

Measurement for Mean Stretched Penile Length of Full-Term Newborns in Thailand

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Background: Neonatal micropenis is an essential indicator of hypogonadism. It is described as a penis that is normally formed but shorter than 2.5 standard deviations (SD) from the mean length of the penis when stretched. In contrast, the normal penile lengths of neonates have been investigated in numerous Western and Middle Eastern populations but have been barely studied in the Thai population.

Objective: To define the norms for penile length and testicular volume in Thai newborn males and to investigate the characteristic of micropenis in the Thai population.

Materials and Methods: The stretched penile length (SPL) and testicular volume of Thai male newborns were measured using an unmarked wooden spatula and a Prader orchidometer, respectively. Measurements were performed in the nursery ward within the first three days of life. Ethical approval was obtained from the Institutional Research Ethics Committee (approval No. IRBRTA 0613/2022).

Results: The study included 239 Thai male newborns, 221 of whom were full-term neonates, and 18 were pre-term. The pre-term group was excluded. The mean SPL of full-term newborns was 3.41 cm, with SD of 0.44 cm. The mean testicular volume was 2.4 mL, with SD of 0.7 mL.

Conclusion: Using 2.5 SD below the mean SPL, micropenis is defined as a SPL of less than 2.31 cm in Thai neonate. In such instances, additional investigation with more study sample is required.

Keywords: Micropenis; Penile length; Pediatrics urology; Urologic endocrinology

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Evaluation of the external genitalia is an important part of the physical exam in newborns. A smaller-than-average penis, or micropenis, may indicate low testosterone or hypogonadism, or abnormal pituitary gland function as hypothalamus-pituitary axis disorder. During the early postnatal period, micropenis is defined as a stretched penile length (SPL) shorter than the mean minus 2.5 times the standard deviation (mean – 2.5 SD)⁽¹⁾. SPL is the length of the stretched penis, which is measured from the pubic symphysis to the tip of the glans.

Previous research has shown that newborn SPL differs among races^(2,3). Research by Lian et al.⁽²⁾

indicated that the penile length of the Chinese newborn's penis is 3.5 cm, compared to the penile length of Malaysians (3.6 cm) and Indians (3.8 cm), which are a statistically significant difference. Including the research work of Cheng & Chanoine⁽³⁾ defined the micropenis of Caucasians, East Indians, and Chinese people as length 2.6, 2.5, and 2.3 cm, respectively. Ting & Wu⁽⁴⁾ stated that the Penile length of Malaysians was 3.52±0.39 cm, Chinese was 3.52±0.4 cm, and Indians was 3.75±0.45 cm. From these data, it is clear that the length of the male newborn's penis varies among different races.

Additionally, the research of Feldman & Smith⁽⁵⁾ and Flatau et al.⁽⁶⁾ indicated that the standard penile length of newborns is 3.5±0.7 cm and 3.5±0.4 cm, respectively. Most of the data was collected from white people, which may not apply to the Thai ethnic population.

Moreover, in Thailand, a large study indicated the standard Penile length of newborns of Thai ethnicity. Assawabumrunikul & Pichetsin⁽⁷⁾ performed a study in 2010 at Bhumibol Adulyadej Hospital that showed that the mean SPL was 3.28±0.249 cm. Another benefit of this research is that it can make doctors aware of

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the length of the newborn's Penile length, so it is necessary to start examining, diagnosing, and treating conditions such as hypogonadotropic hypogonadism, and hypergonadotropic hypogonadism or primary testicular failure, including diseases with genetic abnormalities such as Klinefelter syndrome, X polysomy, Trisomy of chromosome 8, 13, and 18, all of which will affect the development of many aspects of the baby, including genitalia development.

Materials and Methods

Study population

The SPL and testicular volume of Thai male newborns were measured using an unmarked wooden spatula and a Prader orchidometer, respectively. Measurements were performed in the nursery within the first three days of life by the same investigator throughout the research.

