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Original research article

A cross-sectional study to ascertain the proportion of spleen size to the height of individual

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Abstract

Background: The size of spleen varies with age and many diseases which vary from infections to malignancy. Variations are also seen in anthropometric features across. Various populations, sex, races and regions. Ultrasonography is an important technique used to measure these variations as it is non-invasive easy to use safe quick and most accurate. An attempt has been made to provide an insight into these anthropometric variations in the population of North-East Karnataka of age groups 1-17 yrs.

Objective:

1. To evaluate normal spleen size in 1 to 17 years male and female children.
2. To know about correlation of normal spleen size with parameters such as age and height in children.
3. To compare our study with same study done in other states of India and other countries.

Materials and Methods: A cross-sectional study was done in Government Medical College and District Hospital, Bidar, Karnataka. Sample size of 260 cases was taken between the age group of 1 to17 years. All children data including age and height were recorded.Ultrasonographic assessment of the spleen size was done using Philips HDI 4000, 200-240V-5A, 50/60HZ system in all children. Observations obtained was tabulated and findings was statistically analysed and"p"value determined.

Results: The mean height is greater in males. It was observed that mean spleen size is greater in males in all age groups and it increases in older children in the age group of 10-13yrs and 14-17 yrs among males. In both male and female children it was seen that spleen size highly correlated with height.

Conclusion: A standardized method of measurement and analysis is used in this study which can be applied easily. Findings are helpful for radiology and pediatric departments. The results of this study can be used as a practical and comprehensive guide to indicate the normal spleen size range for every child, according to his/her age and body habitus.

Keywords: Age, female, height, male, spleen size, ultrasonography

Introduction

Spleen, a haemo-lymph organ part of the RES lying in the left hypochondrium and partly in the epigastrium. It is flattened, measuring around 12cms in length and 7 cms in breadth and 3cms in thickness, weighing around 150 gms.

Spleen in foetal life manufactures erythrocytes and after birth it manufactures lymphocytes. It filters blood by taking out dead or abnormal erythrocytes and microbial antigens. It also acts as a repository for mononuclear phagocytic macrophages and lymphoid cells.

Materials and Methods

This cross-sectional study was conducted in Government Medical College and District Hospital, Bidar October 2011 to November 2013. Before starting the study, prior permission of Professor,HOD, Department of Anatomy and Radiology was taken and once approval of ethical committee, sample size of 260 cases was taken between the age group of 1 to 17 years, in North-east part of Karnataka.

These children were examined when they came to hospital as outpatients for a routine checkup or follow up examination. Children with any condition affecting the size of the spleen wasnot includedinthestudy.

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Informed and verbal consent was obtained fromtheguardians/parentsof all children, as well verbal consent taken from all children olderthan5 year. Data about age, sex, height were recorded for all the children, age was recorded to the nearest completed month.A wall mountedstadiometer(1 mm markings) were usedto measuretheheight (cm), as per standardmethodology[1].
In each child, the mid clavicular line was defined and all sonographic measurements were done with reference tomidclavicular line[1].

Ultrasonographic evaluation
An ultrasonographic assessment of the spleen size was done by using a Philips HDI 4000 200-240V-5A,50/60HZ system in all children. The measurementofspleensizewastheopticallymaximaldistanceatthehilumonlongitudinal coronalview(betweenthemostsupero-medialandtheinfero-lateral points)asthespleenlengthatthehilumisconsideredthemostreproduciblelinearmeasurement[2]insupineorrightlateral decubitus position. Themeasurements were made duringquiet breathing in younger children and during breath-holding in older children. Neither preparation nor sedation was done.

Statistical analysis
All measured spleen had a normal position, texture and shape. Three sequential measurements were obtained and the mean was calculated, thusassuredminimum variation andgreateraccuracyandreliability ofmeasurements.Observations obtained with all the variables was tabulated. Statistical analysis was doneand“p”value determined.Statistical significance is mentioned below each table.

