

Penile Size in Term Neonates in Addis Ababa, Ethiopia: A Cross Sectional Study

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Abstract

Background: Proper genital examination including stretched penile size in neonates is important. Stretched penile size is different from one nation to another nation, it needs a standard for a particular population.

Objectives: is to establish the standard penile size for term newborns in Ethiopia.

Methods: Hospital based cross sectional study was conducted on 221 term neonates delivered from March 1, 2020 to July 30, 2020 in St. Paul's Hospital Millennium Medical College (SPHMMC)

Results: The minimum and maximum measured penile length was 2.5, and 5 cm respectively with mean (\pm SD) of 3.28 ± 0.42 . There was a weak positive correlation between stretched penile length and head circumference and body length. Neonates born via instrumental delivery had larger penile length.

Conclusion: Mean stretched penile length in our study was 3.28 ± 0.42 cm. Based on our findings, penile length at $\pm 2SD$ were 2.43 cm and 4.12 cm respectively.

Background

Normal growth of penis in a fetus depends on the Hypothalamic-Pituitary-Gonadal (HPG) Axis function, peripheral androgen action, and synthesis of testosterone (1). Fetal pituitary gonadotropin stimulates the production of androgens which in turn determine penile growth during the second and third trimesters of pregnancy. During this time the penile size increase markedly by about 2 centimeter. Failure of the HPG axis function, androgen and testosterone production and action will result in micropenis (2).

Genital examination including the stretched penile size (SPS) measurement is important at birth in order to pick abnormalities like micropenis. Micropenis is defined as penis with stretched penile length (SPL) of 2 SD below mean for age or stage of sexual development (3). It may be an independent clinical presentation or be part of a syndrome with various clinical manifestations with a reported incidence of 1.5 in 10, 000 male children in the USA. The first step in the diagnosis is proper physical examination of external genitalia that peaks small penis as well as normal localization of the urethral meatal opening. Traditional methods of penile measurement use a ruler or caliper to measure the phallus when fully stretched with the thumb holding the foreskin and distance measured from the pubic ramus to the distal end of the glans penis over the dorsal side. The obtained value should be compared with the normal values for the chronological age group of that specific society (4). Feldman and Smith were the first to establish a stepping stone for normal reference value of penile length which is then followed by various independent studies to establish standards for different racial groups (5).

Many studies demonstrated stretched penile length (SPL) is significantly affected by gestational age (GA), anthropometric measurements at birth, number of parity, and ethnicity (1, 6–11). The diagnosis of

micropenis needs nomograms defined for that specific nationality. This study was conducted to establish nomogram of stretched penile standard for newborns in Ethiopia.

Methods And Materials

A hospital based cross sectional study was conducted in a tertiary hospital. The study period was over a period of 5 months from March 1, 2020 to July 30, 2020 after ethical clearance obtained from the Ethical Review Board of SPHMMC. The data was collected by trained data collectors. In this study 221 neonates were included.

Perinatal history was completed from the chart and from the mother through a structured questionnaire. Gestational age was recorded as the number of completed weeks calculated from early obstetric ultrasound done in the first trimester or maternal last menstrual period documented on chart. Ballard score approved for use in SPHMMC neonatal ICU was used when early pregnancy ultrasound results were not available or last normal menstrual period was not reliable (12). Weight, head circumference and length was measured immediately after delivery. Measurement scores were recorded to one decimal. All measuring tools were sanitized before use for all neonates.

Penile length was measured in supine position with legs flexed using Schonfield's method (13). Measurement was made with disposable wooden spatula. It was placed on the dorsal aspect of the penis after the pubic fat pad was pushed and the shaft stretched to maximum resistance. Tip of the glans was palpated and the same level marked on the spatula with a pen. Length from end of spatula on symphysis pubis to the marked end was measured with a ruler in centimeters. All measurements were performed twice and the mean was taken. All measurements were performed within 72 hours of life. The participants' information was anonymized and de-identified before analysis.

The data was entered into Epi-Info version 7 and exported for analysis using SPSS v26. Descriptive statistics for continuous variables were summarized as mean with standard deviation, median, and range while categorical variables were tabulated as percentages. Pearson correlation coefficient was used for continuous variables. One-way ANOVA with post hoc analysis was also used. P-value less than 0.05 was considered statistically significant.

Results

Socio-demographic characteristics and anthropometric measurements

A total of 221 term newborns were included in this study. Mean maternal age was 26.8 ± 4.64 years and mean paternal age was 30.94 ± 6.08 . The mean (\pm SD) computed for birth weight (kg), head circumference (cm), body length (cm), and age at examination (hours) summarized in table (Table 1).

