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Am I normal? A systematic review and construction of nomograms for flaccid and erect penis length and circumference in up to 15 521 men

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Objective

To systematically review and create nomograms of flaccid and erect penile size measurements.

Methods

Study key eligibility criteria: measurement of penis size by a health professional using a standard procedure; a minimum of 50 participants per sample. Exclusion criteria: samples with a congenital or acquired penile abnormality, previous surgery, complaint of small penis size or erectile dysfunction. Synthesis methods: calculation of a weighted mean and pooled standard deviation (SD) and simulation of 20 000 observations from the normal distribution to generate nomograms of penis size.

Results

Nomograms for flaccid pendulous [n = 10 704, mean (SD) 9.16 (1.57) cm] and stretched length [n = 14 160, mean (SD) 13.24 (1.89) cm], erect length [n = 692, mean (SD) 13.12 (1.66) cm], flaccid circumference [n = 9407, mean (SD) 9.31 (0.90) cm], and erect circumference [n = 381, mean (SD) 11.66 (1.10) cm] were constructed. Consistent and strongest significant correlation was between flaccid stretched or erect length and height, which ranged from r = 0.2 to 0.6. Limitations: relatively few erect measurements were conducted in a clinical setting and the greatest variability between studies was seen with flaccid stretched length.

Conclusions

Penis size nomograms may be useful in clinical and therapeutic settings to counsel men and for academic research.

Keywords

penis, length, girth, circumference, nomogram, systematic review

Introduction

The measurement of penis size may be important either in the assessment of men complaining of a small penis or for academic interest. Men may present to urologists or sexual medicine clinics with a concern with their penis size, despite their size falling within a normal range. This type of concern is commonly known as 'small penis anxiety' [1] or 'small penis syndrome' [2]. Some men who are preoccupied and severely distressed with the size of their penis may also be diagnosed with body dysmorphic disorder (BDD), where the preoccupation, excessive self-consciousness and distress is focussed on their penis size or shape [3,4]. The diagnosis of BDD or small penis anxiety excludes 2.28% of the male population who are abnormally small as less than 2 standard deviations (SDs) below the mean [5].

Several studies have measured penile size in various samples. Some authors have tabulated studies of penile size [6–13]. Two studies have produced a nomogram for their samples [9,11]. A nomogram is a graphical representation of the numeric relationship between two variables. Such a tool may be a helpful for clinicians to counsel men who desire to know where they lie within a normal distribution or to establish one's change in size percentile following a procedure claiming size augmentation. Building such a nomogram may also be of academic interest, e.g. to investigate the discrepancy between individuals perceived and actual penis size; or to investigate the relationship between condom failure and penile dimensions [14]. However, there have been no formal systematic reviews of penile size measurements and no attempts to combine the existing data into a definitive nomogram for flaccid and erect penile length and circumference (or 'girth'). Therefore the aim of the present study was to create such nomograms of male penis size measurements across all ages and races, and to conduct a narrative review of the correlations reported. The Preferred

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Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method of reporting was used [15].

Methods

Eligibility Criteria

Studies were included if there was agreement of two of the authors:

1. Quantitative measurement of penis size was measured by a health professional.
2. The sample included a ≥50 participants.
3. Participants were aged ≥17 years.
4. A mean and SD of the sample size measurements were provided.
5. Flaccid or erect length was measured from the root (pubo-penile junction) of the penis to the tip of the glans (meatus) on the dorsal surface, where the pre-pubic fat pad was pushed to the bone.
6. Flaccid stretched length was measured as above while maximally extending the penis.
7. Flaccid or erect circumference (or 'girth') was measured at the base or mid-shaft of the penis, (and not from the corona).
8. They were published in the English language.

Studies were excluded if there was any possible bias in penis size measurements, caused by the study samples or the measurement procedure, such as if participants within the study sample had:

1. Any congenital or acquired penile abnormality (e.g. Peyronie's disease, hypospadias, intersex, hypospadias, phimosis, penile cancer, previous penile or prostatic surgery).
2. A complaint of small penis size or seeking augmentation.
3. Erectile dysfunction [8,16].
4. A self-measurement reading rather than a measurement taken by a health professional [17].
5. Measurements made from cadavers.

