FEMALE AROUSAL AND ORGASM: ANATOMY, PHYSIOLOGY, BEHAVIOUR AND EVOLUTION

Donald Lambert Jesse Quicke

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Female Arousal and Orgasm: Anatomy, Physiology, Behaviour and Evolution

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PREFACE

Why write another book about orgasm and human sex? Well, as Georgiardis et al. put it in two papers, "Sex is a fundamental pleasure and crucial for the survival of our species" and "There is nothing legal that comes close to orgasm pleasure-wise" [1, 2]. With possible exceptions, most human sex is not for procreation but recreation and pleasure [3, 4], although other factors may also play a role [5]. On the other hand, over-emphasis on pleasure may detract from the obviously important role of sex in procreation [6]. Every biologist should therefore have a strong interest in human sex, they wouldn't be reading this were it not for their parents having had sex, and hopefully enjoying it.

The first thing I want to emphasise is that I am not a medical doctor, nor a sex counselor, or a psychotherapist. Therefore, do not take anything here as medical or psychological advice. If you have any medical or psychological concerns, please go and seek expert advice. What I am, however, is a biological scientist, more precisely, mainly an entomologist, systematist, and evolutionary biologist, with a desire to make a lot of the complex medical and scientific literature available to a large audience of reasonably educated lay people.

Some few years ago, a friend of mine, knowing that I was a professor of biology and obviously interested in the subject, asked if I could write an online article about female orgasms for one of his websites. I did some (quite a lot of) research and wrote what I hoped was a passably accurate account. But this left me with many, many questions because I could not readily find definitive answers in the academic literature. Indeed, the more I read, the more contradictions I found. Loving to solve scientific problems, this led me to do more and more research, find more and more problems, delve even deeper, *etc*., and this book is the result.

One of the greatest difficulties that I have faced in this endeavour is that medical practitioners who publish papers on some aspect of female anatomy, sexuality or physiology, almost invariably do not present their data in the same way that most other biologists would. Medical scientific literature has a culture of presenting results that preclude others from doing further analyses. The great majority of the papers cited in this book present summary statistics, but hardly ever scatterplots and even rarer individual-based subject correlations. However, I have endeavoured to obtain raw data so that a more biological analysis approach can be taken.

Another difficulty in writing about 'normal' female sexual anatomy, histology, function, *etc*., is that the vast majority of the literature published in scientific journals does not concern the 'normal', sexually healthy woman, but instead focuses on women with various sexual dysfunctions or diseases. This is, of course, understandable because funding for research/publication is mostly tied to medicine, and of course, there is a great need for doctors to share potentially important information, case studies, *etc*. However, apart from MRI brain scanning (which, contrarily, has been almost totally focused on normal subjects), the great majority of normal sex response or anatomical studies are now rather dated, and most could well do with re-exploration using modern methods.

In recent years, there has been a marked increase in the scientific literature on female sexual function, and a far greater understanding of both mechanisms and variation is emerging. Techniques available for research had advanced in sensitivity and capability far beyond what was possible in the 1950s and 60s when female sex research really took off as a valid area of scientific and sociological study. Nevertheless, there remain controversies, and some indeed heated debates: notable examples being whether women can experience more than one type of

orgasm or whether the G-spot exists. Regarding the former, thousands of women make up to researchers that they can differentiate more than one type of orgasm, which seems to have failed to impress some researchers who base their conclusions on physiological data. Similarly, with the G-spot, which many women say they are well aware of, the scarcity of evidence for a distinct anatomical (though there may be some) structure leads some to deny its existence. In both cases, the actual site of the woman's sensation could easily be in the brain itself based on perhaps subtle differences in the neural information it receives or interprets. Whether the orgasm originates from a specific structure or in the brain, it makes no difference when it comes to a woman's experience.

Since the early research of Alfred Kinsey et al. in the early 1950s and about a decade later by William Masters and Virginia Johnson, many thousands of volunteering women have participated in the laboratory investigation of their sexual arousal and orgasm, nearly all achieved by genital stimulation, yet studies in the scientific literature on anal or nipple-induced orgasms are essentially non-existent. Similarly, despite thousands of histological anatomical studies based both on biopsy samples and dissections of cadavers, there are precious few papers that describe normal histology either in detail or systematically across the sexual structures. Similarly, immunohistochemical research papers tend to focus on single systems with no study including all genital organs. Much is still to be learned about basic anatomy, and there are numerous contradictory statements in the literature that I attempt to resolve.

Whilst there are many books aimed at helping women achieve sexual satisfaction, there are few that really explain much of what is known about arousal and orgasm from a scientific perspective while still being accessible.

This book also includes a considerable amount of information obtained through anonymous elective surveys of women, and reveals several previously unrecognised or unreported trends. These results try to fill some of the gaps in the medical literature with primary, individual-based data.

It is also important to note that it is written largely with reference to studies in Europe, North America, Australia and some Spanish or Portuguese-speaking South American countries. Whilst human anatomy and physiology are largely similar, no matter where one comes from, societal norms can be very different. Some cultures openly practice masturbation [7], whereas this is not the done thing in the 'west' only.

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All graphs were produced, and additional statistical tests were performed using the statistical computing language R [8]. Traces in original publications were digitised using *Plot Digitizer* [9].

ETHICS STATEMENT

This book is predominantly a work of synthesis. Ethics approval is not applicable to the original photographs and video stills, which were all made for Femorg.com Ltd (a for-profit and educational company), and the subjects all received remuneration for their participation. All subject records of ages and consent are kept by the author on behalf of Femorg.com. The anonymous, elective internet surveys were carried out by or on behalf of Femorg.com Ltd.

CONFLICT OF INTEREST STATEMENT

The author declares no conflict of interest.

CHAPTER 1

Introduction

Sex in western society went through a rather taboo period in the 19th and first half of the 20th century. It wasn't talked about much in 'polite circles', and female sexual pleasure and gratification were relatively less discussed and understood. It was in the USA following World War II when a few academic researchers started to apply sociological and scientific methods to the topic. Three questions started to be addressed: (i) What do people do 'in bed', (ii) how often, and (iii) what actually happens anatomically, physiologically and psychologically? The landmark names are Alfred Kinsey (1894–1956), William Masters (1915–2001) and Virginia Johnson (1925–2013), and Shere Hite (1942–2020). Although these were by no means the first researchers to study sex, the sheer size of their studies and the public attention their studies received set them apart. There are also a few, and I generally think under-rated, studies before them, and of particular note should be the detailed, thoughtful and extensive work on female reproduction by Robert Latou Dickinson [10, 11], which considered a very wide range of topics, from the genitals of prostitutes, to where the penis stimulates in different sex positions and where the semen goes in relation to the cervix.

Unlike most researchers today, who are obliged to publish scientific papers in peer-reviewed journals, at what seems like an ever-increasing rate, in order to keep their jobs, these earlier workers, although publishing a few separate papers in scientific journals, generated such voluminous amounts of data that their most important outputs were in the form of books. It is hard to imagine anyone in the current competitive academic climate being able to do that. Indeed, many have commented that neither Charles Darwin's or Albert Einstein's productivities in peer review journals would secure their tenure in top universities in the current age. We must be thankful that Kinsey, Masters and Johnson, and Hite were able to produce their works because they changed so much for the better.

It must be emphasised that societal norms back in the 1950s and 60s were not the same as they are today. A lot of the sexological research back then was coloured to some extent by expectations about social groups, whether the sex was conducted within a married relationship, *etc*. The past 20 or 30 years have seen a great deal more exposure to sex, sexual practices and sexual expectations in the

mainstream media, though often without correct terminology, and so people who reached adulthood during these times might be expected to have had a rather greater awareness of sex practices. In a way, Bose, back in 1937, must be applauded for going against the dogma of the time that there are major racial/skin-colour related differences in 'potency' [12].

Not just sex research but also medical and anatomical publications reflect taboos against anything to do with the sex [13]. There has also been enormous gender bias in both general and medical sex research. Studies on men and male impotence and its potential cure vastly outnumber studies on womens' sexual responses and dysfunctions. Research has gradually been correcting some of this imbalance, but even as recently as 2010, the French gynaecologist Odile Buisson [14] made a point of criticising the French university system in general for showing marked androcentrism and for failing to develop female sexual medicine sufficiently, even for deliberately ignoring it because of their male-dominated views and taboos.

Sex researchers, at least during the early years, tended to be university academics which has had and still has a profound influence on the subjects who participate in their research [15]. With large numbers of undergraduate and postgraduate students at hand, simply posting adverts for volunteers on university noticeboards or newsletters was often enough to get ample research participants. Indeed, Alfred Kinsey and others were often surprised by how readily many, especially female, students, were willing to take part in their studies. Whilst, not a large proportion overall, it likely indicated that these volunteers were aware of the dearth of medical/scientific knowledge about female sexuality at that time. More recently, a far larger proportion of researchers have come from more or less purely medical backgrounds reflecting increasing attention paid by their profession on female sexual medical and psychological problems and also the associated, still incomplete anatomical and physiological knowledge of the subject. It is far harder to recruit subjects from the general population. Advertisements in local newspapers get some, and more recently, the internet has allowed a prudent approach to a far greater potential audience when it comes to gaining responses to questionnaires. The vast majority of participants in actual physical research, however, tend to be young university or nursing-associated subjects, or women seeking medical appraisal. A bimodal and non-random sample.

However, there are many obstacles to be overcome even to start research on human sex, and also on sex in some other mammals. I recall many adverse comments concerning a postdoc who was working on sex in rats whilst I was an undergraduate at Oxford. As Pfaus [16] put it:

"*Doing sex research sometimes feels like stumbling into a Kafka novel where unlocking heavily guarded secrets of the sexual universe are a subversive act met with resistance, deterrence, and retribution. In addition to roadblocks put in place by risk-averse granting agencies and downright terrified academic administrators and their media minions, sometimes the subject itself eludes capture by a plethora of perfectly reasonable experiments that, when taken together, overwhelm us with conflicting information*."

Without a doubt, much harm has been done as a result of Sigmund Freud's [17] theories on female sexuality, and a great deal has been written on this, *e.g*., [18, 19, 20, 21]. Briefly, Freud argued that the attachment of a girl to her mother meant that her early sexual arousal and orgasm experience, which was typically largely focused on her clitoris, was juvenile (even homosexual), and that they must make the transition to having orgasms through heterosexual vaginal penetrative sex in order to be properly adult. If they did not, he labelled them as 'frigid', a stigmatisation that caused many women much anguish and hurt. There have been many good discussions of Freud's theories and how subsequent research, especially starting with Alfred Kinsey and Masters and Johnson, led to major changes in views.

Alfred Charles Kinsey

Alfred Charles Kinsey (Fig. **1.1**) was an entomologist like myself, indeed, a world expert on gall wasps and responsible for amassing a truly enormous collection of them which is now housed in the American Museum of Natural History, New York. He was a full professor at Indiana University. However, he developed a sideline interest for which he was to become most famous, human sexuality and sex research. This led him found the Institute for Sex Research at Indiana University in 1947; the institute is now known as the Kinsey Institute for Research in Sex, Gender, and Reproduction, or just the Kinsey Institute for short. His key publications were on sexual behaviour in the human male [22], and, more relevant here, on sexual behaviour in the human female [23]. Although not the absolute first academic to become involved in this type of research, his studies were certainly revolutionary. Nearly all of the previous research was largely carried out from a medical perspective and carried out by physicians. Indeed, one of Kinsey's predecessors, Havelock Ellis, wrote that he studied medicine specifically because it was the only profession in which one could study sex safely. Kinsey brought a very different descriptive taxonomic approach to sex research, in concordance with his other line of research, insect taxonomy [24].

Kinsey applied for and received an exploratory grant to start his new research venture in 1941, to cover the costs of interviewing many respondents in person.

CHAPTER 2

Anatomy and Histology of the Female Genitalia

ANATOMICAL TERMINOLOGY

Naming things consistently requires that the things being named are sufficiently well understood. For example, two or more anatomically or functionally distinct structures are recognised as separate. Unfortunately, anatomical descriptions of what were, and are still, poorly known vis-a-vis human female genitals, were usually made well before full understanding. This has led to many problems, and it seems that many physicians may not be aware that what they refer to as "X" is what someone else refers to as "Y", and worse, vice versa. The most severe problems concern the various glands and glandular elements of the vulva but are not limited to those. I go into the convoluted problems with gland terminology in more detail in the section *Specialised Glands of the Vestibule*

This has been a long-recognised issue, and recently, Hill *et al.* undertook an extensive survey of medical literature and sought to propose a more standardised nomenclature for the structures of the posterior pelvis and vulva [60]. I will probably get into hot water for disagreeing with some of their proposals.

Anatomical Conventions

Before going into any detail about female anatomy, non-medically trained readers could get a bit confused by some of the basic terminology used in medical and anatomy books and papers. Much of the possible confusion to non-medical/zoological readers comes from the fact that humans stand and walk upright, whereas a lot of the anatomical conventions used relate to the rest of the land mammals that walk on all fours. If you think of a dog or horse, their back is uppermost, and their spinal column is dorsal. In a standing person, their back is vertical, but we call it towards 'the back'. Therefore, anatomists and doctors refer to that side of the human body as dorsal (or posterior) (Fig. **2.1**).

Lateral and medial, and left and right, are used as in normal parlance. Towards the head is referred to as superior, or sometimes as cranial. Towards the legs or feet is referred to as inferior or caudal (*i.e.*, towards the tail, which in our case is the sacrum).

The terms probably most likely to be unfamiliar are proximal and distal. These are illustrated in the right pane of Fig. (**2.1**). Proximal means either towards the body, as in the shoulder is proximal relative to the hand, or towards the centre of the body, for example, where the urethra leaves the bladder is proximal to where it opens to the outside at the vulva. The opposite to proximal is distal, so the foot is distal to the knee, and the urethral meatus is distal to the bladder.

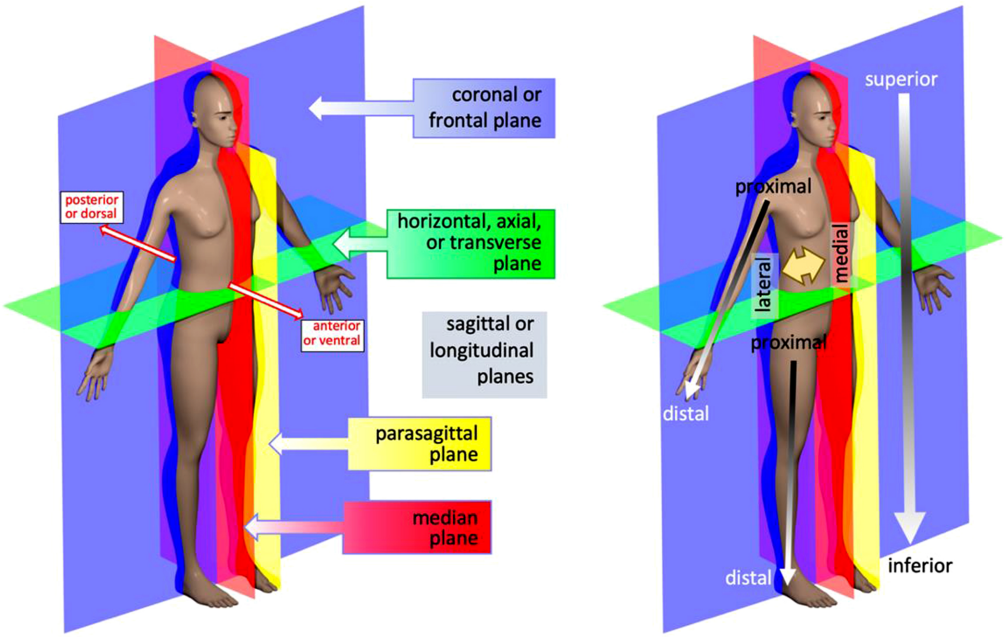

Fig (2.1). Terms describing positions, directions and views as used by human anatomists. (Source: modified from the image by David Richfield and Mikael Häggström *via* Wikimedia, CC-BY-SA 4.0 International).

Readers who have studied biology at school or college will have seen slides or drawings of transverse sections cut through some organism, such as a worm or a locust, and in these and in humans, transverse means at right angles to the long axis, and so it is with human anatomy. Then there are two other planes of section. Ones slicing from the back towards the front of the body, *i.e.*, dorsal to ventral, or posterior to anterior, are called sagittal sections. If a sagittal section is made at the midline of the body, it is sometimes called a medial section. Sections in the third plane, *i.e.*, made between the left and right sides of the and from superior to inferior, are called coronal sections. In this book you will encounter these terms mostly when it comes to MRI scans of the brain or pelvic region.

BASIC FEMALE REPRODUCTIVE ANATOMY

A woman's internal reproductive system comprises a set of organs directly associated with the production of eggs, their fertilisation, embryogenesis, and fetal development through to birth (ovary, fallopian tubes, uterus, cervix, vagina) Fig. (**2.2**). These are intimately associated with other internal structures (the urethra and associated glands, large internal parts of clitoris, rectum, and complex musculature, all located within the pelvic cavity).

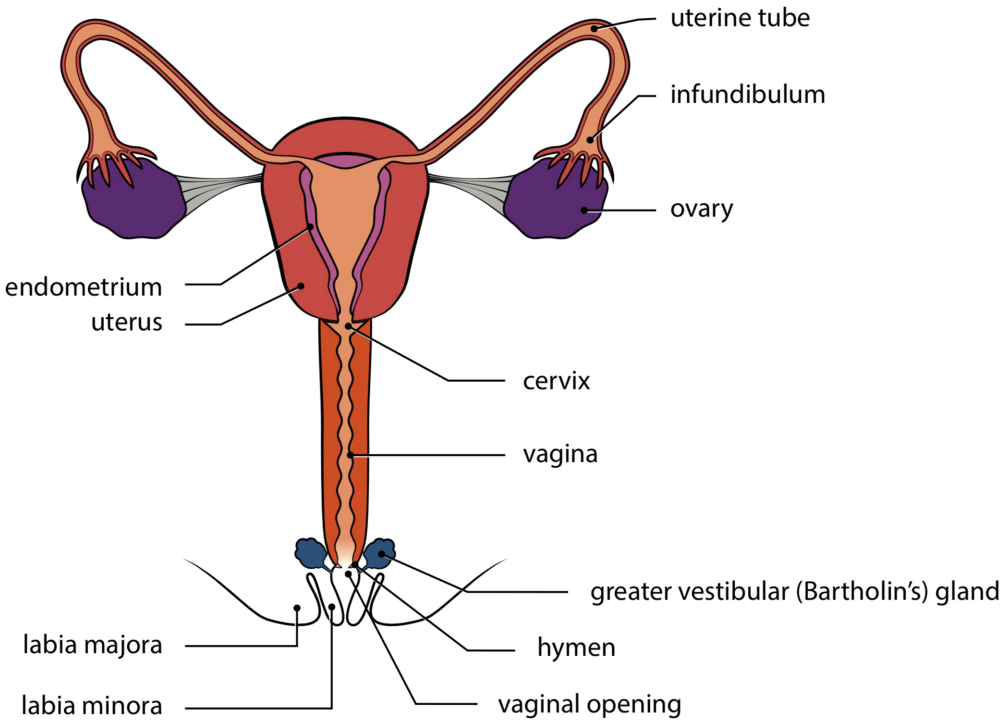

Fig (2.2). Idealised diagram showing the female internal reproductive system. (Source: Schemas © 2019 R. Dewaele (Bioscope, Unige), J. Abdulcadir (HUG), C. Brockmann (Bioscope, Unige), O. Fillod, S. Valera-Kummer (DIP), www.unige.ch/ssi reproduced under Creative Commons licence CC-BY-SA).

The externally visible structures (Fig. **2.3**), often collectively referred to as the pudendum, start at the anterior with a slightly protruding and adult, densely hairy, largely fatty mound called the mons pubis (sometimes called the mound of Venus or mons veneris). Below this and extending towards the anus is a large pair of outer lips (the labia majora), surrounding a pair of inner lips (labia minora), and these, in turn, enclose the flat surface of the vestibule into which open the urethra (at the urethral tubercle) and vagina (the external opening of which is called the introitus). Between the labia majora at the front, where they 'emerge' from the

CHAPTER 3

Muscles of the Pelvic Floor

INTRODUCTION

This is perhaps the most difficult section of this book to write because there is no escaping it; the muscles in the pelvic floor, most of which play some part in orgasm, are arranged in a complex 3-dimensional pattern [425].

The muscles comprise two groups, the deep group, which is superior (towards the head) to the perineal membrane in the area of the anterior pubic triangle (urogenital triangle), and the superficial group, which is located more or less below (posterior to) the perineal membrane.

