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## Evaluation of internipple distance, sternum length and torso length as a screening test in newborn infants' growth in Salahaddin General Hospital

### ABSTRACT:

**Background:** knowledge of the normal growth and development of children is essential for preventing and detecting disease by recognizing overt deviation from normal pattern. Various genetic syndromes, birth defect and acquired diseases are characteristic by abnormal shape and size of the chest and site of nipple. **Aim of the study:** to test and make internipple distance, sternum length, torso length as a part of growth measures in evaluation and diagnosis of growth assessment in newborn infants..

**Patients & methods:** A cross sectional study involve 732 newborns consist of 708 normal newborns: 570 term (298 male and 272 female), 112 preterm (male 42 and female 70) and 26 post-term (male 19 and 7 female); while congenital anomalies were observed in 24 newborns: 21 term newborn (male 6 and female 15) and 3 preterm male between gestational ages 27 and 43 weeks and weighed from 700 gram – 5 kg delivered or attended to Salahaddin general hospital during period from 15th May 2017 to 15th September 2017. Weight, length, occipitofrontal circumference, chest circumference, torso length, internipple distance and sternum length were measured for each newborns.

**Results:** There was a difference found between male and female. The mean internipple distance for term newborns (8.7 cm) in male and (8.6 cm) in female while in pre-term (6.16 cm) and for post-term (9.4 cm). The mean internipple index in our study was being 26% as a larger chest circumference decreases the internipple index. The mean of sternum length in term male (7.8 cm) and in term female (8.7 cm) while in pre-term (6.1 cm) and in post-term (8.9 cm) the sternum length in male is shorter than in female. The sternal index is about (0.47) in our study. The mean of torso length in term male (20 cm) and in term female (19.8 cm) while in pre-term (17 cm) and in post-term (22.8 cm). The internipple distance in screening test was sensitive and specific for males (81.2% and 84.3%) and only specific for female 90%, while sternum length is sensitive and specific for females (89% and 94.4%) and males (70% and 91.8%) as well as torso length which is specific and sensitive in both sex. **Conclusions:** Internipple distance, sternum length and torso length varies with gestational age and increase as the pregnancy continue. A internipple distance of 9.6 cm or an internipple index of 28.2% in the neonatal period indicates widely spaced nipples. and the sternum index considered short when sternal-torso index is below (0.33)

### Keywords:

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## **Introduction:**

Knowledge of the normal growth and development of children is essential for preventing and detecting disease by recognizing overt deviation from normal pattern. There is growing evidence supporting the roles of certain candidate genes in influencing size at birth.<sup>[1]</sup>

Various genetic syndromes, birth defect and acquired diseases are characteristic by abnormal shape and size of the chest and site of nipple. These abnormalities may be evident in longitudinal measurements as short chest, or in horizontal measurement as deviations in chest circumference.<sup>[2]</sup> Children will grow and develop normally when a normal genetic, a healthy well-nourished mother, a normal pregnancy and delivery, the provision of appropriate nutrition needs and a supportive home and community environment had been given.<sup>[3]</sup>

The periodic measurement of anthropometric measures in different population and regions of a country reflect changes in children nutrition and health status and are a reliable tool to evaluate social health.<sup>[4]</sup>

The WHO child growth standards are the product of a systematic process initiated in the early 1990s involving various

reviews of the uses of anthropometric references and alternative approaches to develop a new tools to assess growth.<sup>[5]</sup>

The National Center for Health Statistics (NCHS) data are representative of a population of well-nourished and healthy children in the United States. Although this population is dissimilar to much of the rest of the world.<sup>[6][7]</sup>

The idealist establish local national growth chart reflecting each country own genetic characteristics and prepared according to the features outlined by WHO. The first standard WHO advises for the growth indexes is that population chosen should be composed of "normal" children who have good nutritional status and grow in "optimal" conditions.<sup>[8]</sup>

**Aim of the study:** to test and make inter nipple distance, sternum length, torso length as a guide to normative measures in evaluation and diagnosis of growth assessment in newborn infants.

