



ORIGINAL RESEARCH PAPER

Medicine

NORMAL SIZE AND VALUES IN ADULT POPULATION IN THE WESTERN REGION SAUDI ARABIA: LIVER

KEY WORDS: Liver size, computed tomography, liver coronal, sagittal and axial views.

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ABSTRACT

Background:The liver is the largest organ in the human body. Liver size is a significant indicator of the presence of a disease process. Knowledge of hepatic size is also important in surgical planning and follow-up of treatments and interventions over time. This study aims to assess the normal range of liver size in the population of Jeddah, western area, Saudi Arabia.
Method: This retrospective study targeted Saudi adults with normal liver admitted to King Abdulaziz University Hospital from August to October 2016. The data were collected using a data collection sheet that includes a patient's profile number, age, gender, and liver size in axial, sagittal and coronal views.
Result: The mean age score was 44.1±17.2 (range: 15-95), of which 199 (43.4%) were male and 260 (56.6%) female. The mean scores of liver coronal, sagittal, axial views and the liver volume were 160.9 ± 23 , 141.2± 24.3 , 175±50.1 and 2156±904 respectively.
Conclusion: Determination of pathologic changes in spleen size among adult patients requires knowing the normal range of dimensions for this organ in healthy adults.

INTRODUCTION:

The liver is the largest organ in the human body. The liver, like other organs of the body, grows with age. It has been estimated that between birth and adulthood, there is an at least ten fold increase in liver mass.^[1,2]

Liver size is a significant indicator of the presence of a disease process. Knowledge of hepatic size is also important in surgical planning and follow-up of treatments and interventions over time, so an estimation of liver size can be used as an index to monitor various aspects of liver disease and response to treatment^[3]. A thorough knowledge of liver dimensions and volume are prerequisite for clinical assessment of liver disorders & it can facilitate decision making in liver transplant surgery.^[4,5]

The determination of abdominal organ size and volume has significant potential clinical value. With the advent of liver transplantation, it has become clear that there is a great need for an exact determination of liver size.^[2]

Information about the normal size of the liver at various ages is necessary for the detection of hepatomegaly^[10]. Literature reports on liver size are either quite old or deal with a limited number of population. To the authors knowledge, there are no data on the liver size using Computed tomography (CT) in Arab, in general, and Saudi adult population, in particular.

Therefore, This study aimed to obtain the normal range for Liver size in the population of Jeddah, western area, Saudi Arabia by using computed tomography as a simple and reliable method.

Method

This retrospective study targeted Saudi adults with normal Liver size who admitted to King Abdulaziz University Hospital for other health conditions from August to October, 2016. This study was approved by King Abdulaziz University ethical committee.

A total of 2000 files of patients at KAUH was reviewed during that period. Only 459 patients matched the inclusion criteria and included in the study. Patients were selected when they had CT of the abdomen for conditions unrelated to the hepatobiliary system and no visible hepatic disease at CT images. After review of clinical files, patients with prior history of hepatic disease and/or known hepatic disease were excluded. All selected patients had normal results of laboratory liver function tests (ALT, AST, ALP, GGT and total bilirubin). The data were collected using a data collection sheet that includes a patient's profile number, age of the patient, gender, and Liver size in axial, sagittal and coronal views.

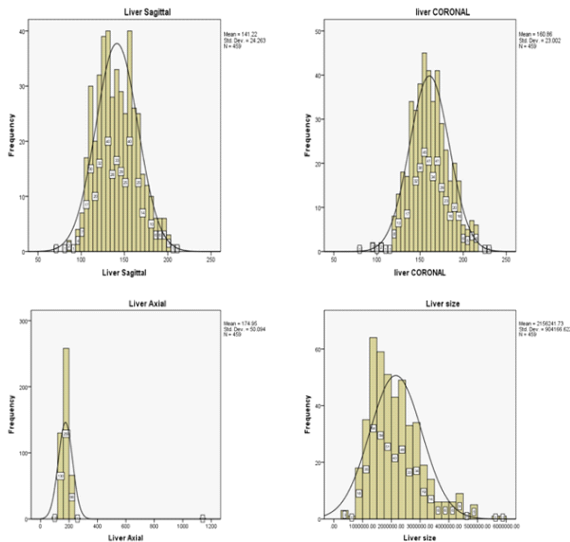
RESULT

The mean age score for the 459 participants was 44.1±17.2 (range: 15-95), of which 199 (43.4%) were male and 260 (56.6%) female. Liver dimensions were reported from three views axial, sagittal and coronal using computed tomography.

The mean scores of Liver in coronal, sagittal, axial views and the Liver volume were 160.9 ± 23 , 141.2± 24.3 , 175±50.1 and 2156±904 respectively, the results and graphs showed symmetrical dataset with slightly leptokurtic for coronal view , approximately symmetrical dataset with slightly platykurtic in the sagittal view, also showed highly positively skewed with leptokurtic in the axial view, and showed moderately positive skewed and leptokurtic for spleen size. **(Table 1 & Figures 1-4)**

Table 1

Variable	N	Minimum	Maximum	Mean	Std.Deviation	Skewness	Kurtosis
Statistics							
Liver coronal	459	80	230	160.86	23.002	.083	.212
Liver sagittal	459	71	209	141.22	24.263	0.248	-.270
Liver Axial	459	105	1120	174.95	50.094	14.722	277.337
Liver size	459	310128.00	5821670.40	2156241.7327	904166.62247	1.032	1.237
Liver Size (cm3)		310.13	5821.7	2156.24			
Valid Number(listwise)	459						



Figures 1-4: Liver Dimensions

DISCUSSION:

This study obtains a standard values of liver size measured by computed tomography for Saudis from age 15-89 years who attend KAUH, which could be used as a reference for future studies & improve hepatomegaly and liver fibrosis detection .

