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Change in Penile Length in Children: Preliminary Study

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Purpose: Studies of penile length in children have been rarely conducted. In Korea, great improvements in height and weight have been observed because of economic development over the past 25 years. We investigated the current status of penile length in Korean children and compared the results with those of a previous Korean study conducted in 1987.

Materials and Methods: The subjects in this study were 233 boys aged 1 to 158 months, each of whom had been brought to outpatient clinics between April and October 2011. Penile length was measured according to the stretched penile length (SPL) technique; testicular size was measured (in ml) by using orchidometry. A comparison of penile lengths between the current study and the 1987 study was made by using Student's t-test.

Results: SPL increased significantly by 0.7 to 1.1 cm in most age groups ($p < 0.05$). Current anthropometric measures of Korean children such as height, body weight, and testicular size have increased compared with those from 1987.

Conclusions: Penile length has increased significantly over the last quarter century. Therefore, it is suggested that novel reference values for penile length in prepubertal Korean children be determined in studies with a larger community-based population in order to diagnose and treat size-related penile disorders.

Key Words: *Anthropometry; Child; Penis*

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INTRODUCTION

Penile length in children has rarely been studied, especially in Korea [1,2]. In 1987, a study of penile length and testicular size was conducted in 1,071 Korean children [3]. Penile length was measured by assessing the stretched penile length (SPL) from the tip of the glans to the base of the penis at its attachment to the symphysis pubis. In newborns, the mean±standard deviation (SD) of SPL was 3.3±0.5 cm. Penile length increased slowly but steadily until 4 years of age and then increased rapidly beginning at puberty.

Early diagnosis of abnormalities in penile size is important both medically and psychologically [4], and the exact penile size is also important in the diagnosis of penile problems such as micropenis. Micropenis is defined as a penile length < 2.5 SD below the mean for the age group with normal function and structure [5,6]. Therefore, current references for penile size in newborns and children are very important in the diagnosis of micropenis, even though the exact penile size in the patient is already known.

Although children's body growth has recently increased in Korea, recent data regarding penile size are scanty. This study was performed to update the normal SPL reference values for Korean children. We also evaluated the association between penile length and anthropometric measures,

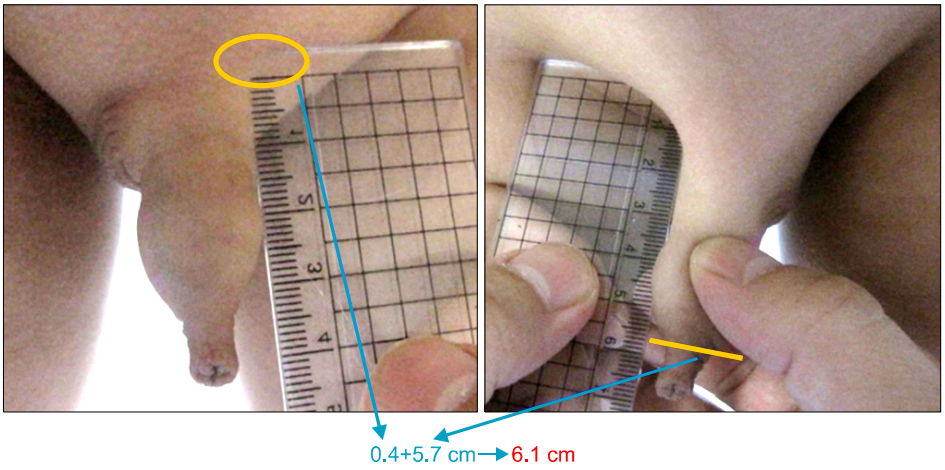

FIG. 1. Method used to measure stretched penile length in the current study.

TABLE 1. Age-related changes in stretched penile length in comparison with data from a previous study conducted in 1987

Age (yr)	Mean±SD (cm)		No. of patients (n=233)	p-value[a]
	1987 yr	Current study		
0–1	3.5±0.6	4.4±0.6	31	<0.001
1–2	4.1±0.7	4.8±0.6	34	<0.001
2–3	4.4±0.7	5.1±0.6	36	<0.001
3–4	4.4±1.0	5.3±0.7	19	<0.001
4–5	4.9±0.9	5.6±0.7	21	<0.001
5–6	5.1±1.0	5.8±0.8	17	0.002
6–7	5.2±0.8	6.0±0.6	15	<0.001
7–8	5.2±0.9	5.9±0.9	12	0.012
8–9	5.4±0.9	5.9±0.5	5	0.045
9–10	5.6±0.8	6.3±0.8	13	0.004
10–11	5.7±0.7	6.4±0.9	12	0.010
11–12	6.1±0.8	7.2±1.6	10	0.033
12–13	6.5±1.1	7.4±1.0	4	0.080
13–	7.5±1.0	11.6±2.4	4	-

Modified from Chung KH, et al. Korean J Urol 1987;28:255-8, with permission of The Korean Urological Association [3].
[a]:Student's t-test.

