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Penile anthropometry in Brazilian children and adolescents

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Abstract

Objective: Classically, the penis has two functions: to make internal fertilization possible and to direct the urine stream. However, objective abnormalities in penis size can lead to diseases being diagnosed. Furthermore, many medical consultations are the result of patients seeking parameters for normal penis size. Additionally, the penile anthropometry of Brazilian children and adolescents has not yet been properly studied. The objective of this study is to carry out penile anthropometry of Brazilian children and adolescents, establishing references for clinical use.

Methods: A cross-sectional study was carried out of 2,010 patients with ages varying from 0 to 18 years. Five penile measurements were taken: diameter of penile shaft; apparent and real length of flaccid penis; apparent and real (RSL_{max}) length of flaccid penis fully stretched. Pubertal development was defined according to Tanner's criteria.

Results: Only RSLmax, out of all of the penile measurements, did not exhibit significant interobserver variation at all ages analyzed (p = 0.255). Results were tabulated with mean RSLmax and the values that define micropenis (mean - 2.5 standard deviations) by age and by Tanner sexual maturity stages. A graph was plotted of the distribution of RSLmax results by the 10th, 25th, 50th, 75th and 90th percentiles and by age.

Conclusions: Out of all of the penile anthropometric measurements, only RSL_{max} is clinically useful. We recommend our results as a reference standard for penile anthropometry of Brazilian children and adolescents.

J Pediatr (Rio J). 2007;83(5):441-446: Anthropometry, penis, child development, adolescent development, growth.

Introduction

Classically, the penis has two functions: to make fertilization possible by means of penetration and to direct the urine stream. However, morphofunctional abnormalities of the penis can affect interpersonal relations and provoke emotional disturbances, affecting quality of life.[1,2] Additionally, there is great interest, both on the part of lay patients and medical professionals, in reference values in relation to the growth and development of the human penis.[3] Determination of penile size is employed clinically in the evaluation of children with abnormal genital development, such as, for example, micropenis, defined as a penis that is normal in terms of shape and function, but is more than 2.5 standard deviations (SD) smaller than mean size in terms of length.[3-5] However, these measurements can be subject to significant international variations, in addition to being obtained with different methodologies in some cases.[4-11] Wang et al. recently published a study that demonstrated differences in penis length between young Taiwanese boys and young Caucasian boys.[11]

Medical consultations related to penis size are very common at pediatric, urology and endocrinology clinics, because the issue has significant medical, sexual, psychological and social relevance.[3,12-14] Tables for use in comparing measurements of penis size do exist, with values distributed to cover

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children and adolescents.[7,15] However, these tables were not developed from measurements taken of Brazilian children and adolescents. Other motives for consultations due to "small penis" are buried penis, obesity, body image disorders and sexuality issues, such as, for example, ignorance of penis size reference parameters. With relation to genital perception, it may be the child or adolescent or parents who are suffering the disorder. Mondaini et al. assessed 67 patients, with a median age of 27 years, varying from 16 to 55, who sought urological treatment for a "short penis", concluding that these patients were overestimating the size of a normal penis size.[16]

There is no other study known to us in the literature that has adequately evaluated the penile anthropometry of Brazilian children and adolescents in all age groups.

Methods

This study, and its free and informed consent protocol, was approved by the local Research Ethics Committee.

A cross-sectional study was carried out with 2,010 children aged from 0 to 18 years 11 months, where subjects between 10 and 19 years old were defined as adolescents, according to World Health Organization (WHO, 2007) criteria.[17] The data collection period was from April, 2004 to April, 2006.

All measurements were carried out in an air conditioned medical consulting room, at temperatures varying from 23 to 25 ºC, in the presence of the patient's guardians and wearing disposable latex gloves. Data were collected by three researchers with experience in penile anthropometry, at pediatric clinics and at the Adolescent Health Studies Center (Núcleo de Estudos da Saúde do Adolescente) at the Hospital Universitário Pedro Ernesto. All patients were selected at the clinics, consecutively, during regular appointments. All patients who agreed to take part were included, both healthy patients and those with diagnoses, none of which were clinically significant to the study. None of them exhibited genital abnormalities. None of the patients or their guardians refused.

