International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2015): 6.391

Establishment of Local Reference for Left Liver Lobe Dimensions in Normal Sudanese School Age Children Using Ultrasonography

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Abstract: ***Liver size varies widely with age. Many diseases can affect liver size, ranging from infective processes to malignant disorders.Palpation and percussion are the standard physical techniques to assess liver size, but are far from accurate to detect small increase in size. Ultrasound (US) is an extremely important imaging method in the evaluation of the liver in children.normative data on liver dimensions of children remain scanty in our population.The objective of this study was to establish a local reference for the left liver lobe dimensions using ultrasound in Sudanese school age. A cross-sectional prospective study of 150 healthy boys and girls, their ages were between 6 and 13 year-old, 65 (43%) of them were boys and 85 (57%) were girls. In a primary schools this study was carried out between March 2016 to September 2016. Sex, age, weight (WT), and height (HT) of the participants were measured. Ultrasound Measurements; craniocaudal (CC) , anteroposterior (AP) lengths and width, were taken in deep inspiration with the subjects holding their breath briefly. No preparation or sedation was used. Measurements were made with the subjects lying in supine position with relaxed abdominal wall. Data were compiled and analyzed using Microsoft Excel program version 2013. After categorisation the subjects based on age the maximum mean of the CC length was 93.7mm and minimum mean was 68.9mm. The maximum mean of width was 44.4mm and minimum was mean 34mm. The maximum mean of AP was 37.7mm and minimum was mean 25.2mm.In all measurements the mean in boys was higher than girls within the same age group. The measurements of left liver lobe were correlated with age, height and weight, using polynomial correlation. The study showed the length of CC of left liver lobe was affected by gender. Age had the strongest correlation among the other variables. In conclusion, the CC length is a good indicator for left liver lobe size. Also, ultrasound must be the first line in diagnose hepatic disease, especially those accompanied with changes in the size and texture.***

Keywords: Ultrasonography, body habitus, Left liver Lobe dimensions, Sudanese, School Age

1. Introduction

Liver size varies widely with age. Many diseases can affect Liver size, ranging from infective processes to malignant disorders. Palpation and percussion are the standard physical techniques to assess liver size, but are far from accurate to detect small increase in size.(1)

Enlargement of liver is associated with different hepatic and systemic diseases which include inflammatory conditions, metabolic diseases, fatty liver, autoimmune diseases, primary and secondary neoplasm, anaemia and cardiac failure. On the other hand, reduced liver size may be associated with liver cirrhosis. (1)

Changing in liver size needs to be evaluated accurately and rapidly. Clinical assessment of hepatomegaly by palpation and percussion has also been shown to lack both accuracy and reliability. (1)

Ultrasound (US) is an extremely important imaging method in the evaluation of the liver in children due to the fact that it is easy to use, provides real-time images, does not require anesthesia and does not utilize ionizing radiation. In most cases, determination of hepatomegaly is necessary and generally sonography is performed for this purpose. (2)

We conducted this study to establish standard reference for left lobe measurements in liver by ultrsonography in healthy Sudanese children of 6 years up to 13 years, based on gender, age, body weight and height.

2. Material and Method

A cross-sectional prospective study of 150 healthy boys and girls their ages were between 6 and 13 year-old, 65 (43%) of them were boys and 85 (57%) were girls. in a primary schools this study was carried out between March 2016 to September 2016. Sex, age, weight WT, and height HT of the participants were measured. With WT measured in kilogram and HT in centimetre. Only healthy looking children were included in the study. Clinical exclusion criteria were fever, jaundice, macular or maculopapular rash, and lymphadenopathy. Scans were done with Digital Ultrasonic Diagnostic Imaging System with 3.5 MHz, convex transducer (Mindray, DP-1100Plus made in China.) Two sequential measurements were obtained for each area and their mean was calculated; this is to minimize intra-operator variation and ensure greater accuracy and reliability of measurements. Measurements of; craniocaudal (CC) , anteroposterior (AP) lengths and width were taken in deep inspiration with the subjects holding their breath briefly. No preparation or sedation was used. Measurements were made

with the subjects lying in supine position with relaxed abdominal wall.