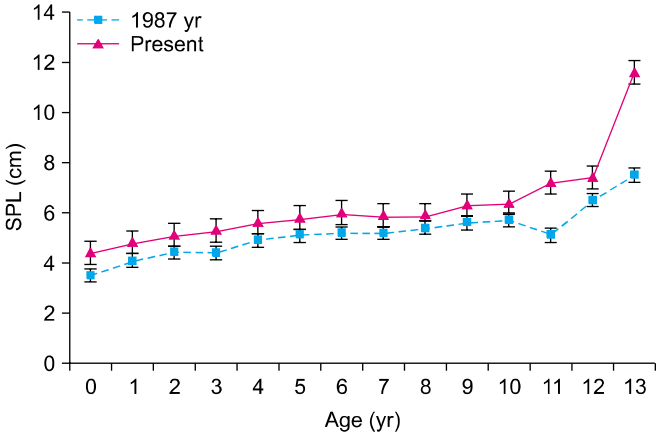

FIG. 2. Age-related changes in stretched penile length (SPL) in comparison with data from a previous study conducted in 1987 (modified from Chung KH, et al. Korean J Urol 1987;28:255-8, with permission of The Korean Urological Association) [3]. There were only four patients aged 12 and 13 years in these two studies, respectively. These results need to be validated in additional epidemiologic studies with more children.

such as height, body weight, and testicular size.

MATERIALS AND METHODS

This cross-sectional study was performed at the outpatient clinic of Ulsan University Hospital between April and October 2011. The subjects in this study were 233 male infants and children aged 1 to 158 months. Exclusion criteria included penile diseases (e.g., phimosis, hypospadias, and concealed penis), cryptorchidism, varicocele, and other growth problems (e.g., chronic renal failure and endocrinologic disorders). Therefore, most children who were brought to the clinic for a general periodic examination, urinary tract infections, enuresis, or lower urinary tract symptoms were included in the current study.

For all children, age, SPL, height, body weight, and testicular size were measured by a single urologist (SP). All measurements were performed in a warm room in the presence of the children's parents. SPL was measured with a ruler by compressing the fat tissue with one end of the ruler through the pubic ramus; then, the penis was fully stretched, and the distance to the glans of the stretched penis was measured and recorded (Fig. 1) [3,7-10]. None of the 233 children had been circumcised. The foreskins of the uncircumcised children were not included in the measurement. Each SPL measurement was performed twice, and the mean of the measurements was recorded. Testicular size was measured by using orchidometry.

1. Statistical analysis and ethics statement

The data were analyzed by using the software package SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as means±SDs. A comparison of SPL, height, body weight, and testicular size in the current

study were compared with data from a study conducted in 1987 by using Student's t-test, and a p-value < 0.05 was considered to be statistically significant. This study was approved by the Institutional Review Board of our institution (IRB no. 11-89). Clinical data were obtained by retrospectively reviewing the medical records of all the participants. Therefore, our Institutional Review Board permitted this study without obtaining informed consent.

RESULTS

The mean±SD SPLs of infants, 5-year-old boys, and 11-year-old boys were 4.4±0.6, 5.8±0.8, and 7.2±1.6 cm, respectively (Table 1, Fig. 2). In most age groups, SPL increased significantly by 0.7 to 1.1 cm as compared with the previous study in 1987 ($p < 0.05$). SPL increased relatively faster after 11 years of age (especially after 13 years of age) as compared with younger ages. The mean SPLs were 6.4, 7.2, 7.4, and 11.6 cm in 10-, 11-, 12-, and 13-year-olds, respectively. The change in testicular size was similar to that in penile size, and testicular size increased faster after 13 years of age (Fig. 3C). No significant change in testicular size between the 1987 study and the current study was observed in 0- to 8-year-olds. In most age groups, height and body weight were significantly greater in the current study than in the 1987 study (Table 2, Fig. 3).

DISCUSSION

The accurate measurement of penile length is very important in children with abnormal genital development (e.g., micropenis, buried penis, or hypospadias) and is specifically performed to detect underlying severe endocrinologic and chromosomal disorders, such as Down syndrome, Noonan syndrome, and William syndrome [11]. Various methods have been introduced to measure penile size. SPL is usually measured with a ruler or calipers by compressing the fat tissue with one end of the ruler through the pubic ramus; the penis is then fully stretched, and the distance to the glans of the stretched penis is measured and recorded [3,7-10]. However, the SPL method is insufficient at accurately measuring penile length in children with an inconspicuous penis. Another option for penile measurement involves the use of a 10-ml disposable syringe [12,13]. This method eliminates measurement variability caused by a suprapubic fat pad, but it does not involve stretching of the penis. Of the various methods available for measuring penile length, SPL has been widely used. Furthermore, the 1987 Korean study, data from which were used for comparison with the current study, used this method to measure

