

## MORPHOMETRIC STUDY OF HUMAN LIVER IN RELATION TO AGE & SEX BY ULTRASONOGRAPHY METHOD

Banvath Anjaneya Babu Naik <sup>1</sup>, Suma MP <sup>\*2</sup>, J Vasu Deva Reddy <sup>3</sup>.

<sup>1</sup> Tutor, Department of anatomy, TOMCH&RC, Bengaluru, Karnataka, India.

<sup>\*2</sup> Assistant professor, Department of Anatomy, TOMCH&RC, Bengaluru, Karnataka, India.

<sup>3</sup> Professor, Department of Anatomy, Padmavathi Medical College (SVIMS), Tirupathi, India.

### ABSTRACT

**Introduction:** The liver is the largest organ of human body occupying right hypochondrium, epigastrium and partially left hypochondrium. It is important in maintaining blood glucose and lipid levels which keep tissues of body alive and healthy. As the body grows from infancy to adulthood, the liver rapidly increases in size. The maximum growth of liver reaches at around 18 years of age. The size of liver varies according to age, sex, and body weight.

**Aim:** To study dimensions of liver span in normal individual, Cranio - caudal dimensions of Right and Left lobes of Liver, and to compare the dimensions of liver in relation to sex & age.

**Materials and Methods:** 80 healthy subjects which include 38 males and 42 females ranging from 17 years to 60 years of age were taken for the study. The sonographic measurements of the liver were collected from real ultrasound images. In this study subjects demographic data such as age, gender, weight, height and had been collected using designed questionnaire. This data is recorded using weighing machine and stadiometer. The body surface area was calculated with the help of Mosteller's formula.

**Results:** The CCL of right lobe progressively increases as age advances and no increase of CCL is noticed in age groups of 41-60 years. CCL of right lobe is more dependable than the left lobe. As per the data, analysed regarding the liver span of both the genders of various age groups indicate that there is gradual increase of Liver Span as age advances. The parameter is marginally more in females than males.

**Conclusion:** Clinical measurement of liver by percussion and palpation can be inaccurate and unreliable. So, clinical evaluation by percussion and palpation is flawed for its inability to provide precise dimensions. Ultrasound is usually the method of choice for screening, diagnostic, prognostic purpose and follow-up after treatment.

**KEY WORDS:** Liver, Ultrasonography, Cranio Caudal Length.

**Address for Correspondence:** Dr Suma M P, Assistant Professor, Department of Anatomy, The Oxford Medical College Hospital & Research Centre, Yadavanahalli, Attibele Hobble, Anekal Tq, Bengaluru-560 107. Mobile-9916166290 **E-Mail:** [sumaprakashmp@gmail.com](mailto:sumaprakashmp@gmail.com)

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### INTRODUCTION

The liver is the largest organ of human body occupying right hypochondrium, epigastrium and partially left hypochondrium. It is divided into larger right lobe and smaller left lobe. The right

and left morphological lobes again divided into eight functional vascular segments. It performs a wide range of metabolic activities required for homeostasis, nutrition and immune defence [1]. It is important in maintaining blood glucose and

lipid levels which keep tissues of body alive and healthy. As the body grows from infancy to adult-hood, the liver rapidly increases in size. The maximum growth of liver reaches at around 18 years of age. The size of liver varies according to age, sex, and body weight.

The size of liver also affected with intrinsic liver diseases and systemic pathologies, now a days hepatomegaly is common clinical finding caused by intrinsic liver diseases or systemic disorders [2] like hepatitis, sickle cell anaemia, tumour, infections either bacterial or viral, poisons, toxins including ingestion of herbs and roots acetaminophen, insecticides and mushrooms and aflatoxin. Some other conditions like cardiac failure, storage disorders, infiltrative disorders like leukaemia, and lymphomas, granulomas like tuberculosis.

