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Beyond the tip of the iceberg: A meta-analysis of the anatomy of the clitoris

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Abstract

An understanding of ranges in clitoral anatomy is important for clinicians caring for patients including those who have had female genital mutilation, women seeking genital cosmetic surgery, or trans women seeking reconstructive surgery. The aim of this meta-analysis is to investigate the ranges in clitoral measurements within the literature. A meta-analysis was performed on Ovid Medline and Embase databases following the PRISMA protocol. Measurements of clitoral structures from magnetic imaging resonance, ultrasound, cadaveric, and living women were extracted and analyzed. Twenty-one studies met the inclusion criteria. The range in addition to the average length and width of the glans (6.40 mm; 5.14 mm), body (25.46 mm; 9.00 mm), crura (52.41 mm; 8.71 mm), bulb (52.00 mm; 10.33 mm), and prepuce (23.19 mm) was calculated. Furthermore, the range and average distance from the clitoris to the external urethral meatus (22.27 mm), vagina (43.14 mm), and anus (76.30 mm) was documented. All erectile and non-erectile structures of the clitoris present with substantial range. It is imperative to expand the literature on clitoral measurements and disseminate the new results to healthcare professionals and the public to reduce the sense of inadequacy and the chances of iatrogenic damage during surgery.

KEYWORDS
anatomy, clitoral, clitoris, range, systematic review, variation, vulva

1 | INTRODUCTION

1.1 | The anatomy and function of the clitoris

The clitoris is a multiplanar structure located within the urogenital triangle that transverses the deep and perineal pouches (O'Connell et al., 2005). It is located deep to the labial fat, labia minora, and inferior to the pubic symphysis and arch (O'Connell et al., 2005). The clitoral complex is pyramidal in shape and maintains a consistent relationship with the urethra and vagina (O'Connell et al., 2008). The clitoris has both external (glans and prepuce) and internal (body, paired crura, and bulbs of the vestibule) components. The prepuce, sometimes referred to as the hood or foreskin, is a layer of thin hairless skin that covers the distal end of the clitoris, the anterior layer is continuous with the labia minora. The glans is a cylindrical structure at the tip of the clitoris which is easily observed by retracting the prepuce and is the most superficial part. The body/corpora is shaped like a boomerang as it folds back on itself, meaning that it has an ascending and descending segment. The apex (most superior part of the body) is anchored to the pubic symphysis via the three-layered

suspensory ligament, that maintains the 'bent' position (Botter et al., 2022). The body is composed of two corpora cavernosa, separated by an incomplete septum. The septum is an extension of the tunica albuginea, which is a fibrous connective tissue sheath that surrounds the corpora cavernosa superficially. The body bifurcates laterally into the left and right crura that follow the inferior border of the ischiopubic rami and are located deep to the respective ischiocavernosus muscles (Gordon et al., 2021; Jackson et al., 2019; O'Connell et al., 1998; O'Connell et al., 2005). Together, the body and crura are shaped like a wishbone. The paired vestibular bulbs are composed of erectile tissue that run parallel to the crura and are located deep to the bulbocavernosus muscles. The posterolateral margin of the bulbs is located adjacent to the paired greater vestibular glands (O'Connell et al., 2005; Di Marino & Lepidi, 2014;). The bulbs maintain a consistent relationship with the clitoral complex and can completely or partially fill the space between labia minora, body, and crura (O'Connell et al., 1998).

The mantra that the clitoris has the sole function of pleasure and orgasm has been perpetuated throughout history (Masters & Johnson, 1966). This reductionist ideology may have caused a lack of thorough studies regarding clitoral function and its evolutionary role in reproduction. Levin (2020) has recently elucidated that clitoral stimulation leads to a cascade of events that are intimately intertwined with the facilitation of conception. Clitoral stimulation leads to increased vaginal blood flow, lubrication, pO_2, and temperature. Additionally, it partially neutralizes the basal vaginal acidity and activates vaginal tenting and ballooning, increasing the chances of conception (Levin, 2020). While it is important to note that clitoral orgasms do not result in conception, Levin's study starts to unravel the importance of clitoral evolutionary existence.

1.2 | The great "re-discovery"

The history of the anatomy of the clitoris has been described previously (Charlier et al., 2020; O'Connell et al., 2005; Park, 1997). In brief, Hippocrates, the father of medicine, initially described a small protrusion of the female genitals and called it the "columella" or "uvula" and stated that it functioned to protect the vaginal opening (Charlier et al., 2020; Hippocrates., 1751). While the clitoris, as an anatomical structure, was known to ancient Greek scholars, it is evident that this knowledge was lost through time. Perhaps this was due to mistranslation of terminology or that some scholars incorrectly assumed that the presence of the clitoris was a rare pathological anomaly (Charlier et al., 2020; O'Connell et al., 2005; Park, 1997). For example, Galen believed that the female genitalia represented a direct external copy of biological male anatomy where the penis was equivalent to the uterus, and the glans equivalent to the vaginal cavity, leaving no explanation or even mention of the existence of the clitoris (Galenus, 1550).

The first published anatomical dissection of the clitoris was performed by Charles Estienne, a French anatomist, who published his work in a *dissection des parties du corps human in 1546* (Estienne, 1546; Mollendorf, 2011; Park, 1997). He used the phrase "*membre honteux*" (shameful member) to describe the structure and stated that it possesses a "glandular function…to enclose, retain, and receive some humidity in its natural sponginess" (Estienne, 1546). Despite Estienne's efforts, the official "re-discovery" of the clitoris is shrouded in controversy (Charlier et al., 2020; Park, 1997). Matteo Colombo, an Italian anatomist, described an organ that became turgid during mechanical stimulation or sexual arousal, stating it was the "principal seat of women's enjoyment in intercourse" in his work *De re anatomica* (Colombo, 1559). However, his own student Gabriele Falloppio insisted that Colombo had stolen his findings, stating that "modern anatomists have entirely neglected it" (Falloppio, 1561), a phrase that arguably still rings true today. In fact, Andreas Vesalius refuted Falloppio's 'discovery' and adamantly stated that this "useless" part was attributed to "hermaphrodites who otherwise have well-formed genitals" (Vesalius, 1564). While these scholarly men squabbled over the existence, or lack thereof, Gross (2022) affirms that the presence of the clitoris has been known by women for millennia. Indeed, a midwife, Jane Sharp (1671), described the sexual function of the clitoris in 1671 (Sharp, 1671). A year later, anatomist Regnier De Graaf (1672) published an accurate description of the clitoral structures, including the bulbs (De Graaf, 1672). Despite this, the neurovasculature was not fully described until 1844 by anatomist George Ludwig Kobelt (Charlier et al., 2020; Kobelt, 1844). Subsequently, interested parties had to wait until 2005, with work initiated in 1998, for a full and accurate anatomical description of the structures of the clitoris and its relationship to other genital structures (O'Connell et al., 1998; O'Connell et al., 2005). Utilizing MRI, cadaveric dissections, and findings from the literature, Helen O'Connell et al. (2005) confirmed that the clitoris is a "multiplanar structure consisting of a non-erectile tip, the glans, and erectile bodies (the paired bulbs, crura and corpora) …with a consistent relationship to the distal urethra and vagina" (O'Connell et al., 2005).

The representation of the clitoris in anatomy textbooks also has an intriguing history and is described by Hayes and Temple-Smith (2022). The relative size of the clitoris compared to other genital structures, and the number of labels depicting clitoral structures fluctuate throughout history (Moore & Clarke, 1995). Specifically, a fully labeled image of the entirety of clitoral structures was not published until the 40th edition of Gray's Anatomy (Hayes & Temple-Smith, 2022; Standring, 2005). Nowadays, only a quarter of specialist gynecological and textbooks report measurements for the clitoris (Adrikopoulou et al., 2013), mirroring a lack of accurate descriptions of variation in anatomical textbooks (Beni et al., 2022).

