

Sonographic Measurement Of Normal Liver And Spleen Dimensions In The Paediatric Population Age Group Between 5-15 Years Of A Rural District In Haryana

Divya Rana^{1*}, Ashita Jain², Monu Sarin³, Khursheed Ganie⁴,

^{1*}Assistant Professor, Medical Radiology & Imaging Technology Department, The Neotia University

²Assistant Professor, Radio & Imaging Technology Department, Shree Guru Gobind Singh Tricentenary University

³Professor, Department of Radio Diagnosis, Shree Guru Gobind Singh Tricentenary University

⁴Assistant Professor, Medical Radiology and Imaging Technology Department, Chitkara University

*Corresponding Author: Divya Rana

Medical Radiology & Imaging Technology Department, The Neotia University, West Bengal; Tel: +91-8800230816;

Email ID: rdivya340@gmail.com

Citation: Divya Rana et al. (2024), Sonographic Measurement Of Normal Liver And Spleen Dimensions In The Paediatric Population Age Group Between 5-15 Years Of A Rural District In Haryana. *Educational Administration: Theory and Practice*, 30(2), 433-443.

Doi: 10.53555/kuey.v30i2.1325

ARTICLE INFO

ABSTRACT

Background: Ultrasonography is one of the routinely done imaging diagnosis methods, especially to evaluate the visceral organs among children, since its characteristics of being non-invasive, non-ionizing, widely available, and cheap. There is prominent evidence that proves the liver and spleen dimensions show variation according to their age groups, sex, genetic or of a different race, socioeconomic factors even with different anthropometric parameters. So it's essential to evaluate their size because hepatomegaly and splenomegaly seem to be very common problems in any part of the world. Since the enlargement of organs can suggest that there is some pathogen activity or any infection or abnormal physiology is initiated in the body, measuring the organ can aid it.

AIM: The aim of this study was to evaluate the dimensions of the liver and spleen among paediatric patients of age group 5-15 years of the rural district of Haryana.

Methods: This is a prospective and quantitative study conducted at the radiology department of S.G.T hospital, Budhera, Gurugram, Haryana, study was done to create normative data for the average dimension of the liver and spleen, measurements were taken by ultrasound machines, ideally done with a 3.5MHz curvilinear probe, dimensions were attained from 50 pediatric patients (37 males and 13 females) of age group 5-15 years, of the rural district of Haryana. Other biological information like height, weight, age, sex, and complaints were also taken.

Result: The length of liver and spleen attained sonographically for a total of 50 paediatric patients was 11.37 ± 1.9 cm and 8.26 ± 1.2 cm. But among males, the liver length was 11.4 ± 1.8 cm, in females, it was 11.29 ± 2.3 cm, the splenic length of males was 8.38 ± 1.1 cm, in females it was 7.93 ± 1.3 cm. When splitting the data into two different age groups, the liver length for below 10 years (5-10) children show 10.77 ± 1.90 cm and splenic length was $7.7 \text{cm} \pm 1.01$ cm, whereas the above 10 years (10-15) children show the liver length of 12.56 ± 1.70 cm and the splenic length of 9.34 ± 0.81 cm.

Conclusion: This study provides normative data of average dimension of length and spleen among the pediatric population of the Haryana district.

The average values of the liver and spleen can act as references for further future studies.

INTRODUCTION

1.1 Spleen

The vascular mass and the lymphoid tissues together form an intraperitoneal organ which is called the spleen, which has dual functions to perform firstly, as a producer of immunological reactions against the antigens, as

well as act as the dumping site for aged or defective erythrocytes. Spleen is situated in the abdominal cavity's left hypochondrium part, where it is hidden between the stomach's fundus and the diaphragm. At the 10th rib, its long axis lies obliquely, applied to the 9th, 10th, and 11th ribs behind the midaxillary line. It has inferior and superior ends, anterior border (appeared notched) and posterior border (appeared rounded) and have two surfaces, visceral and the diaphragmatic surface. The convexed diaphragmatic surface fits the criteria of diaphragm concavity whereas the visceral surface is related to the stomach, left kidney, left suprarenal gland, and left colic flexure.

There is another proposal to have a splenic measurement which is by palpations which are also not possible until the size is enlarged 2-3times¹, though it is not a reliable and beneficial idea and can also cause misleading to the interpretation of evaluating its size². Although it may be normally palpable in 15-17% of healthy neonates and 10% of healthy children³. Splenomegaly which means enlargement in the size of the spleen, this condition can appear because of a large number of reasons, for instance, inflammations, neoplastic, infectious diseases, in any hematopoietic change, infiltrations, immunological diseases, etc.⁴.



Diagram1. Showing the sonographic measurement of spleen on a longitudinal plane at the level of the hilum.

1.2 Liver

The liver behaves as both an exocrine gland as well as an endocrine gland by secreting bile juice, albumen, prothrombin, and fibrinogen. This largest gland of the body weighs 1/50 in adults and 1/20 of body weight in infants. It covers the right hypochondrium, epigastrium, and also expands till the left hypochondrium region of the abdomen where its visceral surface rest against the abdominal oesophagus, stomach, upper duodenum, hepatic flexure of the colon, right kidney, and suprarenal gland, also having gall bladder near the quadrate lobe. Its domed-shaped upper surface interacts with the diaphragm where it separates the liver from the pleura lungs, pericardium, and with heart. The largest portion of the liver is occupied by the right costal margin. The liver is being anatomically divided into the right and left lobe by the falciform ligament. On the visceral surface, two more lobes are marked situated between the limbs of the H, named as quadrate lobe (which is present anteriorly) and the caudate lobe behind⁵. The liver is usually measured in the midclavicular line and the average craniocaudal length is up to 16cm⁶.

