

**Original Article**

# AGE-RELATED CHANGES IN ULTRASONOGRAPHIC SPLEEN LENGTH IN THE ADULT POPULATION OF KANPUR

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## ABSTRACT

**Introduction:** The spleen is an intra-abdominal organ affected by a number of diseases. Estimates of spleen size in vivo are often important in the diagnosis, treatment, and prognosis of many disorders which is unreliable by palpation. Several previous studies have tried to develop norms for spleen size estimation such as CT scan, scintigraphy, MRI, and ultrasound. Conventional ultrasound has been shown to be a good measure of spleen size without the need for ionizing radiation. In this study, an attempt was made to determine the normal range of the spleen and its correlation with age of male and female subjects.

**Materials and Methods:** 80 males and 80 females aged 20 to 60 years from the Department of Anatomy and Radiology, Rama Medical College & Research Centre, Kanpur were selected. Using ultrasound, the length of the spleen was measured.

**Results:** It was observed that in both men and women, the length of the spleen decreases with age. Spleen length decreases at a slower rate until age 50, after which it declines rapidly. Spleen length is greater in men than in women at all ages.

**Conclusions:** Spleen size varies greatly among individuals. Establishing normative spleen length data is crucial for assessing changes. Age significantly influences spleen size, especially in males over 50. Consider age before diagnosing spleen length changes.

**Keywords :** Spleen, Palpation, Hematopoietic system, Portal hypertension

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## **INTRODUCTION**

The spleen being an intraperitoneal organ is located postero-laterally in the left hypochondrium between the gastric fundus and the left half of diaphragm. In the supine position, the long axis of the spleen and the tenth rib are in line, but in the upright position, the spleen becomes more vertical. The extreme or superior angle of the spleen lies roughly 4 cm from the tenth thoracic spine, and its lateral border corresponds to the mid-axillary line in the ninth intercostal space. The normal shape of the spleen is tetrahedral but may be different after enlargement. The splenic hilum is the only part which the peritoneum does not cover, but here the splenic arteries and veins are carried in the peritoneal reflections.

The gastrosplenic ligament attaches the spleen to the stomach, while the lienorenal ligament attaches it to the dorsal body wall. The phrenicocolic ligament supports its inferior end without being directly attached to the spleen. The spleen can enlarge as much as ten times to be able to shift to ectopic locations because of these attachments. The spleen is covered by a connective tissue capsule which projects fibers (trabeculae) into its pulp.

Being an intra-abdominal organ, the spleen is affected by various diseases. In various clinical conditions, the spleen is enlarged, most commonly due to reactive proliferation

of lymphocytes or reticuloendothelial cells. The spleen also enlarges in malignancies of the hematopoietic system such as lymphoma, diseases associated with portal hypertension, disseminated tuberculosis, malaria, kala azar, cirrhosis, collagen storage diseases, etc.

Recognition of pathological changes requires estimation of normal limits of spleen size. Calculating the volume of the spleen is impractical. Thus, splenic length determination is specially meaningful and important [1–3]. Estimates of spleen size in vivo are often crucial in the diagnosis, treatment, and prognosis of many disorders. Accurate measurement of the spleen by palpation is unreliable because in some cases, the spleen may be palpable of normal size while a palpable spleen is not always of normal size. Imaging of the spleen can be obtained with simple radiography [4], but this exposes the patient to avoidable radiation exposure. In addition, if there is an upper lateral quadrant mass, it is very difficult to distinguish splenic tissue from that of nearby organs.

Radionuclide imaging is also used to estimate spleen size. Its accuracy depends on the vascular integrity of the organ and it exposes the patient to excessive gamma radiation [5]. Ultrasound has been shown to be both accurate and reliable for the measurement of splenic dimensions [6]. As a result of recent advances in ultrasonography, assessment of

splenic size (either palpable or unpalpable) has become feasible, reliable, and accurate. A simple, safe, and accurate assessment method of splenic size is ultrasonography. Patients having persistent splenomegaly are advised a close follow up for complications, which may ultimately require the procedure of splenectomy [5].

Ultrasound scanning, apart from being non-ionizing, is painless, non-invasive, widely available, easy to use, and less expensive than most other imaging methods. However, its main limitation is being operator-dependent. It can show the presence and composition of splenic masses, modifications in splenic echotexture and shape, any changes in the masses over time, and the splenic size.

Ultrasonographic measurement of splenic length is reliable in between technicians. But measurement of splenic width is less reliable, as shown by just intra- and inter-rater reliability in moderation. This is in support of the spleen length based historical assessment of splenomegaly. [7]

Low reliability of splenic width measurement, makes splenic volume based definition of splenomegaly more uncertain. [7] In this study, an attempt was made to determine the normal range of the spleen and its correlation with the age of male and female subjects.