The left liver lobe dimensions was measured in sagittal, transverse and oblique planes and also included scan at midsagittal. Scan was done in a slowed rocking and moved transducer in all planes to obtain the best visualization of the whole liver. Data were compiled and analyzed using Microsoft Excel program version 2013. The relationships of all the dimensions of the liver with age, sex, WT and HT were determined and regression models were established.This study was approved by the ethics committee of the ministry of education.

3. Results

Out of the total of 160 participants sampled for this study, only the results of 150 participants, who met all the inclusion criteria, were included. Of these, 65 (43%) of them were boys and 85 (57%) were girls. Distribution of subjects by gender and age is summarized in Table 1. The subjects' age ranged from 6 to 13 years. The nomogram of liver dimensions by age is presented in Table 2. Table 3 & 4 represents height and weight, respectively. In most age categories, males showed higher hepatic dimensions than females.

Table 1: Age gender distribution of study population

Age	No. Boys	No. Girls	total
6 – 7	12	12	24
7 – 8	11	12	23
8 – 9	8	11	19
9–10	6	13	19
10 – 11	11	10	21
11 – 12	6	13	19
12 – 13	7	9	16
13 – 14	4	5	9
	65	85	150

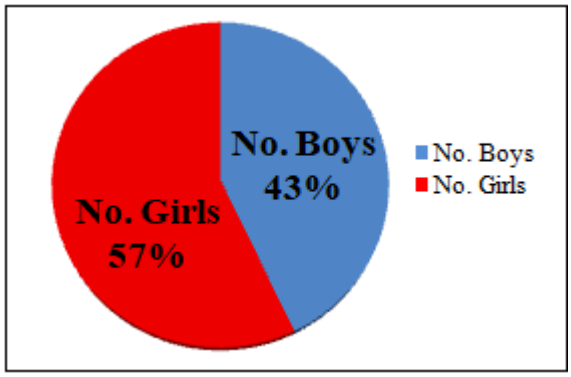

Figure 1: Graph Shows gender and Percentage

Table 2: Distribution of left liver lobe measurements with age

Age	LLL length (CC) in mm		LLL Width in mm		LLL (AP) in mm	
	Boys	Girls	Boys	Girls	Boys	Girls
6	74.75	68.91	34	35.25	28.25	30.83
7	73.63	71.33	38.09	38.16	32.72	30.25
8	76.5	75.63	42	38.9	31.75	32.45
9	78.5	78.84	40.66	40.38	36.33	37.38
10	82.18	83.7	39.81	40.4	32.09	35.4
11	90.33	85.61	40.83	40.84	27.33	36.07
12	93.71	90.77	39.42	41.88	26.85	37.77
13	94	91	39.75	44.4	25.25	36.02

