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**Measurements of a “normal vulva” in women aged 15-84: A cross-sectional prospective single centre study**

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**Shortened running title:** The normal caucasian vulva: A cross-sectional study

**Objective:** Accurate and detailed description of a „normal vulva“ is rare, even though few studies dealt with the topic of normal measurements of parts of the external female genitalia. This leads to a situation with a wide range of existing diagnoses concerning "normal" vulvar morphology.

**Design:** Cross-sectional prospective single center study.

**Setting:** From August 2015 to April 2017 we included 657 women in our gynecological and uro-gynecological outpatient clinic of the Cantonal Hospital Lucerne.

**Population or Sample:** We recruited Caucasian women aged 15-84 years.

**Methods:** Standardized defined measurements were taken of the clitoral gland, distance from the base of the gland to the urethral orifice, length of introitus, length of perineum, length of labia majora, length and width of labia minora. Furthermore we recorded baseline characteristics.

**Main Outcome Measures:** The length of labia minora ( $r = -.364$ ,  $p < .001$ ,  $n = 657$ ) as well as the length of the perineum ( $r = -.095$ ,  $p = .014$ ,  $n = 657$ ) are inversely correlated with the age. A positive correlation between BMI and the length of the labia majora ( $r = .150$ ,  $p < .001$ ,  $n = 657$ ) and the length of the introitus ( $r = .097$ ,  $p = .014$ ,  $n = 657$ ) was found.

**Results:** We provide detailed-data on age-related dimensions and description of the external female genitalia in a homogenous group of caucasian women.

**Conclusion:** With our data we present a baseline for the appearance of a normal caucasian vulva, which could set up standards for indication in gynecological cosmetic surgery.

**Funding Statement:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Key words:** anatomy, external female genitalia, measurements, normal vulva, vulva

**Tweetable abstract:** This study presents data on standard dimension of the external female genitalia and is, to our knowledge the biggest cohort presented on this topic by now.

## Introduction

Accurate and detailed description of the external female genitalia is rare and thus reproducible definitions concerning the “normal” appearance of the vulva are still under debate. Even most medical textbooks lack information of vulvar morphology<sup>1</sup>. Defining the “normal” appearance today, we are using limited data from the beginning of the 20th century.

In 1924 Maria Bonaparte was the first woman publishing data concerning dimensions of the anatomy of the female genitalia. Her idea was that the distance between clitoris and vagina affects the likelihood of women experiencing orgasm during sexual intercourse. Under the pseudonym A.E. Narjani she published her theory of frigidity<sup>2,3</sup>.

The necessity to set up valid standards concerning definitions of anatomical relationship and dimensions of the external female genitalia, is reflected through published data in recent years. Basaran et al. showed in a cohort with pre- and postmenopausal women that a wide variation of the appearance of female genitalia exists. He concluded that further studies are needed on the “normal” appearance of the vulva and clear definitions<sup>4</sup>.

Furthermore, discussions involving women in their reproductive years, is indirectly linked to missing standards and definitions of the „normal“vulva presentation. Genital appearance raised awareness among young women in the last decade<sup>5</sup>.

Despite the fact that the appearance differs depending on ethnicity, age, weight, hormonal status or type of skin, young women are seeking an perfect body image<sup>4,6</sup>. This body image is not seldom influenced by the media and thus rising numbers of cosmetic surgery consultations are resulting<sup>7,8</sup>.

The primary purpose of this prospective cohort study was to present standard values concerning the external female genitalia and its appearance among caucasian women. The primary aim was to set up a database that represents reliable standard values of the vulva.

## Methods

Women were included during outpatient clinics in our gynecological and our uro-gynecological department of the Cantonal Hospital Lucerne, Switzerland. Recruitment period was from August 2015 to April 2017. Women were eligible for inclusion if aged between 15-84 years, able to speak, and to write sufficiently well in the German language, and able and willing to sign an informed consent. We chose to include caucasian women only, to create a homogenous group of just one

ethnicity. Women were excluded if they met one of the following criteria: pregnancy, use of systemic hormone therapy (except contraceptive pill), chronic vulva disease (e.g. Lichen sclerosus), vulvar complaints or any prior surgery of the vulva.

