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Sonographic Measurement of Liver Size in Adult Zambian at the Copperbelt University Micheal Chilufya Sata School of Medicine

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Abstract:
Background: Knowledge of the normal measurements of the organs is important in detecting alteration in the size of these organs that may be due to disease. Ultrasound is a useful, most widely utilized, economical, quick, widely available and safest imaging tool in the assessment and measurement of liver, spleen and kidneys. However, according to our knowledge, no similar study has been conducted among health medical students at a public university in Zambia.
Aim: The aim of this study was to determine the normal liver measurement by ultrasound, in healthy medical students at Copperbelt University, Michael Sata Chilufya, School of Medicine (CBU, MCS-SOM).
Methods: A descriptive cross-sectional study involving 193 randomly selected healthy medical students at CBU, MCS-SOM aged 18 years and above was conducted February to June 2018. Pre tested tools were used to collect data. Ethical Considerations were adhered to. Ultrasound Philips DH3, 3.5 MHZ sector probe and Sony printer were used to collect data. Correlation coefficients analysis were done using SPSS version 21 computer software.
Results: Overall, 193 participated in the study. Liver length ranged between 11 and 17 centimetres. The mean liver size was13.10 cm (SD±1.06 to 2.7). Most (36.8%) of the participants had liver size between 13-13.9 cm. The body Mass Index (BMI) was in the range from 17 to 39 kg/m2, with the majority (57%) participants in the 18.5 to 24.9 Kg/m2.
Conclusion and Recommendation: Our study has shown that only BMI of 25 or more was statistically independently associated with larger liver size. We recommend a further study with larger sample size and an increase in age in order to generalise the findings.
Keywords: BMI, Liver size, Ultrasound, Zambia.

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Introduction

Ultrasound (U/S) is a useful, most widely utilized, economical, quick, widely available and safest imaging tool in the assessment and measurement of internal organs like the liver, spleen and kidneys. In a study of 5,036 Japanese it was found that up to 8% had a larger liver size compared to Caucasians for a given body weight. A study by Murray (1999) found that there are higher risks of many liver diseases in Black-Americans compared to White-Americans due to social, economical and regional factors. Previous literature reviews show that demography, height, weight, and body mass index are predisposing factors of liver variations (Kratzer *et al.,* 2003).

In addition, Kratzer and others reported that gender is a determining factor for liver size and it was found that men had a larger liver size than women. They however reported a significant difference for ultrasound liver measurement between male and female adults with a mean value for men of 14.5 ± 1.6 cm and 13.5 ± 1.7 cm for women (Kratzer *et al.,* 2003).

A prospective study conducted in Jordanian comprising 242 males and 275 female adults it was found that the best predictor of liver span in males was the height and females was the body surface area. BMI contributed to variation in males liver span but to a less extent to females (Emad S. Tarawneh *et al.,* 2009). Studies carried out in Germany on dimensions of various abdominal organs demonstrated values for the liver and found that Body Mass Index (BMI) as the most important factors associated with the liver (Kratzer *et al.,* 2003).

Ultra sound scanning is commonly used to determine liver size even in Zambia, yet there are no reference data on normal sonographic measurements of liver size that can be locally applied. Most data for sonographic measurement of the liver are from studies done in Europe and Asia. According to our knowledge, no study has been done on liver measurements among adults in Zambia.

The aim of this study was to determine the normal range of ultrasound measurements for the liver in healthy adults at the Copperbelt University, Michael Chilufya Sata School of medicine (CBU, MCS-SOM).

Methods and Materials

Study design and site: This was a descriptive cross-sectional study carried out at Kitwe Teaching Hospital (KTH) from February to June 2018. KTH is one of the university teaching hospitals on the Copperbelt province with a bed capacity 630. It serves a wide catchment area in the 3rd largest city of Zambia and is a tertiary referral hospital for North-Western, Luapula and Northern provinces of Zambia. A total of 193 participants were selected using the statistical formula by Kish (1965).

Sampling and sample size: Simple random sampling using random table was used to select 193 medical students who had registered for 2017 academic year aged 19 years or more and had no known liver diseases such as jaundice, hepatitis, malaria within 2 weeks, liver cirrhosis and of African race.

Materials: Participants' heights and weights checked from the hospital's out-patient department (OPD). Height was measured in meters (m) using a Seca brand 214 portable Stadiometers while weight was measured and recorded in kilograms using the Heine Portable Professional Adult Scale 737 (Seca gmbh & Co. kg Humburg, Germany). To ascertain the accuracy of the weighing scale, each participant was weighed twice and the average was

taken as a person's weight. Weight and height were used to calculate body mass index (BMI) using Lenovo laptop calculator. Later participants were taken to the Ultrasound department, which is part of radiology department for liver scans. Phillips ultrasound machine HD 11 and a Sonny printer with A sector probe (transducer) of frequency 2 to 5 kHz was be used.

Data collection: With subject in supine position, the liver was measured from the hepatic dome to the tip of inferior angle of the right liver. To reduce measurement errors, ultrasound measurements of the liver length was taken three times and the mean value was taken under guidance of the supervisor and a competent sonographer using standard techniques recommended for ultrasound. The scanning approach used was mainly subcostal, but if the entire liver was not imaged, then intercostal scans were used. Breath-holding was important for improving the acoustical window into the liver. A pre-standardised collection form was used to enter collected data.

Data analysis: Data collection forms were initially manually checked for completeness and were number before being entered into Excel computer program. Verified excel dataset was then exported to BMI SPSS version 21 for analysis. We compared means of gender, age group and BMI using independent sample T-tests. The mean, standard deviation (SD), mean difference (MD), P-value at 0.05 and their 95% confidence intervals are reported. Only variables with P-value less than 0.05 were considered to be statistically significant.

