Scientific Research Publishing

Open Journal of Medical Imaging, 2024, 14, 86-95
https://www.scirp.org/journal/ojmi
ISSN Online: 2164-2796
ISSN Print: 2164-2788

Ultrasound Biometry of the Liver at the Point "G" University Hospital Center in Bamako

Ousmane Traore[1*], Siaka Diakite[1], Drissa Mansa Sidibe[2], Moussa Konate[1], Mamadou N'Diaye[3], Salia Coulibaly[4], Nouhoum Ongoiba[5], Adama Diaman Keita[1]

[1]Department of Radiology and Medical Imaging, University Hospital Center of Point "G", Bamako, Mali
[2]Department of Family Medicine/Community Medicine, Faculty of Medicine and Odontostomatology (FMOS), Bamako, Mali
[3]Department of Radiology, Bamako-Mali Military Health Center, Bamako, Mali
[4]Department of Radiology and Medical Imaging, University Hospital Center, Kati, Mali
[5]Department of Anatomy, Faculty of Medicine and Odonto-Stomatology, Bamako, Mali
Email: *ghousno1@yahoo

How to cite this paper: Traore, O., Diakite, S., Sidibe, D.M., Konate, M., N'Diaye, M., Coulibaly, S., Ongoiba, N. and Keita, A.D. (2024) Ultrasound Biometry of the Liver at the Point "G" University Hospital Center in Bamako. *Open Journal of Medical Imaging*, **14**, 86-95.
https://doi.org/10.4236/ojmi.2024.143009

Received: June 13, 2024
Accepted: July 29, 2024
Published: August 1, 2024

Abstract

Introduction: Biometrics therefore corresponds to the measurement of the morphological elements of humans. One of the most common ultrasound requests by clinicians is the assessment of liver size. The aim of our study was to study liver biometry using ultrasound in healthy adult subjects. **Material and Methods:** This was a prospective, descriptive and analytical study, carried out at CHU Point-G over a period of 7 months. A liver ultrasound was performed on 100 individuals without lesions, by a doctor in his final year of specialization in radiology and medical imaging. For each subject, we determined the height and anteroposterior diameter of the right liver and the left liver. **Results:** The mean age was 39.05 ± 16.86 years. The body mass index (BMI) 18.5 - 24.9 group was the most represented with 58%. The mean height of the right liver was 138.40 ± 14.85 mm. It was 136.81 ± 14.70 mm in men and 139.92 ± 14.99 mm in women ($P = 0.306$). That of the left liver was 95.55 ± 14.34 mm, in men, it was 91.79 ± 13.51 mm and 99.16 ± 14.31 mm in women ($P = 0.019$). We found a significant correlation between right liver height and BMI ($P = 0.013$). **Conclusion:** The mean values of liver biometry were established in our series. There was a significant correlation between right liver height and BMI. Liver ultrasound remains a reliable technique for liver biometry.

Keywords

Liver Biometry, Ultrasound, Point-G University Hospital, Bamako

1. Introduction

The term "biometrics" comes from the Greek bio (life) and metron (measurement). Biometrics therefore corresponds to the measurement of the morphological elements of humans. One of the most common ultrasound requests by clinicians is the assessment of liver size [1]. Ultrasound is a widespread, efficient, non-invasive and inexpensive technique [2]. It is simple to carry out and allows objective measurements of the dimensions of the liver to be obtained, particularly in adults. This is the first-line imaging examination performed in cases of suspected liver pathology [3]. However, we cannot exclude the importance of the clinic in the diagnosis of presumptive hepatomegaly. Clinical examination underestimates the true size of the liver in adults. This can be demonstrated by the statistically significant difference between the mean value obtained by clinical examination and that obtained by ultrasonography [4]. The morphology of the liver is well appreciated in two-dimensional ultrasound [3]. Hepatic height is measured on a sagittal section passing through the aorta for the left liver and through the right midclavicular line for the right liver. For the hepatic arrow (height of the right liver), we measure the distance between the highest point of the hepatic dome and the lower edge of the right liver [3].