## **Subject and methods:**

The current study was a descriptive cross section study is achieved among 732 newborns; 570 term (298 male and 272 female), 112 preterm (male 42 and female 70) and 26 post-term (male

19 and 7 female) while congenital anomalies were observed in 24 newborns: 21 term newborn (male 6 and female 15) and 3 preterm male from 27 - 43 weeks of gestation were chosen randomly from whom delivered in or attended to Saladin General Hospital during period from 15<sup>th</sup> May 2017 to 15<sup>th</sup> September 2017.

The data collected by direct interview with mother and information filled in papered questionnaire as socio-demographic factors (name, gestational age, gender of newborns and occupation of both parents).

Gestational age included in this study calculated from first day of mothers last menstrual period and in every case, clinical assessments of gestational age were performed by the new Ballard score system. The weight was measured in kilogram on naked newborn by an accurate electronic scale (SECA, Germany made, maximum Weight was 16kg). The length was measured by stadiometer (SECA, Germany made, maximum length was 99cm). The WHO growth chart were used to calculate the weight for length percentile based on sex, weight and length among term newborns that included in

screening test to obtain the normative values<sup>(8)</sup>.

Occipito-frontal circumference (OFC) was measured in centimeters by using a non-stretchable, flexible plastic tape which was run 2 cm above glabella to the occipital prominence that leads to the largest possible measurement. Internipple distance was measured between the Centre of both nipples<sup>[9]</sup>. Internipple index were obtained according to formula:

#### **internipple**

**distance(cm) × 100 / circumference of chest(cm)** chest circumference was determined at the level of nipples by a non-stretchable and flexible tape. Length of sternum was measured by non-stretchable, flexible tape from manubrial notch to xiphoid-sternal junction, the infant should be lying supine. Torso length was obtained from the mandibular notch to superior aspect of symphysis pubis, defined by palpation in midsagittal line. The infant should be lying supine with legs extended.<sup>[9]</sup> The sternal-torso index was obtained by sternum length(cm) / torso length (cm).

In screening test: the study included newborns who complete 37 – 41 weeks and normal birth weight without congenital

anomalies and medical condition (RDS, Jaundice, Asphyxia....etc.) and excluded newborns who preterm and post-term, low birth weight and high birth weight and who had congenital anomalies.

Statistical analysis:

The result of study presented by tables and figures, mean and standard deviation calculated from measurements and then was done by using SPSS program and Microsoft excel 2010 system.

Manual calculation of sensitivity, specificity, and predictive value positive and predictive value negative done for collected data. All these done to evaluate screening test for internipple distance, sternum length and torso length.

## Results

Among 708 newborns 80%(570) were term , pre-term 16%(112) and post-term 4%(26) while normal birth weight 78%(552) , low birth weight 19%(133) and high birth weight 3%(23),according sex distribution according to gestational age which show 298 (42%) male and 272(38%) female of full-term ,while pre-term 70(10%) female and 42 male(6%) and post-term 19male(3%) and 7 female (1%)

,Regarding sex distribution according to birth weight which show 292 (41%) male and 260(36%) female normal birth weight ,while low birth weight 84(12%) female and 49 male(7%) and high birth weight 18male (3%)and 5 female(1%) .

The mean value of internipple distance for normal birth weight and term male newborn was  $(8.7 \pm 1)$  and for females  $(8.6 \pm 0.9)$ .

Regarding use of internipple distance as screening test in male among 282 newborns with normal growth disturbance 238 had internipple distance between( 7.7-9.7cm) which consider as normal range while those with abnormal growth 16 case only 3 cases had normal internipple distance, the test is specific (84.3%) and sensitive (81.2%) for detection of internipple distance in male as show in table 1.

**Table ( 1 ) The use of inter-nipple distance as screening test and weight for length as growth monitor in male**

Screening test Internipple distance	weight for length		
	Abnormal growth	Normal growth	total
Less 7.7cm and more 9.7cm (abnormal)	13	44	57
(7.7cm – 9.7cm) (normal)	3	238	241
total	16	282	298
<p><b>Specificity =84.3%      Sensitivity =81.2 %</b>  <b>False +ve test : 15.6%      False -ve test:19%</b>  <b>predictive value +ve=23 Predictive value – ve =99%</b>  <b>Mean of internipple distance in normal birth weight term male = <math>8.7 \pm 1</math></b></p>			

Regarding use of inter-nipple distance as screening test in female 253 of newborns with normal growth disturbance 228 had internipple distance between( 7.7-9.5 cm) which consider as normal range while those with abnormal growth 19 case only 5 cases had normal internipple distance, the test is highly specific(90%) but sensitivity is low(63%) for detection of internipple distance as show in table ( 2 ).

