

## Original Research Article

**Sonographic Evaluation of Splenic Index in Sudan**Marwa H. Mohammed M.H<sup>1</sup>, Ahmed Abdelrahim Mohammed<sup>1</sup>, Ala Mohammed Abd Elgyoum<sup>2,3</sup><sup>1</sup>Faculty of Radiology Science and Medical Imaging, Alzaiem Alazhari University, Khartoum, Sudan<sup>2</sup>College of applied medical science, Taif University, Taif - Saudi Arabia<sup>3</sup>Faculty of Radiological and Nuclear Medicine Science, National Ribat University, Khartoum - Sudan**\*Corresponding author**

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**Abstract:** The spleen is considered the largest mass of the reticulo-endothelial system. It lies in the left hypochondrial region of the abdomen immediately inferior and anterior to the diaphragm and it protected by ribs. The spleen filters blood and form antibodies, it also contributes importantly to the normal and pathologic removal of blood cells from the circulation and to defiance against infection with the encapsulated bacteria. The aim of the study was to evaluate the importance of ultrasound in the evaluation of splenic index among Sudanese population. The study was conducted on a hundred Sudanese population from both sexes scanned by ultrasound machine with the patient lying on right lateral decubitus position, moving his arm above the head, then ask him to take deep breathing; first I took two measurements, the length and width of the spleen, then the splenic index is calculated by multiplying the length in to width. The study includes of 52% of males and 48% of females of the sample. There was a correlation between splenic index and volunteers body weight, height and age; where there was no significant correlation between splenic index and the volunteer's sex. The best correlation was between the splenic index and volunteer's body weight followed by the splenic index and volunteer's height and finally the correlation between the splenic index and volunteer's age. The mean standard of splenic index was 32.9, the mean standard of splenic length was 9.4 cm, and the mean standard splenic width was 4.5cm, therefore the researcher recommend that to take the splenic index measurement in addition to the essential splenic measurements.

**Keywords:** spleen, index and Ultrasound**INTRODUCTION**

All diagnostic ultrasound applications are based on the detection and display of acoustic energy reflected from interfaces within the body. These interactions provide the information needed to generate high-resolution, gray-scale images of the body, as well as display information related to blood flow. Its unique imaging attributes have made ultrasound an important and versatile medical imaging tool. However, expensive state-of-the-art instrumentation does not guarantee the production of high-quality studies of diagnostic value [1].

Ultrasound is a simple and reliable method for measuring splenic size. Size is usually assessed by a single longitudinal length measurement. Area and volume calculations based on 2D and 3D ultrasound have also been proposed but these more complex

measurements are not used in routine clinical practice. The spleen reaches maximum size soon after puberty but there are conflicting data regarding the normal size of the adult spleen. One large study found 95% of subjects had a splenic length of less than 11 cm, breadth less than 7 cm and thickness less than 5 cm. A other study found that a length of over 12 cm was two standard deviations above the mean [2]. It is difficult therefore to give a single measurement for the upper limit of splenic size that is applicable to all patients and the sonologist will need to make a judgement based on the patient's age, sex and body habitus [2]. Ultrasound imaging is a noninvasive medical test that helps physicians diagnose and treat medical conditions. Conventional ultrasound display the images in thin, flat section of the body advancements in ultrasound display technology include three-dimensional 3-D ultrasound that formats the sound waves data in to 3-D image,

four-dimensional 4-D ultrasound is 3-D ultrasound in motion [4]. Benefits of ultrasound scanning are noninvasive (no needles or injections, usually painless, widely available, easy to use, and less expensive than other imaging methods [6]. In addition ultrasound imaging uses no ionizing radiation and gives a clear picture of soft tissues that do not show up well on x-ray images, also it causes no health problem and may be repeated as often as is necessary and finally it is a preferred imaging modality for the diagnosis and monitoring of pregnant women and their un born babies [4].

The spleen is a crescent shaped mass of lymphoid tissue that sits with its smooth convex side in contact with the left hemi diaphragm and its concave or medial aspect contain central helium. Several splenic veins exit the spleen separately and anastomose to form one large splenic vein medial to the splenic helium. The passes interomedially along the posterior surface of the pancreas. The splenic parenchyma is extremely homogeneous and has a uniform mid to low level echogenicity. The echogenicity is usually slightly greater than that of the normal liver and higher than that of the normal renal cortex [3].