Information Sources

Ovid Medline, Embase and PsychINFO were used to obtain separate literature searches up to March 2014. The results from the three databases were subsequently collated and duplicates removed. In addition, the authors inspected the reference sections of relevant papers retrieved through the database search.

The search strategy was:

1. Penis/
2. (Penis OR penile OR phallus OR genital*).mp
3. 1 OR 2
4. Organ size/
5. Size OR girth OR measurement OR length OR circumference OR dimension*
6. 4 OR 5
7. 3 AND 6

Study Selection

The title and abstract of retrieved studies were screened by one author according to perceived relevance. The full-text articles of relevant studies were then reviewed by two authors and only included if they met the study inclusion and exclusion eligibility criteria.

Data Collection Process

All full text articles were reviewed for inclusion by at least two of the authors.

Data Item

Data extracted from each study included the authors; publication date; population studied; race; the number of participants (*n*); mean and SD of the age and range of participants; the measurement procedure; the mean, SD and range of (i) flaccid length, (ii) stretched flaccid length, (iii) erect length, (iv) flaccid circumference of the shaft, and (v) erect circumference of the shaft at either the base or the mid-point but not under the glans.

Risk of Bias in Individual Studies

Studies followed a penis size measurement procedure described by Wessells et al. [5]. None of the studies had used inter-rater reliability when taking measurements. Some described training procedures to ensure consistency between different raters [6]. Some described repeated measures used to ensure accuracy [18]. None of the studies describe details on how they recruited their samples, e.g. how many refused to participate, in order to determine whether or not they were representative of the population recruited.

Summary Measure

The principal summary measures were the *n*, mean and SD for each of the measurements described.

Synthesis of Results

To construct penis size nomograms a weighted mean (by the number of men in each study) and pooled SD were calculated. Using the overall weighted mean and SD, 20 000 observations were simulated from the normal distribution to generate the nomograms. The cumulative normal distribution for each dimension gave population percentiles based on penis length

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(flaccid, stretched flaccid and erect) and girth (flaccid and erect). All nomograms were generated and edited in the package ggplot2 in R v.30.

Risk of Bias across Studies

Where there were more than two studies reporting one of the five types of penis size measurement, the ratio of between study variance to total variance (intraclass correlation, ICC) was calculated as an index of heterogeneity of studies. High ratios of between-study variance would indicate measures are is less reliable for a particular measurement dimension.

Results

Study Selection

Figure 1 provides a flowchart of the systematic search and the number of studies that were screened for eligibility and subsequently excluded or included in the final review.

Study Characteristics

The characteristics of all studies extracted for inclusion are shown in Table 1 [5–10,12,13,16,18–28].

Risk of Bias across Studies

The ratio of between study variance to total variance (ICC) was relatively low for erect length (0.2), flaccid girth (0.21) and flaccid length (0.26) but was somewhat larger for stretched length (0.58). For the latter, two studies [19,20] had a mean stretched flaccid length of >16 cm and two had a mean of <10 cm. This suggests there may be greater unreliability in the measure of flaccid stretched length.

Synthesis of Results

A nomogram was constructed for each key variable: flaccid, flaccid stretched and erect length in Figure 2, and flaccid and erect girth in Figure 3. The mean and SD for each of the measures are shown at the bottom of Table 1. The ratios between the mean of each of the domains is found in Table 2. Of note is that the mean stretched length and erect length were near identical and that mean flaccid length and circumference was near identical.

Correlation with Somatometric Parameters

Several papers investigated the relationship between penile dimensions and somatometric parameters. The main findings are summarised below.

