

## A descriptive study of normal splenic volume among adult population of Gwalior region attending tertiary care hospital

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### Abstract:

**Background:** Accurate assessment of spleen volume (SV) is used in the clinical treatment of patients with various diseases. The Present study was conducted to see the association between splenic volume with age and sex among the adult population.

**Material and methods:** The present cross-sectional study was done on 160 participants with male female ratio 1:1. Mean with 95% Confidence interval (CI) and correlation coefficient were calculated and graphical presentation done using scatter diagram. Independent-t test and one way ANOVA test was performed and significance level consider at 5 %.

**Results:** Average splenic volume among the males ( $163.76 \pm 60.27$  cc) reported significantly higher as compared with females ( $142.76 \pm 50.12$  cc). In the younger age group ( $\leq 30$  years) average volume reported as  $152.88 \pm 42.92$  cc while in age group 31-50 years average volume was  $171.14 \pm 61.77$  cc which is decreased to  $117.86 \pm 37.21$  cc in age group of  $\geq 51$ . Significant difference was observed for the three age groups for mean splenic volume ( $p < 0.05$ ). Overall Age and splenic volume were found to be significantly negatively correlated ( $p < 0.05$ ).

**Conclusion:** The Splenic volume in adult population continues to increase during 20–50 years of age, and then declines thereafter. The Splenic volume significantly correlates with age.

**Key Words:** Age, Correlation, Female, Male, Spleen.

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### I. Introduction:

The spleen is the largest organ in the reticuloendothelial system.<sup>1</sup> It is intraperitoneal organ, situated in the left hypogastric quadrant of the abdomen beneath the 9th to the 11th intercostal spaces. It is a crescent shaped structure, with a convex outer margin, and indented inner margin.<sup>2</sup> The clinical importance of characteristics i.e sizes and volumes of abdominal organs is paramount. The spleen synthesizes antibodies and removes antibody-coated bacteria and antibody-coated blood cells by way of blood and lymph node circulation.<sup>3</sup> Changes in the size and volume of the organs may be related to many diseases. For example, splenomegaly is a well-known manifestation of some diseases that may include the liver, hematopoietic system, and immune system.<sup>4,5</sup> Splenomegaly can result from antigenic stimulation (e.g., infection), obstruction of blood flow (e.g., portal vein obstruction), underlying functional abnormality (e.g., hemolytic anemia), or infiltration (e.g., leukemia or storage disease, such as Gaucher's disease).<sup>6</sup> Splenic atrophy also occurs in adult coeliac disease. The data produced will allow clinician to identify grade of atrophy and hypertrophy of an organ. Accurate assessment of spleen volume (SV) is used in the clinical treatment of patients with these diseases. In order to identify disease activity in various disorders of reticuloendothelial system (RES); splenic size and volume is used as an indicator. Evaluation of splenic size by palpation can be extremely inaccurate; the normal spleen is usually not palpable, till it is enlarged 2 to 3 times its own size. Accurate non-invasive assessment of splenic volume is used in the clinical treatment of patients with various diseases.<sup>7</sup> Ultrasonography affords a useful non-invasive role in evaluating the spleen and used for best advantage, it can demonstrate the existence and composition of splenic masses, disruption of splenic texture or outline, progressive changes in masses and the size of the spleen.<sup>8</sup>

To detect changes in size and volume of an organ, normal anatomical values should be known and a detailed knowledge of age and sex related structural changes in the spleen are prerequisite for comparison while diagnosing a pathological process. There are previously published studies documenting normal Splenic Volume

(SV) andSS (Splenic Size) in adult populations have some limitations like heterogeneous population ,small sample sizes or participants did not have a healthy spleen<sup>9,10,11</sup> Furthermore, there are no studies specifically designed to evaluate special populations, such as adults in specific age group. The aims of this study were to assess and document the splenic volume in asymptomatic adults and thereby serve as a baseline for comparison in cases of splenomegaly using transabdominal sonography. The finding will be compared to what is obtained elsewhere.