However, we cannot exclude the importance of the clinic in the diagnosis of presumptive hepatomegaly. Clinical examination underestimates the true size of the liver in adults. This can be demonstrated by the statistically significant difference between the mean value obtained by clinical examination and that obtained by ultrasonography [4]. The morphology of the liver is well appreciated in two-dimensional ultrasound [3]. Hepatic height is measured on a sagittal section passing through the aorta for the left liver and through the right midclavicular line for the right liver. For the hepatic arrow (height of the right liver), we measure the distance between the highest point of the hepatic dome and the lower edge of the right liver [3]. A height of the left liver greater than 100 mm and a height of the right liver greater than 150 mm are considered abnormal [3].

The size of the liver is an important element in the diagnosis and monitoring of diffuse liver diseases using ultrasound. However, difficulties lie in determining the presence of hepatomegaly and liver atrophy, because the method used to measure liver size differs between examiners and there is no standard based on corpulence [5]. Frequent damage to the liver by various pathologies, particularly infection, makes it a widely explored organ, especially in ultrasound. Its dimensions can be modified due to different pathologies, hence the interest in knowing its normal dimensions. However, there is currently little African work devoted to ultrasound biometry of the liver in adults. Consequently, European biometrics are usually used in Mali, which is controversial, given the variation in the anthropometric variables of Africans compared to Europeans. Thus, the objective of our work was to determine the dimensions of the liver in healthy Malian adults and analyze them according to sex, age

and body mass index (BMI).

2. Material and Methods

This was a prospective, descriptive and analytical study on liver biometry which took place over a period of 7 months from May 23, 2022 to December 5, 2022. It was carried out at the radiology and medical imaging at Point-G University Hospital in Bamako, Mali. The subjects concerned were "healthy" individuals, examined by ultrasound in the said department. They were voluntary subjects, companions, patients, fasting or not. 100 apparently healthy adults, including 49 men and 51 women, were randomly selected in time. A liver ultrasound was performed according to a standardized protocol with 2 devices: a CHISON Q Bit 5 type device and a SIEMENS ACUSON NX3 Elite type device. The first device was equipped with a low-frequency convex probe of 3.5 Megahertz and a high-frequency linear probe of 7.5 Megahertz. The second device was equipped with multi-frequency probes: Two convex probes, CH5-2 of 1.4 - 5.0 Megahertz and C8-5 of 3.1 - 8.8 Megahertz, a linear probe 11L4 of 3.7 - 13.1 Megahertz and an endocavity probe EC9-4 of 3.3 - 10.3 MHz. The 3.5 MHz or 1.4 - 5.0 MHz convex probe was used for the sections used to measure the dimensions of the liver. Subjects were selected based on their normal history and current conditions without signs of any recent pathology.

After the interview mentioning the socio-demographic characteristics and the medical-surgical history of each individual, we successively carried out:

- Measurement of body temperature in degrees Celsius at the axillary level;
- A measurement of the subject's height with a measuring rod graduated in centimeters;
- An increase in body weight in kilograms;
- A liver ultrasound of the subject.
- This ultrasound was performed in the supine position by doing:
- A sagittal section of the liver on the right midclavicular line with measurement of the height of the right liver going from the hepatic dome to the lower hepatic tip;
- A recurrent cross-section of the right hypochondrium passing through the portal bifurcation into right and left branches with measurement of the anteroposterior diameter of the right liver;
- A longitudinal section of the epigastrium passing through the left liver and the abdominal aorta in the pre-spinal area with measurement of the height of the left liver;
- A recurrent left para-sternal horizontal section passes through the left liver with measurement of the anteroposterior diameter of the left liver.

All examinations were carried out by a single operator, a doctor in his final year of specialization in radiology and medical imaging, to reduce inter-observer errors. The parameters studied were the mean, the median, the coefficients of determination, the linear regression curves. The difference between variables

was considered significant when $P < 0.05$.

3. Results

Our study included 100 patients including 51 women and 49 men.

