Penile Length Measurement: Methodological Challenges and Recommendations, a Systematic Review

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ABSTRACT

Background: Penile length measurement techniques vary widely in published studies leading to inaccurate and nonstandardized measurements.

Aim: To review the methodology used to report data in studies evaluating penile length and provide a detailed recommendation in conducting future high-quality research.

Methods: The MEDLINE database was searched for randomized clinical trials and open-label prospective or retrospective studies.

Outcomes: The panel reviewed the modality of data reporting on these specific areas: patients' age and assessment, patient position, type of measurement instrument used, penile length technique description, examination conditions, and actual examiner.

Results: Overall, 70 studies investigating penile length were selected; among these, 72.85% included at least 50 patients: 16 prospective studies, 5 randomized clinical trials, and 49 retrospective cross-sectional studies. Amongst all studies, 90% reported to measure penile length by health care practitioners in clinical settings. Penile length was assessed in all 70 studies, whereas penile girth was measured in 57.14% of patients. A semi-rigid ruler was the most commonly used measurement aid to assess penile length/girth in 62.86% of studies. Penile measurements were reportedly obtained: (i) stretched state, 60%; (ii) flaccid state only, 52.68%; and (iii) during erection, 27.43%. All studies investigating the penile length in an erect state were simultaneously assessing penile length in the flaccid state. About 90% of studies investigated penile length in adults, whereas 10% were conducted in adolescents.

Clinical Implications: The use of shared methodology to assess penile length in both adults and adolescents allows more accurate and standardized measurements.

Strength & Limitations: A systematic review of the published literature allowed proper data interpretation in order to provide accurate recommendations. Main limitations of the study relied on a relatively limited number of databases for the identification of potentially eligible studies.

Conclusion: The methodology used in studies measuring penile length should be precise and standardized in order to provide accurate data to both clinicians and researchers. **Cakir OO, Pozzi E, Castiglione F, et al. Penile Length Measurement: Methodological Challenges and Recommendations, a Systematic Review. J Sex Med 2021;18:433−439.**

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INTRODUCTION

Penile size is considered a sign of masculinity and virility amongst men.[1] Misleading information about penile length has created widespread anxiety, feelings of inadequacy, and erroneous beliefs within the male population and subsequently increasing presentation to urologists in clinical practice. Conversely, finding excuses to avoid medical assessments have become extremely common due to embarrassment and a perceived sense of shame.[2] In most cases, immediate reassurance in an outpatient setting eliminates these misconceptions. Moreover, if medical or surgical intervention is required, then underlying issues can be resolved. In the modern era, men often underestimate the size of their own penis relative to that of others, because of unrealistic expectations from internet sources and underestimation of the true size of their external genitalia due to high body mass index and suprapubic fat deposition.[3] Some attempts have been made by researchers in order to define nomograms of male penis size measurements across different populations, races, and ages. However, the variability between the studies in the literature was too large to create such a standard nomogram.[3] In addition, several widespread beliefs have been divulged regarding a possible correlation between the size of some body parts and penile length (eg, hands, feet, nose, and height).[4,5] Owing to these expectations, a number of non-evidence based products have been advertised and commercially available for penile elongation (eg, penile pumps, pills, creams, etc), resulting in disastrous consequences in some cases.[6] Finally, underlying genital body dysmorphic disorders (BDD) should always be considered. Genital BDD usually occurs due to patients' misperception of the size and other characteristics of his penis and is characterized by obsessive thinking about it. BDD leads to worrisome signs and symptoms of compulsive checking, attempting to minimize the genital appearance, and social isolation requiring a clear and accurate diagnosis in order to provide immediate appropriate treatment and management. Several studies investigated the penile size in adults and adolescents both in the erect and flaccid states, whereas other authors have proposed different ways to obtain accurate and most reliable measurements; however, the accurate consensus is far from consistent in the clinical setting.[7] Moreover, high heterogeneity in the aforementioned studies regarding the methodology used thus limiting the usefulness and completeness of the data reported. As a consequence, the current literature hampers in providing researchers and clinicians with well-defined standardized penile size measurement techniques. In addition to that, there is a potential observer bias in measuring penile size, which may cause inter-examiner variability resulting in significant measurement variation. Thus, the possibility of obtaining a reliable recommended penile length measurement could result in a very useful tool for everyday clinical practice and for unified and reliable data reporting for medical research. In this context, recent findings from a multicenter, multi-observer study on penis size, flaccid measurements were only moderately accurate in predicting erect length as well as significant observer bias. Moreover, authors demonstrated that measuring penile length from the pubic bone to the tip of glans is more accurate and reliable and that discrepancies are mostly present in overweight patients.[8] In the light of this, the present study aimed to systematically review the published literature on penile length studies to obtain and propose useful and methodological information on how to accurately measure the penile length. This could provide a useful resource used to conduct more standardized future research studies on this topic.