**Table (2 ): the use of internipple distance as screening test and weight for length as growth monitor in female**

Screening test Internipple distance	weight for length		
	Abnormal growth	Normal growth	total
Less 7.7 cm and more 9.5cm (abnormal)	12	25	37
7.7cm – 9.5 cm (normal)	5	228	233
total	19	253	272
<p><b>Specificity =90%, Sensitivity =63 %, False +ve test :10 %</b>  <b>Predictive value + ve=32.4%      False -ve test:26 %</b>  <b>Predictive value – ve =97.8 % Mean of internipple distance in normal birth weight term female = <math>8.6 \pm 0.9</math></b></p>			

The mean value of sternum length for normal birth weight and term male newborn was ( $7.8 \pm 0.7$ ) and for females ( $8.7 \pm 0.9$ ). Regarding use of sternum

length as screening test in male among 282 newborns with normal growth disturbance 259 had sternum length between (7.1-8.5 cm) which consider as normal range while those with abnormal growth 16 case only 5 cases had normal sternum length , the test is highly specific (91.8%) and sensitive (70%) in detection of sternum length as shown in table (3).

**Table (3)the use of sternum length as screening test and weight for length as growth monitor in male**

Screening test Sternum length	weight for length		
	Abnormal growth	Normal growth	total
<b>Less7.1cm and more 8.5cm (abnormal)</b>	11	23	<b>34</b>
<b>7.1cm -8.5cm (normal)</b>	5	259	<b>264</b>
<b>total</b>	16	282	<b>298</b>
<b>Specificity =91.8% Sensitivity = 70%</b> <b>False +ve test : 8% False –ve test: 31</b> <b>predictive value + ve =32% Predictive value – ve = 98%</b> <b>Mean of sternum length in normal birth weight term male = 7.8 ± 0.7</b>			

Regarding use of sternum length as screening test in female among 253 newborns with normal growth disturbance 239 had sternum length between ( 7.8-9.6 cm) which consider as normal range while those with abnormal growth 19 case only 2 cases had normal sternum length , the test is highly specific (94.4%) and sensitive (89%) in detection of sternum length as shown in table (4).

**Table (4 )the use of sternum length as screening test and weight for length as growth monitor in female**

Screening test Sternum length	weight for length		
	Abnormal growth	Normal growth	total
<b>Less7.8cm and more9.6cm (abnormal)</b>	17	14	<b>31</b>
<b>7.8cm - 9.6cm (normal)</b>	2	239	<b>241</b>
<b>total</b>	19	253	<b>272</b>
<b>Specificity = 94.4 % Sensitivity =89%</b> <b>False +ve test :5.5%, False -ve test:10.5%</b> <b>predictive value + ve=54.8%, Predictive value – ve = 99%</b> <b>Mean of sternum length in normal birth weight term female = 8.7 ± 0.9</b>			

The mean value of Torso length for normal birth weight and term male newborn was ( $20 \pm 1.8$ ) and for females ( $19.8 \pm 1.4$ ). Regarding use of torso length as screening test in male among 282 newborns with normal growth disturbance 259 had sternum length between (7.1-8.5 cm) which consider as normal range while those with abnormal growth 16 case only 5 cases had normal sternum length, the test is highly specific(92%) and sensitive(75%) in detection of sternal length as shown in table(5).

**Table (5) the use of torso length as screening test and weight for length as growth monitor in male**

Screening test Torso length	weight for length		
	Abnormal growth	Normal growth	total
<b>Less 18.2 and more 21.8 cm (abnormal)</b>	12	23	<b>35</b>
<b>18.2cm – 21.8cm (normal)</b>	4	259	<b>263</b>
<b>total</b>	16	282	<b>298</b>
Specificity =92%, Sensitivity =75 % False +ve test : 8%, False -ve test: 25% Predictive value + ve=34%, Predictive value – ve =98% Mean of torso length in normal birth weight term male = $20 \pm 1.8$			

Regarding use of torso length as screening test in female among 253 newborns with normal growth disturbance 223 had torso length between (7.1-8.5 cm) which consider as normal range while those with abnormal growth 16 case only 5 cases had normal sternum length, the test is highly specific(88%) but sensitivity is low(79%) in detection of sternum length as shown in table (6).