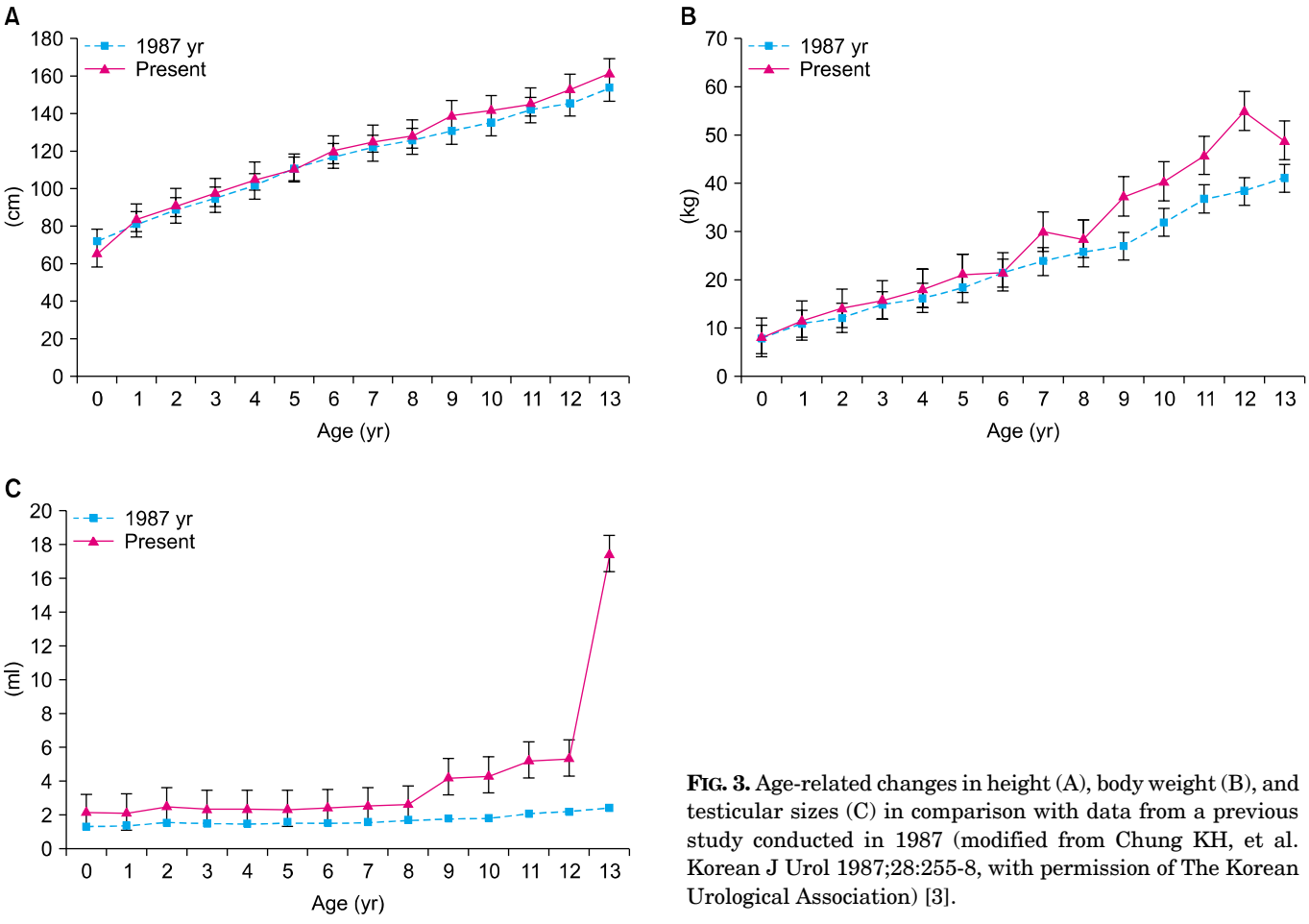

FIG. 3. Age-related changes in height (A), body weight (B), and testicular sizes (C) in comparison with data from a previous study conducted in 1987 (modified from Chung KH, et al. Korean J Urol 1987;28:255-8, with permission of The Korean Urological Association) [3].