1.3 | The shameful organ

Anecdotal evidence suggests that throughout history, and even today, the word 'clitoris' can spark a visceral reaction of embarrassment or intrigue. This, in part, could be due to its lack of representation in medical and scientific literature and in the media (Beni et al., 2022). How can one relatively small bodily structure be shrouded in so much

mystery? How did it take anatomists hundreds of years to truly understand its structure (Charlier et al., 2020)? The answer lies in a multiplicity of sociocultural factors (O'Connell & Vikraman, 2015). Indeed, the majority of anatomists and clinicians were male until a few decades ago (Jefferson et al., 2015). In England, the right to study medicine was formally granted to women in 1915, and moral and ethical issues prevented men from taking a specialist interest in female reproductive anatomy (Jefferson et al., 2015). Moreover, the availability of female cadavers that were dissected by physicians or surgeons in medical schools and colleges was limited compared to males, as many of these bodies were sourced from executed males (Park, 1997). However, Harvard historian of medicine, Katharine Park devoted her whole research to the role of women in dissection. Her book "Cultures of Dissection and Anatomies of Generation" highlight how women were at the center of cadaveric dissection in the Middle-Ages, with multiple case-studies. The interest in the anatomy of women stemmed from a desire to understand the origins of life (Park, 1997).

Furthermore, it has been argued that the use of language to describe the clitoris and genitals alike has perpetuated a stigma that persisted for generations (Charlier et al., 2020; Draper, 2021). For example, the anatomical term "pudendum" which was formally used by Claudius Galen (129–216 BC) to describe both male and female external genitalia of both humans and animals, derived from the Latin word, pudēre, meaning "to be ashamed of." Conversely, Zdilla (2021) argues that the term pudēre has been taken out of context and the root term is inclusive of respect, modesty, virtue, awe, and veneration (Zdilla, 2021). Despite this, the dictionary definition of pudendum states that the word refers "especially to women" and the first edition of Terminologia Anatomica (1998) applied the Latin root only female anatomy (Draper, 2021). While the word pudendum was removed from Terminologia Anatomica in (2019), it remains commonly used in clinical practice, and is still used to describe the neurovasculature in both sexes (i.e., the pudendal nerve) (Draper, 2021).

The etymology of the clitoris is uncertain; however, the Greek translation (κλειτοριζ) is related to the word "hill." It could also be derived from the word "κλειτυς," which translates as the verb "shut" or "close" or the word "κλεις," which translates as "key" or "latch" (Williamson & Nowak, 1998).

1.4 | Clinical significance

The perceived lack of clinical importance of the clitoris has led to a lack of medical and scientific interest, especially when compared to its male counterpart, the penis (O'Connell et al., 2005). However, an understanding of the anatomy of the clitoris should be essential for surgeons performing vulvar procedures, including, but not limited to, gender affirmation surgeries (Zurada et al., 2018), urinary incontinence procedures, pelvic organ prolapse reconstructive surgeries (Azar et al., 2008), episiotomies (Muhleman et al., 2017), hysterectomies (Castiglione et al., 2015), vulvar cancer surgeries (Giannini et al., 2022), genital reconstruction for congenital adrenal hyperplasia (Almasri et al., 2018), repair following clitoral piercings (Dalke et al., 2013), cosmetic surgeries (Motzko et al., 2021), and reconstructive surgery following female genital mutilation (Botter et al., 2022).

Historically, the stigma and lack of understanding of the function of the clitoris led to the justification and, unfortunately, performance of clitoridectomies as a treatment for insanity, epilepsy, catalepsy, and hysteria (Elchalal et al., 1999; O'Connell et al., 2005). However, the removal of the clitoris is still performed worldwide (UNICEF, 2022), during the deeply rooted religious practice of female genital mutilation (FGM) (UNICEF Data, 2022; UNICEF, 2022). The practice can take different forms, which can be classified depending on the genital structures being removed or modified. Type 1 procedures include clitoridectomies, Type 2 procedures involve the removal of the clitoris and labia minora, while Type 3 procedures results in mutilation and infibulation (WHO, 2022). The rationale behind the practice is mainly societal and religious, often ignited by beliefs about what is considered appropriate sexual behavior for young women, as it allows the obtainment of premarital virginity and marital fidelity (WHO, 2022). The World Health Organization estimates that over 200 million women have been affected by FGM and is most prevalent in Africa, Asia, and the Middle East (WHO, 2022). It can result in long-term gynecological and obstetrics issues, not to mention loss of pleasure during sexual activity (Abdulcadir et al., 2016; El-Dirani et al., 2022; Lurie et al., 2020; WHO, 2022). It is important to underline that the practice of FGM is illegal in the United Kingdom and that each case should be reported to the authorities to allow appropriate safeguarding (Home Office, 2011). Genital reconstructive surgery is an option for women suffering from FGM, despite the fact it is still not recommended by the Royal College of Obstetricians and Gynecologists, as current evidence suggests unacceptable complication rates without conclusive evidence of benefit (RCOG, 2015). However, recent studies have described the benefits of these procedures (Puppo, 2017; Wilson & Zaki, 2022).

Gender reaffirming surgeries and genital cosmetic surgeries are additional procedures that require a thorough understanding of vulval anatomy and its variations to reduce complications. Moreover, patients wishing to avail themselves of these surgeries should be informed on what constitutes normal variation to ensure acceptance of the results and their own anatomy. In fact, prior to cosmetic surgery, the American College of Obstetricians and Gynecologists recommends that clinicians reassure patients that size, shape and color of external genitalia vary considerably, prior to elective surgery (ACOG, 2020). Despite this, a study demonstrated that a quarter of general practitioners are not confident in evaluating the normality of female genital anatomy, which may impact patient care (Simonis et al., 2016). Perhaps this is due, in part, to the recycled photographs of anatomical models in the lithotomy position across major anatomical textbooks and a consistent lack of diversity of the genitalia represented (Beni et al., 2022). Furthermore, measurements regarding clitoral structures are lacking from most anatomy textbooks (Adrikopoulou et al., 2013; Beni et al., 2022).

Furthermore, the National Institute of Clinical Excellence (NICE) impact report demonstrated that sexual health should be considered a fundamental part of health alongside well-being and quality of life (NICE, 2018), and a study by Public Health England highlighted that women consider reproductive and sexual health central to their lives

(PHE, 2018). Indeed, a good understanding of genital anatomy is fundamental to achieving a satisfying sexual life (Nagoski, 2015). While a study demonstrated that the clitoris was the most readily recognized structure of biological female external genitalia by the public (Waldersee, 2019), one in 10 women remain distressed or worried about their sex life (PHE, 2018). It has been reported that a sense of female inadequacy is perpetuated by distorted images supplied by the pornographic industry and the mainstream media (Moran & Lee, 2014). This has led some women to perceive that their own vulvar structures, including the clitoris, are inappropriate in shape and size, that may impair sexual satisfaction and wellbeing (Nagoski, 2015). A 2011 audit conducted in the United Kingdom, highlighted that distress caused by the patient's vulvar appearance was the cause of referral for labiaplasty in 71% of the cases analyzed (Deans et al., 2011).

1.5 | Aims

Therefore, this meta-analysis aimed to collate, for the first time, the published measurements relating to the erectile (body, crura, bulbs) and non-erectile (glans and prepuce) structures of the clitoris, and their relationship to other genital structures (external urethral meatus and anus) from cadaveric, living, and medical imaging (MRI and US) studies. The hope is that these data will be a useful guide to clinicians and the general public alike.

2 | METHODS

2.1 | Protocol and registration

This systematic review was submitted to the International Prospective Register of Systematic Reviews (PROSPERO) platform under protocol number CRD42021254598. The report of this study accords with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which consists of a checklist of items recommended for preparing systematic reviews and meta-analyses. As this was a literature study, formal ethics approval was not mandatory.

2.2 | Inclusion criteria

Studies were included if they reported numerical data regarding clitoral measurements from healthy human participants. As cadaveric studies were utilized, data from women over 50, who may be postmenopausal were included. All published measurements were included if the study reported no significant difference ($p > 0.5$) between a study and control group.

2.3 | Exclusion criteria

Measurements from prepubescent and adolescent females (i.e., participants under 18 years of age) were excluded. In addition, measurements from females with clinical conditions were excluded from the dataset if clitoral measurements were statistically different ($p < 0.05$) from control groups. Additionally, measurements were excluded if a study explicitly stated that they were not to be used as standard value.

