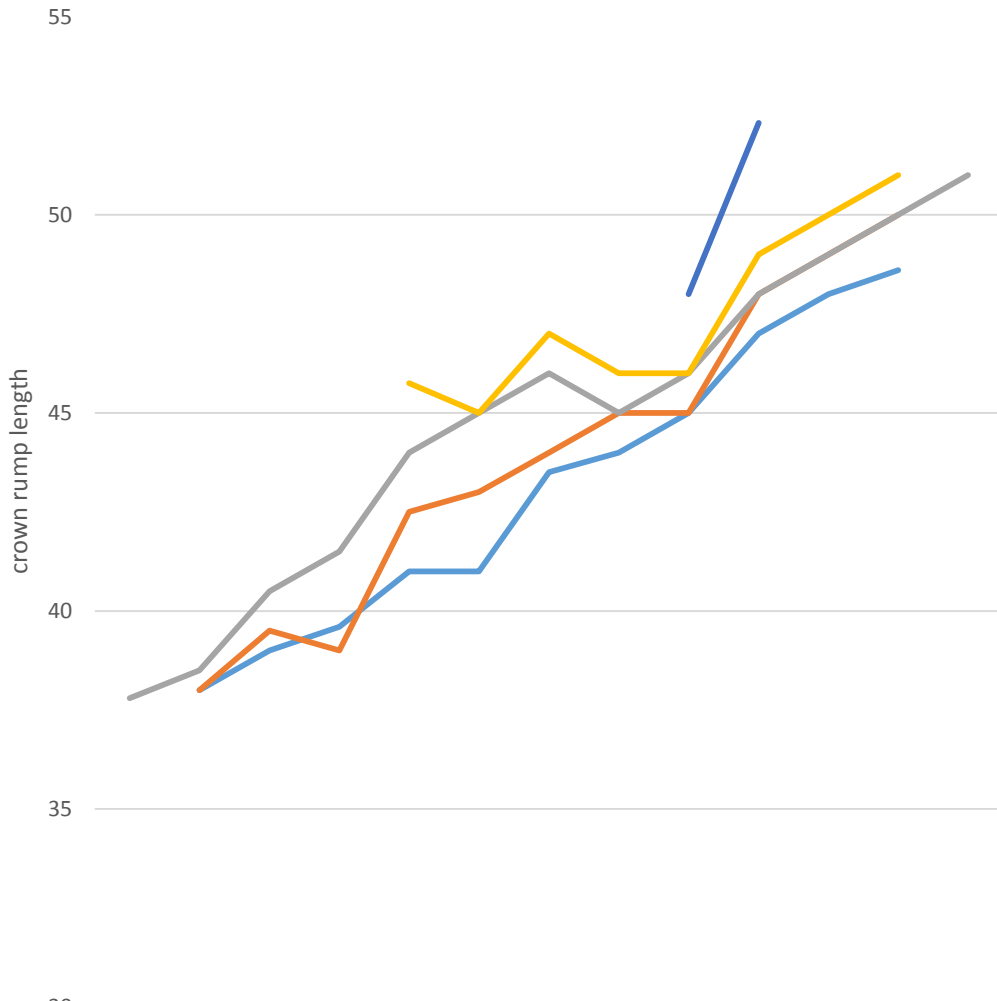
1.6)MAC percentile chart



— Tenth — Twenty fifth — Fiftieth — Seventy fifth — Ninety ninth

UNDER

1.7)CHL percentile chart



	28	29	30	31	32	33	34	35	36	37	38	39	40
Tenth		38	39	39.6	41	41	43.5	44	45	47	48	48.6	
Twenty fifth		38	39.5	39	42.5	43	44	45	45	48	49	50	
Fiftieth	37.8	38.5	40.5	41.5	44	45	46	45	46	48	49	50	51
Seventy fifth			40.6		45.75	45	47	46	46	49	50	51	
Ninety ninth									48	52.32			

— Tenth
 — Twenty fifth
 — Fiftieth
 — Seventy fifth
 — Ninety ninth
 gestational age (weeks)

