

Sonologic Assessment of Dimensions of Spleen in Normal Adult Kashmiri Population and their Correlation with Weight and Height

Snobar Gul¹, Mohd Saleem Itoo², Majid Jahangir³, Younis Kamal⁴

ABSTRACT

Introduction: Anthropometry varies with races and regions of the world. Specific ethnic nomograms are needed for proper medical diagnosis and monitoring the disease process. This study was carried to assess the range of dimensions of spleen in normal adult kashmiri population and to find out their correlation with weight, height and BMI.

Material and methods: This was an observational cross sectional study conducted in department of anatomy GMC Srinagar for a period of 18 months. A total of 300 staff members between 19 and 55 years of age were included in the study.

Results: In our study mean craniocaudal length of spleen was 10.20±1.40cms and transverse diameter was 8.63±1.57cms. We found a statistically significant correlation of splenic dimensions with body weight and BMI.

Conclusion: In conclusion, the normal limits of the spleen are important parameters during a sonographic examination. This study revealed that splenic dimensions showed the best correlation with body weight, and BMI.

Keywords: BMI, Craniocaudal length, Sonography, Spleen, Transverse Diameter.

fact in west. Nomograms of various abdominal organs are available for Indian population. There is an urge to develop specific ethnic population nomogram to provide a better accuracy of measurements of solid abdominal organs in terms of making a proper medical diagnosis and also during monitoring the disease progress. As such no such study has been conducted in kashmiri population to see variation of normal spleen size. To find out the normal variation of splenic size in kashmiri population, department of anatomy conducted ultrasonographic anthropometric measurement of spleen and its correlation with height, weight and BMI in sample of 300 normal and healthy employees of GMC Srinagar and its associated hospitals.

MATERIAL AND METHODS

This study was conducted in the Postgraduate Department of Anatomy in collaboration with Department of Radiodiagnosis and Imaging of Government Medical College, Srinagar for a period of eighteen months. This is an observational cross sectional type of study which has been conducted on employees of Government Medical College Srinagar and its associated hospitals. Informed and written consent was taken from all the subjects who participated in this study. They were also given the right to withdraw from the study. A brief history and physical examination was taken to exclude various pathological conditions affecting the dimensions of spleen. The subjects included in this study are all of Kashmiri ethnicity. Height was taken in centimeters (cm) and weight in kilogram (kg), and BMI was calculated. The height and weight of the subjects were recorded and the BMI (body mass index) of each subject was calculated by using following formula:

$$\text{BMI} = \text{Weight (kg)} / \text{height (m)}^2$$

Ultrasonographic assessment of spleen of all normal adult employees of both sexes were taken. The employees with skin infection at scanning area, any history surgery around upper abdomen, known diabetics, people taking alcohol, any

INTRODUCTION

The size of various abdominal organs varies with age, height and weight. The clinical examination is far from accurate to detect a small increase in size of these organs. Scanning of the viscera is carried out to know the normal dimensions and the echo patterns. Any deviations from normal have led to diagnosis or prediction of pathological conditions.

Ultrasound imaging also known as ultrasound scanning or sonography is based on the principle of piezoelectric effect. It is a relatively inexpensive, fast, non-invasive and radiation-free imaging modality.

Splenic size varies with age, nutrition and hydration. It is relatively large in children, reaching adult size by fifteen years.¹ The rate of palpable splenomegaly can provide an indication of the intensity of malaria transmission in endemic areas when blood smears are unavailable.^{2,3} As a clinical guideline, the distance that the spleen extends below the left costal margin is often used to monitor spleen size, but clinical examination of splenic size is notoriously inaccurate. In addition, mild splenomegaly may be difficult to identify by clinical examination. Hosey et al in a study of a healthy collegiate athletic population found that splenic size was larger in men and white athletes than in women and black athletes.⁴

The variations in the anthropometric features of various populations, races and regions are an established and proved

¹Demonstrator /Senior Resident, ²Associate Professor, Department of Anatomy, ³Professor, Department of Radiodiagnosis and Imaging, ⁴Consultant, Department of Orthopaedics, Government Medical College Srinagar, J&K, India

Corresponding author: Dr Snobar Gul, Demonstrator /Senior Resident, Department of Anatomy, Government Medical College Srinagar, J&K, India

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past history of abdominal trauma were excluded from the study. Any employee with past history of malaria, typhoid fever, malnutrition, anaemia, sickle cell disease, obesity and with evidence of splenic parenchymal mass lesions, abnormal echotexture of the spleen, accessory spleen, splenic cysts were also excluded from the study. Any employee with body weight more than 95 kg or less than 50 kg have been excluded as she/he can have different orientation of the liver necessitating a report of further parameters for the determination of liver size.

The employee who had fever either at the time of the scan or within at least four weeks prior to the scan have also been excluded from the study. Pregnant employees were excluded from the study.

The height and weight of all eligible subjects were recorded. The subjects were counseled about the abdominal ultrasonographic examination and results. The procedure was explained to all subjects in detail and written consent was taken from each subject.