2.4 | Information source

An electronic search was conducted in Ovid Medline and Embase from the creation of each database up until December 2021. To identify relevant studies, the Boolean operator "AND" and "OR" with the MeSH terms: ("clitoris" AND "anatomy" OR "structure" OR "topography" OR "Morphology") were utilized. The following categories were selected using the automatic 'limit' feature within the databases; "English language," "human" and "humans." Subsequently, a manual search from the reference lists in eligible articles to identify those relevant to this research was performed.

2.5 | Data extraction

All relevant demographic data including the authors, title, experimental modality of study (MRI); ultrasound (US); cadaveric; living), number of participants, age group and ethnicity were extracted. The type of fixative within the cadaveric studies was documented; in addition, details from patient studies were recorded.

The average (mean or median were applicable) and range (minimum and maximum) length and width of clitoral structures (glans, body, crura, bulb of vestibule, and prepuce) were reported, in addition to the distance from the clitoris to the external urethral meatus, vagina and/or anus.

2.6 | Study search

All results from the database search were screened by reading the title and abstract, and the eligibility criteria (as described in Section 2.2) were applied by three reviewers (R.B., A.S., and M.P.). Duplicate studies were removed. Thereafter, the full texts of all eligible studies were evaluated by three reviewers (R.B., A.S., and M.P). Any disagreements were resolved by discussion with an additional reviewer (G.L.).

All data (as described in Section 2.4) were extracted, summarized, and tabulated. The risk of bias was limited as all data were assessed and independently verified by two authors (S.J. and P.L). Any disagreements were resolved by an additional author (G.L).

2.7 | Meta-analysis

The overall mean measurement and range (minimum to maximum) for each clitoral structure was calculated using the average measurements from each study within Microsoft Excel. In studies where only the range was reported, the median was used in this calculation. If the range was unavailable, the 5%–95% interquartile range was reported if available.

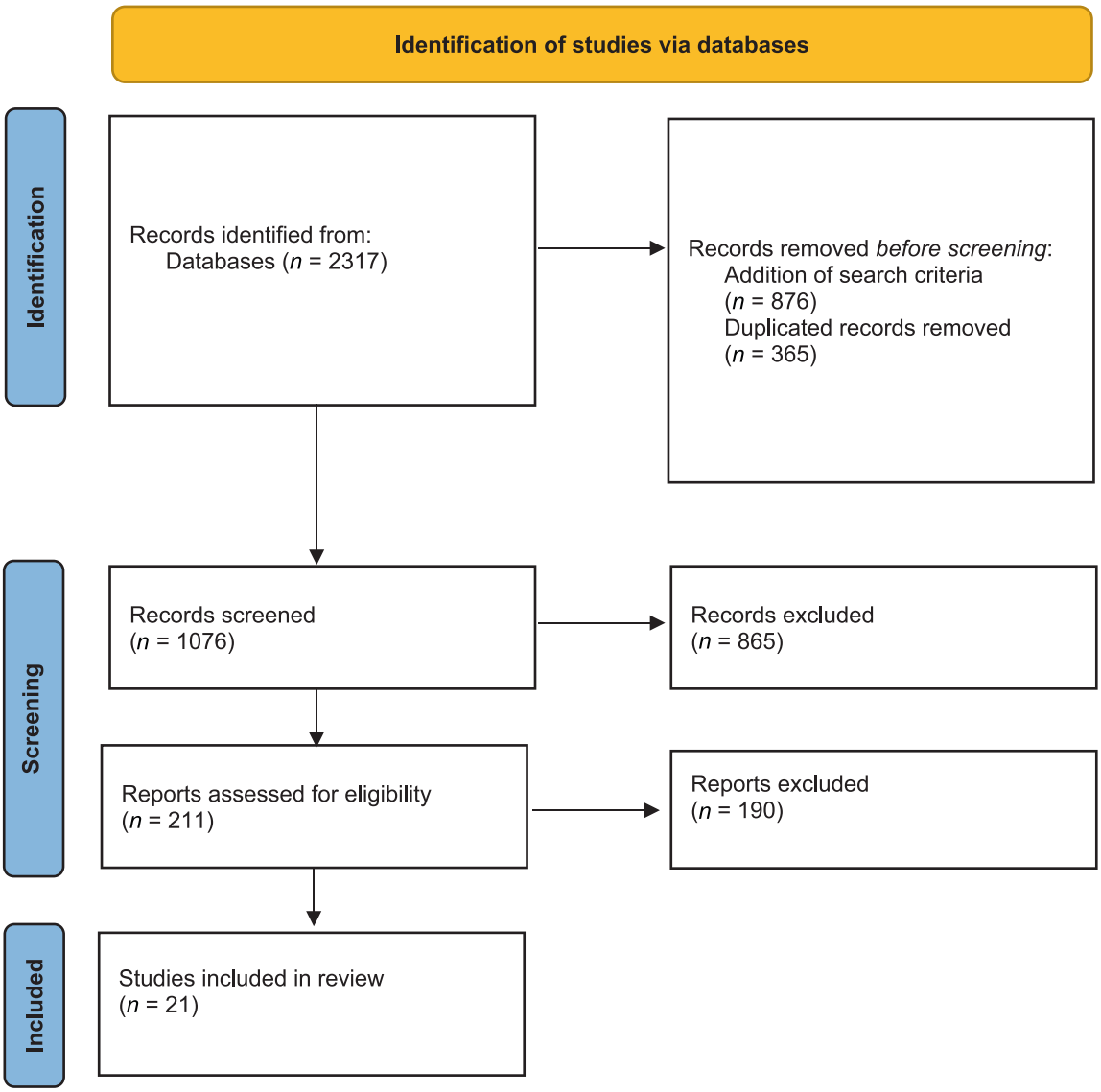

FIGURE 1 The Prisma process used to identify relevant manuscripts with clitoral measurements.

Statistical analysis to compare the average measurements from different experimental modalities (MRI, US, cadaveric and living) was performed on Graph Pad Prism 9, if more than two measurements for each experimental modality were recorded. First, a Shapiro–Wilk test for normality was performed and subsequently a non-parametric Kruskal-Wallis (glans, body and distance between clitoral and external urethral meatus measurements) or Mann–Whitney test (crura length) was performed. Where fewer than two measurements were available for a particular modality, no statistical test was performed.

3 | RESULTS

3.1 | PRISMA search results

The initial electronic literature research retrieved 2317 articles. Before the title and abstract screening, 1241 papers were excluded for not meeting the inclusion criteria (876) or were duplicates (365). After title and abstract screening, 865 reports were excluded. Two hundred and eleven full-text articles were further evaluated. Twenty-one studies met the inclusion criteria and were selected for analysis and data extraction (Figure 1).

3.2 | Number of participants and modality of study

In total, clitoral structures from 2432 biological females (*n*) aged 18–84 years-old were recorded (Table 1). Four studies (Suh et al., 2003 ($n = 18$); Abdulcadir et al., 2016 ($n = 15$); Vaccaro et al., 2014 ($n = 20$); Bowen et al., 2022 ($n = 22$) were performed through MRI ($n = 87$), two studies (Buisson et al., 2008 ($n = 5$); Aydin et al., 2021 ($n = 108$) were performed using US ($n = 113$), four studies (O'Connell et al., 1998 ($n = 10$); Jackson et al., 2019 ($n = 27$); Kelling et al., 2020 ($n = 10$); Blayney et al., 2021 ($n = 7$) measured cadaveric clitoral

structures ($n = 54$), whereas 11 studies (Lloyd et al., 2005 ($n = 50$); Basaran et al., 2008 ($n = 100$); Mendiola et al., 2021 ($n = 100$); Cao et al., 2015 ($n = 319$); Köşüş et al., 2016 ($n = 35$); Kreklau et al., 2018 ($n = 557$); Gyftopoulos et al., 2019 ($n = 56$); Chinkangsadan et al., 2020 ($n = 155$); Ellibeş Kaya et al., 2020 ($n = 208$); Agrawal et al., 2021 ($n = 400$); Ekmez & Ekmez, 2021 ($n = 210$) measured clitoral structures in living patients ($n = 2190$). No significant difference ($p > 0.05$) was observed between each clitoral structure and the experimental modality utilized.

