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Original Article

Anthropometric Measurements for Egyptian Preterms at Birth: Single Center Pilot Study

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Abstract:
Background: Assessment of fetal growth is a major part of antenatal and perinatal care. It reflects the intrauterine environment quality. Developed countries seem to have larger fetuses than developing countries. Birth body length and head circumference (HC) of the newborn are crucial prognostic parameters in determining intrauterine growth.
Aim of work: We aimed to pilot a study to determine whether Fenton charts are applicable to Egyptian preterms.
Materials and Methods: This single-center cross-sectional pilot study included 2001 preterm newborns < 37 weeks gestational age. A single measurement of weight, length, and HC was measured at birth from preterms who were not born to diabetic mothers, or mothers with hypertension, do not have chromosomal or structural abnormalities, congenital cyanotic heart diseases, intrauterine growth retardation, and multiple births. We created anthropometric measurements curves using Lambda Mu Sigma (LMS) chart-maker Pro (version 2, 2006) and compared them with Fenton growth charts for preterms.
Results: The weight percentiles of our studied preterms were similar to those of Fenton´s in all gestational ages. The 3rd percentile of length among female preterms, and their 3rd and 97th percentiles for head circumference were significantly higher than Fenton's data ($p = 0.018$). Only the 3rd and 97th percentiles of HC measurements for our studied boys were significantly higher than Fenton's measurements ($p = 0.031$) and ($p = 0.016$) respectively. Boys (n=1063) were heavier than girls (n= 983) ($p = 0.003$). Boys were taller than girls, and had bigger head circumference than girls ($p = 0.009$) and ($p = 0.000$) respectively.
Conclusion: Anthropometric measurements of our large studied cohort of preterms was in close agreement of the measurements of Fenton growth charts, apart from the larger head circumference encountered among our studied cohort. Fenton charts are applicable to Egyptian preterms.

Level of Evidence of Study: IIA. (*1*)
Keywords: Anthropometric measures; preterms; growth charts
Abbreviations: AGA: appropriate for gestational age; BW: birth weight; CS: caesarean section; HC: head circumference; GA: gestational age; IBP: international biological program; IQR: inter quartile ratio; IUGR: intra uterine growth restriction; LGA: large for gestational age; LMP: last menstrual period; PROM: premature rupture of membranes; SGA: small for gestational age; WHO: world health organization; US: ultrasound.

Introduction

Birth weight (BW), head circumference (HC), and length at birth of newborns are the main clinical measure of prenatal growth as they estimate intrauterine growth (*2*). World Health Organization (WHO) recommends their assessment in evaluating and monitoring perinatal results (*3*). It is accepted worldwide that BW is an important predictor of fetal and neonatal health. Smaller BW is strongly associated with child mortality in different age groups, starting from the fetal period and ongoing (*4*). Prematurity is defined as an infant born < 37 weeks gestation. It associated with smaller measurements. Catch up occurs by the age of 2 years and can extend up to 3 years of age in severe prematurity and intrauterine growth restriction (IUGR) (*5*). Growth curves are standardized to classify measurements of newborns based on their birth proportions (weight, length, HC) and gestational age (GA), these curves determine deviation from comparable are and gender accepted norms and allow proper management plans and identification of risk factors (*6*). Small for gestational age (SGA) is coined to those recognized to be below the 10th percentile while appropriate for gestational age (AGA) is for those in the middle range between the 10th and 90th percentiles and large for gestational age (LGA) for those above the 90th percentile. Intrauterine growth restriction (IUGR) is clarified as estimated fetal weight < 10 percentile, other definitions of IUGR include estimated weight < 2 standards deviations below the mean for the GA (*7*).

The HC and length charts depend on correct estimation of true gestational age. The charts are specific to the ethnic group from a geographic area, the generalization of their use requires that their creation was a product of statistically calculated sample from a diversity of ethnic groups and geographic areas. The differences among norms of charts reflect inherent inequality of traits, health services and environmental factors (*8*).

The Lubchenco (1963) charts, were the first for preterms, these charts comprised weight, length, HC, and Ponderal index [weight (grams)*100/length (cm3)], allowing the comparing weight-for-length at birth from various GA (*9*). The Babson and Benda (1976) charts "fetal-infant growth graph" was obtained from a smaller sample size of neonates born between 26 till 40 weeks GA (*10*). National Egyptian curves of anthropometric measures of preterm infants at birth and their comparison with the established international charts for preterms (Fenton's growth charts) are lacking. We aimed to pilot a study to determine whether Fenton charts are applicable to Egyptian preterms.

Subjects and Methods

Our cross-sectional analytical study, included a purposeful sample of 2001 preterms on the first day of life, < 37 weeks of gestation, recruited from the neonatal intensive care unit (NICU) of the Department of Pediatrics, Cairo University hospitals over a 6-month duration. Preterms with chromosomal or genetic abnormalities, infants born to diabetic mothers, and mothers with hypertension, IUGR, and multiple births were excluded. The study protocol was approved by the council of the Pediatrics Department, Faculty of Medicine, Cairo University, and ethical committee approval were done through the Pediatrics department committee. Confidentiality in handling the database was guaranteed and the privacy of participants was ensured. The requirements of the Revised Helsinki Declaration of Bioethics were followed while designing the study (2013) (*11*).