Observations and Results
This cross-sectional study included 260 cases, in which 149 are female children and 111 are male children (57.3% are female and 42.7% are male 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
Height (cm)	128.3	26.5	134
Spleen length (cm)	8	1.1	8.8

In females,mean age= 10.7, mean height =128.3.
Mean spleen length = 8, SD = 1.1, median = 8.8.
Male Statistics: n = 111.

Table 2: Mean, SD, and median for different parameters among male children

Parameter	Mean	SD	Median
Age (yrs)	10.9	4.4	12
Height (cm)	132.2	28.5	140.2
Spleen length(cm)	8.8	1.4	8.1

In males,mean age= 10.9, mean height = 132.2.
Mean spleen length = 8.8, SD = 1.4, median = 8.1.

The observations and results showed that mean height is greater in male children. There is no significant difference in results of mean spleen length between the female and male children.
The sample size was divided into four groups respectively. In each age group, number of female and male children was calculated and observations are represented in the above bar diagram:
In 1-5 yrs (pre-school age),Female children = 21, male children = 14.
In 6-9 yrs (school age),Female children = 29, male children = 25.
In 10-13 yrs (early adolescence age),Female children = 54, male children = 34.
In 14-17 yrs (middle adolescence age),Female children = 45, male children = 38.

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

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Table 3: Mean spleen length among male and female children in different age groups

	Female	Male
Age Group (yrs)	**Spleen length(cm)**	**Spleen length(cm)**
1-5	7.1 ± 0.67	6.6 ± 0.63
6-9	7.8 ± 0.83	7.8 ± 0.8
10-13	7.8 ± 1.26	8.0 ± 1.37
14-17	8.6 ± 0.97	9.1 ± 1.52

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 were highly significant, that is defined in the Table 3. The significance level used for the test was 0.05.

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

In all age groups mean spleen length was greater in males and it is increased in older children in 10-13 and 14-17 yrs among both male and female children. 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 and this is more in males.

Spleen length correlated with each of the variables: age and height. The correlation was calculated for each of the variables differently for both male and female children. The correlation observed was similar in magnitude and highly significant (P < 0.0001).The pattern of the relationship between variables is explored using simple linear regression analysis.

Co-relation and simple regression analysisin female children

Spleen size (length) in relation to age and height.

1. Spleen length to age

Table 4: Mean spleen length in 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 height

Table 5: Mean spleen length and height in different age groups in female children

	Female	
Age Group(yrs)	**Height(cm)**	**Spleen length(cm)**
1-5	79.2 ± 19.83	7.1 ± 0.67
6-9	118.32 ± 15.75	7.8 ± 0.83
10-13	136.24 ± 9.55	7.8 ± 1.26
14-17	148.38 ± 14.63	8.6 ± 0.97

The observation shows that spleen length increases with height.r = 0.47, p < 0.0001.

Co-relation and simple regression analysisin male children

Spleen size (length) in relation to age and height.

1. Spleen length to age

Table 6: Mean spleen length in different age groups in male children

Male	
Age group(yrs)	**Spleen length(cm)**
1-5	6.6 ± 0.63
6-9	7.8 ± 0.8
10-13	8.0 ± 1.37
14-17	9.1 ± 1.52

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The observation shows that spleen length increases with age. r = 0.5, p < 0.0001.

2. Spleen length to height

Table7: Mean spleen length and height in different age groups in male children

	Male	
Age Group(yrs)	**Height(cm)**	**Spleen length(cm)**
1-5	79 ± 20.16	6.6 ± 0.63
6-9	117.78 ± 19.85	7.8 ± 0.8
10-13	138.03 ± 8.52	8.0 ± 1.37
14-17	156.11 ± 10.97	9.1 ± 1.52

The observation shows that spleen length increases with height. r = 0.57, p < 0.0001.

Discussion

The observations of the present study are compared here along with the available literature from past.