Since spleen and liver size may vary with the age, especially in paediatric patients where the organs are continuously going through growth and development⁷. However, it is very difficult to have normative data of children. Also, hepatomegaly is a very common clinical condition among children whose cause can be intrinsic liver diseases or any other diseases which can correlate with the liver and the cause can be from any infective etiology to any neoplastic or malignant change³.

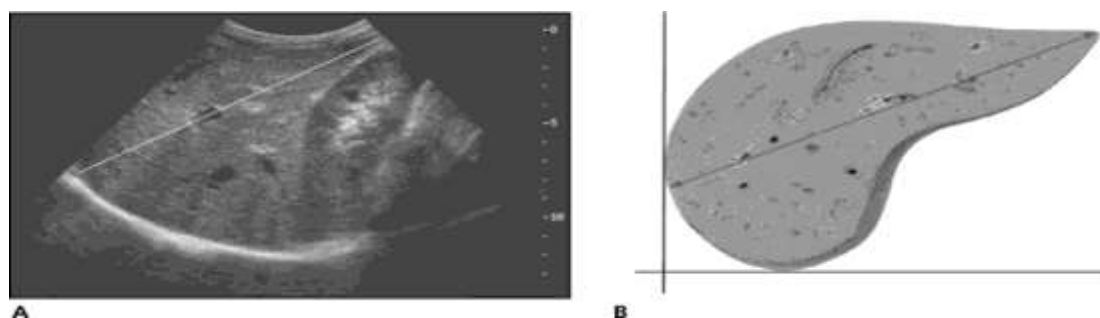


Diagram2. The A and B Diagram showing methods to measure the liver size in the right mid clavicular line extending from the hepatic dome to the lower hepatic margin.

1.3 Role of ultrasound and curvilinear probe:

When the medical world was enhancing its borders to provide a better diagnosis, after the discovery of the X-rays, ultrasound came for further detailing. Before medical application, ultrasound was used as a practical application for the search of sunken titanic, then it came in the medical field for meeting the need of diagnosis, like performing scans of the abdomen, obstetric scans, and even monitoring the flow of blood by a procedure called doppler. Ultrasound is a sound beam that requires a medium for transmitting energy and transmits through the liquid as a longitudinal wave. An ultrasound transducer is a device that can convert one form of energy into another by working on the “piezoelectric effect”. If we focus on the abdominal scan, the curvilinear or convex probe is especially used for performing abdominal scans, usually, the bandwidth range of this probe is 3.5 MHz to 5 MHz. After working with the help of transducers, we can acquire an ultrasonic imagine by displaying those returning echoes on a TV monitor and that can be seen through different modes, but for an abdominal scan, B mode is best suited as it supports the two-dimensional imaging⁸.

1.4 Ultrasonography benefits and limitations:

To evaluate accurate dimensions of the liver and spleen, they should be observed very closely as they can be monitor via abdominal USG scans especially in paediatric patients since its radiation-free, means it is a safe, quick, non-invasive, reliable, cheaper and well-established procedure to keep on monitoring the minute changes in the organs⁹. But the only limitation of this modality is it's being the operator dependent, because of that there are chances to have fake positive readings which can cause trouble to patient's mental health like anxiety, eventually repeated scans may occur that can lead to lots of trouble and confusion in patients' medical history, eventually repeated scans will be the only solution to remove these queries¹⁰. Since normative data for organ, dimensions, especially in paediatric patients, is now the necessity which will be resolved by USG.

1.5 Justification

There is always a persistent need to have an average dimension of organs to detect any disease or pathologies, for instance, if any pathogen or any foreign factor begins to disturb the normal functioning organ, it will soon be going to disturb organs physiological processes, eventually going to disturb the anatomy of that particular organ also. So, to protect the organ from having severed problem, if we can have the average dimensions of the organ, we can start working for a cure in the initial stage when we can spot the change in its size before the organ reaches to a very critical situation by closely monitoring it through different follow-ups of radiology imagining scans. Therefore, it's a severe need to understand which size and shape define the abnormality of an organ as there are so many other factors also which can help to solve the mystery of defining the normal and abnormal sizes of a particular population of people.

AIM & OBJECTIVES

AIM:-

To evaluate the dimensions of liver and spleen among normal paediatric patients of age group 5 to 15 years in the rural district of Haryana.

OBJECTIVES:-

1. To identify the common complaints among paediatric patients who were advised to have an abdominal USG scan.
2. Evaluate the comparison of the age, sex, height, and weight parameters with the liver and splenic dimensions.

Materials and methods

Study area:

This is prospective and quantitative study whose motive was to attain a normative form of data for the dimension of liver and spleen among 50 paediatric patients of age group 5-15 years, study was conducted in the radiology department of the S.G.T hospital and research institute, Budhera, Gurugram, Haryana.

Study duration:

The study took place from November 2020 to April 2021.

Study type and Study design:

This is a prospective and quantitative study that was done to collect data on dimensions of liver and spleen among paediatric population age group 5-15 years (37 males and 13 females), study was conducted in the radiology department of the S.G.T hospital and research institute, Budhera, Gurugram, Haryana. Most of the paediatric patients were referred from the paediatric department who usually came with common complaints of abdominal pain etc. Consent was obtained verbally before scanning selected children for the study.

Sample size:

There were 50 children (37 males and 13 females) of age group 5-15 years selected for this study, most of them were those patients who were referred from the paediatric department of which they visited the radiology department of S.G.T hospital for an abdominal scan and the rest were the volunteers who willingly participated in this study.