Baseline characteristics (age, height, weight, parity and type of delivery) were sampled by a physician during outpatient clinics. Body mass index (BMI) was calculated from height and weight and categorized in one of the following four groups according to the World Health Organisation classification: underweight ( $<18.5 \text{ kg/m}^2$ ), normal range ( $18.5\text{-}24.99 \text{ kg/m}^2$ ), overweight ( $25\text{-}29.99 \text{ kg/m}^2$ ) and obese ( $>30 \text{ kg/m}^2$ ).

According to the women's age they were matched in one of the following seven subgroups (decades): decade I aged between 15 and 24 years, decade II aged between 25 and 34 years, decade III aged between 35 and 44 years, decade IV aged between 45 and 54 years, decade V aged between 55 and 64 years, decade VI aged between 65 and 74 years and decade VII aged between 75 and 84 years.

The aim was to include a total of 650 women. In decades I-VI a total of 100 were in each group and in decade VII 50 women.

Recording measurements of the external female genitalia was performed in lithotomy position using a disposable paper measure. Analysis was performed for each site: width of the clitoral gland, clitoral length, distance from the base of the gland to the urethral orifice, length of introitus, length of perineum (posterior fourchette to anterior anal margin), length of labia majora, length of labia minora (from clitoris to the lower margin of the labia), width of labia minora (from the sulcus infralabialis to the margin of the labium minora, not stretched). All values are visualized in Figure 1.

An educational period of teaching the accurate measurements was initiated before the start of the inclusion period. The study coordinator performed a one-on-one instruction lecture for each investigator and supervised the first five measurements to reduce inter-observer variability. A total of 12 gynecologists, approved by the ethic committee, performed the examinations.

Analysis of data was performed using Stata (Version 14.2, StataCorp, College Station, Texas, USA) by LD (Dirk Lehnick). Descriptive statistics were calculated for basic patient characteristics. A two-tailed p-value less than 0.05 was considered the threshold of statistical significance; Results presented as means  $\pm$  standard deviation.

Human Research Ethics approval has been obtained for this study from the „Ethikkommission Nordwest- und Zentralschweiz (EKNZ). The commission accepted this study on the 28th of July 2015 (EKNZ 2015-222).

Core outcome sets and patient involvement were not employed and the study was unfunded.

## Results

During a 20 months period, August 2015 to April 2017, a total of 657 women were recruited.

Mean age of the women was  $47.27 \pm 18.5$  years. Women varied in height from 142 to 186 cm (mean  $165 \text{ cm} \pm 6.79$ ) and weight from 35 to 136 kg (mean  $68.8 \pm 14.6$ ). BMI ranged from 13.7 to 51.8 kg/m<sup>2</sup> ( $25.4 \text{ kg/m}^2 \pm 5.3$ ). Regarding parity, 245 were nulliparous and 412 were parous, 56 of them had an cesarean section, 331 a vaginal delivery and 25 both (cesarean section and vaginal delivery). Baseline characteristics are summarized in Table 1.

Average measurements of the vulva incorporating the whole cohort are demonstrated in Table 2. Asymmetry of right and left-side measurements of the labia majora and labia minora were not statistically significant. Standard values concerning the external female genitalia for each cohort according to decades are summarized separately in Table 3. The results for each cohort are visualized as boxplots (Figure S1-S11) and percentile (Figure S12-S22).

In a further step we analyzed correlations between baseline characteristics and the obtained measurements.

Statistical significant negative correlation between the age and the following parameters was seen: The length of the clitoris ( $r = -.169, p < .001, n = 657$ ), the distance of the clitoris to the urethra ( $r = -.283, p < .001, n = 657$ ), the length of labia minora ( $r = -.364, p < .001, n = 657$ ) as well as the length of the perineum ( $r = -.095, p = .014, n = 657$ ).

Positive correlation was found between the BMI of the patient and the length of the introitus ( $r = .097, p = .014, n = 657$ ) and the length of the labia majora ( $r = .150, p < .001, n = 657$ ).

In contrast, negative correlation between the BMI and the length ( $r = -.170, p < .001, n = 650$ ) as well as the the width of the labia minora ( $r = -.133, p < .001, n = 650$ ) and the length of the clitoris ( $r = -.078, p = .048, n = 650$ ) was found.