Sociodemographic aspects:

- **Age**

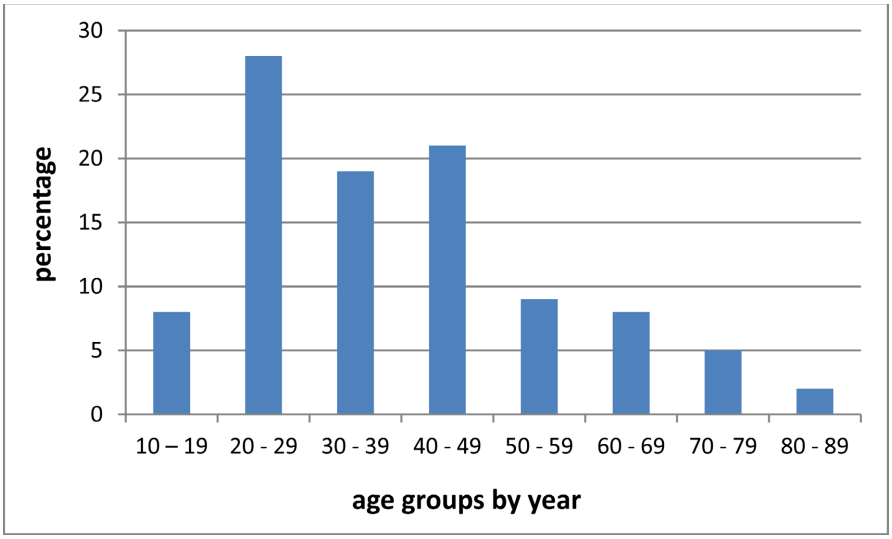

Figure 1. Distribution of patients according to age groups.

The 20 - 29 age group was the most represented with 28% of cases. The average age was 39.05 ± 16.86 years with extreme from 12 to 81 years.

- **Weight**

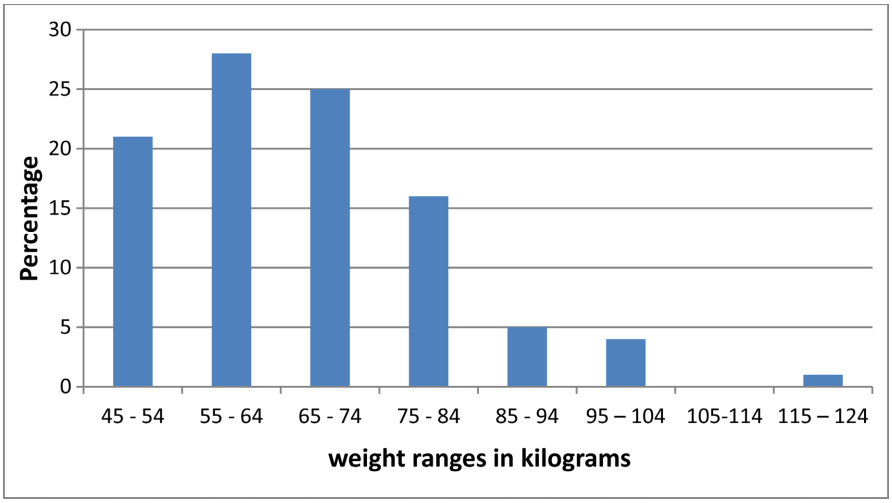

Figure 2. Distribution of patients according to weight groups.

The 55 - 64 kg weight group was the most represented with 28% of cases. The average weight was 66.85 ± 14.38 kg. Overweight subjects were not sufficiently represented in our series.

