

STUDY OF SPLEEN LENGTH IN RELATION TO WEIGHT IN NORTH-EAST KARNATAKA CHILDREN BY ULTRASONOGRAPHY

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ABSTRACT

Background: Spleen length vary with age. Various diseases can affect their size. Palpation and percussion are standard bedside techniques to document but are far from accurate to detect small increases in size. Anthropometric variations are found in different populations, races and regions. Sonography is effective for imaging soft tissues of body. Ultrasound is an extremely important imaging method in evaluation of spleen length in children due to the fact that it is easy to use, non invasive, safe, quick and accurate. In present study, aim is to evaluate correlation of spleen length with age and weight in female children.

Objective: To know whether there is any correlation between the normal spleen length with age and weight in female children.

Materials and methods: The present study is cross-sectional in nature and conducted in Government Medical College and District Hospital, Bidar. Sample size of 260 cases were taken between the age group of 1 to 17 years, (infancy to middle adolescence period) living in North-east part of Karnataka. Baseline data including the age, sex and weight were recorded for all the children in a structured performa. All the children underwent an ultrasonographic assessment of the spleen length by using a Philips HDI 4000, 200-240V -5A, 50/60HZ system. Observations obtained in respect with all the variables were tabulated and shown by using Scatter plots. The findings was then statistically analysed and "p" value determined.

Results: The mean spleen length is lesser in females in all age groups and it increases in older children in the age group of 10-13yrs and 14-17 yrs among females. Spleen length highly correlated with age and weight in female children.

Conclusion: The methods of measurement and analysis used in this study is standardized and easy to apply. The results of this study can be used in radiology and pediatric departments as a practical and comprehensive guide to indicate the normal spleen length range for every child, according to her age and body habitus.

KEY WORDS: Spleen length, Ultrasonography, Age, Female, Weight.

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Access this Article online	Journal Information	
Quick Response code  DOI: 10.16965/ijar.2019.258	International Journal of Anatomy and Research ICV for 2016 90.30 ISSN (E) 2321-4287 ISSN (P) 2321-8967 https://www.ijmhr.org/ijar.htm DOI-Prefix: https://dx.doi.org/10.16965/ijar	
	Article Information Received: 20 Jun 2019 Peer Review: 21 Jun 2019 Revised: None	
	Accepted: 05 Aug 2019 Published (O): 05 Sep 2019 Published (P): 05 Sep 2019	

INTRODUCTION

Spleen is highly vascular, friable, and elastic, moving with respiration and not essential to life, possesses only efferent lymphatic vessels. The spleen is part of the lymphatic system. Blood supply is by both short gastric arteries and the splenic artery. The red pulp filters red blood cells and white pulp causes active immune response and cell mediated pathway. Other functions are – Production of opsonins, properdin, and tuftsin. Creation of red blood cells.

Spleen has important haematopoietic functions until fifth month of gestation. Storage of red blood cells, lymphocytes and other formed elements. Splenomegaly is enlargement of spleen. The spleen has to be two and half times its normal size to become palpable, therefore an enlarged spleen is not always palpable. Splenomegaly is caused by septicaemia, malaria, kala-azar, CCF, cirrhosis, sarcoidosis, leukemias, lymphoma, Gaucher's disease, metastasis, secondaries, arsenic and phosphorus poisoning. Splenomegaly is of great concern.

MATERIALS AND METHODS

This is a cross-sectional study conducted in Government Medical College and District Hospital, Bidar. Before starting the study, prior permission of Professor and Head of Department, Anatomy and Department of Radiology faculties was taken. Approval of ethical committee was taken before starting the study.

Sample size of 260 cases was taken between the age group of 1 to 17 years, infancy to middle adolescence period living in North-east part of Karnataka. This age group was selected since there is increase in longitudinal dimensions of organs rapidly during first year of life and puberty along with body growth.

These children came to our hospital as outpatients for either a follow up examination or a routine check up with conditions such as mild upper respiratory tract or urinary tract infections, while the check up concerned routine cases with atypical recurrent abdominal pain.

Any child under evaluation for/follow-up case of a condition which could affect the spleen length was not included in the study. It was ensured by detailed structured parental

history, examination and medical record review (if available) that these children did not have any pre-existing suspected inflammatory, metabolic, traumatic, collagen or hematopoietic diseases and malignancies, that could affect spleen length. Informed and verbal consent was obtained from the accompanying guardians/parents of all children, and verbal consent taken from all children older than 5 year. Baseline data including the age, sex and weight were recorded for all the children in a structured proforma. The age was recorded to the nearest completed month. An manual weighing scale (accuracy 50 g) was used to measure the weight (kg) and height (cm), as per standard methodology¹. In each child, the mid clavicular line was defined and all as well as sonographic measurements were done with reference to midclavicular line [1].