Positive correlation was detected between vaginal delivery and the length of the introitus ( $r = .136$ ,  $p < .01$ ,  $n = 546$ ) and the length of labia majora ( $r = .133$ ,  $p < .01$ ,  $n = 546$ ). Negative correlation was seen in the distance of the clitoris to the urethra ( $r = -.241$ ,  $p < .001$ ,  $n = 546$ ) for women with vaginal delivery. In women with cesarean section no significant differences were found.

## Discussion

### Main findings

Concerning the size and appearance of the external female genitalia we were able to reveal dependencies based on our analysis. Correlation between length of the labia majora and the BMI of the patient, which was already described by Cao et al. in 2015 is confirmed with these results<sup>9</sup>. This fact supports the assumption that uniform thresholds concerning the size of the vulva for diagnoses of vulvar diseases are inappropriate. Measurements of the external female genitalia in women are of great value in setting up diagnoses but must rather be interpreted on an individual basis than used as irrefutable diagnostic criteria. This is also underlined by the finding that vaginal delivery, the length of the introitus and the length of the labia majora correlate positively. Measurements should be standardized and used with caution, since previous studies presented very differing means of vulvar structures, suggesting a population-based and observer-based bias<sup>4,6</sup>. Consciously we choose caucasian origin as an inclusion criteria to create a large homogenous group of women without diversities based on ethnicity.

### Strengths and limitations

The small number of elderly women (decade VII: 75 to 84 years) is justified due to substantially lower numbers of women being eligible for inclusion or willing to participate.

We also know about the fact, that we are presenting only limited data because of our limitation to caucasian women. Further studies are needed to present data of heterogenous groups of women and different ethnicities.

### Interpretation

The individual analysis of measurements of the external female genitalia becomes even more important in the field of highly elective cosmetic surgeries like labioplasty. Over the last decade the self-perception concerning the genital appearance raised awareness among young women. Subsequently, this leads to increasing numbers of consultations for cosmetic surgery as young women seek information especially in vaginal tightening and labial reduction<sup>5,7</sup>.

However, dimensions of labia minora being used have been based on only small studies and there is

no consensus in the literature concerning classification and definition of hypertrophy of the labia minora<sup>10</sup>. Clerico et al. defined the normal size for labia minora with a length of 20-30 mm and a width of 15 mm<sup>11</sup>. Conventionally labial hypertrophy is defined as maximal width exceeding 5 cm<sup>12, 13</sup>. In contrast, Rouzier et al. proposed 4 cm and Munhoz et al. 3 cm<sup>14, 15</sup> as threshold for plastic surgery. The current study provides additional data about mean labial dimensions and the factors that are associated with variations in size. Furthermore, with the presented values for each cohort and decade it could be possible to interpret values on a more objective basis.

### **Conclusion**

This cross-sectional study presents the largest cohort on demographic data concerning the normal size of the external female genitalia. Despite the fact that these data, being solely from caucasian women, we are convinced this study will pave the way for further studies publishing data between different ethnicities and from heterogeneous groups of women around the world.

Nevertheless, with our data we present a baseline for the appearance of a normal caucasian vulva and set up standards not just for indication in gynecological cosmetic surgery. In combination with measurements of the vulva in patients with diagnosed vulvar diseases these data do have the potential to set international valid guidelines.

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### **Disclosure of interests**

The authors report no conflict of interest. Completed disclosure of interest forms are available to view online as supporting information.

### **Contribution to authorship**

Conception and design of the work: AK, AG, IV

Data collection: AK, IV, FS, RB, CC

Data analysis and interpretation: AK, FO, AG

Drafting the article: AK, FO, AG, CC

Critical revision of the article: AK, IV, FO, FS, RB, CC, AG

Final approval of the version to be published: AK, IV, FO, FS, RB, CC, AG

### **Ethics approval**

This study was approved by the "Ethikkommission Nordwest- und Zentralschweiz" on 28th of July 2015 (EKNZ 2015-222).