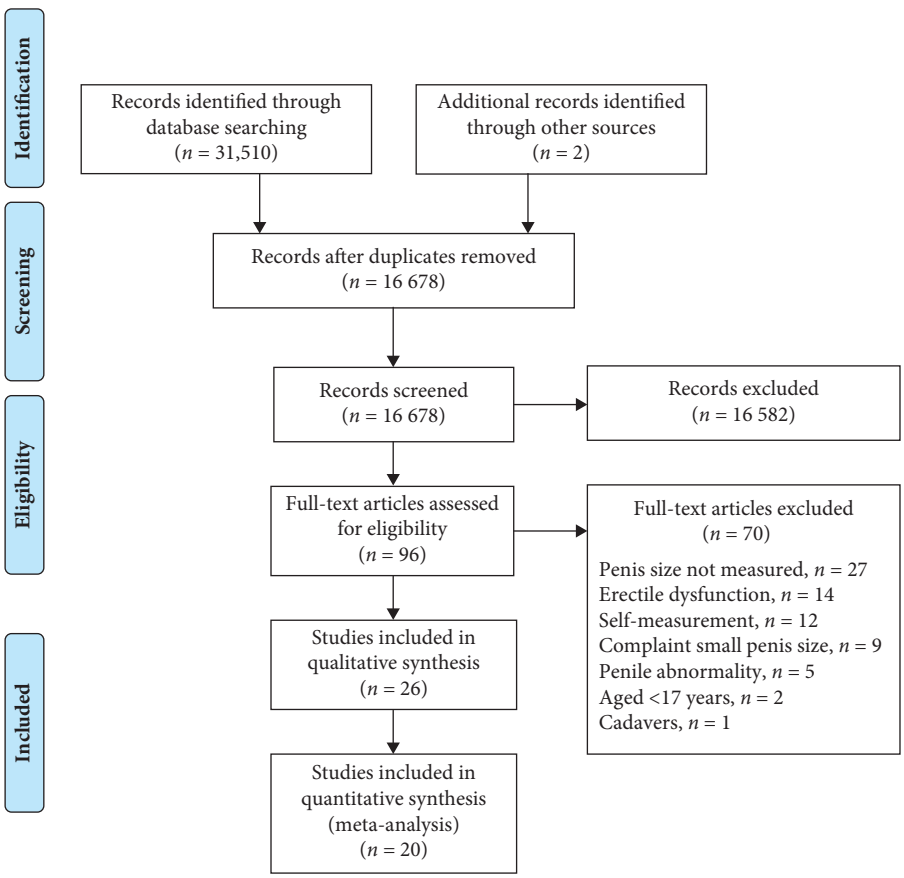

Fig. 1 PRISMA flowchart of the studies included in the final review.

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Table 1 Studies included in the nomograms.