Data sampling:

Data of 50 children of age group 5-15 years were collected, most of them were referred from the paediatric department and the rest were willing participants, verbal consent was taken before conducting the scan from parents of those children who were selected for this study and we even did proper counselling of the parents or guardians and children to make them understand the procedure to avoid any confusion. Only those paediatric patients were selected who fall in the desired age group which was 5-15 years and those who were willingly participated in this study. Later on, to acquire the result, the paediatric population was first divided into gender (male and female) and then again the data got distributed into two groups according to their age, which was below 10 years old(5-10years) and above 10 years old children(10-15years).

Method of collection of data:

Data of 50 children of age group 5-15 years were selected for this study, verbal consent of the parents or guardians of those selected children were taken to make them understand the motive of the study, also, to avoid any confusion regarding the procedure. Most of the children were those who were referred from the paediatric department visited the radiology department for abdominal scans and others were the volunteers who willingly participated in this study. And the other additional biometric information was collected from the selected children who were also taken in the radiology department itself, information includes height which was measured using a vertical scale of the wall-mounted stadiometer, the readings from that were taken when the participants stand in the erect position without shoes and the head held in the Frankfurt plane, weight measurements were done using the electric weighing machine, age, the sex was the other parameters which were also recorded during the study. To acquire the result, data was firstly distributed in terms of gender, and then later on distributed in two age groups, below 10 years(5-10years) and above 10 years (10-15years). The measurement of the liver is done by taking the longitudinal axis in after clearing imaging of the liver in the midclavicular plane with a simultaneous demonstration of the right kidney. Where the uppermost edge of the liver under the dome of the diaphragm is defined as the upper margin and the lowermost edge of the liver is defined as the lower margin (diagram2). The splenic dimensions were usually carried out on a longitudinal coronal plane by keeping most of the superomedial and the most inferolateral margins in between at the level of the hilum for reference (diagram 1). The measurements of organs dimension were taken in quiet breathing in younger children and during breath-holding in older children, also in the majority of previous study measurements were usually taken during deep inspiration¹¹. The possible reason to take readings of splenic length in deep inspiration was that the spleen descends downwards during deep inspiration when the patients are positioned in the right lateral decubitus position. In some rare cases when the lung base obscured the spleen on deep inspiration, then scans performed on shallow inspiration or at rest¹². No other preparation or sedation on children was needed for this study. The collected data was entered into the excel spreadsheet, and then the data was further analyzed using SPSS statistics version 21.

Inclusion criteria:

- Patients in the age group 5-15 years
- Willing patients or children

Exclusion criteria:

- Other age groups were excluded from this study except for the above-mentioned age group.
- Those with a medical history of surgery of liver and spleen or patients with any different or unusual echotexture of liver and spleen or any neoplastic change were not accepted in this study.

Statistical analysis:

Average, Standard deviation, line chart, bar chart etc. were evaluated by using software SPSS version 21. Average and standard deviation operations were performed to have the average age of children in table 1 of which bar graph was made, in table 2 average height, weight, liver length, splenic length among males and females were created and to show the comparison line graph was applied, the third chart was also a bar graph talks about the comparison of average values and their standard deviation of height, weight, splenic and liver length among 2 different age groups.

Setting and resources:

The setting and resources were taken from the department of radiology of S.G.T medical college, hospital and research institute, Gurugram, Haryana. The patients selected for the study were examined using a GE logiq f8 whose curvilinear probe bandwidth was 2-5MHz and a Philips affiniti 50 was another ultrasound machine used whose curvilinear probe bandwidth range was 2-6 MHz with the help of the transducer, the majority of real-time images were captured usually on a 4MHz frequency by the radiologist.

Result

The study includes 50 paediatric patients (37M, 13F), with an average age of 9.08 ± 3.08 years and an age range of 5-15 years. The average age of females was 8.62 ± 2.84 years and 9.24 ± 3.18 years in males. The demographic distribution of patients included in the study is shown in table1 & chart1 below.

Table1. Distributing the patients in terms of male and female:

GENDER	NO.OF PATIENTS (N)	AVG. AGE (Yrs.)	STANDARD DEVIATION	AGE RANGE (YRS)
MALE	37	9.24	3.18	5 TO 15
FEMALE	13	8.62	2.84	5 TO 15
TOTAL	50	9.08	3.08	5 TO 15

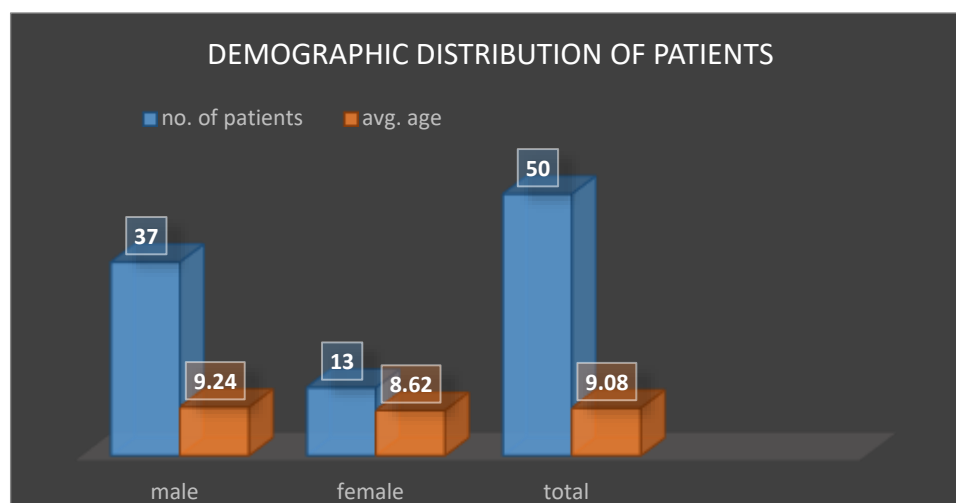


Chart 1. Demographic distribution of the patients in terms of male and female.