Participants

All the care takers of preterms included were subjected to full history taking, and full maternal history. Clinical assessments for all preterms were performed. Preterms with missing information regarding GA or sex were excluded. We also excluded cases of caput succedaneum and cephalohematoma to avoid false results in HC measurements. We excluded preterms with obvious chromosomal or genetic abnormalities, infants born to diabetic mothers and mothers with hypertension, IUGR, and multiple births were excluded.

Methods

- Gestational age assessment

The findings of an early dating ultrasound (US) were used in the calculation of GA, or it was estimated from the last menstrual period (LMP). After birth, the GA of each was estimated using the new Ballard score (*12*). We included infants whose calculated gestation agreed within one week with postnatal GA assessment.

- Family History

Parents or the caregivers were asked relevant questions to identify maternal disease and family socioeconomic status. The questions included the following points: (1) level of education of each parent: (Illiteracy or incomplete primary education, (2) primary education, preparatory education, secondary school general or technical or University degree, (3) occupation of each parent (student or unemployed, unskilled worker, skilled worker, employee or professional).

- Anthropometric Measurements: A single measurement of length, weight, and HC at birth was recorded. Weight: The weight of the naked preterms was measured to the nearest 5 grams by using a standard digital scale (LACIA, Italy). Calibration before each measurement was assured, according to the international biological program (IBP) (*13*). Length: Supine length (Crown-Heel length): Using an Infantometer (Advin Health Care Company, India). Measurements for a single neonate was done by 2 personnel. The infant's head was held against the headboard with both lower limbs extended and another held the footboard up against both heels. Skull Circumference: Occipitofrontal HC was measured using a flexible, non-stretchable Lasso tape applied just above the eyebrows, above the ears, and crossing the occipital protuberance on the back.

- Data collection:

The attending pediatrician collected the measurements 3-4 times per week for 8-12 hours. The inclusion criteria were met. The data regarding the social survey questionnaire, residence, and maternal data was collected by the researcher from the parents or caregivers. All the anthropometric measurements were checked by the researcher within 24 hours after birth.

- Creating Percentile Charts:

Using the studied data, anthropometric measurements growth curves were created by using Lambda Mu Sigma (LMS) chart-maker Pro (version 2, 2006), (Harlow Printing Ltd, England) creating smoothed percentile curves for the 3rd, 10th, 25th, 50th, 75th, 90th, and 97th percentiles. This LMS method obtains homogenized growth centile standards, which is considered simpler. The curves were created by using LMS chart-maker. The LMS method measures 3 parameters at equivalent degrees of freedom (EDF): skewness (l), median(m), and coefficient of variation(s) (*14*). Our reported anthropometric measurements were plotted on Fenton international growth charts for preterms (*15*) to compare our study measurements with them.

Statistical Analysis

All the data was revised for completeness and logical consistency. Pre-coded data were entered using the Microsoft Office Excel software program for windows and were then transferred to the statistical package of the social science software program, version 16 (SPSS) (IBM, USA). Statistical analysis was performed. Data summarization was obtained by descriptive statistics and data checking from simple frequencies. Quantitative data were presented using mean and standard deviation (SD) for normally distributed and median with interquartile range (IQR) for not normally distributed data. Bi-variate relationships were displayed in cross-tabulation. Using T-test and Mann Whitney tests to compare the groups. One sample t-test was used to compare different anthropometric measurements of studied preterm infants with Fenton growth charts, the least statistical significance level used was a P-value of ≤ 0.05. The percent difference for the 3rd, 50th, and 97th percentiles was calculated using the following formula:

$$\frac{(\textbf{the study measurement} - \textbf{Fenton measurement})}{\textbf{the study measurement}} \times \mathbf{100}$$

Results

This single-center study was conducted on 2001 preterm neonates < 37 weeks GA at the NICU of Cairo University hospitals. It compared anthropometric measurements of Egyptian preterms (weight, length, and HC) with the internationally established Fenton growth chart for preterms. The studied group of preterms comprised1063 (53.1%) males and 938 (46.9%) females, of them 579 (29%) were delivered vaginally and 1422 (71%) via Caesarean section (CS). The range of GA of the study was 26 – 36 weeks with a mean of 32 weeks. The mean GA among male preterms was 33 weeks ± 2.5 SD and in female preterms was 32.8 weeks ± 2.5 SD. The mean maternal age was 28 ± 5.3 years. Some maternal illnesses were detected; 776 (38.8%) had premature rupture of membranes, 170 (8.9%) had an antepartum hemorrhage and 89 (4.7%) had placenta previa which were the identified causes of prematurity. The weights of the studied preterms ranged between 610 and 4350 grams, the length range was 28-55 cm and the HC range was 24-45 cm. Figures 1-3 illustrate the anthropometric measurements plotted as charts for our studied preterm boys and girls.

