Original Article

Penile anthropometry in North Indian children

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ABSTRACT

Introduction: Physicians frequently encounter questions by parents regarding the normal size of a child's penis. We evaluated normal variations of penile dimensions, correlation of penile length with height, weight, and body mass index (BMI) of boys and analyzed the differences in penile dimensions from those reported from other countries.

Materials and Methods: A cross-sectional study was conducted at our institution during October 2012-December 2012. A total of 250 subjects (birth to 10 years) were evaluated and divided into 10 groups with 1-year interval taking 25 children in each. Penile dimensions measured twice by a single observer with Vernier calipers included the length of flaccid penis fully stretched and diameters at mid-shaft and corona. Diameters were multiplied by pi ($\pi = 3.14$) to calculate circumferences. Mean, standard deviation, and range were calculated. Height, weight, and BMI were noted and statistically correlated with the penile length using the Pearson correlation coefficient. Data were compared with similar studies reported on other populations in the past and individually evaluated with every study using Student's *t*-test.

Results: The mean values for the penile length, mid-shaft circumference, and coronal circumference were 3.34, 3.05, 3.29 cm during infancy, 4.28, 3.86, 4.11 cm during 4-5 years, and 5.25, 4.78, 5.05 cm during 9-10 years, respectively. The penile length increased with advancing age in successive age groups, but it did not have a direct correlation with either height, weight, or BMI. Penile dimensions in North Indian children were found to be statistically smaller in comparison with most studies from other countries.

Conclusion: We provide the normal range and variations of penile dimensions in North Indian children.

Key words: Anthropometry, circumference, penis, length

INTRODUCTION

Physicians often encounter questions from parents regarding the normal size of their child's penis . Aberrant growth of male external genitalia may be the first sign of underlying biophysiologic or psychosocial illness.[1] Medical consultations regarding these have associated medical, sexual, psychological, and social implications.[2-4] Morphological abnormalities of the penis can affect interpersonal relations and provoke emotional disturbances as the child grows into an adult. With relation to the genital size, it may be the child or parents who are suffering from a misconception, when all that is required is the knowledge of normal variation. At the same time, one must rule out micropenis,[5] which is defined as a penis that is normal in terms of shape and function, but is >2.5 SD smaller than the mean size in terms of length for age of the child.

Penile dimensions and normal variations in children have been previously reported,[6-12] but similar data in Indian population is sparse. It is important to establish reference values for penile dimensions in Indian children as significant variations may exist among males from different races and ethnicities right from birth to childhood and adulthood.

MATERIALS AND METHODS

Between October and December 2012, we conducted a cross-sectional study on 250 subjects with age ranging from birth to 10 years recruiting 25 subjects in each age group with 1-year intervals. Institutional ethics committee clearance was taken prior to undertaking this study. Informed consent from the parents in their own language was taken for examining their child, explaining the purpose of the study.

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Access this article online	
Quick Response Code:	Website: www.indianjurol.com
	DOI: 10.4103/0970-1591.152917

We included healthy boys not suffering from any genital, endocrinological, nutritional, or psychosocial disease from among the relatives of other patients, boys admitted for disease unrelated to genitalia, and healthy children coming for routine immunization. A Vernier calipers was used to measure:

- Stretched length of flaccid penis from pubopenile vertex to the tip of the glans [Figure 1]. Penis was fully stretched till comfortably tolerated by the subject
- Diameter at the mid-shaft on the transverse and dorsoventral axis (the mean was used in the data table) [Figure 2]
- Diameter at the corona on the transverse and dorsoventral axis (the mean was used in the data table).

All the measurements were taken by a single observer and taken twice to overcome the variability in measurements. The readings were found to be reproducible on examining the child second time in the majority of the cases, but in the case of difference between the two readings, the mean of the two was taken for data analysis. As the penis is not symmetrically cylindrical, diameters at the two mutually perpendicular axes at the corona and mid-shaft were found to differ by 0.5-1.5 mm and thus the mean of the two diameters was used in the tabulated data for each age group to nullify the difference.

The diameters were multiplied by pi ($\pi = 3.14$) to calculate circumferences at the mid-shaft and corona. The mean and standard deviation were calculated for each age group, with establishment of normal range for reference values with 2 SD. The height (in cm) and weight (in kg) of all the subjects were measured and the body mass index (BMI, kg/m^2) was calculated.

Data were tabulated for the mean stretched penile length and the mean circumferences at the corona and mid-shaft in all the age groups. To derive correlation of penile length with weight, height and BMI and to rule out the confounding factor of age, the Pearson correlation coefficient was calculated individually for each age group. The *r* values reaching statistical significance were derived for the study data. Graphical representations were made to generate nomograms for the penile dimensions with age.