Table 2 represents the average values of different anthropometric measurements of all the paediatric patients which were created through every single individual's reading taken during the study. Those parameters were average age (years), height(cm), weight(kg), oblique length of the liver(cm), oblique length of the spleen(cm). The table indicates that in the total population liver and spleen average oblique length was 11.37 ± 1.9 and 8.26 ± 1.2 but when compared in terms of gender, the male population shows greater values in every aspect except the weight, during comparison the average height of males was 128.95 ± 17.0 cm whereas in females it was 126.38 ± 17.2 cm, the male average weight was 26.46 ± 8.6 kg which was lesser than the average weight of the female, that was 27 ± 11.3 kg, average liver oblique length in male was 11.4 ± 1.8 cm whereas in the female it was 11.29 ± 2.3 cm, the average splenic oblique length among male was 8.38 ± 1.1 cm, in the female, it was 7.93 ± 1.3 cm respectively. The last parameter was the average age of males which was 9.24 ± 3.2 years and females were 8.62 ± 2.8 years. The data of a total of 50 children includes the average age which was 9.08 ± 3.1 , average height was 128.28 ± 16.9 , the average weight was 26.6 ± 9.3 . Lastly, the data according to this table indicates that when we compare the values in terms of gender all these values shows that males measurements were greater when compared with females except in weight parameter this means even in terms of liver and splenic lengths males shows greater values.

TABLE 2. Comparison of average age, height, weight, liver length, spleen length among males and females and also with the total population.

GENDER	Avg. AGE (Yrs.)	HEIGHT (cm)	WEIGHT (kg)	LIVER LENGTH (cm)	SPLEEN LENGTH (cm)
MALE	9.24±3.2	128.95±17.0	26.46±8.6	11.4±1.8	8.38±1.1
FEMALE	8.62±2.8	126.38±17.2	27±11.3	11.29±2.3	7.93±1.3
TOTAL	9.08±3.1	128.28±16.9	26.6±9.3	11.37±1.9	8.26±1.2

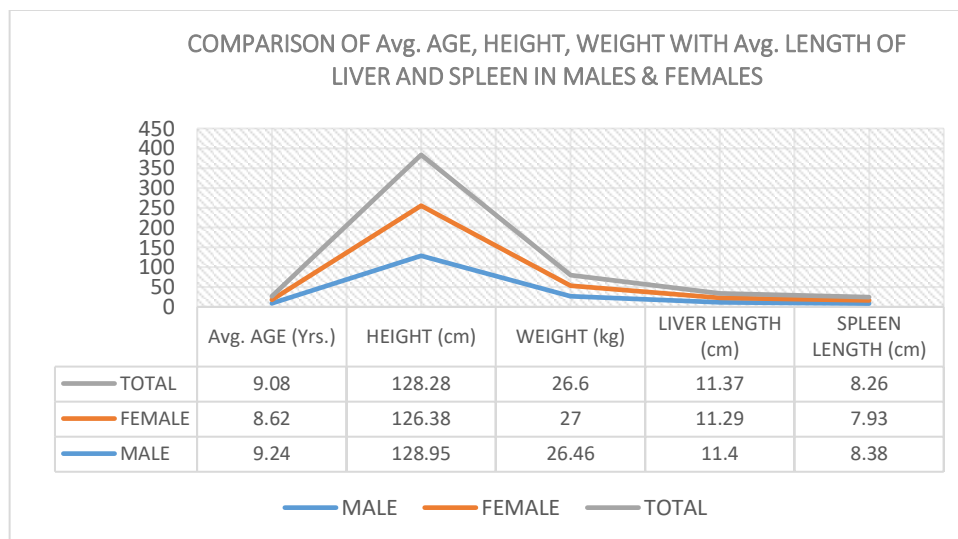
**Chart 2. representing the comparison of average age, height, weight with an average length of liver and spleen in males and females.**

Table 3 split the sample into two different age groups, which were below 10 years(5-10years) and above 10 years(10-15 years), according to this differentiation, the data of below 10 years of children shows the average age of 7.21±1.85 years, having an average height of 119.12±8.71 cm, an average weight of 22.3±6.93 kg, average liver oblique length of 10.77±1.90 cm, average splenic length of 7.7±1.01 cm whereas the data of above 10 years children have an average age 12.71±1.05, the average height of 146.06±12.12 cm, average weight 34.94±7.16 kg, average liver oblique length of 12.56±1.70 cm and the average splenic oblique length of 9.34±0.81 cm. This suggests that all parameters are greater in the higher age group (10-15 years). Therefore, it indicates that liver and splenic length is greater among 10-15 years children who also have greater height, weight as compare to another age group which was 5-10 years that indicates that these children have small liver and spleen accompanied with small height and weight.

TABLE 3. Comparison of avg. age, height, weight, liver length and spleen length among age groups.