Deep Pelvic Muscles

Dissecting down from the superior (abdominal) side, we have a set of deep pelvic muscles (Fig. **3.1**), the ilacus muscle, and the levator ani. The latter has a complex structure being formed by the confluence of three separate muscles, the puborectalis, pubococcygeus and iliococcygeus muscles. The iliacus muscle is a large, flat, triangular muscle that inserts broadly on the concave inner face of the ilium (iliac fossa) (see Fig. **2.6**) and the anterior, inferior iliac spine, and inserts on the femur. Its only sexual role is in moving the legs. Internal to the iliacus is the complex levator ani muscle. The levator ani is not a single muscle but is composed of three parts: the pubococcygeus, iliococcygeus and the puborectalis.

The puborectalis also originates at the posterior of the pubic bone at the symphysis, and the two halves extend to behind the rectum, where they unite. The arrangement is responsible for the bend between the anal canal and rectum. It is partly interconnected with the anal sphincter.

The pubococcygeus is a belt-like part of the levator ani and provides support for organs towards the anterior of the pelvic cavity. It inserts anteriorly on the pubic bone lateral to the origin of the puborectalis muscle, and posteriorly it inserts on the coccyx. As it lies closest to the middle and distal urethral canal, it helps to control the flow of urine. It contracts rhythmically during orgasm. It is almost contiguous with the puborectalis, which is located slightly above it. It has insertions on the perineal body and vaginal musculature.

The iliococcygeus arises anterolaterally on the ischial spines and internal obturator fascia, then fans out medially, attaching posteriorly to the lateral surface of the coccyx and the anococcygeal ligament.

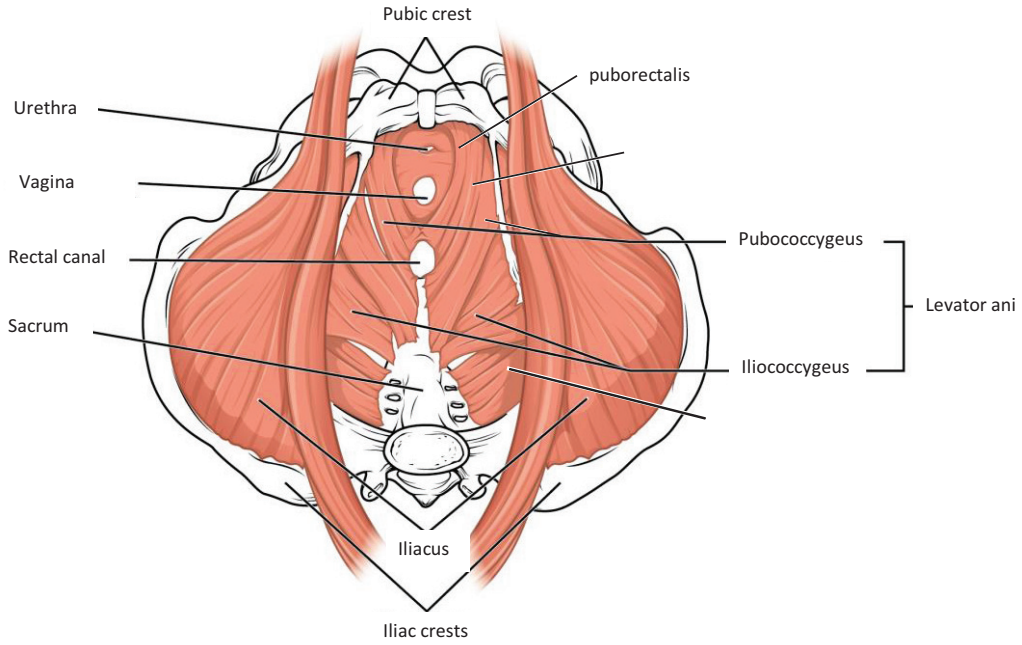

Fig. (3.1). Locations and relationships of major deep female pelvic muscles seen in dorsal view. (Source: reproduced and modified from Openstax Anatomy and Physiology under terms of Creative Commons license 4.0 International, *via* Wikimedia.)

The levator ani appears not to be innervated by the pudendal nerve, contrary to what many well-respected anatomical textbooks say, but rather their innervation originates from the sacral nerve roots (S3–S5) and travels over the superior surface of the pelvic floor (levator ani nerve) [104].

The Perineal Membrane

This complex structure is a thin but tough fascia that extends between the inferior margins of the ischiopubic rami on either side, and anteriorly is attached to the pubic symphysis. It is penetrated by the urethra and vagina and plays an important role in supporting the internal organs such as the blatter and uterus. It lies anterior to the internal clitoral complex, and anteriorly, it is closely associated with the fascia of the anterior part of the levator ani muscle [426]. Slightly more dorsally, it fuses with the superior sides of the clitoral crura and bulbs.

Superficial Pelvic Muscles

Posterior to the deep muscles, *i.e.*, closer to the vulval skin, are a set of superficial muscles that similarly provide a floor of support for the internal pelvic organs. Working from superior to inferior, one encounters two pairs of muscles diverging posteriorly from the pubic bone (the ischiocavernosus and the bulbospongiosus (=bulbocavernosus in earlier literature), the latter being conspicuously active during orgasm. The superficial transverse perineal muscle running laterally from the perineal body, the external anal sphincter, and two pairs of diverging muscles originating from the coccyx, the levator ani muscle group, and the lower part of the gluteus maximus, the large muscle that gives the buttocks their shape (Fig. **3.2**).

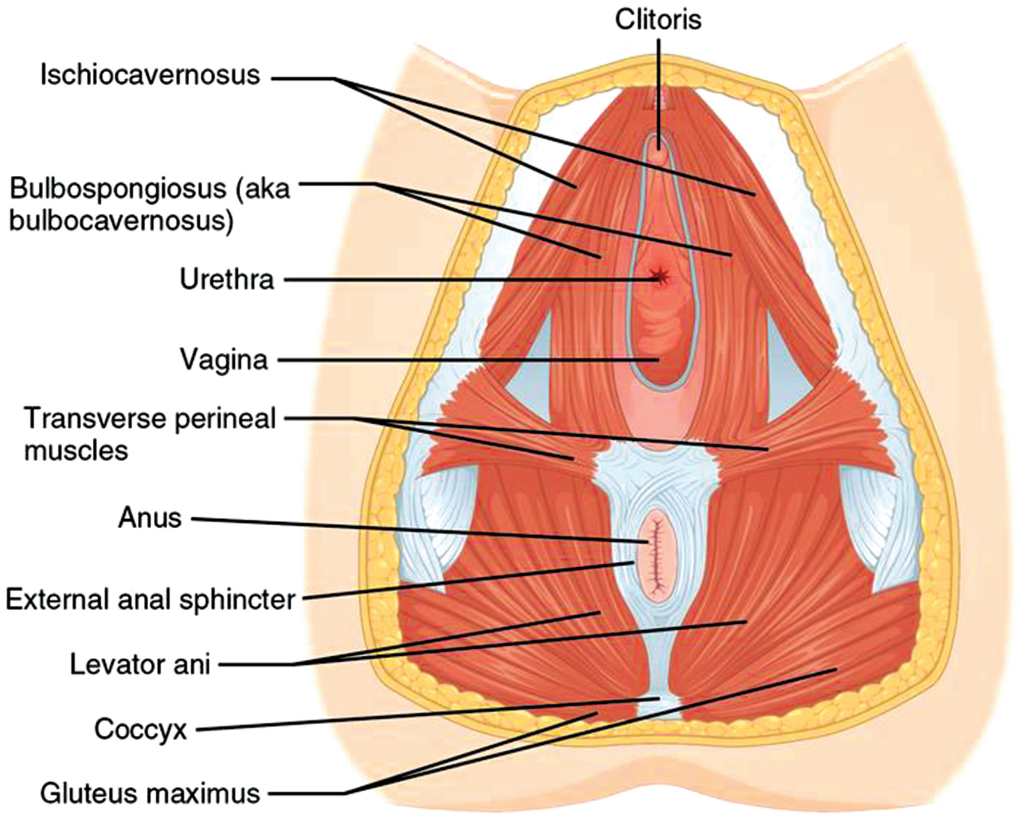

Fig. (3.2). Locations and relationships of superficial perineal/pelvic muscles in the female, inferior (from below) view. (Source: reproduced under terms of Creative Commons license 3.0, *via* Wikimedia.)

CHAPTER 4

The Menstrual Cycle

INTRODUCTION

From puberty onwards, usually for about 30 years (but varying quite a lot), a woman typically experiences approximately monthly menstrual cycles as the body releases mature eggs and prepares the lining of the uterus to maximize successful implantation of any egg that gets fertilised. The typical menstrual cycle lasts 28 days but can be anywhere between 21 and 35 days in normal women, and its regularity is more apparent in some women than others. Typically cycle length decreases a little after the first few years of menstruation.

The onset of the cycles is marked by the girl's first menstruation or menarche, and this happens typically between the ages of 12 and 15 though there are small but significant ethnic differences, and it is well documented that childhood nutrition has a strong effect. The latter, *via* an increase in public health and socio-economic conditions in Western countries, is almost certainly the cause of the progressive advance in menarche at least up until the 1980s [461, 462]. However, other possible factors might include increased consumption of phytosterols (see Chapter 17). After a few cycles, menstruation usually settles down to a fairly regular rhythm which is typically stated as being 28 days (a lunar month), but there is a lot of inter-individual variation.

Follicular and Luteal Phases

Each cycle is divided into three phases (Fig. **4.1**); the follicular phase, through which one follicle containing an early development egg cell, starts to mature, followed by ovulation. Then, the luteal phase, when the remains of the follicle form a whitish-yellow patch called the corpus luteum and degenerate. Menstruation, during which the old lining of the uterus is shed, occupies approximately the first week of the follicular phase. By the time the egg follicle has fully matured the lining of the uterus has thickened enough so that implantation can take place. The uterine lining continues to thicken until the end of the luteal phase, when menstruation starts the next full cycle. Occasionally two or more follicles may mature in a single cycle, and if both eggs get fertilized, this leads to dizygotic twins.

Quite a lot of changes take place through the menstrual cycle, not least of which is menstruation which, by definition, occupies the first few days (up to a week normally) of the follicular cycle. Change may occur in the women's mood and/or behaviour, as well as changes in the microanatomy of sex organs. As in many women sexual behaviour shows an approximately six-day increase beginning three days before the luteinising hormone surge, accompanied by stronger sexual desire and more sexual fantasies. Bullivant *et al*. [463] proposed the term "sexual phase" should be applied to this part of the cycle, since the follicular phase is over-inclusive and the ovulatory phase is not sufficient.

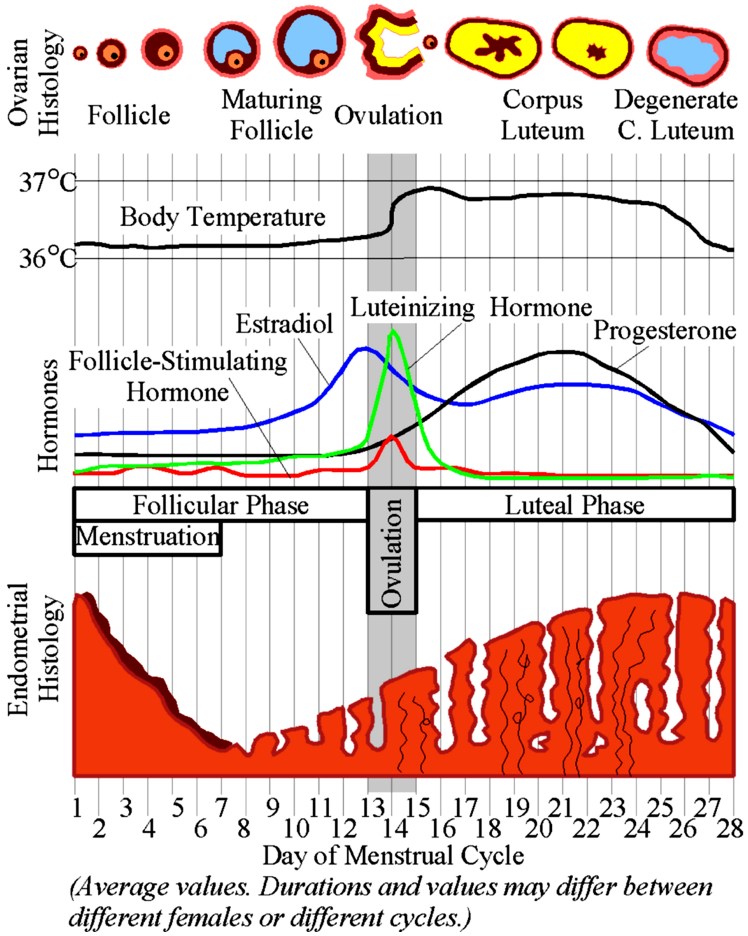

Fig. (4.1). Diagram showing changes in the uterus wall structure and hormone levels through one menstrual cycle (standardised to 28 days). Source: reproduced under the terms of Creative Commons Attribution Licence CC-BY 3.0 credit Chris 73).

The Hormone Cycle

The hormones controlling the main features menstrual cycle and ovulation are released from the anterior pituitary gland as a response to stimulation from the hypothalamus (Fig. **4.1**). However, some of these changes are due to the release of two less-well-known hormones in the ovaries, inhibin A and inhibin B. The first of these is primarily produced by the dominant follicle and the corpus luteum for a while after ovulation. Inhibin B is primarily produced by granulosa cells of small developing ovarian follicles. They both have an inhibitory effect on the production and secretion of follicle-stimulating hormone (FSH) production by the pituitary, but this is especially so in the case of inhibin B.

Although the physiological changes of the menstrual cycle (uterine lining development, ovulation and menstruation) are controlled by the interactions of the four hormones shown in Fig. (**4.1**), testosterone levels also fluctuate. They typically rise during the follicular phase to a maximum which is maintained over approximately the middle third of the cycle, then decline to a low point during the first few days of the subsequent follicular phase [464].

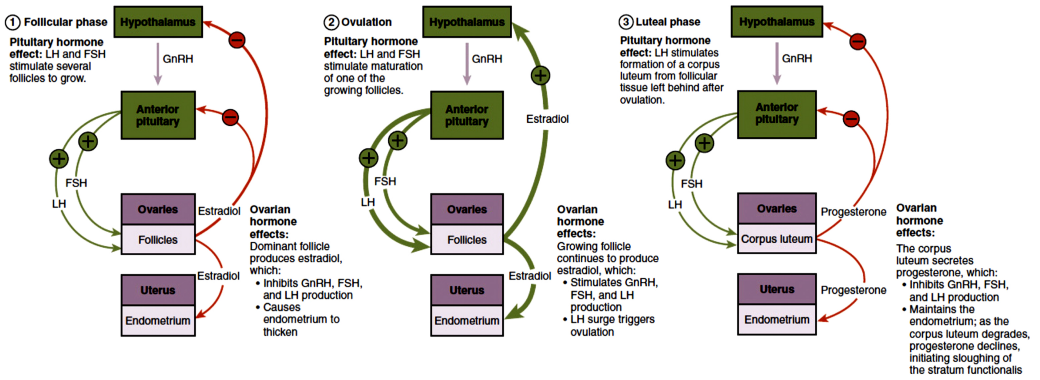

Fig. (4.2). Interactions between hormones during the three main menstrual cycle phases. (Source: image modified (rearranged) from Phil Schatz CC-BY4.0).

ANATOMICAL GENITAL CHANGES THROUGH THE CYCLE

As discussed in relation to various genital structures in Chapter 2, there are cyclical changes in the vaginal epithelium, thickness of the labia minora and their blood flow, and clitoral volume, micro-vascularisation and blood flow and various other genital aspects, including an apparently a rather larger change in the vaginal introitus area. During their ultrasound investigation of labia minora menstrual cycle vascular changes, Battaglia *et al*. [148] also made the incidental discovery that the oval area of the vaginal introitus increased significantly during the periovulatory period (by approximately 50%), and there was an associated

CHAPTER 5

Orgasm Research and the Model Orgasm

INTRODUCTION

As Hoon wrote in 1984 [485]

"Any approach to the assessment of female sexuality is not complete without the consideration of cognitive (self-rating of the intensity of sexual arousal or response), psychometric (standardized questionnaire of attitude or affect), behavioural (often a checklist of the past week sexual behavior), and physiologic factors."

In this and the next three chapters, I will focus on the last of these, particularly how they are measured and how various measures change through sexual arousal and orgasm. Firstly, I will describe the most important conceptual models of the human female sexual response.

FEMALE ORGASM MODELS

Masters and Johnson's Linear Model

Masters and Johnson were the first people to define the structure of female sexual response in their classic paper (published in an obscure journal) (Fig. **5.1**) [486], and their diagram and slight modifications of it have been reproduced numerous times in both the scientific and popular media.

The Masters and Johnson model was based on laboratory sessions with male and female volunteers. Their study was very thorough, and in addition to involving many participants, they note:

"... sexual activity of study subjects included, at various times, manual and mechanical manipulation, natural coition with the female partner in supine, superior or knee-chest position, and, for many female study subjects, artificial coition in the supine or knee-chest positions".

It should be emphasised that they were only looking at physical responses and not psychological ones.

The Masters and Johnson model divides the sexual response cycle into four phases: excitement, plateau, orgasm and resolution [31]. Some workers have merged arousal and plateau to give a three-phase version. In any case, although this may be a rather simplistic interpretation, I think, still useful, at least at a physiological level [47].

1. Excitement Phase

This is the earliest phase and can be initiated by thoughts or physical stimuli, or both. Characterised by muscle tension, racing heart, the "sex flush" (blood "rash" on chest or breasts), and an increase in the size of labia minora and they darken in colour due to increased blood flow, the clitoris becomes turgid (might not be noticed) as do the nipples, and the vagina becomes moist.

It is not only contacted with erogenous zones that may lead to arousal, but it can also result from the subject knowing that a certain part of their body is being looked at.

2. Plateau Phase

This is essentially the same as the end point of the excitement phase being prolonged [487]. A physical stimulus is now more important and must continue if orgasm is to be achieved.

Masters and Johnson add and illustrate, with diagrams, that the clitoris retracts under the prepuce at this time [31: p. 39]. I have to say that I have not really observed this. It is probably a combination of the prepuce becoming somewhat engorged and expanding a bit, engorgement of the clitoral crura and bulbs, and contraction of the ischiocavernosus muscle.

3. Orgasm

The majority of women experience a series of rhythmic contractions of some pelvic floor muscles during orgasms. However, whilst visible and subjectively experienced rhythmic contractions, for example, of the vagina and anal sphincter, occur in the majority of women when they orgasm, they seem not to be present in all, or at least not in association with all of their orgasms [31, 488].

It is often stated that orgasmic contractions have a separation (wavelength) of 0.8 s. However, this is a gross oversimplification. There is variation within each train of contractions as well as very marked inter-individual differences.

"*A series of muscular contractions- frequency 0.8 secs*" - particularly the lower third of the vagina and 'around' the rectal sphincter. This is of varying intensity in women. It is a subjective experience and impossible to assess. The uterus also contracts during orgasm, and this can be cramp-like and painful. Masters and Johnson reported 3 to 15 rhythmic contractions, but a more recent study reported that some subjects during "long orgasms" had up to 34 additional irregular pelvic muscle contractions [53].

4. Resolution

Everything goes back to normal gradually, but the sense of "well-being" persists, sometimes accompanied by a desire to sleep. Probably the majority of women who can orgasm at all, are able to return to orgasm during this phase, whereas in men, this is a very uncommon ability.

The duration of the resolution phase depends on whether orgasm has occurred, and if it hasn't, it takes longer for the engorged tissues to return to pre-stimulation condition, and there is usually, in both sexes, a feeling of dissatisfaction and persistent annoying unresolved engorgement.

The Kaplan Variations

There have been many subsequent modifications of the Masters and Johnson model, which is purely a physiological description of what happens. The first generally accepted variant was by the well-respected sex therapist Helen Singer Kaplan. Her first model reduced the number of recognised phases from four to just two, genital engorgement followed by orgasmic clonic muscle contractions, thus amalgamating arousal and plateau and rather ignoring resolution [33] since she thought plateau was just an extension of the culmination of arousal [489]. She justified recognising just two phases because each is under the control of a different part of the autonomic nervous system, vasocongestion by the parasympathetic nervous system, and orgasm by sympathetic nervous system pathways. Also, many anorgasmic women nevertheless achieve full genital vasocongestion with appropriate stimulation. Over the next few years, she revised her model from this simple biphasic one to a triphasic one by incorporating a desire phase before arousal [44]. So in this Kaplan model, the sequence goes:

desire > arousal > orgasm

.

CHAPTER 6

Arousal and its Measurement

INTRODUCTION

In colloquial terms, the woman may start feeling horny, or alternatively, arousal results from rather simple mechanical and non-emotional stimulation, although it is usually some combination of the two. Either way, a number of changes start to take place in the woman's genital region, and the first observable sign is usually a marked increase in vaginal lubrication [31]. This might therefore seem to be an ideal measure of arousal. However, as will be explained below, objective measurement of lubrication is far from as simple as it might sound (see below). Since vaginal lubrication is the result of transudation, it must necessarily be preceded by increased blood flow, and that is far simpler to measure.