METHODS

Literature Search and Study Eligibility

This systematic review was conducted according to the PRISMA guidelines.[9] We searched MEDLINE using the query (((penis AND (size AND (length OR circumference)) "English" [Language])) AND ("1980"[Date - Publication]: "2019" [Date - Publication]) with the advanced research filter "Human". For the specific purpose of this study, randomized clinical trials, open-label prospective studies, or retrospective studies investigating penile length measurements (up to April 2019) were included. Studies were included if 2 of the coauthors agreed: (i) quantitative measurement of the penile size, (ii) flaccid or erect states, that is, stretched length or multiple measured from the root, (iii) flaccid or erect circumference measured at the base and/or mid-shaft of the penis, and (iv) English language original articles. Non-English studies, case-series, letters, and editorials were excluded. Studies reporting penile measurements on congenital penile curvatures, Peyronie's Disease, and measurements from cadavers were excluded from the study.

Data Extraction

Data were extracted from each study: design; number of included patients; adult vs adolescent; instrument for penile measurement (ruler vs other); patient position (supine vs orthostatic vs other), presence of BDD; measurement details (flaccidity, erect state, or flaccid stretched); length and girth data; and if measurements were taken in clinical settings by health care practitioners or by patients' themselves outside a health care facility. Abstracts were reviewed by 2 authors for relevance to the defined review question (O.O.C. and E.P.). Any discrepancies or doubts that an abstract could contain relevant data, the full paper was immediately assessed and discussed with other authors (O.O.C., E.P., F.C., H.A., A.S., A.M.). Relevant studies were analyzed and summarized after an interactive peer-review process. Disagreements were resolved by consensus. Descriptive statistical analyses were performed using R studio Inc (2016) integrated development environment for R software v. 3.5.3, Boston, MA (USA).

Review Methods

This methodology study aims to systematically review the published literature on penile length studies in order to offer
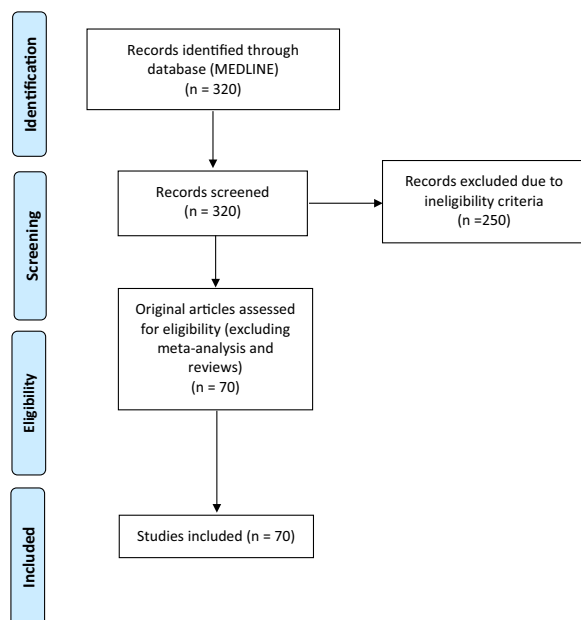
Figure 1. PRISMA flowchart—study selection with inclusion and exclusion criteria of the reviewed studies. Figure 1 is available in color online at www.jsm.jsexmed.org.

physicians and researchers a more rigorous and standardized methodology regarding penile length measurements.

EVIDENCE SYNTHESIS

A total of 320 papers related to penile length measurements were retrieved. After the screening and review process, 70 articles investigating penile measurements were considered suitable for evaluation (Figure 1). The complete list of included studies is shown in Supplementary Table S1. The majority of published studies were cross-sectional (47; 67.14%). Of the remaining studies, 16 (22.86%) were prospective and 5 (7.14%) were

Table 1. General characteristics of the studies selected

Design	N (%)
Cross-sectional	47 (67.14%)
Prospective	17 (24.28%)
Randomized controlled trial (RCT)	5 (7.14%)
Experimental	1 (1.44%)
Year of publication, N (%)	
< 2000	7 (10%)
2000—2005	12 (17.14%)
2006—2010	16 (22.85%)
2011—2015	22 (31.42%)
>2015	13 (18.59)
Patients included, N (%)	
≤50	19 (27.14%)
51—100	11 (15.71%)
101—300	24 (34.29%)
301—500	6 (8.57%)
>500	10 (14.29%)