Table 1: Characteristics of study participants

| | Maternal Age | Paternal Age | Postnatal age (h) | HC (cm) | Birth weight (gm) | Length (cm) |
|----------------|--------------|--------------|-------------------|---------|-------------------|-------------|
| Mean | 26.84 | 30.94 | 22.24 | 35.44 | 3131.49 | 49.11 |
| Median | 27 | 30 | 19 | 35.5 | 3000 | 49 |
| Std. Deviation | 4.64 | 6.08 | 19.51 | 1.19 | 475.83 | 2.19 |
| Minimum | 18 | 22 | 1 | 33 | 2500 | 44 |
| Maximum | 40 | 55 | 72 | 38.5 | 4400 | 55 |

Obstetric characteristics of the study participants

Studied mothers had an average of two children (mean 1.92 ± 1.15) and mean gestational age was 38.9 ± 1.27 (Table 2).

About quarter of the mothers (26.6%) had pregnancy related complications with Preeclampsia (17.6%) and Gestational DM (5%) accounting for most (Fig. 1: Frequency of pregnancy related complications in mothers in SPHMMC, Addis Ababa, Ethiopia). More than half of the neonates (60.4%) were born by cesarean section, more than third of them (38.3%) born naturally and instruments were applied for the remaining neonates. None of the mothers had intervention for infertility, there were no consanguineous marriages, and there were no families with ambiguous genitalia.

Table 2: Obstetric characteristics of study participants

| | Minimum | Maximum | Mean | Std. Deviation |
|--------------------------|---------|---------|-------|----------------|
| Parity | 1 | 6 | 1.92 | 1.15 |
| Gestational age in weeks | 37 | 41 | 38.87 | 1.27 |
| Number of pregnancy | 1 | 2 | 1.07 | .25 |

Reference range for Stretched Penile Length

The minimum and maximum measured penile length were 2.5 cm and 5 cm, respectively with mean of 3.28 ± 0.42 cm. This study showed that the 2 SD below and above mean were 2.43 and 4.12 cm, respectively. The lower and upper limits ($\pm 3SD$) of SPL were 1.78 and 4.72 cm, respectively. Details of $\pm 1SD$, $\pm 2SD$, $\pm 3SD$ are summarized in Table 3 and Figure 2 (Fig 2: Nomogram of stretched penile length

in centimeter based on different GA of neonates. GA: Gestational age; SD: Standard deviation; SPL: Stretched penile length).

Table 3: Mean and SD of stretched PL (measured in cm) based on different GA of neonates

| GA | No. of cases | -3 SD | -2 SD | -1 SD | Mean | 1 SD | 2 SD | 3 SD |
|----|--------------|-------|-------|-------|------|------|------|------|
| 37 | 35 | 1.78 | 2.27 | 2.76 | 3.25 | 3.59 | 4.23 | 4.72 |
| 38 | 61 | 2.11 | 2.48 | 2.85 | 3.22 | 3.59 | 3.96 | 4.33 |
| 39 | 48 | 1.97 | 2.41 | 2.85 | 3.29 | 3.73 | 4.17 | 4.61 |
| 40 | 52 | 1.98 | 2.42 | 2.86 | 3.3 | 3.74 | 4.18 | 4.62 |
| 41 | 25 | 2.22 | 2.61 | 3.0 | 3.39 | 3.78 | 4.17 | 4.56 |

Correlation

There was a weak positive correlation between SPL and head circumference ($r = 0.147$, $p = 0.029$) and body length ($r = 0.188$, $p = 0.005$) but Pearson's correlation showed no statistically significant relationship between SPL and GA, weight, maternal age, paternal age, order of birth, and postnatal age (Table 4). Mode of delivery had a statistically significant association with SPL, ($F(2, 29) = 5.06$, $p = 0.007$). Post hoc analysis revealed neonates born via instrumental delivery had larger penile length than those who were born naturally and by cesarean delivery.

Table 4: Correlation between SPL and studied parameters

| Variable | Pearson's r | P value |
|--------------------|-------------|---------|
| Parity | -.015 | .819 |
| GA | .017 | .111 |
| Birth weight | .077 | .254 |
| Body length | .188* | .005 |
| Maternal Age | -.005 | .946 |
| Paternal Age | .036 | .594 |
| Head Circumference | .149 | .029 |
| Post natal age | .119 | .076 |

*Correlation is significant at the level 0.05 (2 tailed)

Discussion

The current study which included only term babies showed mean SPL of 3.28 ± 0.42 cm for all gestational age. Cutoff points at 2SD below and above the mean were 2.43 and 4.12 cm respectively.