Study	Population	Country	*n*	Age, years mean (SD) {range}	Reported measurement details	Flaccid length, cm mean (SD) {range}	Stretched length, cm mean (SD) {range}	Erect length, cm mean (SD) {range}	Flaccid circumference, cm mean (SD) {range}	Erect circumference, cm mean (SD) {range}
Ajmani et al. 1985 [18]	Medical students	Nigeria	320	n/a {17–23}	One examiner recorded measures several times. Room temperature. Circumference mid-shaft.	8.16 (0.94)	n/a	n/a	8.83 (0.02)	n/a
Aslan et al. 2011 [7]	Military volunteers	Turkey	1132	20.3 (0.9) {19–30}	One examiner. Room temperature. Standing with the penis held parallel to the floor.	9.3 (1.3)	13.7 (1.6)	n/a	n/a	n/a
Awwad et al. 2004 [8]	Urology outpatients	Jordan	271	44.6 (16.3) {17–83}	Two examiners. Lying down, legs slightly abducted. Measuring tape. Circumference at mid-shaft.	9.3 (1.9) {4.0–15}	13.5 (2.3) {7.5–20}	n/a	8.9 (1.5) {2.0–12}	n/a
Bondil et al. 1991 [19]	Urology patients	France	905	53 (18.19) {17–91}	A flexible centimetre ruler.	10.74 (1.84)	16.74 (2.29)	n/a	n/a	n/a
Choi et al. 2011 [21]	Urology in-patients	Korea	144	57.3 (16.5) {21–89}	One examiner. Under anaesthesia. Lying down, legs slightly abducted. Measuring tape.	7.7 (1.7) {4.0–12.0}	11.7 (1.9) {7.5–17.0}	n/a	n/a	n/a
Chrouser et al. 2013 [6]	Circumcision patients	Tanzania	253	{19–47}	Under local anaesthesia. Circumference at mid-shaft. Ruler.	n/a	11.5 (1.6)	n/a	8.7 (0.9)	n/a
Kamel et al. 2009 [16]	Urology outpatients	Egypt	949	36 (10.9) {17–60}	Rigid ruler.	n/a	12.9 (1.9)	n/a	n/a	n/a
Khan et al. 2012 [9]	Urology outpatients ($n = 499$) and surgery ($n = 110$)	Scotland, UK	610	43 {16–90}	Two examiners. Room temperature. Lying down, legs adducted.	10.2 (1.4)	14.3 (1.68)	n/a	n/a	n/a
Mehraban et al. 2006 [23]	Volunteers	Iran	1500	29.61 (5.50) {20–40}	Circumference at mid-shaft. Rigid measuring tape.	n/a	11.58 (1.45) {7.5–19.0}	n/a	8.66 (1.01) {4.4–13.5}	n/a
Ponchietti et al. 2001 [10]	Volunteers	Italy	3300	n/a {17–19}	One examiner. Circumference at mid-shaft. Measuring tape.	9 (2.0)	12.5 (2.5)	n/a	10 (0.75)	n/a
Promodu et al. 2007 [12]	Sexual dysfunction clinic	India (Kerala)	301	31.58 (6.38) {18–60}	Three examiners. Circumference at mid-shaft.	8.21 (1.44) {4.5–13}	10.88 (1.42) {6.5–16}	12.93 (1.63) {10.5–17}	9.14 (1.02) {6–12.5}	11.49 (1.04) {9–13.5}
Savoie et al. 2003 [20]	Pre-radical prostatectomy patients	USA	124	59.1 (7.4) {42–76}	Pre-anaesthesia. Circumference at mid-shaft.	9.3 (2.0) {5–15}	17.5 (2.6) {7.5–21}	n/a	9.4 (1.4) {5.5–13}	n/a
Schneider et al. 2001 [25]	Volunteers	Germany	111	n/a {18–19}	A ruler.	8.60 (1.50) {5–14.5}	n/a	14.48 (1.99) {10–19}	n/a	n/a
Sengezer et al. 2002 [26]	Volunteers	Turkey	200	21.2 {20–22}	Measuring tape and a straight edged ruler.	6.80 (0.08) {4–9}	8.98 (0.09) {6.5–12.5}	12.73 (0.11) {9.5–17}	n/a	n/a
Shalaby et al. 2014 [27]	Volunteers	Egypt	2000	31.6 (4.2)	Standing holding penis parallel to floor	n/a	13.84 (1.35) {12–19}	n/a	n/a	n/a
Siminoski et al. 1993 [22]	Volunteers	Canada	63	39.6 (12.4) {27–71}	No further details.	n/a	9.4 (1.4) {6–13.5}	n/a	n/a	n/a
Söylemez et al. 2011 [13]	Volunteers	Turkey	2276	21.1 (3.1) {18–39}	Standing. Circumference at mid-shaft. A ruler.	8.95 (1.04) {6–15}	13.98 (1.58) {9–20}	n/a	8.89 (0.86) {6.5–13.5}	n/a
Spyropoulos et al. 2005 [24]	Urology patients	Greece	52	25.9 (4.4) {19–38}	One examiner. Room temperature. Lying down, legs adducted. Circumference at base of shaft. Measuring tape.		12.18 (1.7) {9–17.5}	n/a	8.68 (1.12) {6–11}	n/a
Tomova et al. 2010 [28]	Volunteers									
	Group 2	Bulgaria	310	17	Circumference base-shaft. Measuring tape.	9.15 (1.07)	n/a	n/a	9.46 (0.95)	n/a
	Group 3		310	18		9.07 (1.05)			9.23 (0.94)	
	Group 4		310	19		9.56 (1.12)			9.67 (0.91)	
Wessells et al. 1996 [5]	Urology patients	USA	80	54 (14.37) {21–82}	One examiner. Circumference at mid-shaft.	8.85 (2.38) {5–15.5}	12.45 (2.71) {7.5–19}	12.89 (2.91) {7.5–19}	9.71 (1.71) {6.5–13}	12.30 (1.31) {9–16}
Totals and mean (SD) or {range}	–	–	15521	{17–91}	–	9.16 (1.57)	13.24 (1.89)	13.12 (1.66)	9.31 (0.90)	11.66 (1.10)

n/a, not available.

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Table 2 Ratios between the mean of each dimension.