All the children underwent an ultrasonographic assessment of spleen length by using a Philips HDI 4000 200-240V -5A,50/60HZ system. The measurement of spleen length was the optically maximal distance at the hilum on longitudinal coronal view (between the most supero-medial and the infero-lateral points) as the spleen length at the hilum is considered the most reproducible linear measurement² in supine or right lateral decubitus position. The measurements were made during quiet breathing in younger children and during breath-holding in older children. Neither preparation nor sedation was used.

All measured spleen had a normal position shape and texture. Three sequential measurements were obtained and calculated mean, thus assured minimum intraoperator variation and greater accuracy and reliability of measurements. Observations obtained in respect with the variables was tabulated and shown by using Scatter plots. The findings was then statistically analysed and "p" value determined. Statistical significance is mentioned below each table.

OBSERVATIONS AND RESULTS

This cross-sectional study is done among 260 cases, where in 149 are female children, that is 57.3% are female children.

Female Statistics: n = 149

Table 1: Mean, SD, and median for different parameters among female children.

Parameter	Mean	SD	Median
Age (yrs)	10.7	4.3	11
Weight (kg)	29.7	12.2	29
Spleen length (cm)	8	1.1	8.8

In females, mean age= 10.7, mean weight=29.7, mean spleen length = 8, SD = 1.1, median = 8.8. The following observations and results show that mean weight and mean spleen length has no significance difference among female children. This may be due to difference in body composition and habitus of females.

The sample size of 260 cases were divided into 4 age groups : 1-5 yrs (pre-school age), 6-9 yrs (school age), 10-13 yrs(early adolescence age) and 14-17 yrs(middle adolescence) respectively. In each age group, number of female children was calculated.

In 1-5 yrs, Female children = 21

In 6-9 yrs, Female children = 29

In 10-13 yrs, Female children = 54

In 14-17 yrs, Female children = 45

In all the age groups, the number of female children is greater and the number of female children in 10-13 yrs (early adolescence) is greater than in any other age groups. This may be due to the poor general conditions of females particularly in the early adolescence period for which they visit the hospital.

Table 2: Mean spleen length of female children in different age groups.

Female	
Age Group (yrs)	Spleen length(cm)
1-5	7.1 ± 0.67
6-9	7.8 ± 0.83
10-13	7.8 ± 1.26
14-17	8.6 ± 0.97

Anova test was applied for determining if Spleen length varies significantly across above age groups:

The test shows that spleen length between the 4 age groups that is defined in the Table 2 were highly significant. The significance level used for the test was 0.05.

Spleen - (Analysis of variance, $F = 25.8$; $df = 3, 256$; $P < 0.001$)

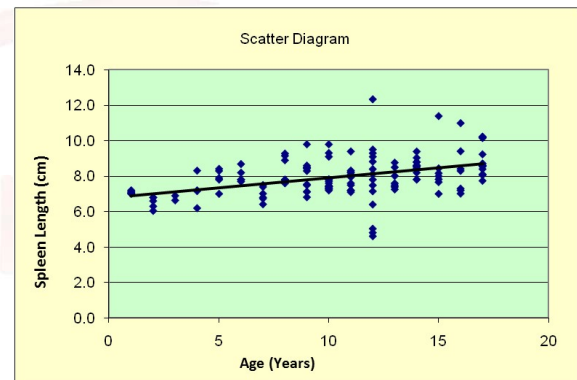
The mean spleen length increased in older female children in age group 10-13 and 14-17

yrs. General body growth is rapid during 1-2 yrs and puberty. In the intervening period of mid childhood, the somatic growth velocity is relatively slowed down.

Spleen length highly correlated with each of the two variables: age and height. The correlation was calculated for each of the variables differently for female children and the scatter plots for the same can be seen below. The correlation observed was all similar in magnitude and highly significant ($P < 0.0001$). The pattern of the relationship between variables is explored using simple linear regression analysis.

Spleen size (length) in relation to age and weight

1. Spleen length to age

Fig. 1: scatter plot of spleen size (length) against age shows simple linear correlation in female children.**Table 3:** Mean spleen length different age groups in female children.

Female	
Age group (yrs)	Spleen length (cm)
1-5	7.1 ± 0.67
6-9	7.8 ± 0.83
10-13	7.8 ± 1.26
14-17	8.6 ± 0.97

The observation shows that spleen length increases with age. $r = 0.44$, $p < 0.0001$

2. Spleen length to weight

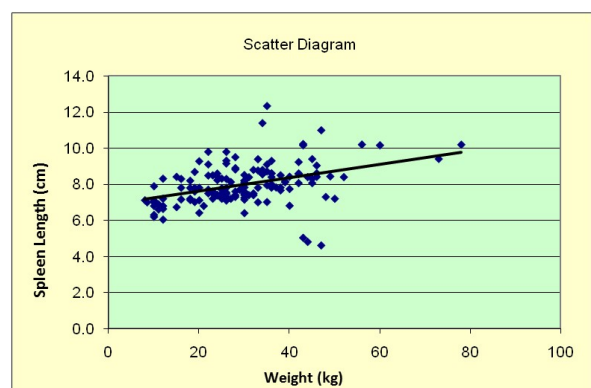
Fig. 2: Scatter plot of spleen size (length) against weight shows simple linear correlation in female children.