In general, arousal starts with an increase in blood flow to the genitals. This has several effects. The erectile tissues of the clitoris and labia minora and majora swell, the whole vulva can get progressively engorged, and this causes heightened sensitivity and awareness of the genital region. Increased blood flow in the vessels of the wall of the vagina leads, more or less directly, to increased vaginal lubrication, a preparation for sex [540]. The vaginal lubrication itself is largely a watery blood filtrate (transudate) mixed with some secreted mucus proteins originating from the cervix and traces of components from the endometrium and fallopian tubes.

Firstly, I will describe stimuli that can lead to arousal, including the body's erogenous zones and erotica. A summary of genital responses observed during arousal is given in Table **6.1**, and non-genital responses in Table **6.2**. I discuss each of these in more detail below as well as the methods employed to measure them.

THE EROGENOUS ZONES

A woman's erogenous zones vary somewhat between individuals. The erogenous areas of the genital area are diverse and comprise the labia minora, vaginal introitus, the clitoral shaft and glans, clitoral bulbs, the mucous membrane surrounding the urethral, the urethral meatus tubercle (U-spot; [39]), the urethra

(or possibly the Skene's gland or both), Halban's fascia (the space between the anterior vaginal wall and bladder), the G-spot and the anterior fornix erogenous zone (the anterior fornix wall of the vagina) (see Chapter 2) and perineum [546]. Other parts of the body can lead to arousal, especially the lips of the mouth, nipples and areola, anus, earlobes, and feet.

Nearly all research on genital erogenous zones has focused on the clitoris, but Kinsey [23: p. 577] wrote:

"*As sources of erotic arousal, the labia minora seem to be fully as important as the clitoris" and noted that female masturbation usually involves some sort of stimulation of the labia's inner surface*".

Schober *et al*. [550] asked 62 healthy, sexually active, adult women (mean age 37.9 years, range 21 – 60) to rate the intensity of sexual pleasure and the intensity of orgasm that they experienced from stimulation of different parts of their genitals using a five-point Likert scale. The clitoral glans and clitoral body above it were given virtually identical scores, both sites giving the most intense orgasms and the ones requiring the least stimulation effort. Rather unexpectedly, excluding the clitoris, the deep interior of the vagina ranked the next highest in terms of intensity and relative ease of stimulation. The same group had earlier found a very similar result, that the deep vagina was on a par with the labia minora in terms of orgasm intensity [551].

Table 6.1. Genital responses to female sexual arousal through to plateau *sensu* [31]. (Sources: based on [31, 37, 137]).

Response	Description	When	Additional references or comment
Increased vulval blood flow	Colour of the genitals becomes redder; engorgement of the clitoris (both superficial glans and body, and internal crura and bulbs) and labia minora, which consequently become more sensitive; slight engorgement and separation of labia majora	progressive to a plateau	-
Increased vaginal blood flow	Colour of vaginal wall becomes darker	progressive to a plateau	[541]
Clitoral tumescence	Texture of glans smooths due to slight increase in volume; clitoral body become firmer	early arousal	see (Fig. **6.3**)

(Table 6.1) cont.....

Response	Description	When	Additional references or comment
Clitoral 'erection' and elongation	The shaft and glans are pulled back against the symphysis, and glans may disappear under prepuce	plateau	[31: p. 51, 542: Fig. 2]
Cervical mucus secretion	Stated as very rare [31] but can be quite marked (pers obs.)	-	-
Increased lubrication	Vaginal transudation; labia minora and vestibule become moistened	progressive to a maximum but subsequently declines if there is a prolonged plateau phase	-
Clitoral bulbs	Engorgement through arousal and often visible on a change in the appearance of the vestibule	-	[11]
Anal engorgement	Vasocongestion within the anal canal in response to sexual stimuli (not found in males)	arousal	[543]
Tenting of proximal vagina	The cervix (and obviously the uterus) are withdrawn up into the false pelvis effectively	plateau	[39]
Labia majora lateral flattening	The lips change from evenly rounded in profile to having a distinct medial ridge	plateau	see *Labia Majora – the Outer Lips*, Chapter 2, and (Fig. **6.4**)
Dilation of *os cervix*	Minimal dilatation in nulliparous females	arousal and up to 20 – 30 mins post-orgasm	-
Vaginal floor muscle	Voluntary and involuntary flexing, the former to increase arousal	-	[544]
Clitoral vibrational sensitivity	Increase during arousal	-	[545]
Response	Description	When	Additional references
Pain threshold	elevated pain threshold	late or strong arousal	[547, 548]
Breast engorgement	breast profile changes and breasts enlarge, with increased visibility of superficial veins (vascular tree) on the upper part of breast, and during plateau may also be visible on lower breast surface. Size increase more obvious in nullipara	through arousal, maximal at plateau and orgasm	-

CHAPTER 7

Orgasm(s) and Resolution

INTRODUCTION

In this Chapter, I summarise the physiological changes that occur during a woman's orgasm and discuss the ability of a proportion of women to have multiple orgasms. Some consideration is given to factors that affect the probability of orgasm, and what neurological processes are involved.

Very little conspicuously happens to the genitals, although a large proportion of women have a series of synchronised contractions of various pelvic floor muscles and the anal sphincter, which are homologous to the ejaculation spurts of semen in men. The other changes require some technology to record (Table **7.1**).

Table 7.1. Genital responses at female sexual orgasm (based on [31, 37, 669]).

Response	Description	When	Additional references
Uterine pressure	sharp drop in internal pressure	at orgasm	
Uterine contractions	contractions and, in multipara, up to 50% size increase		
Vaginal sphincter and bulbocavernmuscles	involuntary rhythmic contraction pattern in	through orgasm	
Vaginal blood volume	sharp brief drop in vaginal blood volume (VBV)		
Clitoris sensitivity	becomes highly (almost painfully) sensitive to touch	immediately after orgasm in some women	[680]
Cervix	dilation of *os cervix* lasting 20 – 30 minutes	immediately after orgasm	

The subjective experience is, of course, more profound, and quite a lot of orgasmic responses are shown by other regions of the body outside of the genitalia, and these are summarised in Table **7.2**.

In addition to the above, a number of other rare peri-orgasmic phenomena, some of which are medically significant (such as post-orgasm illness syndrome, head-

aches, seizures and panic-attacks), may happen with some women. Several have been reviewed by Reinert and Simon [681], to which may be added vertigo [682]. Other less dramatic things are weakness (cataplexy), crying and laughing. I can also attest that one previous sexual partner of mine always laughed involuntarily as they had an orgasm, but fortunately she had warned me prior to the event that this would happen. This happens with a few males too.

Table 7.2. Extra-genital responses to female orgasm (largely based on [31, 387] and other sources where indicated).

Response	Description	Comments	Additional references
Hyperventilation	from a basal rate of 14 breaths/min to a max of 40 breaths/min	late plateau, maximal at orgasm, ending soon after	
Tachycardia	from a basal rate of 80 beats/min to a max of 180		
Hypertension	diastolic blood pressure elevated by 20 – 80 mm Hg, systolic blood pressure by 80 – 100 mm Hg		
Rhythmic contractions of pelvic floor and anal sphincter muscles	typically a series of 5 – 10 sharp contractions, the first few typically with an interval of 0.8 seconds	at and through orgasm in most women	
Sex flush	superficial maculo-papular (vasocongestive) rash initially over epigastrium and anterior chest wall then on neck, face, and forehead, but can extend to thighs, buttocks, soles of feet.	through plateau, maximal at orgasm, usually rapid loss after orgasm but might last for two hours	[683, 137]
Areolae engorgement and tumescence	engorgement	during arousal: engorgement and tumescence at orgasm	
Nipple erection	elongation + 0.5 – 1.0 cm, base diameter + 0.25 – 0.5 cm		
Areola corrugation	detumescence of congestion with transient corrugation	immediately after orgasm starts	[410]
Areola contraction	visible contraction at orgasm (approximately 1% of women)		
Breast engorgement	increased vasocongestion causes breasts to swell and change profile	through arousal	
Myotonia	loss of voluntary control; elevated tension in muscles (legs, arms, neck, face (grimacing), abdomen, feet (carpo-pedal spasm)	pre-orgasm and orgasm	[684]

(Table 7.2) cont.....

Response	Description	Comments	Additional references
Other myotonic responses	pelvic thrusting and/or folding at the waist	orgasm	[684, 685]
Vocal emissions	sighs, moans, groans, grunts, "Ahhh"s, verbal instructions, sometimes screams	increasing rate before, and then during orgasm	[686, 687]
Perspiration	Widespread film of perspiration not related to physical activity	Resolution	
Pupil dilation		from early arousal, especially visual cues	[573, 688]

Rhythmic (Clonic) Contractions of the Vagina, Anus and Pelvic Floor Muscles

The most easily visible sign of a real orgasm in most women is a series of nearly regularly spaced contractions of the anus. However, whilst these contractions occur in most women, there is considerable evidence that they do not always accompany subjective orgasms [53, 488, 689-693] and in a proportion, they seem not to be visible at all. Masters and Johnson thought this was a more or less guaranteed way of knowing whether a woman has an orgasm rather than pretending to have one because the sharpness of the contractions cannot be voluntarily mimicked [31, 694] (Fig. **7.1**)

I do not think it is known whether there is any sequence to the pelvic floor muscle contracts or whether they are all synchronous, nor precisely which ones are involved. The contractions clearly involve the external vaginal and anal sphincters and bulbospongiosus (= bulbocavernosus) muscles. Masters and Johnson [31] describe the perineum as contracting and occasionally the external urethral sphincter. Visually the perineum bulges transversely as the contracted anus is drawn closer to the fourchette, so possibly not only muscles involved in the perineal body but also transverse perineal muscles may be contracting.

A lot of the popular and scientific literature on vaginal contraction patterns during stimulation (typically masturbation either digitally or with a vibrator) is either highly stylised or highly selective. As noted by Geer and Quartararo, "*Recordings of pressure pulse throughout orgasm were so confounded by artifacts in most subjects as to preclude measurement*" [695]. It is practically far easier to record anal contractions.

CHAPTER 8

Hormone Changes During Arousal and Orgasm

INTRODUCTION

Blood plasma levels of four hormones, in particular, show significant changes through periods of sexual activity in men and women, these being oxytocin, prolactin, testosterone and noradrenalin, though far less is known about the roles of the latter two. The second of these play a large role in the capacity (or lack thereof) for male multiple orgasms.

In men, a combination of sex steroids and thyroid and pituitary hormones (oxytocin, prolactin) have been indicated as playing roles in the control of orgasm (ejaculation) [731]. Investigating such things in both men and women relies heavily on investigations of patients with atypical/pathological orgasm problems. With men, this may include both subjects who habitually experience premature ejaculation or others who find it hard or impossible to orgasm during sex of normal or unlimited duration (delayed ejaculation). With women, it is almost invariably patients who experience anorgasmia, though there are a few studies of women who regularly or very frequently experience unwanted orgasms, sometimes as a consequence of taking particular drugs.

Again in men, blood levels of both prolactin and thyrotropin are positively correlated with the male's time to ejaculation ranging from severe premature ejaculation to complete anorgasmia. In contrast, testosterone levels are highest in individuals who experience premature ejaculation and lowest in those with delayed ejaculation/anorgasmia [732].

A summary of hormone changes that occur during female orgasm is given in Table **8.1**.

Oxytocin

This hormone is released into the systemic circulation from nerve endings in the posterior pituitary. The axons themselves originate from neurons in the paraventricular nucleus of the hypothalamus, which is where oxytocin is synthesised.

Oxytocin is associated with increased sexual behaviours (both sexes) [733] facilitation of social approach behaviour in women [734, 735], reduced pain sensitivity, and reduction in memory. Oxytocin release is brought about by vagino-cervical stimulation as well as by suckling. The relationship between cervical stimulation and oxytocin release is known as the Ferguson reflex [736].

Table 8.1. Hormonal changes during female orgasm. (Source: based on [37]).

Source	Hormone	Action	Additional references
anterior pituitary	increased secretion of prolactin	remains elevated for approximately 60 minutes after orgasm	[737, 738, 739]
posterior pituitary	increased secretion of antidiuretic hormone (ADH; vasopressin)	contraction of uterine musculature; inhibition of urination; delay loss of semen due to flowback	
posterior pituitary	increased secretion of oxytocin	fallopian tubes and uterus motility; induction bonding feelings and emotions	[740, 741]
adrenal medulla and sympathetic nervous system	increased plasma noradrenaline	many generally excitatory effects on brain and metabolism	[737]
adrenal glands	increased plasma adrenaline		[737]
widespread in CNS	increased plasma 2-arachidonoylglycerol	endocannabinoid associated with reward brain mechanisms	[742]
ovaries, adrenal glands	increase testosterone witharousal and sex		[743]

Salonia *et al*. [744] showed that in healthy women, oxytocin levels in circulating blood vary with the phases of the menstrual cycle being significantly higher during the mid-follicular and ovulatory periods than during the mid-luteal period, but they are not involved in the control of the cycle, and they are not affected by taking oral contraceptives. They found that oxytocin levels were significantly correlated with the FSFI-lubrication domain during the luteal ($r = 0.69$, $p = 0.007$) phase for a group of normally cycling women who were not on an oral contraceptive. For the group of subjects who had been on oral contraceptives for at least the last 3 months, plasma oxytocin values were significantly correlated with both the FSFI arousal ($r = 0.72$, $p = 0.04$) and lubrication ($r = 0.84$, $p = 0.009$) domains.

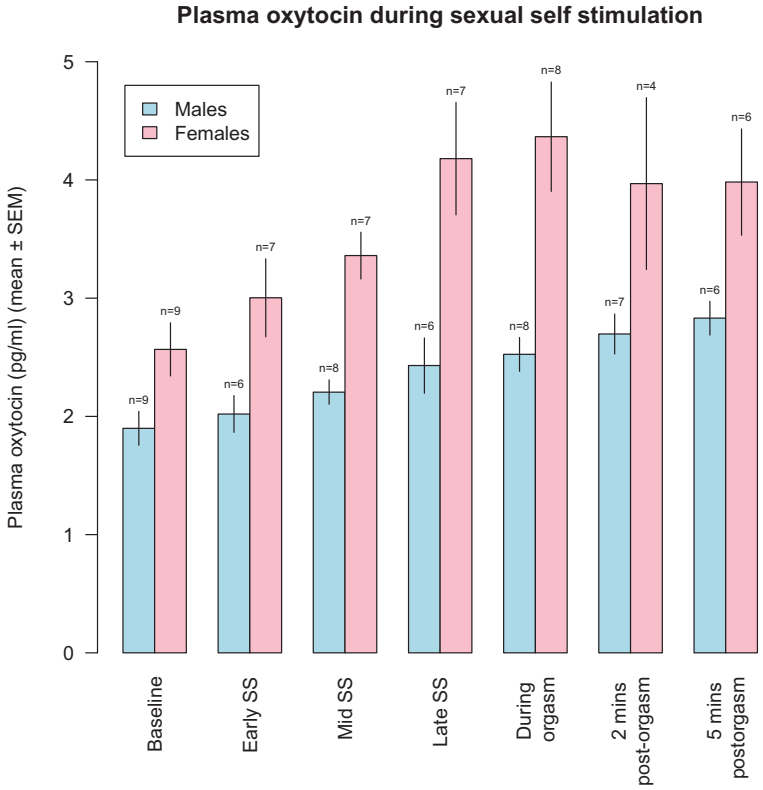

Fig. (8.1). Changes in blood plasma oxytocin level through self-stimulation to orgasm and beyond in men and women. (Source: data from [740]).

Oxytocin enhances the onset of lactation, and as a nasal spray, is often used to help women produce milk after childbirth. Anderson-Hunt and Dennerstein [733] reported the case of a 26-year-old woman who had presented 17 months after the birth of her second child and who had been having treatment for low milk production. Approximately two hours after receiving two doses of intra-nasal oxytocin spray, she noticed copious vaginal transudate trickling down her leg, followed by intense sexual desire, and she also noticed that her cervix had opened slightly. She had initiated sex with her partner and commented that the uterine and vaginal orgasmic contractions were intensified, along with her experiencing heightened subjective pleasure. Much the same happened when she was administered a subsequent dose two days later. No similar cases have been reported (so don't anyone rush out to obtain oxytocin spray), and it is possible that this response reflects a particular case of an interaction between oxytocin and the subject's sex hormones.

CHAPTER 9

What Happens During Copulation/Coitus?

INTRODUCTION

Fairly obviously, it is an activity, and so it does burn some calories, but usually, less for the woman (mean 3.1 kcal/min, n = 21) than the man (4.2 kcal/min, n = 21) [789], and in both cases rather a lot less than using a treadmill.

Although it may seem fairly obvious to participants, there is very little scientific study indeed of what actually happens in the vagina during penetrative sex, *i.e*., exactly what parts of the penis go and press exactly where, and what does this do to the woman's internal structures. Previous to these, there were only imagined interpretations. Leonardo da Vinci (c. 1493) depicted a fine imagined sagittal section of sex in his drawing "The Copulation" (reproduced in [650], the original being in the Royal collection of His Majesty, King Charles III). Similar depictions, perhaps even based on da Vinci, are to be found in some anatomical textbooks [10, 11]. This has been investigated using ultrasound [790, 791] and a few MRIs [650, 651, 792]. I have to say, that whilst these studies are not the simplest to execute, the sample size is terribly small. So, much has been published about where the penis touches inside the vagina, is there cervical buffeting, where does the semen go in relation to the cervix, and in what positions? But there have been no comparative MRI or ultrasound studies of men with different penis lengths or girths nor of women with different vaginal lengths or cervix/vaginal orientations, let alone men whose erect penises are straight, curve upwards or downwards. Effectively this is an unstudied area, so all that I can do is report what has been done.

Dickinson described and illustrated what he believed (supposititious as he phrased it) were the relative positions of clitoris, penis and cervix, during intercourse in various positions [10, 11]. As will be seen from the MRI studies referred to below, there are some slight errors regarding the shape adopted by the penis, but the principles would seem sound, and I reproduce four of his illustrations here (Fig. **9.1A-D**) and also his interpretation of what these meant for semen retention (Fig. **9.1e, f**) and hence conception.

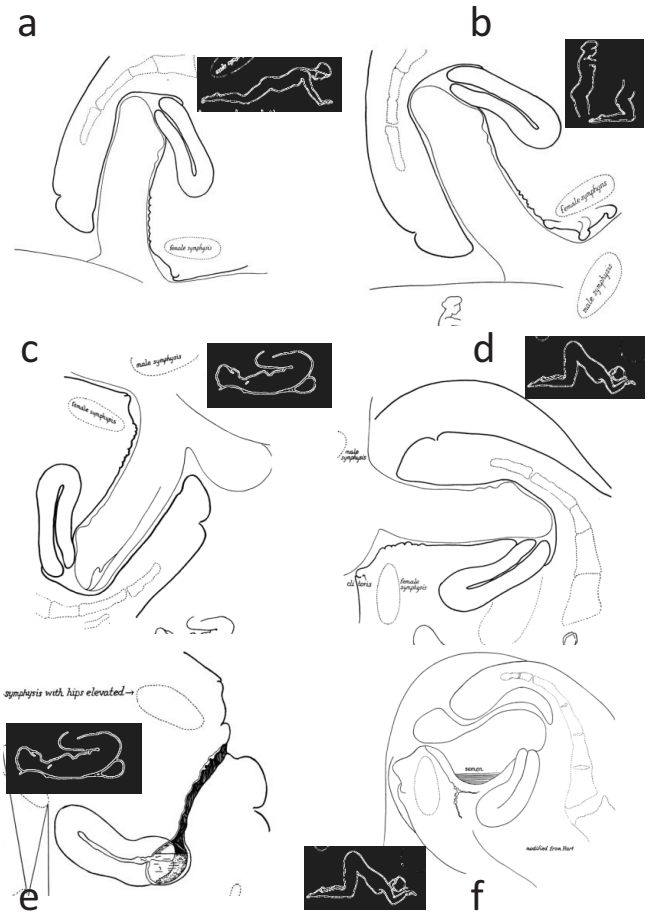

Fig. (9.1). Diagrams rearranged from Dickinson (1933) [10] showing imagined relative positions of the man's penis and the vagina, cervix, uterus, *etc.* of the woman, during coitus in four common positions: (a) woman lying above and regulating clitoris pressure and penetration; (b) woman sitting across man's knees (straddling); (c) missionary with elevated hips (notice pillow under her buttocks in the cartoon); (d) rear-entry (doggystyle in common parlance but referred to as knee-chest posture by [10]); (e) post-coital situation after (c) showing potential bathing of *os cervix* with semen; (f) post-coital situation after (d) showing ballooned vagina and lack of access of a normal-sized ejaculate to the *os cervix*. (Source: from [10]).

