Suggested Technique for Creating Physical Growth Curves Charts for Anthropometric Measurements in Admixed form in a sample of children under two years of age In Diyala Governorate

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المستخلص :

الهدف: تهدف الدراسة إلى تقييم تقنية جديدة مقترحة لمنحنيات النمو (منحنيات الخصائص الجسمية) للأطفال تحت السنتين في عيّنة غير احتمالية.

المنهجية: تم اختيار عينة بحجم (٤٢٠) طفلا دون سن الثانية من العمر من بين ١٢ مركزاً للرعاية الصحية ألأولية في محافظة ديالى وذلك باستخدام القياسات الانثربومترية أثناء الفترة من الخامس عشر من تشرين الثّاني ٢٠١٠ ولغاية الثالث عشر من آذار ٢٠١١ طبقاً لأسلوب المزج ما بين الصفات الجسمية المختلفة برسم بياني واحد لمنحنيات النمو المتضمنة على الأقل الوزن ، الطول ومحيط الرأس.

النتائج: أظهرت نتائج الدراسة إنه يمكن المزج ما بين الصفات الجسمية المختلفة برسم بياني واحد لمنحنيات النمو المتضمنة على الأقل الوزن ، الطول ومحيط الرأس وذلك من أجل تجاوز مشكلة افتراض التوزيع الطبيعي الواجب تحققها عند تطبيق الطرائق التقليدية المتبعة لـ (منحنيات الخصائص الجسمية).أيضا تم تقدير أو تخمّين القيم (أعلى / أدنى) الحدود القياسية بالإضافة إلى المتوسط المشذّب الذي أستند على المشاهدات الأصلية للبيانات التي تم جمعها ميدانياً.

التوصيات: توصل البحث إلى بعض التوصيات منها الاستمرار في تطبيق التقنية المقترحة في إضافة الخصائص الجسمية الأخرى مثل محيط الذراع، طول الجذع المرتبط بمركز البطن.

Abstract:

Objective: This study aimed to assessing new suggested technique of Physical Growth Curves (PGC) charts in children under two years old of a non-probability sample.

Methodology: A non-probability sample of size (420) children under two years selected from 12 Primary Health Care Centers in Diyala governorate during the period from 15th Nov. 2010 to 13th Mar. 2011 according to admix of a different properties together in one chart/or growth curve chart included in at least weight, Height, and Head circumference.

Results: the results showed different properties that can be admix together in one chart/or growth curve chart included in at least weight, Height, and Head circumference. And to overtake the problem of the normal distribution assumption that ought to be presented with the random variables of (PGC) in applying the conventional methods. Obtaining or estimating the (min. and max.) of the standard limits as well as the trimmed mean which were accredited on their original observations which were collected from the studied field.

Recommendations: Continuous to apply the suggested technique in added another physical body's properties such as (MUAC, Trunk Length related to abdomen center).

Keywords: Physical Growth Curves (PGC) charts, Percentile, Polynomial Regression Growth Curve.

Introduction:

Growth charts consist of a series of percentile curves that illustrate the distribution of selected body measurements in children[1]. Percentiles are graph with lines showing average measurements of height, weight, and head circumference compared with age and sex, against which the physical development of a child or fetus can be assessed. The lines of growth on the graph , and the number of a centile predicts the percentage of individuals who are below that measurement for a given age; for example, the 10th centile means that 10% of the age and sex matched population will be smaller and 90% will be bigger. A child or fetus will normally follow a particular centile, but if growth crosses percentiles or lies outside the 97th or 3rd percentiles, further investigation may be warranted [1] .

Anthropometric measurements are commonly used for assessing growth and nutritional status of children. These include weight for age, height for age and weight for height. Observed values are compared with standard or reference data to determine whether a child is growing normally. Careful procedures for training and measurement standardization were followed, and high-quality instruments were used for weight and length (or stature) measurements. In the WHO study, anthropometrics' took measurements once. In general, both WHO and CDC assessed length (measured lying down) for children aged < 24 months and stature [2,3] .