A summary of details from each publication, including the inclusion and exclusion criteria, was documented (Table 2). Additionally, details on the anatomical landmarks used to measure each structure (Table 3) and distance between other genital structures as document in the publications was recorded (Table 4).

3.3 | Key clitoral measurements

The average length and width of the glans was 6.40 mm (range 1.00–21.00 mm) and 5.14 mm (range 2.00–32.00 mm), respectively.

The average length and width of the body was 25.46 mm (range 5.00–59.00 mm) and 9.00 mm (range 5.00–20.00 mm), respectively.

The average length and width of the crura was 52.41 mm (range 23.00–90.00 mm) and 8.71 mm (range 2.00–13.00 mm), respectively.

The average length and width of the bulb was 52.00 mm (range 13.00–70.00 mm) and 10.33 mm (3.00–29.00 mm), respectively.

The average length of the clitoral prepuce was 23.19 mm (range 5.00–40.00 mm).

The average distance from the clitoral glans to the external urethral meatus was 22.72 mm (range 7.00–52.00 mm). The average distance to the vagina was 43.14 mm. The average distance from the clitoris to the anus was 76.30 mm (and the 5%–95% interquartile range was 59.50–96.10 mm) (Figure 2).

4 | DISCUSSION

This is the first meta-analysis to collate all recorded measurement of clitoral structures from MRI, US, cadaveric, and living people. This study confirmed clitoral structures present with a range of measurements that is not accurately represented in anatomical textbooks. For example, the average length of the clitoral glans in this study was 6.40 mm (1.00–21.00 mm), while the average length of the body was 25.65 mm (5.00–59.00 mm). Only two anatomical textbooks have published empirical data on these structures and have published the combined length of the body and glans as 20.00 mm (Moore et al., 2014) or ranging from 30.00 to 40.00 mm (Paulsen et al., 2018). This study has revealed that these published figures are smaller than in-vivo measurements, as the combined average length of the body and glans from this study was 32.05 mm (6.00–80.00 mm).

The distance between the clitoris and the external urethral meatus is also reported in anatomical textbooks (Beni et al., 2022); seven of which state that this distance is 2.5 cm (Sinnatamby, 2011, p. 307; Standring, 2015, p 1289; Loukas et al., 2017, p. 249; Paulsen et al., 2018, p. 386; Ellis & Mahadevan, 2019, p. 120; Waschke et al., 2019, p. 386; Brennan et al., 2020, p. 551). While this measurement is similar to the average from this review (22.72 mm), textbooks fail to document that there is substantial variation in this distance between women (7.00 and 52.00 mm).

An objective decision was made to omit data from adolescent females under 18 years old, as they are still developing (Brix et al., 2019). Despite this, a study demonstrated that the median clitoral glans width in 44 adolescent females, aged 10–19 years-old, was 3.00 mm and ranged from 1.00 to 8.00 mm (Brodie et al., 2019). This length is smaller than that reported in this review (5.00 mm). Kreklau and colleagues grouped 15–24 years old and reported that the average length of the glans was 7.86 mm, slightly higher than our reported average (6.84 mm). We included data from studies that did not report a statistical difference from control groups. This included women without sexual dysfunction or with female sexual function index scores >3.6. Conversely, we omitted cohorts of data in which there was a statistically significant difference in clitoral measurements in women with pathological conditions, such as polycystic ovaries (Köşüş et al., 2016), recurrent postcoital cystitis (Gyftopoulos et al., 2019), and stress urinary incontinence (Ekmez & Ekmez, 2021), as these clitoral measurements were statistically different ($p < 0.05$) from control groups. Köşüş et al. (2016) speculate that high androgen levels in women with PCOS could cause virilization, which may cause clitoral enlargement, and that hyperandrogenism is linked to longer clitoral length. Clitoral lengths were significantly greater in women with polycystic ovaries (4.00 mm), compared to those without (2.0 mm) (Köşüş et al., 2016). Moreover, the distance between the clitoris and urethra was significantly greater (31 mm) in patients with recurrent postcoital cystitis, compared to a control group (28 mm) (Gyftopoulos et al., 2019). Furthermore, the distance between the clitoral glans and the anus was significantly greater in women with stress urinary incontinence (81.1 mm), compared to a control group (72.1 mm) (Ekmez & Ekmez, 2021). As part of the exclusion criteria, we omitted measurements from women who have experienced FGM. However, Abdulcadir et al. (2016) reported no significant difference in the width of the clitoral glans and length of the body. Despite this, they did find a significantly smaller clitoral and bulbar volume in women with FGM, compared to those without (Abdulcadir et al., 2016). While we have not reported on the volume of clitoral structures, studies performed using US demonstrated that clitoral volume can fluctuate throughout the menstrual cycle (Battaglia et al., 2008; Battaglia et al., 2009). Other factors that may affect clitoral dimensions include body mass index (BMI) (Vaccaro et al., 2014) and parity (Verkauf et al., 1992). While Vaccaro et al. (2014) reported that a positive correlation between BMI and clitoral distance to the anterior vaginal wall is caused by increased adipose tissue, the increase in size of clitoral structures in women with higher BMIs "does not have a clear etiology." Furthermore, while arousal can increase the size of the vestibular bulbs during arousal, there are no changes in the dimension of the clitoral body (Suh et al., 2004).

TABLE 1 Measurements of clitoral structures in mm.

Modality	Publication	Notes	Study size	Age range	Glans length average (range)	Glans width average (range)	Body length average (range)	Body width average (range)	Crura length average (range)	Crura width average (range)	Bulb of vestibule length average (range)	Bulb of vestibule width average (range)	Prepuce length average (range)	Distance to external urethral meatus (range)	Distance to vagina (range)	Distance between anus and clitoris (mm)
MRI	Abdulcadir et al. (2016)	Premenopausal women (No FGM)	15	32.07[a]	n/a	4.80	25.73	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Bowen et al. (2022)	Nulliparous women	22	20–49	6.00 (5.00–12.00)	5.00 (4.00–7.00)	18.00 (9.00–24.00)	11.00 (5.00–16.00)	36.00 (23.00–54.00)	7.00 (5.00–11.00)	n/a	n/a	n/a	n/a	37	n/a
	Suh et al. (2003)	Postmenopausal	6	40–65	n/a	n/a	n/a	9.00 (7.00–12.00)	n/a	n/a	n/a	5.00 (3.00–8.00)	n/a	n/a	n/a	n/a
		Premenopausal	12	21–39	n/a	n/a	n/a	10.00 (8.00–12.00)	n/a	n/a	n/a	8.00 (6.00–10.00)	n/a	n/a	n/a	n/a
	Vaccaro et al. (2014)	Sexually active females	20	41.6[a]	12.67	5.38	29.98	5.6	64.03	10.12	n/a	n/a	n/a	n/a	49.27	n/a
US	Aydin et al. (2021)	Low orgasm group = FSHI <3.6	30	35.4[a]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21	n/a	n/a
		Control group = FSHI >3.6	78	38.3[a]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	16.1	n/a	n/a
	Buisson et al. (2008)	"healthy volunteers"	5	25–45	n/a	n/a	(8.00–10.00)	(7.00–11.00)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cadaveric	Blayney et al. (2021)	Fresh cadavers	7	60+	5.90	5.90	33.00	5.30	42.00	n/a	n/a	n/a	n/a	21	n/a	n/a
	Jackson et al. (2019)	Fresh cadavers	27	48–96	8.00 (5.00–12.00)	4.00 (3.00–10.00)	29.00 (13.00–59.00)	9.00 (5.00–14.00)	50.00 (25.00–68.00)	9.00 (2.00–13.00)	54.00 (13.00–69.00)	18.00 (9.00–29.00)	n/a	25.00 (14.00–37.00)	n/a	n/a
	Kelling et al. (2020)	Fresh cadavers	10	43–88	7.9 (6.00–9.00)	n/a	37.00 (28.00–50.00)	7.10 (5.00–10.00)	n/a	n/a	n/a	n/a	23.40 (19.00–26.00)	n/a	n/a	n/a
	O'Connell et al. (1998)	2 fresh and 8 fixed cadavers	10	22–88	n/a	n/a	(20.00–40.00)	(10.00–20.00)	(50.00–90.00)	n/a	(30.00–70.00)	n/a	n/a	n/a	n/a	n/a
Living	Agrawal et al. (2021)	"Indian" vulva measurements by age, BMI, parity or delivery	59	18–25	4.91 (3.00–7.00)[b]	2.89 (2.00–4.00)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	18.6 (10.00–26.20)[b]	n/a	n/a
			118	26–35	5.06 (3.00–7.00)[b]	3.05 (2.00–4.00)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21.5 (13.00–31.00)[b]	n/a	n/a
			115	36–45	5.18 (3.00–7.00)[b]	3.22 (2.00–4.30)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21.00 (13.00–32.00)[b]	n/a	n/a
			66	46–55	5.43 (4.00–8.00)[b]	3.21 (2.00–4.00)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	22.00 (14.25–33.25)[b]	n/a	n/a
			23	56–65			n/a	n/a	n/a	n/a	n/a	n/a	n/a		n/a	n/a

