Penile size in term newborn infants

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The objective of this study was to establish standard penile size in healthy full-term Turkish newborns and to evaluate the relation between penile and other anthropometric measures. For this prospective study, stretched penile length (SPL) and penile diameter (PD) of live-borns delivered in our hospital between September 2007-December 2008 were measured, and their birthweight, length and head circumference were recorded. Penile versus other anthropometric correlations were determined by Pearson analyses, followed by linear regression. In 1217 full-term subjects, mean SPL was 3.16±0.39 cm (±2.5 SD=2.19–4.14 cm), and mean PD was 1.21±0.11 cm (±2.5 SD=0.93–1.49 cm). Linear regression analysis showed a strong correlation of SPL (p=0.0001) to height, and PD to height (p=0.0001) and birthweight (p=0.002). Formulas were calculated for predicted individual values for PL and PD of newborns. In conclusion, there is a correlation between neonatal anthropometric measurements and penile anthropometry. Mean anthropometric differences of various ethnicities may account for the differences in mean SPL and PD among various ethnic populations.

Key words: newborn, anthropometric values, micropenis, penile length, penile diameter.

Evaluation of external genitalia is an important part of the physical examination of the newborn child. A penis of “inadequate” size in a male newborn alerts the clinicians in cases of potentially life-threatening abnormalities and can cause parental anxiety[1-4]. The presence of age-related standard values for penile sizes can be helpful for the early diagnosis and treatment of potential diseases[2,5]. Penile length (PL) may vary in different populations, with race and ethnicity, and may yield different normal values[2,4-6]. The most established normative data on healthy full-term newborn males come from two widely referenced studies[7,8] on Caucasian babies. However, recent studies from various parts of the world have aimed to establish penile norms representing their own populations[1,4,9-13] . Studies done on the measurement of the male external genitalia in newborns are scarce[1,4,6,7,10,14,15]. In Turkey, little information is available on penile dimensions in newborns, and the reports regarding values in different ages incorporate only a small number of neonatal subjects[16-18]. This study was planned to establish a comprehensive set of referable standard values for penile sizes in healthy full-term newborn males from Turkey. It also aimed to evaluate whether or not there is any relationship between penile dimensions and other anthropometric measures.

Material and Methods

For this prospectively designed cross-sectional study, all male live-borns delivered in the Obstetrics Department of Dr. Lütfi Kırdar Kartal Training and Research Hospital between September 1, 2007 and December 31, 2008 were examined in detail for penile size and structure. The measurements were taken following the newborn’s routine examination, by the same member of the study group, trained in the use of the measuring equipment. All examinations were performed in a warm and comfortable room temperature, with the child in supine position. Both the stretched penile length (SPL) and penile diameter were measured. Three measurements were taken to the nearest millimeter from each infant to minimize errors, and the mean value was recorded. The difference between the three measurements was no more than 0.1-0.15 cm for PL and less than 0.1 cm for the diameter.

Penile length (PL) was determined by the method described by Schonfeld and Beebe[19]. A specially prepared scale (straight edge ruler) marked in millimeters, with a groove on one side to place it at the root of the penis, was used. The SPL was determined by measuring the distance from the penile base under the pubic symphysis to the tip of the glans. The shaft of the penis was stretched, applying traction along the length of the penis, to the point of increased resistance, as the scale was placed at the base of the penis while the pubic pad of fat was maximally depressed, and the measurement was taken along the dorsal aspect. The foreskin was not included in the measurement[1,3,19].

The diameter of the penis was measured at the midshaft, as it has the largest diameter. The measurements were taken by employing a circular scale with discrete holes, graduating by two millimeters in diameter. All measurements were taken to the nearest even 2 mm. All penile measurements were taken within the first 48 hours after birth.

The anthropometric measurements of the body were simultaneously taken with the penile measurements, by the same member of the group. Body weight was measured, by weighing newborns naked on an electronic weighing scale (Seca; Hamburg, Germany) to the nearest 10 g. Recumbent body length was measured with a portable infantometer to the nearest 0.1 cm. The head circumference was determined using a plastic measuring tape. Body mass index (BMI) was calculated as weight (kg)/length^2 (m^2).