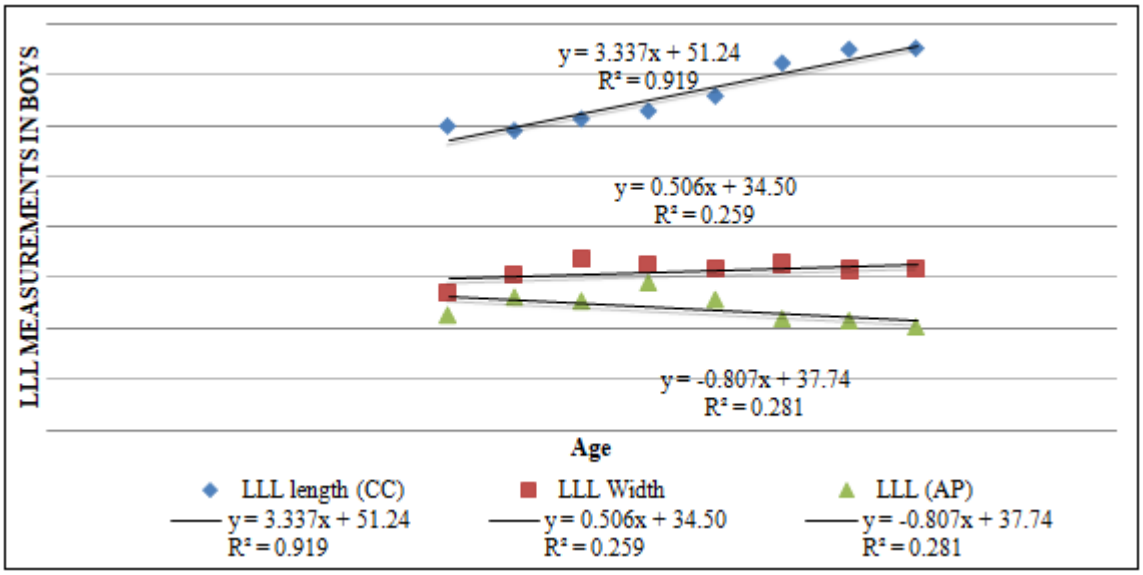

Figure 2: Scatter Plot of LLL measurement correlated with age in boys.

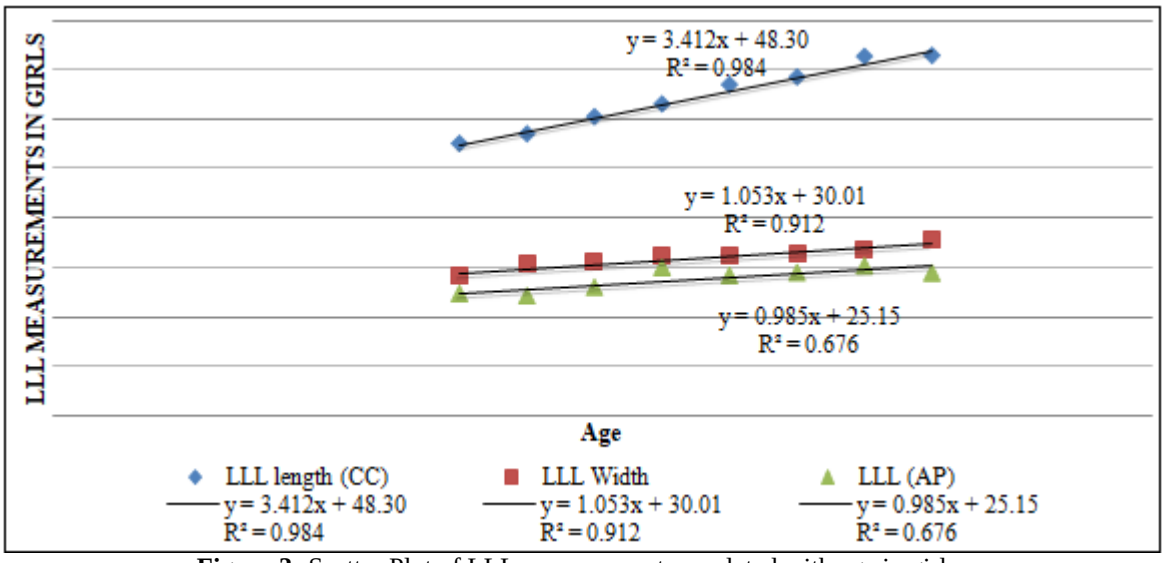

Figure 3: Scatter Plot of LLL measurement correlated with age in girls.