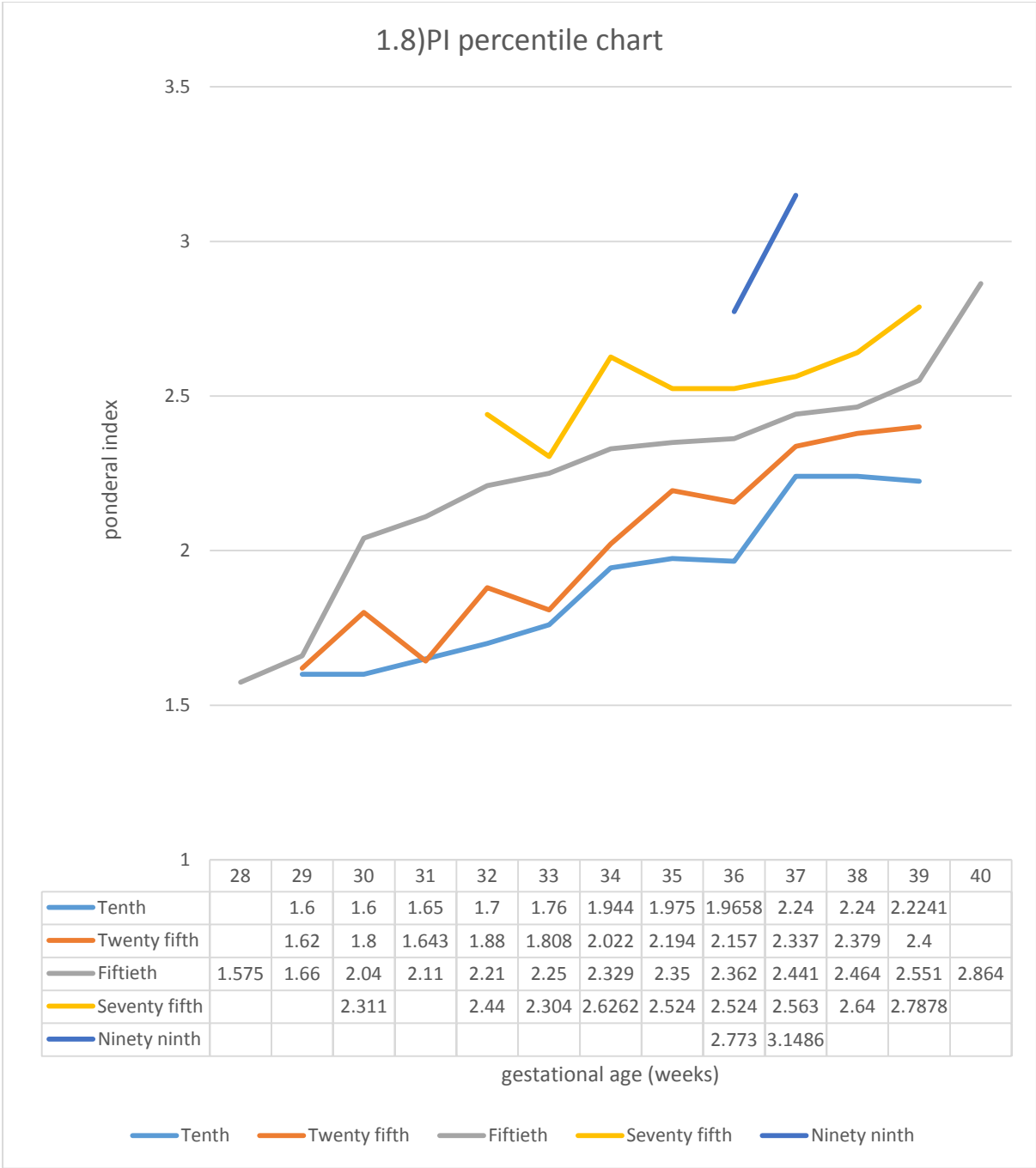
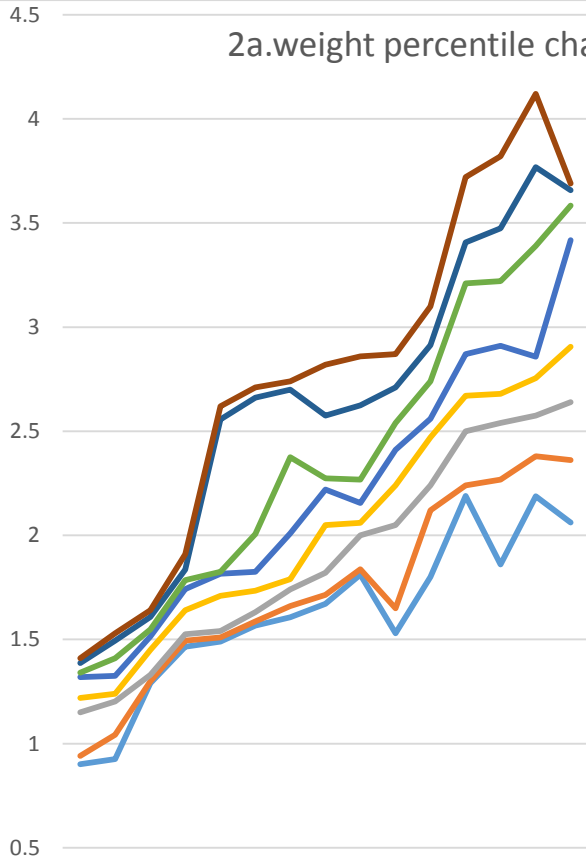