Furthermore, the physical features, anthropometric measures (birthweight in grams, length and head circumference in centimeters), presence of congenital anomalies if any, and other relevant data were recorded onto case forms. The antenatal history of each infant, maternal and paternal demographic data, as well as the medical and pregnancy history of the mothers were also determined and recorded.

Inclusion and Exclusion Criteria

Healthy male newborns were included in the study if they were delivered between 37 and 42 completed gestational weeks (born at term) and within a birthweight range of 2500-4000 g. Those who possessed major congenital malformations, syndromes, genital anomalies (hypospadias, cryptorchidism), or physical signs of endocrinological or chromosomal abnormalities or diseases were excluded from the study. Stillbirths, those who died immediately after birth, and newborns whose mothers had received androgenic medication during pregnancy were also not included. As a result, the study group consisted of 1217 healthy looking full-term, male newborns. This study was approved by the Institutional Ethics Committee at the hospital. Provision of written consent from the parents was a main criterion for the inclusion of subjects.

Statistical Analysis

Statistical calculations were performed with NCSS 2007 (Utah, USA) program for Windows. Besides descriptive statistical calculations (mean and standard deviation, median and frequency), the correlations between penile dimensions (penile length and diameter) and other anthropometric measures (weight, length, head circumference and BMI of the newborns at birth) were determined by Pearson correlation analysis.

Linear regression analyses on the established correlations were conducted. Statistical significance level was established at $p<0.05$. The results were evaluated within a 95% confidence interval (95%CI).

Results

In our study group, the mean maternal age of the 1217 term newborns was 26.80±5.45 years (min-max: 15-45 yrs) and their mean parity was 1.92±1.10 (1-8). The mean values and ranges of the anthropometric measurements and penile sizes of the newborns in the study group are listed in Table I.

The mean SPL of the term newborns was 3.16±0.39 cm and lower and upper limits (±2.5 SD) were 2.19–4.14 cm. The mean penile midshaft diameter was 1.21±0.11 cm, while lower and upper limits (±2.5 SD) were

Table I. Anthropometric Measures of the Body and Penis

	N	Min.	Max.	Median	Mean	SD
Birth length (cm)	1217	44	54	49	48.88	1.80
Birthweight (g)	1217	2500	4000	3230	3322.69	381.21
BMI	1217	10	18.11	13.89	13.88	1.14
Head circumference (cm)	1217	31.2	38.4	34	34.47	1.13
SPL (cm)	1217	1.7	4.6	3.2	3.16	0.39
Penile diameter (cm)	1217	1.0	1.6	1.2	1.21	0.11

BMI: Body mass index. SPL: Stretched penile length. SD: Standard deviation.

0.93–1.49 cm. There were 24 (2%) newborns with a SPL less than 2.19 cm (-2.5 SD), and 16 (1.3%) with a SPL of more than 4.14 cm (+2.5 SD). As for the penile diameter measurements, none of the cases had a measurement below 0.93 cm (-2.5 SD), but there were 6 (0.5%) newborns with a penile diameter above 1.49 cm (+2.5 SD).

Percentiles for the penile dimensions of the study group (SPL, penile diameter) were calculated and are presented in Table II.

We assessed the variables affecting penile anthropometric measurements. The results of the Pearson correlation test demonstrated that SPL and penile diameter at birth correlated positively with one another ($r=0.403$, $p=0.0001$). There was a statistically positive correlation of SPL versus body length at birth ($r=0.164$, $p=0.0001$) and head circumference ($r=0.068$, $p=0.017$), while there was no correlation of SPL with birthweight ($p=0.663$). On the other hand, BMI had a negative correlation with SPL ($r= -0.127$, $p=0.0001$). The penile diameter was positively correlated with birthweight ($r=0.246$, $p=0.0001$), length at birth ($r=0.262$, $p=0.0001$), head circumference ($r=0.203$, $p=0.0001$), and BMI ($r=0.118$, $p=0.0001$).