## **MATERIAL AND METHODS**

A total of 160 patients, 80 men, and 80 women aged 20 to 60 years were selected for this study. Prior informed consent was taken from all patients. The study's purpose, potential effects, and examination stages were explained either individually or in groups.

Psychological reassurance was provided to the patients and were told to relax before the examination. The patients were then asked to lie on the couch in the supine position with their arms stretched out while taking shallow breaths.

All measurements were conducted on sections across the hilum to ensure a consistent point of reference for reproducibility, following the American Institute of Ultrasound in Medicine guidelines [8], described by Lamb et al. [9]. Length of the spleen (the maximum distance between the splenic tip and its dome) was measured along the longitudinal section.

*Exclusion criteria:* Patients with a history of splenectomy, age under 20, history of malignancy, hematologic disorders, or persistent fever were excluded from the study.

*Ethics:* Ethical clearance was obtained from the college ethics committee [RMCHRC/Ethics/2022/2035-A].

Age	No. of subject	Mean±SD (cm)	Range (cm)	F ratio
21-30 yrs.	20	10.61 ± 1.35	9.97-11.24	F=9.088 (P<0.001)
31-40 yrs.	20	10.38 ± 1.81	9.82-10.93	
41-50 yrs.	20	9.95 ± 1.33	9.32-10.57	
51-60 yrs.	20	8.64 ± 1.33	8.02-9.26	

**Table 1. Comparison of splenic length in different age groups in males**

*Statistical analysis:* All data were entered into a Microsoft Excel sheet and then statistically analyzed using SPSS software version 26 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics of frequency, percentage, mean, and standard deviation were performed.

## RESULTS

Spleen length was 10.61 ± 1.35 cm in the age group of 21-30 years and decreased to 8.64 ± 1.33 cm in the age group of 51-60 years in males [Table-I]. In females, there was a significant decrease in the spleen length from 9.63 ± 1.32 cm to 8.41 ± 1.43 cm between the age group of 21-30 years to 51-60 years [Table-II]. This decrease in length was significant both in males (F=9.082, P<0.001) as well as females (F=3.108, P<0.05).

In both males and females, splenic length decreased with age. The splenic length decreased at a slow rate up to the age of 50 years, after which it decreased rapidly. The splenic length was greater in males than females in each age group.

Correlation analysis showed that spleen length was negatively correlated with age in all adults [Table-III]. So, with increasing age, spleen length was found to be decreasing. This decrease in splenic length is significant (Pearson Correlation -0.259, P<0.05) in males and was not significant in females (Pearson Correlation -0.076, P>0.05).

## DISCUSSION

The splenic size may provide insights into the diagnosis and prognosis of gastrointestinal and hematologic diseases [10]. Most individuals in this study had spleens less than 11 cm in length, consistent with Frank et al.'s findings [5].

According to Rosenberg et al. [11], girls aged 15 years or older have spleens with an upper normal limit of 12 cm, slightly differing from this study's results. In this study, splenic length gradually declined until age 50, then reduced rapidly, consistent with Loftus and Matrewali's findings [12]. It was seen that the splenic length increased up to age 20, after which it moderately declined by age 50.

Age	No. of subject	Mean±SD (cm)	Range (cm)	F ratio
21-30 yrs.	20	9.63 ± 1.32	9.01-10.25	F=3.108 (P<0.05)
31-40 yrs.	20	9.41 ± 1.27	8.81-10.00	
41-50 yrs.	20	9.21 ± 1.34	8.57-9.84	
51-60 yrs.	20	8.41 ± 1.43	7.74-9.08	

**Table 2. Comparison of splenic length in different age groups in females**

Konus et al. [13] observed the highest correlation between body height and splenic length. Splenic length, breadth and thickness showed a decrease with age in both males and females. Statistically, age and splenic measurements showed a significant negative correlation in males [14].

An exploration in China showed rapid-fire splenic length increase till 20 years of age, followed by gradual decline until age 50, and then a rapid decline. The average spleen measured  $9.56 \pm 1.37$  cm, with a negative correlation between age and splenic length [15].

Studies in Tripura, West Nepal, East Nepal, and North India show an inverse relationship between adult subjects' age and splenic size, indicating a drop with age. [16]. Ezeofor et al. [17] studying children aged 5 to 17 years, noted a significant correlation between splenic length and age ( $P < 0.001$ ), in which males demonstrated longer spleens than females.

**CONCLUSION**

Spleen size varies greatly among individuals, emphasizing the need for normative data to assess changes accurately. Patient age

Parameters	Splenic length(cm)			
	Male (80)		Female (80)	
	Pearson's Correlation	P value	Pearson's Correlation	P value
Age(years)	-0.259	<0.05	-0.076	>0.05

**Table 3. Correlation of spleen length and age**

significantly influences spleen size. Therefore, age consideration is crucial when evaluating spleen length changes due to disease. In males over 50, spleen size is typically reduced, warranting caution in reporting normal spleen size.