Growth assessment using growth curves is a useful tool for defining health and nutritional status in children [4]. Growth monitoring helps to improve nutrition, educate the care givers and enables early detection of growth disorders. Proper growth monitoring consists of serial assessments of various physical parameters like weight, length/height, head circumference etc over time [5] . Diligent growth monitoring using appropriate growth charts and early intervention has the potential to prevent this long term morbidity. There are two types of growth curves: “growth reference” and “growth standard” [6]. A ‘reference’ chart simply describes its sample without making any claims about the health of its sample, whereas a ‘standard’ represents the ideal healthy growth of a population and hence is of prescriptive nature [7].

Growth charts currently in use in infants and children describe existing growth patterns and are therefore references, not prescriptive standards [8] .

The importance of this study is to look and to cover the effects of the interaction that ought to be occurrences among the physical properties that realized and represents the actual assessment of normal or abnormal growth consideration, while these considered matter were neglected through applying the alternative of the conventional a (PGC) charts which were implemented that physical in lonely formed [9] ,that is for the properties first time as far as (we know). This study was aimed to Assessing the new suggested technique of (PGC) curves in children under two years old and to encroach/or overtake the problem of the normal distribution assumption that ought to be followed with the all studied random variables (Physical growth of the Body’s properties) in applying the conventional methods.

Methodology:

Data collection and the studied variables:

Children under two years of age (< 30 days-23 months) of a non-probability sample of size (420), children were selected from 12 primary health care centers in Diyala governorate, which were distributed on three health districts (Al- Muqdadyia, Baqubah and Al- Khalis respectively) during the period from 15 November . 2010 to 13 March. 2011. The studied variables were collected (Weight, Height, Head Circumference). Type of data was from a historical source, that used for obtaining/or estimating the (min. and max.) of the standard limits of the studied measurements as well as the trimmed means.

Statistical methods:

The suitable statistical methods were used to analyze and assess the new suggested technique, they includes [10]:

a. Statistical table.

b. Estimating the minimum and Maximum as well as the trimmed means values of the studied physical properties through applying (Stem-Leaf) plotting method by transcendence for the existence of extremes and outliers.
c. High-Low charts included the Suggested technique of plotting Weight / Length & Head circumference according to standardized in admix formed of the different properties (Anthropometric measurements) together in one chart/or growth curve chart.

In order to studying and analyzing the observations of the studied parameters (Weight, Height, Head Circumference) and creating a standard limitation for the two gender in different age groups , according to inferential whole restricted cases in stability of ordered statistics, Stem – Leaf or Explorer method that had been used. Table (1) included the (min. and max.) of the standard limits which were accredited on the original data from the reference, as well as the summary statistics associated with explores the order statistics of the studied body's properties.

Results :

Table 1. Summary Statistics for the studied of the physical growth curves parameters under 2 years of age for the studied sample