The structured questionnaire that addressed socio-demographic characteristics of newborns and their residence revealed the following:

Maternal education: 374 (23.2%) mothers were illiterate and primary school graduates, 768 (47.6%) were preparatory and secondary school graduates and 470 (29.2%) represented the higher education category. Maternal occupation: the majority were housewives 1456 (89.2%), and 146(8.9%) represented the professional and employee categories. Father Education: 241 (18.4%) of the fathers were illiterate and primary school graduates, 592 (45.2%) were preparatory and secondary school graduates and 474 (36.3%) represented the higher education category. Father Occupation: The majority of fathers, 554 (59.1%) were (skilled or non-skilled) workers, 302 (23.2%) represented the employee category, 208 (15.9%) were from the professional category, and 24 (1.8%) were unemployed fathers.

Residence: 1495 (75.5%) of the studied group belonged to urban areas and 486 (24.5%) were from rural areas. The studied population were born to families belonging to 14 goverments , Giza (45%), Cairo(30.5%), El-Fayoum (7%), Beni-Suef (4%), El-Menia (3%), El-Sharqia (2%), El-Menofia (1%), Aswan (1%), Red sea (1%), Qena (0.5%), El-Qalyubia (2%), Sohag (1%), Kafr El-sheikh (1%) and El-Gharbia (1%).

The 3rd, 50th and 97th percentiles of weights, length and head circumference of our studied preterms are compared with Fenton growth charts week by week. (Tables 1 and 2) (Figures 4-9). Preterm boys in our study showed significantly larger weights, were taller, and with a bigger head circumference than girls with (p =0.009) and (p= 0.000) respectively. Only the 3rd and 97th percentiles of HC measurements for our studied boys were significantly higher than Fenton's measurements (p =0.031) and (p=0.016) respectively. The 3rd percentile of preterm girls for length, and the 3rd and 97th percentiles for HC were significantly higher than Fenton's measures (p= 0.017) for length and (p= 0.018) for HC percentiles. (Tables 3-5).

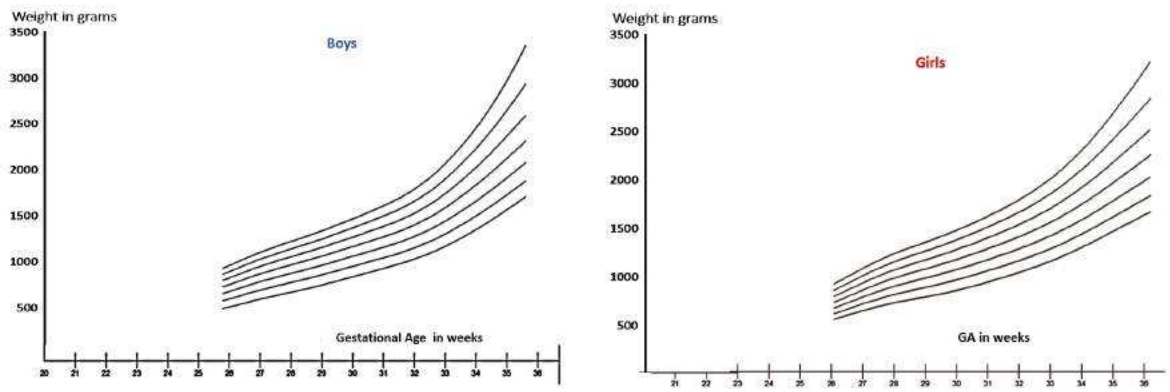

Figure 1. Weight percentiles for preterm boys and girls of the studied group smoothed by Lambda Mu Sigma (LMS).

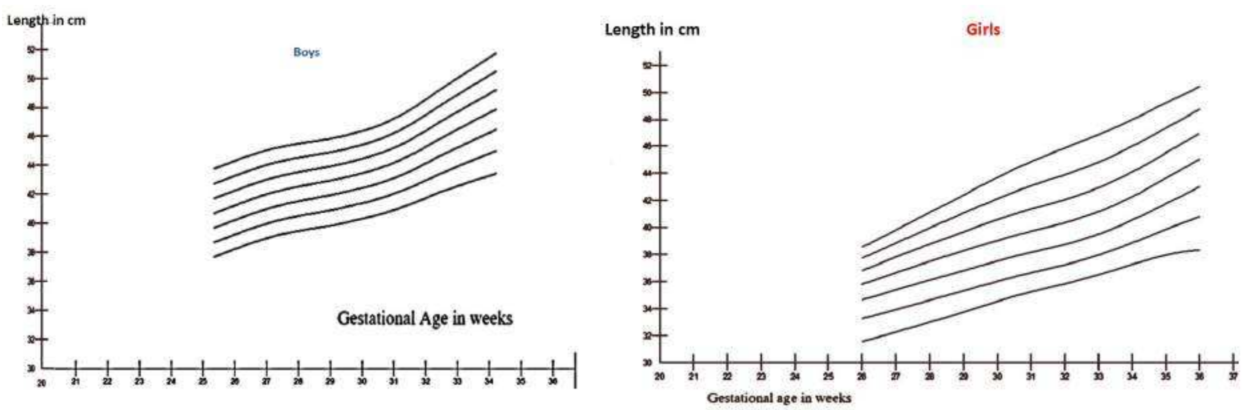

Figure 2. Length percentiles for preterm boys and girls of the studied group smoothed by Lambda Mu Sigma (LMS).