**Table (6) the use of torso length as screening test and weight for length as growth monitor in female**

Screening test torso length	weight for length		
	Abnormal growth	Normal growth	total
<b>Less 18.4cm and 21.2 cm (abnormal)</b>	15	30	<b>45</b>
<b>18.4 cm – 21.2 cm (normal)</b>	4	223	<b>227</b>
<b>total</b>	19	253	<b>272</b>
Specificity =88 %, Sensitivity =79 % False +ve test :12%, False -ve test:21% Predictive value + ve=33%, Predictive value – ve =98 % Mean of torso length in normal birth weight term female = $19.8 \pm 1.4$			



**Table(7) the mean and standard deviation of measurement according to gender differences in newborn without congenital anomalies.**

Measurements	Male(359) Mean± SD	Female(349) Mean ± SD
Weight (kg)	3.11 ± 0.62	2.85 ± 0.82
OFC (cm)	34 ± 2.78	34.1 ± 2.66
Chest circumference(cm)	33.5 ± 2.7	32.4 ± 4.2
Internipple distance(cm)	8.6 ± 1	8.2 ±1.3
Internipple index	25.49 ± 2.11	25.10 ± 2.05
Length(cm)	50.27 ± 3.43	48.32 ± 4.22
Sternum length(cm)	7.8 ± 0.9	8.1 ± 1.4
Torso length(cm)	20 ± 1.8	19.8 ± 1.4
Sternal index	0.47 ± 0.08	0.47 ± 0.08

**Table (8 ) the mean and standard deviation of measurements according to gestational age in newborn without congenital anomalies**

Measurement	Gender	Pre-term(112) Mean ± SD	Term (570) Mean ± SD	Post-term(26) Mean ± SD
Weight(kg)	Male	1.99 ± 0.34	3.2 ± 0.4	4.75 ± 0.15
	female	1.59 ± 0.56	3.1 ± 0.49	4.54 ± 0.25
Internipple distance(cm)	Male	6.9 ± 1	8.7 ± 1	9.3± 0.8
	female	6.4 ± 0.8	8.6 ± 0.9	9.1± 0.8
OFC (cm)	Male	31 ± 1.84	34.35 ± 2.41	36.89 ± 1.52
	female	30 ± 2.46	35 ± 1.61	37.71 ± 2.36
Internipple index	Male	24.98 ± 2.12	25.58 ± 2.44	26 ± 2.26
	female	24.4 ± 1.9	25.29 ± 2	25.9 ± 2.12
C.C (cm)	Male	28.5 ± 1.3	34 ± 2.1	35.9 ± 1.32
	female	25.6 ± 2.7	34 ± 2	35.42 ± 1.27
Sternal length (cm)	Male	6 ± 0.8	7.8 ± 0.7	8.6 ± 0.9
	female	6.3 ± 1	8.7 ± 0.9	8.8 ± 1
Sternal index	Male	0.35 ± 0.05	0.47 ± 0.08	0.6 ± 0.08
	female	0.31 ± 0.03	0.43 ± 0.04	0.58 ±0.07
Length (cm)	Male	44.28 ± 1.53	51 ± 2.85	52.78 ± 1.27
	female	42.2 ± 3.92	49.77 ± 2.54	51.85 ± 1.34
Torso length (cm)	Male	17 ± 1.62	20 ± 1.8	22.8 ± 2
	female	16.3 ± 1.1	19.8 ± 1.4	22.2 ± 1.7



**Table (9) the mean and standard deviation of measurements according to birth weights in newborn without congenital anomalies**