Liver ultrasound:

- **Height of the right liver**

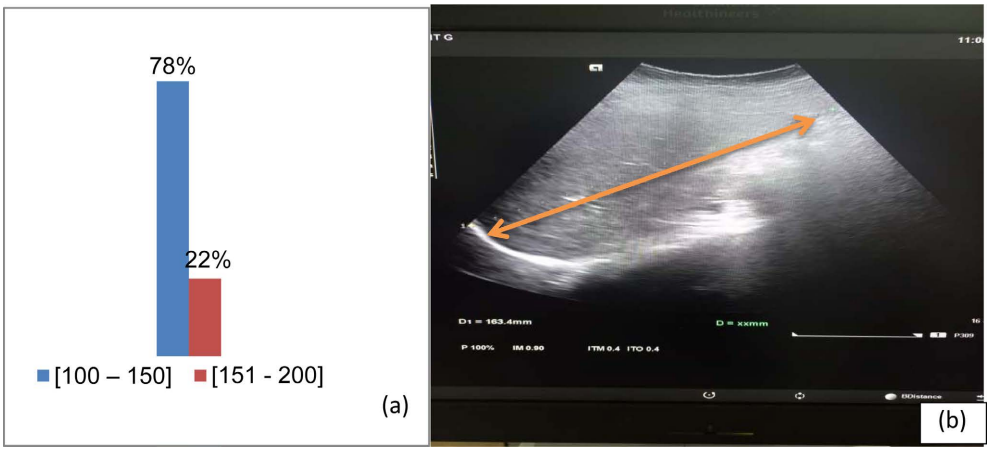

Figure 3. (a) Distribution of patients according to the height of the right liver in mm. (b) Ultrasound measurement technique for the height of the right liver (arrow).

Seventy-eight (78)% of individuals had a right liver height between 100 and 150 mm. The mean height of the right liver was 138.40 ± 14.85 mm.

- **Antero-posterior diameter (APD) of the right liver**

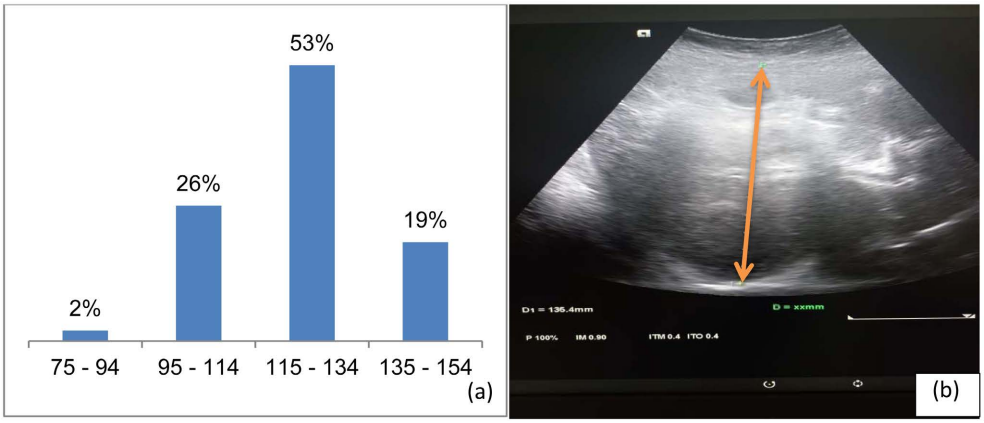

Figure 4. (a) Distribution of patients according to the anteroposterior diameter of the right liver in mm. (b) Ultrasound measurement technique of the anteroposterior diameter of the right liver (arrow).

Fifty-three (53)% of individuals had an anteroposterior diameter of the right liver between 115 and 134 mm. The mean anteroposterior diameter of the right liver was 122.21 ± 13.94 mm.

- **Height of the left liver**

Sixty-two (62)% of subjects had a left liver height between 51 and 100 mm. The mean height of the left liver was 95.55 ± 14.34 mm.

- **Anteroposterior diameter (APD) of the left liver**

Seventy-seven (77)% of subjects had an anteroposterior diameter of the left liver between 41 and 70 mm. The mean anteroposterior diameter of the left liver