Hepatomegaly is a condition that needs an urgent further evaluation [3]. So it has become clear that great need for an exact determination of liver size. Ultrasound is usually the method of choice for screening, diagnostic, prognostic purpose and follow-up after treatment. Because of its accuracy, easy accessibility, avoids use of ionizing radiation, non-invasive technique and cheap. Various methods for assessment of liver sizes have been reported in literature [4].

Some of which include clinical evaluation by percussion and palpation, radiography radionuclide studies, Ultrasonography and computed tomography. Clinical measurement of liver by percussion and palpation can be inaccurate and unreliable. So, clinical evaluation by percussion and palpation is flawed for its inability to provide precise dimensions. This procedure gives gross estimation of size with high tendencies for over estimation due to pleural effusion or lung consolidation or under estimation due to tympanic note in right upper abdomen. Diagnostic imaging techniques have been reported to be much more superior to clinical examination, in determining size of liver. Some imaging techniques are criticised as radiography and radionuclide studies for exposure of patients to ionizing radiation. CT and MRI have been noted to be expensive and uncommon in developing countries. Ultrasound has been made popularly due to its accuracy, affordability and portability.

Ultrasound can be described as the sound waves beyond the ordinary limits of human hearing range (20 Hz-20 kHz). Medical diagnostic ultrasound is a modality that uses ultrasound energy and acoustic properties of body to produce an image from either a stationary or moving structure within the body [3].

Ultrasonography of the liver is one of most common routine investigation suggested by clinicians at present which assesses size, texture and pathological changes. It is first line of investigation for differential diagnosis of suspected liver pathologies.

The Sonographic analysis of hepatic morphometric parameters is very relevant and helps identification and evaluation of liver pathology which ultimately is of immense help in management of hepatic disorders. The liver sectional anatomy is best prescribed, imaged and defined by using real time ultrasound image.

Ultra sound remains a very important imaging modality, most popular and wide spread when the liver is concerned because it is simple, quick, practical, accurate, and easy to use, provides real time images and does not utilize ionizing radiation. So, Ultrasonography method is chosen in our study to assess the liver size because it is unbeaten by any other imaging modality, due to real time, dynamic nature, high resolution and good safety imaging technique.

## **MATERIALS AND METHODS**

A prospective study of age and sex interrelated samples of 80 healthy subjects which include 38 males and 42 females ranging from 17 years to 60 years of age appeared to the department of radio diagnosis, SVIMS, TIRUPATI and these subjects are screened by investigative history and physical examinations excluded clinical conditions like hepatic (or) biliary diseases, hepatomegaly, alcohol consumption, diabetes mellitus upper abdominal surgery, hepatitis B and C, congestive heart failure, fatty (or) focal hepatic abnormality, pain in abdomen, gastritis, colitis, urinary problem and other gynaecological problems. The Sonographic measurements of the liver were collected from real ultrasound images. Subjects selected for the study evaluated sonographically for abdominal or pelvic problems unrelated to the

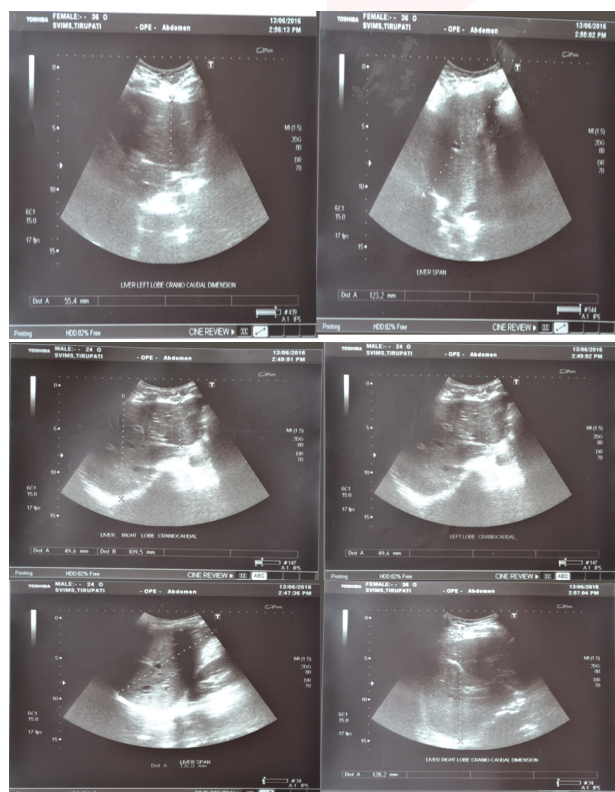
Liver. Right kidney should be normal in size. Position and echo texture in the subjects to qualify for inclusion in the study. In this study subjects demographic data such as age, gender, weight, height and had been collected using designed questionnaire. This data is recorded using by weighing machine and stadiometer. The body surface area was calculated with the help of Mosteller's formula:  $\text{body surface area} = \frac{\text{height} \times \text{weight}}{3600}$

