

Original article:

Estimation of standard splenic index (SI) in Indian population: A CT scan based study

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Abstract:

Introduction: Splenic index (SI) is commonly used tool to assess the splenic size by the radiologist specially. Though it is the crude indicator for assessment but advantageous because it is the easy, simple and rapid method of evaluation.

Methods: Current study was done to know the normal range of SI in Indian population which is lacking till date. CT scans data of normal adult were collected by ruling out any disorder affecting spleen. With the help of 3-D doctor software was used to calculate the SI. The SI was correlated with physical parameters of person with help of statistical software.

Results: one hundred twenty-six subjects were selected for study after confirming that there was no evidence of disease which could alter the size of spleen. The mean SI observed was $494.82 \pm 226.83 \text{ cm}^3$ without any sexual variation. It has positive correlation with height, body surface area but negative with age.

Conclusion: Value of splenic index (SI) is high normal in comparison with developed nation may be due to endemic of parasitic and bacterial infection.

Key words: splenic index, CT-scan, splenomegaly, height, age.

Introduction: Splenic index (SI) is a research tool and used as an indicator in malaria surveillances. It is also used for calculating splenic volume by many authors. The SI is a volumetric index calculated by multiplication length x width x thickness. [1, 2, 3] There are many modes of investigation to identify the spleen e.g.—plane radiograph, sonography, computed tomography, MRI and radionuclide scan. Out of these modalities sonography and computed tomography are most reliable for intra-abdominal organs.[4] Various studies were done by sonography to study the linear dimension of spleen—length, width, and thickness. Unfortunately, dimensions determined by 2-D USG and X-ray are limited

predominantly by the variable, irregular contour of spleen and difficulty in completely scanning the entire organ or visualizing complete contours due to the presence of overlying structures such as bone, bowel gas or kidney.[5] CT imaging is more accurate than ultrasonography and X-ray because this drawback doesn't occur with computed tomography.[6, 7] The SI is used as indicator for immunity against malaria and even in case of filarial infection. Population having high SI is immune to these parasitic infections. To calculate the normal standard splenic index is difficult in Indian population due to endemic zone of malaria and filaria which alter the size of spleen.

TABLE-1: Physical standard of patients.

SEX	PHYSICAL STANDARD OF PATIENTS					
	AGE(YRS.)	WEIGHT (KG.)	HEIGHT (CM)	BODY SURFACE AREA(M ²)	BODY MASS INDEX	NUMBERS OF PATIENTS
MALE	51.33±18.82	65.4±9.9	165.45±4.4	1.72±0.13	24±3.22	72
FEMALE	49±12.18	55.22±4.38	155.4±4.3	1.56±0.035	23.12±1.43	54
TOTAL	NO SIGNIFICANT DIFFERENCE (P>0.05)					126

Our study was aimed to give CT-based SI in North Indian adult population which was missing till date and to generate the normative data. We had tried here to observe the correlation of the SI with body habitus. **Material and Methods:** CT scans of 126 patients (72 male and 54 female) were used to measure the splenic index. The age of patients ranged from 20 to

70 yrs (50.33±18.9yrs) (Table-I). The data was collected from December 2006 to April 2007 with permission of Department of Radio-diagnosis and informed consent taken from each patient. CT scan data was obtained for various clinical indications and follow-up of abdominal trauma, abdominal pain and to exclude an abdominal mass or adenopathy.