Penile measurement	Flaccid length	Flaccid stretched length	Erect length	Flaccid circumference	Erect circumference
Flaccid length	–	1.44	1.43	1.01	1.27
Flaccid stretched length	0.69	–	0.99	0.70	0.88
Erect length	0.69	1.0	–	0.71	0.89
Flaccid circumference	0.98	1.42	1.41	–	1.25
Erect circumference	0.79	1.13	1.12	0.8	–

Fig. 2 Nomogram for flaccid, flaccid stretched and erect length of the penis.

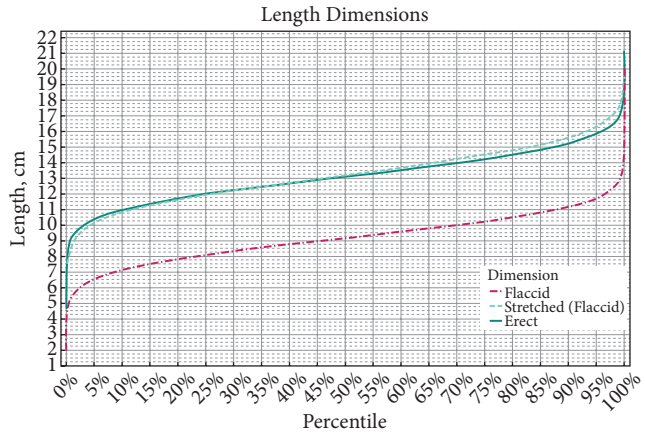
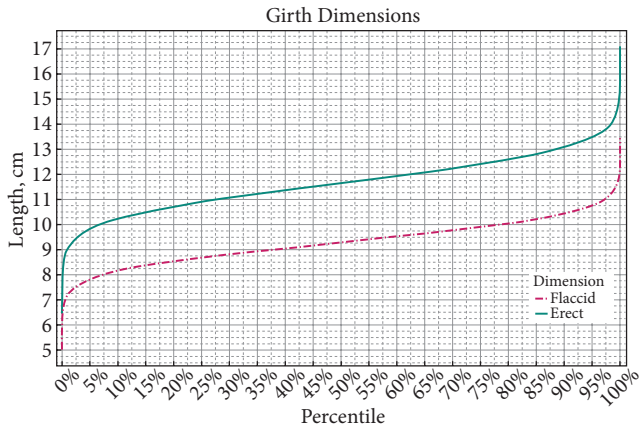


Fig. 3 Nomogram for flaccid and erect girth of the penis.



Height and flaccid length

One study [7] found flaccid length to be moderately significantly correlated with height ($r = 0.32$) and three studies [10,21,22] found weak correlations ($r = 0.19$–0.2). However, two studies [8,21] reported no significant correlation between flaccid length and height.

Height and stretched flaccid or erect length

Aslan et al. [7] found height to be moderately significantly correlated with stretched length ($r = 0.61$); four studies [10,12,22,23] found a weak correlation with erect or stretched length (range $r = 0.21$–0.31).

Flaccid length and weight or body mass index (BMI)

One study [7] found a moderately significant correlation between flaccid length and weight ($r = 0.40$) and BMI ($r = 0.39$) and one [12] found a weak significant correlation (weight $r = 0.21$ and BMI $r = 0.24$). One study [21] found no correlation between penile length and weight or BMI. Lastly, one study [10] found a weak inverse significant correlation ($r = -0.14$ and -0.24).

Erect or stretched flaccid length and weight or BMI

One study [12] found erect length to be weakly significantly correlated with BMI ($r = 0.24$). Two studies [7,12] found weak significant correlations between flaccid stretched length and weight or BMI ($r = 0.21$ and 0.27). One study [21] found no correlation between penile length and weight or BMI. However, one study [10] found stretched length to have a significantly weak inverse correlation with weight and BMI ($r = -0.14$ and -0.17).

Digit ratio

One study [23] found a weak significant correlation between penile length and index finger length ($r = 0.23$), whilst one study did not [21]. However, the latter found a significantly weak inverse correlation between stretched penile length and the ratio between the length of second to fourth digit ($r = -0.22$).

Testicular volume

One study [7] found a weak significant correlation ($r = 0.14$) between testicular volume and flaccid and stretched penile length whereas one did not [24].

Foot size

One study [22] found stretched length to be significantly weakly correlated with foot size ($r = 0.27$) and one study [29] did not find a correlation between penile length and foot size.