AGE GROUP	Avg. AGE (Yrs.)	HEIGHT (cm)	WEIGHT (kg)	LIVER LENGTH (cm)	SPLEEN LENGTH (cm)
BELOW 10 Yrs.	7.21±1.85	119.12±8.71	22.3±6.93	10.77±1.90	7.7±1.01
ABOVE 10 Yrs.	12.71±1.05	146.06±12.12	34.94±7.16	12.56±1.70	9.34±0.81
TOTAL	9.08±3.08	128.28±16.9	26.6±9.26	11.37±1.95	8.26±1.17

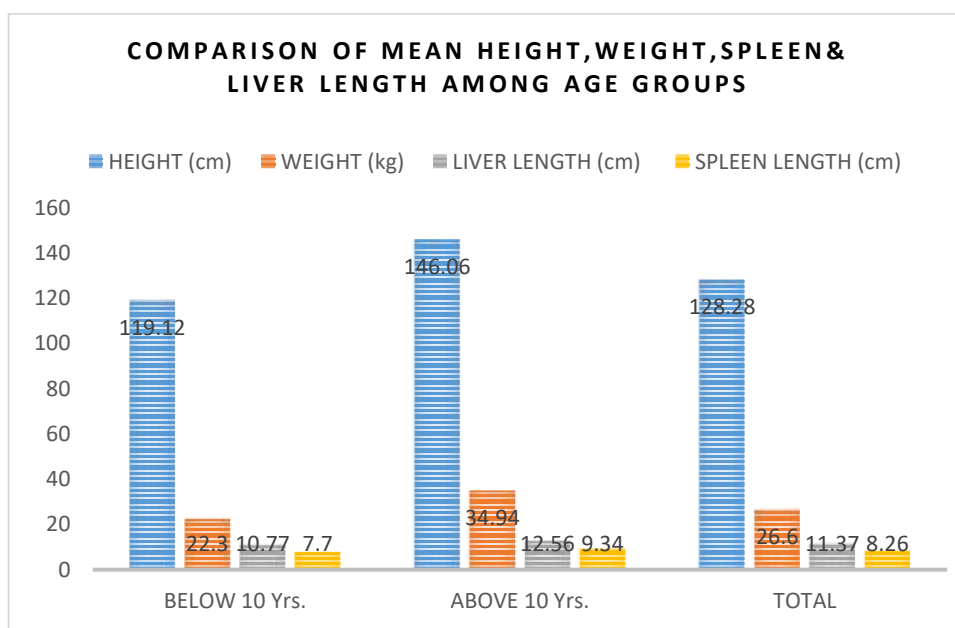


Chart 3. Comparison of mean height, weight, liver and spleen length among 2 different age groups.

Table 4 matches the demand of one of the objectives that talk about finding the common symptoms among a sample size of 50 paediatric patients who had their abdominal ultrasound done. For that purpose, individuals were distributed based on their common complaints, according to the data 20% of patients had only abdominal pain, 14% of patients were volunteers with no symptoms, whereas there were two groups of the same percentage were 10% of patients in which one group shows cough, fever with abdominal pain, and then that another 10% patients group shows fever with abdominal pain. Abdominal pain and vomiting symptoms were seen in 8% of paediatric patients, abdominal pain accompanied with fever and vomiting were seen by another group of 8% of patients, 6% of patients show fever, loose stools with vomiting, these were the common complaints carried by the maximum population of the sample size. The least common symptoms were infrequent relapse along with UTI and scrotal swelling (in 4% of patients), whole-body swelling with abdominal pain (in 4% of patients), fever, loss of appetite and vomiting (in 4% of patients), abnormal body movements (in 2% of patients), abdominal pain and bleeding through the mouth (in 2% of patients), abdominal pain with loose stools and vomiting (in 2% of patients), dysuria with abdominal pain (in 2% of patients), abdominal pain with a decrease in appetite (in 2% of patients), lastly yellowish eyes with fever (in 2% of patients). Data suggests that abdominal pain was the most common symptom seen among that 20% of paediatric patients which is the highest percentage of patients among the data of those paediatric patients who came for an ultrasound scan in the radiology department.

TABLE 4. DISTRIBUTION OF PATIENTS ON THE BASIS OF COMMON COMPLAINTS IN THE PATIENTS.

S.NO	COMPLIANTS	NO. OF PATIENTS	%AGE OF PATIENTS
1	ABDOMINAL PAIN	10	20%
2	INFREQUENT RELAPSE WITH UTI & SCROTAL SWELLING	2	4%
3	ABNORMAL BODY MOVEMENTS	1	2%
4	ABDOMINAL PAIN & BLEEDING THROUGH MOUTH	1	2%
5	ABDOMINAL PAIN , LOOSE STOOLS & VOMITING	1	2%
6	FEVER, LOOSE STOOLS & VOMITING	3	6%
7	VOLUNTEER	7	14%
8	DYSURIA & ABDOMINAL PAIN	1	2%
9	COUGH, FEVER, ABDOMINAL PAIN	5	10%
10	FEVER & ABDOMINAL PAIN	5	10%
11	WHOLE BODY SWELLING & ABDOMINAL PAIN	2	4%
12	ABDOMINAL PAIN & VOMITING	4	8%
13	ABDOMINAL, PAIN FEVER & VOMITING	4	8%
14	FEVER, LOSS OF APPETITE & VOMITING	2	4%
15	ABDOMINAL PAIN & DECREASE IN APPETITE	1	2%