Stretched penile length

The SPL, which is measured from the pubic symphysis to the tip of the glans, using the Schonfeld's method⁽⁸⁾, was measured via an unmarked wooden spatula. While stretching the penis, the end of the spatula was placed against the pubic symphysis, and then a pencil was used for marking the length at the tip of the glans on the spatula. After that, the marked spatula was compared to a standard ruler for SPL, as per the modified Schonfeld's method. This process had been done thrice continuously for each newborn, and the median value was collected to eliminate bias and errors.

Testicular volume

The testicular volume, which is measured thrice in both testes, was measured with one hand and then ran through a standard Prader orchidometer with the other until a model of orchidometer appeared to have the same volume as the testis. To reduce the error of observation, the orchidometer was run through in both ascending and descending order. Three measurements were made for both testes, and their median was recorded as the testicular volume, following the Schonfeld's method⁽⁸⁾.

Reliability

All newborns in the study had three measurements made by the same investigator. The reliability of the investigator and measurement was assessed by establishing the intra-observer reliability collected from the first 20 newborns. The intra-observer reliability was 91% (Cronbach's $\alpha=0.91$).

Inclusion and exclusion criteria

Inclusion criteria consisted of all male newborns at the nursery ward in Phramongkutklo Hospital, Bangkok, Thailand, between July 2022 and November 2022. Since this research focused on Thai full-term healthy newborns, the exclusion criteria consisted of neonate whose mothers did not consent to participate in the research, non-Thai ethnicity, and the following conditions, ambiguous genitalia, hypospadias, undescended testis, hydrocele, dysmorphism, multiple congenital abnormalities, suspected endocrinological disorders, illness that required treatment in a hospital or intensive care unit, mothers with a history of taking hormones during pregnancy, and mothers with a history of living in an area where pesticides were used during pregnancy⁽⁹⁾. Newborns with hydrocele were excluded due to the potential impact on scrotal examination accuracy. Mothers with known hormonal therapy use or environmental exposure to endocrine-disrupting chemicals such as pesticides were excluded based on potential fetal hormonal influence.

According to Ting & Wu⁽⁴⁾ study, they found that the SD was 0.4 cm. Therefore, using this data, the calculated sample size was more than 62 cases.

Statistical analysis

The present study summarized continuous variables using means and SD. Pearson's correlation coefficient (r) was utilized to quantify the strength and direction of linear relationships between continuous variables. Degrees of freedom and t-statistics were calculated. Furthermore, associations between variables were explored through linear regression models. A p-value of less than 0.05 was established as the threshold for statistical significance. All statistical computations were performed using IBM SPSS Statistics, version 28.0 (IBM Corp., Armonk, NY, USA).

Ethical approval was obtained from the Institutional Research Ethics Committee (approval No. IRBRTA 0613/2022).

Results

Between July and November 2022, 259 newborns were observed and 38 were excluded. The other 221 newborns were included in the study (Figure 1). The characteristics of the included newborns are shown in Table 1. The mean gestational age was 38.38 weeks with a range of 37 to 41 weeks. The mean birth weight was 3134.58 grams with a range of 2,196 to 4,350 grams.

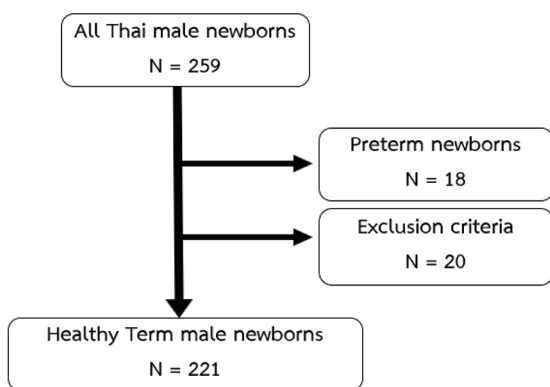


Figure 1. Research methodology.

Table 1. Demographic data (n=221)

Demographic data	Minimum	Maximum	Mean	SD
Gestational age (weeks)	37	41	38.38	0.90
Body weight (grams)	2,196	4,350	3,134.58	392.36

SD=standard deviation

An unmarked wooden spatula was used to measure the length from pubic symphysis to tip of glans penis thrice, then the median value was collected by the same investigator to eliminate bias and errors, and the Prader orchidometer was used to measure the testicular volume as described.