was 64.87 ± 12.42 mm

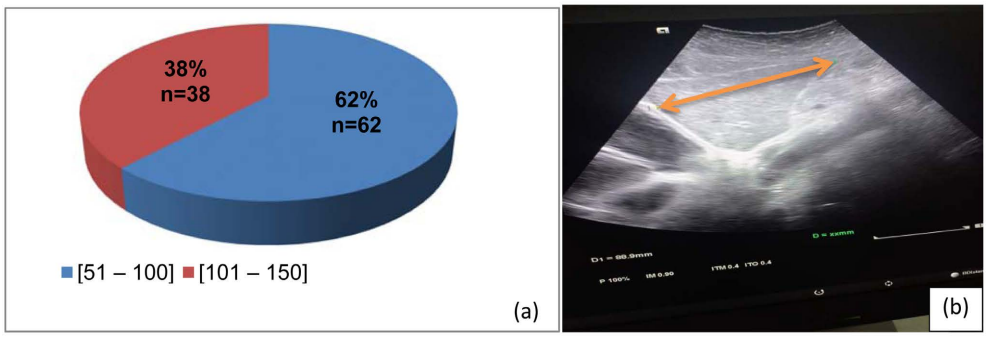

Figure 5. (a) Distribution of patients according to the height of the left liver in mm. (b) Ultrasound measurement technique for the height of the left liver (arrow).

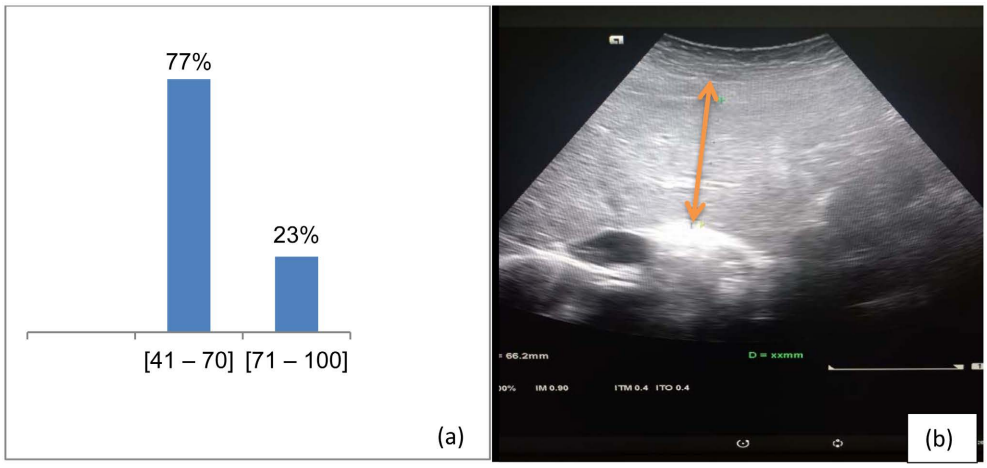

Figure 6. (a) Distribution of patients according to the antero-posterior diameter of the left liver in mm. (b) Ultrasound measurement technique of the anteroposterior diameter of the left liver (arrow).

- **Liver dimensions and sex**

Table 1. Average dimensions of the liver according to sex.

Liver dimensions	Male (n = 49)	Femal (n = 51)	P-value
Average height of the right liver	136.81 ± 14.70 mm	139.92 ± 14.99 mm	0.306
Mean DAP of the right liver	124.51 ± 13.35 mm	120 ± 14.27 mm	0.158
Average left liver height	91.79 ± 13.51 mm	99.16 ± 14,31 mm	0.019
DAP left middle liver	65.10 ± 11.64 mm	64.65 ± 13.25 mm	0.546

The sex ratio (F/M) was 1.04.

Concerning the average height of the left liver, there is a significant difference between the two sexes ($P = 0.019$).

- **Liver dimensions and body mass index (BMI)**

The BMI group in 18.5 - 24.9 was the most represented with 58% of cases.

There is a significant link between the height of the right liver and BMI ($P =$

0.013).

HMFD = Average height of the right liver; HMFG = Average height of the left liver.

Table 2. Average dimensions of the liver according to BMI.