Table 2. Detailed characteristics of the studies selected regarding penile length measurements

Age of patients	N (%)
Adults	65 (85.71%)
Adolescents	9 (12.86%)
Both	4 (5.71%)
Measurement device, N (%)	
Rigid ruler	44 (62.86%)
Flexible ruler	10 (14.29%)
Other	16 (22.85%)
Patients position, N (%)	
Supine	13 (18.57%)
Orthostatic	1 (1.43%)
Not specified	56 (79.82%)
Measurement technique reported, N (%)	
Length	70 (100%)
Flaccid state	37 (52.86%)
Flaccid stretched	42 (60%)
Flaccid (combined)	20 (28.57%)
Erect state	32 (27.43%)
Girth	40 (57.14%)
Examiner, N (%)	
Health care provider	63 (90%)
Patients	7 (10%)

randomized clinical trials (Table 1). A total of 51 (72.85%) studies included at least 50 patients. Studies reporting data relating to penile length measurement were mainly conducted on adults (65; 85.71%); only 9 (12.86%) investigated the penile length among adolescents; 4 (5.71%) studies reported data for both adults and adolescents. The length was measured in all 70 studies selected, and the circumference was evaluated in 40 (57.14%). The most commonly used measuring instrument was a semi-rigid ruler, with 44 (62.86%) studies using it as the measuring aid; 10 (14.29%) reported using a flexible ruler, whereas 16 (22.85%) used a range of different devices (eg, tape measurer, self-measurement kit, cylinder sizer). Thirteen (18.57%) studies performed measurements with the patient in a supine position; only 1 (1.43%) study reported to measure patients' penile length in the orthostatic position. Most studies (56; 79.82%) did not specify the patients' position. Measurements were mainly conducted in clinical settings by health care practitioners (Table 2). Finally, the presence of BBD was only investigated in one study.

DISCUSSION

The methodology used to measure penile size has remained unchallenged. Penile length measurement has not achieved a proper consensus regarding the use of a validated or standardized technique. This occurred due to the following reasons. First, the penis is a dynamic organ which has flaccid, semi-erect, and fully rigid phases.[10,11] Furthermore, different external and internal parameters, such as the ambient temperature or patient's anxiety

level, may affect the degree of flaccidity and rigidity.[12,13] In addition, the presence of specific comorbidities such as erectile dysfunction and/or Peyronie's disease can dramatically affect the measurements.[14–16] Moreover, lack of standardized protocols due to inaccuracies and high variability of the published literature makes it difficult to have uniform and reliable results that allow formal comparisons between studies. Therefore, this systematic review aimed to investigate the methodology of data reporting of studies evaluating penile length in order to provide a detailed recommendation on how to perform future standardized high-quality research on this topic. The main limitation of the present study relies on a relatively limited number of databases searched for the identification of potentially eligible studies. Finally, risk of bias assessment was not performed.

Measuring the Length and Circumference

Several methods have been reported to measure penile length and circumference. This review found that the majority of selected studies reported the use of a rigid ruler (63%) to measure penile length. Alternatively, 14% and 23% used a flexible ruler or other instruments (eg, tape measurer), respectively. Although this holds true, different measurement techniques can lead to extremely heterogeneous results. In this context, Habous et al[17] found that flaccid measurements underestimated the erect size with a significant interobserver variability. Likewise, in a larger, multicenter, multi-observational study, the same group confirmed that flaccid measurements were only moderately accurate in predicting the penile erect size. In addition, measuring penile length from the pubic bone to the tip of the glans was found to be more accurate and reliable, especially among overweight men.[8] In contrast, Sengezer et al[18] demonstrated that the most accurate results could be obtained using the stretched penile length, confirming that flaccid length had little importance in determining and predicting an erect penile length. These findings were confirmed by many other groups.[3,6,18–23] In our systematic review, 60% of studies reported measuring the penile length with a stretched penis. Although measuring the penile length during an erection would be the most accurate method, this can be a challenging procedure in routine clinical practice. In this context, studies reporting penile length measurement at an erect state were only performed during invasive diagnostic procedures such as penile duplex Doppler ultrasound or intraoperatively (eg, intraoperative artificial erection).[8,24–30] However, we acknowledge that reporting penile length measurements during erection would be difficult in both a clinical and research setting. To overcome this issue, authors could consider reporting penile length by measuring it with a stretched penis from the pubic bone to the tip of the glans.[8,17,19,22,29,31–46] Thereof, the penis should be gradually stretched to its maximal length with a 90° angle relative to the abdominal wall and measured from the pubic bone to the tip of the glans (dorsally); the pubic symphysis is exposed by pressing and/or displacing abdominal fat. In this context, we believe in the implied superiority of using a rigid ruler for length measurement especially on examining patients with high body mass index with a suprapubic fat