MRI OF COITUS

Modern technology has allowed us to improve a bit on Leonardo's and Dickinson's imaginations. The use of ultrasonography and MRI has provided new information to actually imagine the real thing.

I find it rather strange that two of these, by Buisson *et al*. [791] and Faix [651, 792], indicate that they are pilot studies as if there would be follow-ups, but there appear to have been none, which is a pity given the improvements in the

technologies that have happened since. Also, results from sample sizes of one can hardly be considered generally applicable.

The first, and in terms of published image quality the best, investigated intercourse in ten couples in the "missionary position" [650]. Different from the imagined depictions mentioned above, the penis does not stay straight but assumes a "boomerang" shape at full penetration (Fig. **9.2**). The second MRI investigation [651] also in the missionary position concentrated more on how the penis affected the shape and positions of the vagina, bladder and uterus at full penetration. The glans penis reaches the cervix entering and distending the anterior fornix (Fig. **9.4**). The axis of the vagina was made less inclined as was the axis of the uterus, which was pushed upwards and backwards. Penis contact was preferential with the anterior vaginal wall.

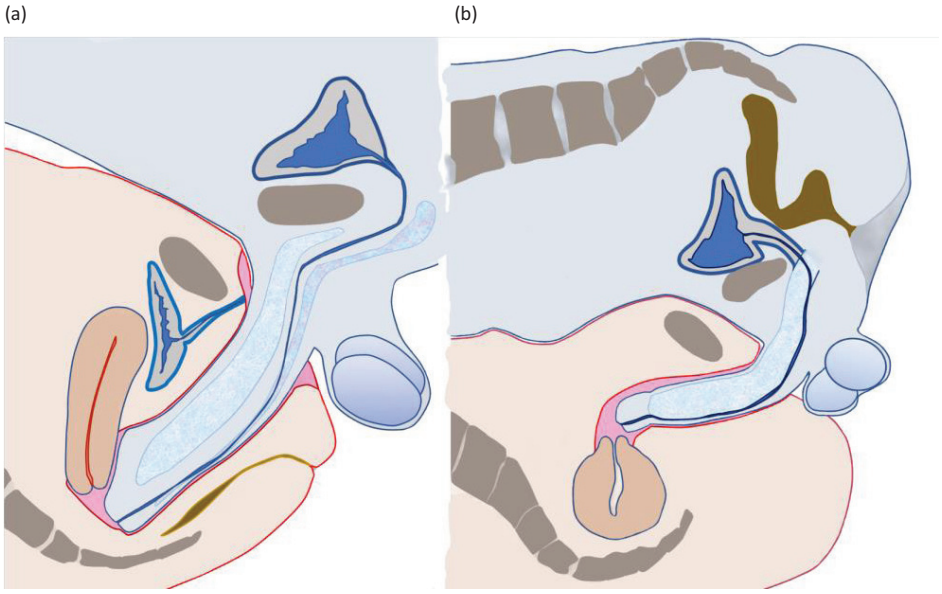

Fig. (9.2). Diagrams showing the boomerang configuration of the penis during coitus; (a) as imagined before MRI studies (based on da Vinci *via* [650]); (b) from MRI (based on [650]). The broken green line indicates the so-called boomerang-like angulation of the penis.

A follow-up study investigated the relationships between the penis and vagina in the reverse-entry position [792]. It is not stated explicitly, but given the confines of the MRI machine, this would be in a prone position rather than "doggy-style". In this entry position, the penis seems to reach the posterior fornix with preferential contact of the posterior vaginal wall, and the bladder and uterus are pushed forwards.

CHAPTER 10

Non-Genital Sources of Arousal and Orgasm

INTRODUCTION

Genital arousal, and in some subjects, excitation all the way to orgasm, can result from stimulation of parts of the body other than and remote from the pudenda. Exercise-induced orgasm is a well-known phenomenon [820]. Kinsey *et al*. report women being able to be brought to orgasm by having their eyebrows stroked, or by having the hairs on their body gently blown [23]. Orgasms can result from kissing, toothbrushing, nipple sucking and breastfeeding, lying next to another fully dressed, being shampooed by a male hairdresser, looking at a naked statue, and even from giving birth [821, 822].

When an orgasm is brought about by stimulation of a part of the body that is not normally sexual, it is sometimes referred to as a 'zone orgasm' [823, 824, 825].

Herbenick *et al*. provide a summary of descriptions concerning non-genital orgasms based on an incidental but quite large set of responses on an anonymous internet post site. Reported cases could mostly be classified either according to whether they were associated with doing obviously physical activities (*e.g*., exercise, a playground as a child, doing chores/labor, dancing), on transport experiencing vibration, acceleration, turbulence (airplane, train, car/bus, motorcycle) or more passive things (taking drugs, sleeping, eating, reading, listening, urinating, defecating), as well as a result of various emotional, mental, tactile or visual stimuli [822]. It makes the reading interesting.

ANAL ORGASMS

Perhaps because of its connection with shit rather than reproduction, anal sex has frequently been considered deviant (sodomy). Indeed, in many countries, it still is a criminal offence, and can carry a severe penalty. For various historical reasons, it is not always clear whether legislation only applies to males or whether it is more encompassing, although in the USA until 1960, all forms were illegal though the prosecution was normally restricted to male-male activity.

Nevertheless, it is well known that many men enjoy anal stimulation, although when anal sex or anal toying leads to orgasm, it is very often conjoint with stimu

lation of the prostate gland, approximately a finger's length inside the anal canal on its anterior wall. Women, of course, have no such organ close to that location, the female homologue being separated by the vagina. Among women, the desire for anal stimulation is not that uncommon, and orgasms can be attained through this type of stimulation alone [823, 826]; a far larger proportion include anal stimulation as a regular part of their sex repertoire. I have encountered a few women for whom it is an almost vital addendum to other stimulation in order for them to orgasm. Unlubricated anal sex, or anal probing, can be painful because the anus is not self-lubricating. Sometimes painful anal sex is an aspect, with the pain contributing to the final achievement of orgasm [826].

Probably cultural factors affect the proportion of couples who perform anal sex, penetration or other stimulation. Baldwin and Baldwin [827], in a survey of 647 non-virgin students at a USA university (62% female), almost 23% had engaged in anal intercourse, whereas Chou and Shih report approximately 5% of Taiwanese women do it [828]. It also seems likely that it is tried as an experiment by more people than those who adopt it as part of their regular sexual repertoire.

In males, sensory nerve traffic from the prostate travels *via* the hypogastric nerve, and probably that is true also for the female prostatic (Skene's gland) tissue. This leaves open the possibility of neuronal 'cross-talk' between genital and rectal components [825].

It should also be borne in mind that mental attitude and thoughts alone can lead to orgasm in some women (see *Imagery Orgasms*, below), and thus, one might not necessarily be looking for a pure anal stimulus to orgasm pathway.

NIPPLE, AREOLA AND BREAST ORGASMS

For most of the early part of 20th-century sex research, the nipple and areola have been rather side-lined. Kinsey *et al*. stated that breast and nipple stimulation played only a minor role in a woman's overall sexual response and suggested that it was really primarily for the man to stimulate but only in the early stages of 'sexual liaison' [23]. Indeed, there is almost nothing in the scientific literature about the significance of breast and nipple stimulation for a woman's sexual satisfaction for approximately the next 50 years. Even a quick foray into pornographic media shows that the great majority of women fondle and squeeze their nipples, areolas and breasts during sex, often while their partner is otherwise engaged. In a global internet survey of 360 women with a mean age of 32, 31.1% of the most commonly reported activity leading up to orgasm was stimulation of the breasts [829]. Whilst the whole breast is sensitive and may be manipulated, the bulk of attention is applied to the nipple-areola complex (NAC).

Recently, a few scientific studies have started to focus on this aspect. Responses from a questionnaire given to 153 sexually experienced undergraduates (age range 17 – 29 years) started to lead to a change in this [830]. The great majority of respondents (81.5%) reported that stimulation of the NAC and/or breasts as a whole caused or enhanced sexual arousal, and that once already aroused, 78.2% responded that nipple/breast stimulation increased their level of arousal, 17.1% reporting that they sometimes asked their partners to stimulate their breasts. Only 7.5% found that nipple/breast stimulation decreased their arousal.

Probably significantly, MRI brain scanning showed that NAC self-stimulation, in addition to exciting thoracic brain regions, also excited parts of the brain's genito-sensory cortex overlapping with parts of the medial paracentral lobule excited by genital stimulation [405] (see Fig. **14.3,** Chapter 14).

Erection of the nipple is brought about by the contraction of smooth muscle fibres that are innervated adrenergic nerves, that is, the neuromuscular transmitter that excites them is adrenalin. The particular muscle receptor type involved is the alpha-1 adrenalin receptor. Therefore, applying agonists of adrenaline that activate the alpha-adrenergic receptors also causes contraction of the NAC smooth muscles.

Two very recent studies have looked to see whether pharmacological agents that activate NAC smooth muscle contraction and which induce nipple erection could thereby enhance sexual function with the view to aiding women with some degree of sexual dysfunction. At first, the application of an alpha-1 adrenergic receptor agonist to the NAC significantly improved female function [831]. The agent, phenylephrine hydrochloride, increased NAC sensitivity by approximately 20% (Fig. **10.1**). In a second study, the norephedrine-releasing agent RJ101 was found to have a similar effect [832].

IMAGERY ORGASMS (THOUGHT ORGASMS)

These are orgasms that some women can make themselves have simply by thinking erotic thoughts without physical stimulation [833]. These have been known for a considerable number of years; they are sometimes called “mental orgasms”, “idealised coitus”, “moral or psychic masturbation”, “the mental vulva”, and “erotic daydreaming” [4]. In 1902, Block [834] described female orgasms being induced simply by looking at nude statues, and at that time, it is no wonder that museum statues provided perhaps the first views of the male anatomy. Levin [4] notes that several authors quoted by Kinsey [23] on this topic “*... expressed the curious and certainly unfounded opinion that this is “the most noxious” of all forms of masturbation.*”

CHAPTER 11

Types of Orgasm and what Affects Them

INTRODUCTION

In this chapter I deal with several disparate topics, but mostly I will discuss whether clitoral and vaginally induced orgasms are one and the same thing or, at least, feel to the woman quite distinct.

A History — Marie Bonaparte and Sigmund Freud

One of the earliest considerations of the significance of an individual woman's sexual anatomy and her probability of having orgasms through intercourse was Marie Bonaparte (1882–1962), yes indeed, a descendant of Napoleon Bonaparte (Napoleon I), and also a patient of Sigmund Freud. Marie Bonaparte was also 'frigid', which presumably played no small part in her pioneering interest in the topic [849]. She proposed that a shorter distance between a woman's clitoris and the urethral meatus (CUMD) (Fig. **11.1**) increased the likelihood of orgasming during sex, probably because of her position and gender, published under the pseudonym A.-E. Narjani [850]. The same conclusion was reached fifteen years later by Landis *et al.* [851]. In those times, biology and medicine were not really into statistical analysis of data, and certainly did not have computers. The raw data from these two studies were subsequently tracked down and properly analysed some 75 and 60 years later [75]. Data from both these early studies demonstrate a strong inverse relationship between CUMD and orgasm during intercourse though only in Bonaparte's was there a strong statistically significant effect, that of Landis *et al*. being borderline at the one in twenty level ($\chi^2 = 5.0$, d.f. = 1, $p = 0.05$) (Fig. **11.2a**). Interestingly, Bonaparte's study also included whether her subjects could achieve autosexual orgasm (which is taken to mean masturbation). In this case, there was no significant difference in CUMD (Fig. **11.2b**), showing that the effect is due to how the women were being stimulated during coitus.

The observant will notice that the above two historic studies report significantly different mean CUMDs for their samples (2.3 ± 0.1 cm [850] vs. 2.9 ± 0.1 cm [851], $t = 4.8$, d.f. = 76, $p < 0.001$). It is obviously unlikely that the samples differed to such an extent; therefore, it seems most likely that the measurements

had been made differently. Subtracting 5 mm, the approximate length of the glans clitoris, from the Landis *et al*. data removed the significance [75], suggesting that was the explanation.

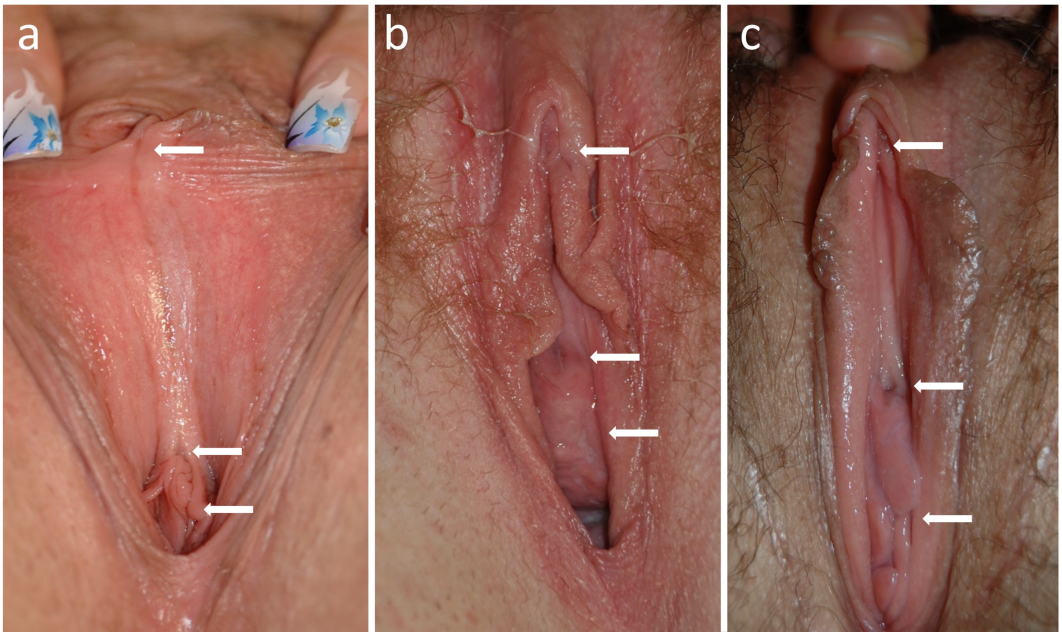

Fig. (11.1). Three examples showing a range of variation in clitoral to urethral meatus distance (CUMD) and relative urethro-vaginal space at the level of the vestibule, with arrows indicating approximate locations of the clitoral frenulum, central urethral meatus and anterior margin of introitus: a, large CUMD and very short urethro-vaginal space; b, intermediate condition; c, short CUMD and large urethro-vaginal space.

Various vulval measurements were analysed with respect to sexual functioning in a very recent study that involved 108 sexually active Turkish women, of whom 30 (27.7%) reported a low orgasm domain score in the FSFI [852]. For each subject, 11 vulval measurements were made (glans clitoris volume, an anterior triangle of genital hiatus area, anteroposterior diameter of the genital hiatus, clitoris–fourchette distance, clitoris–urethra distance, fourchette perineal body distance, mons pubis thickness, levator urethra gap, subpubic angle, the transverse diameter of the genital hiatus). Three raw measurements were found to differ significantly between normal and low orgasm groups: anterior triangle area was larger in the control group ($p = 0.03$), clitoris–urethra distance was shorter in the control group (16.1 ± 2.2 mm) than in the low orgasm group (21 ± 3.9 mm) ($p = 0.04$) and glans clitoris volume (measured using trans-perineal ultrasonography) was larger in controls (1,081 ± 258.4 mm^3) than in women with a low orgasm score (947.7 ± 256 mm^3) ($p = 0.02$). However, following stepwise regression, only two of the variables remained significant predictors of normal orgasm. These

were the anterior pelvic triangle area with $p = 0.04$, but by far, the best predictor was clitoris–urethra distance ($p < 0.0001$). These data confirm the earlier findings regarding clitoris–urethra distance, but the discovery that a narrower anterior triangle of genital hiatus area is a significant correlate is suggested as possibly being due to how much penile-vaginal intercourse distorts and stimulates the clitoral bulbs and crura. The following is only something that I deduce from this, but if the correlation with an anterior pelvic triangle is corroborated, then it might be worth seeking correlations with the width of the hips (*i.e.*, relative pelvis width).

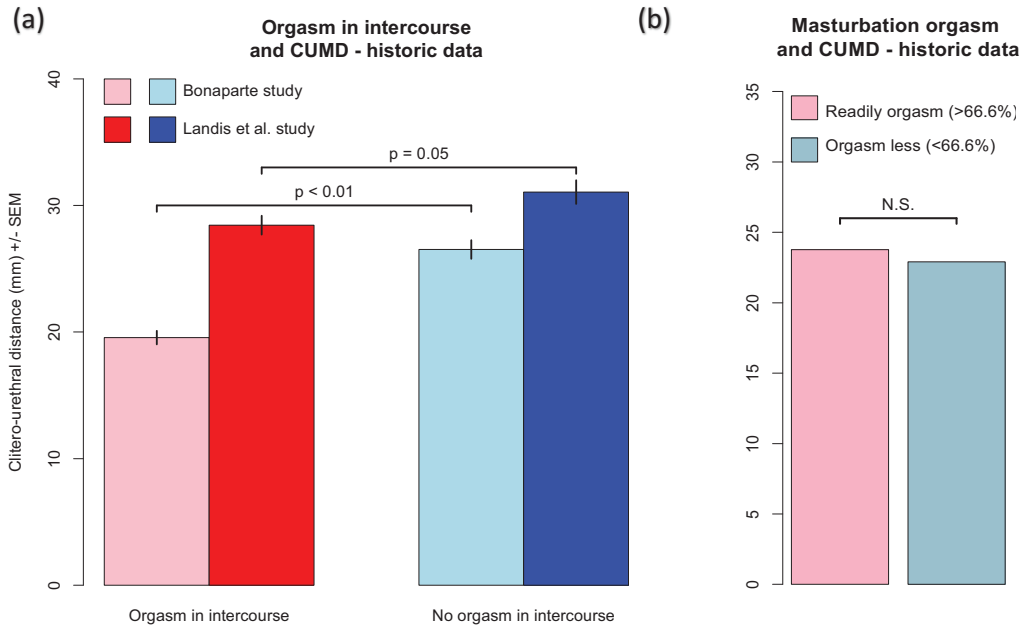

Fig. (11.2). Graphical presentation of the mean distance between the clitoris and urethral meatus in two early studies and whether women achieve orgasm. (a) comparison of Bonaparte's and Landis EA's studies; (b) the ability to orgasm through masturbation ("*autosexual*") from Bonaparte's study. (Source: data from [75]).

Glans Clitoris Exposure

It appears that whether the glans is actually exposed in its normal state may significantly affect the probability of a woman achieving orgasms regularly during sex. When a woman is examined in the standard lithotomy position (Fig. **11.3**), Pulatoğlu and Ellibeş Kaya found no statistically significant differences in clitoral glans width, length, or prepuce length between subjects with normal or reduced orgasmic function (Mann-Whitney U-tests: $p = 0.11$, $p = 0.63$, $p = 0.35$, respectively) [205]. However, in 41 of 51 patients in the normal orgasmic

CHAPTER 12

The G-Spot and Female Ejaculation

INTRODUCTION

The anterior vaginal wall is associated with two controversial topics, a highly erogenous zone called the G-spot and the elicitation of urethral expulsion called female ejaculation

The G-spot is so called because Drs John Perry and Beverley Whipple in Addiego *et al*. [892], named it the Gräfenberg spot after the German physician and scientist Ernst Gräfenberg (1881–1957), who wrote a paper about an erogenous zone on the anterior internal wall of the vagina [893]. See *Female Ejaculation* below for a detailed description of the observations reported in [892]. He reported that either penile or digital stimulation of an area towards the antero-distal end of the vagina could cause a woman to have an orgasm. The name G-spot was popularised in the book [693], and the name has stuck ever since [894].

It is probably one of the most enigmatic and almost certainly the most controversial aspects of female sexuality because authors seem to be unnaturally polarised either for or against its existence. Could the G-spot really be like 'the emperor's new clothes'? A modern gynaecological myth [895]? Could the G-spot really be like 'the emperor's new clothes'? A modern gynaecological myth? Something thousands believe (in this case millions) but which simply does not exist, perhaps like the Loch Ness 'Monster' or Yeti? As D'Amati [58] points out, Masters and Johnson [31] completely denied its existence and also that of female ejaculation!

A distinction must be made, but often not, between whether there is an associated, discrete, anatomic feature (a G-spot organ, so to speak) and whether there is an intensely erogenous zone at the location. Unfortunately, some of the debate and research seems to focus on the word “spot” which suggests that the area, if it exists, is really rather small and discrete, and, therefore, might be associated with some distinct anatomical, sensory structure [896].