## REFERENCES

1. Megremis SD, Vlachonikolis IG, Tsilimigaki AM. Spleen length in childhood with US: normal values based on age, sex, and somatometric parameters. *Radiology*. 2004 Apr;231(1):129-34. doi: 10.1148/radiol.2311020963.
2. Safak AA, Simsek E, Bahcebasi T. Sonographic assessment of the normal limits and percentile curves of liver, spleen, and kidney dimensions in healthy school-aged children. *J Ultrasound Med*. 2005 Oct;24(10):1359-64. doi: 10.7863/jum.2005.24.10.1359.
3. Watanabe Y, Todani T, Noda T, Yamamoto S. Standard splenic volume in children and young adults measured from CT images. *Surg Today*. 1997;27(8):726-8. doi: 10.1007/BF02384985.
4. Schindler G, Longin F, Helmschrott M. [The individual limit of normal spleen size in routine x-ray film (author's transl)]. *Radiol*. 1976 Apr;16(4):166-71.
5. Frank K, Linhart P, Kortsik C, Wohlenberg H. [Sonographic determination of spleen size: normal dimensions in adults with a healthy spleen]. *Ultraschall Med*. 1986 Jun;7(3):134-7. doi: 10.1055/s-2007-1011931.
6. Petzoldt R, Lutz H, Ehler R, Neidhardt B. [Determination of splenic size by ultrasonic scanning (author's transl)]. *Med Klin*. 1976 Nov;71(48):2113-6.
7. Hosey RG, Mattacola CG, Kriss V, Armsey T, Quarles JD, Jagger J. Ultrasound assessment of spleen size in collegiate athletes. *Br J Sports Med*. 2006 Mar;40(3):251-4; discussion 251-4. doi: 10.1136/bjsm.2005.022376.
8. Al-Salem AH, Al-Aithan S, Bhamidipati P, Al-Jam'a A, Al Dabbous I. Sonographic assessment of spleen size in Saudi patients with sickle cell disease. *Ann Saudi Med*. 1998;18(3):217-20. doi: 10.5144/0256-4947.1998.217.
9. Lamb PM, Lund A, Kanagasabay RR, Martin A, Webb JA, Reznek RH. Spleen size: how well do linear ultrasound measurements correlate with three-dimensional CT volume assessments? *Br J Radiol*. 2002 Jul;75(895):573-7. doi: 10.1259/bjr.75.895.750573.
10. Niederau C, Sonnenberg A, Müller JE, Erckenbrecht JF, Scholten T, Fritsch WP. Sonographic measurements of the normal liver, spleen, pancreas, and portal vein. *Radiology*. 1983 Nov;149(2):537-40. doi: 10.1148/radiology.149.2.6622701.
11. Rosenberg HK, Markowitz RI, Kolberg H, Park C, Hubbard A, Bellah RD. Normal splenic size in infants and children: sonographic measurements. *AJR Am J Roentgenol*. 1991 Jul;157(1):119-21. doi: 10.2214/ajr.157.1.2048509.

12. Loftus WK, Metreweli C. Normal splenic size in a Chinese population. *J Ultrasound Med.* 1997 May;16(5):345-7. doi: 10.7863/jum.1997.16.5.345.
13. Konuş OL, Ozdemir A, Akkaya A, Erbaş G, Celik H, Işık S. Normal liver, spleen, and kidney dimensions in neonates, infants, and children: evaluation with sonography. *AJR Am J Roentgenol.* 1998 Dec;171(6):1693-8. doi: 10.2214/ajr.171.6.9843315.
14. Chime PE, Oti B, Okenwa WO. The Relationship between Splenic Length and Age in Adult Nigerians. *J Biosci Med.* 2020;8(4):121-7. doi: 10.4236/jbm.2020.84011.
15. Chakraborti S, Saha N, Debbarma B, Das S, Leishram D. Normal Spleen Length by Ultrasonography in Adults of Tripura. 2016 Feb;15:55-60.
16. Ezeofor SN, Obikili EN, Anyanwu GE, Onuh AC, Mgbor SO. Sonographic assessment of the normal limits of the spleen in healthy school children in South-East Nigeria. *Niger J Clin Pract.* 2014;17(4):484-8. doi: 10.4103/1119-3077.134046.
17. Mohtasib RS, et al. Sonographic measurements for spleen size in healthy Saudi children and correlation with body parameters. *Ann Saudi Med.* 2021;41(1):14-23. doi: 10.5144/0256-4947.2021.14.