Figure 2: percentile charts Shah Study⁷

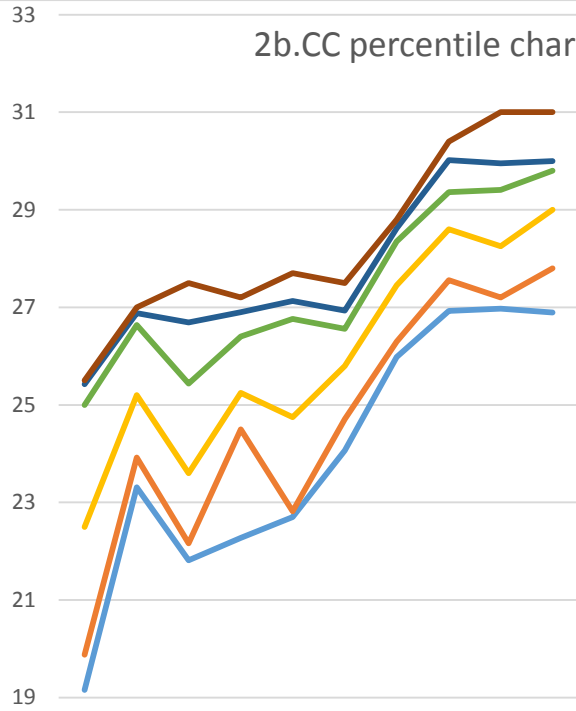
2a.weight percentile chart



- Third
- Tenth
- Twenty fifth
- Fifteth
- Seventy fifth
- Nintieth
- Ninty seventh
- Hundredth

	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Third	0.9	0.9	1.3	1.5	1.5	1.6	1.6	1.7	1.8	1.5	1.8	2.2	1.9	2.2	2.1
Tenth	0.9	1	1.3	1.5	1.5	1.6	1.7	1.7	1.8	1.7	2.1	2.2	2.3	2.4	2.4
Twenty fifth	1.2	1.2	1.3	1.5	1.5	1.6	1.7	1.8	2	2.1	2.2	2.5	2.5	2.6	2.6
Fifteth	1.2	1.2	1.5	1.6	1.7	1.7	1.8	2.1	2.1	2.2	2.5	2.7	2.7	2.8	2.9
Seventy fifth	1.3	1.3	1.5	1.7	1.8	1.8	2	2.2	2.2	2.4	2.6	2.9	2.9	2.9	3.4
Nintieth	1.3	1.4	1.5	1.8	1.8	2	2.4	2.3	2.3	2.5	2.7	3.2	3.2	3.4	3.6
Ninty seventh	1.4	1.5	1.6	1.8	2.6	2.7	2.7	2.6	2.6	2.7	2.9	3.4	3.5	3.8	3.7
Hundredth	1.4	1.5	1.6	1.9	2.6	2.7	2.7	2.8	2.9	2.9	3.1	3.7	3.8	4.1	3.7