Gestational age specific ± 1 , ± 2 , ± 3 SD were also determined. There was a weak positive correlation between stretched PL and HC and body length.

The earliest publication on penile standards for American newborns by Feldman et al. reported a larger penile length for full term infants $3.5 \text{ cm} \pm 0.7 \text{ cm}$ compared to the current study (5). Studies that employed similar methodology reported different penile sizes for Asian population. The study done by Mondal et al reported a larger measure of stretched penile length of $3.5 \pm 0.42 \text{ cm}$ measured at 48 – 72 hours of life for Indian babies whereas Singal et al. who did the measurement at similar age of life had comparable measurement result of $3.31 \pm 0.38 \text{ cm}$ to our current study (1, 14). Another study from India done by Bhakhri et al. demonstrated a smaller penile length at $2.98 \pm 0.48 \text{ cm}$ with measurement done within the first 24 hours of life (6).

Contributing factors to this observed difference might include inter observer variation, ethnic/racial differences and postnatal age at which the measurement was done. The edematous peripubic skin could make adequate stretching of the penis difficult when measurements were done at an earlier post natal age. Report by Matsuo et al. showed that length measured during the first 12 hours of life differed significantly from values between 1 and 7 (0.3 cm 95% CI 0.22 – 0.34) days of life by the same examiner even though they had small sample size and its statistical significance is unknown since they didn't provide p value (15).

Far smaller size of penile length was reported from an Indonesian study with mean (SD) of $2.86 \pm 0.23 \text{ cm}$ while another study for Chinese babies found a result of $3.0 \pm 0.4 \text{ cm}$ in larger sample size (16, 17). The result from both studies showed smaller penile size than our study.

Iranian study aimed to determine SPL values and cut off level of micro penis in term and preterm neonates showed much smaller phallic size of $2.59 \pm 0.15 \text{ cm}$ for term babies and cutoff values of 2.25 to diagnose micropenis in both sets of study population respectively (10). Similar studies from Turkish neonates showed different results with Halil et al. reporting comparable mean to our study ($3.2 \pm 0.55 \text{ cm}$) whereas another study reporting larger PL $3.77 \pm 0.35 \text{ cm}$ (11, 18). Inter observer variation might contribute to the difference observed in these studies as there is a report of as large as 0.5 cm measurement variation between various researchers(19).

Our study showed a closely similar mean SPL to babies from other parts of Africa. Studies from different Obstetric centers of Nigeria reported similar results to our current study. The mean reported by Ogundoyin et al. was $3.14 \pm 0.65 \text{ cm}$ from three different Obstetric centers (7). Our result is also similar to a study reported by Elusiyan et al. that reported size of $3.17 \pm 0.5 \text{ cm}$ (20). Another study from Nigeria that included neonates of all gestational age (Preterm, Term, and Post term) showed a larger mean of $3.4 \pm 0.48 \text{ cm}$ (21). Mohamed et al. reported mean of $3.14 \pm 0.38 \text{ cm}$ for Egyptian neonates with cutoff point of 2.19 cm for micropenis, whereas Ghanaian neonates also have closely related but a bit larger measured mean length of $3.3 \pm 0.5 \text{ cm}$ and penile length of 2.1 cm to diagnose micropenis (8, 9).

The difference in penile length among different populations can be explained by difference in race or genetic variation, sample size and type of participants as well as difference in methodological studies. Difference in standard deviations below mean or percentiles used contributed to the difference in values set to diagnose micropenis. Significant differences in SPL and the cutoff values among different races/ethnicities is an indication that health workers should use values that are specific for their population.

Our study demonstrated a weak but statistically significant correlation between SPL and head circumference ($r= 0.147$ $p= 0.029$) and body length ($r=188$, $p=0.005$) but not with GA, birth weight, maternal age, order of birth, or number of pregnancy. In our study neonates delivered by instrumental delivery had a larger penile size than born either through spontaneous vaginal delivery or cesarean section. The larger body length that positively correlates to SPL might contribute to difficult labor and higher rate of instrumental delivery in those neonates. But the number of neonates delivered by instrumental delivery in our study was too small to make this conclusion.

Correlation of SPL and different factors reported from many studies is considerably different. SPL is correlated positively with GA, body length, birth weight (1, 6–11, 17). Positive correlation between SPL and head circumference was also reported previously whereas some studies reported no correlation between SPL and other measured factors (1, 16, 18, 20, 21). Few studies reported mode of delivery and they showed babies born via cesarean section had the lowest mean penile length while other studies showed the correlation only (9, 10).