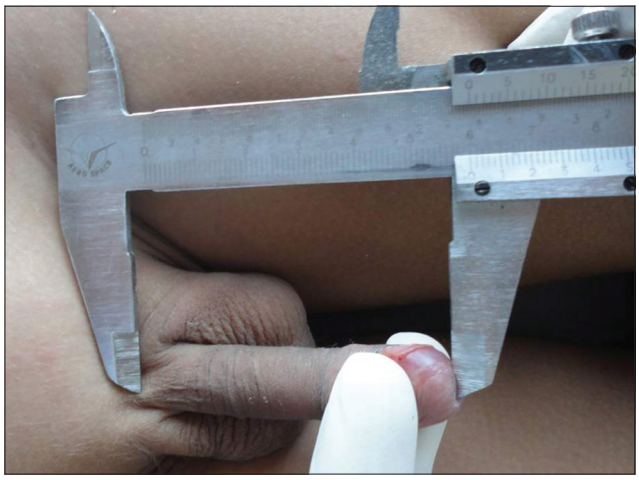

Figure 1: Measurement of the length of stretched penis

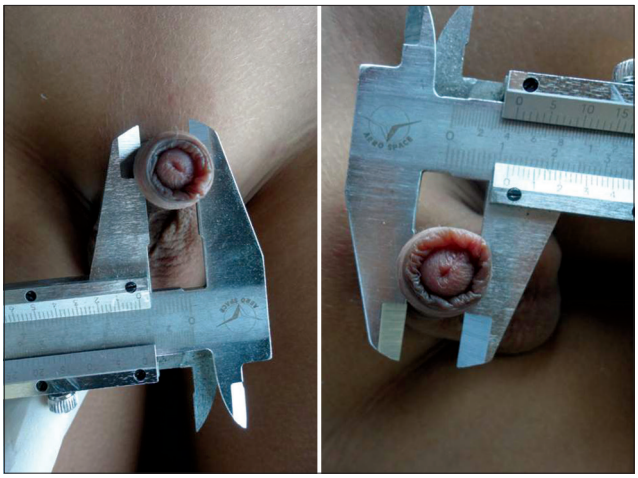

Figure 2: Measurement of mid-shaft circumference

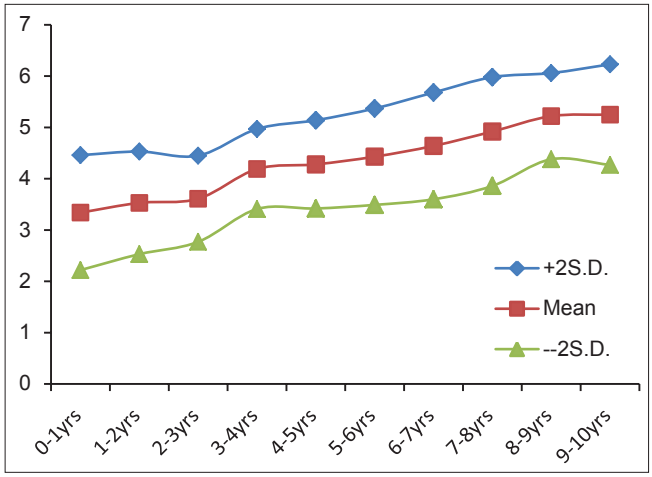

Figure 3: Correlation of penile length (cm) with age (years)

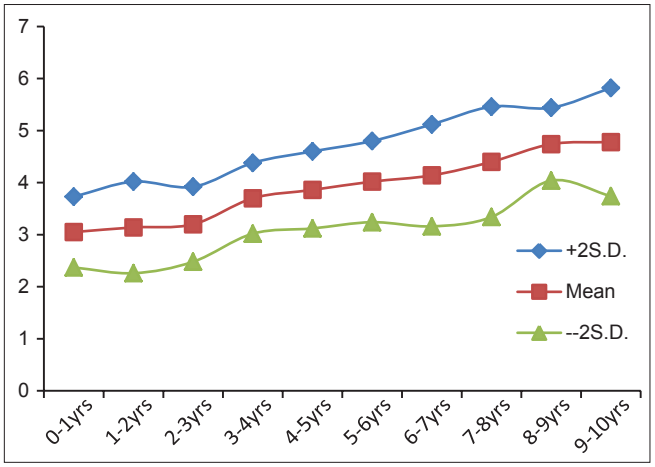

Figure 4: Correlation of mid-shaft circumference (cm) with age (years)

The data were compared with the similar studies conducted previously in other parts of the world, and the differences in the results were analyzed individually with each study using Student's *t*-test.