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## Figure and Table Legends

**Figure 1:** Standard measurements of the external female genitalia

**Table 1:** Patient distribution and basic patient characteristics

**Table 2:** Genital measurement (whole cohort)

**Table 3:** Genital measurements (each cohort separately)

## Supporting Figure Legends

**Figure S1:** Width of Clitoris distinguished by decades

**Figure S2:** Length of Clitoris distinguished by decades

**Figure S3:** Length of Perineum distinguished by decades

**Figure S4:** Distance Clitoris Urethra distinguished by decades

**Figure S5:** Length of Introitus distinguished by decades

**Figure S6:** Length of Labia majora (right) distinguished by decades

**Figure S7:** Length of Labia majora (left) distinguished by decades

**Figure S8:** Length of Labia minora (right) distinguished by decades

**Figure S9:** Length of Labia minora (left) distinguished by decades

**Figure S10:** Width of Labia minora (right) distinguished by decades

**Figure S11:** Width of Labia minora (left) distinguished by decades

**Figure S12:** Width of Clitoris distinguished by decades

**Figure S13:** Length of Clitoris distinguished by decades

**Figure S14:** Length of Perineum distinguished by decades

**Figure S15:** Distance Clitoris Urethra distinguished by decades

**Figure S16:** Length of Introitus distinguished by decades

**Figure S17:** Length of Labia majora (right) distinguished by decades

**Figure S18:** Length of Labia majora (left) distinguished by decades

**Figure S19:** Length of Labia minora (right) distinguished by decades

**Figure S20:** Length of Labia minora (left) distinguished by decades

**Figure S21:** Length of Labia minora (left) distinguished by

**Figure S22:** Width of Labia minora (left) distinguished by decades

| age in years   | number in total | mean age in years | mean BMI |
|----------------|-----------------|-------------------|----------|
| 15- 24         | 100             | 21.31             | 22.86    |
| 25- 34         | 100             | 29.41             | 23.43    |
| 35- 44         | 102             | 39.46             | 25.41    |
| 45- 54         | 104             | 48.93             | 25.41    |
| 55- 64         | 100             | 59.07             | 27.1     |
| 65- 74         | 100             | 69.62             | 26.61    |
| 75- 84         | 51              | 78.53             | 27.13    |
| <b>Overall</b> | 657             | 47,27             | 25.42    |

**Table 1:** Patient distribution and basic patient characteristics

|                                       | mean<br>(in mm) | Standard deviation | Minimum<br>(in mm) | Maximum<br>(in mm) |
|---------------------------------------|-----------------|--------------------|--------------------|--------------------|
| <b>Width of Clitoris</b>              | 4.62            | 2,538              | 1                  | 22                 |
| <b>Length of Clitoris</b>             | 6.89            | 4,965              | 0.5                | 34                 |
| <b>Distance Clitoris - Urethra</b>    | 22.63           | 7,661              | 3                  | 65                 |
| <b>Introitus Opening</b>              | 27.91           | 10.36              | 6                  | 75                 |
| <b>Length of Perineum</b>             | 21.34           | 8,544              | 3                  | 55                 |
| <b>Length of Labia majora (right)</b> | 79.71           | 15.25              | 12                 | 180                |
| <b>Length of Labia majora (left)</b>  | 79.99           | 15.44              | 20                 | 180                |
| <b>Length of Labia Minora (right)</b> | 42.1            | 16.35              | 6                  | 100                |
| <b>Length of Labia Minora (left)</b>  | 42.97           | 16.29              | 5                  | 100                |
| <b>Width of Labia Minora (right)</b>  | 13.4            | 7,875              | 2                  | 61                 |
| <b>Width of Labia Minora (left)</b>   | 14.15           | 7,643              | 1                  | 42                 |