3600

**Inclusion criteria:** 80 healthy subjects without any liver pathologies and anomalies.

**Exclusion criteria:** Subjects with upper abdominal surgeries, Subjects having habit of alcohol consumption, Subjects with hepatitis B & C infections, Subjects with liver anomalies and pathology.

**Fig. 1:** Showing measurements of CCL of right and left lobes and liver span in both Male and female subjects.



**Examination:** Measurements were taken in deep inspiration with the subjects holding their breath briefly. Measurements were made with the subjects lying in supine position with relaxed abdominal wall. The subjects right hands were raised behind the head to help enlarge the intercostals spaces and the space between lower costal margin and the iliac crest, thereby creating better access to the liver [5].

Then coupling gel is applied on abdominal wall in the right hypochondriac and epigastric region in order to assure optimal transmission of energy between the patient and probe. According to the method described the liver size was measured in the right mid clavicular line for the right lobe and mid sagittal plane for the left lobe from the highest to the lowest point of the liver. The diagonal axis of the liver from its most inferior aspect on the right to the most lateral aspect on the left was measured as the liver span.

Liver with the right and left lobes had been scanned and shown Cranio Caudal Length (CCL) in addition to the liver span. Liver was measured 3 times, and the mean value was recorded as the absolute length. This examination was performed by Department of Radiology SVIMS.

## RESULTS

In the present study of Morphometric dimension of liver by Ultrasonography was studied in 38 Male subjects and (47%) and 42 Female subjects (53%) and representation made in a pie chart.

**Table 1:** Showing percentages & No. of male & female subjects in present study.

S. No.	Sex	Total No.
1	Male	38
2	Female	42

**Table 2:** Showing age group frequency of the selected subjects in present study.

S. No.	Age groups (yrs)	Frequency
1	17-20	19
2	21-30	16
3	31-40	24
4	41-50	15
5	51-60	6

In the above table the frequency of both male and female subjects of different age groups is studied. Out of total 80 subjects of both male and female gender, the maximum frequency of occurrence of 24 observed in age group of 31-40 years. The least frequency of occurrence of 6 is observed in the age group of 51-60 years.

**Table 3:** Showing mean and SD values of CCL of liver right lobe in various age groups.

S. No.	Age group (yrs)	Mean Rt. Lobe CCL (cm)	SD Rt. Lobe CCL (cm)
1	17-20	12.3	1.2
2	21-30	12.5	1.3
3	31-40	13.7	1.4
4	41-50	14	1.4
5	51-60	14	1.2



The above table shows the mean value of CCL of right lobe and SD CCL of right lobe of liver of both genders of different age groups. The maximum mean value of CCL of right lobe is observed as 14 cm in age groups of 41-50 and 51-60 years indicating no change between 41-60 years. The minimum mean Value of CCL of right lobe is observed as 12.3 cm in the age group of 17-20 years. The maximum SD value of right lobe CCL is observed as 1.4 cm in age group of 31-50 years, and the minimum SD value of right lobe CCL is observed as 1.2 cm in age group of 17-20 and 51-60 years of age.