RESULTS

All the penile dimensions increased, along with the height and weight of the child, in successive age groups. Penile length increased gradually with the age, with a spurt between the ages of 3 and 4 years [Figure 3]. The mid-shaft circumference [Figure 4] showed a trend analogous to the penile length with a steep curve during the 3-4 year age group, which relatively flattens toward the end at 8-10 years of age, suggesting the relatively small increment in the penile dimensions in comparison with the other age groups in successive years [Table 1]. Coronal circumference followed a similar pattern of progression in size with age as observed in the penile length and mid-shaft circumference.

The mean height and weight of the children in the study groups were in keeping with the normal range defined by the Indian Association of Pediatrics. The Pearson correlation coefficient values did not follow a regular trend for either weight, height, or BMI. Some age groups showed statistically significant positive relation with penile length, some showed positive but not statistically significant correlation, and a few age groups even had a negative correlation with penile length [Table 1]. The inconsistent pattern in the Pearson correlation coefficient values in the various age groups was suggestive that the penile length did not have a direct correlation with weight, height, or BMI of the subjects. Among all the age groups, the highest Pearson correlation coefficient values for penile length with height (0.70), weight (0.77), and BMI (0.62) were found during infancy.

Upon individually comparing the results using Student's *t*-test with other studies conducted in the past, the values in this study were found to be statistically smaller from the most of the other studies (Brazil,[7] Korea,[9] and Turkey[10]) with a $P < 0.01$ during infancy, 4-5 years as well as 9-10 year age group. However, on comparing the results with the study conducted on Bulgarian boys,[8] the penile length was statistically smaller during infancy, smaller but not statistically significant in the age group 4-5 years and larger in the age group 9-10 years.

DISCUSSION

The age-adjusted values of penile dimensions must be known in order to determine the abnormal penile size and to follow the treatment of underlying diseases. Penile length increases gradually and slowly during childhood.[6] Differences in penile anthropometry may exist between several populations owing to ethnic, geographical, genetic, and nutritional factors.

The only other study in the literature for Indian children that we could find was by Vasudevan *et al.*[13] Their study comprised only of 135 newborn boys and they found the mean stretched penile length to be 3.57 cm and width to be 1.04 cm at birth. These values are marginally greater than our study group and may have been because of differences in growth parameters between North and South Indian population.

A study on Taiwanese boys by Wang *et al.*[3] suggested that the average penile length increased with chronological age,

Table 1: The mean and normal range for all the penile dimensions in the various age groups along with Pearson correlation coefficient of penile length with weight, height, and BMI

Age (years)	Stretched penile length (cm)			Midshaft circumference (cm)			Coronal circumference (cm)			Mean weight (kg)	Pearson correlation coefficient of weight with penile length (*r* value)	Mean height (cm)	Pearson correlation coefficient of height with penile length (*r* value)	Mean BMI (kg/m^2)	Pearson correlation coefficient of BMI with penile length (*r* value)
	Mean	Normal range		Mean	Normal range		Mean	Normal range							
		−2 SD	+2 SD		−2 SD	+2 SD		−2 SD	+2 SD						
0-1	3.34	2.22	4.46	3.05	2.37	3.73	3.29	2.59	3.99	5.85	0.77	61.72	0.70	15.35	0.62
1-2	3.53	2.53	4.53	3.14	2.26	4.02	3.43	2.51	4.35	9.89	0.54	79.85	0.38	15.51	0.42
2-3	3.61	2.77	4.45	3.20	2.48	3.92	3.46	2.72	4.20	12.55	−0.04	90.15	0.20	15.44	−0.16
3-4	4.19	3.41	4.97	3.70	3.02	4.38	3.95	3.25	4.65	14.43	0.40	97.97	0.26	15.03	0.20
4-5	4.28	3.42	5.14	3.86	3.12	4.60	4.11	3.37	4.85	15.82	0.30	105.05	0.06	14.96	0.23
5-6	4.43	3.49	5.37	4.02	3.24	4.80	4.27	3.47	5.07	18.15	0.38	110.95	0.12	15.47	0.44
6-7	4.64	3.60	5.68	4.14	3.16	5.12	4.42	3.40	5.44	20.12	−0.03	116.25	0.40	15.33	−0.13
7-8	4.92	3.86	5.98	4.40	3.34	5.46	4.68	3.62	5.74	21.97	0.50	120.4	0.65	15.15	0.29
8-9	5.22	4.38	6.06	4.74	4.04	5.44	5.01	4.29	5.73	25.46	0.67	125.75	0.46	16.10	0.06
9-10	5.25	4.27	6.23	4.78	3.74	5.82	5.05	3.99	6.11	28.85	0.33	131.85	−0.03	16.59	0.31