(Continues)

TABLE 1 (Continued)

Modality	Publication	Notes	Study size	Age range	Glans length average (range)	Glans width average (range)	Body length average (range)	Body width average (range)	Crura length average (range)	Crura width average (range)	Bulb of vestibule length average (range)	Bulb of vestibule width average (range)	Prepuce length average (range)	Distance to external urethral meatus (range)	Distance to vagina (range)	Distance between anus and clitoris (mm)
					5.69 (3.10–8.00)[b]	3.43 (3.00–4.90)[b]								20.1 (14.00–27.90)[b]		
			19	(65+)	5.89 (3.00–8.00)[b]	3.42 (2.90–4.00)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19.60 (13.80–26.2)[b]	n/a	n/a
	Basaran et al. (2008)	Premenopausal	50	22–39	n/a	10.20 (3.00–27.00)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	29.20 (15.00–45.00)	n/a	n/a
		Postmenopausal	50	47–60	n/a	10.30 (3.00–32.00)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	28.70 (12.00–52.00)	n/a	n/a
	Cao et al. (2015)	Chinese women seeking genital cosmetic surgery	319	18–64	5.04 (1.00–10.00)	4.14 (2.00–8.00)	n/a	n/a	n/a	n/a	n/a	n/a	25.66 (15.00–40.00)	24.95 (15.00–40.00)	n/a	n/a
	Chinkangsadan et al. (2020)	Premeopausal Thai women	108	20–70	n/a	6.61	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19.41	n/a	n/a
		Postmenopausal Thai women	47	n/a	n/a	6.89	n/a	n/a	n/a	n/a	n/a	n/a	n/a	15.2	n/a	n/a
	Ekmez and Ekmez (2021)	No stress urinary incontinence	210	36.6[a]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	72.2
	Ellibeş Kaya et al. (2020)	Negative and positive FSD	208	18–52	8.7 (4.00–21.00)	8.00 (3.00–11.00)	n/a	n/a	n/a	n/a	n/a	n/a	20.50 (5.00–35.00)	22.45 (7.00–42.00)	n/a	n/a
	Gyftopoulos et al. (2019)	No cystitis	56	18–40	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	28.00[a] (25.00–30.00)[c]	n/a	n/a
	Köşüş et al. (2016)	No PCOS	35	18–33	2.00 (1.00–3.20)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Kreklau et al. (2018)	"White" vulva measurements by age	100	25–34	7.27 (2.00–19.85)[b]	4.69 (2.00–9.95)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.80 (14.00–40.00)[b]	n/a	n/a
			102	35–44	7.47 (3.00–19.85)[b]	4.52 (2.00–9.00)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	24.27 (12.15–40.00)[b]	n/a	n/a
			104	45–54	6.75 (2.25–14.00)[b]	4.58 (2.00–10.00)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21.58 (11.25–35.00)[b]	n/a	n/a
			100	55–64	6.83 (3.00–17.95)[b]	4.99 (2.00–10.95)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	20.94 (11.00–34.85)[b]	n/a	n/a
			100	65–74	6.04 (3.00–13.85)[b]	4.38 (2.00–8.95)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19.92 (10.00–30.00)[b]	n/a	n/a
			51	75–84	5.17 (1.60–17.00)[b]	4.33 (2.00–11.60)[b]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19.69 (7.20–33.20)[b]	n/a	n/a
			50	18–50	n/a			n/a	n/a	n/a	n/a	n/a	n/a		n/a	n/a

TABLE 1 (Continued)

Modality	Publication	Notes	Study size	Age range	Glans length average (range)	Glans width average (range)	Body length average (range)	Body width average (range)	Crura length average (range)	Crura width average (range)	Bulb of vestibule length average (range)	Bulb of vestibule width average (range)	Prepuce length average (range)	Distance to external urethral meatus (range)	Distance to vagina (range)	Distance between anus and clitoris (mm)
	Lloyd et al. (2005)	Premenopausal women				5.50 (3.00–10.00)	19.10 (5.00–35.00)							28.50 (16.00–45.00)		
	Mendiola et al. (2012)	Healthy "Spanish women"	100	18–23	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	80.4 (59.50–96.10)[b]
Total average		MRI	75	n/a	9.34 (5.00–12.00)	5.06 (4.00–7.00)	24.57 (9.00–29.98)	8.90 (5.00–16.00)	50.02 (23.00–64.03)	8.56 (5.00–11.00)	n/a	6.50 (3.00–10.00)	n/a	n/a	43.14	n/a
		US	113	n/a	n/a	n/a	9.00[a] (8.00–10.00)	9.00[a] (7.00–11.00)	n/a	n/a	n/a	n/a	n/a	18.55 (16.10–21.00)	n/a	n/a
		Cadaveric	54	n/a	7.27 (5.00–12.00)	4.95 (3.00–10.00)	32.25 (13.00–59.00)	9.10 (5.00–20.00)	54.00 (25.00–90.00)	9.00 (2.00–13.00)	52.00 (13.00–70.00)	18.00 (9.00–29.00)	23.40 (19.00–26.00)	23.00 (14.00–37.00)	n/a	n/a
		Living	2190	n/a	5.38 (1.00–19.85)	5.18 (2.00–32.00)	19.10 (5.00–35.00)	n/a	n/a	n/a	n/a	n/a	23.08 (5.00–40.00)	22.57 (7.00–52.00)	n/a	76.30 (59.50–96.10)[b]
		Overall	2432	18–96	6.40 (1.00–21.00)	5.14 (2.00–32.00)	25.46 (5.00–59.00)	9.00 (5.00–20.00)	52.41 (23.00–90.00)	8.71 (2.00–13.00)	52.00 (13.00–70.00)	10.33 (3.00–29.00)	23.19 (5.00–40.00)	22.27 (7.00–52.00)	43.14	76.30 (59.50–96.10)[b]

[a]Median.

[b]Interquartile range, 5%–95%.

[c]Interquartile range, 25%–75%.

Abbreviations: BMI, body mass index; FGM, female genital mutilation; FSD, female sexual dysfunction; FSFI, female sexual function index; MRI, magnetic resonance imaging; n/a, data not available; PCOS, polycystic ovary syndrome; US, ultrasound imaging.

TABLE 2 Inclusion and exclusion criteria of studies, with a brief summary of conclusions.