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 these organs with sex, age and height were investigated. No statistically significant differences were found between the two sexes in any age group forany measured organ dimension. In the present study, it showed that the mean spleen length between the 4 age groups is highly significant and the significance level used for the test was 0.05. Mean spleen length was larger in male children in all age groups.

Konus[3] found that among the body parameters, height correlated best with the longitudinal dimension of each organ in male Turkish children. Similarly, in the present study, it was observed that height significantly correlated with spleen length in male children of North-east Karnataka.

In the study done by SD Megremis[4], 512Greek children on the island of Crete were examined. Megremis found in theage range of 1 day (full-term neonate) to17 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 male children.

In the present study, ANOVA test shows that spleen length among 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 is greater in males in all age groups and it increased with age in male children.

In study done by Megremis[4], spleen length highly correlated with age and height and highly significant (P < .001) in male Greek children. Similarly, in the present study age and height showed significant correlation with spleen length in male 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 the spleen showed weakest correlations with age and height in male children (p< 0.001). In the present study, age and height significantly correlated with spleen length in male children. (P< 0.000)

In males,For,Spleen length, p<0.19.

In the study done by Bhavana 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 (males, 7.06cm). In present study, among 260 cases, 111 were male children and in males, mean spleen length is 8.8, SD = 1.4 and median is 8.1.

Table 8: Comparison of mean spleen length

Mean Spleen length(cm)	
Authors	Male
Bhavana Dhingara (1 mnth to 12 yrs)	7.06
Presentstudy (1 to 17 yrs)	8.8

In the study done by Bhavana Dhingra[6]in North Indian children, males had larger mean spleen length. Similarly, in the present study, it was observed that the mean spleen length was larger in males but the values are higher in North-east Karnataka children when compared to North Indian children.

Bhavana Dhingara[6] showed that the mean spleen length increased with age and significantly correlated with age and height in female children in North Indian children. Similarly, the meanspleen length increased with age and significantly correlated with age and height in male children in North-east Karnataka.

Our results provide a standard set of normal range of spleen size according to age and sex of the children, as determined by ultrasonography. We found height to be a significant correlate of the spleen size across all ages, in the males. The results of this study can be used as guide practically to indicate the normal spleen length range for every child, according to his/her age and body habitus.

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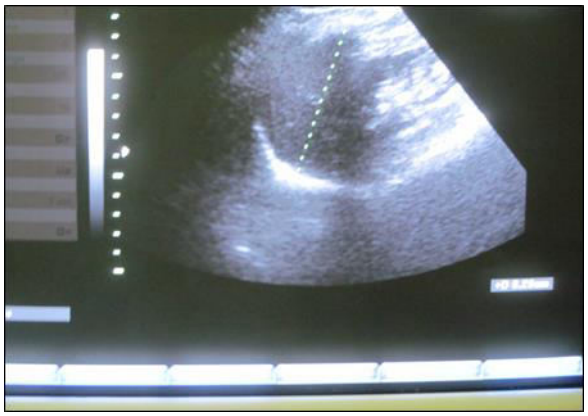
Photograph 1: Ultrasonographic measurement of spleen size in the largest diameter in supine subject



Photograph 2: Ultrasonographic measurement of spleen size in the largest diameter in supine subject

Conclusion

In the present study an attempt was made to determine the normal range of length of spleen and to correlate this with the age, sex and height.

Comparison is also done with other studies done in India and in other countries and noted whether there is any relation of our study with other regions.

Spleen length significantly correlated with age and height. 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. Most statistically significant correlation with spleen lengthwas observed with height in male children. The mean spleen length increased with age.

Defining normal parameters is mandatory for knowing the pathologic changes in size of the liver, spleen, and kidneys in routine sonographic examinations of children. The methods of measurement and analysiswe used in this study are standardized andeasy to apply. Results are handy, reliable and are suitable for radiology and paediatric departments.

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