**Table 4:** Showing mean & SD values of CCL of liver left lobe in various age groups.

S.No.	Age group (yrs)	Mean CCL of Left lobe (cm)	SD CCL of Left Lobe (cm)
1	17-20	4.9	0.9
2	21-30	5.4	1.1
3	31-40	5.5	1
4	41-50	5.9	1.4
5	51-60	4.8	0.6

The above table shows the mean value of CCL of left lobe of liver and SD value of CCL of left lobe of liver of both genders of different age groups. The maximum mean value of CCL left lobe is observed as 5.9 cm in age group of 41-50 years. The minimum mean value of CCL of left lobe is observed as 4.8 cm in age group of 51-60 years. The maximum SD value of CCL of left lobe of liver is observed as 1.4 cm, in age group of 41-50 years. The minimum SD value of CCL of left lobe is observed as 0.6 cm in group of 51-60 years.

**Table 5:** Showing Mean & SD Values of liver Span in various age groups.

S. No.	Age group (yrs)	Mean value of Liver Span (cm)	SD of Liver Span (cm)
1	17-20	13.5	1.3
2	21-30	13.6	1.1
3	31-40	13.8	1.6
4	41-50	14.7	1.8
5	51-60	15	0.9

The above table showing the mean values of SD values of liver span of both genders of various age groups. The maximum mean value of liver span is observed as 15 cm in age group of 51-60 years. The minimum mean value of liver

span is observed as 13.5 cm in age group of 17-20 years. The maximum SD value is observed as 1.8 cm in age group of 41-50 years and minimum mean SD value is observed as 0.9 cm in age group of 51-60 years.

**Table 6:** Showing comparison of count, mean, SD values of CCL of the liver right and left lobes between male & female subjects.

S. No.	Lobes	Sex	Count	Mean(cm)	SD(cm)	P' value
1	Right lobe	Male	38	13.5	1.5	0.057
2	Right lobe	Female	42	12.9	1.4	
3	Left lobe	Male	38	5.8	1.1	0.001
4	Left lobe	Female	42	5	0.9	

Regarding mean value of CCL of right lobe out of 38 male subjects the mean value is 13.5 cm and out of 42 female subjects the mean value is 12.9 cm indicating increase in CCL right lobe in males is more than that of females. Regarding mean value of CCL of left lobe out of 38 male subjects the mean value is 5.8 cm and out of 42 female subjects the mean value is 5 cm indicating increase in CCL left lobe in male is more than females. Regarding the CCL of left lobe of both the genders the "P" values is significant indicates the mean CCL of left lobe is more in males than females.

**Table 7:** Showing Comparisons of Count and Mean SD values of liver span.

S. No	Sex	Count	SD Liver span (cm)	Mean liver span (cm)	P value
1	Male	38	1.2513	13.926	0.844
2	female	42	1.7069	13.993	

Regarding comparison of Mean and SD values of liver span in males and females, the above table showing the mean value of liver span of 38 male subjects is observed as 13.926 cm and SD liver span observed as 1.2513 cm. Out of 42 female subjects of mean liver span is observed as 13.993 cm and SD liver span observed as 1.7069 cm, indicating that slightly increase in liver span of females than males. In relation to mean and liver span of males and females the 'P' value is not significant. Mean liver span 'P' value is more in males.

## DISCUSSION

The Aetiology is typically established to a combination of history, specific blood tests and wherever appropriate imaging and liver biopsy. There is increasing interest in non-invasive

approach including various imaging modalities, but the staging of liver disease mostly depends on histological approach. Among the valuable Neoinvestigatory procedures the ultrasonography occupies prominent chair, because of least side effects when compared to other investigatory methods. Ultrasonography being the best investigatory procedure, the present study is taken up with the help of Ultrasonography method. The present study was done on 80 healthy adult subjects of Rayalasema population consist of 38 male and 42 female subjects, with age groups of 17-60 years.