Table 3: Distribution of left liver lobe measurements with height

Height (CM)	LLL length (CC) in mm		LLL Width in mm		LLL (AP) in mm	
	Boys	Girls	Boys	Girls	Boys	Girls
100 - 110	72.5	68	33.8	35. 5	28	35.4
111 - 120	73.7	70.8	36.2	36.7	30.3	30.7
121 - 130	76.8	76.1	39.9	39.09	32.7	33.2
131 - 140	88.5	84.2	39.1	40.8	30.4	36.1
141 - 150	90.1	85.2	41.8	42.4	35	38.3
151 - 160	91	94.7	44.5	44.2	40	37.2
161-170	-	95	-	45	-	37.2

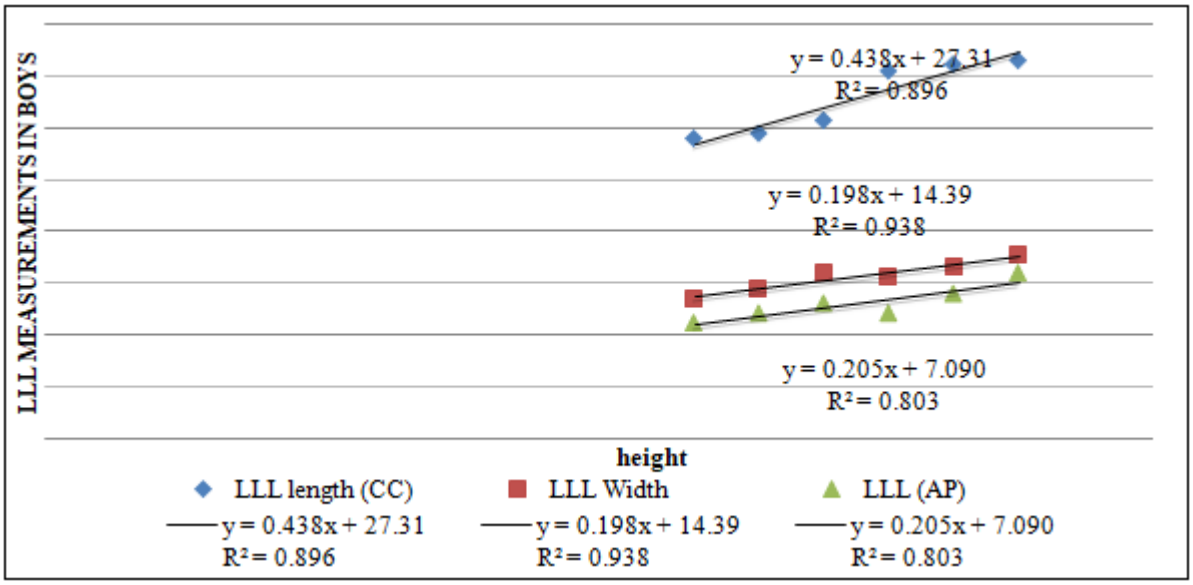

Figure 4: Scatter Plot of LLL measurement correlated with height in boys.