The ultrasonography scan of subjects was performed in ultrasonographic laboratory in the Department of Radiodiagnosis, Government Medical College, Srinagar. Same radiologist performed usg scan every time to avoid any inter-observer variation.

The SIEMENS ACUSONX 300 ultrasonic diagnostic imaging systems with convex array 3.5MHz transducer was used for scanning. The technique of right lateral decubitus position in the coronal plane was adopted for the spleen length measurement. The spleen was scanned at the left hypogastrium, it was viewed in its longitudinal axis and the Cranio-Caudal Length (CCL) measured from both superior and inferior poles of the spleen. Spleen was also viewed in transverse axis to measure the transverse diameter.

STATISTICAL ANALYSIS

A total of 300 subjects were scanned and all the parameters recorded in excel sheet of Microsoft office.

Descriptive statistics were applied on the available data. Mean \pm SD was presented for age, height, weight, BMI, craniocaudal length and transverse diameter of spleen. Data analysis was carried out using SPSS 20. Data comparison (statistical test of significance) was done with t-test and ANNOVA test. At 95% interval, two-tailed P-values less than or equal to 0.05 were considered to be statistically significant.

RESULTS

A total of 300 eligible subjects were included in the study, among them 168 were female subjects and 132 male subjects. The average age of the subjects was 34.4 years with range from 19-55 years with 41% between 19 to 30 years, 35.3% between 31 and 40 years and 23.7% between 41 and 55 years of age.

The mean weight of our study group was 59.55kgs. The mean height was 161.15cms. The mean BMI was 22.96kg/m². Mean weight and mean height were more in males than females but mean BMI was more in females. The average

size was more in males than females but the difference was not found to be significant (p value > 0.05). There was a significant correlation of dimensions of spleen with body weight and body mass index (BMI) in both males and females. There was a significant correlation of craniocaudal length of spleen with body height in male.

		Correlation in males	Correlation in females
Craniocaudal length	r value	0.371	0.360
	p value	<0.001	<0.001
Transverse diameter	r value	0.353	0.372
	p value	<0.001	<0.001

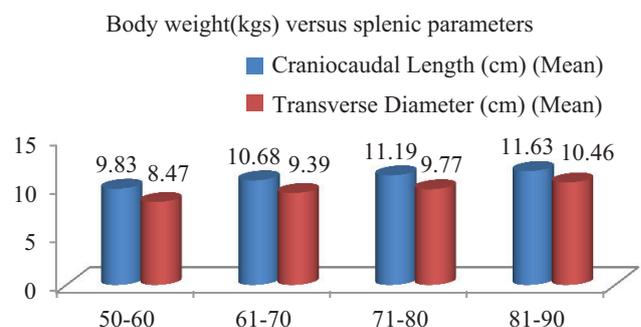
Table-1: Results of analysis comparing spleen size with weight in males and females

		Correlation in males	Correlation in females
Craniocaudal length	r value	0.288	0.177
	p value	<0.001	0.022
Transverse diameter	r value	0.142	0.128
	p value	0.104	0.099

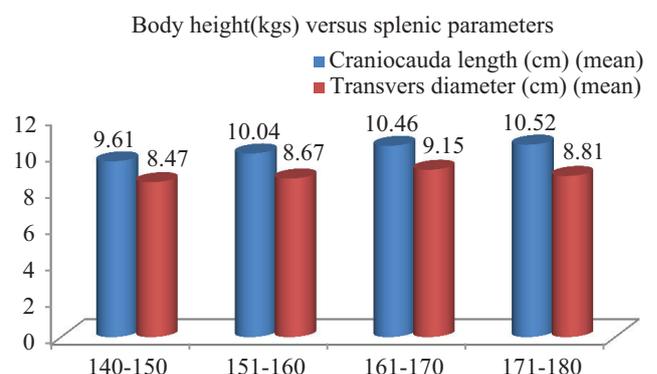
Table-2: Result of analysis comparing spleen size with body height in males and females

		Correlation in males	Correlation in females
Craniocaudal length	r value	0.244	0.207
	p value	0.005	0.007
Transverse diameter	r value	0.297	0.255
	p value	<0.001	0.001

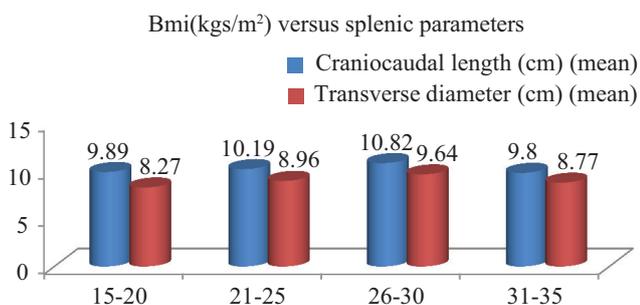
Table-3: Results of analysis comparing spleen size with BMI in males and females



Graph-1: Body weight(kgs) versus splenic parameters



Graph-2: Body height(kgs) versus splenic parameters



Graph-3: BMI(kgs/m²) versus splenic parameters

In our study the mean craniocaudal length of spleen was 10.20 ± 1.40 cms and transverse diameter was 8.63 ± 1.57 cms. The mean craniocaudal length of spleen was 10.32 ± 1.43 cms in males and 10.10 ± 1.39 cms in females. The mean transverse diameter of spleen was 8.89 ± 1.62 cms in males and 8.81 ± 1.49 cms in females.