16	YELLOWISH EYES & FEVER	1	2%
	TOTAL PATIENTS	50	100%

Discussion

With the help of epic and vast advancements in diagnosing procedures, the health care system provides that kind of treatment that became more evidence-based rather than based on experiential or observational knowledge¹³. There are some organs like the liver and spleen, their size may give information about the diagnosis and the course of gastrointestinal and hematological diseases¹⁴. Thus, the determination of normal organ size plays a vital role in the detection of any abnormality or pathogen. Since any deviation from the normal has led to diagnosis or prediction of a pathological condition³. So to evaluate the normal organ size, some organs like the liver and spleen show several palpatory characteristics for instance tenderness, liver edge, nodularity and consistency of the surface, etc.¹ All of them contribute significantly to the overall bedside assessment of any organomegaly, all this palpatory and percussing approach to examine the organs in terms of their size was something that leads to an empirical kind of treatment, which was not reliable and accurate¹⁵. So to match the desperate need for accurate measurements and reliable readings of the organ dimensions, one of the diagnostic methods like ultrasonography came forward, it proved to be the ideal method that further turn to be routinely used for the diagnosis of the diseases such as splenomegaly, etc. Ultrasound scanning was desirable because of the characteristics it offers which are non-ionizing, widely available, easy to use, less expensive than most other imaging methods¹⁶. In the case of measuring the spleen, it has been reported that the presence of neighbouring organs like the colon, stomach, and lung near the spleen makes the examination a bit difficult, for that intercostal approach permits good examination of the spleen. Since evolution, the different human races have evolved with complex processes and lead to the variation in the dimensions of various organ systems of the body. So the size of the various abdominal organ varies with age, height, and weight. Several disorders are accompanied by the altered size of these organs, including infective, infestation, infiltrative, immunological and can be malignant conditions. Similarly, in the case of liver and splenic size when exposed to many variations at different periods of life, in different individuals and the same individual under different conditions size of organs can vary from individual, depending on the height, age, and sex¹⁷.

In this study, we only included the length of the liver and spleen, the average liver length was 11.37 ± 1.9 cm and the average splenic length was 8.26 ± 1.2 cm from the total of 50 paediatric population. whereas average liver length among males was 11.4cm and in females was 11.29cm and the average splenic length in males was 8.38cm and in females was 7.93cm. The study was done by Tonelli et al¹⁸, in the USA, declares the average mean values of splenic length and width in females were 9.91cm and 4.7cm whereas in males the mean values of splenic length and width were 11.29cm and 5.54cm in the USA respectively which was higher than this recent study. Even a study was done in the Bihari population by Alka Singh et al¹⁹ observed that the length of the spleen increased with an increase in height in both males and females. Comparatively, in a previous study done by Spielmann et al²⁰, the average length of the spleen was found to be 11.40 ± 1.7 cm in males and 10.30 ± 1.3 cm, which was higher than that found in our study. This can be because in his study the subjects were tall adult healthy athletes. Mittal R et al¹⁴ found that the average length of the spleen was 9.40 ± 0.91 cm in males and 9.34 ± 0.95 cm in females in the Rajsthani population which is higher than our population since his population window was wider as his age group was 11 to 70 years and the total population was of 200 subjects other reason can be due to genetic and environmental factors, whereas in our study only 5-15 years of subjects were included with a population size of 50 subjects.

Again, the possibility of genetic, nutritional, and socioeconomic factors cannot be denied. The current study demonstrated that splenic length was significantly higher in males and was comparable to other studies²¹.

The liver size in this study is greater in males as compared to females which were opposite to the study done by Sohail Ahmed Khan et al²² among the Pakistani population, in his study the size of the liver was greater in female's possible reason because of fatty infiltration of the liver may be responsible for the increase in liver size among females of age group more than 16 years. In the study done by Bhawana Dhingra¹, she selected 597 healthy children between the age group 1 month to 12 years, in her study, the mean(SD) liver length was 9.59 (1.98)cm (males, 9.63 cm; females, 9.54cm) whereas in our study the values of liver length were higher, which was like this, mean liver length was 11.37 ± 1.9 cm, in males 11.4 ± 1.8 cm and females 11.29 ± 2.3 cm, the possible reason for having higher values in our study can be because of age group selected in the study was 5-15, higher age group than the age range selected by Bhawana Dhingra. But when come to comparison with the genders even in the study done by Bhawana Dhingra in North Indian children, males show larger mean liver length as compared to females which are also similar to this current study.

There are some limitations of this study, like the ultrasonography was not performed by a single radiologist, in this study subjects were only taken from the age group 5-15years, and the sample size was also small which was 50 subjects. And in our study, only one dimension of the liver and spleen was taken, which was the length. Since we got to know that many chronic diseases also can affect the size of organs like nutritional anaemia and malnutrition, they were not specifically excluded. This recent study even suggests that the majority of the paediatric patients gone through an abdominal ultrasound scan because of having a common complaint of abdominal pain, that may or may not be accompanied by vomiting or fever or cough, etc. The advantage of this

study it gives normative data of liver and spleen size for the paediatric patients of Haryana. And this data may be helpful for further future studies related to this topic.

Conclusion

This study tried to establish a normative form of data that can create a baseline for the dimension of liver and spleen among the paediatric population (age range 5-15Y), from the district of Haryana. Since many previous studies and those from the literature suggests that Physical measurement of the individuals like age, sex, height, weight, and even the genetic, regional, race and socioeconomic factors also play a vital role in variation among the size of visceral organs like liver & spleen. The study concludes that male with higher age, weight, height shows the greater size of liver & spleen length. This study even suggests that the majority of the paediatric patients visited the radiology department with the complaint of abdominal pain.