This difference in correlation could be caused by the difference in response to androgen by different tissues as penile size depends on the level and action of testosterone in contradiction to other measured anthropometric parameters that depend on the intra uterine environment, mainly nutrition. The absence of correlation between SPL and birth weight in this study helps to extend the use of proposed data to be used in term neonates who are small for gestation.

Limitations Of The Study

We tried to study as many variables as possible but other variables that could had correlation with SPL such as ano-genital distance and serum testosterone level were not studied. Confounders were not controlled in this study.

Conclusion

This study showed mean SPL that was comparable to results from other parts of Africa. It generated reference values for our setup. Cutoff points for 2 SD below and above mean are 2.43 and 4.12 cm respectively.

Abbreviations

GA: Gestational Age; **GDM:** Gestational Diabetes Mellitus; **HC:** Head Circumference; **ICU:** Intensive Care Unit; **IRB:** Institutional Review Board; **SD:** Standard Deviation; **SPHMMC:** Saint Paul's Hospital Millennium Medical College; **SPL:** Stretched Penile Length; **SPS:**

Declarations

Ethics Declaration

Ethics Approval and consent to participate

This study was approved by Institutional Review Board of St. Paul's Hospital Millennium Medical College and all parents/guardians of the participants provided written informed consent for participation in the study. The study protocol was carried out in accordance with the Declaration of Helsinki.

Consent for publication: Not applicable

Availability of data and materials: The datasets used during the current study are available from the corresponding author on reasonable request

Competing interests: The authors declare that they have no known competing interests

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Author's Contribution: KM conceived the study, designed data collection tool, undertook data review and performed statistical analysis, interpretation of the data and drafted the manuscript. AY advised on statistical analysis. BF advised the research work starting from the proposal development and manuscript writing. FM advised on topic selection, proposal development, and manuscript writing. All authors revised the manuscript and approved the final version.

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Figures

Fig. 1

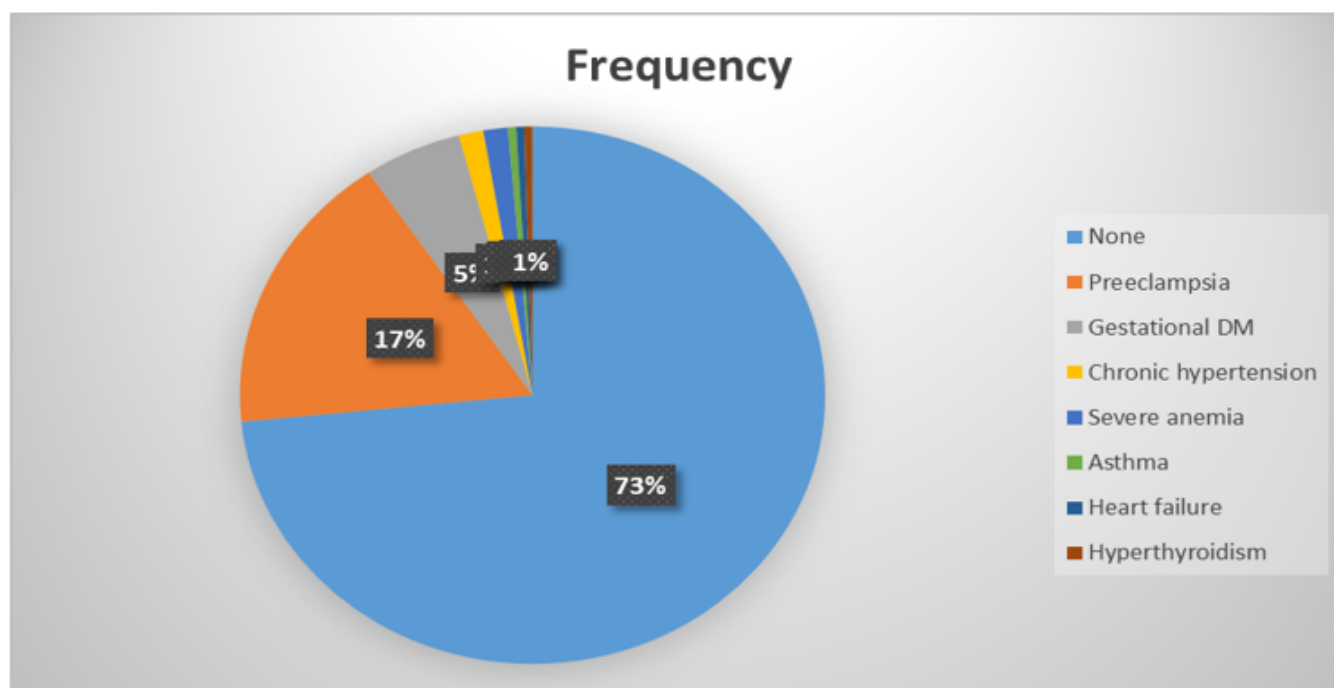


Figure 1

About quarter of the mothers (26.6%) had pregnancy related complications with Preeclampsia (17.6%) and Gestational DM (5%) accounting for most (Fig. 1: Frequency of pregnancy related complications in mothers in SPHMMC, Addis Ababa, Ethiopia).