A quick internet search for “G-spot” on Google (February 2021) gave 34,900,000 hits; even on Google Scholar, the predominantly English language academic papers search engine, gave 7,700 hits. It should be noted that both searches also

recover references to non-gynaecological things that are also called "G-spot," but these are in a large minority.

Stimulation of the anterior vaginal wall (sometimes rather vigorous) may also lead to fluid emission from the urethra, and in some cases, this fluid is not the urine, or at least not pure urine. The fact that it is stimulation of the same erogenous vaginal wall area that can lead to ejaculation suggests a functional connection between the two, which is why I am treating them in a single chapter.

THE GRÄFENBERG SPOT (G-SPOT) CONTROVERSY

In a series of papers by Romanian sexologist Vasile Nițescu and co-workers, *e.g.*, [897, 898, 899], the G-spot is renamed "H Area" standing for the region of hypersensitivity. It is just another name really for the G-spot, but it is less explicit that the place is a very precise spot, and although perhaps technically more appropriate, I see no reason why not to continue giving credit to Gräfenberg.

It is certainly the most controversial topic in sexology still after seventy years have passed [894, 900]. However, that the anterior vaginal wall is a particularly sexually sensitive region has been written about since the 2nd century A.D. at least, based on Chinese and East Indian writings [901]. Much of the problem, I will conclude, is in focusing too much attention on the word "spot".

I find it quite amusing that many of the researchers publishing positively about the G-spot are women (e.g., Beverly Whipple, Odile Buisson), some of whom, at least one would imagine, knew what their own bodies experienced. In contrast, several of those that deny its existence are men and, therefore, really unlikely to have experienced a G-spot or vaginal orgasm in person. For example, the renowned gynaeclogical sexologist Dr. Vincenzo Puppo (Italiano di Sessuologia, Bologna, Italy) and colleagues have written vociferously against it. I think one quote from Puppo and Gruenwald [902] will suffice:

"In our opinion, all published scientific data point to the fact that the Gräfenberg spot does not exist. Vaginal/uterine/clitoral orgasm, female ejaculation, the G-, A-, C-, U-, or K-spot orgasm, as well as G-spot amplification, are terms that should not be used by urologists, gynecologists, sexologists, the mass media, and all women".

Indeed, Puppo and colleagues [10, 199, 214, 902] are pretty much against the idea that anything other than stimulation of the clitoral glans, and maybe the shaft and hood, can bring a woman to orgasm [4].

Not all women seem to possess such an erogenous zone, and what exactly is producing the intense erotic sensations in those that do is unclear. This may be

because there is variation between women, any actual structure there might be small or not even visible with the techniques used. Or perhaps it is just a zone with a particular combination of sensory nerve endings or nerves with particular connectivity in the CNS. Possibly because stimulation of the area sometimes has to be quite strong to achieve an effect, the actual structures may be removed from the immediate point of stimulatory contact on the vaginal wall.

Pan *et al*. [903] reviewed publications concerning the existence of a G-spot and concluded that whilst the anterior vaginal wall is particularly erotically sensitive in many women, there is no evidence for an anatomically discrete G-spot.

What do Women Say About the G-spot?

Hoch [904] reports on whether gynaecological patients perceived digital examination of four different aspects of their vaginas as uncomfortable, neutral, slightly, or highly erotic (Table **12.1**), though admittedly the sample size (n = 56) is a little small. Views about stimulation of the posterior and lateral vaginal walls were almost entirely neutral; views were polarised regarding the cervix, with many reporting its stimulation as uncomfortable, but one individual rating it as highly erotic.

Table 12.1. Reports of sensations produced by sexological vaginal examination of women with coital anorgasmia but who otherwise were readily able to achieve orgasm (*e.g.*, through self or partner masturbation) (%, n = 56). (Source: data from [904]).

Stimulated area	Discomfort	Not erotic	Slightly erotic	Highly erotic
Posterior vaginal wall and fornix	0	97	3	0
Uterine cervix	67	27	5	1
Lateral vaginal location (at 4 o'clock and 8 o'clock)	0	98	2	0
Anterior vaginal wall (including urethra, bladder and Halban's fascia)	4	0	11	85

Who ought to know best whether they have a hyper-sensitive area on the anterior wall of their vaginas than women themselves. Many surveys have asked this apparently simple question: "Are you aware of having a G-spot?" or similar. Results of one such survey, which covers a wide age range of women, are shown in Fig. (**12.1**). There appears to be a decline in denial and an increase in uncertainty with age.

CHAPTER 13

Pharmacology of Desire, Arousal and Orgasm

INTRODUCTION

Relaxation of the normally, tonically contracted smooth muscles of the arteriolar and arterial walls of the corpora, causes tumescence and erection of a man's penis, but the constriction of the ischiocavernosus muscles also play a role in restricting the exit of blood from the penis which contributes to the full hard erection. The situation with the clitoris is similar though the external glans shows relatively little change apart from tumescence during excitation and orgasm – this is most apparent by a change in texture from a slightly wrinkled appearance when unstimulated to a shinier, stretched appearance when engorged (erect), and similarly it and its body feel somewhat firmer, and especially in women with rather large clitorises, the shaft may be seen to widen considerably. In some women, the increase in size may be somewhat more noticeable.

The relaxation of smooth muscles in the erecting penis has been shown to be the result of nitric oxide (NO) -induced cyclic guanosine monophosphate (cGMP) accumulation. cGMP-dependent protein kinase (PKG) then opens large-conductance, calcium-activated potassium channels (BKCa), leading to hyperpolarisation and, thence, relaxation of the vascular and trabecular smooth muscle cells, hence engorgement.

Clitoral Pharmacology and Sildenafil (Viagra)

Sildenafil was introduced onto the market by the international pharmaceutical company Pfizer in 1998 for the treatment of male erectile problems and has been enormously successful. It had initially been developed in relation to treating heart-related chest pain. It inhibits phosphodiesterase type 5 in human clitoral corpus cavernosum smooth muscle [936], and this, in turn, reduces resistance to arterial blood entering this erectile tissue leading to turbidity and typically minor increases in length and width. Obviously, there is a potentially huge market for approved drugs for alleviating female sexual arousal and related sexual dysfunction problems.

A histological study of the clitoris (see Chapter 2) has revealed various versions of the enzyme nitric oxide synthase [97]. Neuronal nitric oxide synthase was det-

ected in nerve bundles and fibers within the glans clitoris and especially in the corpora cavernosa, and endothelial nitric oxide synthase was found in the vascular and sinusoidal endothelium, especially in the glans clitoris. They did not detect specific inducible nitric oxide synthase, and concluded that nitric oxide is generated within the clitoris itself.

Just as with men, various phosphodiestase type 5 (PDE_5) inhibitors such as sildenafil citrate (Viagra®), tadalafil (Cialis®), and vardenafil (Levitra®) [937, 938, 939, 940] cause an increase in genital blood flow and hence swelling of the clitoris, labia minora and general genital area in various animals and women, but clinical uses have not been very forthcoming. Some women take these medications recreationally to enhance their level of arousal, just as men do to achieve (or improve or prolong) erection.

Laan *et al*.'s [941] study also revealed that vaginal vasocongestion and lubrication were also strongly affected by whether the subject thought that they had received sildenafil or thought that they had been given the placebo, *i.e*., if the subjects thought that they had received Viagra but had really received a placebo, they nevertheless showed greater vasocongestion.

Cavalcanti *et al*. [942] performed a placebo-controlled trial of treatment with a daily 50-mg dose of sildenafil on 22 postmenopausal women and assessed their response to it with three measures: Doppler ultrasonography for clitoral blood flow resistance (RI index) and peak systolic velocity (PSV) and the Golombok Rust Inventory of Sexual Satisfaction (GRISS). After 15 days, their results showed that clitoral blood flow was higher in the treatment than the control group ($p < 0.05$) (Fig. **13.1**). Also, the mean GRISS scores of the sildenafil group increased from 73.73 to 80.55, a mean increase of 6.5 compared with a mean increase of only 0.46 in the placebo group ($p < 0.01$).

Sildenafil has been shown not to increase engorgement and swelling of the internal clitoral crura and bulbs relative to placebo using MRI [666]. In their randomised, double-blind, placebo-controlled, two-way crossover study of 19 premenopausal patients with female sexual arousal disorder (FSAD) (age 22 – 44), not only was there no significant treatment effect, engorgement occurred equally with sildenafil and placebo, more than 80% responded with clitoral engorgement including 13 (68%) who achieved a ≥ 50% increase in clitoral volume after just 30 minutes. The latter shows that, at least in this sample, FSAD was not due to problems of genital engorgement.

Chivers and Rosen [943] reviewed 16 studies on phosphodiesterase type 5 inhibitors and concluded that whilst physiological investigations all revealed positive actions on such things as engorgement, investigations into self-reported

measures of sexual function did not reveal any effect. They concluded that this is most likely due to markedly higher discordance between psychological and genital (at least as measured) components in women compared with men [673]. Therefore, it seems that for most cases and most aspects of female sexual dysfunction, they will provide no benefit. Table **13.1** presents an annotated summary of studies.

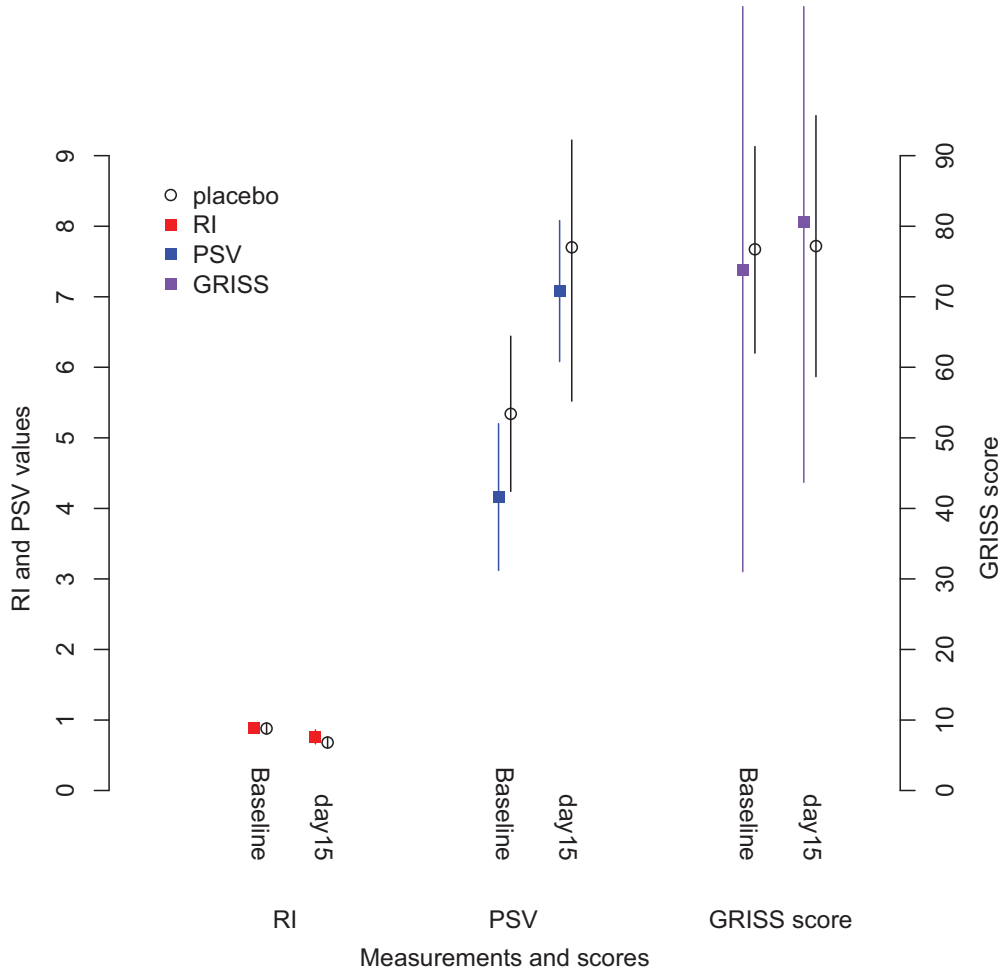

Fig. (13.1). Effects of 15 day Sildenafil (Viagra) (n = 11) versus placebo (n = 11) treatment on clitoral blood flow parameters (RI and PSV) and sexual satisfaction (GRIS) on postmenopausal women. (Source: data from table 2 in [942]).

CHAPTER 14

Sex in the Brain and Spinal Cord

INTRODUCTION

Male and female brains are similar but not identical [981, 982]. The amygdala, hippocampus, insula and planum temporale display sex differences, and the first three of these are all involved in sexual arousal and/or orgasm, as well as in sex-biased neuropsychiatric conditions as well as depression and schizophrenia. The left and right parts of the amygdala are larger in men than in women. The left and right thalamus, which is also important in the orgasmic response and processing of sensory information, is larger in women.

Studies on brain activity during sexual stimulation, arousal and orgasm in men and women started with electroencephalography (EEG), in which small metal disc electrodes are placed on the surface of the scalp. The first such study in the literature [983] and obtained visually similar results to subsequent studies. Members of both sexes show similar EEG responses through arousal, orgasm and post orgasm though there is considerable variation. In general, the right hemisphere shows increased electrical activity relative to the left hemisphere [984]. Advances in computing have greatly enhanced the detail that can be obtained from EEG [985].

GENERAL BRAIN STRUCTURE

To help readers understand where important relevant brain structures are located, a general map showing external lateral features of a human brain is shown in Fig. (**14.1**), and a sagittal section in Fig. (**14.2**). Stoléru *et al*. [986] presented a meta-analysis of brain region activation or inactivation during sexual arousal. Sixteen of the studies included women (mostly heterosexual), and 41 included men, with 11 of the studies comparing both. The main regions involved in female sexual arousal and orgasm include sensory, motor, reward, frontal cortical, and brainstem regions. The particular brain parts where increased activity happens are the nucleus accumbens, insula, corpus striatum, anterior cingulate cortex (gyrus), hippocampus, operculum, occipitotemporal cortex, hypothalamus, preoptic area, pituitary (connected to the hypothalamus), amygdala, thalamus, and the orbitofrontal cortex, right angular gyrus, ventral tegmental area, and dorsal raphe

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[654, 659, 987-989]. Stoléru *et al*. noted, in line with the common behavioural study finding that men respond more to visual stimuli than women, that their amygdalas and thalami also responded to a greater extent.

Essentially all major brain systems are activated during orgasm, including the brainstem, limbic system, cerebellum, and cortex [988]. Calabrò *et al*. [990] summarise the functions of the main brain areas involved with sexual arousal and orgasm as follows:

- Thalamus: relays erotic stimuli incoming from the spinal cord
- Hypothalmus: coordination of autonomic events in sexual behaviour
- Amygdala: provides emotional significance to incoming erotic stimuli
- Prefrontal cortex: blunts the initiation of sexual behaviour
- Cingulate cortex: processing sexual stimuli in relation to conflicts
- Insula: involved in awareness of genital arousal.

The hypothalamus and pituitary are functionally connected, the pituitary gland being the release site for hormones produced in hypothalamic neurones. These are effectively slow hypothalamic responses, whereas fast responses involve direct activation of the sympathetic and parasympathetic motoneurons in the brainstem and spinal cord [991].

BRAIN SCANNING AND FMRI

Several imaging techniques now largely supplant patients who have incurred various brain injuries for working out what parts of the brain are involved in what processes. Technology improvements have enabled remarkably precise localisation not only of passive structures but also of what parts of the brain are especially active or inactive at any given time. This has enabled comparisons between the sexes, for example, of what brain regions are involved in arousal and during orgasms.

The most used technique is called functional Magnetic Resonance Imaging (fMRI), which relies on detecting areas where there is an increased or decreased supply of oxygenated blood to highly, especially active brain regions. When brain activity goes up, glucose is metabolised to provide the ATP needed to energise the ion pumps that restore the concentrations of sodium, potassium and other ions to resting conditions in the neurones, thus making them prepared for further action. There is a delay of about two seconds between a part of the brain, indicating an increased need for oxygen and the blood system supplying it. Therefore, there is a small time delay, for example, from the onset of an orgasm and the imaging system showing a response.

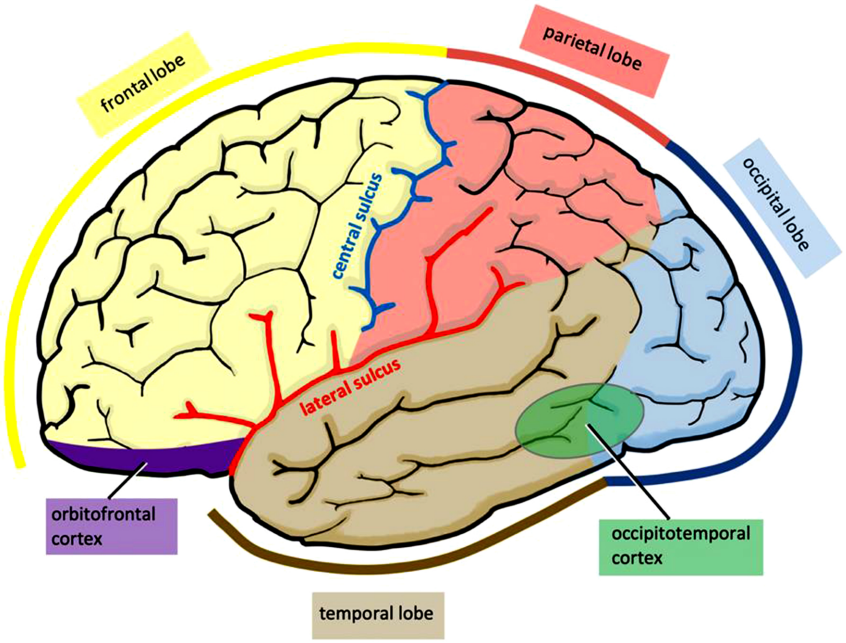

Fig. (14.1). Side view of the human brain (cerebrum) showing major regions and main external areas where activity levels change markedly during arousal and/or orgasm.

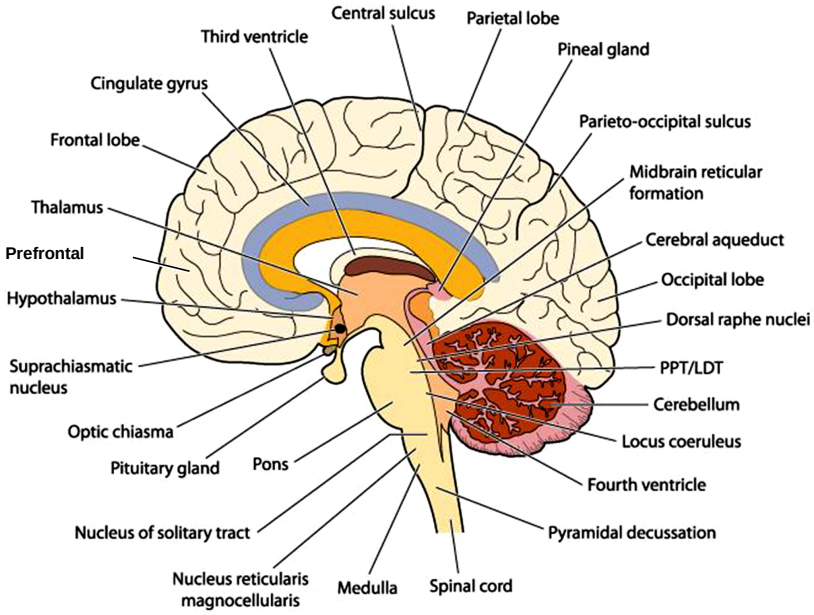

Fig. (14.2). Overview of parts of the human brain, view of right half cut sagittally. (Source: modified from Shutterstock with permission).

CHAPTER 15

Masturbation Demography, Frequency, Age and Method

INTRODUCTION

Victorian attitudes persist still, and there can be no doubt that for a large part of the 20th century, masturbation, perhaps especially in boys, has been seen as harmful [1025]. Indeed, it seems likely that the anti-masturbation campaign that lasted until the middle of the 20th century and beyond, started with a single pamphlet, published anonymously around 1712, though probably by the quack doctor and medical pornographer John Martin [1026, 1027], with the wonderfully anachronistic title "*Onania; or, the Heinous Sin of Self Pollution, and all its Frightful Consequences, in both SEXES Considered, with Spiritual and Physical Advice to those who have already injured themselves by this abominable practice*." Perhaps, a little surprisingly for the date, the title explicitly includes female masturbation as well as male, so the author's views on it did not just relate to the loss of semen. Masturbation, and perhaps especially female masturbation, has for a long time been seen by parts of the medical profession as the cause of many mental and physical disorders [1028, 1029]. What terrible things this led to.