Type	Publication	Summary	Inclusion	Exclusion	Conclusion
	Abdulcadir et al. (2016)	MRI for anatomy in FGM vs control group without	Sexual intercourse during previous 4 weeks, no pregnancy, last delivery >12 months earlier, no intake of estrogens or androgens or HRT, no history of vaginal surgery including episiotomy, no vulvar condition other than FGM, no previous hysterectomy, absence of psychiatric disease	N/a	No significant results for anatomy: glans width or body length or clitoral volume or bulbar volume
MRI	Bowen et al. (2022)	MRI measurements of clitoris to see if this is a more reliable measurement method	Nulliparous, no prior surgery, underwent pelvic imaging without contrast for medical indications, acceptable abnormalities: non-infected urethral diverticuli <33 m; uterine fibroids <3 cm; IUD; thrombosed pelvic vein; thickened endothetrial stripe; hydrosalpinx	Abnormalities outside the inclusion criteria, history of pelvic surgery, presence of recall or vaginal contrast, scans that failed to fully capture the clitoral anatomy	MRI measurements are a comparable and more consistent method of measuring anatomy
	Suh et al. (2003)	MRI study comparing premenopausal and menopausal anatomy	N/a	Use of estrogen, use of hormonal medications, acute or chronic medical conditions, history of sexual dysfunction, current pregnancy, delivery within the last 12 months, history of hysterectomy, history of vaginal surgery, gynecological disease, malignancy, PID, vaginal infection, known anatomical abnormalities of the genitalia	Postmenopausal women have smaller labia minora width; vestibular bulb width; vaginal width; and wall thickness; and cervical diameter than premenopausal
	Vaccaro et al. (2014)	Retrospectively looked at MRI of pelvis and asked patients to complete sexual satisfaction questionnaire to see if anatomy correlates to FSFI	Sexually active (any encounter including self-stimulation within 4 weeks; does not list anal), over 18 years old, underwent pelvic MRI with or without contrast	Male gender, incorrect axial and sagittal cuts of distal vagina; clitoris; and vulva, poorly visualized clitoral anatomy, pregnant, large pelvic mass impeding measurements, grossly abnormal pelvic anatomy	Sexual function improved in women with smaller clitoris specifically clitoral body and crus, BMI and hypertension positively correlates with certain anatomy
US	Aydin et al. (2021)	US to measure clitoris and compare to women with a low orgasm domain score to see if anatomy affects orgasmic function	Sexually active, heterosexual, premenopausal, admitted to gynecology clinic complaining of orgasm difficulties or low sexual desire or routine gynecological examination	Pelvic organ prolapse greater than stage 2 on pelvic organ prolapse quantification system (?), previous prolapse or incontinence surgery, unable to be examined in lithotomy position, anatomical defects such as vaginal septum or Mullerian anomalies, pregnant, vaginal delivery within 6 months, menopause, neurological or psychiatric disorders, antidepressant medication use, dyspareunia, hypoactive sexual desire disorders	Increased distance between clitoris and urethra is related to difficulty with orgasm, Increased space within the genital hiatus for the clitoris is also associated with difficulty with orgasm
	Buisson et al. (2008)	US study of unstimulated clitoris and discusses the anatomy they found	Healthy, non-aroused, between day 2 and 14 of cycle, no history of perineal surgery or trauma, not taking birth control pills,	N/a	US is a good and non-invasive method to measure anatomy and could be useful in future studies

TABLE 2 (Continued)

Type	Publication	Summary	Inclusion	Exclusion	Conclusion
			not receiving hormonal treatment, no sexual dysfunction as measured by FSFI scoring		
	Blayney et al. (2021)	Cadaveric study of dorsal nerve of clitoris and vasculature	Not mentioned but all >60 years of age and no FGM	N/a	Mean and range of widths of dorsal nerve of the clitoris is similar to other cadaveric studies (Jackson, Kelling)
Cadaveric	Kelling et al. (2020)	Cadaveric study to look at dorsal nerve of clitoris route and related genitalia with a surgical focus	Caucasian, self-enrolled donors to the university	N/a	Discusses anatomy, clitoral body longer than previously mentioned
	Jackson et al. (2019)	Cadaveric study looking mainly at dorsal nerve of the clitoris but also measures vulva structures	Embalmed female cadavers	History of gynecological cancer, evidence of metastatic cancer to the vulva	Nerve has a consistent and reproducible path, most vulnerable with surgical entry or laceration that extend from midline of the prepuce to the inferior pubic rami
	O'Connell et al. (1998)	1998 cadaveric study reviewing the appropriateness of the clitoral nomenclature at the time	Both fresh and fixed cadavers, menopausal status unknown, no evidence of prior perineal surgery	N/a	Textbooks at the time seems to have described female anatomy by comparing to male anatomy. Discusses the anatomy findings in detail
	Agrawal et al. (2021)	400 patient study of Indian women (18 to 25) to look at anatomy and see if there is a relation to age or BMI or parity or delivery mode	Over 18, able to understand the language, signed informed consent	Chronic vulva disease, vulvar problems, prior surgery of vulva, above stage 2 pelvic organ prolapse, systemic hormone therapy use (not OCP), pregnant	Significance of vulva measurements with age and height and BMI and obstetric history and mode of delivery
	Basaran et al. (2008)	Comparing measurements of external genitalia in premenopausal and postmenopausal (cessation for 6 months) women with tape measure to determine objective measurements	Routine control examinations, sexually active	Previous history of pelvic surgery, complaints related with external genital organs, use of hormone replacement therapy in menopause group, use of oral contraceptives, congenital genital abnormality, previous vaginal birth with mediolateral episiotomy	Width of labia minora significantly higher in premenopausal, length of vagina longer in premenopausal group
	Cao et al. (2015)	Measured 12 parameters of the external genitalia anatomy of 319 Hans nationality Chinese women	Women who came seeking cosmetic surgery of vulva, over 18 years, Han nationality	Precious vaginal and/or perineal gynecological or aesthetic surgical interventions, stage >2 pelvic organ prolapse, urinary incontinence, pregnancy	Normal ranges vary, correlation with demographics which should be heeded in any reconstructive or cosmetic genitalia surgery
	Chinkangsadan et al. (2020)	N/a	Only Thai women who answered the GAS questionnaire on the satisfaction with the scale = 0 (most satisfied) Participants with previous vaginal delivery with median episiotomy or no episiotomy or natural perineal tear	History pelvic reconstructive surgery or vulvovaginal cosmetic surgery, prior vaginal birth with known history of mediolateral episiotomy or obviously noticed mediolateral episiotomy scar, and known congenital Mullerian anomaly	N/a
Living	Ekmez and Ekmez (2021)	Retrospective measurements of distance between anus and clitoris; anus and fourchette;	Both nulliparous and multiparous women	Urge and/or mixed incontinence, sever mental inability, severe neurological disease, neurogenic bladder, refusal to	Shorter perineal body length and longer distance between anus and clitoris resulted in a higher incidence of SUI

(Continues)

TABLE 2 (Continued)

Type	Publication	Summary	Inclusion	Exclusion	Conclusion
		genital hiatus to see if there is a correlation with stress urinary incontinence		content, less than 18 years old, history of stress incontinence surgery, presence of gynecological tumor, rectal disease, active infection in anogenital area	
	Ellibeş Kaya et al. (2020)	Measure 206 healthy premenopausal women to find 'normal' measurements and whether this affects sexual function and general perception	Premenopausal, over 18 years, sexually active, seen for routine gynecological examination, no known illness	Postmenopausal, pregnant, previous vaginal or perineal or gynecological or aesthetic interventions, stage >2 pelvic organ prolapse, urinary incontinence, menstrual irregularities, gynecological cancer, PCOS, oral contraceptive use, antidepressant use, IUD	Range is too wide to define 'normal' anatomy, there was no significance between anatomy measurements and sexual dysfunction
	Gyftopoulos et al. (2019)	Case control study looking at anatomy of women with and without recurrent UTI associated with sexual intercourse	18–40 years old, visiting as outpatients with acute post coital UTI and a history of recurrent UTI related to sexual intercourse, culture confirmed UTI, otherwise healthy, contraceptive use	History of STD, history of voiding dysfunction, history of pregnancy and vaginal delivery, previous pelvic or genital surgery, diabetes, multiple sex partners, practicing anal intercourse	Shorter urethra-vagina distance plays a role in acquiring recurrent UTI related to sexual intercourse
	Köşüş et al. (2016)	To see if mild to moderately elevated androgen levels in PCOS affects external genitalia in Turkish women	Rotterdam criteria for PCOS diagnosis	Less than 18, aged over 40 years, pregnancy, presence of other androgen excess disorders, patients with systemic diseases: Such as hypertension or diabetes, history of genital surgery	Statistically significant but not clinically apparent changes to external genitalia such as clitoral and labial lengths higher in PCOS
	Kreklau et al. (2018)	Large homogenous study looking at vulva measurements separated by decade age group	Aged between 15 and 84 years, able to speak and write German sufficiently, white women	Pregnancy, use of systemic hormone therapy but not the oral contraceptive pill, chronic vulva disease such as lichen sclerosis, vulvar complaints, prior vulva surgery	Only includes data for white women but provides a baseline
	Lloyd et al. (2005)	Measurements of external genitalia in premenopausal women	Premenopausal, sexually active or not sexually active, both nulliparous and multiparous, did not matter if taking systemic hormones as they found no statistical difference	Non-English speaker without interpreter present, under 18 years of age, postmenopausal, previous surgery to external genitalia, FGM	Great diversity in measurements
	Mendiola et al. (2012)	To see if anogenital distance is related to ovarian follicular count	Aged over 18 and born after 31st December 1987 (18–23), born in Spain, healthy	Did not exclude PCOS	Hormonal contraception associated with shorter AGD measurements, anogenital distance (both AC and AF) were positively and strongly associated with the presence of greater ovarian follicular number

Abbreviations: FGM, female genital mutilation; HRT, hormone replacement therapy; IUD, intrauterine device; MRI, magnetic resonance imaging; N/a, data not available; OCP, oral contraceptive; PCOS, polycystic ovarian syndrome; US, ultrasound; UTI, urinary tract infection.