Linear regression analysis showed a significantly meaningful correlation only between length at birth ($p=0.0001$) and SPL (adjusted $R^2=0.126$, $p=0.0001$). Linear regression with PL as the dependent variable versus body length at birth as the independent variable can be formulized with the following equation[1].

Y [expected PL (cm)] = 1.081+ [0.042x body length (cm)].

With this equation, the expected SPL at birth can be calculated based on the body length at birth.

Linear regression analysis established that penile diameter was also correlated to only length at birth ($p=0.0001$) and birthweight ($p=0.002$) (adjusted $R^2=0.174$, $p=0.0001$). Linear regression with penile diameter as the

Table II. Percentiles of the Penile Dimensions

	Penile length (cm)		Penile diameter (cm)	
Percentile	Value	95% CI	Value	95% CI
3	2.00	(2-2)	1.00	(1-1)
5	2.40	(2.3-2.5)	1.00	(1-1)
10	2.50	(2.5-2.5)	1.00	(1-1)
25	3.00	(2.8-3)	1.20	(1.2-1.2)
50	3.20	(3.1-3.2)	1.20	(1.2-1.2)
75	3.50	(3.5-3.5)	1.20	(1.2-1.2)
90	3.72	(3.7-3.8)	1.40	(1.4-1.4)
95	4.00	(3.8-4)	1.40	(1.4-1.4)
97	4.20	(4-4.3)	1.40	(1.4-1.6)

CI: Confidence interval.

[1] Table III in the Appendix shows the linear regression formula for penile length (cm).

[2] Table IV in the Appendix shows the linear regression formula for penile diameter (cm).

dependent variable versus body length at birth and birthweight as the independent variables resulted in the following equation[2].

Y (Expected penile diameter)= 0.557+ [0.011x birth length (cm)] + [0.0001x birth weight (g)]

Basic demographics are presented in the individual measures of PL plotted against body length (in cm). The mean regression line and the 95% CI for an individual value are shown in Fig. 1.

Discussion

In newborn males, SPL has been used in many studies for more accurate measurement with the purpose of proper and valid evaluation[3,7,19]. Not all previous studies have included information on measurement variation, and various techniques are available[5,9,22,23]. SPL is the most consistent measurement and correlates closely with erect PL[1,3,7,19,24]. The values observed for SPL differ slightly among different studies, as do the values to diagnose micropenis[1,5,6,15]. However, not only variations in sample size, but also racial and ethnic differences may cause significant discrepancies in penile measurements[2,4-6].

Until recently, the most widely acknowledged normative data for healthy full-term newborn penile sizes were derived from a small number of Caucasian babies. Schonfeld and Beebe[19], Flatau et al.[8] and Feldman and Smith[7] reported the mean SPLs of term newborns to be 3.75 cm, 3.5±0.4 cm and 3.5±0.7 cm, respectively, which have been acknowledged as the standard value in many studies[12,16,24].

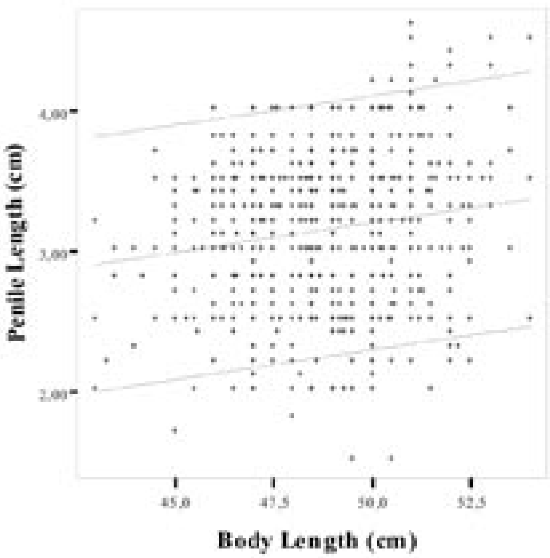

Fig. 1. Penile length versus body length. Regression line and 95% confidence interval for individual values are shown.