The mean SPL of Thai term newborns was 3.41 cm, and the SD was 0.44 cm (Figure 2). The 95% confidence interval is 3.35 to 3.47 cm. According to the definition, micropenis in Thai newborns is defined as a length below 2.31 cm.

The scatterplot (Figure 3) showed a correlation between penile length and birth weight. The r value was a correlation coefficient. There was a weak positive correlation between penile length and birth weight, in other words, newborns with higher birth weight might have longer penile lengths.

Furthermore, the scatterplot (Figure 4) showed a weak positive correlation between testicular volume and birth weight, meaning that newborns with birth weight might also have larger testicular volumes.

Discussion

Micropenis is defined as a SPL shorter than the mean – 2.5 SD⁽¹⁾. SPL is the length of the stretched penis, which is measured from the pubic symphysis to the tip of the glans.

Studies have shown differences in stretched penile length between races^(2-6,10,11) (Figure 5).

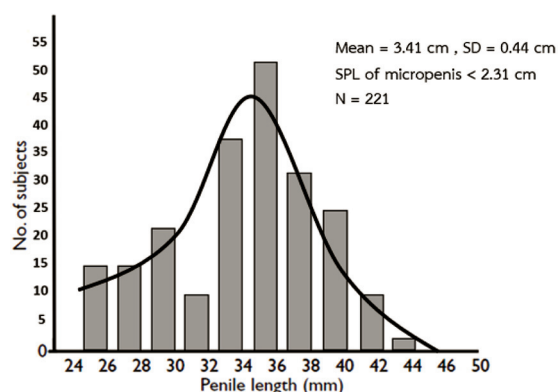


Figure 2. Histogram shows the distribution of stretch penile length of Thai term newborns.

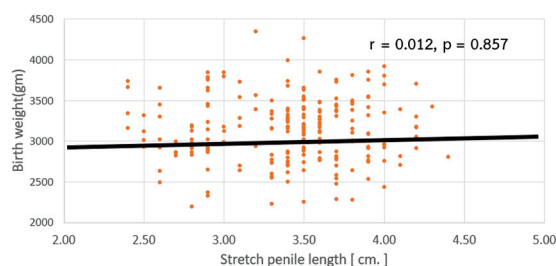


Figure 3. Scatterplot shows correlation between penile length and birth weight.

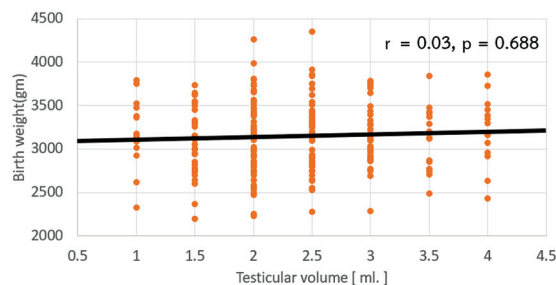


Figure 4. Scatterplot shows correlation between testicular volume and birth weight.

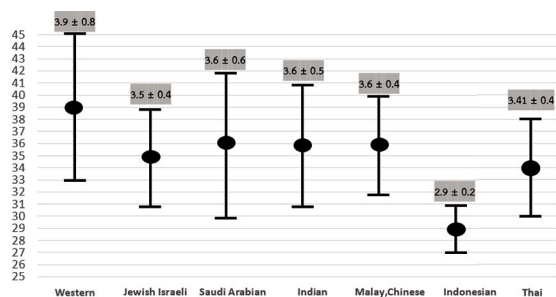


Figure 5. Mean SPL ± standard deviation (cm) between races^(2-6,10,11).