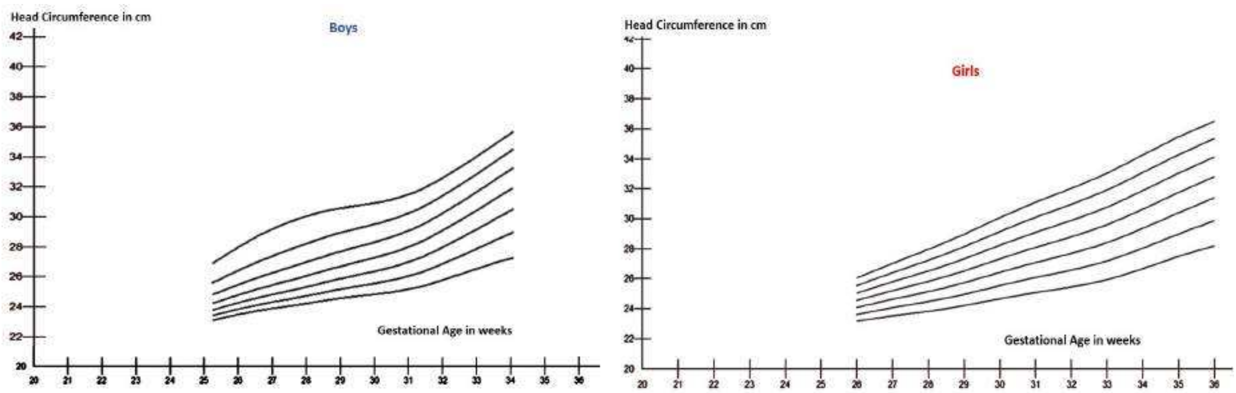

Figure 3. Head circumference percentiles for preterm boys and girls of the studied group smoothed by Lambda Mu Sigma (LMS).

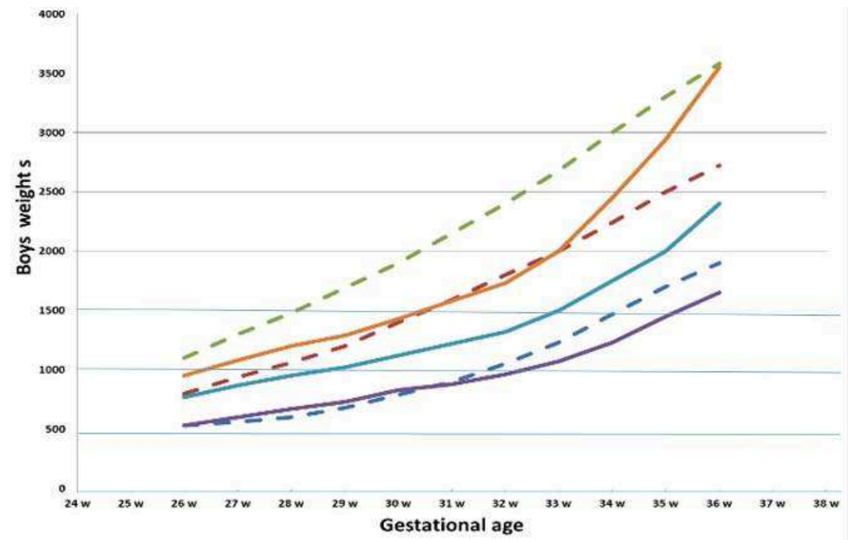

Figure 4. The 3rd, 50th and 97th percentiles of weight of preterm boys of studied group and Fenton growth charts for preterm boys. Dashed lines represent Fenton Chart percentiles. Straight lines represent our studied cohort percentiles.

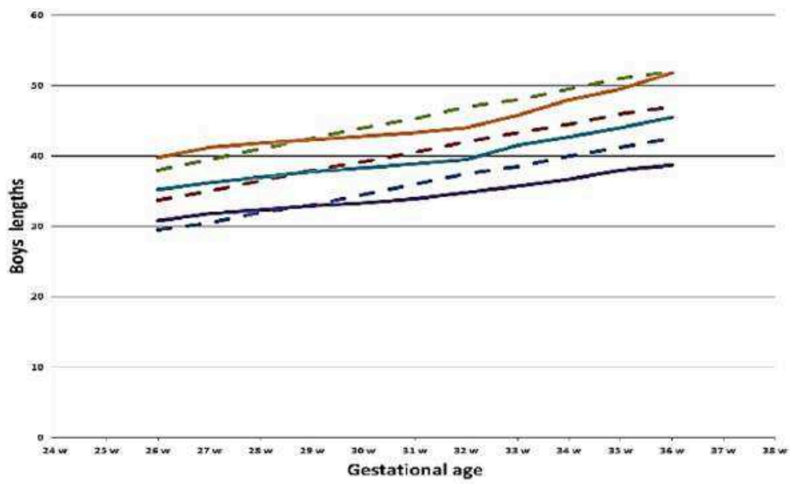

Figure 5. The 3rd, 50th and 97th percentiles of length of preterm boys of studied group and Fenton growth charts for preterm boys. Dashed lines represent Fenton Chart percentiles. Straight lines represent our studied cohort percentiles.