This study is, to date, the largest cross-sectional study on penile sizes of full-term Turkish newborns, among the others, which incorporate merely a small number of newborns as study subjects[16-18]. In this study, the mean SPL of term newborns was 3.16±0.39 cm. Some studies from Asia present significantly lower values[1,14,24,26]. Sutan-Assin et al.[26] from Indonesia reported SPL in newborns as 2.86±0.23 cm, Wang et al.[14] from Taiwan as approximately 3 cm, Fok et al.[1] from China as 3±4 cm, and Kulkarni et al.[24] from India as 2.31±0.61 cm. Furthermore, Al-Herbish[15] reported a value of 3.55±0.57 cm, Lian et al.[6] from Singapore, 3.4±0.4 cm, and Ting and Wu[4] from Malaysia, 3.5±0.4 cm. Recently, Boas et al.[5] from Denmark and Finland reported SPL to be 3.49±0.4 cm, and they declared new longitudinal reference curves of penile growth in Caucasian children, which corresponds well with previous studies on white Caucasian boys. Preiksa et al.[10] from Lithuania found SPL to be 3.57±0.45 cm.

In Turkey, in the study of Çamurdan et al.[16] on 165 newborns, SPL was found to be 3.65±0.27 cm. Akarsu et al.[17] determined a SPL of 3.5±0.4 cm in 130 newborns. On the other hand, Uyanık[18] reported a mean SPL among 230 newborns of 3.14±0.36 cm, which is consistent with our findings.

Micropenis is usually defined as a normally formed penis that has a SPL less than 2.5 standard deviations below the mean size[3,11]. Micropenis has been formerly defined as any value under 1.9 cm in newborns[3,7,8,11,19]. In this study, a SPL less than 2.19 cm (mean - 2.5 SD) was defined as micropenis. Ting and Wu[4] reported that a SPL of less than 2.5 cm was considered as micropenis for Malay term newborns, Boas et al.[5] reported this length as 2.49 cm, Preiksa et al.[10] as 2.45 cm, and Al-Herbish[15] from Saudi Arabia as 2.13 cm. In the study of Uyanık[18] from Istanbul, this value was found to be 2.2 cm, which corresponds with our results. These results challenge the usage of a single standard value claiming applicability

Table III. Linear Regression for Penile Length

	Non-standardized coefficients		Standardized coefficients		
	B	Std. Error	Beta	t	p
(Constant)	1.081	0.357		3.026	0.003
Body length (cm)	0.042	0.007	0.164	5.809	0.0001
Dependent variable: Penile length (cm)					

Y= 1.081+ [0.042 x Body Length (cm)]

and universality for all.

In this study, the mean penile midshaft diameter was 1.21±0.11 cm. Flatau et al.[8] reported this value as 1.1±0.1 cm, Preiksa et al.[10] as 1.2±0.1 cm, Sutan-Assin et al.[26] as 0.82±0.33 cm, and Uyanık[18] as 1.15±0.12 cm. In contrast to SPL, there are no significant divergences between countries or regions with respect to penile midshaft diameter.

Some studies have determined strong positive correlations between penile measurements and anthropometric body measurements[1,5,6,8,16]. Similar to the results of Flatau et al.[8], Lian et al.[6], Fok et al.[1], Boas et al.[5], and Çamurdan et al.[16], in this study, we determined that SPL had a strong positive correlation with length at birth. Cheng et al.[2], however, had reported no such relation, which may be attributed to the small number of the study subjects in their study.

Fok et al.[1] and Çamurdan et al.[16] reported a weak but significant correlation between the SPL and birthweight. However, parallel to the findings of Boas et al.[5], we did not find any correlation between SPL and birthweight. Studies in patients with androgen insensitivity showed that testosterone is a major determinant of PL, but plays a minor role in fetal weight gain[2]. This could be considered as an explanation for the discrepancy in the results.