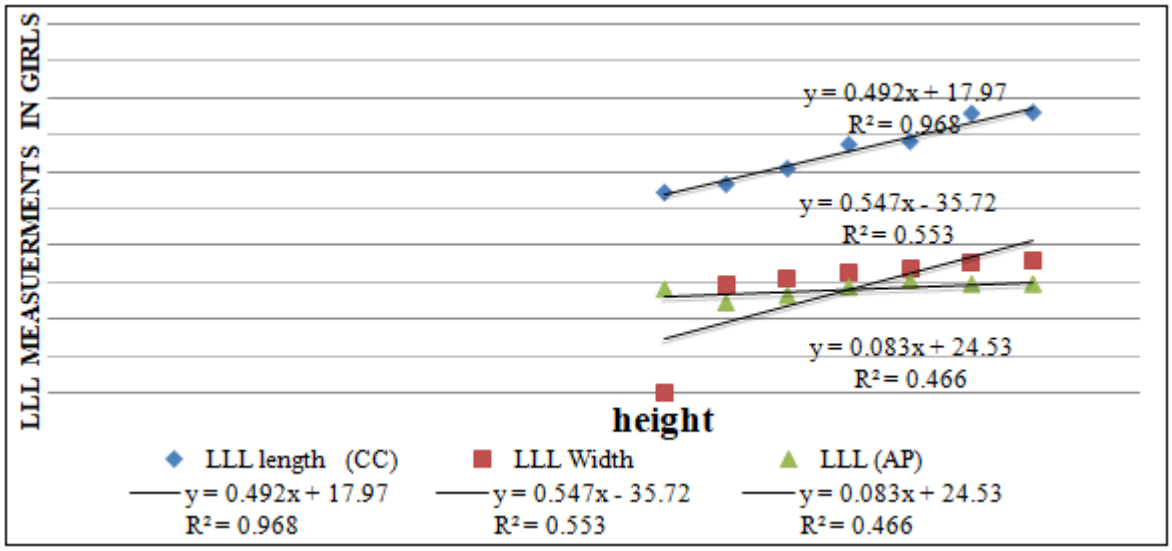

Figure 5: Scatter Plot of LLL measurement correlated with height in girls

Table 4: Distribution of left liver lobe measurements with weight

Weight in kg	LLL length (CC) in mm		LLL Width in mm		LLL (AP) in mm	
	Boys	Girls	Boys	Girls	Boys	Girls
15 - 20	73.1	67.4	33.1	37	27.1	32.6
21 - 25	74.8	76.5	36.4	36.7	33.4	30.7
26 - 30	82.8	81.7	40	39.8	30.8	35.8
31 - 35	91.3	82.6	40.1	40.9	28.6	34.6
36 - 40	92	86.5	42.4	43.3	28.4	41
41-45	-	86	-	43.2	-	34.5
46-50	-	88	-	48	-	34.5
51-55	-	89	-	41	-	42
56-60	-	89.3	-	46	-	40.3

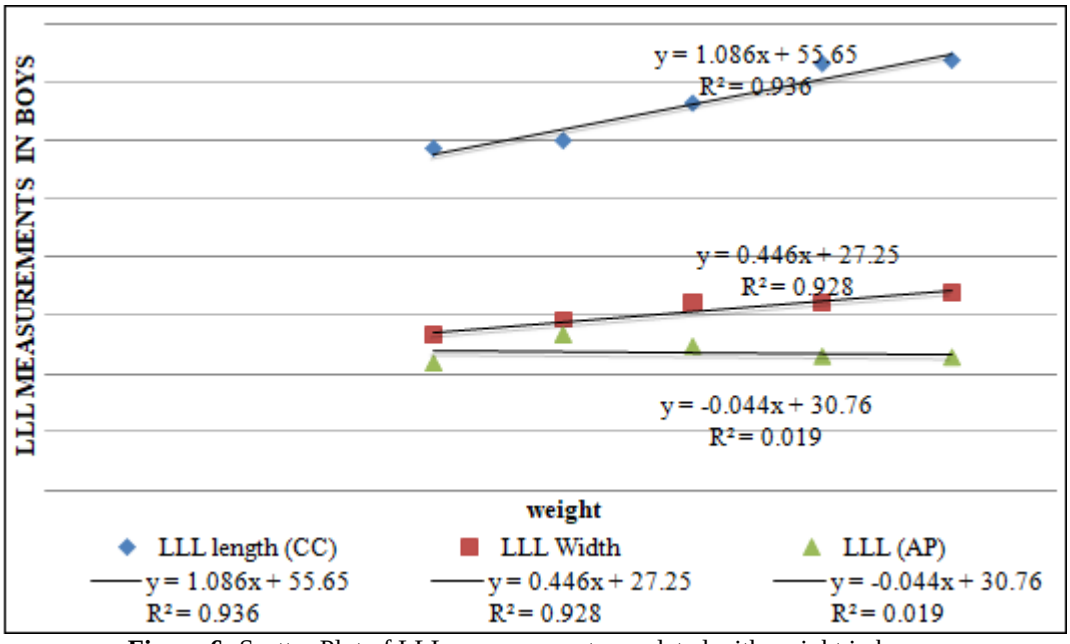

Figure 6: Scatter Plot of LLL measurement correlated with weight in boys.