THE BMI GROUP	Average BMI	Effective	HMFD en mm	HMFG en mm
[1 - 18.4]	17.57	9	136 ± 12.07	96.25 ± 14.41
[18.5 - 24.9]	21.43	58	136.75 ± 14.49	94.53 ± 13.65
[25 - 29.9]	27.23	23	137.59 ± 15.80	98.32 ± 17.22
[30 - 40]	33.44	10	152.30 ± 11.88	94.30 ± 12.17
Total	99.67	100	562.4	383.4

4. Discussion

Our small sample size was one of the weaknesses of this study, as a larger sample size could improve the precision of the estimates as well as the generalizability of the data. The nutritional status of the subjects was not recorded and liver function tests to assess the normal physiological state of the liver were not recorded.

4.1. Sociodemographic Aspects

The average age of our patients was 39.05 ± 16.86 years. It was 45.16 ± 18.03 years for men and 33.16 ± 13.39 years for women. There was a significant age difference between the two sexes ($P = 0.000$). Yong KK and Dong KH [5] found in South Korea a mean age of 22.53 ± 2.12 years for men and 21.80 ± 2.60 years for women with no significant age difference between the two sexes ($P = 0.154$). The average weight was 66.85 ± 14.38 Kg. It was 68 ± 13.53 Kg in men and 65.74 ± 15.20 Kg in women, with no significant difference between the two sexes ($P = 0.233$). Yong KK and Dong KH [5] found in a South Korean series a mean weight of 71.34 ± 13.41 kg in men and 57.13 ± 11.47 kg in women with a significant difference between the two sexes ($P < 0.001$).

4.2. Liver Ultrasound

The 3.5 MHz or 1.4 - 5.0 MHz convex probe was used to make the sections used to measure the dimensions of the liver. Mustapha M *et al.* [6] used a 2.5 to 6 MHz curvilinear probe. We measured the craniocaudal diameter of the right liver on a sagittal section made on the right midclavicular line. This technique was adopted by Mustapha M *et al.* [6] as well as Jessie TC *et al.* [7]. Studies have shown that all anthropometric variables contribute strongly and significantly to liver dimensions in women [8]. However, the same factors except body mass index, contribute significantly to the variation in hepatic arrow in men, but to a lesser extent than in women. The mean height of the right liver was 138.40 mm ± 14.85 with extremes of 104 and 180 mm. It was 136.81 mm ± 14.70 in men and 139.92 mm ± 14.99 in women. There was no significant difference between the

two sexes ($P = 0.306$). Mustapha M *et al.* [6] found similar results in North-West Nigeria with an average height of 141.50 mm ± 14.60 and extremes of 104 and 188 mm; in men it was 142.20 mm ± 12 and 140.70 mm ± 16.70 in women. Irina S *et coll* [9] in Russia made the same observation with 143.46 mm ± 3.23 in men and 140.31 mm ± 3.12 in women as the average height of the right liver ($P = 0.49$). On the other hand, Udoak A *et al.* [10] found a significant sex-related difference in the height of the right liver in southern Nigeria (128 mm in women; 120 mm in men), the average height of the right liver being 131.3mm. Yong KK and Dong KH [5] found among South Koreans an average height of 123.40 mm ± 11.80 for men and 110.70 mm ± 9.30 for women with a significant difference between the two. sexes ($P < 0.001$). In addition, Khereilla *et al.* [11] on the adult Saudi population (125 mm in women; 119 mm in men) and Tarawneh *et al.* [12] in Jordanian adults (126 mm in women; 121 mm in men)) observed a significant difference linked to sex. We found a significant correlation between the height of the right liver and the BMI ($P = 0.013$) of the individuals. These results are similar to those of other authors [6] [13]-[18]. However, Niederau *et al.* [19] as well as Udoaka *et al.* [10] did not find a significant correlation between the height of the right liver and BMI. These discrepancies with our study could be explained by the influence of genetics, different ethnic origins or nutritional and environmental factors on the different populations. The average anteroposterior diameter of the right liver was 122.21 mm ± 13.94 with extremes of 75 and 151 mm. It was 124.51 mm ± 13.35 in men and 120 mm ± 14.27 in women without a significant difference between the two sexes ($P = 0.158$). Yong KK and Dong KH [5] found 139.40 mm ± 14.60 in men and 126.70 mm ± 12.30 in women with a significant difference between the two sexes ($P < 0.001$). Irina S *et coll* [8] in Russia found 126.73 mm ±2.30 in men and 113.28 mm ±1.66 in women as the average anteroposterior diameter of the right liver with a significant difference between the two. sexes ($P < 0.001$). The average height of the left liver was 95.55 mm ± 14.34 with extremes of 62 and 150 mm. It was 91.79 mm ± 13.51 in men and 99.16 mm ± 14.31 in women. There was a significant difference between the two sexes ($P = 0.019$). Yong KK and Dong KH [5] found 100 mm ± 9.90 in men and 87.90 mm ± 11.90 in women with a significant difference between the two sexes ($P < 0.001$). Irina S *et coll* [8] in Russia found 91.19 mm ± 3.35 in men and 92.41 mm ± 3.86 in women as the average height of the left liver without significant difference between the two sexes ($P = 0.81$). The average anteroposterior diameter of the left liver was 64.87 mm ± 12.42 with extremes of 43 and 100 mm. It was 65.10 mm ± 11.64 in men and 64.65 mm ± 13.25 in women without a significant difference between the two sexes ($P = 0.546$). Yong KK and Dong KH [5] found similar results with 59.30 mm ± 10.90 in men and 51.80 mm ± 9.90 in women with a significant difference between the two sexes ($P < 0.001$). Irina S *et coll* [8] in Russia found 77.23 mm ± 2.28 in men and 61.88 mm ± 1.81 in women as the average anteroposterior diameter of the left liver with a significant difference between the two. sexes ($P < 0.001$). However, knowledge of the normal size