Çamurdan et al.[16] from Ankara reported a significant correlation between SPL and BMI. However, in accordance with the findings of Boas et al.[5] , in this study, the values of SPL showed a significant negative correlation with BMI. Boas et al.[5] had claimed that increased body fat via aromatase activity may lead to an increased endogeneous estradiol synthesis from testosterone, thereby altering the estrogen-androgen balance; however, they were not able to corroborate this hypothesis[5].

There was a significant positive correlation between penile diameter and length at birth and birthweight in this study. Previous studies that include penile diameter measurements are few[2,7,8,10,18,26]. Preiksa et al.[10] had also reported a positive correlation between penile diameter and birthweight and height, in contrast to Cheng et al.[2] who reported no correlation.

There are some reports describing the relationship between ethnicity and the size of the penis in healthy newborns[2,6,14,24]. Measurements of PL showed statistically significant differences between countries[22]; for instance, Boas et al.[5] reported that Denmark has slightly larger values than Finland. Fok et al.[1] showed that Chinese term infants have shorter PLs than Caucasians and other Asian counterparts. Lian et al.[6] from Singapore reported a small but significant difference between male newborns of Indian versus Chinese origin. Furthermore, Cheng et al.[2] from Vancouver reported that there are small

Table IV. Linear Regression for Penile Diameter

	Non-standardized coefficients		Standardized coefficients		
	B	Std. Error	Beta	t	p
(Constant)	0.557	0.097		5.771	0.0001
Body length (cm)	0.011	0.002	0.175	4.437	0.0001
Weight (g)	0.0001	0	0.122	3.088	0.002
Dependent variable: Penile diameter (cm)					

Y= 0.557+ [0.011 x Body Length (cm)]+ [0.0001 x Weight (g)] but significant differences in the mean PL and width in full-term newborn males of the three major ethnic groups (Caucasian, Chinese, East-Indian) living in Vancouver. It was also found that penis size was smaller in adult subjects from South-Asia compared to subjects of Caucasian origin[2]. It has been speculated that the mechanisms underlying differences in PL and width could be due to genetic factors and/or to their nutritional modulation[2,22].

In adult studies, Ponchietti et al.[27] reported that penile dimensions are correlated with other anthropometric measurements such as height and weight, suggesting that penile dimensions are themselves anthropometric measures. Promodu et al.[22] confirmed this observation with their results. Similarly, we found in newborn males that SPL is strongly correlated with the length at birth. This positive correlation could explain the lower mean PL in various studies, usually reported from several locations in Asia[1,2]. We have further found a correlation of penile diameter with birthweight and SPL. Mean anthropometric differences, especially in height, of various ethnicities may account for the differences in mean SPL and penile diameter among various ethnic populations[2,16,22].

In conclusion, this study establishes the existence of a correlation between neonatal anthropometric measurements and penile anthropometry. The mean anthropometric differences, especially with regards to the height of various ethnicities, may help explain the varying mean SPL of different populations. Based on the literature and the data collected, it becomes meaningful to evaluate PL and the diagnosis of micropenis based on each full-term male newborn's birth length individually. While this study incorporates a large number of study subjects, it is nevertheless a single center study. That is to say, the individual expected values for SPL and penile diameter of the newborns that this sample represents can be calculated with the use of the formulas given. However, the nature of these correlations on a much more comprehensive scale can only be understood via the contribution of future studies by various centers around the world on the penile anthropometry of newborn males.