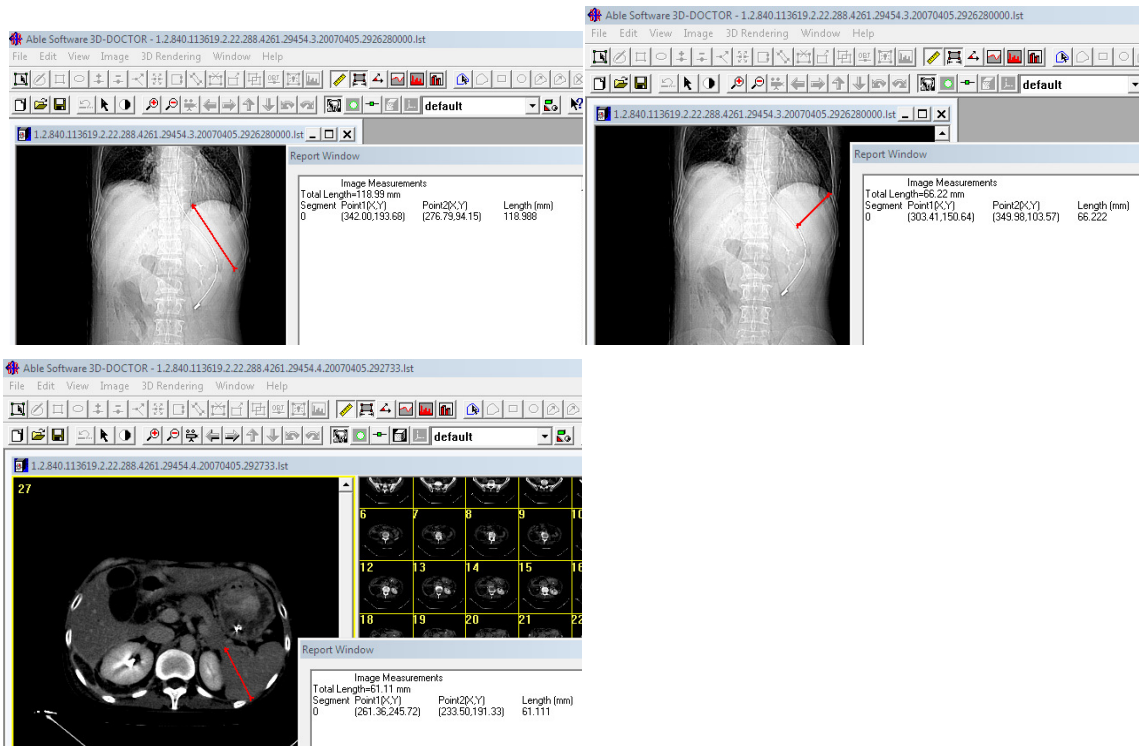


Figure I-III: Measurement of length (cephalo-caudal), Width and Thickness with the help of 3-D doctor Software.

The patient's body weight and height at or near the time of the CT examination were recorded. Spleen axial and cross sectional image were obtained a CT Helical instrument. The technical parameters were 120 kv potential, 120 mA current, 10mm slice width with identical reconstruction index and a rotation time of 1.5 secs. The medical records of all patients were reviewed. Patients whose spleens appeared abnormal on CT scans were excluded. Additionally, any patients who had clinical, biochemical or imaging evidence of conditions that could affect the size of the spleen, hematological disorders, abdominal malignancies, infection and portal hypertension, splenic trauma, cyst, and auto-immune diseases were excluded from the study.

CT-scan dicom images of each patient were opened in Able-3D-doctor software. Spleen was identified in each cross section and longitudinal section of CT-scan images. The length of spleen was recorded in longitudinal section along 10th rib in cephalo-caudal direction (figure-1). Width of spleen was also recorded in longitudinal direction (figure-2) but thickness was measured in cross-section image (figure 3). Maximum dimension appreciated in sections were recorded for better accuracy.

Statistical analysis:

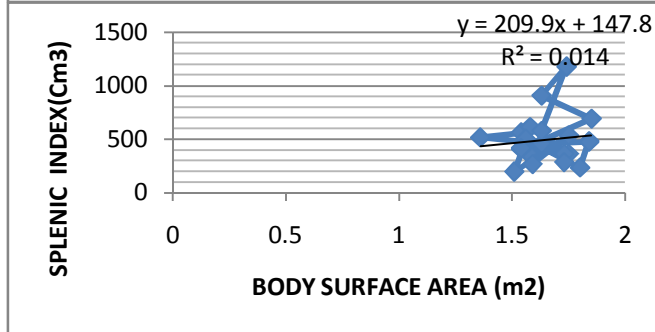
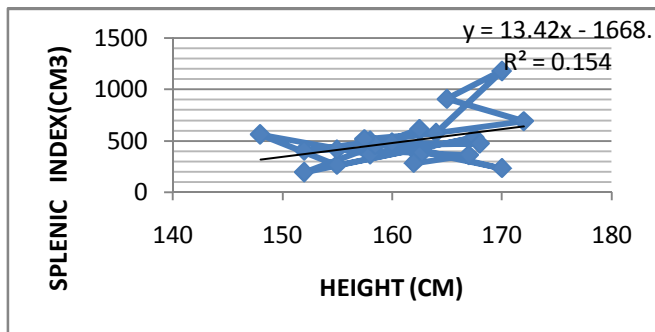
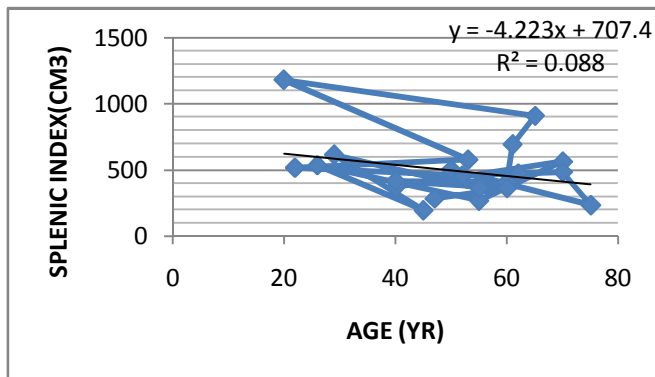
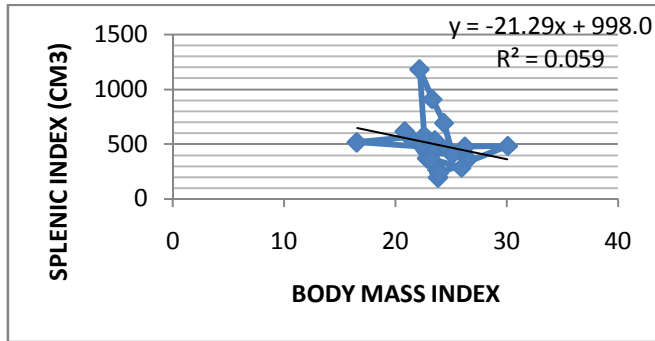
All statistics were generated by SPSS version 10. The student T-test was used for comparison of means. $P < 0.05$ was considered significant for comparison of means and for regression analysis. Association between splenic index and physical standards of patients was assessed with the Pearson correlation coefficient; to identify the exact pattern of relationship, non-linear regression as well as linear regression was applied. Multiple regression analysis was applied in backward stepwise fashion to test the independent effect of all physical standards on splenic parameters.

Results and discussion: The average ages of male and female patients were 51.33 ± 18.82 years and 49 ± 12.18 years respectively. Mean weight and height in male and female were 65.4 ± 9.9 kg, 165.45 ± 4.4 cm and 55.22 ± 4.38 kg and 155.4 ± 4.3 cm respectively. No significant difference of physical standards found in both sexes (Table-I). The mean SI observed was $494.82 \pm 226.83 \text{ cm}^3$. On the basis of statistical analysis, we found that the association of splenic index with height, body surface area was positive but association with age, weight and body mass index was negative but none has achieved the level of significance ($p < 0.05$) (Graph I-IV). The SI did not show significant sexual difference though female had lesser value (male $525.31 \pm 285.35 \text{ cm}^3$ and female $454 \pm 115.84 \text{ cm}^3$, $p < 0.4$).

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Is now with IC Value 5.09

Graph I-IV: correlation of splenic index with age, Height, Body Mass Index, Body surface area



Calculation of the SI with CT by multiplying spleen length, width and thickness is a simple and rapid procedure for defining splenic size in vivo. The SI is a needful tool to assess splenomegaly. Before deciding the splenomegaly, it is necessary to know normal value of splenic index in scenario of Indian sub-continent which is an endemic zone of malaria, filarial etc.

Strijk et. al. (1987) had measured the SI which was ranged from 342 to 454 (mean value 449) on European population. [8] Jong et.al. (2008) found a weak but significant negative correlation between CT measurements and age (splenic index, -0.30; splenic volume, -0.30; maximal splenic dimension, -0.30; all $p < 0.01$). The mean value of SI, splenic volume, and maximal splenic dimension were 395 ± 163 cm³; 259 ± 95 cm³; 10.2 ± 1.7 cm respectively. [9] Therefore they defined the upper limit of normal for splenic

index as 725 cm³; splenic volume, 450 cm³; and maximal splenic dimension, 13.5 cm. L Grissom (1998) calculated and adjusted his upper normal value was 425-450 cu cm. Shintr (1998) calculated the SI by multiplying the greatest AP, transverse and length measurements of the spleen. This is usually by CT measurements although MRI or US could also be used. Normal value of SI is around 480 cu cm. [10]

So, we find that splenic index of Indian adult population lies near upper limit of range of splenic index of European and American population. It may be due to endemics of malaria, filaria and presence of chronic infections. Splenic index has negative correlation with age.

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