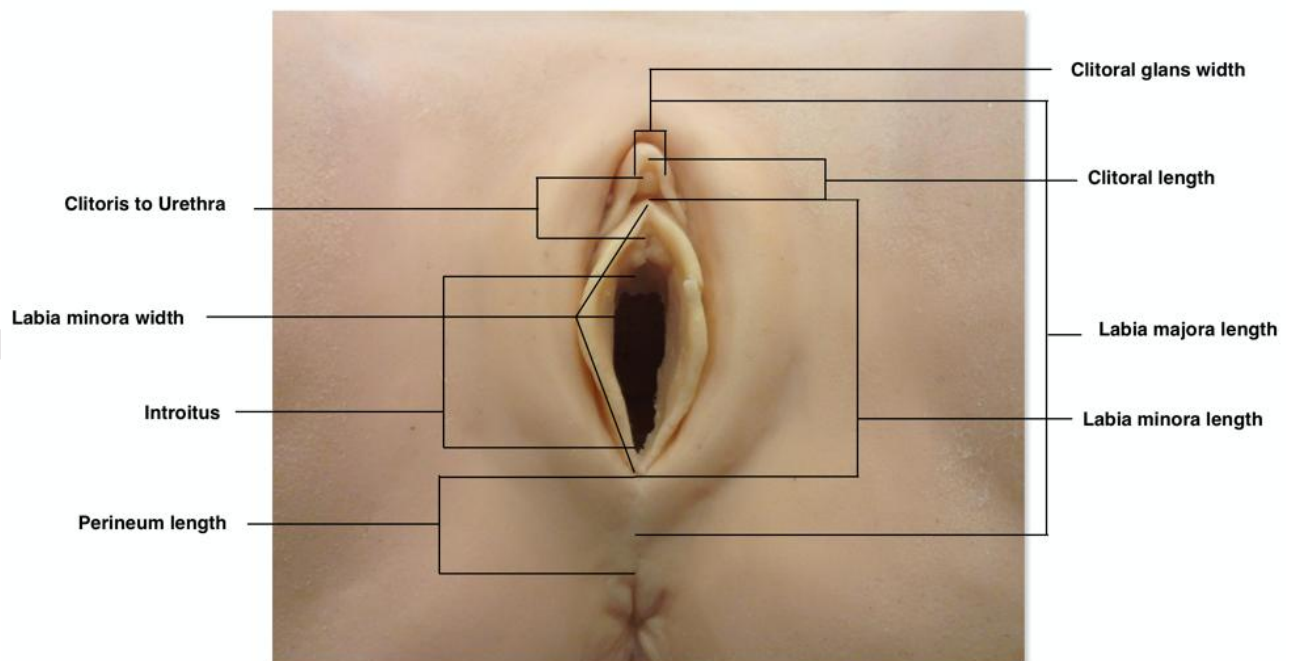
**Table 2:** Genital measurements (whole cohort)

|  | 15-24<br>years | 25-34<br>years | 35-44<br>years | 45-54<br>years | 55-64<br>years | 65-74<br>years | 75-84<br>years |
|--|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| <b>Width of Clitoris</b>               | 4.73           | 4.69           | 4.52           | 4.58           | 4.99           | 4.38           | 4.33           |
| <i>5. Percentile</i>                   | 2              | 2              | 2              | 2              | 2              | 2              | 2              |
| <i>50. Percentile</i>                  | 4              | 4              | 4              | 4              | 4              | 4              | 4              |
| <i>95. Percentile</i>                  | 10.95          | 9.95           | 9              | 10             | 10.95          | 8.95           | 11.6           |
| <b>Length of Clitoris</b>              | 7.86           | 7.27           | 7.47           | 6.75           | 6.83           | 6.04           | 5.17           |
| <i>5. Percentile</i>                   | 2              | 2              | 3              | 2.25           | 3              | 3              | 1.6            |
| <i>50. Percentile</i>                  | 6              | 6              | 6              | 5              | 5              | 5              | 4              |
| <i>95. Percentile</i>                  | 21.9           | 19.85          | 19.85          | 14             | 17.95          | 13.85          | 17             |
| <b>Distance Clitoris -<br/>Urethra</b> | 24.78          | 25.8           | 24.27          | 21.58          | 20.94          | 19.92          | 19.69          |
| <i>5. Percentile</i>                   | 15             | 14             | 12.15          | 11.25          | 11             | 10             | 7.2            |
| <i>50. Percentile</i>                  | 25             | 25             | 24             | 20             | 20             | 20             | 20             |
| <i>95. Percentile</i>                  | 39.9           | 40             | 40             | 35             | 34.85          | 30             | 33.2           |
| <b>Introitus Opening</b>               | 27.07          | 27.75          | 28.53          | 28.12          | 29.38          | 27.79          | 25.55          |
| <i>5. Percentile</i>                   | 13.03          | 14             | 14             | 14             | 12             | 10             | 11.6           |
| <i>50. Percentile</i>                  | 25             | 26             | 28.5           | 26             | 30             | 26             | 25             |
| <i>95. Percentile</i>                  | 44             | 47.85          | 45             | 46.75          | 45             | 49.9           | 40             |
| <b>Length of Perineum</b>              | 21.39          | 21.13          | 22.71          | 22.57          | 22.27          | 19.73          | 17.71          |
| <i>5. Percentile</i>                   | 10.1           | 10             | 10             | 10             | 10             | 8.1            | 6.2            |
| <i>50. Percentile</i>                  | 20             | 20             | 22             | 20             | 20.5           | 20             | 18             |