Table 1. Difference of Preterm Boys Percentiles between the studied group and Fenton growth charts by gestational age in weeks.

GA weeks	3rd % Fenton	3rd % study	% difference	50th % Fenton	50th % study	% difference	97th % Fenton	97th % study	% difference
Weight percentiles									
26w	530	630	15.9	800	697.4	-14.7	1100	1180	-6.30
27w	560	700	20	940	930	-1.1	1300	1270	2.30
28w	600	713.2	15.9	1060	1000	-6	1480	1287.2	-15
29w	680	740	8.1	1200	1080	-11.1	1690	1327.5	-27.3
30w	790	833.4	5.2	1400	1250	-12	1900	1443.2	-31.7
31w	900	1093.6	17.7	1590	1395	-14	2150	1609.6	-33.6
32w	1050	1125	6.7	1800	1395	-29	2400	1857.9	-29.2
33w	1230	1160.4	-6	2000	1560	-28.2	2680	1918.9	-39.7
34w	1470	1380.4	-6.5	2240	1910	-17.3	3000	2410	-24.5
35w	1700	1515.8	-12.2	2500	2100	-19	3300	2700	-22.2
36w	1900	1870.7	-1.6	2720	2544.9	-6.9	3580	3841.5	6.8
Length Percentiles									
26w	29.5	28	-5.4	33.7	35	1.3	39	40	-2.56
27w	30.5	32	4.7	35	36	1	39.5	41	-3.7
28w	32	34	5.9	36.5	38	1.5	41	45	8.9
29w	33	34.8	5.4	38	38.5	0.5	42.5	43	1.2
30w	34.5	32.3	-6.7	39.2	38	-1.2	44	42	-4.8
31w	36	35	-2.9	40.5	40	-0.5	45.3	43.6	-3.8
32w	37.5	35.4	-5.7	42	40	-2	47	44	-6.8
33w	38.5	37	-4.1	43.3	40	-3.3	48	46	-4.3
34w	40	38	-5.3	44.5	43	-1.5	49.5	48	-3.1
35w	41.2	38	-8.4	46	45	-1	51	49	-4.1
36w	42.5	40	-6.3	47	46	-1	52	51	-2
Head Circumference Percentiles									
26w	21	24	12.5	23.7	24.5	3.3	26	26	0
27w	22	25	12	24.5	26	5.8	27	27.5	-1.85
28w	23	25	8	25.5	26	1.9	28	29	3.4
29w	24	24.8	3.6	26.5	27	1.9	29	32	9.4
30w	25	24.3	-2.7	27.5	28	1.8	30.2	34	11.2
31w	25.8	25.6	-0.5	28.5	28	-1.8	31.2	31	-0.6
32w	26.8	26	-3.1	29.5	29	-1.7	32	32	0
33w	27.3	26	-5	30	29	-3.4	33	33	0
34w	28.2	27	-4.4	31	31	0	34	34.2	0.8
35w	29	28	-3.6	32	32	0	34.8	36	3.3
36w	30	28.1	-6.8	32.8	34	3.5	35.5	39	9

GA: gestational age.

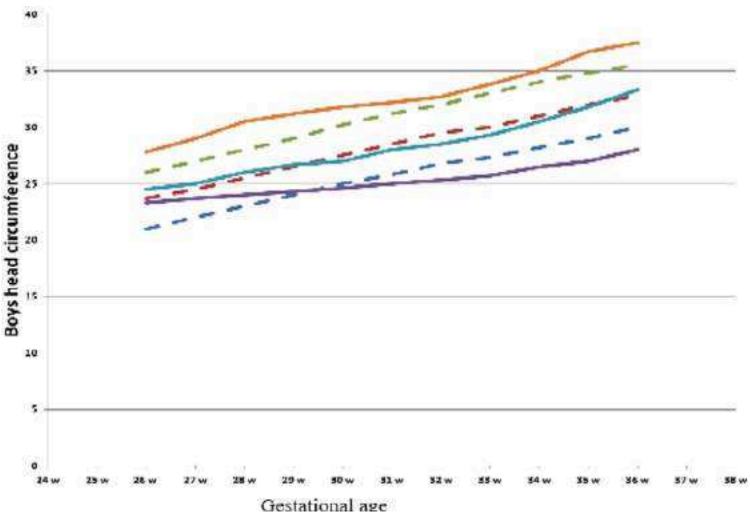

Figure 6. The 3rd, 50th and 97th percentiles of head circumference of preterm boys studied group and Fenton growth charts for preterm boys. Dashed lines represent Fenton Chart percentiles. Straight lines represent our studied cohort percentiles.