Initially, weight and height measurements were taken in order to calculate body mass index (BMI) and to define pubertal development or sexual maturity according to the Tanner criteria.[18] All dissidents were weighed on a balance calibrated by the National Institute of Metrology, Standardization and Industrial Quality (INMETRO -Instituto Nacional de Metrologia Normalização e Qualidade Industrial), and height was measured with an anthropometric rule standardized by the Brazilian Society of Pediatrics (SBP - Sociedade Brasileira de Pediatrics). The definition of obesity and adopted for this study is in accordance with WHO recommendations.[17] Children were defined as obese when their z score for weight/height was greater than two. For adolescents, BMI was used, calculated with the formula weight/(height)^2, according to the values proposed by Must et al.[19,20]

Measurements of penis length and diameter were taken with a rigid rule, graded millimeters, and with a pachymeter, both approved by INMETRO. A preliminary analysis of the results of penile anthropometric measurements from 300 individuals allowed the most appropriate method, and whether there was interobserver variation, to be assessed. Penile measurements were taken with the penis flaccid and maintained fully stretched manually. Stretched measurements correlate with erect penis length.[15] All final measurements were the mean of three consecutive measurements.

The penile measurements assessed were: D: diameter at the mid point of the penile shaft; AFL: apparent flaccid length, from the pubopenile skin vertex to the extremity of the glans, with the ruler or pachymeter placed against the dorsal part of the penis; RFL: real flaccid length, from the pubopenile skin vertex, depressing the pubic fat, to the extremity of the glans with the ruler or pachymeter placed against the dorsal part of the penis; ASL_{max}: apparent fully-stretched flaccid length, from the pubopenile skin vertex to the extremity of the glans, with the ruler or pachymeter placed against the dorsal part of the penis; RSL_{max}: real fully-stretched flaccid length, from the pubopenile skin vertex, depressing the pubic fat, to the extremity of the glans with the ruler or pachymeter placed against the dorsal part of the penis.

Final results were expressed using descriptive statistics in the form of mean, plus or minus 1 SD from the mean. Differences between groups were tested using two-tailed analysis of variance ANOVA, followed by the Bonferroni test when appropriate. Differences between values were considered significant when $p < 0.05$. The final results of the anthropometric measurement of greatest clinical utility were used to plot a graph with distribution by percentiles for all age groups. All of the data were stored and analyzed using SPSS for Windows, version 10.0 (SPSS Inc., Chicago, Illinois, United States).

Results

Initially, penile length measurements (AFL, RFL, ASL_{max} and RSL_{max}) were made using a rigid anthropometric rule and with a pachymeter, with no statistically significant difference being observed between these measurements ($p > 0.455$). The only penile measurement of all those obtained that did not exhibit statistically significant interobserver variations was RSL_{max} ($p = 0.255$). Based on these results, we considered RSL_{max} to be the ideal measurement for clinical practice, and all of the statistical analyses in this study were based on this measurement.

A total of 81 patients, 4.0% of the overall sample, were defined as obese (BMI > 30 kg/m^2).

The distribution of patients by age according the Tanner sexual criteria indicates an age range of onset of puberty from 8 to 15 years (Table 1). The sample is well distributed and does not exhibit any tendencies that cannot be found in the literature.

Table 1 - Distribution of the study population by age and according to the Tanner stages of sexual maturity

Age	n	Tanner 1	Tanner 2	Tanner 3	Tanner 4	Tanner 5
0 to 12 months	126	126				
1 year	130	130				
2 years	130	130				
3 years	114	114				
4 years	105	105				
5 years	105	105				
6 years	94	94				
7 years	101	101				
8 years	106	100	6			
9 years	100	88	12			
10 years	118	100	18			
11 years	105	63	42			
12 years	113	30	63	20		
13 years	101	16	41	31	13	
14 years	115		36	47	26	6
15 years	91		9	37	29	16
16 years	87			25	40	22
17 years	85			14	26	45
18 years	84				13	71
Total	2,010	1,302	227	174	147	160
%	100.0	65.0	11.0	8.5	7.5	8.0

Table 2 contains the mean values for penis size (RSL_{max}) distributed by age, and the RSL_{max} value defined as micropenis, i.e. the point equal to 2.5 SD below the mean. The value of the SD of the mean increased from puberty onwards.