References

1. Dhingra, B., Sharma, S., Mishra, D., Kumari, R., Pandey, R.M., & Aggarwal, S. (2009). Normal values of liver and spleen size by ultrasonography in Indian children. *Indian Pediatrics*, 47(6), 487-492. doi:10.1007/s13312-010-0090-6.
2. Joshi R, Singh A, Jajoo N, Pai M, Kalantri SP. Accuracy and reliability of palpation and percussion for detecting reliability of palpation and percussion for detecting hepatomegaly: a rural hospital-based study. *Indian J Gastroenterol* 2004.
3. Calle-Toro, J. S., Back, S. J., Viteri, B., Andronikou, S., & Kaplan, S. L. (2019). Liver, Spleen, and Kidney Size in Children as Measured by Ultrasound: A Systematic Review. *Journal of Ultrasound in Medicine*, 39(2), 223-230. doi:10.1002/jum.15114.
4. Eze, C., Agwu, K., Ezeasor, D., Agwuna, K., & Aronu, A. (2014). Sonographic Determination of Spleen to Left Kidney Ratio among Igbo School age Children of South east, Nigeria. *African Health Sciences*, 14(1), 246.
5. Ellis, H. (2011). Anatomy of the liver. *Surgery (Oxford)*, 29(12), 589-592. doi:10.1016/j.mpsur.2011.09.012.
6. Grays Anatomy. ed. 38th, U.K. Churchill Livingstone, 1995.
7. Poddar, U., & Jagadisan, B. (2010). Measuring liver and spleen by ultrasonography. *Indian Pediatrics*, 47(6), 475-476. doi:10.1007/s13312-010-0086-2.
8. Curry, T. S., Dowdey, J. E., Murry, R. C., & Christensen, E.E. (1998). *Christensens physics of diagnostic radiology*. Philadelphia: Lippincott Williams & Wilkins.
9. Megremis SD, Vlachonikolis LG, Tsilimigaki AM. Spleen length in childhood with US: Normal values based on age, sex and somatometri parameters. *Radiology* 2004; 23:129-134.
10. Chow, K. U., Luxembourg, B., Seifried, E., & Bonig, H. (2016). Spleen Size Is Significantly Influenced by Body Height and Sex: Establishment of Normal Values for Spleen Size at US with a Cohort of 1200 Healthy Individuals. *Radiology*, 279(1), 306-313. doi:10.1148/radiol.20151508.
11. Warnakulasuriya, D. T., Peries, P. P., Rathnasekara, Y. A., Jayawardena, K. T., Upasena, A., & Wickremasinghe, A. R. (2017).
12. Yahuza MA, Tabari AM, Isyaku K, Suwaid MA, Umar MU, Kabo NA, Shehi AA, Nura I, Idris G. Sonographic measurement of spleen dimensions in healthy adults in North-Western Nigeria. *Niger J Basic Clin Sci* 2016;13:30-5.
13. Snobar Gul, Mohd Saleem Itoo, Majid Jahangir, Younis Kamal. Sonologic assessment of dimensions of spleen in normal adult kashmiri population and their correlation with weight and height. *International Journal of Contemporary Medical Research* 2018;5(2):B1-B4.
14. MITTAL R, CHOWDHARY DS. A PILOT STUDY OF THE NORMAL MEASUREMENTS OF THE LIVER AND SPLEEN BY ULTRASONOGRAPHY IN THE RAJASTHANI POPULATION. *Journal of Clinical and Diagnostic Research [serial online]* 2010 August [cited: 2010 August 15]; 4:2733-2736.
15. Deligeorgis D, Yannakos D, Panayoton P, Doxiadis S. The normal borders of the liver in infancy and childhood. *Arch Dis Child*. 1970;45:702-4.
16. Kanakaraj K. Ultrasonographic Study of Splenic Dimensions. *Sch. J. App. Med. Sci.*, Oct, 2018; 6(10): 4100-4105. doi:10.21276/sjams.2018.6.10.86.
17. Danila M. The Ultrasound examination of the spleen. *Medical ultrasonography*. 2010 Sep 1;12(3):253.
18. Tonelli, A. R., Yadav, R., Gupta, A., Arrossi, A. V., Heresi, G. A., & Dweik, R. A. (2013). Spleen Size in Idiopathic and Heritable Pulmonary Arterial Hypertension. *Respiration*, 85(5), 391-399. doi:10.1159/000339423.
19. Singh, A., Ansari, H., Das, J., & Chandra, N. (2011). Ultrasonographic Measurement of Splenic Length in Relation with Height in Bihari Adult Population a Prospective Study. *Journal of Anatomical Society of India*, 60(2), 188-189. doi:10.1016/s0003-2778(11)80023-7.
20. Spielmann AL, DeLong DM, Kliever MA. Sonographic evaluation of spleen size in tall healthy athletes. *AJR Am J Roentgenol* 2005;184(1):45-49.