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REFERENCES

1. Fok TF, Hon KL, So HK, et al. Normative data of penile length for term Chinese newborns. Biol Neonate 2005; 87: 242-245.
2. Cheng PS, Chanoine JP. Should the definition of micropenis vary according to ethnicity? Horm Res 2001; 55: 278-281.
3. Elder JS. Anomalies of the penis and urethra. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF (eds). Nelson Textbook of Pediatrics (18th ed). Philadelphia: Saunders; 2007: 2256-2257.
4. Ting TH, Wu LL. Penile length of term newborn infants in multiracial Malaysia. Singapore Med J 2011; 50: 817-821.
5. Boas M, Biosen KA, Virtanen HE, 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: 125-129.
6. Lian WB, Lee WR, Ho Ly. Penile length of newborns in Singapore. J Pediatr Endocrinol Metab 2000; 13: 55-62.
7. Feldman KW, Smith DW. Fetal phallic growth and penile standards for newborn male infants. J Pediatr 1975; 86: 395–398.
8. Flatau E, Josefsberg Z, Reisner SH, Bialik O, Laron Z. Letter: penile size in the newborn infant. J Pediatr 1975; 87: 663–664.
9. Gabrich PN, Vasconcelos JS, Damiao R, Silva EA. Penile anthropometry in Brazilian children and adolescents. J Pediatr (Rio J) 2007; 83: 441-446.
10. Preiksa RT, Zilaitiene B, Matulevicius V. Penile size and testicular volume in healthy Lithuanian newborns. Endocr Abstr 2011; 20: P637.
11. Aaronson IA. Micropenis: medical and surgical implications. J Urol 1994; 152: 4-14.
12. Tuladhar R, Davis PG, Batch J, Doyle LW. Establishment of a normal range of penile length in preterm infants. J Paediatr Child Health 1998; 34: 471-473.
13. Levy JB, Husmann DA. Micropenis secondary to growth hormone deficiency: does treatment with growth hormone alone result in adequate penile growth. J Urol 1996; 156: 214–216.
14. Wang CH, Lin WD, Bau DT, Tsai CH, Liu DC, Tsai FJ. Penile length of normal boys in Taiwan. Acta Paediatr Taiwan 2006; 47: 293-296.
15. Al-Herbish AS. Standard penile size for normal full term newborns in the Saudi population. Saudi Med J 2002; 23: 314-316.
16. Çamurdan AD, Oz MO, İlhan MN, Camurdan OM, Şahin F, Beyazova U. Current stretched penile length cross-sectional study of 1040 healthy Turkish children aged 0 to 5 years. Urology 2007; 70: 572-575.

17. Akarsu S, Öcal C, Kurt A, Yılmaz E, Kurt AN, Aygün AD. Sağlıklı çocuklarda penis uzunluğu ve testis çapı. Çocuk Dergisi 2005; 5: 259-263.

18. Uyanık B. Sağlıklı yenidoğanlarda ortalama penis boyu ve ürogenital anomali sıklığı. Uzmanlık Tezi, İstanbul 2006.

19. Schonfeld WA, Beebe GW. Normal growth and variation in the male genitalia from birth to maturity. J Urol 1942; 48: 759–777.

20. Stoll BJ, Adams-Chapman I. The high-risk infant. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF (eds). Nelson Textbook of Pediatrics (18^{th} ed). Philadelphia: Saunders; 2007: 698-710.

21. Troshev K. Contribution to the anthropometric study of the penis in a group of Bulgarian boys from birth to the age of seven years. Acta Chirurgiae Plast (Praha) 1969;11: 140-148.

22. Promodu K, Shanmughadas KV, Bhat S, Nair KR. Penile length and circumference: an Indian study. Int J Impot Res 2007; 19: 558-563.

23. Özbey H, Temiz A, Salman T. A simple method for measuring penile length in newborns and infants. BJU Int 1999; 84: 1093-1094.

24. Kulkarni ML, Rajendran NK. Normal values for penile standards in newborns. Indian Pediatr 1991; 28: 1341-1343.

25. Vasudevan G, Manivarmane B, Bhat BV, Bhatia BD, Kumar S. Genital standards for south Indian male newborns. Indian J Pediatr 1995; 62: 593–596.

26. Sutan-Assin M, Rukman J, Dahlan A. Penile dimensions of newborn infants. Paediatr Indones 1989; 29: 146-150.

27. Ponchietti R, Mondaini N, Bonafe M, Loro FD, Biscioni S, Masieri L. Penile length and circumference: a study on 3300 young Italian males. Eur Urol 2001; 39: 183-186.