#### OBJECTIVES

The aim of the study is to evaluate the importance of ultrasound in the evaluation of splenic index among Sudanese population.

#### MATERIALS AND METHODS

This is descriptive and an analytical study dealing with normal Sudanese volunteers, during the period between October 2010 and January 2011. A hundred of normal volunteers were selected randomly by the technique of simple random sample. The primary data was collected from data collection sheets by using different types of ultrasound machine i.e- Aloka, Siemens, and Toshiba with electronic 3.5MHZ convex array probe, ultrasonic gel, height meter, and measuring instrument. Transabdominal ultrasound was performed for hundred volunteers of Sudanese population that came to ultrasound departments by themselves and the scans was done every Monday and Tuesday per week during time between October 2010 till January 2011. The examination was performed with the patient lying comfortably on the right lateral decubitus, the left arm was over their head to elevate the lower ribs and the left leg was slightly flexed. The transducer was placed

perpendicularly on midcoronal plane and the patient had been asked to take deep breathing during scanning.

#### RESULTS AND DISCUSSION

The study was done on a hundred of normal volunteers were selected randomly by the technique of simple random sample. The mean age was 31.1, the maximum limit of splenic index was 53.8 and the minimum limit was 17.2, the maximum limit of volunteer's height was 187 cm and the minimum limit was 145 cm, and the maximum limit of volunteers weight was 95 kg and the minimum limit was 36 kg. In The study the mean splenic index was found to be 32.9 and the normal splenic index is up to 45. For testing the correlation between splenic index and volunteer's height, there was a relationship between the two variables because the P- value was 0.002 [ $<0.05$ ] and the correlation was significant at 0.01 level. For testing the correlation between splenic index and volunteer's weight, there was a relationship between the two variables because the P- value was 0.00 [ $<0.05$ ] and the correlation was significant at 0.01 level. For testing the correlation between splenic index and volunteer's age, there was a relationship between the two variables because the P- value was 0.038 [ $<0.05$ ] and the correlation was significant at 0.05 level. For testing the correlation between splenic index and volunteer's sex, there was no a relationship between the two variables because the P- value was 0.075 [ $>0.05$ ]. For testing the correlation between volunteer's sex and each of splenic length and width, there was no a relationship between the variables because the P- value was  $>0.05$ . For testing the correlation between volunteer's age and each of splenic length and width, also there was no a relationship between the variables because the P- value was  $>0.05$ . For testing the correlation between volunteer's height and each of splenic length and width, there was a relationship between the variables because the P- value was  $<0.05$  and correlation was significant at 0.01 levels for splenic length and significant at 0.05 for splenic width. For testing the correlation between volunteer's weight and each of splenic length and width, there was a relationship between the variables because the P- value was  $<0.05$  and correlation was significant at 0.01 levels for both the splenic length and width. The best correlation was between splenic index and volunteer's weight followed by the splenic index and volunteer's height and then the splenic index and volunteer's age.

**Table 1: Shows the correlation between the volunteer’s age and splenic index.**

Correlations			
		Age	Splenic index
Age	Pearson Correlation	1	.208*
	Sig. (2-tailed)		.038
	N	100	100
Splenic index	Pearson Correlation	.208*	1
	Sig. (2-tailed)	.038	
	N	100	100

\* Correlation is significant at the 0.05 level (2-tailed).

Sig = 0.038 (sig < 0.05) so there is a correlation between age and splenic index. R=0.208 and the correlation is significant at the 0.05 level.

**Table 2: Shows the correlation between volunteer’s height and splenic index**

Correlations			
		Height	Splenic length
Height	Pearson Correlation	1	.312**
	Sig. (2-tailed)		.002
	N	100	100
Splenic length	Pearson Correlation	.312**	1
	Sig. (2-tailed)	.002	
	N	100	100

\*\* Correlation is significant at the 0.01 level (2-tailed).

Sig = 0.002 (sig < 0.05) so there is a correlation between volunteer height and splenic index. R= 0.312 and Correlation is significant at the 0.01 level.

**Table 3: Shows the correlation between the volunteer’s weight and splenic index.**

Correlations			
		Body weight	Splenic length
Body weight	Pearson Correlation	1	.433**
	Sig. (2-tailed)		.000
	N	100	100
Splenic length	Pearson Correlation	.433**	1
	Sig. (2-tailed)	.000	
	N	100	100

\*\* Correlation is significant at the 0.01 level (2-tailed).