2b.CC percentile chart

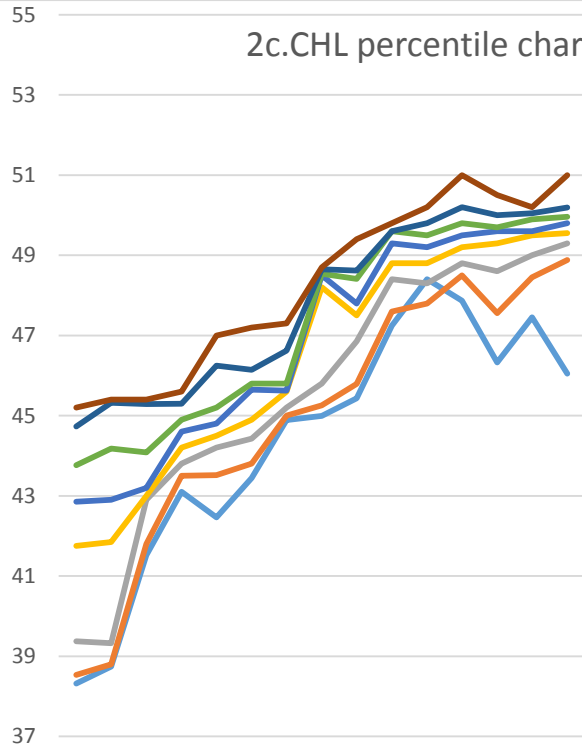


- THIRD CC
- Tenth
- Fifteth
- Nintieth
- Ninty seventh
- Hundredth

	28	29	30	31	32	33	34	35	36	37
THIRD CC	19.16	23.31	21.82	22.28	22.7	24.07	25.98	26.93	26.97	26.89
Tenth	19.88	23.92	22.16	24.5	22.82	24.71	26.3	27.56	27.2	27.8
Fifteth	22.5	25.2	23.62	25.25	24.75	25.8	27.45	28.6	28.25	29
Nintieth	25	26.64	25.44	26.4	26.76	26.56	28.35	29.36	29.41	29.8
Ninty seventh	25.42	26.88	26.69	26.9	27.13	26.93	28.62	30.02	29.96	30
Hundredth	25.5	27	27.5	27.2	27.7	27.5	28.8	30.4	31	31

UNDER

2c.CHL percentile chart

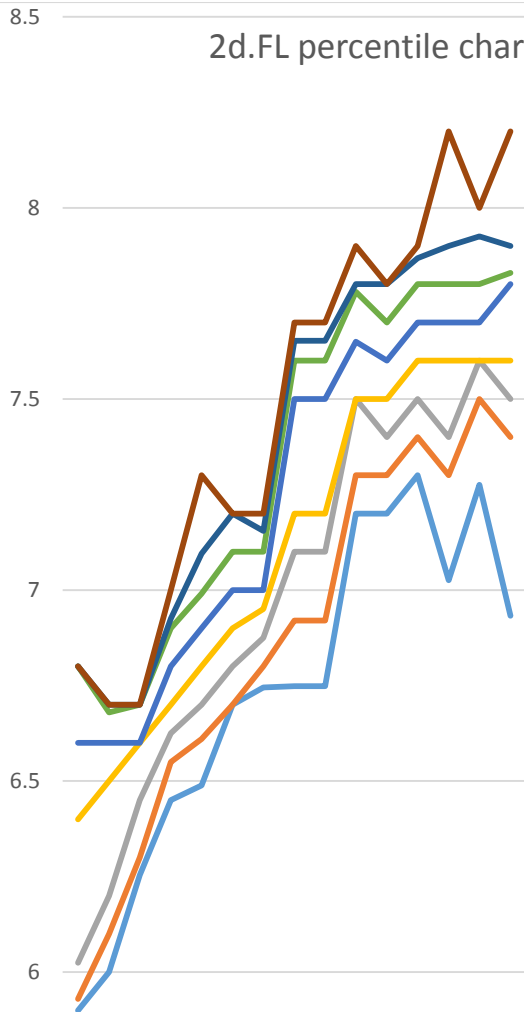


- third chl
- Tenth
- Twenty fifth
- Fifteth
- Seventy fifth
- Nintieth
- Ninty seventh
- Hundredth

	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
third chl	38	39	42	43	42	43	45	45	45	47	48	48	46	47	46
Tenth	39	39	42	44	44	44	45	45	46	48	48	49	48	48	49
Twenty fifth	39	39	43	44	44	44	45	46	47	48	48	49	49	49	49
Fifteth	42	42	43	44	45	45	46	48	48	49	49	49	49	50	50
Seventy fifth	43	43	43	45	45	46	46	49	48	49	49	50	50	50	50
Nintieth	44	44	44	45	45	46	46	49	48	50	50	50	50	50	50
Ninty seventh	45	45	45	45	46	46	47	49	49	50	50	50	50	50	50
Hundredth	45	45	45	46	47	47	47	49	49	50	50	51	51	50	51