The mean RSL_{max} and the penis size considered as micropenis are listed in Table 3 according to Tanner sexual maturity stages. Tanner stage 1 was not included because of the large variation in RSL_{max} from age 0 to 10 years.

Figure 1 illustrates all of the RSL_{max} values in the form of percentiles by age, and it can be observed that there is greater penile growth between 0 and 5 years, and again after 10 years, coinciding with the onset of puberty.

Discussion

Our results have demonstrated that penis length does not exhibit any great increase between 5 years and the onset of puberty, when the final period of penile growth takes place. This pattern of penile growth and development can be observed in Figure 1, which illustrates that there is a small amount of penile growth from birth to 5 years, followed by a phase of little growth between 5 and 10 years and culminating in a period of greater growth from 11 to 18 years of age, which coincides with puberty. Although the mean values of our measurements exhibit a small variation from the international literature, this pattern of development is in line with other series.[7,15]

Micropenis, buried penis and obesity should be considered as differential diagnoses when a "small penis" is being assessed subjectively. These abnormalities have diverse etiologies, including genetic, anatomic, endocrinological and idiopathic causes.[3,5,21] Initial assessment of these patients includes precise measurement of penis length and comparison with the normal penis size for age and sexual development, which should be established in advance. Due to the importance of diagnosing and treating these abnormalities, and also because no adequate reference table based on Brazilian data exists, we carried out this study with appropriate methodology in order to provide data to serve as a national reference of the penile anthropometry of children and adolescents.

Other authors have evaluated different methodologies for measuring penis length.[4,22] Children aged from 0 to 24 months, with normal external anatomy, underwent ultrasound examination of the penis to investigate whether this could offer more precise penis length measurements in relation to classically described measurements.[4] It was concluded that further studies were needed to assess the

Table 2 - References for mean penis length and the length considered micropenis for each age

	Mean (mm)	± SD (mm)	Micropenis (mm) (mean - 2.5 SD)
0 to 12 months	47	8	27
1 year	51	8	31
2 years	55	8	35
3 years	61	9	38
4 years	63	9	40
5 years	67	9	44
6 years	67	9	44
7 years	69	10	44
8 years	70	10	45
9 years	70	10	45
10 years	74	11	46
11 years	78	12	48
12 years	86	12	56
13 years	101	12	71
14 years	115	13	82
15 years	129	15	91
16 years	133	15	95
17 years	143	16	103
18 years	145	16	105

SD = standard deviation.

intraobserver reproducibility of ultrasound and ultrasound probe size limitations to measuring larger penises. In the same study, the authors did not find any statistically significant variation in penis size between children of different races. However, they did observe a statistically significant difference between circumcised, and uncircumcised penises or penises with phimosis. However, they report that this variation was the result of the greater ease with which the circumcised penis could be stretched. We found greater difficulty in anthropometric evaluation of the penises of obese children and with those with long foreskins or phimosis, because of greater difficulty stretching the penis, but not to an extent that could interfere significantly with taking the measurement. A recent study undertaken with a sample of 2,126 Taiwanese children, made up of 156 newborns, 1,198 children under 2 years old and 772 children over 2, and from which were excluded children with congenital anomalies, genital anomalies or congenital heart diseases were excluded, evaluated penis length while flaccid and while fully stretched manually.[11] In conclusion, the authors observed that penis size varies between different ethnic groups and that, when compared with the penis length of Caucasian children, the length of Taiwanese children's penises is shorter. Their results underscore the importance of our study to develop a penis reference table for Brazilian children and adolescents. In response to the ethnic variety of the Brazilian population and because we do not have standard terms for races established in Brazil, patients were not separated by race or skin color in our study, nor by

Table 3 - Mean penis size, assessing real length, fully stretched (RSL_{max}), and the values considered as diagnosing micropenis, by Tanner stages

	Mean (mm)	± SD (mm)	Micropenis (mm) (mean - 2.5 SD)
Tanner 2	88	12	58
Tanner 3	118	13	85
Tanner 4	136	13	103
Tanner 5	145	14	110

SD = standard deviation.