**Objective:**

- 1) To measure the splenic volume of adults and compare the age and sex variation among them .
- 2) To find the correlation between splenic volume of males and females of different age groups.

**II. Material and Methods:**

Present cross-sectional study was performed at the Department of Radiodiagnosis, Gajra Raja Medical College Gwalior, between December 2017 to December 2018.Total 160 participants were included in the study, and written informed consent was taken for each case. Ethical approval was obtained from institutional ethical committee.

Study participants were volunteers who were otherwise attending the radiology department for ultrasound for reasons unrelated to spleen; they were screened by interview questionnaire to exclude any previous or current condition that might affect the size of spleen.Exclusion criteria used were clinical or laboratory evidence of infection (subjects who had fever either at the time of the examination or within at least 4 weeks prior to the examination), b) hematopoietic diseases, c) genetic diseases (thalassemia and sickle cell anemia), d) lymphadenopathy, e) liver diseases (cirrhosis or portal hypertension), f) renal failure, g) history of splenic trauma, h) non-traumatic benign splenic lesions (infarctions, lobulations, cysts, accessory spleen, and hemangioma), i) malignant lesions, and j) pregnancy.

All ultrasound examinations were performed by senior radiologists and data collected by the authors.The subjects were placed and examined in the supine and/or right posterior oblique positions, and the spleen was scanned during suspended respiration.

**Splenic Volume** was calculated with the following standard ellipsoid formula as = (0.524 x Width x Length x Thickness).<sup>12</sup>

Means, Standard deviation (SD), Standard error (SE) was calculated. Statistical test like independent t test, one way ANOVA and Pearson’s correlation coefficient was calculated and p value were calculated at 5 % level of significance.Data entry were done in Microsoft excel software and analysis were performed on the SPSS-16 software.

**Ethical Clearance:**Ethical clearance was obtained from institutional ethical committee. Informed consent was obtained from each participant at the time of data collection.

**III. Results:**

Total 160 participants were included in the study with males and females in equal proportion i.e.80-80 in numbers. Average age of the patients were 40.98±12.53 years and average volume was 153.26±56.25 cc.Male participant’s average age was 41.29-12.71 years while females participants had average age of 40.67±12.41 years with range 21.0-60.0 years, both in males and females.

Average volume among the males (163.76±60.27 cc) reported significantly higher as compared with females (142.76±50.12 cc).In the younger age group (≤30 years) average volume reported as 152.88±42.92 cc while in age group 31-50 years average volume was 171.14±61.77 cc which is decreased to 117.86±37.21 cc in age group of ≥51.Significant difference was observed for the three age groups for mean splenic volume (p<0.05). (Table1)

**Table1:** Comparison of splenic volume in sex and age -group

Independent Variables		Number (N)	Volume (Mean ± SD)	95% CI of mean	Max-min	P value
Gender	Female	80	142.76±50.12	131.61-153.91	277.86-47.41	t=-2.396 p=0.018
	Male	80	163.76±60.27	150.34-177.16	329.10-36.45	
Age Group	≤30	40	152.88±42.92	139.16-166.61	51.62-234.10	F=13.91, P=0.00001
	31-50	80	171.14±61.77	157.40-184.89	36.45-329.10	
	≥51	40	117.86±37.21	105.96-129.76	43.46-203.63	