UNDETECT

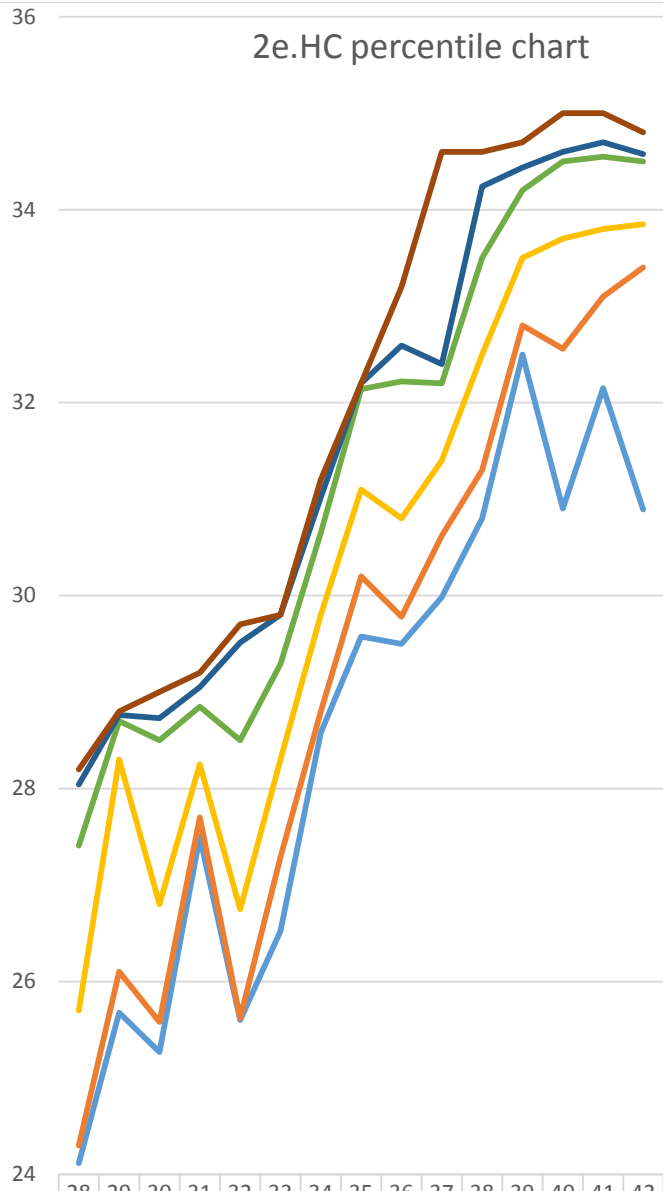
2d.FL percentile chart



- THIRD FL
- Tenth
- Twenty fifth
- Fifteth
- Seventy fifth
- NINTIETH
- Ninty seventh
- Hundredth

	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
THIRD FL	5.9	6	6.36	6.56	6.56	6.76	6.76	6.76	6.77	6.77	6.77	6.77	6.77	6.77	6.77
Tenth	5.96	6.16	6.36	6.66	6.66	6.76	6.86	6.96	6.97	6.97	6.97	6.97	6.97	6.97	6.97
Twenty fifth	6	6.26	6.56	6.66	6.76	6.86	6.97	6.97	6.97	6.97	6.97	6.97	6.97	6.97	6.97
Fifteth	6.46	6.56	6.66	6.76	6.86	6.9	7	7.27	7.27	7.57	7.57	7.67	7.67	7.67	7.67
Seventy fifth	6.66	6.66	6.66	6.86	6.9	7	7	7.57	7.57	7.77	7.67	7.77	7.77	7.77	7.77
NINTIETH	6.86	6.76	6.76	6.9	7	7.17	7.17	6.76	6.76	6.87	6.77	6.87	6.87	6.87	6.87
Ninty seventh	6.86	6.76	6.76	6.97	6.97	6.97	6.97	6.97	6.97	6.97	6.97	6.97	6.97	6.97	6.97
Hundredth	6.86	6.76	6.77	7	7.37	6.27	6.27	6.77	6.77	6.97	6.87	6.98	6.28	6.28	6.28