TABLE 2. Age-related changes in height and weight in comparison with data from a previous study conducted in 1987

Age (yr)	Height (cm)			Weight (kg)		
	1987 yr	Current study	p-value[a]	1987 yr	Current study styssstudy	p-value[a]
0–1	72.2±3.1	66.0±6.6	<0.001	7.7±1.5	8.2±1.6	0.066
1–2	81.3±3.9	84.8±12.8	0.028	10.9±1.6	11.7±1.5	0.012
2–3	88.5±4.0	93.0±7.8	<0.001	12.2±2.2	14.2±2.0	<0.001
3–4	94.6±4.1	98.5±3.6	<0.001	14.8±1.9	16.0±1.7	0.011
4–5	101.9±4.3	106.9±3.9	<0.001	16.2±1.8	18.4±3.0	<0.001
5–6	110.8±4.4	111.4±12.1	0.367	18.4±2.5	21.4±7.0	0.001
6–7	117.6±6.9	121.4±6.6	0.025	21.5±3.4	21.8±7.7	0.405
7–8	121.8±5.1	126.9±4.0	<0.001	23.9±2.5	30.1±7.1	<0.001
8–9	125.8±7.0	129.7±8.6	0.118	25.8±3.6	28.7±11.0	0.076
9–10	131.1±3.6	140.0±9.6	<0.001	27.1±3.9	37.5±7.7	<0.001
10–11	135.6±5.2	142.8±5.7	<0.001	32.0±4.3	40.6±11.4	<0.001
11–12	142.2±5.7	146.7±9.6	0.018	36.9±5.3	46.0±13.4	<0.001
12–13	145.9±7.1	154.0±10.4	0.028	38.5±6.6	55.2±13.2	<0.001
13–	154.0±6.7	162.5±1.0	0.005	41.2±6.9	49.0±4.8	0.013

Values are presented as mean±SD.
Modified from Chung KH, et al. Korean J Urol 1987;28:255-8, with permission of The Korean Urological Association [3].
[a]:Student's t-test.

penile length. Therefore, we used the SPL method to measure penile length in the current study.

Studies of penile length in children have been rarely conducted, especially in a wide range of age groups. Studies of SPL published before 2000 were primarily conducted in non-Asian infants. Many recent studies of penile length were performed only in the neonatal period [10,14,15]. This has been accepted as the standard in many studies, and SPLs in term neonates were 3.75, 3.5±0.7, and 3.5±0.4 cm, respectively, in these three studies. In the 1987 Korean study, SPLs for newborns and infants were 3.3±0.5 and 3.5±0.6 cm, respectively [3]. Studies originating from some Asian countries, such as South India, Singapore, and Saudi Arabia, obtained similar results for SPL in newborns [16-18], and some studies from Indonesia, Japan, and China obtained significantly lower values [19-21]. Unfortunately, in the current study, no data on penile length in neonates were obtained; therefore, comparisons with these other studies were not possible. The penile length of infants (0 to 1 years of age) in the current study was 4.4±0.6 cm, which is longer than that observed in the 1987 Korean study [3] and similar to that observed in a 1942 study of whites [10] and in a 2007 study of Turkish children [8].

The penile growth observed in our study was not linear. A similar pattern of growth in penile length was reported in the 1987 Korean study [3] and in a Japanese study [20]. However, there were only four patients aged 12 and 13 years in these two studies, respectively. These results need to be validated in additional epidemiologic studies with more children.

In comparison, Boas et al. [22] observed a sharp increase in penile length from 0 to 3 months of age. The findings of Camurdan et al. [8] were similar: the fastest rate of increase in penile length occurred from 0 to 6 months of age and was slower from 48 to 60 months of age; however, no data on penile growth after 5 years of age were provided.

Why has penile length increased in the same country over the past 25 years? First, there was a regional difference between the two studies. The current study was performed in Ulsan, and the previous study (1987) was conducted in Seoul, Korea. However, the cohorts included in the previous and current studies both consisted of Koreans; therefore, this was thought to be a minor factor. Second, penile length was measured by different people in each study. However, the SPL method was used in both studies, so this should not have caused a problem. Third, anthropometric change was suggested to be the main factor. In the 2010 study, which was a national research project conducted by the Korean Agency for Technology and Standards, the average height increased by about 5 cm as compared with the study in 1986. This result supports our hypothesis that the standards that have been used since 1987 need to be updated. Many factors, including biologic and environmental changes and the different feeding patterns resulting from rapid economic growth since 1987, could have affected the growth and development of certain organs. The current study showed that anthropometric measures in Korean children have increased recently compared with those from 1987. A significant difference in height and body weight was also shown (Table 2, Fig. 3). Cinaz et al. [9] reported that penile length was directly proportional to age, height, and body weight, and height was the measure that was most significantly related to penile length.

Before the results of the current study are used as the new standards, they should be validated in additional epi-

demiologic studies with more children in a community-based population.

CONCLUSIONS

Penile length has increased significantly over the last quarter century. Therefore, it is suggested that novel reference values for penile length in prepubertal Korean children be established, from additional studies conducted in a larger community-based population, in order to diagnose and treat size-related penile disorders.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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