Fig: 2

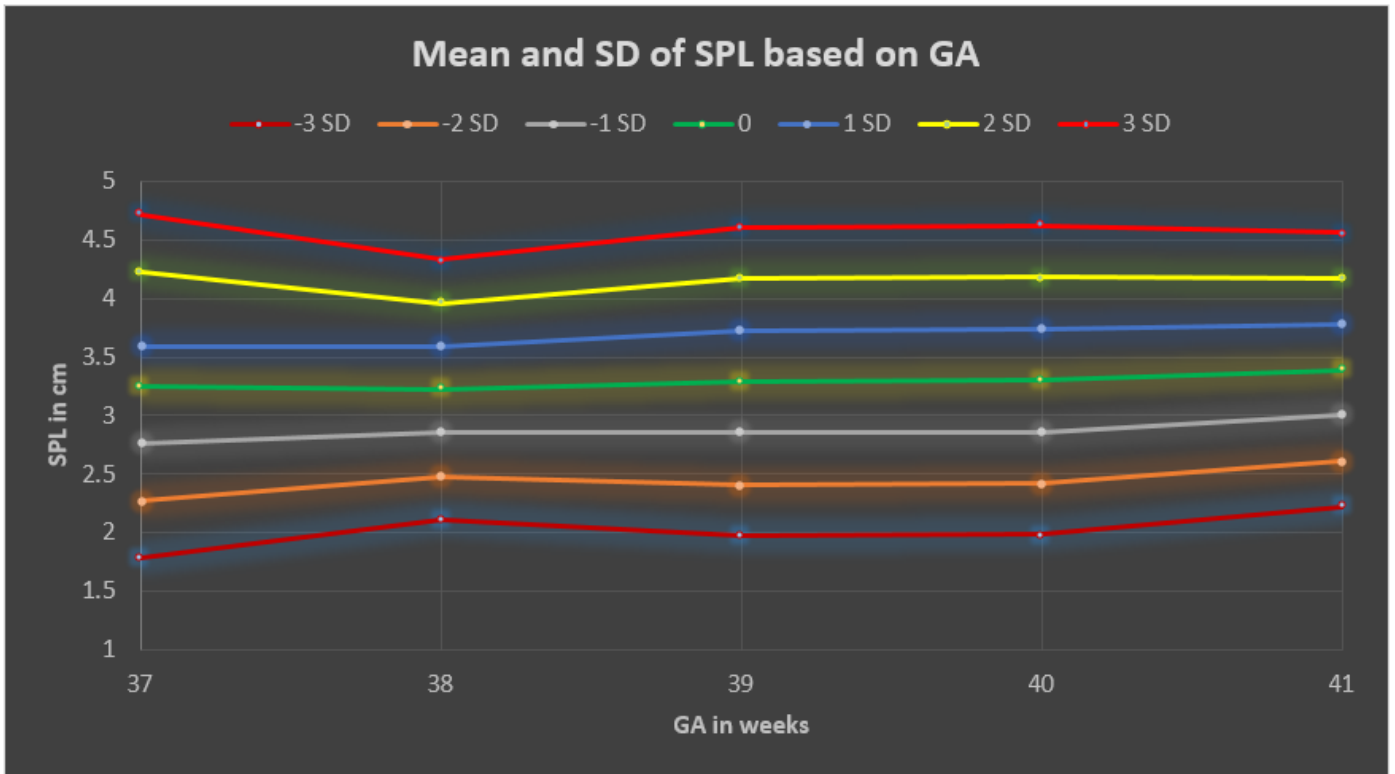


Figure 2

The minimum and maximum measured penile length were 2.5 cm and 5 cm, respectively with mean of 3.28 ± 0.42 cm. This study showed that the 2 SD below and above mean were 2.43 and 4.12 cm, respectively. The lower and upper limits ($\pm 3SD$) of SPL were 1.78 and 4.72 cm, respectively. Details of $\pm 1SD$, $\pm 2SD$, $\pm 3SD$ are summarized in Table 3 and Figure 2 (Fig 2: Nomogram of stretched penile length in centimeter based on different GA of neonates. GA: Gestational age; SD: Standard deviation; SPL: Stretched penile length).