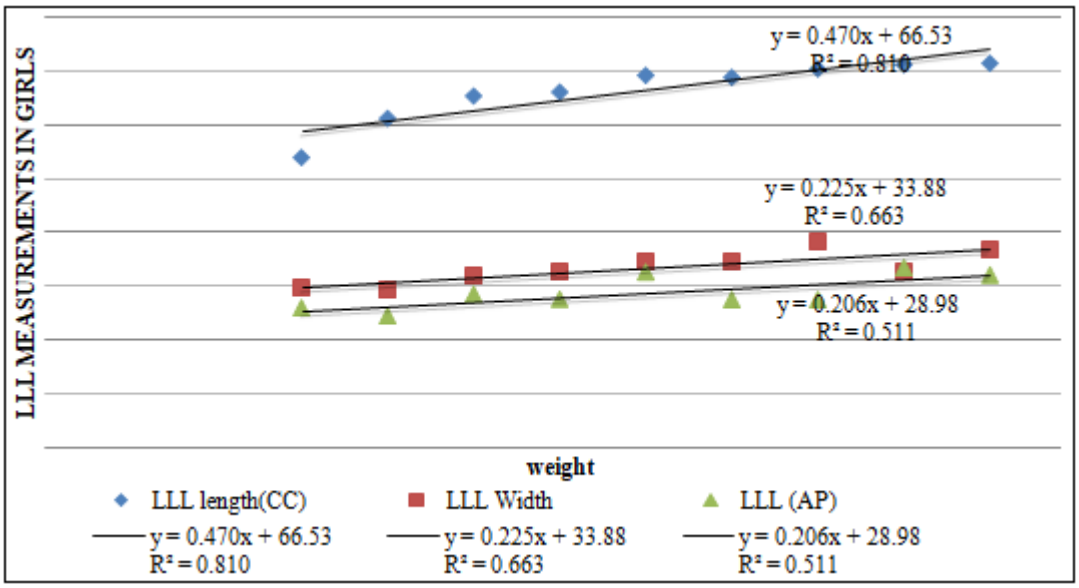

Figure 7: Scatter Plot of LLL measurement correlated with weight in girls

4. Discussion

The importance of the knowledge of the normal range of left liver lobe in the identification of early pathological changes in the size of the liver, must be detected as early as possible. This study has set baseline data with ultrasound, which can be used as a comprehensive guide to normal left liver dimensions for the Sudanese children within the age range of 6–13 years. Liver dimensions have been reported to vary with races and countries.[3,4,5,6]

In the literature, there are few detailed studies to interpret the left liver lobe dimensions by ultrasound in children. By reviewing the literature Normative data of hepato-splenic sizes in Pakistani pediatric population using ultrasonography has been done in 2014, by Raza F et al. it stated Normal liver length significantly correlated highly with the height/length (r=0.7) and weight of the subjects (r=0.7).[7] In 2014 Ezeofor SN, et al examined 1315 children between the ages of 5 and 17 years, Age and all the body size indices correlated positively and significantly with the liver dimensions ($P < 0.01$, $P < 0.05$). Has stated also Liver sizes in males were larger than those in females[8]. The current study showed strong correlation between left liver lobe dimensions with body parameters Among which, the age and body height is correlated best to the left liver lobe measurements, Weight also showed to correlated with left liver lobe dimensions, but to a lesser degree. Also the study showed the length of CC of left liver lobe affected by gender (both gender have different means) where showed boys have a larger length of CC of left liver lobe for every categories than girls. So that this study agreed much with Raza F et al and Ezeofor SN, et al, But disagreed with the study done by Kaya S, et al. in 2000 , where they stated that there was no statistically significant correlation between the age, weight, height and body surface area of the children and the ultrasonographic measurement of the liver size.[2]

5. Conclusion

We have been able to set baseline data for left liver lobe dimensions according to weight, height and age categories for healthy Sudanese school age children. This study also has set up the limits of normal values for each of the age category. The all left liver lobe measurements are in co-relation with age, height and weight. This correlation was a polynomial correlation. Age has the highest strong correlation among the other variables. Several studies have established sexual dimorphism in liver dimensions where boys showed larger liver sizes than girls. In this study boys have a larger length of CC of left liver lobe for any categories than girls.

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