Child Age per months.	Child gender		Male			Female		
	Statistics		Weight per kg.	Height per cm.	Head Cir. per cm.	Weight per kg.	Height per cm.	Head Cir. per cm.
< 1 m.	Mean		3.69	49.75	36.07	3.64	49.00	35.85
	95% C.I. for Mean	L.b.	3.50	48.76	35.72	3.40	48.38	35.37
		U. b.	3.88	50.74	36.41	3.89	49.62	36.33
	5% Trimmed Mean		3.66	49.74	36.06	3.66	48.95	35.80
	Median		3.50	50.00	36.00	3.50	49.00	36.00
	Std. Deviation		0.50	2.66	0.930	0.58	1.47	1.14
	Minimum		3.00	45.00	34.50	2.25	47.00	34.00
	Maximum		5.00	55.00	38.00	4.50	52.00	39.00
1	Mean		4.16	51.67	36.61	3.89	51.78	36.50
	95% C.I. for Mean	L.b.	3.50	49.91	35.85	3.47	49.51	35.47
		U. b.	4.82	53.43	37.37	4.32	54.04	37.53
	5% Trimmed Mean		4.15	51.63	36.62	3.85	51.75	36.53
	Median		4.00	52.00	36.50	3.70	51.00	36.50
	Std. Deviation		0.86	2.29	0.990	0.55	2.95	1.35
	Minimum		3.00	48.00	35.00	3.50	47.00	34.50
	Maximum		5.50	56.00	38.00	5.00	57.00	38.00
2	Mean		4.85	54.14	37.69	4.90	53.68	37.59
	95% C.I. for Mean	L.b.	4.46	52.89	37.22	4.46	52.30	36.98
		U. b.	5.24	55.39	38.17	5.34	55.06	38.20
	5% Trimmed Mean		4.87	54.00	37.66	4.95	53.78	37.65
	Median		5.00	54.00	38.00	4.75	54.00	38.00
	Std. Deviation		0.87	2.74	1.04	0.86	2.69	1.19
	Minimum		3.20	49.00	36.00	2.75	48.00	35.00
	Maximum		6.20	62.00	40.00	6.25	57.50	39.00
3	Mean		5.70	56.10	39.27	5.80	57.50	38.81
	95% C.I. for Mean	L.b.	5.13	54.55	38.44	4.95	55.71	37.84
		U. b.	6.27	57.65	40.09	6.65	59.29	39.78
	5% Trimmed Mean		5.74	56.06	39.38	5.79	57.39	38.79
	Median		6.00	56.00	39.00	6.00	57.00	38.75
	Std. Deviation		1.04	2.79	1.49	1.02	2.14	1.16

Table 1. (Continues)

	Minimum		3.25	51.00	35.00	4.50	55.00	37.00
	Maximum		7.50	62.00	41.50	7.20	62.00	41.00
4	Mean		5.91	59.83	40.00	6.42	59.90	40.07
	95% C.I. for Mean	L.b.	5.38	58.11	39.21	6.02	57.07	38.94
		U. b.	6.44	61.56	40.79	6.82	62.73	41.20
	5% Trimmed Mean		5.93	60.15	40.11	6.41	59.94	40.13
	Median		6.00	61.00	40.00	6.25	61.00	40.00
	Std. Deviation		1.17	3.79	1.74	0.72	5.11	2.04
	Minimum		4.00	50.00	35.50	5.50	50.00	36.00
	Maximum		7.50	64.00	42.50	7.60	69.00	43.00
5	Mean		6.80	61.00	41.50	6.33	61.00	39.72