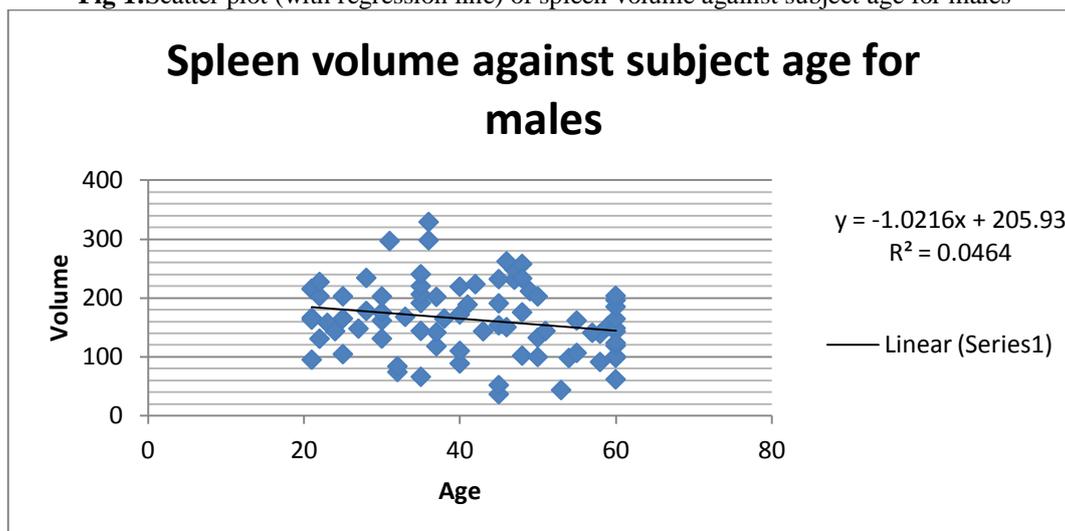
Pearson's correlation coefficient between splenic volume and age showed a very weak negative relationship ( $p < 0.05$ ), separately among males and females weak negative correlation exist though it was not a statistically significant correlation ( $p > 0.05$ ). (Table2, Fig1, 2, 3)

**Table 2:** Correlation table of splenic volume for with Age

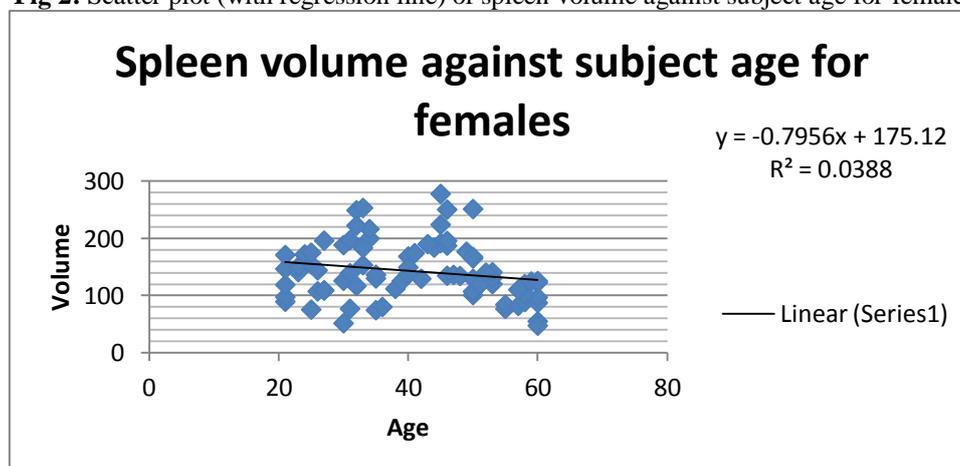
Age	Volume					
	Female		Male		Total	
	R	P	R	p	r	p
	-0.197	0.080	-0.216	0.055	-0.198	0.012*

\*Correlation is significant at the 0.05 level (2-tailed).

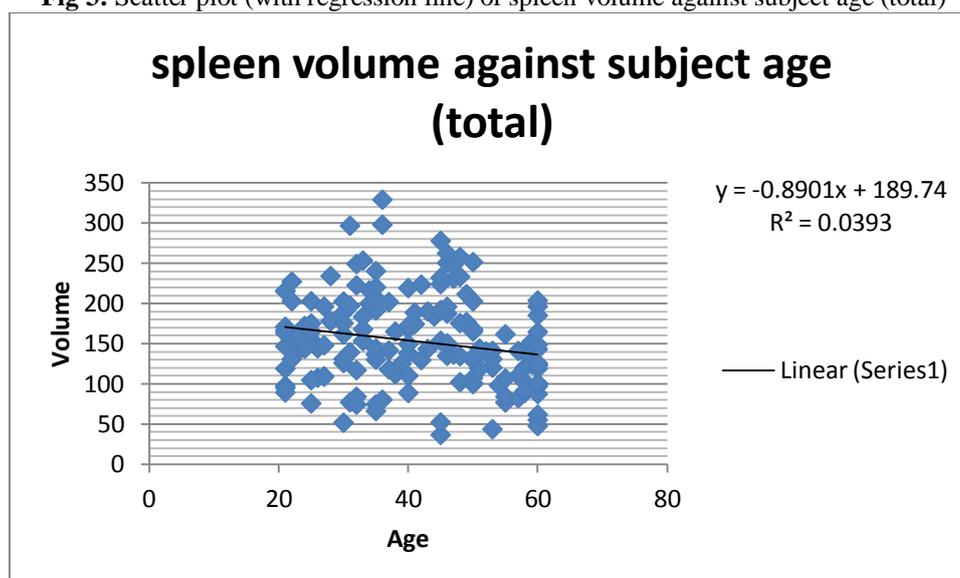
**Fig 1:** Scatter plot (with regression line) of spleen volume against subject age for males