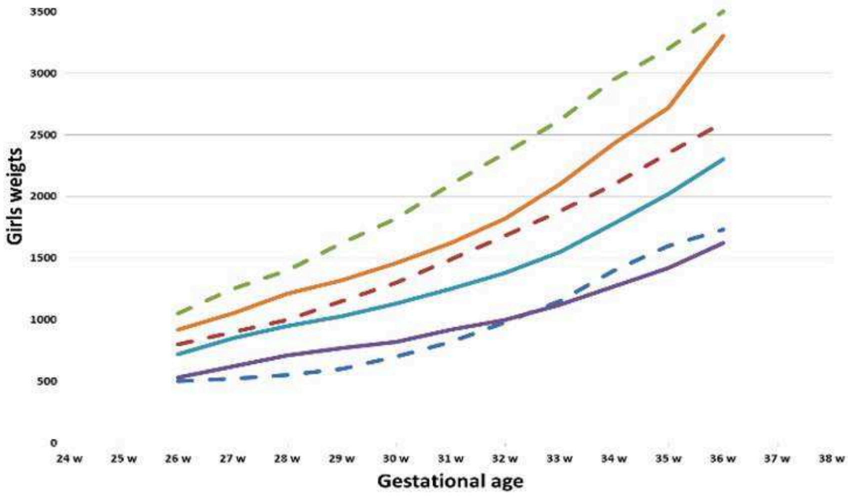

Figure 7. The 3rd, 50th and 97th percentiles of weight of preterm girls of studied group and Fenton growth charts for preterm girls. Dashed lines represent Fenton Chart percentiles. Straight lines represent our studied cohort percentiles.

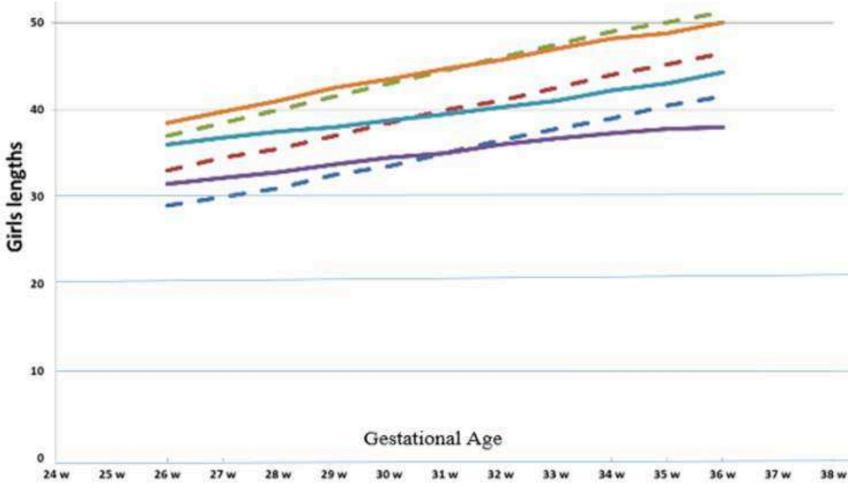

Figure 8. The 3rd, 50th and 97th percentiles of lengths of preterm girls of studied group and Fenton growth charts for preterm girls Dashed lines represent Fenton Chart percentiles. Straight lines represent our studied cohort percentiles.

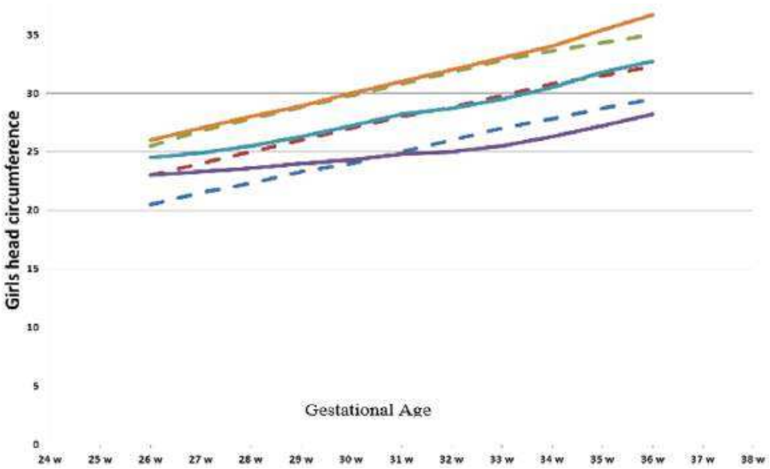

Figure 9. The 3rd, 50th and 97th percentiles of head circumference of preterm girls of studied group and Fenton growth charts for preterm girls. Dashed lines represent Fenton Chart percentiles. Straight lines represent our studied cohort percentiles.

Table 2. Difference of Preterm Girls Percentiles between the studied group and Fenton growth charts by gestational age in weeks.