|                                       |       |        |        |       |       |        |       |
|---------------------------------------|-------|--------|--------|-------|-------|--------|-------|
| <i>95.Percentile</i>                  | 35    | 37     | 37.55  | 40.5  | 35    | 35     | 32    |
| <b>Length of Labia majora (right)</b> | 74.03 | 77.81  | 84.82  | 83.72 | 81.13 | 79.31  | 74.14 |
| <i>5.Percentile</i>                   | 55    | 60     | 65     | 60.75 | 60    | 55.15  | 41.2  |
| <i>50.Percentile</i>                  | 74    | 79.5   | 81.5   | 81    | 80    | 80     | 70    |
| <i>95.Percentile</i>                  | 99.75 | 100.95 | 112.55 | 105   | 100   | 109.75 | 103.2 |
| <b>Length of Labia majora (left)</b>  | 74.17 | 78.29  | 85.24  | 83.46 | 81.69 | 79.3   | 75.24 |
| <i>5.Percentile</i>                   | 55    | 60     | 64.15  | 63.5  | 55.15 | 50.05  | 44.8  |
| <i>50.Percentile</i>                  | 74    | 80     | 85     | 80.5  | 80    | 80     | 75    |
| <i>95.Percentile</i>                  | 99.75 | 100.95 | 112.55 | 105   | 109.5 | 110    | 103.2 |
| <b>Length of Labia minora (right)</b> | 45.87 | 45.26  | 50.18  | 46.42 | 36.63 | 32.55  | 31.33 |
| <i>5.Percentile</i>                   | 25    | 25     | 23     | 20.5  | 20    | 15     | 6     |
| <i>50.Percentile</i>                  | 46    | 45     | 50     | 44.5  | 31    | 30     | 30    |
| <i>95.Percentile</i>                  | 70    | 69.85  | 82.55  | 82.25 | 70    | 55     | 62    |
| <b>Width of Labia minora (right)</b>  | 13.29 | 14.03  | 15.1   | 14.98 | 11.59 | 11.65  | 11.98 |
| <i>5.Percentile</i>                   | 4     | 5      | 5      | 4.25  | 3     | 3      | 0     |
| <i>50.Percentile</i>                  | 11.5  | 12     | 14     | 15    | 10    | 10     | 11    |
| <i>95.Percentile</i>                  | 26.95 | 33.8   | 27.85  | 29.75 | 28.9  | 24.85  | 30    |
| <b>Length of Labia minora (left)</b>  | 45.97 | 46.39  | 51.1   | 48.23 | 37.32 | 32.37  | 33.53 |
| <i>5.Percentile</i>                   | 22.15 | 25     | 28.15  | 22.5  | 17.05 | 18.05  | 9     |
| <i>50.Percentile</i>                  | 45.5  | 48     | 50     | 45.5  | 35    | 30     | 30    |

|                              |       |       |       |       |       |      |       |
|------------------------------|-------|-------|-------|-------|-------|------|-------|
| 95.Percentile                | 70    | 70.95 | 82.55 | 84.5  | 65    | 55   | 67    |
| Width of Labia minora (left) | 13.27 | 14.96 | 16.06 | 15.87 | 12.99 | 11.9 | 12.84 |
| 5.Percentile                 | 4     | 5     | 5     | 6     | 4     | 3    | 0     |
| 50.Percentile                | 12    | 15    | 15    | 15    | 10    | 10   | 12    |
| 95.Percentile                | 25    | 30    | 27.85 | 30    | 29.95 | 25   | 30.8  |

**Table 3:** Genital measurements (each cohort separately)



**Figure 1:** Standard measurements of the external female genitalia