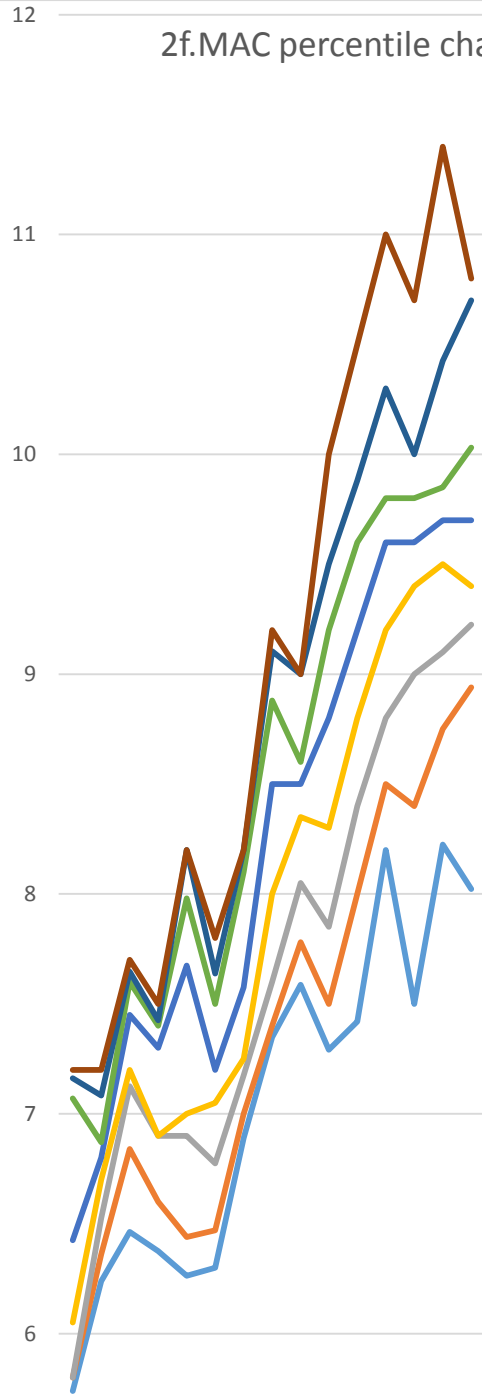
2e.HC percentile chart



	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
THIRD HC	24.1	25.7	25.3	27.5	25.6	26.5	28.6	29.6	29.5	30.8	32.5	30.9	32.3	30.9	
Tenth	24.3	26.1	25.6	27.5	25.6	27.3	28.8	30.2	29.8	30.6	31.3	32.8	32.6	33.1	33.4
Fifteth	25.7	28.3	26.8	28.3	26.8	28.3	29.8	31.1	30.8	31.4	32.5	33.5	33.7	33.8	33.9
Nintieth	27.4	28.7	28.5	28.9	28.5	29.3	30.7	32.1	32.2	32.3	33.4	34.2	34.5	34.6	34.5
Ninty seventh	28.2	28.8	28.7	29.1	29.5	29.8	31.2	32.2	32.6	32.4	34.2	34.4	34.6	34.7	34.6
Hundredth	28.2	28.8	29.2	29.7	29.7	29.8	31.2	32.2	33.2	34.6	34.6	34.7	35.0	35.0	34.8