	95% C.I. for Mean	L.b.	5.01	56.03	39.54	5.56	59.42	38.46
		U. b.	8.59	65.97	43.46	7.11	62.58	40.98
	5% Trimmed Mean		6.81	61.00	41.56	6.33	61.11	39.80
	Median		6.50	62.00	42.00	6.50	61.00	41.00
	Std. Deviation		1.44	4.00	1.58	1.01	2.06	1.64
	Minimum		5.00	56.00	39.00	5.00	57.00	37.00
	Maximum		8.50	66.00	43.00	7.75	63.00	41.00
6	Mean		7.15	63.21	42.04	7.03	63.38	41.03
	95% C.I. for Mean	L.b.	6.85	60.95	41.22	6.55	61.58	40.30
		U. b.	7.45	65.46	42.86	7.52	65.17	41.76
	5% Trimmed Mean		7.17	63.29	41.99	6.99	63.19	41.06
	Median		7.13	64.00	42.00	7.00	63.50	41.50
	Std. Deviation		0.47	3.55	1.29	0.91	3.36	1.37
	Minimum		6.00	55.00	40.00	5.60	59.00	38.50
	Maximum		8.00	70.00	45.00	9.30	71.00	43.00
7 -	Mean		8.15	66.55	42.95	6.67	63.50	40.93
	95% C.I. for Mean	L.b.	7.42	64.66	41.79	5.73	60.76	40.15
		U. b.	8.89	68.43	44.12	7.62	66.24	41.70
	5% Trimmed Mean		8.21	66.61	42.89	6.67	63.39	40.92
	Median		8.75	67.00	43.00	7.00	62.00	41.00
	Std. Deviation		1.10	2.81	1.74	1.02	2.96	0.84
	Minimum		6.00	62.00	40.00	5.40	61.00	40.00
	Maximum		9.25	70.00	47.00	7.90	68.00	42.00
8	Mean		8.22	65.75	43.88	7.89	67.25	41.75
	95% C.I. for Mean	L.b.	6.83	60.85	42.64	5.44	61.99	39.03
		U. b.	9.61	70.65	45.11	10.34	72.51	44.47
	5% Trimmed Mean		8.27	65.97	43.86	7.91	67.22	41.72
	Median		8.63	67.50	44.00	8.13	67.00	41.50
	Std. Deviation		1.67	5.86	1.48	1.54	3.30	1.71
	Minimum		5.50	54.00	42.00	5.80	64.00	40.00
	Maximum		10.00	73.50	46.00	9.50	71.00	44.00
9	Mean		8.41	69.16	44.59	8.04	67.75	42.65
	95% C.I. for Mean	L.b.	8.01	67.31	43.65	7.52	65.17	41.38
		U. b.	8.81	71.00	45.54	8.55	70.33	43.92
	5% Trimmed Mean		8.42	69.23	44.44	8.04	67.83	42.67
	Median		8.40	69.50	44.75	8.00	68.25	43.25
	Std. Deviation		0.75	3.46	1.77	0.72	3.60	1.78
	Minimum		7.00	63.00	42.00	7.00	61.00	40.00
	Maximum		9.50	74.00	50.00	9.00	73.00	45.00
10	Mean		8.68	69.14	43.79	9.25	67.67	44.00
	95% C.I. for Mean	L.b.	7.54	66.79	42.00	7.94	62.36	43.06
		U. b.	9.82	71.50	45.57	10.56	72.97	44.94
	5% Trimmed Mean		8.67	69.21	43.76	9.29	67.77	44.00
	Median		9.00	69.00	43.50	9.50	67.00	44.00