TABLE 3 Anatomical landmarks used for measuring clitoral structures as described in the publications.

	Publication	Glans length (mm)	Glans width (mm)	Body length (mm)	Body width (mm)	Crura length (mm)	Crura width (mm)
MRI	Abdulcadir et al. (2016)	The visible part of the clitoris	Axial plane	In sagittal plane from elbow to end of glans	N/a	Maximal length in axial or axial oblique plane	Maximal widths in axial plane
	Bowen et al. (2022)	Body and glans form a boomerang shape that lies inferiorly to the pubic symphysis length measured along the inferior–superior direction	N/a	Elbow of the clitoris separates the body from each crus. Inferior portion of the body ends where the midline septum of the glans is visible in the axial plane length measured along the inferior–superior direction	Measured at midpoint along the medial lateral direction in the frontal plane	Attachment site to ischiocavernosus muscles length measured from the elbow of clitoral body-glans junction to the end of the lateral end of the crus	Width measured at its widest point such that it was perpendicular to its length in the axial plane
	Suh et al. (2003)	Measured at greatest prominence of the clitoral body which was at the level of the ischial tuberosity	N/a	N/a	N/a	N/a	N/a
	Vaccaro et al. (2014)	Includes sagittal and axial dependent variables, all measurements were straight line distances measured in millimeters and at right angles to the structures being measured where possible	N/a	N/a	N/a	N/a	N/a
US	Aydin et al. (2021)	Non erectile	N/a	N/a	N/a	N/a	N/a
	Buisson et al. (2008)	N/a	N/a	N/a	7–11 is the mean diameter of the clitoral bodies just before their junction. They meet on the medial line and form the raphe	N/a	N/a
Cadaveric	Blayney et al. (2021)	Glans and distal body is close to the ventral wall of the distal urethra	N/a	Is wrapped inside a thin connective tissue layer consistent with the tunica albuginea	Distal body and dorsal bundles are close to the pubic arch and attached to it by the suspensory ligament	Fixed to the inferomedial surface of each ischiopubic ramus by a solid capsule	N/a
	Kelling et al. (2020)	After transection of free end of clitoral hood from origin of the clitoral hood to base of glans	N/a	Length of descending segment of the clitoral body was determined by measuring the distance from the most proximal point of	Found in the midline of the clitoral complex and also referred to as the corpora. Gives rise to bilateral crura	Found under and after removal of ischiocavernosus and bulbospongiosus muscles. Crura lies	Slightly narrower than the clitoral body.

(Continues)

TABLE 3 (Continued)

	Publication	Glans length (mm)	Glans width (mm)	Body length (mm)	Body width (mm)	Crura length (mm)	Crura width (mm)
				attachment of the deep suspensory ligament on the clitoral body to the base of the glans	which extends laterally. Body is found directly anterior to the urethra.	parallel to the ischiopubic rami. The urethra is flanked deeply by the crura.	
	Jackson et al. (2019)	Measured prior to dissection from the junction with prepuce skin to the most distal extent	Measured prior to dissection at the junction with the prepuce skin	Measured along dorsal surface	Measured at the midpoint, includes all tissue layers as taken prior to dissection	Shown in Figure 1 only: from junction with clitoral body to most distal extent of crura	N/a
	O'Connell et al. (1998)	Found superficially at the junction of the labia minora anterior to the urethra	N/a	Body of clitoris is covered by the suspensory ligament	N/a	N/a	N/a
Living	Agrawal et al. (2021)		N/a	N/a	N/a	N/a	N/a
	Basaran et al. (2008)		Widest horizontal diameter of glans clitoris	N/a	N/a	N/a	N/a
	Cao et al. (2015)	Length of the clitoral glans seen slightly retracting the prepuce	Greatest transverse diameter of the clitoral glans	N/a	N/a	N/a	N/a
	Chinkangsadan et al. (2020)	N/a	N/a	N/a	N/a	N/a	N/a
	Ekmez and Ekmez (2021)	N/a	Greatest width of the clitoral glans	N/a	N/a	N/a	N/a
	Ellibeş Kaya et al. (2020)	Longest craniocaudal length of clitoral glans	Transverse diameter of clitoral glans	N/a	N/a	N/a	N/a
	Gyftopoulos et al. (2019)	From junction with the prepuce skin to the most distal extent	Junction with the prepuce	Along the dorsal surface	Measured at midpoint prior to removal of surrounding layers, included all tissue layers surrounding the clitoral body	N/a	N/a
	Köşüş et al. (2016)	Only provides a diagram	N/a	N/a	N/a	N/a	N/a
	Kreklau et al. (2018)	Only provides a diagram	N/a	N/a	N/a	N/a	N/a
	Lloyd et al. (2005)	Only provides a diagram	N/a	N/a	N/a	N/a	N/a
	Mendiola et al. (2012)	N/a	N/a	N/a	N/a	N/a	N/a

Abbreviation: N/a, data not available.

TABLE 4 Anatomical landmarks used for measuring clitoral distances as described in the publications.

	Publication	Bulb of vestibule length (mm)	Bulb of vestibule width (mm)	Prepuce length (mm)	Distance to external urethral meatus (mm)	Distance to vagina (mm)	Distance to anus (mm)
MRI	Abdulcadir et al. (2016)	N/a	N/a	N/a	N/a	N/a	N/a
	Bowen et al. (2022)	N/a	N/a	N/a	N/a	Minimum surface to surface distance from glans to vagina	N/a
	Suh et al. (2003)	N/a	N/a	N/a	N/a		N/a
	Vaccaro et al. (2014)	N/a	N/a	N/a	N/a	Distance from posterior aspect of glans to anterior vaginal wall	N/a
US	Aydin et al. (2021)	Body, bulb, and crura are composed of erectile tissues of the clitoral nerve and may play a greater role in female orgasm from penile vaginal intercourse	Body, vestibular bulbs, and crura are attached to the pubic bone	N/a	N/a	N/a	N/a
	Buisson et al. (2008)	N/a	Difficult to measure bulbs because their diameters are variable at different levels	N/a	N/a	N/a	N/a
Cadaveric	Blayney et al. (2021)	Bulbs closely attached to the mid-line where crus meet. Here it is connected to the ventral part of the incomplete septum of two corpus cavernosa	N/a	N/a	N/a	N/a	N/a
	Kelling et al. (2020)	Long triangular shape which is covered by a flimsy/ delicate capsule which is very different from the thick capsule surrounding the clitoral body. The urethra is flanked superficially by the bulbs. The bulbs lie on the superficial aspect of the vaginal wall. The bulbs lie deep the bulbospongiosus muscle and sit posterior to the body.	Bulbs partially or completely fill the gap between the labia minora, body and crura lateral to the vaginal wall and urethra. O'Connell suggests the bulbs of the vestibule should be renamed (bulbs of clitoris) as they relate to the clitoris and urethra more than the labia minora.	N/a	N/a	N/a	N/a
	Jackson et al. (2019)	N/a	N/a	N/a	Closest distance between the glans	N/a	N/a