Bar chart showing correlation between craniocaudal length of spleen (r value=0.370, p value<0.001) and transverse diameter (r value=0.355, p value<0.001) with body weight. Bar chart showing correlation of craniocaudal length of spleen (r value=0.224, p value<0.001) and transverse diameter of spleen (r value=0.123, p value=0.033) with respect to body height

Figure-3 shows correlation between craniocaudal length of spleen (r value=0.207, p value<0.001) and transverse diameter of spleen (r value=0.265, p value<0.001) and body mass index (BMI)

DISCUSSION

With the advent of scientific method of diagnosing the different diseases, health care system has moved from empirical basis of treatment to evidence based method of treatment. To find various causes of pathological process enumerable number of diagnostic methods have been developed over a period of time. Ultrasonography scanning is one of the easiest, reliable, non hazardous method of diagnosing solid organ abnormality in human body. Its is based on piezoelectric principle of reflecting back the sound waves from various solid organs of the human body.

Since with evolution the different human races have evolved with complex processes and lead to the variation in dimensions of various organ systems of the body.

The size of various abdominal organs varies with age, height and weight. The dimensions of the solid abdominal viscera also vary in cadaveric and living state. The clinical examination is far from accurate to detect a small increase in size of these organs. Scanning of the viscera is usually carried out to know the normal dimensions and the echo patterns. Any deviations from normal have led to diagnosis or prediction of pathological conditions. A number of disorders are accompanied by altered size of these organs, including infective, infestation, infiltrative, immunological and malignant conditions. Various studies have been carried out to know the dimensions of spleen in various populations. The mean transverse diameter of spleen was 8.89 ± 1.62 cms

in males and 8.81 ± 1.49 cms in females. The average size of spleen was more in males than females but the difference was not found to be significant. Similar observation was found by Ferdinand Morabe M.D.⁵

Comparatively in a previous study done by Spielmann et al⁶ the average length of the spleen was found to be 11.40 ± 1.7 cm in males and 10.30 ± 1.3 cm in females, which was higher than that found in our study. This was because in his study the subjects were tall healthy athletes. As splenic size correlates with height, this may be the reason of higher dimensions in his study.

Mittal R et al⁷ 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 Rajsthani population which is lower than in our population. In his study the author has included the subjects with age less than 18 years while in our study subjects were above 18 years. This may be the reason of higher dimensions in our study plus it can also be due to genetic and environmental factors.

Niederau C Sonnenberg A et al in 1983⁸ demonstrated that mean longitudinal diameter of spleen was found to be 5.8 ± 1.8 cms and transverse diameter was 5.5 ± 1.4 cms. These dimensions were much smaller than present study because the authors did not measure the maximum length of spleen.

In our study the difference between male and female spleen was 0.12cms while in a study done by N Arora et al⁹ on north Indian adults splenic length in males was 0.2cms longer than splenic length of females. This may be due to difference in height, weight, body surface area and genetic factors.

In our study we found a statistically significant correlation ($p < 0.001$) between craniocaudal length and transverse diameter of spleen and body weight in both males and females which was found in various other studies like Ogbeide Ehimwenma et al.¹⁰

Sirisena U.A.I et al in 2015¹¹ found that the splenic length significantly correlated with only BMI ($r = 0.333$, $p < 0.05$) and not weight (p value=0.107) while our study revealed that splenic dimensions significantly correlated with both body weight and BMI. It may be due to relatively smaller sample size of 50 in his study while a larger sample of 300 subjects in our study.

We also found a statistically significant correlation between body height and craniocaudal length and transverse diameter of spleen (more of craniocaudal length of spleen). Craniocaudal length and not the transverse diameter of spleen in males correlates well with body height (p value<0.001, $r = 0.288$). Same applies to splenic parameters in females ($p < 0.05$). A study done in Bihari adult population by Alka Singh et al¹² observed that the length of spleen increased with increase in height in both males and females. Same was found in our study. Our study revealed strong correlation between BMI versus craniocaudal length and transverse diameter of spleen in both males and females with p value<0.05, similar observations were made by Sirisena U.A.I et al in 2015¹¹ and Veli Caglar et al in 2014.¹³

CONCLUSION

In conclusion, the normal limits of the spleen are important parameters during a sonographic examination. This study revealed that splenic dimensions showed the best correlation with body weight, and BMI. Nomograms from this data can be used locally for Kashmiri ethnic population to avoid false positive and false negative diagnosis of pathological enlargement or reduction of spleen, liver and kidney in clinical practice.

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