Table 1. (Continues)

	Std. Deviation		1.23	2.54	1.93	1.25	5.06	0.89
	Minimum		7.00	65.00	41.00	7.25	59.50	43.00
	Maximum		10.50	72.00	47.00	10.50	74.00	45.00
11	Mean		9.56	71.00	44.93	7.88	66.63	43.13
	95% C.I. for Mean	L.b.	8.12	66.50	43.88	6.87	64.25	39.43
		U. b.	11.01	75.50	45.98	8.88	69.00	46.82
	5% Trimmed Mean		9.52	70.67	44.89	7.89	66.67	43.08
	Median		9.50	69.00	44.50	8.00	67.00	42.75
	Std. Deviation		1.56	4.86	1.13	0.63	1.49	2.32
	Minimum		7.50	67.00	44.00	7.00	64.50	41.00
	Maximum		12.50	81.00	46.50	8.50	68.00	46.00
12 - 15	Mean		9.75	74.12	45.77	8.92	71.36	44.36
	95% C.I. for Mean	L.b.	9.02	72.75	45.16	8.38	69.62	43.62
		U. b.	10.48	75.48	46.37	9.47	73.09	45.09
	5% Trimmed Mean		9.99	73.94	45.79	8.93	71.45	44.42
	Median		10.00	74.00	46.00	8.90	72.00	44.75
	Std. Deviation		1.94	3.65	1.63	0.94	3.00	1.28
	Minimum		1.20	68.00	42.00	7.25	65.00	41.50
	Maximum		12.00	84.00	49.00	10.50	76.00	46.00
16 - 19	Mean		10.67	78.09	46.50	10.16	77.11	45.89
	95% C.I. for Mean	L.b.	10.27	76.63	46.00	9.52	74.93	45.17
		U. b.	11.07	79.55	47.00	10.80	79.29	46.61
	5% Trimmed Mean		10.67	78.28	46.42	10.11	77.31	45.83
	Median		10.73	79.00	46.50	10.00	77.00	46.00
	Std. Deviation		1.12	4.05	1.40	1.48	5.04	1.66
	Minimum		8.50	67.00	44.00	8.00	64.00	43.00
	Maximum		13.00	85.00	51.00	13.50	86.00	50.00
20 - 23	Mean		11.55	80.46	47.11	11.27	80.78	46.38
	95% C.I. for Mean	L.b.	11.07	78.58	46.17	10.60	77.70	45.73
		U. b.	12.03	82.34	48.05	11.93	83.87	47.02
	5% Trimmed Mean		11.53	80.63	47.09	11.28	81.20	46.42
	Median		11.38	81.25	47.50	11.50	83.00	46.75
	Std. Deviation		0.83	3.26	1.63	1.25	5.79	1.20
	Minimum		10.50	74.00	44.50	9.25	67.00	44.00
	Maximum		13.00	84.00	50.00	13.00	87.00	48.00