Measurement	gender	LBW(133) Mean $\pm$ SD	NBW(552) Mean $\pm$ SD	HBW(23) Mean $\pm$ SD
Weight(kg)	Male	1.99 $\pm$ 0.34	3.2 $\pm$ 0.41	5.1 $\pm$ 0.4
	female	1.59 $\pm$ 0.56	3.1 $\pm$ 0.49	4.7 $\pm$ 0.6
OFC (cm)	Male	31.57 $\pm$ 2.44	34.35 $\pm$ 2.41	37.55 $\pm$ 0.98
	female	30.88 $\pm$ 2.8	34 $\pm$ 1.6	37 $\pm$ 1
Internipple distance (cm)	Male	6.9 $\pm$ 0.9	8.7 $\pm$ 1	11.5 $\pm$ 0.8
	female	6.7 $\pm$ 0.7	8.6 $\pm$ 0.9	10.3 $\pm$ 0.3
Internipple index	Male	24.12 $\pm$ 1.94	25.83 $\pm$ 1.80	28.3 $\pm$ 1.47
	female	23.42 $\pm$ 1.79	25.73 $\pm$ 2	27.4 $\pm$ 1.32
Chest circum-ferences (cm)	Male	29.18 $\pm$ 1.75	34 $\pm$ 2.15	36.22 $\pm$ 1.69
	female	26.54 $\pm$ 3.3	34 $\pm$ 2.17	36 $\pm$ 1.58
Sternum length (cm)	Male	6.2 $\pm$ 0.9	7.8 $\pm$ 0.7	8.9 $\pm$ 0.7
	female	6.7 $\pm$ 1	8.7 $\pm$ 0.9	9.1 $\pm$ 0.4
Sternal index	Male	0.35 $\pm$ 0.05	0.48 $\pm$ 0.08	0.6 $\pm$ 0.08
	female	0.32 $\pm$ 0.03	0.44 $\pm$ 0.08	0.59 $\pm$ 0.08
Torso length (cm)	Male	17.7 $\pm$ 2	20 $\pm$ 1.8	23.6 $\pm$ 1.6
	female	16.3 $\pm$ 1.4	19.8 $\pm$ 1.4	22.8 $\pm$ 1.4
Length (cm)	Male	45.22 $\pm$ 2.37	50.78 $\pm$ 2.66	55.16 $\pm$ 0.98
	female	43.4 $\pm$ 4.4	49.78 $\pm$ 2.6	54.6 $\pm$ 0.89

**Table (10) the relation between chest circumference , internipple distance and internipple index according to gestational age**

Gestational age	Gender	Chest circumference	Internipple distance	Internipple index
Less than 37 wk	Male	28.5 $\pm$ 1.3	6.9 $\pm$ 1	24.98 $\pm$ 2.12
	Female	25.6 $\pm$ 2.7	6.4 $\pm$ 0.8	24.4 $\pm$ 1.9
37- 41 wk	Male	34 $\pm$ 1.2	8.7 $\pm$ 1	25.58 $\pm$ 2.44
	Female	34 $\pm$ 2	8.6 $\pm$ 0.9	25.29 $\pm$ 2
More than 41wk	Male	35.9 $\pm$ 1.32	9.3 $\pm$ 0.8	26 $\pm$ 2.26
	Female	35.42 $\pm$ 1.27	9.1 $\pm$ 0.8	25.9 $\pm$ 2.12

### Congenital anomalies

Total number of congenital anomalies who diagnosed clinically without chromosomal analysis was 24 cases, 63% of cases was female and 37% was male that shown in table(11)

Type of congenital anomaly	Frequency (%)
Anencephaly	3 (12.5%)
Hydrocephaly	3 (12.5%)
Turner Syndrome	3 (12.5%)
Edward Syndrome	5 (21%)
Klippeil feil Syndrome	4 (16.5%)
Down Syndrome	3 (12.5%)
Spina bifida with meningocele	3 (12.5%)

Table(12) the mean and standard deviation of measurement according to gender differences in newborn with congenital anomalies