**Fig 2:** Scatter plot (with regression line) of spleen volume against subject age for females

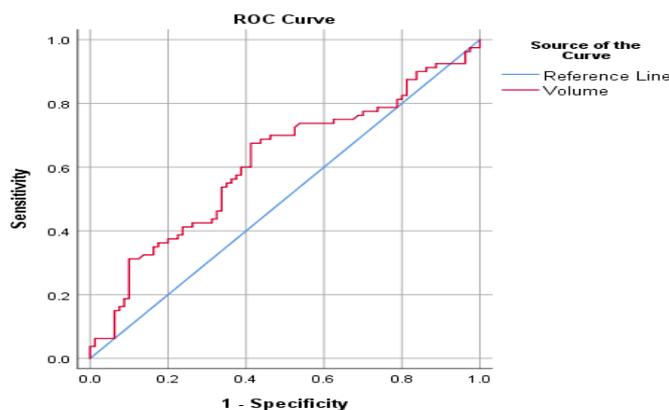


**Fig 3:** Scatter plot (with regression line) of spleen volume against subject age (total)



Roc curve analysis showed Cut-off for volume among males is 141.31 cc with sensitivity 0.675 and specificity 0.588; Youden index =0.263(=sensitivity+specificity-1).Area under curve using receiver operation characteristic (ROC) curve was 0.613 (p=0.012) with standard error 0.045 and 95% CI: 0.525-0.701 for volume among males.

**Fig 4:** ROC curve for volume



#### IV. Discussion:

Present study was conducted with the aim to measure the variations in splenic volume according to age and sex by ultrasonography and to find out possible correlations with the age and gender distribution with the splenic volume. In our study ; Splenic volume was also greater in males than in female and the difference was statistically significant ( $p < 0.05$ ). Our study findings were in accordance with the study done by Kanakraj K et al.<sup>13</sup> where the mean values of volume were 137.8cc in females and 180.8cc in males respectively. In the study done by Ehimwenma and Tagbo<sup>8</sup> the mean splenic volume for male were 202.7 cc, and for the females it was 153.7 cc .In our study it was also observed that, there was overall decrease in the splenic volume in advanced age group, which was found to be statistically significant and comparable with Arora N et al. <sup>14</sup> Our study found that there was a negative correlation between age of subjects and volume; similar findings was also reported by Tekle et al. <sup>12</sup> This wide range of splenic volume and dimensions in different populations was due to genetic, racial & environmental factors of different populations of different regions. The splenic volume in different age groups of males and females increased first, then finally decreased in advanced age group. The present study was an attempt to determine the normal range of the spleen volume which correlated variably with different age in groups. So, our study had provided anthropometric parameter of spleen volume by ultrasonography which will be useful for reference value of spleen dimensions and volume in Gwalior region.

## V. Conclusion:

The study shows that in both males and females' splenic volume first increased slightly and finally decreased at older age group. It was found that the splenic volume was greater in males than in females in the each age group. Normal splenic volume thus obtained can be used as reference value to the radiologists, surgeons and clinicians for splenic diseases in Gwalior region.

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**Conflict of interest:** Nil

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