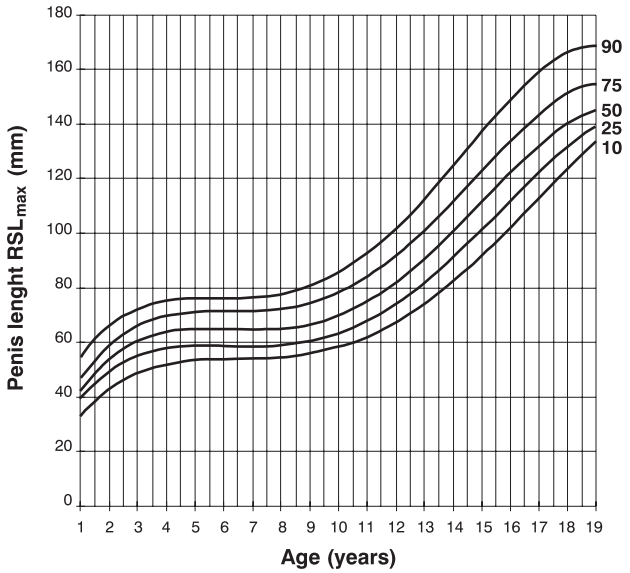

Figure 1 - Distribution of penis size values, assessed as real fully-stretched length (RSL_{max}), expressed as the 10th, 25th, 50th, 75th and 90th percentiles

any other parameter which could characterize the patients. This study was based on a consecutive and representative series of the population, with the intention of simulating clinical consultation conditions.

We initially carried out a pilot study, comparing measurements of penis length taken with a rigid ruler and with a pachymeter, and the results did not reveal any statistically significant differences between these measurements, demonstrating that there was no need for specific materials for taking human penile anthropometry measurements.

During the data collection phase we were able to see the importance of differentiating patients, not just by age, but also by degree of sexual maturity, since during adolescence patients of the same age can be at different stages of sexual maturity. This was evident even between univitelline twins who, despite having the same chronological age, were at different stages of sexual maturity, which caused a large difference in penis length.

In order to learn the correct penile anthropometry method, a brief training session is needed. Measurements are taken quickly and there are few difficulties or complications during these measurements. The only case of a major complication took place when a patient presented clinically significant postural hypotension, which resulted in immediate interruption of measurements until the patient had completely recovered. Minor problems can come up during measurements: children who exhibit psychomotor agitation due to neurological diseases make data collection difficult; children with excessive timidity; erections during the measurements, which, in our study, led to interruption of the procedure. In clinical practice, penis length can also be measured with the penis erect, since the measurement is equivalent to RSL_{max}.[23]

Son et al. carried out a study of 123 young Korean soldiers, measuring penis lengths while flaccid and fully stretched manually, and also penis circumferences. The patients replied to a questionnaire on their perceptions of their own penis size as "very small", "small", "normal", "large", or "very large".[14] Patients who replied with an underestimate of their penis size had higher scores for depression and poorer quality of life compared with patients who thought their penis was normal. The study demonstrated that dissatisfaction with penis size, whether actually smaller than average or average, can directly affect the self-esteem and quality of life of these patients.

We conclude that, out of possible penile anthropometric measurements, the clinically useful measure is RSL_{max}, and we recommend our data as a reference for penile anthropometry of Brazilian children and adolescents. Despite the use of Figure 1 being extremely useful in clinical practice, primarily for monitoring patient development, we recommend they be used in combination with the RSL_{max} values distributed by degree of sexual maturity, according to Tanner's criteria, for those who have reached puberty. We believe that, used in this manner, the applicability of our data to clinical practice can be maximized.