Measurements	Male(9) Mean $\pm$ SD	Female(15) Mean $\pm$ SD
Weight (kg)	2.54 $\pm$ 0.45	2.46 $\pm$ 0.43
OFC (cm)*	33.5 $\pm$ 1.9	34.5 $\pm$ 1.8
Chest circumference(cm)	32.22 $\pm$ 1.71	32.33 $\pm$ 1.91
Internipple distance(cm)	7.72 $\pm$ 1.56	8.7 $\pm$ 0.88
Internipple index	24.67 $\pm$ 3.62	26.33 $\pm$ 2.28
Length(cm)	46.88 $\pm$ 4	45.4 $\pm$ 3.13
Sternum length(cm)	6.11 $\pm$ 1.63	7.26 $\pm$ 1.19
Torso length(cm)	17.7 $\pm$ 2.15	17.1 $\pm$ 1.88
Sternal index	0.34 $\pm$ 0.19	0.43 $\pm$ 0.13

\*exclude cases of anencephaly 3 from calculate the mean and standard deviation of OFC. Regarding if the family had previously newborn about 9 cases (37.5%) had history of congenital anomalies while 15 (62.5%) without history of previously congenital anomalies and about 18(75%) of cases their mothers had history of abortion while 6(25%) had no history of abortion.

### Discussion

Measurements of internipple distance, sternum length and torso length with OFC, body weight and length of the human individual consider as an early tool of physical anthropology, it has been

used for the purposes of understanding human physical variation and in various attempts to correlate physical with racial and psychological traits. Those Anthropometrics involves the systematic measurement of the

physical properties of the human body, primarily dimensional descriptors of body size and shape. Those measures are considered as diagnostic aids for clinical genetics and many physicians depended on it because it is more applicable, universal, inexpensive and non-invasive technique for assessing of body parts and given simple clue about newborn state.

Internipple distance varies with gestational age and chronological age, but the internipple index, which is highest in the neonatal period.<sup>[10]</sup> The mean internipple distance for normal term newborns (8.7 cm) in male and (8.6 cm) in female. This result agree with Leung<sup>[11]</sup>, Fok<sup>[12]</sup>, and Faridi<sup>[13]</sup> but disagree with Kulkarni and Rajendran<sup>[14]</sup> and Ejiwumni<sup>[15]</sup> which reported less distance between the nipples for term 7.35cm. Internipple distance is directly proportional to gestational age and increases as the pregnancy continues. The internipple distance were significantly greater in male than female newborns in this study, but other authors have not found these measurements to differ according to gender<sup>[11,16,17]</sup>. Screening test for males is sensitive (81.2%) and specific (84.3%) but is only specific (90%) in females.

The mean internipple index in this study was being 26 and this result agree with Chen<sup>[18]</sup> 26.1 and disagree with that made by Faridi<sup>[13]</sup>, Leung<sup>[11]</sup> which show that internipple index was 27% and more than those made by other authors Ejiwumni<sup>[15]</sup>, Plez<sup>[19]</sup> that show index of 23.4% as a larger chest circumference decreases the internipple index. An internipple distance of 9.6 cm or an internipple index of 28.2 % in the neonatal period indicates widely spaced nipples.

The mean of sternum length in term male (7.8 cm) and in term female (8.7 cm), the sternum length in male is shorter than in female because the manubrium of the female sternum exceeds half the length of the body, while the body in the male sternum is, at least, twice as long as the manubrium<sup>[20]</sup>. Screening test for females is sensitive (89%) and specific (94.4%) and also is specific (91.8%) and sensitive (70%) in males.

No previous studies have been performed to differentiate between male and female to compare with it.

The sternal index is about (0.47) for both sex in our study and the sternum is considered short when sternal-torso index is below (

0.33) our study was differ from those made by Sivan<sup>[21]</sup> which show that sternal index was 0.28 consider short , this index became smaller when the torso length is long.

The mean of torso length in term male (20 cm) and in term female (19.8 cm). The sensitivity of torso length is 75% and highly specific is 92 % in males while the sensitivity is 79 % but specificity is 88 % in females. No previously studies have been performed to differentiate between male and female to compare with it.

- Internipple distance is different in mean in normal than congenital anomalies newborns because there is 3 from 24 cases diagnosed clinically as Turner syndrome among newborns with congenital anomalies.
- Sternum length there is different in mean the measurements between normal and congenital anomalies in newborns because there was 5 from 24 cases diagnosed clinically as Edward syndrome among newborns with congenital anomalies.
- Torso length no difference was found in means measurements between normal and congenital anomalies.