In this study measurements of Cranio Caudal Length of right and left lobes of liver and liver span has been taken and compared between both genders of various age groups in relation to height, weight and body surface area. The mean CCL of right lobe of liver of different age groups of 17-20, 21-30, 31-40, 41-50, 51-60 were measured and measurements were 12.3, 12.5, 13.7, 14, 14cm. In normal subjects, the present study also identified age as a factor influencing liver size. These measurements were confirmed that CCL of right lobe increase with age as age advances up to 60 years. This study is similar with study of Moawia Gammeraddin et al., 2015 with a statement that right lobe CCL increases with age up to 60 years. In present study the mean CCL of right lobe in male is 13.5cm, while in females it is 12.9cm with a "P" value >0.05.

The mean CCL of right lobe in males 0.6cm more than that of females, indicating the CCL of right lobe is slightly more than that of female's subjects [30] (Kratzer et al., (2003) conducted a similar prospective study on a larger population to establish normal value for liver diameter at CCL of right lobe and to determine the influence of sex. In their sample, the average measured liver diameter at CCL of right lobe was 14.0 cm compared to 13.5cm in our study. Emad, Tarawehet al., (2009) did a similar Sonographic study among Jordanian adults in 2009. Their study population was 242 males and 275 females. They found the mean CCL of right lobe of liver for males is 12.6cm and for females 12.1cm with 5cm difference in size between two genders. But in this study it is about 0.6cm difference between male and female subjects.

A study done by Mittal et al., (2010) in

Rajsthani population got mean CCL of right lobe in males is 12.99cm and in females it is 12.66cm which has a difference of 5mm in males and 3 mm in females from our study. A similar study done by Udoka et al., (2012) stated that the right CCL of liver large in males with mean of 13.42cm in males and 13.0 cm in females which is similar to this study.

In this study the mean liver span of different age groups of 17-20, 21-30, 31-40, 41-50, 51-60 years were measured and measurements are 13.5, 13.6, 13.8, 14.7, 15.0cm. The results were proved that the mean liver span in increases with age as age advances up to 60 years. In present study mean liver span in males is 13.9cm while it is 13.99cm in females. This is slightly higher in females than males.

A similar study done by Jiranun Weerakul et al., (2011) on children (boys and girls) with mean liver span having 5.06 cm and 5.12 cm respectively. In their study the mean liver span in girl was long than that in boys by 0.06cm. A study conducted in Saudi Arabia between 2004 and 2005 by Mohammad, Mouzan et al. They measured liver size among 112 healthy Saudi children and adolescents up to 18 years of age. They found that there was no difference in liver span between boys and girls of up to 60 months of age.

Thereafter, a difference could be seen increasing with age, with girls having smaller liver spans than boys and which is not similar with our study.

## CONCLUSION

The early diagnosis benefits the patient which ultimately is the human endeavours in conquering the disease and provides a healthy living. For the present study of analysis of various Morphometric parameters of liver the Ultrasonography method is chosen. Out of 80 subjects of both the genders of various parameters like age groups, height, weight, and body surface area (BSA) are considered and the data is analysed.

The data regarding the CCL of right lobe and left lobe of different age groups belonging the both genders indicate that the CCL of right lobe progressively increases as age advances and no increase of CCL is notice in age groups of

41-60years.

The CCL of right lobe intimated the above mentioned data but the CCL of left lobe has not gone parallel to the CCL of right lobe, indicating that CCL of right lobe is more dependable than the left lobe. As per the data, analysed regarding the liver span of both the genders of various age groups indicate that there is gradual increase of Liver Span as age advances.

The analysis of the data regarding CCL of right and left lobes with relevance to the gender it shows that the CCL of right and left lobes is more in males when compared to females. The significant 'P' value was observed in CCL of left lobe indicating that the CCL of left lobe is more in males than females. The mean liver span of both males and females indicate that the parameter is marginally more in females than males.

**Conflicts of Interests: None**

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