Of Kinsey *et al*.'s sample of 5,940 white female American interviewees, 62% said that they masturbated or had at some time masturbated [23]. The Hite Report [42] revealed that out of the 1,844 American women surveyed, approximately 82% masturbated. The next significant sexual research project, The Janus Report on Sexual Behavior [1030], which had 1,384 female respondents, reported that 38% masturbated frequently, and 67% viewed masturbation as a natural part of life. Masturbation was practiced most commonly by women in their late 20s to their 40s (slightly more than 40% through this period). More than 25% reported masturbation well after the age of 50. Although there is variation in the reported percentages, probably mostly due to sampling demographics and maybe the era that the information was gleaned, the data agree that considerably more than half of all women masturbate. The interesting questions, therefore, relate to why some women do and why some do not.

Even as recently as 1984, a fairly extensive survey of masturbation and orgasm among female residential 'freshmen' and sophomore (2nd year) students, with a

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mean age of 19.4 years, at a mid-western USA university, was published in the journal *Deviant Behaviour* [57]. This study revealed a highly significant association between never having masturbated and never having had an orgasm (n = 365, χ^2 = 11.907, d.f. = 1, p = 0.00056). Interestingly, nearly 9% of those who were currently masturbating were uncertain whether they had ever had an orgasm (see also *What is Normal?,* Chapter 1), and nearly 16% of those who had never masturbated were similarly uncertain. In his sample, only 65% of the students said that they had definitely had an orgasm, and 23% were sure they hadn't, the remaining 12.6% were uncertain.

There is a widely held dogma among men (and indeed many women) that if a woman says that she does not masturbate, then she is lying (see Kinsey [23: p. 133]). However, consistent surveys say that quite a high proportion of women deny ever masturbating, and some have zero interest in anything to do with sex. While it is almost certainly the case that there is some sort of shame effect, even with respondents who are willing to share other details of their sex lives, some choose to exclude masturbation information, and others maintain that they do not, so it seems likely that masturbation is far from universal among women. From various surveys, many of which seem unlikely to be causing false responses, somewhere between 5 and 15% of women in various [western] samples report never masturbating.

What percentage of women practice masturbation has long been a subject of inquiry. Even with anonymous questionnaires, reporting may be affected by marital status because for a married woman to admit that she masturbates might be seen as implying that her husband does not adequately satisfy her sexual needs. Nevertheless, back in 1929, in Katharin Davis's survey of over 2,000 American women, 65% of respondents 'admitted' to doing so [1031]. In the same year, another study came up with approximately 75% [1032], and values of around 75 – 80% are typical of the first half of the 20th century [1025] and indeed still are now [1029]. Kraus compared the proportions of French women who reported masturbation across surveys carried out in 1970, 1992, 2006, 2012 and their own in 2017 and showed a virtually linear increase over time with [1033]. They also suggest that despite the possible negative effects, women discuss masturbation more with their partners than with their friends. Increasing media attention on the subject is helping to bring female masturbation out in the open, which is a healthy thing.

Over the past 40 or so years, there have been many large surveys of peoples' masturbation history, some providing additional demographic information such as age., *e.g.*, German, Portuguese, UK women [1034, 1035, 1036], US adolescents [1037]. However, there are far fewer studies, certainly large sample size ones, of

female masturbation practices outside of Europe and North America. In one Portuguese survey [1035], more than 30% of respondents in most age classes reported that they had masturbated within the past week (Table **15.1**).

Schulman and Horne [1038], in a sample of 96 women in Memphis, Tennessee, found that a higher proportion of European American women reported masturbating (69% versus 51%; $\chi^2 = 3.88$, d.f. - 1, $p < 0.05$), did so more frequently ($\chi^2 = 9.51$, d.f. = 3, $p < 0.05$), but they also had higher rates of body dissatisfaction ($t = -2.31$, d.f. = 94, $p < 0.02$) than did African American women.

Table 15.1. Percentage of a sample of Portuguese women who most recently masturbated in various preceding time windows. (Source: data from Table 2 in [1035]).

Most recent masturbation (n)	17 – 26 (1563)	27 – 36 (1534)	37 – 46 (412)	47 – 56 (141)	>56 (37)
In the past week	34.0	33.3	34.7	29.8	45.9
In the past three months	28.6	29.9	29.6	31.9	21.6
4 – 6 months ago	13.5	13.7	13.3	9.9	10.8
6 – 12 months ago	5	4.8	4.4	6.4	2.7
1 – 5 years ago	6.3	5.6	6.3	7.1	2.7
more than 5 years ago	2.1	4.6	5.8	6.4	8.1
Never masturbated	10.6	7.1	5.8	8.5	8.1

Hogarth and Ingham used interview techniques with British schoolgirls to assess their attitudes to self-exploration, masturbation and developing sexuality [1039]. The narrative responses showed a wide range of attitudes. Here are two example extracts, the first very positive,

"Giving myself so much pleasure and orgasms whenever I want one is just great, and I can't imagine being without that...you know...knowing how to do it...god, did I use it when I was revising. [laughs] . . . I think every girl should be encouraged to do it...there is nothing worse than feeling horny [sexually aroused] and not knowing what to do about it [laughs]." (Daisy, age 18),

the second neutral

"*Gawd...I don't think its ever crossed my mind you know...er...no I don't think it has...um...I mean I like watching a romantic...you know...a film that makes you feel good...like...oh I can't think but something sexy . . . but I wouldn't go away and do anything...you know...to myself.... I just wouldn't...."* (Hannah, age 17).

CHAPTER 16

Factors Affecting the Probability of a Woman Achieving Orgasm

INTRODUCTION

Women, although not alone in this respect, have a relatively high rate of not reaching orgasm during penetrative sex. Obviously, there is enormous variation between individuals, as well as variation associated with experience and age. In many relationships or encounters, the couple may well work together to ensure she has an orgasm at least by some stimulatory means (oral, digital, toy), though certainly not in all.

As mentioned previously, many studies indicate that (i) a proportion of women never manage to achieve orgasm by any means, (ii) a larger percentage can achieve orgasm through some means (masturbation and/or sex), and that some can achieve orgasm through solo or partnered clitoral stimulation, but not through penetrative sex alone. Data from one small survey indicate approximately 93% of those women who have experienced orgasms reported they had experienced orgasm reported some level of conscious control over whether or not the orgasm actually took place [37].

Importance of Orgasm

If a woman is capable of reaching orgasm we might expect that she might work harder to achieve one both in masturbation and intercourse. In a series of national surveys in Finland, the most orgasmic women rated achieving orgasm as more important than the less orgasmic respondents (Fig. **16.1**).

Duration of Coitus

Despite what might appear from pornographic movies, typical sex between real couples in real life appears to be a rather briefer thing. It is, of course, a little tricky to get hard data. My internet searches for “duration of coitus”, “duration of copulation,” and similar yielded at most five results for humans though the second of these resulted in hundreds of hits for spiders, millipedes, various insects, *etc*. The normal places you might look, such as [23, 32], provide no quantitative data though Kinsey *et al*. give an approximate value of 2 minutes [22], and an earlier

study states that coitus normally lasts 1.5 to 5 minutes [12]. Slightly more recently, seven subjects taking part in a heart monitoring study engaged in coitus for a mean of 13.6 minutes (range 8 – 21) [1064], and [1065] reported durations from subjects of 7.02 minutes. Despite its enormous size, Seymour Fisher's study did not report the duration of copulation but did report 5.75 minutes as the median time for women to orgasm during penetrative sex [805].

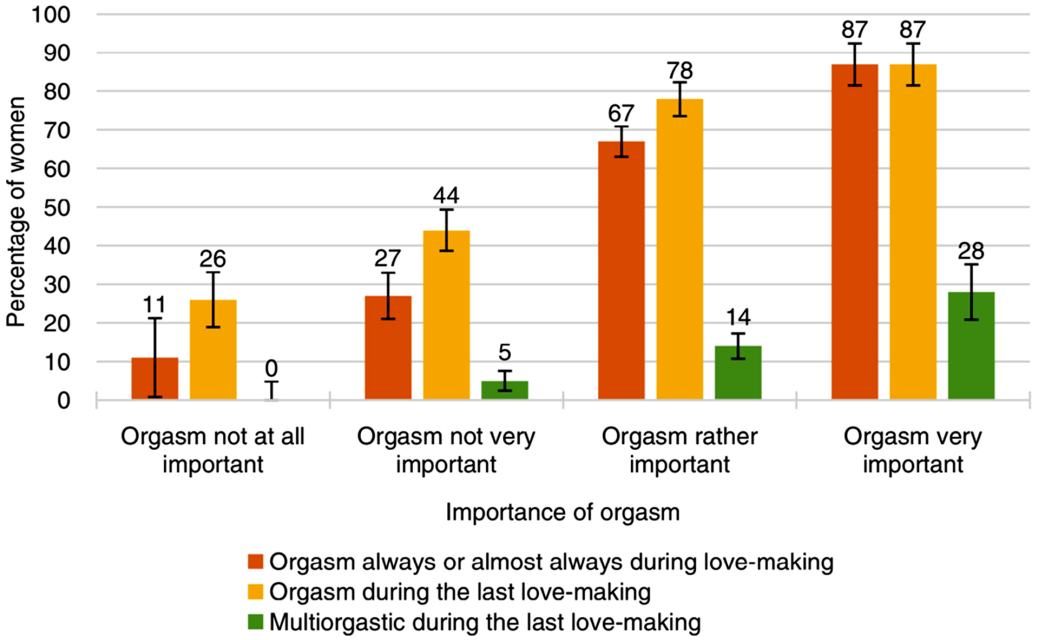

Fig. (16.1). How orgasmic women in five combined nationally representative Finnish sex surveys rated the importance of having an orgasm in relation to their normal and most recent during their last 'love-making (n = up to 12,685). The graph shows that orgasms are considered more important by more orgasmic women. (Source: reproduced from [808] under Creative Commons Licence CC-BY 4.0).

Miller and Byers [1066] asked the men and women in 152 heterosexual couples about the actual and their desired durations of foreplay and coitus. Men and women agreed on their ideal length of foreplay (men: 18.10 ± 11.42 mins; women: 18.93 ± 13.32 S.D).. However, men reported a significantly (t-test; $p < 0.01$) longer ideal duration of coitus (men: 18.45 ± 12.19 mins; women: 14.34 ± 11.08 S.D).. For both men and women, these desired durations of coitus were more than twice as long as what the depicted couples actually did.

Of course, coitus may last much longer, perhaps, especially in newly acquainted couples. What an evolutionary biologist might be interested in, is what were the conditions under which duration, which is partly regulated by how long it takes the male to ejaculate, was determined by natural selection. Our ape and other *Homo* species ancestors were largely diurnal, like most monkeys and all extant

apes. They probably mostly lived in the African savannas, and activity as conspicuous as sex might easily attract the attention of other conspecifics or large predators. Evolution would favour those males who could get the job done quickly [1067, 1068], see below).

Ishibashi investigated factors involved in sexual satisfaction in 286 married Japanese women (mean age 36.18 years; range 24.5 – 54.5) and obtained information on average intercourse duration (based on 15-minute time bins) [1069]; the mean frequency of intercourse was 32.55 times per year (range 1 – 156). Duration of intercourse had a significant ($p < 0.05$) positive effect when the data were binned data were treated as numeric, but there was no significant effect if they were treated as categorical. However, frequency of sex, when demographic, working, and partner's characteristics were controlled for, was significantly positively correlated with sexual satisfaction. Ishibashi also found a significant positive association between the amount of time spent in conversation with their partners and sexual satisfaction.

Another Japanese survey based on 300 married couples [1070] found that the women (39.7 years ± 11.0 S.D). collectively displayed a wide range of desired intromission durations. The women estimated that the mean duration of intromission was 13.6 minutes, whereas the mean desired duration was stated as 15.7 minutes (*i.e.*, on average, they wanted penetrative sex to last approximately 15% longer). For the subset of women who reported not experiencing coital pain, 42.6%, 43.6% and 13.7%, stated that they wanted coitus to last longer, to remain about the same, and be shorter, respectively.

Levitt used a different approach in which respondents were shown a film of a couple performing foreplay and then sex (coitus) without telling them the purpose, and then later (*e.g.*, the next day), asking them to estimate how long the two phases lasted [1071]. Using a sophomore class enrolled in a medical degree course at Indiana University. The film "*Close-Up*" (Edcoa Productions, Inc). included a 12.7-minute foreplay period followed by a 2.8-minute copulation. The results were quite interesting (Fig. **16.2**). Both male and female students significantly overestimated the durations of both film activities, indeed, the coitus estimates were nearly twice as long as in the actual film (t-tests, $p < 0.01$). The women also showed a greater tendency to overestimate all durations more than the men.

CHAPTER 17

Sexual Dysfunction

INTRODUCTION

This is a huge area and rather clinical, so I will only deal here with some of its major aspects. The Mayo Clinic (www.mayoclinic.org accessed 30 June 2021) defines female sexual dysfunction (FSD) as a:

"*Persistent, recurrent problems with sexual response, desire, orgasm or pain.*"

These problems affect somewhere near 50% percent of women, though it is very difficult to be precise [1176, 1177]. A recent Dutch survey [1178] of 521 sexually active women (age range 20 to 80 years) found that 28% had FSFI scores below 26.55, the clinically defined cutt-off for sexual dysfunction. One study of African university students in Cameroon (n = 405) [1179] revealed an incidence of 42%, the commonest forms being problems of sexual pain (46.9%), orgasm (42.0%), desire (29.1%) and arousal (21.2%). Given the generally young age of the students, this seems remarkably high, and certainly, FSD increases with age [1180: table 8], particularly at and after menopause. FSD problems may be temporary, such as when they are brought about by medications or periods of stress or ill health, or they may be lifelong. FSD can affect women in any age group.

FSD can be split into a number of sub-categories (*e.g*., Basson *et al*. [1181], Traish [1182]), depending upon which aspect of the sexual response is dysfunctional:

- Hypoactive Sexual Desire Disorder (HSDD)
- Female Sexual Arousal Disorder (FSAD)
- Female Sexual Orgasm Disorder (FSOD)
- Sexual Aversion Disorder (SAD)
- Sexual pain disorders (dyspareunia, vaginismus, vulvar vestibulitis, and non-coital sexual pain)

FSAD is defined as [1183], persistent or recurrent, inability to attain, or maintain until completion of the sexual activity, adequate lubrication or swelling response

to sexual excitation. FSAD can be further subdivided in accordance with whether the cause is subjective, genital or some combination of the two [1184, 1185].

In addition to the above list, I include here persistent genital arousal disorder (PGAD), which lies at the other end of the spectrum. PGAD has not been included in the American Psychological Association categories of mental disorders [1186, 1183, 502] because its aetiology is probably peripheral rather than in the brain [1187].

Despite all of the research and media attention, Moynihan [1188] points out that FSD is a hugely profitable medical industry. Much, of the research is financed by 'big pharma'. Whilst much of the lucrative pharmacology has been concerned with alleviating male erectile dysfunction with drugs such as sildenafil, vardenafil and tadalafil, the potential profit from extending this market to women is huge (see *Clitoral Pharmacology and Sildenafil (Viagra)* and *Prostaglandins*, Chapter 17). His view is that what started off being considered a difficulty became a dysfunction and is being pushed towards the status of the disease. Of course, nearly all women have orgasms as much as men, and those who cannot achieve them and those who find them hard to achieve, must feel disappointed and dissatisfied. Understandably, many would jump at an easy pharmacotherapy aid. Who could blame them?

MEASURING SEXUAL FUNCTION/DYSFUNCTION

By far, the most widely used method is to ask the subject or patient to complete a questionnaire, usually in written form, and then the responses are converted into one or more numerical indices. Some assessments involve interviews. Over the years, there have been quite a range of such questionnaires, many aimed at discerning more detail about the nature of the problems, if any exist [1189]. A fairly basic example is that of the Monash University, *Women's Health Programme of Female Sexual Satisfaction* questionnaire (Appendix H). Like many, this uses a Likert scale where answers are subjectively rated, for example, from “no never” through to “Always”. This particular example which only includes 12 questions, is really aimed at detecting whether there is a problem but does allow a little bit of differentiation between problems of receptivity, or orgasm, as well as a sort of overall domain of receptivity, arousal, lubrication, sexual pleasure, sexual satisfaction. Many sex-related questionnaires are more specialised, for example, the Bodily and Physiological Sensations of Orgasm [1190] (Appendix I), the Changes in Sexual Functioning Questionnaire [1191] (Appendix J), the Sexual Satisfaction Questionnaire [1192] (Appendix K) and the Sexual Excitation/Sexual Inhibition Inventory for Women and Men (SESII-W/M) [1193] (Appendix L). Meston and Derogatis [1194] compare five such FSD asse-

-ssment methods test-retest reliability, inter-rater reliability, and internal consistency reliability.

The Female Sexual Function Index (FSFI)

The Female Sexual Function Index (FSFI), a 19-question, multiple-answer inquiries into a woman's recent sexual experience (Appendix B) [1195]]. There is also a shorter six-question version, but I will only discuss the original. The simplicity of asking these questions and arriving at some number, or numbers that can easily be appraised is appealing, and as a consequence, the FSFI has now been translated into many other languages, including Iranian [1196], Italian [1197], Malay [1198], and Urdu [1199]. There are very many others. Obviously, when something is translated into a foreign language, especially when there might be subtle nuances, to do the job properly, the text is first translated into the new language by a native speaker, and then back into the original language (English in this case), and any inconsistencies are then ironed out. It follows that it is also important to carry out validation tests to ensure that results obtained from women answering in different countries will be comparable.

The FSFI answers can be partitioned into a number of sub-domains to obtain further insight. The normal ones considered by sex researchers and physicians are desire, arousal, lubrication, orgasm, satisfaction and pain.

More than 80 studies have examined how reliable the scores obtained from the FSFI are, see [1200] for a recent summary. The outcome is not terribly impressive. However, we need to consider what exactly the rather negative results mean. Clearly, if a respondent has almost entirely given top or near top scores to all the questions, they should be happy enough, and on the other hand, if they have answered predominantly 0s, 1s or 2s, they might well have reason to hope that some clinical or counselling intervention could improve matters. Perhaps the main purpose of the FSFI is really to assess whether clinical intervention is justified and, if so, in what area (domain).

In one large study, the FSFI questionnaire (Appendix B) was completed by several groups of women with various sexual dysfunctions (n = 568) to develop diagnostic cut-off scores for potential classification of women's sexual dysfunction [1201]. Their sample comprised non-dysfunctional controls (n = 261) plus groups of women FSAD, HSDD, FSOD, dyspareunia/vaginismus (pain), and multiple sexual dysfunctions. After thoroughly analysing the data using classification and regression trees, MANOVA and principal components analysis, the authors concluded that the FSFI total score of 26.55 was the optimal cut-off for differentiating between women with and without sexual dysfunction. However, this picked out only 70.7% of women with sexual dysfunction as being

CHAPTER 18

Genetics of Orgasmicity

INTRODUCTION

There has been surprisingly little work on what part genetics plays in how orgasmic a person is, either male or female. The mainstay of this sort of research is twin-based studies. If the similarity between monozygotic (identical) is greater than between dizygotic twins (found for most traits), then genetics play an important role in that factor. Mother-daughter comparisons can also provide information, but it is hard, or impossible, in that case, to disentangle cultural aspects.

Female sexual dysfunction (FSD) seems to have a large genetic component [1340], and work on identifying the genes responsible is underway [1341]. This, in turn, may lead to the development of novel targeted therapies in the future.

HERITABILITY OF EASE AND DIFFICULTY OF ORGASM

A questionnaire survey of 10,000 Finnish twins and siblings found that both male and female orgasmic function had significant genetic components, *i.e*., the more easily orgasmic a woman is, the more likely it is that her sisters and mother would also reach orgasm easily, and similarly for males and their twin brothers [1342]. However, the interesting thing about their findings was a lack of cross-sex correlation, *i.e*., a woman's orgasmic was not correlated with that of her brothers' or vice versa, indicating that the genetic mechanisms underlying this must be largely different between men and women.

To try and understand whether female sexual dysfunction had a genetic basis, Dunn *et al.* carried out a classic twin-study using confidential questionnaires for a large sample from the TwinsUK register [1343]. Among their total sample of 4,037 twins, there were 683 monozygotic and 714 dizygotic pairs (age range 19 – 83 years). Approximately a third of the women (32%) reported never or only infrequently achieving orgasm during intercourse, although during masturbation, this was true for only 21%. Difficulty reaching orgasm had a significant degree of heritability, specifically 34% (95% confidence interval 27 – 40%) for orgasm during intercourse and 45% (95% confidence interval 38 – 52%) for orgasm during masturbation.