(Continues)

TABLE 4 (Continued)

	Publication	Bulb of vestibule length (mm)	Bulb of vestibule width (mm)	Prepuce length (mm)	Distance to external urethral meatus (mm)	Distance to vagina (mm)	Distance to anus (mm)
					and external urethral orifice		
	O'Connell et al. (1998)	N/a	N/a		N/a	N/a	N/a
Living	Agrawal et al. (2021)	N/a	N/a	N/a	N/a	N/a	N/a
	Basaran et al. (2008)	N/a	N/a	N/a	Distance from the base of the glans to the urethral orifice (central)	N/a	N/a
	Cao et al. (2015)	N/a	N/a	Skin fold of the clitoral root to the tip of the clitoral glans	Clitoris glans to 12 o'clock point of the urethral orifice	N/a	N/a
	Chinkangsadan et al. (2020)	N/a	N/a			N/a	N/a
	Ekmez and Ekmez (2021)	N/a	N/a		Length from the tip of the glans to the opening of the urethra	N/a	Lithotomy position with 45°angle of thighs upper edge of anus and clitoris distance
	Ellibeş Kaya et al. (2020)	N/a	N/a	Length of skin fold on the clitoris (from superior edge of clitoris glans to hood of clitoris/most superior edge of mucosa)	Mid glans to mid urethra	N/a	N/a
	Gyftopoulos et al. (2019)	N/a	N/a	N/a	N/a	N/a	N/a
	Köşüş et al. (2016)	N/a	N/a	N/a	N/a	N/a	N/a
	Kreklau et al. (2018)	N/a	N/a	N/a	N/a	N/a	N/a
	Lloyd et al. (2005)	N/a	N/a	N/a	N/a	N/a	N/a
	Mendiola et al. (2012)	N/a	N/a	N/a	N/a	N/a	From anterior clitoral surface to the center of anus, lithotomy position with legs at 45 degrees

Abbreviation: N/a: Not applicable, that is, not provided in publications.

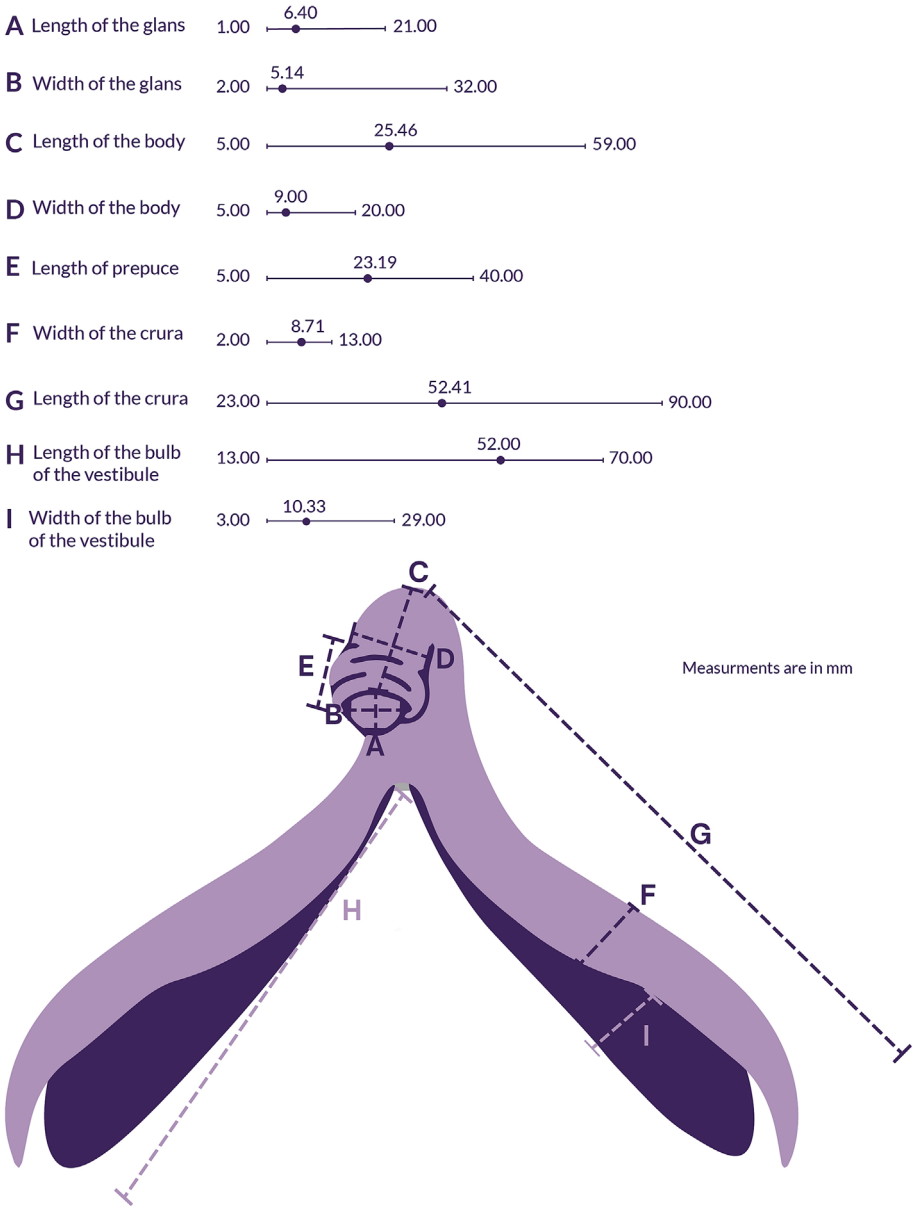

FIGURE 2 A schematic diagram of the clitoral complex with measurements from the literature.

While Basaran et al. (2008) and Chinkangsadan et al. (2020) found no significant difference in clitoral glans width in women who had experienced the menopause, Chinkangsadan et al. (2020) found a significant difference in the distance between the clitoris and the external urethral meatus. There is a general consensus that labia majora length is affected by the menopause (Agrawal et al., 2021; Cao et al., 2015), which is likely to be caused by hormonal changes (Battaglia et al., 2008).

Different modalities were utilized to measure the clitoral structures. Living patients have the advantage of allowing large scale studies, as these can be conducted in regular gynecological clinics (Agrawal et al., 2021). On the downside, examination in vivo does not allow measurement and examination of the internal clitoral structures. Cadaveric research is valuable, but there is a limited number of cadavers available each year, and these are usually from mature patients, who may have undergone menopause. Additionally, different dissecting and embalming techniques might result in different final measurements of the specimen, adding bias to the process (O'Connell et al., 2005). US studies have been proven to give important information and measurement regarding the internal anatomy of the clitoris (Buisson et al., 2008), but operator-depended factors, such as the pressure exercised by the probe, have not been taken into consideration. MRI studies are considered the gold standard, as they have been proven to be a reliable source of information, due to the visualization of internal structures and the possibility to enhance certain tissues, differentiating them because of their response to magnetic resonance (O'Connell et al., 2005).

We appreciate that there may be factors that have influenced the reported measurements in the studies. These include the different experimental modalities (MRI, US, cadavers, and living patients), the cadaveric fixative, anatomical landmarks (Tables 3 and 4), and human error. However, no significant difference was reported between the

experimental modality and the results obtained, indicating that different techniques can be used to measure clitoral structures and determine viable ranges in individuals. To prove this, a further in-vivo study should be performed measuring clitoral structures in biological females, from various backgrounds and ages, utilizing one experimental modality, with standardized and defined anatomical landmarks.

5 | CONCLUSION

The results in our meta-analysis were novel in highlighting how the clitoral components can vary in size and shape, whilst remaining within the normal range. It is of utmost importance for the medical profession to advocate for the acceptance of the increased range demonstrated in these results, creating an environment of acceptance and normalization of female genitalia. As such, these findings call for an updated and expanded representation of the clitoris and its components in anatomical textbooks, to increase awareness and knowledge amongst medical professionals and the general public. These measurements confirm the presence of normal variation within clitoral structures and this will be beneficial for the care of all women, including those who have experienced FGM, in addition to those who feel insecure about their genitalia and may be considering cosmetic or gender reaffirming surgery.

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