Ethnic differences in penile length standards

Studies have demonstrated that the mean SPL in newborns varies significantly across ethnicities. For example, data from Singapore revealed that Indian infants had a longer average SPL at 3.8 cm compared to Malays at 3.6 cm and Chinese at 3.5 cm. Similarly, Caucasian newborns in Western studies consistently showed a mean SPL of approximately 3.5 cm^(5,6). These findings highlight the necessity of establishing local normative values, as direct application of Western or multiethnic standards may not be appropriate for populations with distinct anthropometric and genetic characteristics, such as Thai newborns.

Importance of ethnic-specific definitions of micropenis

Micropenis is commonly defined as an SPL below 2.5 SD from the mean. However, if the reference mean was derived from a different ethnic group, this threshold may lead to under- or over-diagnosis. For example, applying Western norms to Thai newborns might misclassify infants with normal anatomical development as having micropenis, resulting in unnecessary endocrinologic evaluations and parental anxiety. Therefore, defining micropenis based on population-specific data is crucial for accurate diagnosis and appropriate clinical decision-making.

Risk of over- or underdiagnosis

Using universal thresholds without considering population variability increases the risk of misclassification. Overdiagnosis may lead to unnecessary hormonal tests or imaging, whereas underdiagnosis may delay the detection of conditions such as hypogonadotropic hypogonadism or chromosomal abnormalities. By establishing a Thai-specific SPL reference, the present study aimed to reduce such risks and support pediatricians and pediatric urologists in making evidence-based clinical decisions.

Comparison with previous Thai study

Assawabumrunkul & Pichetsin⁽⁷⁾ conducted a study involving 1,013 full-term Thai newborns and reported a mean SPL of 3.28±0.25 cm with a micropenis cutoff at 2.65 cm. The present study found a slightly higher mean SPL of 3.41±0.44 cm and a lower micropenis threshold of 2.31 cm. Several factors may explain this discrepancy.

Measurement techniques and tools: The previous

study did the measurement by placing the end of a straight edge ruler against the pubic ramus following the Schonfeld's method, whereas the present study used repeated measurements by a single trained examiner to enhance reliability. And the researchers used an unmarked wooden spatula calibrated to a standard ruler following the modified Schonfeld's method, which may decrease measurement bias and error.

Population and time: The present study mean SPL, obtained in 2022, was measured in newborns who might have different or better maternal environments, antenatal care, and nutrition than those born in 2010. These factors may affect the mean SPL, which was found to be slightly higher than the previous study.

Clinical implications

The findings of the present study provide an updated Thai-specific reference for SPL and testicular volume in full-term newborns. These values can serve as a practical guide for the early detection of disorders of sex development (DSDs), congenital hypogonadism, and chromosomal syndromes. Identifying micropenis early enables timely referral for hormonal testing and genetic workup, which may improve long-term outcomes in affected children.

Limitation

The present study has limitations. It was conducted at a single tertiary-care hospital, which may limit generalizability to rural or underserved populations. Only full-term newborns were included; therefore, the findings may not be applicable to preterm infants or those with intrauterine growth restriction. Maternal factors such as age, health status, or medication history were not evaluated, which could be potential confounders. Environmental exposures, such as endocrine-disrupting chemicals, were only superficially addressed. Long-term follow-up of the studied neonates was not performed; thus, the predictive value of SPL for future pubertal or hormonal outcomes remains uncertain.

Conclusion

The mean of SPL of Thai term newborns is 3.41 cm, with a SD of 0.44 cm. Micropenis in Thai newborns is defined as a length below 2.31 cm, which requires further investigation for hormonal or radiological abnormalities.

What is already known about this topic?

The research of Feldman & Smith⁽⁵⁾ and Flatau et al.⁽⁶⁾ indicated that the standard penile length of newborns is 3.5 ± 0.7 cm and 3.5 ± 0.4 cm, respectively, in 2010, Assawabumrunikul & Pichetsin⁽⁷⁾ reported a mean SPL of 3.28 ± 0.25 cm.

What does this study add?

This study shows new information about the mean of penile length and testicular volume of Thai newborns. Moreover, the research creates the definition of micropenis in the Thai population.

Conflicts of interest

The authors declare no conflict of interest.

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