Ethical considerations: The study protocol was reviewed and approved by the Tropical Disease Research Ethics Committee IRB Registration Number 00002911 and FWA Number 00003729. Permission to conduct the study among female medical students was sought from The Dean of students, Copperbelt University. The purpose of the study was explained to them. Those who voluntarily agreed to participate in the study were then requested to sign the consent form. Data collection forms were viewed only by approved study personnel

Results

A results of 193 participants showed that 98 (50.9%) were females. The participants were aged between 18 and 43 years, mean age of 27.88 (SD=5.77). The liver size ranged from 11 to 17 cm, the mean liver size was13.10 cm (SD±1.06 to 2.7).

Most (36.8%) of the participants had liver size between 13-13.9 cm. The body Mass Index (BMI) was in the range from 17 to 39 kg/m2, with the majority (57%) participants in the 18.5 to 24.9 Kg/m2. Participants with a BMI of 25 or more had larger liver size of 15 cm or more. Table 1 summarizes the association between participants' variables and the liver size. Participants whose BMI was 25 and above were find to have a large liver size.

Table 1. Association between participants Age, Gender, BMI and Liver size

Variable	Mean	SD	MD	P-Value	95% CI
Age Group					
≤30 Years	13.26	1.044	-.162	.310	-.477 -.153
≥30 Years	13.43	1.096			
Gender					
Male	13.26	1.131	-.113	.461	-.416 -.189
Female	13.38	.966			
BMI ≤ 25	13.16	1.003	-.396	**.010**	-698 -.095
≥ 25	13.55	1.107			

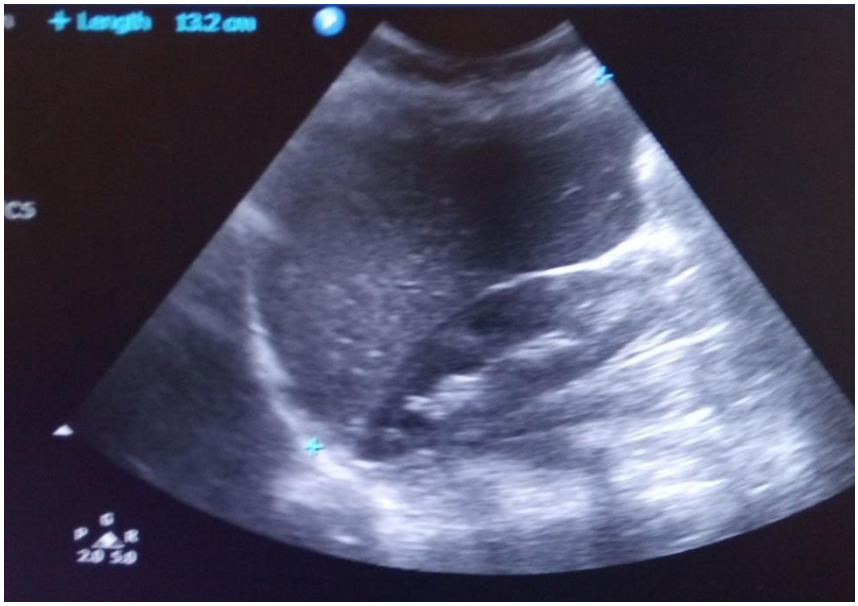

Figure 1. Sonogram showing measurement of the liver in a 23 years old male student. It measured 13.2 cm

Discussion

In this study the liver size ranged from 11 to 17 cm with the mean of the liver size was 13.10 cm which was larger when compared to 10.5 to 12.3 cm found by Niederau *et al.*, (1983) and Moawia in a study conducted in Saudi Arabia who found mean liver size of 12.29 cm (Moawia, 2015).

In a similar study conducted by Kratzer and others at mid-clavicular line to determine the influence of sex, height, BMI and alcohol consumption on liver size found the average measured liver diameter at mid-clavicular line to be 14 cm which was within range when compared to 13.10 cm in our study (Kratzer *et al.*, 2003).

In the present study, we found that there was no statistical significant difference between males and females at measurement at midclavicular diameters of the right lobes of the liver. However, our study has demonstrated that BMI of 25 or more is associated with large liver size. This finding is similar to what were found in a study on relationship between Body Mass Index, liver span and lipid profile in Medium Woman: a preliminary observation study (Rajpathy *et al.*, 2016). Similarly, in a study in Calabar Nigeria on Sonographic correlation of liver dimension and anthropometric variables of height, weight and Body Mass Index found positive relationship between Body mass Index and liver dimension (Ekpo *et al.*, 2013).

The increase in the liver size in those with higher BMI could be attributed to higher fat deposition on the liver seen in over weight and obese individuals (Ekpo *et al.*, 2013). In addition, high BMI could be associated with increased activity of the liver, hence such individuals tend to have an increase in liver size (Rajpathy *et al.*, 2016).

Conclusion and Recommendation

Our study has shown that liver size is affected more by BMI than gender or age in the population we studied. We recommend that further study with increased age group and larger sample size be conducted to help generalise the findings in the country, Zambia.

Author's contributions

KN and KE conceptualized the study, participated in the protocol preparations, data collection, analysis and interpretation, drafting and revision of manuscript, MV participated in the conceptualization of the study, protocol preparation and revision of manuscript. SS supervised data analysis, interpretation of findings and preparation of the manuscript, MA data analysis, interpretation and revision of manuscript.

Conflict of interest: None.

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