- THIRD HC
- Tenth
- Fifteth
- Nintieth
- Ninty seventh
- Hundredth

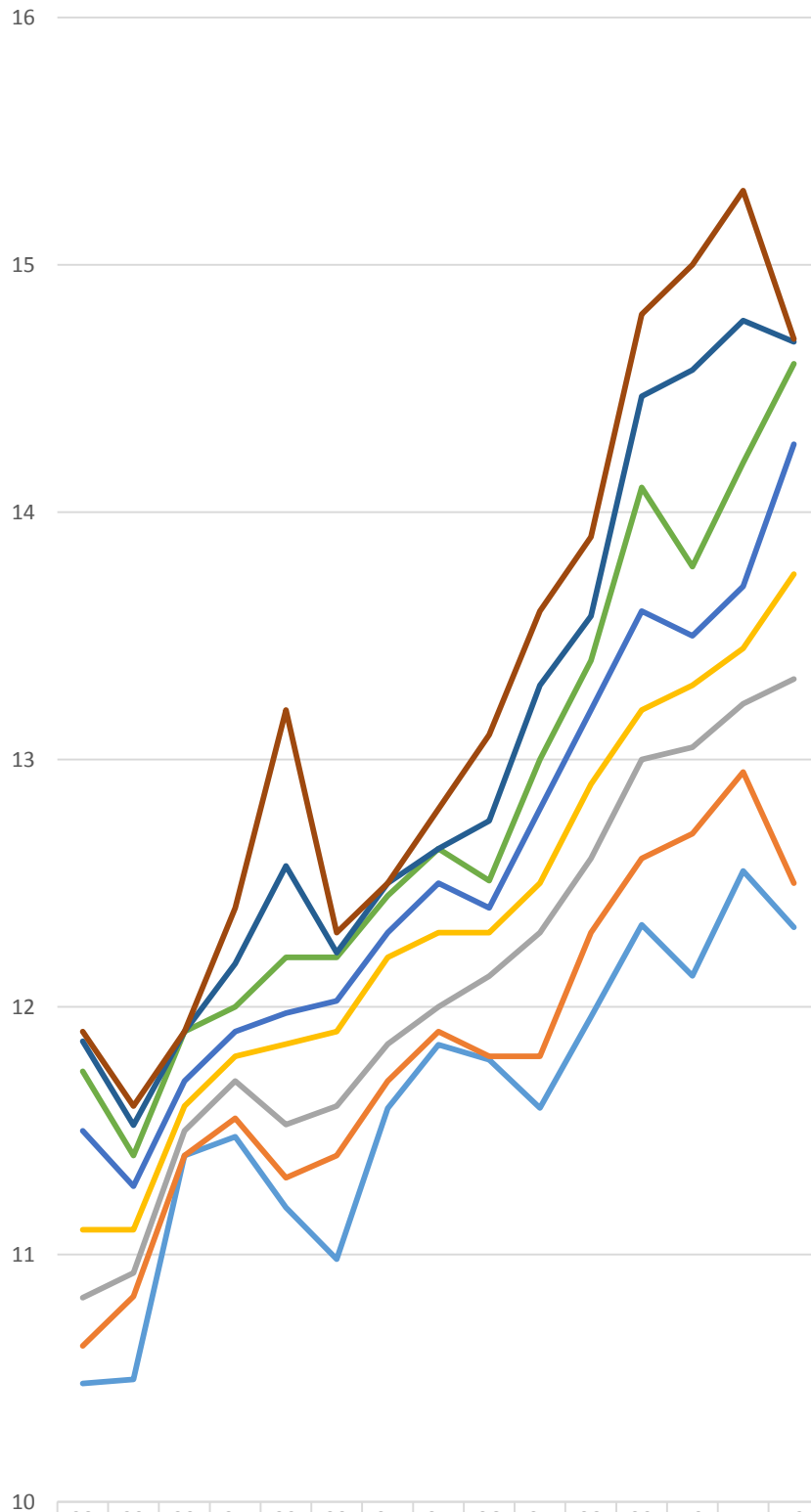
2f.MAC percentile chart



	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
thirdmac	5.76	6.26	6.56	6.46	6.36	6.97	7.37	7.67	7.37	7.48	7.27	7.58	7.2	8	
Tenth	5.86	6.46	6.86	6.66	6.46	6.57	7.47	7.87	7.58	8.58	8.48	8.88	8.9		
Twenty fifth	5.86	6.57	6.16	6.96	6.96	6.87	7.68	8.17	8.98	8.48	8.89	9.19	9.2		
Fifteth	6.16	6.77	6.26	6.97	7.17	7.38	8.48	8.38	8.89	9.29	9.49	9.59	9.4		
Seventy fifth	6.46	6.87	6.57	6.37	6.77	6.27	6.68	6.58	6.58	6.89	6.29	6.69	6.69	6.79	7
Nintieth	7.16	6.97	6.67	6.48	6.88	7.58	7.18	7.98	6.99	6.29	6.69	6.89	6.89	6.9	10
Ninty seventh	7.27	6.17	6.67	6.48	6.27	6.68	6.29	6.19	6.99	6.59	6.910	6.10	6.10	6.11	
Hundredth	7.27	6.27	6.77	6.58	6.27	6.88	6.29	6.29	6.910	6.11	6.11	6.11	6.11	6.11	

- thirdmac
- Tenth
- Twenty fifth
- Fifteth
- Seventy fifth
- Nintieth
- Ninty seventh