of the liver according to BMI, sex and age would be of capital importance in the search for acute or chronic liver pathology and could be used to carry out and improve reproductive monitoring in the treatment of liver pathologies in Mali.

5. Conclusion

Liver biometry is done by ultrasound. It is the most widespread technique in the world. This ultrasound allowed us to have the average values of liver biometry in our study population. The mean height of the right liver was 138.40 ± 14.85 mm. It was 136.81 ± 14.70 mm in men and 139.92 ± 14.99 mm in women. The mean height of the left liver was 95.55 ± 14.34 mm. It was 91.79 ± 13.51 mm in men and 99.16 ± 14.31 mm in women. Liver ultrasound remains a reliable technique for liver biometry.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Gosink, B.B. and Leymaster, C.E. (1981) Ultrasonic Determination of Hepatomegaly. *Journal of Clinical Ultrasound*, **9**, 37-41. https://doi.org/10.1002/jcu.1870090110

[2] Ernst, O., Sergent, G. and L'Herminé, C. (1998) Early Diagnosis of Hepatocarcinoma. Encyclopédie Médico-Chirurgicale, Radiodiagnostic-Digestive System, 33-520-A-15, Elsevier, 6.

[3] Legmann, P. and Fayet, P.B. (2017) Practical Medical Imaging. Ultrasound Guide. 5th Edition, Elsevier Masson, 62-72.

[4] Mauricida Silva, R., Becker Pereira, R. and Vasconcelos Siqueira, M. (2010) Correlation between Clinical Evaluation of Liver Size versus Ultrasonography Evaluation According to Body Mass Index (BMI) and Biotypes. *Revista médica de Chile*, **138**, 1495-1501. https://doi.org/10.4067/s0034-98872010001300004

[5] Kim, Y. and Han, D. (2018) Liver Size Measurement Method by Ultrasonography and Reference Range Based on Normal Adult Physique Index. *Journal of Radiological Science and Technology*, **41**, 13-24. https://doi.org/10.17946/jrst.2018.41.1.13

[6] Mustapha, M., Adamu, A.A., Babayemi, J.O., Hamman, W.O., Dahiru, A.U., Aliyu, I.A., *et al.* (2019) Liver Span by Ultrasound in Healthy Adults in Zaria, North-Western Nigeria. *IOSR Journal of Dental and Medical Sciences*, **18**, 37-41.