Donald Lambert Jesse Quicke

Remarkably similar heritability estimates were obtained the same year by Dawood *et al*. [1344] using the Australian Twin Registry, and recruited from a large, partly longitudinal, twin-family study. Three thousand and eighty women responded to the anonymous self-report questionnaire, including 667 monozygotic pairs and 377 dizygotic same-sex pairs, 366 women from complete dizygotic opposite-sex pairs, and 626 women whose co-twins did not participate. Significant twin correlations were found for both mono- and dizygotic twin pairs for frequency of orgasm during sexual intercourse, during other partnered sexual activities, and during masturbation. They found that genetic factors accounted for approximately 31% of the variance of frequency of orgasm during sexual intercourse, 37% of the variance of frequency of orgasm during sexual contact other than during intercourse, and more than half (51%) of the variance of frequency of orgasm during masturbation. Dawood *et al*. could not statistically exclude the possibility of some additive shared environmental influences.

More recently, Zietsch *et al.* [1345] confirmed a high genetic component to orgasm frequency in a community sample of 2,914 adult female twins from the Australian National Health and Medical Research Council Twin Registry who reported their orgasm rates during masturbation, intercourse, and other sexual activities, and who completed demographic, personality, and sexuality questionnaires. However, they also found that orgasm rate did not correlate strongly with any of 19 other traits (e.g., socioeconomic, sexual, personality, and health traits, relationship length extraversion, lifetime number of sex partners, preference for committed vs. uncommitted sexual relations, risky sexual behaviour, libido, educational level, *etc*. Incidentally, most of the other traits showed substantial heritabilities too.

The Other 70%

Cohen and Belsky [1346] turn the heritability of womens' orgasm capacity on its head, arguing that since only about one-third of orgasmic function is inherited, a substantial part is not. They predicted that this remaining variation might be due to varying levels of attachment avoidance that might originate from early experience. Using internet survey data, they found that, as predicted, higher levels of romantic avoidance were significantly negatively correlated with orgasm frequency.

GENETICS AND THE G-SPOT

There appears to date to have been only one study of whether a self-reported G-spot shows any degree of heritability, and that was by Burri *et al*. [908]. In a sample of 1,804 female twins, 56% of respondents reported having a G-spot, but the data produced no evidence of any genetic influence. This lack of any apparent

heritability contrasts with virtually all other twin studies of anatomical and physiological traits. If this is true, there seem to be only two possible conclusions. One, women differ markedly in their ability to detect their own G-spot, assuming that it really exists, or two, there is no such thing as a G-spot. The authors concluded the latter. However, this study, despite its large sample size, has been criticised heavily by Jannini *et al*. [1347] on the basis that Burri *et al*. [908]:

" *... reached their personal conclusion neither by face-to-face medical and sexological anamnesis with a certified professional, nor by validated questionnaires on the G-spot, nor by gynecological consultations, nor by medical imaging or any tool that can directly measure the anatomical variability of the self-reported G-spot*."

I think a key point was the specificity of the relevant question that Burri *et al*. asked their respondents, specifically, "*Do you believe you have a so-called G-spot, a small area the size of a 20p coin on the front wall of your vagina that is sensitive to deep pressure?*". This is a clear dichotomous question to which they obtained a clear response. They did not ask whether the women found stimulation of their anterior vaginal wall arousing, so in a way, Jannini *et al*.'s criticism that the survey did not explore the purported sensitivity of the whole area or the cliterourethrovaginal complex is not entirely pertinent. I think that there is a great need for a similar twin-based investigation of the whole area of vaginal wall sexual sensitivity.

Of course, if the G-spot phenomenon is not due to any single structure but rather to a combination of factors, that would necessarily make genetic analysis more difficult. I doubt that there could be more than a few factors in such a case, as it would then be increasingly unlikely that the right variants would occur in a large number of women. Ideally, one would not only like larger twin-study sample sizes but also individual information on various other things that might contribute to women feeling strong erogenous sensations thereabouts. However, it seems unlikely that such intrusive data would be readily obtainable.

CHAPTER 19

Evolution of Human Female Arousal and Orgasm

INTRODUCTION

When non-human mammals have been implied to have orgasms during sex, it is always a result of some period of penile-vagina thrusting. With possibly the exceptions of some close relatives of *Homo sapiens*, petting of the female's clitoris, vulva or vagina in order to stimulate her during heterosexual interactions in the way we know it is, at the very least, uncommon. Sherfey [1008] wrote that mammals divide into two distinct groups, those with prolonged courtship before intromission, and those without. She places the behaviour of dogs in the former, writing:

"*A bitch in heat will keep a pack of males running after her for hours before she finally relents and stands still. During this time, she will frequently stop, allowing her genitals to be smelled and licked, thus providing herself with a long foreplay period*."

The courtship, even if it doesn't involve physical genital stimulation, could nevertheless be arousing, at least in the sense that it makes the female more likely to (maybe even want to) be mated. However, the female orgasm has not been suggested for canids (*i.e*., dogs and relatives), and, as far as I know, digital or oral stimulation of the exposed clitoris to bring a female to orgasm is a uniquely human attribute.

Firstly, let's consider what vertebrate animals have penises. The phylogenetic distribution of male intromittent structures is shown in Fig. (**19.1**) [1348]. A penis homologous to that of humans, *i.e*., enclosing the urethra, is restricted to mammals, although some similar structures have evolved independently in various other groups.

When it comes to clitorises, these are present in all mammals. Within the primates, the external clitoris of human women is rather diminutive in relation to body size [1349]. In a few cases, even outside of the primates, it can be essentially the same size as the un-erected male organ [1350]. In the case of the spotted hyaena, *Crocuta crocuta*, a functional explanation has been forth-coming. In this social but rather aggressive species, females, from a very early age, possess a

highly erectile pseudopenis, prepuce, and even a fatty pseudoscrotum. In spotted hyaenas, an erect penis is a signal of submission, and it has been shown that females display this as do males to avoid aggression from more powerful, dominant female individuals [1351, 1352].

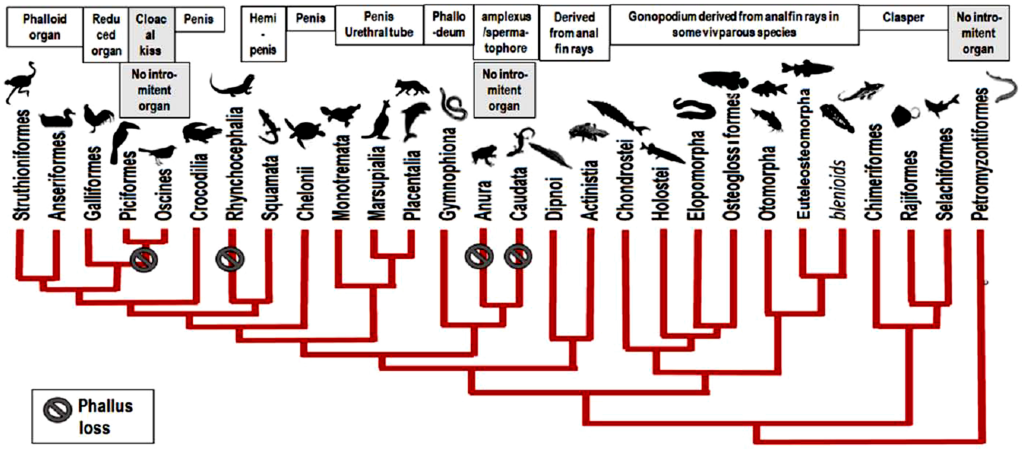

Fig. (19.1). Phylogenetic tree of vertebrates showing the distribution of male intromittent organs such as penises or other structures with similar functions. (Source: from [1348] reproduced with permission and © Thierry Lodé).

Since the role of a large clitoris in the spotted hyaena is certainly not the role of the clitoris in other mammal species, the considerable material expenditure in growing a large clitoris would seem to imply some other, probably sexual, functionality. Probably of most relevance is the clitoris of the bottle-nosed dolphin (*Tursiops turnucatus*). As with primates, dolphins are able to copulate throughout the year, and as many swimmers and divers can attest, bottle-nosed dolphins are relatively highly sexed; both male and female dolphins masturbate, they try sexual encounters with humans in the water, they enact the cetacean equivalent of lesbianism with one female manipulating the clitoris of another with their snouts, flippers or tail flukes [1353]. Their all-year sex is thought to help them to establish and maintain social bonding. During heterosexual intercourse, the location of the clitoris close to the vaginal introitus makes it likely to be stimulated during copulation. In both detailed anatomy, including erectile tissues, crura and bulbs and sensory innervation, bottle-nosed dolphin females have very similar clitoral structures to that of humans. Combining the behavioural observations with their anatomical studies of dolphin clitorises, the authors conclude that dolphin females probably experience sexual pleasure. As they suggest, understanding the ” *... phylogenetic history of sexual pleasure may elucidate the role of female orgasm*”. We do not know whether female dolphins

have orgasms. In an evolutionary sense, it is probably unimportant whether the female of a species such as a bottle-nosed dolphin has an orgasm, only that she enjoys and seeks our sexual stimulation, and maybe bonds with efficient providers.

Here I consider the evolution of sexual arousal as a separate topic from the more debatable evolution of female orgasm because the first is clearly a facilitator of sex, but female orgasm is not necessary for procreation.

EVOLUTION OF FEMALE SEXUAL AROUSAL

Kim Wallen [1354] makes the distinction between the ability to copulate and the desire to copulate. Female higher primates differ from most other mammals in that their ability to mate is not hormone-dependent, whereas female rodents, such as the archetypal laboratory rat, are unable to mate without hormonal stimulation. This emancipation of the ability to copulate from hormonal influence makes female sexual motivation the primary regulator of mating in primates, but it also means that they are physically capable of intercourse even when it is unwanted, and they can mate all year round. Female primates are therefore freed to use sex for purposes other than reproduction. Interestingly, even female rats show a sexual arousal response. Aristotle noticed this writing by observing female rats that the humidified sex of the female swells when she approaches a male" [1355, 188].

Rape and the Preparation Hypothesis

It is thought that early humans lived in groups including multiple females (polygyny), and this breeding system means that males with different competitive abilities have a range of different reproductive options [1356]. In this scenario, rape would be an evolved strategy that best suited those individuals who were unable to compete for the resources or status necessary to secure high investment pair bonds with high-status females.

It has been postulated that arousal evolved not only to make sex easy (and desirable) for the consenting animal but in a "prepared for anything" hypothesis, even for rape, more simply called the 'preparation hypothesis' [1357]. Rape of an unlubricated vagina will not only be painful but might cause more serious physical damage [1358]. Even consensual sex can occasionally lead to severe injury [1359-1362]. Although the precise details of each case are not recorded, a survey of 36 cases of severe vaginal trauma reported over a six-year period at a Nigerian teaching hospital included several cases of vaginal wall rupture (often at the posterior fornix) and associated severe, life-threatening blood loss [1359]. Predisposing factors included rough coitus, first sexual intercourse, puerperium

APPENDICES

APPENDIX A

Orgasm Rating Scale Questionnaire

The Orgasm Rating Scale questionnaire originally proposed by Mah and Binik [711] was designed to assess the phenomenological sensations associated with orgasm in both women and men. It was used to develop a multidimensional model of the subjective experience of orgasms. This survey asks individuals to say how well each of forty adjectives describe their most recent orgasm using a Likert scale where 0 does not describe it at all, 5 = describes it perfectly. It has been validated and investigated by various others [1190, 1456, 1457, 1458].

	0	1	2	3	4	5
Absorbed	□	□	□	□	□	□
Elated	□	□	□	□	□	□
Flooding	□	□	□	□	□	□
Immersing	□	□	□	□	□	□
Pulsating	□	□	□	□	□	□
Satisfying	□	□	□	□	□	□
Spurting	□	□	□	□	□	□
Uncontrolled	□	□	□	□	□	□
Blissful	□	□	□	□	□	□
Engulfing	□	□	□	□	□	□
Flowing	□	□	□	□	□	□
Loving	□	□	□	□	□	□
Quivering	□	□	□	□	□	□
Shooting	□	□	□	□	□	□
Swelling	□	□	□	□	□	□
Unifying	□	□	□	□	□	□
Building	□	□	□	□	□	□
Euphoric	□	□	□	□	□	□
Flushing	□	□	□	□	□	□
Passionate	□	□	□	□	□	□
Rapturous	□	□	□	□	□	□
Shuddering	□	□	□	□	□	□

	0	1	2	3	4	5
Tender	□	□	□	□	□	□
Unreal	□	□	□	□	□	□
Close	□	□	□	□	□	□
Exciting	□	□	□	□	□	□
Fulfilling	□	□	□	□	□	□
Peaceful	□	□	□	□	□	□
Relaxing	□	□	□	□	□	□
Soothing	□	□	□	□	□	□
Throbbing	□	□	□	□	□	□
Warm	□	□	□	□	□	□
Ecstatic	□	□	□	□	□	□
Exploding	□	□	□	□	□	□
Hot	□	□	□	□	□	□
Pleasurable	□	□	□	□	□	□
Rising	□	□	□	□	□	□
Spreading	□	□	□	□	□	□
Trembling	□	□	□	□	□	□
Wild	□	□	□	□	□	□

The describing adjectives can be divided into a number of domains or dimensions, e.g. **affective** dimension (*elated, satisfying, blissful, exciting, fulfilling, pleasurable*), **sensory** dimension (*flooding, pulsating, uncontrolled, quivering, shooting, euphoric, flushing, throbbing, exploding, rising, spreading, trembling, wild*), **intimacy** dimension (*loving, tender, close*) and a **rewards** dimension (*peaceful, relaxing, soothing*).

APPENDIX B

The Female Sexual Function Index (FSFI)

This is the most widely used and translated questionnaire for assessing overall female sexual function [1195].

Q1. Over the past 4 weeks, how often did you feel sexual desire or interest?

5 = Almost always or always . . . . . □

4 = Most times (more than half the time) . . . . . □

3 = Sometimes (about half the time) . . . . . □

2 = A few times (less than half the time) . . . . . □

1 = Almost never or never . . . . . □

0 = No sexual activity . . . . . □

Q2. Over the past 4 weeks, how would you rate your level (degree) of sexual desire or interest?

5 = Very high . . . . . □

4 = High . . . . . □

3 = Moderate . . . . . □

2 = Low . . . . . □

1 = Very low or none at all . . . . . □

Q3. Over the past 4 weeks, how often did you feel sexually aroused ("turned on") during sexual activity or intercourse?

5 = Almost always or always . . . . . □

4 = Most times (more than half the time) . . . . . □

3 = Sometimes (about half the time) . . . . . □

2 = A few times (less than half the time) . . . . . □

1 = Almost never or never . . . . . □

Q4. Over the past 4 weeks, how would you rate your level of sexual arousal ("turn on") during sexual activity or intercourse?

0 = No sexual activity . . . . . □

5 = Very high . . . . . □

4 = High . . . . . □

3 = Moderate . . . . . □

2 = Low . . . . . □

1 = Very low or none at all . . . . . □

Q5. Over the past 4 weeks, how confident were you about becoming sexually aroused during sexual activity or intercourse?

0 = No sexual activity . . . . . □

5 = Very high confidence . . . . . □

4 = High confidence . . . . . □

3 = Moderate confidence . . . . . □

2 = Low confidence . . . . . □

1 = Very low or no confidence . . . . . □

Q6. Over the past 4 weeks, how often have you been satisfied with your arousal (excitement) during sexual activity or intercourse?

0 = No sexual activity . . . . . □

5 = Almost always or always . . . . . □

4 = Most times (more than half the time) . . . . . □

3 = Sometimes (about half the time) . . . . . □

2 = A few times (less than half the time) . . . . . □

1 = Almost never or never . . . . . □

Q7. Over the past 4 weeks, how often did you become lubricated ("wet") during sexual activity or intercourse?

0 = No sexual activity . . . . . □

5 = Almost always or always . . . . . □

4 = Most times (more than half the time) . . . . . □

3 = Sometimes (about half the time) . . . . . □

2 = A few times (less than half the time) . . . . . □

1 = Almost never or never . . . . . □

Q8. Over the past 4 weeks, how difficult was it to become lubricated ("wet") during sexual activity or intercourse?

0 = No sexual activity . . . . . □

1 = Extremely difficult or impossible . . . . . □

2 = Very difficult . . . . . □

3 = Difficult . . . . . □

4 = Slightly difficult . . . . . □

5 = Not difficult . . . . . □

Q9. Over the past 4 weeks, how often did you maintain your lubrication ("wetness") until completion of sexual activity or intercourse?

0 = No sexual activity . . . . . □

5 = Almost always or always . . . . . □

4 = Most times (more than half the time) . . . . . □

3 = Sometimes (about half the time) . . . . . □

2 = A few times (less than half the time) . . . . . □

1 = Almost never or never . . . . . □

Q10. Over the past 4 weeks, how difficult was it to maintain your lubrication ("wetness") until completion of sexual activity or inter- course?

0 = No sexual activity . . . . . □

1 = Extremely difficult or impossible . . . . . □

2 = Very difficult . . . . . □

3 = Difficult . . . . . □

4 = Slightly difficult . . . . . □

5 = Not difficult . . . . . □

Q11. Over the past 4 weeks, when you had sexual stimulation or intercourse, how often did you reach orgasm (climax)?

0 = No sexual activity . . . . . □

5 = Almost always or always . . . . . □

4 = Most times (more than half the time) . . . . . □

3 = Sometimes (about half the time) . . . . . □

2 = A few times (less than half the time) . . . . . □

1 = Almost never or never . . . . . □

Q12. Over the past 4 weeks, when you had sexual stimulation or intercourse, how difficult was it for you to reach orgasm (climax)?

0 = No sexual activity . . . . . □

1 = Extremely difficult or impossible . . . . . □

2 = Very difficult . . . . . □

3 = Difficult . . . . . □

4 = Slightly difficult . . . . . □

5 = Not difficult . . . . . □

Q13. Over the past 4 weeks, how satisfied were you with your ability to reach orgasm (climax) during sexual activity or intercourse?

0 = No sexual activity . . . . . □

5 = Very satisfied . . . . . □

4 = Moderately satisfied . . . . . □

3 = About equally satisfied and dissatisfied . . . . . □

2 = Moderately dissatisfied . . . . . □

1 = Very dissatisfied . . . . . □

Q14. Over the past 4 weeks, how satisfied have you been with the amount of emotional closeness during sexual activity between you and your partner?

0 = No sexual activity . . . . . □

5 = Very satisfied . . . . . □

4 = Moderately satisfied . . . . . □

3 = About equally satisfied and dissatisfied . . . . . □

2 = Moderately dissatisfied . . . . . □

1 = Very dissatisfied . . . . . □

Q15. Over the past 4 weeks, how satisfied have you been with your sexual relationship with your partner?

5 = Very satisfied . . . . . □

4 = Moderately satisfied . . . . . □

3 = About equally satisfied and dissatisfied . . . . . □

2 = Moderately dissatisfied . . . . . □

1 = Very dissatisfied . . . . . □

Q1. Over the past 4 weeks, how satisfied have you been with your overall sexual life?

5 = Very satisfied . . . . . □

4 = Moderately satisfied . . . . . □

3 = About equally satisfied and dissatisfied . . . . . □

2 = Moderately dissatisfied . . . . . □

1 = Very dissatisfied . . . . . □

Q17. Over the past 4 weeks, how often did you experience discomfort or pain during vaginal penetration?

0 = Did not attempt intercourse . . . . . □

1 = Almost always or always . . . . . □

2 = Most times (more than half the time) . . . . . □

3 = Sometimes (about half the time) . . . . . □

4 = A few times (less than half the time) . . . . . □

5 = Almost never or never . . . . . □

Q18. Over the past 4 weeks, how often did you experience discomfort or pain following vaginal penetration?

0 = Did not attempt intercourse . . . . . □

1 = Almost always or always . . . . . □

2 = Most times (more than half the time) . . . . . □

3 = Sometimes (about half the time) . . . . . □

4 = A few times (less than half the time) . . . . . □

5 = Almost never or never. . . . . □

Q19. Over the past 4 weeks, how would you rate your level (degree) of discomfort or pain during or following vaginal penetration?

0 = Did not attempt intercourse . . . . . □

1 = Very high . . . . . □

2 = High . . . . . □

3 = Moderate . . . . . □

4 = Low . . . . . □

5 = Very low or none at all . . . . . □

APPENDIX C

Clitoral-Vaginal Index

Question options used by Seymour Fisher in his 1973 book "The Female Orgasm" to define his Clitoral-Vaginal Index [805].