21. Hosey RG, Mattacola CG, Kriss V, Armsey T, Quarles JD, Jagger J. Ultrasound assessment of spleen size in collegiate athletes. *Br J Sports Med* 2006; 40:251-4.
22. Khan, S. A., Yasmeen, S., Adel, H., Adil, S. O., Huda, F., & Khan, S. (2018). Sonographic Evaluation of Normal Liver, Spleen, and Renal Parameters in Adult Population: A Multicenter Study. *Journal of the College of Physicians and Surgeons Pakistan*, 28(11), 834-839. doi:10.29271/jcpsp.2018.11.834.
23. El-Affifi, A., El-Shafie, A., El-Nemr, F., & Allam, A. (2015). Correlation between clinical examination and ultrasound of liver and spleen span in normal children between 12 and 18 years of age. *Menoufia Medical Journal*, 28(2), 382. doi:10.4103/1110-2098.163889.
24. Pelizzo G, Guazzotti M, Klersy C, Nakib G, Costanzo F, Andreatta E, et al. (2018) Spleen size evaluation in children: Time to define splenomegaly for pediatric surgeons and pediatricians. *PLoS ONE* 13(8): e0202741. <https://doi.org/10.1371/journal.pone.0202741>.
25. Usha.C, Amit Singh Bharati, Sandeep Malegonkar, Subhashini Rani. STUDY OF CORRELATION OF LIVER SIZE WITH HEIGHT IN NORTH-EAST KARNATAKA CHILDREN BY ULTRASONOGRAPHY. *Int J Anat Res* 2018;6(3.3):5625-5631. DOI: 10.16965/ijar.2018.297.
26. Childs, J. T., Esterman, A. J., Phillips, M., Thoires, K. A., & Turner, R. C. (2014). Methods of Determining the Size of the Adult Liver Using 2D Ultrasound. *Journal of Diagnostic Medical Sonography*, 30(6), 296-306. doi:10.1177/8756479314549070.
27. Sağiroğlu, A., Acer, N., Ertekin, T., Kurtoğlu, E., Coşkun, A., Yıldırım, A., & Zararsız, G. (2014). Estimation of spleen volume and surface area of the newborns' cadaveric spleen using stereological methods. *Folia Morphologica*, 73(2), 183-192. doi:10.5603/fm.2014.0027.
28. Thapa NB, Shah S, Pradhan A, Rijal K, Pradhan A, Basnet S. Sonographic Assessment of the Normal Dimensions of Liver, Spleen, and Kidney in Healthy Children at Tertiary Care Hospital. *Kathmandu Univ Med J* 2015; 52(4):286-91.
29. Özdikici M. Normal values of liver size by ultrasonography in children in the Eastern. Anatolia region *Revista Argentina Anatomía Online* 2017; 8 (1): 19 – 22.
30. Tanna NA, Ambiyé MV, Tanna VA, Joshi HA. Ultrasonic Measurement of Normal Splenic Size in Infants and Children in Paediatric Indian Population. *Natl J Community Med.* 2012; 3(3):529-33.
31. Özmen Z, Aktas F, Özmen ZC, Almus E, Demir O. Ultrasound measurement of liver longitudinal length in a North Anatolian population: A community-based study. *Niger J Clin Pract* 2018;21:653-7.
32. Chakraborti S. Normal Spleen Length by Ultrasonography in Adults of Tripura. e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 15, Issue 1 Ver. I (Jan. 2016), PP 55-60. www.iosrjournals.org. doi:10.9790/0853-15115560.
33. Banvath Anjaneya Babu Naik, Suma MP, J Vasu Deva Reddy. MORPHOMETRIC STUDY OF HUMAN LIVER IN RELATION TO AGE & SEX BY ULTRASONOGRAPHY METHOD. *Int J Anat Res* 2017;5(3.3):4326-4332. DOI: 10.16965/ijar.2017.322.
34. Çeliktas, M., Özandaç, S., Göker, P., & Bozkir, M. G. (2015). Sonographic Determination of Normal Spleen Size in Turkish Adults. *International Journal of Morphology*, 33(4), 1401-1405. doi:10.4067/s0717-95022015000400035.
35. Sharma, K., Lamichhane, P., Sharma, B., & Sharma, B. (2017). Sonographic Measurement of Spleen in Relation to Age: A Prospective Study among Adult Nepalese People in Western Nepal. *Journal of Gandaki Medical College-Nepal*, 10(1), 11-16. doi:10.3126/jgmcn.v10i1.17904.
36. Kumar A, Anita, Giri VP. Ultrasonographic Study on Size and Echotexture of Spleen in Normal and Diseased Adult Population in Kosi Region of Bihar. *Int Arch BioMed Clin Res.* 2018;4(1):81-86.
37. Karadag, C. A., Erginel, B., Kuzdan, O., Sever, N., Akın, M., Yıldız, A., & Dokucu, A. I. (2015). Impact of Spleen Size on Outcomes in Laparoscopic Splenectomy in Children. *Gastroenterology Research and Practice*, 2015, 1-4. doi:10.1155/2015/603915.
38. Singhal, R., Patel, S., Agrawal, M., Rupareliya, S., Patel, D., & Shrivastava, A. (2018). Sonographic Measurement of Spleen in Relation to Age: A Prospective Study in Adult Gujarati Population. *Indian Journal of Anatomy*, 7(4), 412-418. doi:10.21088/ija.2320.0022.7418.11.
39. QUINTANA, F. E. R. N. A. N. D. O. G., CADENA, J. U. L. I. A. A., & CERVANTES-GONZALEZ, F. R. A. N. C. I. S. C. O. J. (2018). Obesity and liver function in a group of children visiting a Pediatric clinic in South Texas. *Diabetes*, 67(Supplement 1). <https://doi.org/10.2337/db18-2462-pub>.
40. Mohtasib, R. S., Alshamiri, K., Jobeir, A., Ambu-Saidi, F. M., Masawi, A., Alabdulaziz, L., & Hussain, F. B. (2021). Sonographic measurements for Spleen size in HEALTHY Saudi children and correlation with body parameters. *Annals of Saudi Medicine*, 41(1), 14–23. <https://doi.org/10.5144/0256-4947.2021.14>
41. Ezeofor SN, Obikili EN, Anyanwu GE, Onuh AC, Mgbor SO. Sonographic assessment of the normal limits of the spleen in healthy school children in South-East Nigeria. *Niger J Clin Pract* 2014;17:484-8.
42. Tekle Y, Hiware SD, Abreha M, Mucho A, Ambaw M, Tegegne Z. Determination of Normal Dimension of the Spleen by Ultrasound and its Correlation with Age. *Asian J. Med. Res.* 2018;7(4): AT08-AT11.
43. Yahuza MA, Tabari AM, Isyaku K, Suwaid MA, Umar MU, Kabo NA, Shehi AA, Nura I, Idris G. Sonographic measurement of spleen dimensions in healthy adults in North-Western Nigeria. *Niger J Basic Clin Sci* 2016;13:30-5.

-
44. Shivanand V Patil, Satish D Patil, Ravikumar Yeli, Vishal Nimbale, Suresh Kanamadi. Spleen and kidney ratio in the assessment of mild splenomegaly. *International Journal of Contemporary Medicine Surgery and Radiology*. 2020;5(3):C129-C132.