Relation between measurements and gestational age: A study on pre-term, term and post-term newborns that evaluated anthropometric measurements as a tool to differentiate between normal and abnormal babies. The study found a positive correlation between gestational age and internipple distance, sternum length and torso length, the mean internipple distance for males and females in pre-term were 6.9 and 6.4 cm which is less values made by by Merlob<sup>[3]</sup> Sivan Y<sup>[21]</sup> and Fok T F<sup>[12]</sup>, and the mean in post-term 9.3 and 9.1 cm for males and females .The mean sternum length for males and females in pre-term were 6 and 6.3 cm which is less values made by by Merlob<sup>[3]</sup> Sivan Y<sup>[21]</sup> and Fok T F<sup>[12]</sup>, and the mean in post-term 8.6 and 8.8 cm for males and females . The mean torso length for males and females in pre-term were 17 and 16.3 cm which is less values made by Merlob<sup>[3]</sup> Sivan Y<sup>[21]</sup> and Fok T F<sup>[12]</sup>, and the mean in post-term 22.8 and 22.2cm for males and females.

Relation between measurements and birth weight: The study found a positive correlation between birth weight and internipple distance, sternum length and torso length, the mean internipple distance for

males and females in LBW were 6.9 and 6.7 cm , and the mean in HBW 11.5 and 10.3 cm for males and females .The mean sternum length for males and females in LBW were 6.2 and 6.7 cm, and the mean in HBW 8.9 and 9.1 cm for males and females . The mean torso length for males and females in LBW were 17.7 and 16.3 cm , and the mean in HBW 23.6 and 22.8 cm for males and females.

No previously studies have been performed to compare with it.

Anthropometric measurements in newborns with congenital anomalies:

- The mean birth weight in newborns without congenital anomalies was(3.11 kg for males and 2.85 kg for females) and in congenital anomalies were smaller as (2.54kg for males and 2.46 kg for females) p-value 0.03.
- The OFC result in babies without anomalies was( 34 cm) for both males and females when OFC in males with anomalies were (33.5 cm) smaller than OFC in females(34.5cm) due to presence of 3 cases among 15 cases female with hydrocephalus with OFC (45.8cm) and 2 cases of male with anencephaly which excluded from the mean and standard deviation of OFC the result is not significant ( p-value 0.14 ).
- Chest circumference in newborns without anomalies were higher in males than in females (33.5 cm for males and 32.4 cm for females) while equal in both sex in babies with congenital anomalies p-value 0.01.
- Internipple distance in newborns without congenital anomalies was (8.6 cm for males and 8.2 cm for females) and babies with anomalies were widely differs due to presence of 3 cases diagnosed clinically as Turner syndrome (7.72 cm for males and 8.7cm for females) where internipple index were similar in both sex (25.4) but were differ in babies with congenital anomalies as (24.67 for males and 26.32 for females).
- Sternum length were similar in newborns with and congenital anomalies which is smaller in males than females, when sternal index were similar in newborns without anomalies and are shorter in males (0.34) than females (0.43).
- Torso length in babies with congenital anomalies are (17.7

cm for males and 17.1 for females) while slightly longer in newborns without anomalies (20 cm for males and 19.8 cm for females).

- Length in newborns without anomalies were (50.27 cm for males and 48.32 cm for females when the length in newborns with anomalies were shorter as (46.88 cm for males and 45.4 cm for females) p-value 0.04.

### Conclusion

1. Internipple distance and torso length were greater in male than female while sternum length are shorter in male than female ,and varies with gestational age and increase as the pregnancy continue.
2. Newborn with internipple distance of 9.6 cm and internipple index of 28.2 consider as widely spaced nipple.
3. The screening test for internipple distance ,sternum length and torso length were

specific and sensitive for torso length and sternum length in both sex and internipple distance in males.

4. Sternal index less than 0.33 consider as short sternum which depend on the length of sternum length and torso length as long torso length reduce the sternal index .
5. Gender , gestational age, newborn length and consider as factors that effect on newborn growth parameters.

**Recommendation:** The study recommend to perform evaluation of newborn infant overall Iraq and neighbor countries regarding to internipple distance, sternum length and torso length as a screening test and obtain basic parameter for middle east newborn population.

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