The liver is the largest organ, accounting for approximately 2% to 3% of average body weight and it has 2 lobes^[7]. Liver anatomy is mainly defined by ligaments and fissures as well as by the vascular architecture: branches of hepatic artery, portal vein, and bile ducts in their parallel course define the centers of liver segments anatomy. A simplified anatomy divides the liver into the larger right lobe (including segment V, VI, VII, VIII), and left lobe with its medial (VIa,b) and lateral segments (II, III), and the caudate lobe (I)^[11]. And it maintains its position through peritoneal reflections, referred to as ligamentous attachments that also attach the liver to the surrounding structures.^[7] These are the Falciform ligament , the Coronary ligament – and Triangular ligament.^[8]

Hepatic size has been an important biomarker for assessing disorders and surgical planning.^[9] So measurement of liver volume provide a useful and even critical information in a large range of clinical situations.

It is mandatory before living donor liver transplantation, before extensive partial resection to estimate the volume of the remaining liver and in patients with diffuse liver disease to monitor response to therapy.^[10]

Clinically, the liver size is estimated by percussion and palpation of the abdomen, whose combination is used to provide an estimation of the hepatic height.^[10] Estimating liver size by physicians using palpation and percussion are approximate and adequate for diagnosing only cases of massive hepatomegaly. Blendis et al found that only half of enlarged livers detected by plain radiography were also identified by physical examination, while approximately half of normal livers were diagnosed as enlarged.^[9] In order to provide accurate information regarding the actual volume of the liver , such information can be obtained only by imaging techniques that provide quantitative and reproducible results.^[10]

Diagnostic imaging techniques are superior to clinical examination in determining the size of the liver.^[11] Imaging techniques of liver include Ultrasound, Radionuclide Imaging, Computed tomography and Magnetic Resonance Imaging, can generally give more accurate measurement of liver size.^[10]

Referral for abdominal ultrasound is often the first line investigation in the evaluation of the liver^[13], simply because it is easy to use, inexpensive, rapid , non-invasive, providing real time images which doesn't require anaesthesia or utilize ionising radiation.^[11] Although liver volume can be measured by ultrasound it is bounded by some variations due to inter-observer bias and variability.

However, considering the complexity of liver shape, liver span alone cannot appropriately represent liver mass.^[12]

Therefore , three-dimensional imaging techniques are commonly used for the quantitative analysis of multiple organs and provide information that is beyond the reach of two- dimensional imaging.^[10]

Computed tomography (CT) and magnetic resonance imaging (MRI) are currently considered the gold standard methods to determine liver size, both techniques using volume as a measure of liver size. Liver volume is a better way to assess liver size as it represents the entire liver, rather than linear measurements in single planes. MRI and CT have both been shown to be reliable and valid in the determination of liver volume via both manual and semi-automated methods.^[13]

There are very few published studies on assessment of liver volume with computed tomography (CT) scan. The present study was therefore conducted to assess the normal liver volume of healthy adults using computed tomography scans.

Accordingly, this study used CT scan to define liver size, where the mean score of liver volume was 2156±904 cm³, which was higher than other studies. So it would be clinically advantageous to establish the range for normal liver size in adult .

Madhu Sharma et al. study where they assess liver volume with spiral computed tomography in India, showed the mean score of liver volume was 1385.2 cm³^[12]. Another study was done in Japan reported that the normal liver volume was 1115 cm³ in which authors used 3D image-processing and volumetric softwares.^[14] While A. Bora et al. study from Turkey they assess liver volume with computed tomography the average liver volume was found to be 1315.24±338.75 cm³^[15].

The relation between age and liver size showed a negative correlation in Indian, and European studies^[12, 10], which was consistent with what was mentioned in a Meta-Analysis that performed to determine Changes in Liver Volume from Birth to Adulthood: (birth-18 yr old), in which a combined North American/Northern European/Japanese database was observed.^[16]

As regard to the relation between gender and liver size, Hepatic volumes were significantly greater in men by comparison with those obtained in women in European study^[10] Also El Mouzan MI et al conducted a study in Saudi Arabia Between 2004 and 2005, in which 18 112 healthy children up to 18 years of age were examined, they found that there was no difference in the 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 do.^[6]

There are several factors that cause impact on normal liver volume such as sample size, age, gender, body surface area (**BSA**), and other anthropometric variables (Weight, Height, BMI, and waist circumference).^[9,10,11,12]

Limitations:

The fact that all the participants were from one health Center (KAUH) limited the ability to generalise the results with the community. The height and weight values were not available for the patients.

CONCLUSION:

It is of great clinical importance to be able to detect early gradual change in hepatic size before the patient develops hepatomegaly and to establish normal range of normal values of liver size. Thus, this study provides a reference data for the normal liver size.

There is a need to determine cut off point to define hepatomegaly. Moreover, multi-centre based studies with large sample size need to be conducted in order to provide inclusive and critical information and to determine all factors that influence the liver size among the Saudi population.

Conflict of interest:

The authors and author's institutions have no conflicts of interest.

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