Box 1 Methodological suggestions to report penile length measurements

Medical history
- Obtain accurate medical history including sexual and past surgical history
- If body dysmorphic disorder (BDD) is suspected, refer the patient for psychosexual counselling or a body image counsellor

Clinic settings
- Inform the patient about the examination
- Ask permission to examine the patient and offer a chaperone
- Control the room temperature and maintain privacy
- Only one examiner should be in the room (or limit the number of examiners)

Measurement techniques
- The patient should be in supine position
- The genital area should be fully exposed between the umbilicus and knees
- Use a rigid ruler for length measurement (the penis should be gradually stretched to its maximal length with a 90° angle relative to the abdominal wall and measured from the pubic bone to the tip of the glans (dorsally); the pubic symphysis is exposed by pressing and/or displacing abdominal fat.)
- Use a tape measurer for circumference measurements at the mid-shaft (or at the penile base, the penis should be flaccid and unstretched)
- If radical prostatectomy/cystectomy is planned, inform the patient that penile length might change; therefore, document the penile length preoperatively
- If the patient is adolescent, penile length measurement technique should be the same

pad. Regarding penile circumference, less heterogeneity has been observed because fewer techniques exist. Most studies reported on taking measurements at the base or at the midshaft of the penis that does not comprise final measurements.[3] Therefore, we believe that this should be performed using a tape measurer at the base and/or midshaft, the penis should be flaccid and unstretched. Finally, 80% of reviewed studies did not report optimal patients' position during penile length measurement. Moreover, supine position was acknowledged to be the most reliable and comfortable position for both the patient and examiner (Box 1).

Examiner and Settings

The examiner plays a major role in this context. Fewer studies, 10%, reported that patients' themselves performed the measurements. Instead, 90% reported that measurements were carried out by health care practitioners within a clinical setting. Particular attention should be paid regarding examination conditions. Stressful context and room temperature can negatively affect the results as different studies have shown[12,13] (Box 1).

Patient Population and Methods of Taking a Good Medical History

Our findings showed that 85% of penile measurements were carried out on adults, with 15% on adolescents. The patient population plays a significant role especially if specific surgeries

have been performed. Controversial results regarding penile shortening after a radical prostatectomy have been reported. For instance, Engel et al[36] found that penile length was shortened immediately after surgery, but returned to its preoperative length after 9 months. Likewise, another study found that penile shortening after radical prostatectomy peaked at the time of catheter removal and continued for at least 1 year. Nerve-sparing surgery and recovery of erectile function appeared to have an independent protective effect on penile length loss at 1 year. Therefore, this should be carefully considered when counseling patients for radical prostatectomy. Conversely, Briganti et al[47] reported penile changes in flaccidity and at maximum erection after bilateral nerve-sparing robotic radical prostatectomy in patients treated by one high-volume surgeon. Postoperative preservation of erectile function was positively correlated with the maintenance of penile length postoperatively. They found no changes in penile size postoperatively. In this context, a good medical history is fundamental in considering previous surgeries and the presence of erectile dysfunction that might negatively affect the penile length. In conclusion, the preoperative penile length measurement is fundamental to address any postoperative changes in length and circumference. Finally, only one study reportedly analyzed BDD in adolescents, indicating that it should be investigated further.[24] Moreover, from the psychological standpoint, men complaining of short penis could be treated using basic principles of sex education with objective methods of penile size evaluation. This combination can correct any previous sexual misconceptions, relieve unnecessary anxiety concerning penile size, and decrease the desire to undergo penile lengthening procedures.[44] In this context, psychosexual counselling plays a key role in the management of these patients (Box 1).

CONCLUSIONS

The penile size measurement technique has not yet achieved proper consensus due to high heterogeneity in terms of data assessment and reporting methodologies among different studies. In this systematic review, published literature on studies evaluating penile length should be evaluated in order to obtain and propose useful and methodological information on the accurate measurement of penile length and girth. Proper penile size measurement should fulfil specific methodological criteria by collecting a precise medical history, arranging the optimum clinic settings, and performing ideal measurement techniques (Box 1).

Conducting studies in the field of penile length measurement with a homogeneous methodology would allow adequate and internationally standardized measurement techniques to detect penile length and girth. Therefore, this would provide better counselling on the patients' penile size.

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STATEMENT OF AUTHORSHIP

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SUPPLEMENTARY DATA

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