L.b. = lower bound, U.b. = upper bound, cm=centimeter, kg=kilogram, Cir. =circumference

Figure (1) presents or explores the order statistics of the studied body's properties, Weight, Height & Head circumferences for creating Standard limits for Iraqis Aged (< 30 days - 23) Months according to gender by Stem & Leaf Plot with extremes and outliers. While after the exclusion of contaminated observations from the studied sample.

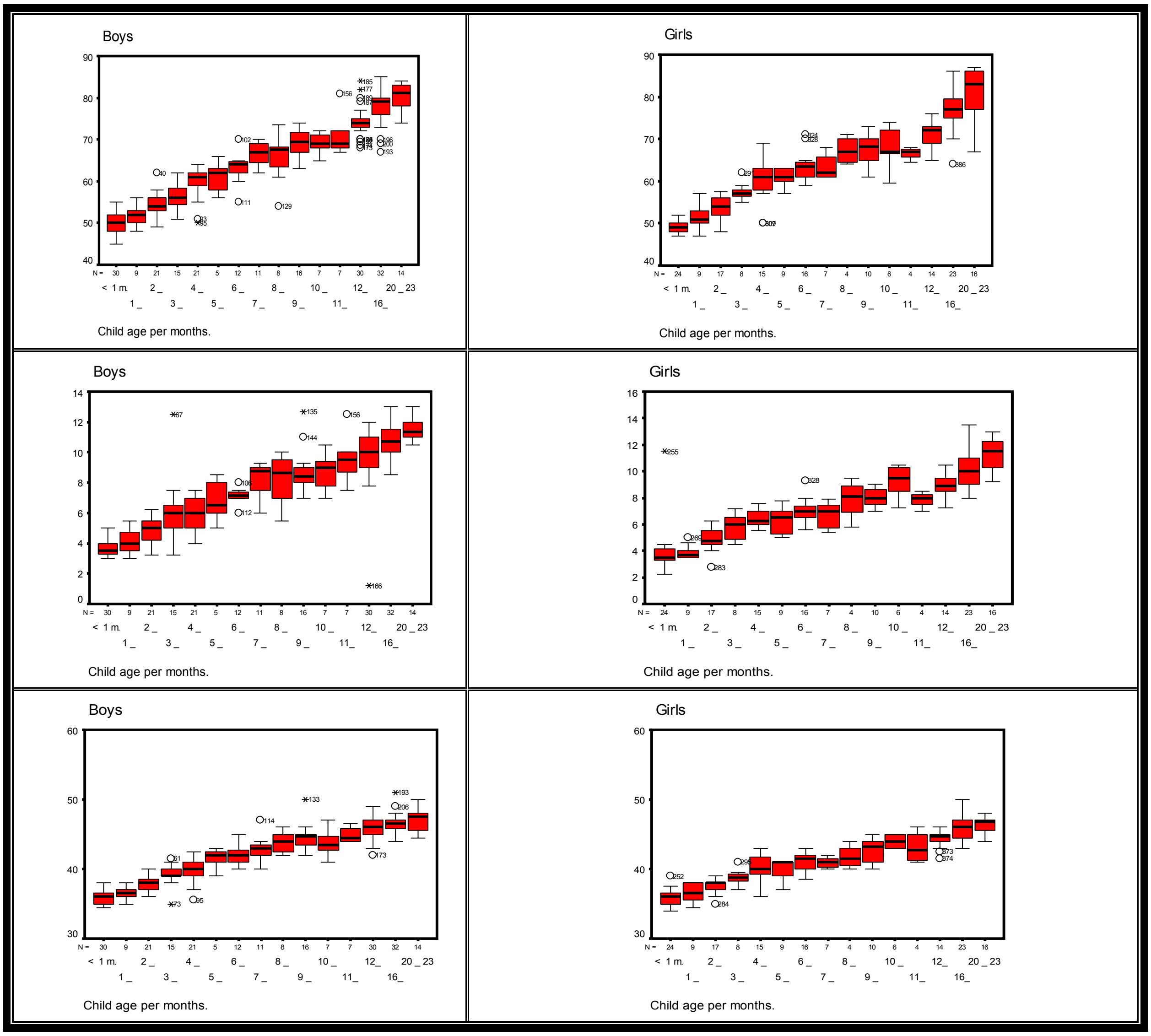

Figure 1. Weight – Height & Head Circumferences ordered values Aged (< 30 days 23) Months according to gender By Stem & Leaf Plot with extremes and outliers

Figure (2) presents or explores the smoothed order statistics of the studied of the physical properties, Weight, Height & Head circumferences for creating Standard limits for Iraqis Aged (< 30 days - 23 Months) according to gender by Stem & Leaf Plot without extremes and outliers.