2g.TC percentile chart

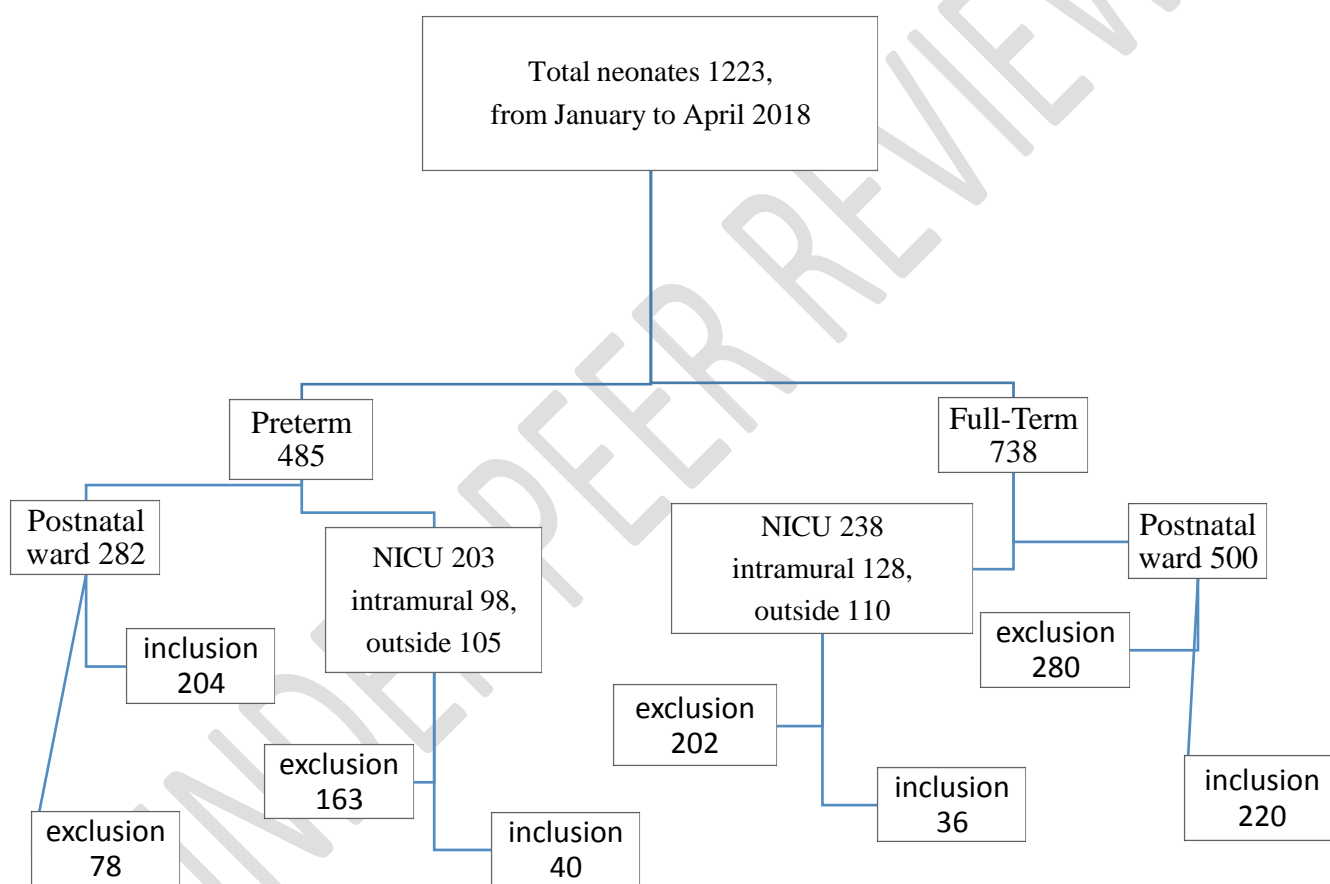


	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
third mtc	10.5	10.5	11.4	11.5	11.2	11	11.6	11.8	11.8	11.6	12	12.3	12.1	12.6	12.3
Tenth	10.6	10.8	11.4	11.6	11.3	11.4	11.7	11.9	11.8	11.8	12.3	12.6	12.7	13	12.5
Twenty fifth	10.8	10.9	11.5	11.7	11.5	11.6	11.9	12	12.1	12.3	12.6	13	13.1	13.2	13.3
Fifteth	11.1	11.1	11.6	11.8	11.9	11.9	12.2	12.3	12.3	12.5	12.9	13.2	13.3	13.5	13.8
Seventy fifth	11.5	11.3	11.7	11.9	12	12	12.3	12.5	12.4	12.8	13.2	13.6	13.5	13.7	14.3
Nintieth	11.7	11.4	11.9	12	12.2	12.2	12.5	12.6	12.5	13	13.4	14.1	13.8	14.2	14.6
Ninty seventh	11.9	11.5	11.9	12.2	12.6	12.2	12.5	12.6	12.8	13.3	13.6	14.5	14.6	14.8	14.7
Hundredth	11.9	11.6	11.9	12.4	13.2	12.3	12.5	12.8	13.1	13.6	13.9	14.8	15	15.3	14.7

third mtc Tenth Twenty fifth Fifteth

Figure 3

Flowchart: study design



UNDER PEER REVIEW

Figure 4 Distribution of newborns according to gestational age