GA weeks	3rd % Fenton	3rd % study	% difference	50th % Fenton	50th % study	% difference	97th % Fenton	97th % study	% difference
Weight percentiles									
26w	26w	500	610	18	800	635	-26	1050	1180
27w	27w	520	680	23.5	900	880	-2.3	1250	1226
28w	28w	550	747.7	26.4	1000	1017.5	1.7	1400	1340
29w	29w	600	678	11.5	1150	1055	-9	1620	1281.5
30w	30w	700	772.4	9.4	1300	1220	-6.6	1820	1480
31w	31w	820	1019	19.5	1490	1320	-12.9	2100	1645
32w	32w	980	1122.4	12.7	1680	1430	-17.5	2350	1780.8
33w	33w	1150	1200	4.2	1880	1570	-19.7	2620	2082
34w	34w	1400	1268	-10.4	2100	1830	-14.8	2950	2156
35w	35w	1600	1577.4	-1.4	2350	2035	-15.5	3200	3472.6
36w	36w	1730	1691.3	-2.3	2600	2350	-10.6	3500	3200
Length Percentiles									
26w	26w	29	36	19.4	33	36	8.3	37	37.5
27w	27w	30	33	9.1	34.5	37	6.8	38.5	36
28w	28w	31	32.8	5.4	35.5	37	4.1	40	41
29w	29w	32.5	32.2	-1	37	38	2.6	41.5	42
30w	30w	33.5	34	1.5	38.5	39	1.3	43	45.9
31w	31w	35	36	2.8	40	40	0	44.5	43.9
32w	32w	36.5	35	-4.4	41	40	-2.5	46	46
33w	33w	37.8	38	0.5	42.5	41	-3.7	47.5	47
34w	34w	39	38	-2.6	44	42	-4.8	49	46
35w	35w	40.5	38	-6.6	45.2	44	-2.7	50	51.3
36w	36w	41.5	38	-9.2	46.5	45	-3.3	51.2	50
Head Circumference Percentiles									
26w	26w	20.5	24	14.6	23	24	4.2	25.5	26
27w	27w	21.5	24	10.4	24	26	7.7	26.8	26.5
28w	28w	22.3	24	7.1	25	26	3.8	27.1	27
29w	29w	23.3	24	2.9	26	26	0	28.8	29
30w	30w	24	25	4	27	27	0	29.5	30
31w	31w	25	25	0	28	28	0	30.8	30.9
32w	32w	26	26	0	28.8	29	0.7	31.8	33
33w	33w	27	25	-8	29.8	30	0.7	32	33
34w	34w	27.8	26	-6.9	30.8	31	0.6	33.6	35
35w	35w	28.7	27.9	-2.8	31.5	32	1.6	34.3	38
36w	36w	29.5	28	-5.4	32.3	33	2.1	35	36

GA: gestaonal age.

Table 3. Anthropometric measurements according to gender.

	Boys (No.=1063)	Girls (No.=938)	P value
Weight			
Mean ± SD	1793 ± 615	1703 ± 548.5	0.003
Median (IQR)	1750 (1320- 2160)	1650 (1290- 2020)	
Length			
Mean ± SD	42 ± 3.9	41.5 ± 3.6	0.009
Median (IQR)	42 (39- 45)	41 (39- 44)	
HC			
Mean ± SD	30.3 ± 3	29.7 ± 2.8	0.000
Median (IQR)	30 (28- 33)	30 (28-32)	

SD: standard deviation; IQR: interquartile range; p= <0.05 is statistically significant

Table 4. Percentiles of the studied group compared to Fenton growth charts for boys

		Studied Preterms Centiles	Fenton Centiles	P value
Weight (grams)	3rd percentile	1069.3 ± 396.3	1037.2 ± 478.7	0.434
	50th percentile	1442.± 553.7	1659 ±648.2	0.423
	97th percentile	1672.3 ± 1109.8	2234.5 ± 830.8	0.682
Length (cm)	3rd percentile	34.8 ± 3.4	35.9 ± 4.3	0.237
	50th percentile	39.9 ± 3.4	40.5 ± 4.4	0.266
	97th percentile	37.4 ± 18.6	45.2 ± 4.6	0.016*
HC (cm)	3rd percentile	25.6 ± 1.5	25.6 ± 2.9	0.031*
	50th percentile	28.5 ± 2.9	28.3 ± 3	0.675
	97th percentile	27.2 ± 13.7	30.9 ± 3.2	0.016*

SD: standard deviation.

We identified the following maternal risk factors, where 776 infants (38.8%) were born to mothers having premature rupture of membranes (PROM), 218 infants (10.9%) to mothers having pervious preterm, 170 infants (8.9%) to mothers having antepartum hemorrhage and 98 infants (4.7%) to mothers having placenta previa. Only a history of previous preterm birth delivery was significant. Preterms with a previous preterm sibling showed a statistically significant reduction in weight than those without previous siblings. Weight of those with previous preterm siblings was 1666.7 ± 530 grams, while in those without a history of previous preterm siblings was 1761.4 ± 592 grams (p = 0.000). (Table 6).

Table 5. Percentiles of the studied group compared to Fenton growth charts for girls.

		Our Studied Preterm data	Fenton data	P-value
Weight (grams)	3rd percentile	1033.2 ± 374.1	959 ± 449.7	.446
	50thpercentile	1394.7 ± 517.6	1568.1 ± 606.6	.455
	97thpercentile	1676.1 ± 1090	2169 ± 824.4	.698
Length (cm)	3rd percentile	35.2 ± 2.1	35.1 ± 4.2	.017*
	50thpercentile	39.9 ± 2.9	39.7 ± 4.5	.104
	97thpercentile	40.8 ± 14.1	44.3 ± 4.7	.225
HC (cm)	3rd percentile	25.3 ± 1.4	25 ± 3	.018*
	50thpercentile	28.3 ± 2.8	27.8 ± 3.1	.775
	97thpercentile	26.6 ± 13.5	30.6 ± 3.1	.018*

SD: standard deviation.

Table 6. Anthropometric Measurements of Preterms of mothers with pervious preterm and the others.