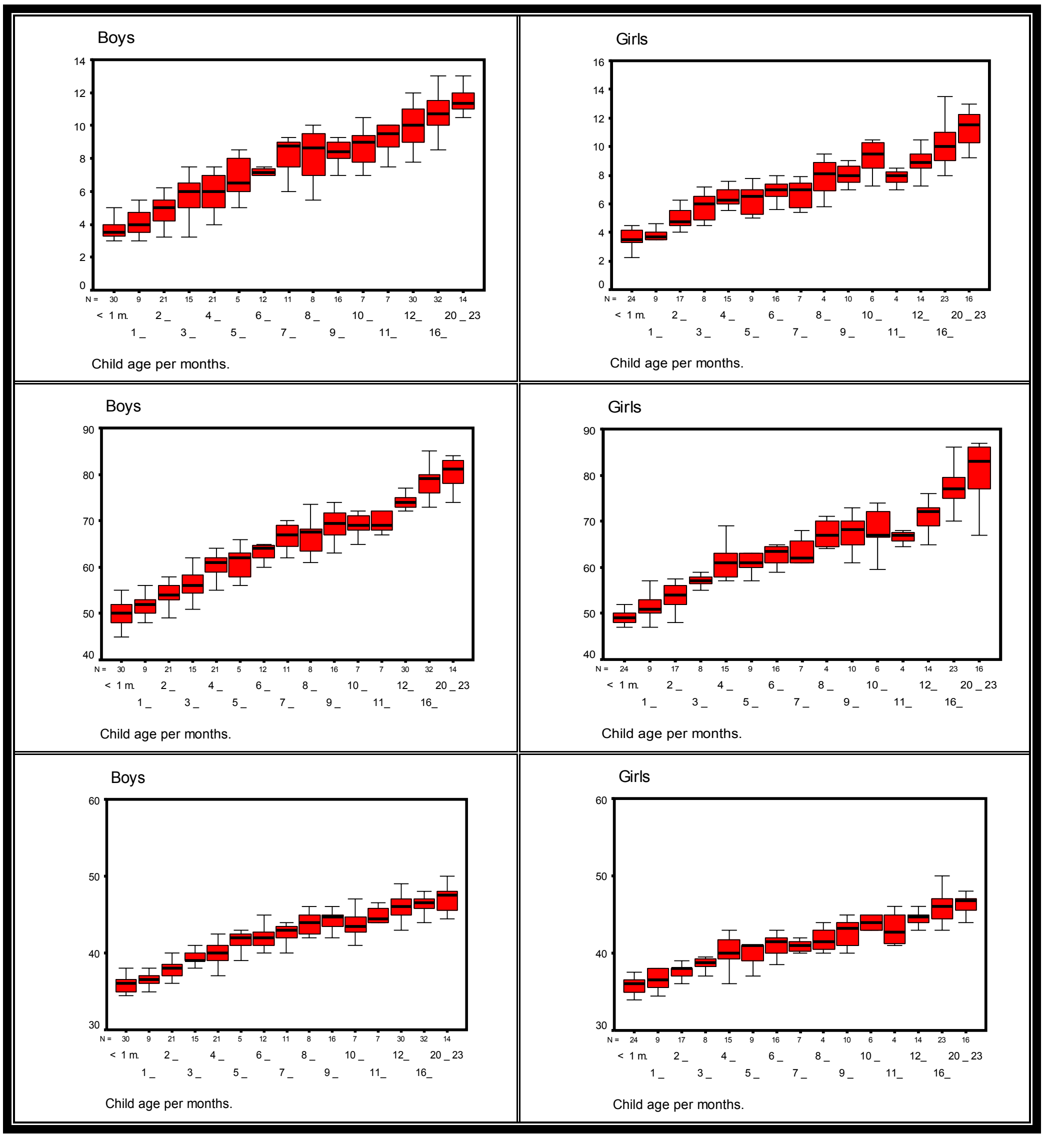

Figure 2. Weight – Height & Head Circumferences ordered values Aged (< 30 days – 23) Months according to gender By Stem & Leaf Plot without extremes and outliers

Figure (3) presents the Suggested technique of plotting Weight / Length &Head circumferences of Iraqis sample, Aged (<30 days - 23Months) according to (Males & Females).

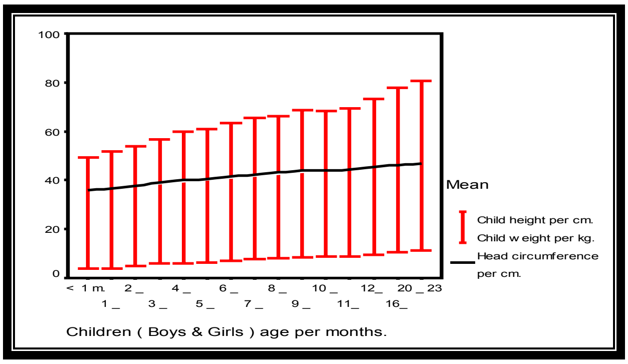

Figure 3. Suggested technique of plotting Weight / Height & Head Circumferences Aged (< 30 days – 23) Months according to both gender through pointed mean values

Figure (4) presents the Suggested technique of plotting Weight / Length & Head circumference of Iraqis sample, Aged (<30 days - 24 Months) according to Boys through pointed mean values

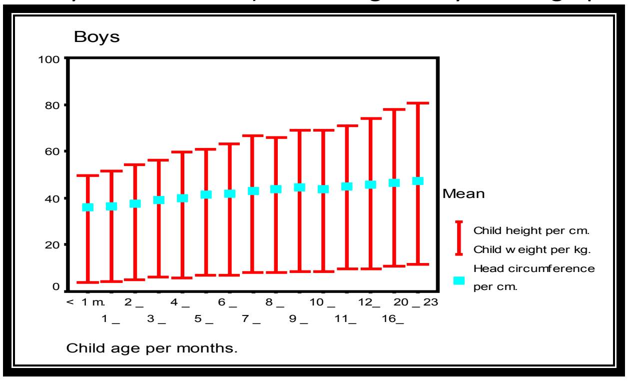

Figure 4. Suggested technique of plotting Weight / Height & Head Circumferences aged (< 30 days – 23) Months according to Boys through pointed mean values

Figure (5) presents the Suggested technique of plotting Weight / Length & Head circumference of Iraqis sample, Aged (30 days- 24 Months) according to Girls through pointed mean values