References

1. Diseth TH, Bjordal R, Schultz A, Stange M, Emblem R. Somatic function, mental health and psychosocial functioning in 22 adolescents with bladder exstrophy and epispadias. J Urol. 1998;159:1684-9; discussion 1689-90.
2. Da Silva EA, Schiavini JL, Yang S, Miranda ML, Damião R. Health-related quality of life of patients who underwent multiple surgeries for penile diseases. J Sex Med. 2004;1:80.
3. Aaronson IA. Micropenis: medical and surgical implications. J Urol. 1994;152:4-14.
4. Smith DP, Rickman C, Jerkins GR. Ultrasound evaluation of normal penile (corporeal) length in children. J Urol. 1995;154(2 Pt 2):822-4.
5. Elder JS. Abnormalities of the genitalia in boys and their surgical management. In: Walsh PC, Retik AB, Vaughan Jr. ED, Wein AD, editors. Campbell`s urology. Philadelphia: Saunders; 2002. p. 2340-2.
6. Souza HF. Estudo transversal do desenvolvimento puberal no sexo masculino no estado do Rio de Janeiro [dissertação]. Rio de Janeiro (RJ): Universidade Federal do Rio de Janeiro; 1987.
7. Damon V, Berlier P, Durozier B, François R. [Study of the dimensions of the penis from birth to adult age and as a function of testicular volume]. Pediatrie. 1990;45:519-22.
8. Yachia D. A simple method for measuring penile length in newborns and infants. BJU Int. 2000;86:150.
9. Santos HO. Medida antropométrica peniana em lactentes e pré-escolares. J Pediatr (Rio J). 1985;59:263-7.

10. Boas M, Boisen KA, Virtanen HE, Kaleva M, Suomi AM, Schmidt IM, et al. Postnatal penile length and growth rate correlate to serum testosterone levels: a longitudinal study of 1962 normal boys. Eur J Endocrinol. 2006;154:125-9.

11. Wang CH, Lin WD, Bau DT, Tsai CH, Liu DC, Tsai FJ. Penile length of normal boys in Taiwan. Acta Paediatr Taiwan. 2006;47:293-6.

12. Perovic SV, Djordjevic ML. Penile lengthening. BJU Int. 2000;86:1028-33.

13. Shamloul R. Treatment of men complaining of short penis. Urology. 2005;65:1183-5.

14. Son H, Lee H, Huh JS, Kim SW, Paick JS. Studies on self-esteem of penile size in young Korean military men. Asian J Androl. 2003;5:185-9.

15. Schonfeld WA, Beebe GW. Normal growth and variation in the male genitalia from birth to maturity. J Urol. 1942;48:759-77.

16. Mondaini N, Ponchietti R, Gontero O, Muir GH, Natali A, Caldera E, et al. Penile length is normal in most men seeking penile lengthening procedures. Int J Impot Res. 2002;14:283-6.

17. World Health Organization. Child and Adolescent Health Development. http://www.who.int/child-adolescent-health/OVERVIEW/AHD/adh_over.htm. Access: 11/04/2007.

18. Tanner JM. Growth at adolescence. 2th ed. Oxford: Blackwell; 1962.

19. Must A, Dallal GE, Dietz WH. Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht2) and triceps skinfold thickness. Am J Clin Nutr. 1991;53:839-46.

20. Abrantes MM, Lamounier JA, Colosimo EA. Prevalência de sobrepeso e obesidade em crianças e adolescentes nas Regiões Sudeste e Nordeste. J Pediatr (Rio J). 2002;78:335-40.

21. Lee PA, Danish RK, Mazur T, Migeon CJ. Micropenis. III. Primary hypogonadism, partial androgen insensitivity syndrome, and idiopathic disorders. Johns Hopkins Med J. 1980;147:175-81.

22. Feldman KW, Smith DW. Fetal phallic growth and penile standards for newborn male infants. J Pediatr. 1975;86:395-8.

23. Wessells H, Lue TF, McAninch JW. Penile length in the flaccid and erect states: guidelines for penile augmentation. J Urol. 1996;156:995-7.

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