Values of Pearson coefficient (*r* value) >0.396 are statistically significant. BMI = Body mass index, SD = Standard deviation

which is similar to our findings. The mean penile length in the study conducted by Gabrich *et al.*[7] on Brazilian children was 4.7 cm and 7.4 cm during infancy and at 10 year age, which are more than our study group having value 3.34 and 5.25 cm in the respective age groups. This may be due to comparatively higher values of average height and weight in the Brazilian population. The penile length in the study conducted by Analia *et al.*[8] at the Cleveland clinic was 3.55 cm during infancy, which is longer than 3.34 cm as measured in our study group, but at 10 years of age, it was 4.84 cm that is shorter in comparison to 5.25 cm as in our study group. This might be due to difference in the extent of stretching of penis and different methodologies adapted for measurements. Lee *et al.*[9] in their study on Korean boys found the mean penile length to be 3.5 cm during infancy and 5.6 cm at 10 years, which is slightly more than our study and similarly the penile length was comparatively more in Turkish boys with values of 4.44 cm during infancy and 6.79 cm as found in the study by Peyami *et al.*[10]

No direct correlation of penile length with either weight, height or BMI was found when all the age groups were evaluated. Of all the age groups, height, weight and BMI had a strong positive correlation with penile length during infancy, which may suggest that birth weight and height may bear some influence on penile length of the child.

Camurdan *et al.*[11] found a significant positive correlation between the penile length and BMI in Turkish children while in our study the correlation between the two variables was not found to be statistically significant. Similar to our findings, Adriansyah *et al.*[12] in a study on adolescent boys in Indonesia found no significant variation in penile length in relation to BMI (Pearson coefficient, 0.25). Analia *et al.*[9] found penile shaft circumference to be 4.38 and 5.52 cm at 1 and 10 year age, and Peyami *et al.*[10] found the values to be 4.34 and 5.02, which are larger in comparison with values 3.05 and 4.78 noted in our study group.

Although there have been studies conducted in other parts of the world to measure penile length and shaft circumference in prepubertal age groups, we have additionally measured coronal circumference to take into account the size of the glans. These variables may be used in the future to analyze their effect on diseases affecting the morphology of penis like hypospadias, epispadias, etc., along with their surgical outcomes. The size of the glans is a relevant criterion[14] in hypospadias surgery, the smaller ones being more difficult to repair and may need local testosterone application to augment results.

Different methodologies adapted for measurements may also influence the results. We used a Vernier calipers in our study as it achieves highest accuracy in comparison with rigid tape,[8] measuring ruler,[7,9] and spatula[10,12] used in various studies. Although there is a theoretical risk of trauma to the child while taking the measurements with a Vernier calipers due to its shape, we preferred it because of its accuracy and did not come across any traumatic event during our study. Limitations of our study are that we took the mean of the two mutually perpendicular diameters for calculating the circumferences at corona and mid-shaft, which may not be the representative of true circumferences as penis is not uniformly cylindrical in shape. However, the method adapted for measurement was the same so inference with age could be derived. All the subjects were examined to exclude any genital, endocrinological, nutritional, or psychosocial disease but since no objective investigations were done to exclude these diseases, few of them may have had some confounding disease influencing the results. Although all the measurements were taken twice by a single observer with the intend to overcome the variability in measurements, but if taken by two different observers might have reduced the bias or error.

CONCLUSION

The penile length was 3.34 cm during infancy, 4.28 cm at 5 years, and 5.25 cm at 10 years, respectively. The mid-shaft circumference values were noted to be 3.05 cm during infancy, 3.86 cm at 5 years, and 4.78 cm at 10 years, respectively. Coronal circumference had values of 3.29 cm during infancy, 4.11 cm at 5 years, and 5.05 cm at 10 years, respectively. The penile length increases with advancing age, but no direct correlation with body weight, height or BMI could be established. Penile dimensions in North Indian children were found to be statistically smaller in comparison with most of the previous studies conducted in other countries.

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How to cite this article: Bhat A, Upadhyay R, Bhat M, Sabharwal K, Singla M, Kumar V. Penile anthropometry in North Indian children. Indian J Urol 2015;31:106-10.
Source of Support: Nil, **Conflict of Interest:** None declared.