Table 4: Mean spleen length and weight in different age groups in female children

Female		
Age Group (yrs)	Weight(kg)	Spleen length(cm)
1-5	11.88 ± 2.75	7.1 ± 0.67
6-9	22.62 ± 4.76	7.8 ± 0.83
10-13	30.31 ± 6.33	7.8 ± 1.26
14-17	42.11 ± 9.99	8.6 ± 0.97

The observation shows that spleen length increases with weight. $r = 0.41$, $p < 0.0001$

DISCUSSION

With the observations of other studies, findings of present study are compared. There have been quite a few previous reports giving the standard size of spleen by ultrasound in children, but none has been done in North-east Karnataka population. Our results are comparable to these studies.

In the study done by Konus [3], 307 pediatric subjects were involved. The subjects were 5 days to 16 years old children. At least two dimensions were obtained for spleen. Relationships of the dimensions of the organ with sex, age and body weight were investigated. No statistically significant differences were found between the two sexes in any age group for any measured organ dimension.

In the present study, the mean spleen length between the 4 age groups is highly significant. The significance level used for the test was 0.05. Female children had lesser mean spleen length in all age groups. Konus [3] found that longitudinal dimensions of spleen length correlated with age and weight in female children. Similarly, in the present study, spleen length highly correlated with age, weight in females.

In the study done by S D Megremis [4], 512 Greek children on the island of Crete were examined. Megremis found in the age range of 1 day (full-term neonate) to 17 years; the Analysis Differences between the 11 age groups were highly significant (analysis of variance, $F = 177.17$; $df = 10, 443$; $P < .001$): older children had longer mean spleen length. Spleen length increased with age in female children.

In the present study, ANOVA test shows that spleen length between the 4 age groups is highly

significant. The significance level used for the test was 0.05. For spleen - (Analysis of variance, $F = 25.8$; $df = 3, 256$; $P < 0.0001$). The mean spleen length increased with age in female children. In study done by Megremis [4], spleen length highly correlated with age and weight and highly significant ($P < .001$) in female Greek children. Similarly, in the present study, age and weight showed significant correlation with spleen length in female North-east Karnataka children. ($p < 0.0001$).

In the study done by Safak [5], 712 school-aged children in the age group from 7 to 15 years were screened in Turkey. Safak found longitudinal dimension of spleen showed weakest correlations with age in female children ($p < 0.001$). In the present study, age showed significant correlation with spleen length in female children ($p < 0.0001$). Safak found that weight showed best significant correlation with spleen length in female children ($p < 0.001$).

In the present study, weight showed significant correlation with spleen length in female children ($p < 0.0001$).

In females, for, Spleen length, $p < 0.10$

In the study done by Bhavna Dhingra [6], in 597 healthy children between the ages of 1 month to 12 years, the mean (SD) splenic length is 6.99 (1.36) cm (females, 6.88cm). In present study, among 260 cases, 149 were female children and 111 were male children. In females, mean spleen length is 8, SD = 1.1 and median is 8.8.

Table 5: Comparison of mean spleen length.

Mean Spleen length(cm)	
Authors	Females
Bhavna Dhingara (1 mnth to 12 yrs)	6.88
Present study (1 to 17 yrs)	8

In the study done by Bhavna Dhingra [6] in North Indian children, mean spleen length values are higher in North-east Karnataka children when compared to North Indian children. Bhavna Dhingara [6] showed that the mean spleen length increased with age and significantly correlated with age and weight in female children in North Indian children. Similarly, that the mean spleen length increased with age and

significantly correlated with age and weight in female children in North-east Karnataka children. In addition to size, there are several palpatory characteristics of the spleen (tenderness, liver edge, nodularity and consistency of the surface, etc.) that contribute significantly to the overall bedside assessment of the organomegaly.

The bedside assessment of splenic enlargement will not obviate diagnostic imaging when such information is vital to further therapeutic management of the patient. We believe that the results of this study can be used as a practical and comprehensive guide to indicate the normal spleen length range for every child, according to his/her age and body habitus.

Conflicts of Interests: None

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How to cite this article:

Usha. C, Surya kumari. N, Subhashini Rani. STUDY OF SPLEEN LENGTH IN RELATION TO WEIGHT IN NORTH-EAST KARNATAKA CHILDREN BY ULTRASONOGRAPHY. Int J Anat Res 2019;7(3.3):6924-6928. DOI: 10.16965/ijar.2019.258