Age

Seven studies [5,7–9,21,22,24] found no significant correlation between age and penile size. Two studies [13,23] reported that age was weakly positively correlated with flaccid

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circumference ($r = 0.05$ and 0.19, respectively) but not flaccid length. Schneider et al. [25] found a small group of younger men (aged 18–19 years) to be significantly smaller in their flaccid length and erect circumference but not erect length compared with a group of men aged 40–68 years.

Summary

All the correlations between penile dimensions and somatometric parameters were either inconsistent or weak. The most consistent and strongest significant correlation was between flaccid stretched or erect length and height, which was found in four studies and ranged from $r = 0.21$ to 0.31 and in one study was 0.61.

Discussion

In all, 20 studies, with up to 15 521 males, meeting the inclusion and exclusion criteria were found. Five definitive nomograms for the flaccid and erect penis size measurements with a mean and SD were created. Strengths of the present review are that strict inclusion and exclusion criteria were used and there was (modest) homogeneity in the studies. Consistent weak but significant correlations between height and stretched flaccid or erect size were found. However, correlations with other somatometric parameters were either inconsistent or weak.

Wessels [5] suggested that beyond 2 SDS below the mean should define a candidate for penile augmentation (2.28% of the male population), which we found was <6 cm in the flaccid length and <9.5 cm in the stretched length. A micropenis, however, is defined as <2.5 SDs below the mean (0.14% of the male population), which was <5.2 cm in flaccid and <8.5 cm in the stretched length.

Stretched flaccid length appears to be an excellent estimate of erect penile length, which for some individuals presenting to clinical settings, may indicate that it may not be necessary to measure erect length as well as flaccid size. However, there was greater variability in the measures, which suggests less reliability. This was found by Chen et al. [30] who reported that a minimal tension force of ≈450 g during stretching of the penis was required to reach a full potential erection length and that the stretching forces exerted by a urologist in their clinical setting were experimentally shown to be significantly less than the pressure required. This may account for a discrepancy observed in three out four of our present studies in Table 1, which measured stretched and erect length simultaneously and found that the erect length was longer than the stretched flaccid length. There is therefore a greater risk of bias in measuring the stretched length if insufficient pressure is applied and the greatest need for training and measuring inter-rater reliability.

It is not possible from the present meta-analysis to draw any conclusions about any differences in penile size across different races. Lynn [31] suggest that penis length and girth are greatest in Negroids (sub-Saharan Africans), intermediate in Caucasoids (Europeans, South Asians and North African), and smallest in Mongoloids (East Asians), but this is based upon studies that did not meet our present inclusion and exclusion criteria. The greatest proportion of the participants in the present meta-analysis were Caucasoids. There was only one study of 320 men in Negroids and two studies of 445 men in Mongoloids. There are no indications of differences in racial variability in our present study, e.g. the study from Nigeria was not a positive outlier. The question of racial variability can only be resolved by the measurements with large enough population being made by practitioners following the same method with other variables that may influence penis size (such as height) being kept constant. Future studies should also ensure they accurately report the race of their participants and conduct inter-rater reliability.

Herbenick et al. [32] found from their self-report data of 1661 men, a mean erect penile length of 14.15 cm and a mean erect penile circumference of 12.23 cm. This is about 1 cm larger than the mean erect length and 0.6 cm larger than that the mean circumference from our nomograms. This might be dismissed as the unreliability or bias of self-report but they argue that their sample was more accurate, as the data were reported anonymously over the internet and were motivated to obtain a condom that fitted their erect penis. Their data also suggest that the mode of getting an erection may influence erect penile dimensions (e.g. being with a sexual partner at the time of the measurement) and that this may be more accurate than self-stimulation especially in a clinical setting.