[7] Childs, J.T., Esterman, A.J., Phillips, M., Thoirs, K.A. and Turner, R.C. (2014) Methods of Determining the Size of the Adult Liver Using 2D Ultrasound. *Journal of Diagnostic Medical Sonography*, **30**, 296-306. https://doi.org/10.1177/8756479314549070

[8] Sapira, J.D. (1979) How Big Is the Normal Liver? *Archives of Internal Medicine*, **139**, 971-973. https://doi.org/10.1001/archinte.139.9.971

[9] Stepanyan, I., Izranov, V., Gordova, V., Rohwein, R. and Stepanyan, S. (2020) Magnetic Resonance and Ultrasound Imaging: Do the Linear Liver Measurements Differ in Men and Women? *Archiv Euromedica*, **10**, 48-50. https://doi.org/10.35630/2199-885x/2020/10/3.11

[10] Udoaka, A.I., Enyi, C. and Agi, C.E. (2013) Sonological Evaluation of the Liver,

Spleen and the Kineys in an Adult Southern Nigerian Population. *Asian Journal of Medical Sciences*, **5**, 33-36. https://doi.org/10.19026/ajms.5.5354

[11] Kheiralla, O.A.M., Babikr, W.G. and Elbadri, A.H. (2016) Sonographic Average Value Of Normal Liver Span Among Saudi Adults Referred To Najran University Hospital. *IOSR Journal of Dental and Medical Sciences*, **15**, 27-34.

[12] Tarawneh, E.S., Hadidy, A.M., Haroun, A.A., Mahafza, W.S., Samara, O.A., Fadi, M., *et al.* (2009) Ultrasound Measurement of Liver Span in Jordanian Adults: A Preliminary Experience. *Jordan Medical Journal*, **43**, 197-204.

[13] Kratzer, W., Fritz, V., Mason, R.A., Haenle, M.M. and Kaechele, V. (2003) Factors Affecting Liver Size. *Journal of Ultrasound in Medicine*, **22**, 1155-1161. https://doi.org/10.7863/jum.2003.22.11.1155

[14] Konuş, O.L., Ozdemir, A., Akkaya, A., Erbaş, G., Celik, H. and Işik, S. (1998) Normal Liver, Spleen, and Kidney Dimensions in Neonates, Infants, and Children: Evaluation with Sonography. *American Journal of Roentgenology*, **171**, 1693-1698. https://doi.org/10.2214/ajr.171.6.9843315

[15] Safak, A.A., Simsek, E. and Bahcebasi, T. (2005) Sonographic Assessment of the Normal Limits and Percentile Curves of Liver, Spleen, and Kidney Dimensions in Healthy School-Aged Children. *Journal of Ultrasound in Medicine*, **24**, 1359-1364. https://doi.org/10.7863/jum.2005.24.10.1359

[16] Soyupak, S.K., Narlı, N., Yapıcıoğlu, H., Satar, M. and Aksungur, E.H. (2002) Sonographic Measurements of the Liver, Spleen and Kidney Dimensions in the Healthy Term and Preterm Newborns. *European Journal of Radiology*, **43**, 73-78. https://doi.org/10.1016/s0720-048x(01)00466-1

[17] Dhingra, B., Sharma, S., Mishra, D., Kumari, R., Pandey, R.M. and Aggarwal, S. (2009) Normal Values of Liver and Spleen Size by Ultrasonography in Indian Children. *Indian Pediatrics*, **47**, 487-492. https://doi.org/10.1007/s13312-010-0090-6

[18] Mauricida Silva, R., Becker Pereira, R. and Vasconcelos Siqueira, M. (2010) Correlation between Clinical Evaluation of Liver Size versus Ultrasonography Evaluation According to Body Mass Index (BMI) and Biotypes. *Revista médica de Chile*, **138**, 1495-1501. https://doi.org/10.4067/s0034-98872010001300004

[19] Niederau, C., Sonnenberg, A., Müller, J.E., Erckenbrecht, J.F., Scholten, T. and Fritsch, W.P. (1983) Sonographic Measurements of the Normal Liver, Spleen, Pancreas, and Portal Vein. *Radiology*, **149**, 537-540. https://doi.org/10.1148/radiology.149.2.6622701