	Pervious preterm (number= 218)	First preterm (number= 1783)	P value
Weight (Mean ± SD)	1666.7 ± 530	1761.4 ± 592	0.024*
Length (Mean ± SD)	41 ± 3.3	41.9 ± 3.8	0.002*
HC (Mean ± SD)	29.4 ± 2.7	30.1 ± 3	0.002*

HC: Head circumference; SD: standard deviation.

Discussion

Assessment of fetal growth is considered a very crucial part of antenatal and perinatal care. The status of the intrauterine conditions can be revealed. Higher perinatal morbidity and mortality were seen in infants with SGA compared to those with AGA Growth monitoring of preterms is an important entity of the medical and nutritional evaluation of preterms. The population targeted and updated growth percentiles should be applied for proper classification of infants into SGA or LGA or AGA (*16*). Prematurity and its sequalae of complications is a serious challenge in the neonatal care practice that burdens the neonatologists a well as the health care services, preterm birth is considered the leading cause of under 5 years deaths worldwide. Incidence of preterm births are rising globally. It is estimated that 5% to 18% of babies are born preterm (*17*). Lubchenco (1963) charts percentile growth curves and other charts for preterm infants at birth and post-natal follow-up have been successively constructed validated (*18*, *19*).

Fenton charts were applicable to our studied cohort of 2001 preterms except for the head circumference. Our pilot study cohort sample size was not calculated, and was not collected to represent Egyptian population. The increment in head circumference might reflect the lack of head molding during vaginal delivery as 71% of our studied cohort were delivered by caesarian section, which is more than double fold the 32% reported in USA (*20*). It might reflect inherent racial trait, underestimation of gestational diabetes or miscalculation of gestational ages. To rule out the miscalculation of GA we relied on validated age calculation of relying on the findings of an early dating ultrasound (US) were used in the calculation of GA, or it was estimated from the last menstrual period (LMP) (*21*).

A statistically significant increase in the 97th percentiles of length, the 3rd and 97th percentiles of HC among boys than those of Fenton´s, also a statistical significance increase in the 3rd percentile of length and 3rd and 97th percentiles of HC in girls were found. It is not clear why our studied cohort was taller than the measurements of Fenton charts. Yet, we did not measure the mid-parental height centile, and we are not aware if this is a racial difference. Against this racial difference is the fact that the recent Egyptian growth charts for children and adolescents did not point out that Egyptians were particularly taller than others (*22*).

Environmental factors affect height, and 32% of Egyptians suffer from poverty (*23*) which should be reflected as shorter and smaller sized babies (*24*). Our studied preterm babies were born to mostly workers (59%) and underprivileged families. Again, it would have been expected to find them significantly smaller than those from developed countries whose measurements are presented in Fenton preterm charts. The increment of length in our study group might reflect inherent traits, that is influenced by the socioeconomic status as gestational age advances. Under nutrition of our pregnant mothers is much expected. Nutrients in pregnant women in Egypt were studied and showed that apart from the carbohydrate intake, the dietary intake of all macro and micronutrients was low (*25*). Iron intake was <50% of the recommended dietary allowance (RDA), also, zinc and protein intake constituted < 70% of the RDA (*26*). Iron deficiency anemia affects one in every two pregnant women in rural districts in Egypt, and impedes normal intrauterine growth by decreasing oxygen delivery through the placenta to the fetus (*24*, *27*). Other studies highlighted the periconceptional multivitamins use and the risk of preterm or SGA (*28*). Head circumference reflects intracranial volume and correlates with brain size (*29*). Factors other than GA were found to play a role in head growth in very preterm infants. Most studies found that gender but not ethnicity have an impact on the head size, with larger head sizes in Boys. Relatively smaller head sizes was related to children born to Hispanic or black mothers (*30*). The cause of prematurity, is also known to influence the size of the preterm (*31*), but it was not within the scope of this current study.

The compatibility of the sizes of our large sample pilot study of preterms with Fenton preterm charts might reflect the equality of health care in the primary health care units across Egypt. Yet, the study of the factors influencing the sizes of the preterms were not part of the scope of this study. Preterm boys were found heavier than girls for all studied gestational age percentiles, and both conformed with measurements of Fenton charts for preterms. Measurements of our studied population was noted to be smaller than measurements of Fenton charts, but the difference was mild and not statistically different. Measurements from a larger sample size would define if this finding is a true one or not.

Conclusion

Every population has peculiar different conditions (race, genes, environment, nutrition status, socio-economic status, and health care) that influence fetal growth which is reflected in anthropometric measures at birth. We can rely on the Fenton´s growth charts for preterms as a reference. In conclusion, existing anthropometric reference values for preterm infants need to be updated regularly every 10 years to observe secular trends.

Author Contributions:

Professor Yasmin Mansi and Professor Eman Taher: Conception and design of the work, revising all data and revising the article. Dr. Asmaa Abdallah: Patient Data collection, data analysis and interpretation. Dr. Amira Sabry: Drafting the article, critical revision of the article and final approval of the version to be published.

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CONFLICT OF INTEREST

The authors declare no conflict of interest in connection with the reported study. Authors declare veracity of information. They declare that they do not have affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

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