Limitations

All the studies included in the present review described a standardised procedure for measuring penile size. However, temperature, level of arousal, and previous ejaculation could also affect the penile dimensions. There is potential risk of bias in the measurement of penis size, although there was little evidence of heterogeneity in the studies. There were considerably more flaccid measurements than erect, with only four studies ($n = 692$) measuring erect length and only two studies ($n = 231$) measuring erect circumference. Our present nomograms do not reflect the relative uncertainty (or number of men) that contributed to each estimate of weighted mean and pooled SD. Flaccid length and girth may for example be less reliable measures and more dependent on the temperature of their surroundings, the level of arousal and the professional measuring. We recommend future studies report their method in greater detail with a system for training of the practitioner(s) and the inter-rater reliability. We recommend privacy in an air-conditioned consulting room at a constant temperature (21 °C) at sea level. Using a disposable tape measure, a participant should have three parameters measured in the flaccid state: circumference (girth) of the penile

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mid-shaft; length from suprapubic skin to distal glans (skin-to-tip); and pubis to distal glans (bone-to-tip). In the flaccid state, a stretched measurement can be recorded, by grasping the glans and exerting a stretching force until a participant feels mild discomfort to obtain maximum stretch [33]. If possible, a participant should not have ejaculated in the previous 24 h. Erect measurement may be reported either after self-stimulation and watching pornography alone or induced by a prostaglandin injection. Further research is required to determine whether erect measurements in naturalistic settings with a sexual partner may be associated with a larger erect measure.

It is acknowledged that some of the volunteers across different studies may have taken part in a study because they were more confident with their penis size than the general male population. Confidence to take part in size measurements may bias the measures to the larger end of the distribution. Equally there may be a bias towards the smaller end of the distribution if the full stage of genital development had not been reached in some men who had not reached the age of 18 years (or individual maturity), although this may depend on nutritional status and culture [18,34]. The greatest proportion of participants were Caucasian and Middle Eastern men. Therefore, it is not possible from the present meta-analysis to draw any conclusions about any differences in penile size across different cultures.

Conclusions and Future Research

The nomograms may be helpful clinically and in research to determine the discrepancy between what a man perceives to be their position on the nomogram and their actual position. Thus, Mondaini et al. [11] found that 48 men (71.7%) with small penis anxiety 'seemed to be reassured about their normal penile size after a thorough explanation during the visit'. However, 50% of men might interpret being less than average as being defective or abnormal. Comparing one's self or one's attributes against others is a 'double-edged sword' [35] and may confirm perceived inadequacy. It is especially problematic in those with body image problems. Some may understand that by definition, half the population must be below average in a normal distribution. What is not known is if those above the 50th percentile were more likely to be reassured and satisfied than those below the mean and whether those below 50th percentile are more likely to remain anxious or dissatisfied. This could be answered by a randomised controlled trial in which men with BDD or small penis anxiety are randomly allocated to either: (i) being told their percentile measure compared with others or (ii) being told they are in the normal range without being given their percentile.

A nomogram may also be used to investigate the tendency for humans to view themselves as better than average (self-enhancement) and to hold a positive bias for socially valued dimensions [36,37]. Thus, one might hypothesise that men without any concerns about their penile size have 'rose-tinted glasses' and estimate their size to be larger than they actually are on a nomogram. However, this remains to be investigated. Furthermore, men with penis size anxiety or BDD may have lost their 'rose-tinted glasses'. In addition, such men are likely to believe that others think that they should be larger. If this hypothesis were accepted, then the finding could contribute to tailoring of the psycho-education of men with small penis anxiety.

An important observation also comes from Lever et al. [38] who found in a large internet survey of 52 031 heterosexual men and women, 85% of women were satisfied with their partner's penis size, but only 55% of the men were satisfied with their own penis size. Thus, only 15% of women say that erect penis size is important and erect girth is generally more important than length [39]. It is not known how many of the 15% of women were also partnered with a man who also thought he was too small. Such preferences may also be different in the homosexual community.

Measurement of penile size is of course only one aspect of assessment of men with small penis anxiety or a micropenis. Equally as important is male genital image satisfaction [40–42]; an understanding of the beliefs and attitudes about penile size [43]; the frequency of avoidance and safety seeking behaviours to prevent the risk of shame or humiliation [1] and the need to screen for BDD either by a questionnaire [44,45] or structured diagnostic interview [46]. This is because helping a man with BDD may require a more complex psychiatric intervention [47–49] than for those with small penis anxiety without BDD, where psycho-education and counselling may be helpful [50,51]. However, those hypotheses are beyond the scope of the present paper and require randomised controlled trials with standardised scales and long-term follow up.

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Conflicts of Interest

None.

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Abbreviations: BDD, body dysmorphic disorder; BMI, body mass index; ICC, intraclass correlation; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

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