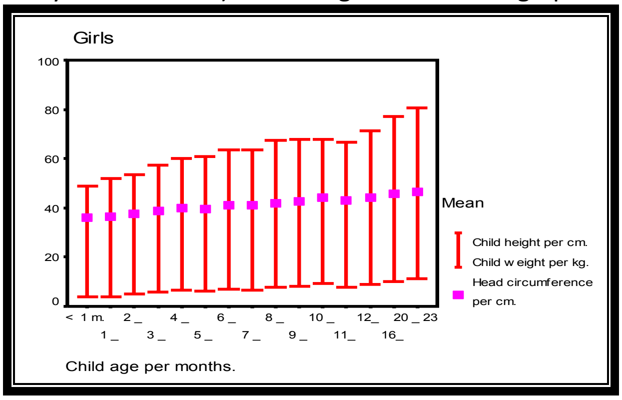

Figure 5. Suggested technique of plotting Weight / Height & Head Circumferences aged (< 30 days – 23) Months according to Girls through pointed mean values

Discussion:

The procedure of this method depending on the order statistic of the actual observations in ascending form with determining the (1st & 3rd) Quartiles. The form (⌶) pointed the lower and upper sides or data limitation which include the ordered observations of that having less than two degree of deviation by their mean value (2 Std Dev.) and the two edges belong to the first and third quartiles and the median value between them. In addition to that, the observations that increased in more than two deviations grades would be pointed by a circle(s) and known extreme value(s) and the observations that increased in more than three deviations grades would be pointed by a star(s) and known outlier value(s). The preceding values were known contaminated values. (PGC)of the body's properties for less than two years of age assumed that the body's properties responses would be studied independently. These assumptions in fact may be playing misdoing for obtaining/or realized for the objectives of that curves. Possibly exist one individual having overweight /or non-staple weight compared by the standard growth curve of weight and age factors and having in addition to that non staple by the standard growth curve of Height and age factors, and the same assumptions for the Head circumference which were pointed /or examined in sole forms, while if that individual summing his different properties together in one curve included in at least weight, Height, and Head circumference, we may give him a normal respond/or fall him in the accepted area of assessment. Reliance to that individual (child) we can talk in a reverse cases such as an individual having underweight /or unstapled weight (i.e. thin) compared by the standard growth curve of weight and age factors and having in addition to that unstapled by the standard growth curve of Height and age factors, and the same assumptions for his Head circumferences which were pointed /or examined in sole forms, while if that individual summing his different properties together in one curve included in at least weight, Height & Head circumference, we may give him a normal respond/or fall him in the accepted area of assessment.

In addition to that, the conventional methods of creating a (PGC) whether leaned on the polynomial regression model of order (k) (i.e. quadratic, cubic, … or any suitable order) or leaned on median (3 percent to 97 percent) assumed that the random variables (Physical growth of the Body's properties) should be having/or followed a normal distribution function .This assumption might be destroyed in the cases of included/or existence of an outlier(s) of readings in any one of that random variables, and with credence of which was written by Huber (1973) " One outlier can be enough to destroyed your distribution assumption" (11) . For all that obvious reasons our new technique will takes the significant of applying formulas under the normal distribution assumption as well as the individuals that ought to be fall in the accepted area of assessment.

Since a smoothed order statistics for the studied of the physical body's properties had been registered through applying the (Stem-Leaf) plotting methods before estimation of the minimum and maximum readings, the normal distribution function assumption should be not destroyed with suggested new technique, while these restricted of the distribution form might be destroyed with applying the conventional methods of creating a (PGC).

Recommendations:

Continue to apply the suggested technique in adding another physical body's properties such as (MUAC, Trunk Length related to abdomen center, Pelvis with the Length of Lower extremities, Shoulder dimension related to Scapula and Spine). It is not possible always to find a satisfactory transformation/or the assumption of normality shaped of the distribution function that ought to be presented in the underlying data so the researchers recommend to apply the suggested technique in order to transcending the preceding assumption.

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