Sig = 0.00 (sig < 0.05) so there is a correlation between Body weight and splenic index. R= 0.433 and the Correlation is significant at the 0.01 level.

**Table 4: Shows the correlations between volunteer’s sex and splenic index**

Correlations			
		Sex	Splenic index
Sex	Pearson Correlation	1	-.179
	Sig. (2-tailed)		.075
	N	100	100
Splenic index	Pearson Correlation	-.179	1
	Sig. (2-tailed)	.075	
	N	100	100

Sig = 0.075 (sig > 0.05) so there is no correlation between the volunteers sex and splenic index.

**Table 5: Shows the Cross tabulation for splenic index and volunteers sex**

splenic index * sex Cross tabulation				
Count		Sex		Total
		Male	female	
splenic index	less than 22	5	4	9
	22-26.9	9	15	24
	27-31.9	7	8	15
	32-36.9	12	7	19
	37-41.9	8	7	15
	42-46.9	5	7	12
	47-51.9	2	0	2
	more than 52	4	0	4
Total		52	48	100

**Table 6: Shows the Cross tabulation for splenic index and volunteers age**

splenic index * age Cross tabulation								
Count		Age						Total
		15-24	25-34	35-44	45-54	55-64	65-74	
splenic index	less than 22	5	2	0	0	2	0	9
	22-26.9	15	5	1	1	2	0	24
	27-31.9	6	6	1	0	1	1	15
	32-36.9	7	5	4	2	1	0	19
	37-41.9	6	6	0	1	2	0	15
	42-46.9	4	1	0	5	2	0	12
	47-51.9	1	0	0	0	0	1	2
	more than 52	1	1	2	0	0	0	4
Total		45	26	8	9	10	2	100

**Table 7: Shows the Cross tabulation for splenic index and volunteers height.**

Splenic index * Body height Cross tabulation								
		Body height						Total
		less than 175	157-163	163-168	169-174	175-181	more than 181	
Splenic index	less than 22	0	3	3	1	2	0	9
	22-26.9	6	6	2	6	3	1	24
	27-31.9	3	2	3	5	2	0	15
	32-36.9	0	5	7	4	2	1	19
	37-41.9	2	0	5	4	2	2	15
	42-46.9	0	4	3	3	2	0	12
	47-51.9	0	0	1	0	0	1	2
	more than 52	0	0	0	1	2	1	4
Total		11	20	24	24	15	6	100

**Table 8: Shows the Cross tabulation for splenic index and volunteers weight.**

Splenic index * Body weight Cross tabulation									
Count									
		Body weight							Total
		less than 44	44-51	52-59	60-67	68-74	75-84	more than 84	
splenic index	less than 22	1	3	2	3	0	0	0	9
	22-26.9	4	5	4	6	4	0	1	24
	27-31.9	1	2	4	7	1	0	0	15
	32-36.9	0	1	4	5	4	1	4	19
	37-41.9	0	1	2	5	2	3	2	15
	42-46.9	0	1	1	2	0	3	5	12
	47-51.9	0	0	1	0	1	0	0	2
	more than 52	0	0	1	1	0	0	2	4
Total		6	13	19	29	12	7	14	100

**CONCLUSION**

Out of one hundred patients 52% were males and 48% were females, the best correlation was between the splenic index and volunteer’s body weight followed by the splenic index and volunteer’s height and finally the correlation between the splenic index and volunteer’s age. There was a correlation between splenic index and volunteers body weight, height and age; where there was no significant correlation between splenic index and the volunteer’s sex. The mean age was 31.1, the maximum limit of volunteer’s height was 187 cm, the minimum limit was 145 cm, the maximum limit of volunteer’s weight was 95kg, minimum was 36 kg, and the maximum limit of splenic index was 53.8 and the minimum was 17.2. According to my study the mean standard for splenic index was 32.9, for splenic length was 9.4cm, and for splenic width was 4.5 cm. There is a correlation between splenic length and volunteers body weight, height, and age, also there is a correlation between splenic width and volunteers body weight, height, and age.

**Recommendation**

The mean standard of splenic index was 32.9, the mean standard of splenic length was 9.4 cm and the mean standard splenic width was 4.5cm. I recommend that to take the splenic index measurement in addition to the essential splenic measurements.

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