"*This question concerns the relative importance of clitoral as compared to vaginal stimulation in your attaining orgasm. Put a circle around the appropriate number."*

1. Clitoral stimulation contributes much more than vaginal stimulation.

2. Clitoral stimulation contributes somewhat more than vaginal stimulation.

3. Clitoral stimulation contributes a little more than vaginal stimulation.

4. Vaginal stimulation and clitoral stimulation make an equal contribution.

5. Vaginal stimulation contributes a little more than clitoral stimulation.

6. Vaginal stimulation contributes somewhat more than clitoral stimulation.

7. Vaginal stimulation contributes much more than clitoral stimulation.

APPENDIX D

The Female Genital Self Image Scale

This survey was designed to gain understanding of how positively or negatively, women perceive their own genital appearance [1109, 1110, 1459, 1460]. Originally it was a seven-item questionnaire, but later a reduced four item one was found to give better results. It differs from many questionnaires in that some of the items are double-barrelled, *i.e*. they ask about two separate things. Its versions have been quite widely used and adapted in various counties, *i.e*. [1110, 1111, 1459].

Each of the seven questions has the same four possible responses: 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree.

	1	**2**	**3**	**4**
I feel positively about my genitals.	□	□	□	□
I am satisfied with the appearance of my genitals.	□	□	□	□
I would feel comfortable letting a sexual partner look at my genitals.	□	□	□	□
I think my genitals smell fine.	□	□	□	□
I think my genitals work the way they are supposed to work.	□	□	□	□
I feel comfortable letting a healthcare provider examine my genitals.	□	□	□	□
I am not embarrassed about my genitals.	□	□	□	□

APPENDIX E

Spontaneous Orgasms: Selected Comments from Women in Internet Chat Groups

From Reddit.com accessed 18 May (2020)

(1) I was at my SO's apartment sitting in the couch and we were watching the movie 'Snatch', I was definitely not sexually aroused at the moment, he left the room to answer a call and it just happened. I took me a moment to realise what was actually happening, but yeah I was orgasming there, alone, thinking about nothing! I'm 25 and I don't masturbate, I just can't get any out of it most of the times and I just gave up. On the other hand I orgasm pretty easily with PIV. I could tell it was a clitoral orgasm.

(2) I had to give an oral presentation in my history class. Got up, did it, went to sit back down. I was so nervous I was shaking a bit, my heart was racing, my legs were twitching. Then suddenly the walls of my vagina just started contracting and then boom, full on orgasm while sitting in class. So not sure if it was entirely spontaneous, but yeah apparently if I'm nervous enough I can orgasm hands free.

(3) This happens to me occasionally as well. I am multi-orgasmic and I cum very easily through PIV sex. That said, there have been instances where I come for no real reason. I've had it happen a few times while driving (bumpy road or not), while reading a good book (it didn't have anything sexual either), just talking with my SO about anything (this one may stem from how sexy his voice is though), and even when I just have to pee really bad (those ones are always interesting). They can be inconvenient and every once in a while, unwanted, but they are almost always enjoyable and my SO loves how sensitive I am. IMHO, so long as it doesn't really start affecting my day-to-day life (or yours, for that matter) there is absolutely nothing wrong with it.

(4) When I was younger I had one just sitting on the couch. Although I was aroused, just never touched and it happened. I had them ALL THE TIME when I was pregnant, especially in my sleep. I'd wake up midway, and wondering wtf was happening. Then I read it was normal, and just enjoyed it. Awesome experience.

(5) I have them in my sleep too! I wake up orgasming but I never know if I was having a sexual dream or not! Interesting stuff.

From wisegeek.com

(6) I had a spontaneous orgasm several times a month from the age of about 14 until menopause at about 55. A hysterectomy at 29 didn't stop them as I still had my ovaries. I'm now coming up to 76. Since menopause I tend to have a spontaneous orgasm once or twice a year, but if I'm warm and comfortable in bed it's more frequent. I'm glad I don't get them when I'm driving any more!

(7) Three months ago I had a mommy makeover, then a few weeks later while doing nothing in particular, my body slowly rocked into a full blown orgasm. I wasn’t thinking about anything sexy, just BAM! Since then I wake up every morning and have 2-3 uninitiated

orgasms that I hide from my husband as stretching and yawning. A plus is our sex life has gotten much better, but I haven't told him about the spontaneous orgasms. I asked my doctor for the surgical report to see if he could have done something, and even asked him point blank if he had done anything to cause this change to happen in me. He was pretty wide-eyed and said he didn't.

(8) I am 33 years old and I just started experiencing this while healing from a hysterectomy. It happens when I sleep causing me to wake up in pain. It has happened up to four times in a row. The funny thing is they took my cervix in the surgery so I did not think an internal orgasm was possible. It would be nice to know if this is just a side affect from the surgery.

(9) This happens to me in bed and generally wakes me up. The orgasm is internal and happens every 10 seconds. I can't stop or control them. To be honest, one is OK, but hundreds are exhausting. Funny thing is, I do not climax during sex and never have. In the past, I have used a vibrator to stimulate orgasm. These are not fun, nor do they make me happy. They keep me awake and make me tired.

(10) I am 18 years old and I suffer from Spontaneous Orgasm. Some may say it's lucky, but at my age I wish it would just go away. I've suffered from it for two years, but when I was younger I thought it was just a "feeling of having to go to the bathroom". Now that I'm older, It happens about 10 – 15 times a week. It might not happen every day or one day for many times. These normally last 3 – 5 minutes. Sometimes It happens in public while I'm walking to work, in the car with my parents. Sometimes I breathe really heavy or even hum to myself. What makes it worse, I am not even sexually active. I am a "Gold Star Lesbian", and my last relationship was almost six months ago, so yes I am a virgin.

(11) I have schizoaffective disorder. When I initially became actively psychotic, at age 34, I first started to have frequent multiple orgasms (up to 30 per day). Needless to say, it was difficult to leave the house. As my disorder progressed, so did my paranoia, and I became more and more manic — staying up all night dancing to loud music with the deluded idea that it would keep the State Department from controlling my body and causing me to have these orgasms (a theory I developed over a few weeks after they started). I was checked out by a neurologist who told me that spontaneous orgasms happen occasionally in very old women (that is, women over 90), for no apparent reasons

(12) In my reading I'm seeing the word "suffer" a lot. I don't suffer from spontaneous orgasms, but I do experience them and enjoy them. Only once did it happen in public: I was waitressing at age 18 and experiencing a lot of stress when the wonderful feelings exploded in my genitals. Luckily I was in the kitchen and not in the dining area when it happened! Since then, 30-plus years have passed and I've had spontaneous orgasms on occasion throughout the years, mostly if I haven't had a sexually stimulated orgasm for a few months and mostly at night while sleeping. It always wakes me up and I will often use my hands to improve the sensations, which are deep vaginal palpitations. Lovely. I've talked to friends about his and they're amazed and jealous. I consider myself lucky.

(13) I am 25 years old and experienced one about three years ago while taking a university exam. I was very nervous and anxious about the exam. Before I started writing, I had mild orgasm that lasted about 10 seconds. I managed to compose myself so no one noticed. It was

a really strange experience, but I am fascinated to find out exactly what triggers it off and why.

(14) I'm 25 years old and I had my first spontaneous orgasm two days ago. I suffer from depression and anxiety. I am taking Prozac. I had an argument with my boyfriend that night and I went home crying. After I parked my car and all of a sudden, with no physical stimulation, I had an orgasm like I have never felt before. I felt it directly on my clitoris and started moaning inside my car, having no control over it. I read on a blog where a girl said that these spontaneous orgasms occur when she is thinking about a boy she likes or when she is mad at her boyfriend. I don't know why this happened. Maybe it was

(15) I am a woman with two children and I am 32. I have been suffering from severe spontaneous orgasms since I started to crawl. I am on anti-depressants and I always thought everyone was having what I have. But I suffered from low self esteem and I am very self conscious of myself all the time. I am extremely embarrassed by this and I feel I can't even mow the front lawn for my husband anymore. I have always isolated myself from loved ones and friends because of this. Please give me some advice?

(16) I am a 65-year old healthy, active woman in a good relationship with a fiance. I have occasionally experienced spontaneous orgasms in my sleep. This is always related to a very stressful situation in a dream and resolves as I wake up, with no feelings of sexual arousal whatsoever. What is concerning to me is that last week, when I was suddenly under extreme stress in public (lost driving a car), I experienced two spontaneous orgasms one after another. This was very embarrassing to me, even though no one noticed. What is going on?

*From*www.psychologytoday.com*/us/blog/evolution-the-self/201310/the-three-surpri-ing-types-spontaneous-orgasms (accessed 17 July 2021).*

(17) Just recently, I think I experienced a spontaneous orgasm. I'm 47, female. No erotic dreams, no touching, nothing. But absolutely feeling vaginal contractions and pleasure . . .

(18) I'm a 46-year old woman with a high sex drive—although I'm not sure if that has anything to do with it. . . [The orgasms] are not as strong as [those] I experience during intercourse but they are still there. It can be a bit unnerving if I'm not expecting it . . .

(19) I have it happen to me during my sleep sometimes. I won't even be having a sexual dream and it happens. . . I've never had it while I was awake.

(20) I was driving, and was running late to work due to really bad traffic. . . I re-routed and got lost. Long story short, my drive was a little intense, and I was already stressed out. All of a sudden, I got so intensely anxious and felt like I needed to get out of the car, and get air. A few seconds following that, I quickly realised I am about to have an orgasm. It was the strangest feeling. So intense, and my whole body felt it for what seemed like a long time. I felt all the blood pumping in my body, and I was throbbing. Very freaky, and I felt almost embarrassed about it. I have recently started some new meds, and upped the dosage on another.

(21) It happens a lot while I'm sleeping, but only once while I was awake . . . With [me], I'm almost certain [that at night] it's because of a full bladder.

(22) I am 67 years old. Recently I was undergoing a medical examination. I was fully clothed, lying on an examining table on my back. . . While [the doctor was at his desk writing], I began feeling a lot of tension throughout my entire body. Then I started experiencing sexual arousal, to my astonishment. That lasted about a half a minute while I wondered how this had happened. [When the doctor told me I could sit up, I immediately had] a very strong climax (vaginal contractions and extreme pleasure included) [which] tore through my body, head to foot, and I actually screamed out loud.

APPENDIX F

Questions of the Female Genital Self-Image Scale (FGSIS) [1109]

1. I feel positively about my genitals.

2. I am satisfied with the appearance of my genitals.

3. I would feel comfortable letting a sexual partner look at my genitals.

4. I think my genitals smell fine.

5. I think my genitals work the way they are supposed to work.

6. I feel comfortable letting a healthcare provider examine my genitals.

7. I am not embarrassed about my genitals

APPENDIX G

Genital Appearance Satisfaction Questionnaire

This index is from [1112]. The index value is the score given for answers is the number preceding that answer.

1. I feel that my genitals are normal in appearance

3 = Never . . . . . □

2 = Sometimes. . . . . □

1 = Often . . . . . □

0 = Always .. . . . . □

2. I feel that my genitals are unattractive in appearance

0 = Never . . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

3. I feel that my labia are too large

0 = Never . . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

4. I am satisfied with the appearance of my genitals

3 = Never . . . . . □

2 = Sometimes. . . . . □

1 = Often . . . . . □

0 = Always .. . . . . □

5. I experience irritation to my labia when exercising/walking

0 = Never . . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

6. I feel, or have felt, conscious in sexual situations because of the appearance of my genitals

0 = Never . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

7. Embarrassment about the appearance of my genitals spoils my enjoyment of sex

0 = Never . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

8. I feel discomfort around my genitals when I wear tight clothes

0 = Never . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

9. I feel that my genital area is visible under tight clothes

0 = Never . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

10. I worry about the appearance of my vaginal area

0 = Never . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

11. I feel that my genital area looks asymmetric, or 'lopsided'

0 = Never . . . . □

1 = Sometimes. . . . . □

2 = Often . . . . . □

3 = Always .. . . . . □

Three factors (or domains) are defined as follows:

Factor 1. 'Appearance of genitals': items 1, 2, 3, 4 and 11.

Factor 2. 'Impact on daily living': items 5, 8 and 9.

Factor 3. 'Impact on sex': items 6, 7 and 10.

APPENDIX H

Monash Women's Health Program Female Sexual Satisfaction Questionnaire

Monash Women's Health Program
Female Sexual Satisfaction Questionnaire
(Monash WHP FSSQ)

Please answer the following questions in terms of your experience in the last 24 hours. Please read each statement carefully and mark the appropriate box with an X corresponding to the extent each statement applied to you.
All questions need to be answered if you engaged in sexual activity in the last 24 hours.

1. I have had sexual activity within the last 24 hours

Not at all ☐ Once ☐ More than once ☐

2. My sexual activity involved a partner

Yes ☐ (Continue) No ☐ (Go to Q6)

3. My sexual activity involved intercourse

Yes ☐ No ☐

4. I initiated the sexual encounter

Yes ☐ No ☐

5a. My partner initiated sex

Yes ☐ (Continue) No ☐ (Go to Q6)

5b. I was receptive (I was ready and willing to receive favorably)

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
Not at all — Moderately so — Very much so

6. I became easily aroused

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
Not at all — Moderately so — Very much so

7. My vaginal lubrication (wetness) was

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
Absent — Adequate — A great deal

8. I had an orgasm during sexual activity

Yes ☐ No ☐

9. I achieved orgasm

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
With great difficulty — With some effort — Very easily

10. My sexual experience was

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
Not at all — Moderately so — Very much so

11. I found sex satisfying

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
Not at all — Moderately so — Very much so

Monash WHP FSSQ Scoring System:

Items 1, 3, and 5a:

No contribution to score (for information only).

Items 2 and 4, linked to item 5b (receptivity):

If response to 2 is "No", item 5b receives highest possible score of 9. No points given for "Yes" response to item 2.

If response to item 4 is "Yes", item 5b receives highest possible score of 9. No points given for "No" response to item 4.

Items 5b, 6, 7, 10, 11 (receptivity, arousal, lubrication, sexual pleasure, sexual satisfaction):

Scored from 1 – 9, whereby 1 is the lowest possible score and represents the lowest ranking for the question.

Items 8 and 9 (orgasm):

If response to 8 is "Yes", no points given for 8 and score is a 1 to 9 ranking for response to item 9

If response to 8 is "No", 0 points given for item.

Total score:

Adding scores of items 5b, 6. 7, 9, 10, and 11 produces a minimum score of 5 and a maximum possible score of 54.

APPENDIX I

Bodily Sensations of Orgasm Questionnaire

Dubray *et al*. [1190] extended the two-dimensional model questionnaire developed by Mah and Bilik [711] (see Appendix A) because the latter's conceptualisation of orgasm is based on cognitive, sensory and cognitive-affective characteristics, but the list of adjectives do not capture the specific bodily sensations associated with climax whereas the Bodily Sensations of Orgasm questionnaire specifically does. It also includes a dysreflexia dimension to indicate unpleasant aspects as can occur with some medical conditions.

Cardiovascular dimension					
Increased blood pressure	□	□	□	□	□
Increased heart rate	□	□	□	□	□
Heart beating stronger	□	□	□	□	□
Irregular heart beating	□	□	□	□	□
Faster breathing	□	□	□	□	□
Choppy breathing (apnea)	□	□	□	□	□
Moaning	□	□	□	□	□
Muscular dimension					
Clitoral or penile pulsation	□	□	□	□	□
Vulvar or testicular pulsation	□	□	□	□	□
Anal contractions	□	□	□	□	□
Urethral contractions	□	□	□	□	□
Overall muscular tension	□	□	□	□	□
Lower limb spasms	□	□	□	□	□
Abdominal contractions	□	□	□	□	□
Autonomic dimension					
Hypersensitive clitoris	□	□	□	□	□
Ejaculation	□	□	□	□	□
Hardening nipples	□	□	□	□	□
Shivers or goosebumps	□	□	□	□	□
Hot flashes	□	□	□	□	□
Reddening of ears or skin rash (sex flush)	□	□	□	□	□
Perspiration	□	□	□	□	□
Hot and cold	□	□	□	□	□
Facial tingling	□	□	□	□	□

Skull tingling	□	□	□	□	□
Urge to urinate	□	□	□	□	□
Autonomic dysreflexia dimension					
Feeling of tightness	□	□	□	□	□
Intracranial pressure	□	□	□	□	□
Cranial pulsations or headache	□	□	□	□	□

APPENDIX J

Changes in Sexual Functioning Questionnaire short-form (CSFQ-14)

The original Changes in Sexual Functioning Questionnaire was developed Clayton *et al*. [1461] and comprised 36 questions. These are the items of a short form developed by Keller *et al*. [1191].

1. Compared with the most enjoyable it has ever been, how enjoyable or pleasurable is your sex life right now?

2. How frequently do you engage in sexual activity (sexual intercourse, masturbation, *etc.*) now?

3. How often do you desire to engage in sexual activity?

4. How frequently do you engage in sexual thoughts (thinking about sex, sexual fantasies) now?

5. Do you enjoy books, movies, music or artwork with sexual content?

6. How much pleasure or enjoyment do you get from thinking about and fantasizing about sex?

7. How often do you become sexually aroused?

8. Are you easily aroused?

9. Do you have adequate vaginal lubrication during sexual activity (get wet)?

10. How often do you become aroused and then lose interest?

11. How often do you experience an orgasm?

12. Are you able to have an orgasm when you want to?

13. How much pleasure or enjoyment do you get from your orgasms? 14. How often do you have painful orgasm?

APPENDIX K

Sexual Satisfaction Questionnaire

This ten item questionnaire was developed by [1192]. Each question answered on a four-point Likert scale, with questions 1, 3, 5, 8 and 9 being scored in reverse order to the rest.

1. I am disconcerted with a part of my sexual life

2. Sex is a source of pleasure for me

3. Thinking about sex generates negative emotions

4. I feel sexually attractive

5. I find myself a poor sexual partner

6. I do not have any problems in my sexual life

7. I like thinking about my sexual life

8. My sexual life frustrates me

9. I am afraid I do not satisfy my sexual partner

10. I find my sexual life fulfilling

APPENDIX L

Sexual Excitation/Sexual Inhibition Inventory for Women and Men (SESII-W/M)

This is the twenty-four item version of the SESII-W [1193]. Each of the questions has the same four possible Likert scale responses: 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree. There are six subgroups (domains). The scoring for the 'setting' domain questions is reversed.

Relationship importance (SI)					
	Score	1	2	3	4
2	If I think that I am being used sexually it completely turns me off.	□	□	□	□
27	If I think that a partner might hurt me emotionally, I put the brakes on sexually.	□	□	□	□
16	It would be hard for me to become sexually aroused with someone who is involved with another person.	□	□	□	□
28	I really need to trust a partner to become fully aroused.	□	□	□	□

Dyadic elements of the sexual interaction (SI)					
6	If I am uncertain how my partner feels about me, it is harder for me to get aroused.	□	□	□	□
13	While having sex, it really decreases my arousal if my partner is not sensitive to the signals I am giving.	□	□	□	□
20	If interferes with my arousal if there is not a balance of giving and receiving pleasure during sex.	□	□	□	□

Inhibitory cognitions (SI)					
7	If I feel that I am expected to respond sexually, I have difficulty getting aroused.	□	□	□	□
15	If I think about whether I will have an orgasm, it is much harder for me to become aroused.	□	□	□	□
1	Sometimes I have so many worries that I am unable to get aroused.	□	□	□	□
11	Sometimes I feel so 'shy' or self-conscious during sex that I cannot become fully aroused.	□	□	□	□
29	If I am concerned about being a good lover, I am less likely to become aroused.	□	□	□	□
26	When I am having sex, I have to focus on my own sexual feelings in order to stay aroused.	□	□	□	□

Setting (SE)					
5 (rev.)	If it is possible someone might see or hear us having sex, it is more difficult for me to get aroused.	□	□	□	□
14 (rev.)	I find it harder to get sexually aroused if other people are nearby.	□	□	□	□

Partner characteristics and behaviours (SE)					
23	If I see a partner interacting well with others, I am more easily sexually aroused.	□	□	□	□
10	I find it arousing when a partner does something nice for me	□	□	□	□
8	Someone doing something that shows he/she is intelligent turns me on.	□	□	□	□
30	If a partner surprises me by doing chores, it sparks my sexual interest.	□	□	□	□

Arousability (SE)					
9	I think about sex a lot when I am bored.	□	□	□	□
12	Just talking about sex is enough to put me in a sexual mood.	□	□	□	□
3	When I think about someone I find sexually attractive, I easily become sexually aroused.	□	□	□	□
17	Sometimes I am so attracted to someone, I cannot stop myself from becoming sexually aroused.	□	□	□	□
24	Just being physically close with a partner is enough to turn me on	□	□	□	□

GLOSSARY

A-spot a zone of the anterior wall of the vagina 2 – 3.5 cm blow the anterior fornix, posterior to the bladder purported by some to be erogenous and whose stimulation can contribute to the orgasmic response [1462].

Adrenal glands endocrine glands attached to dorsal side the kidneys and which produce adrenalin as well as a wide range of steroid hormones (in the various cortex layers). The steroids collectively have diverse physiological functions and include androgens which are converted into fully functional sex hormones in the gonads and other organs.

Adrenarche increased secretion of mild androgens by the adrenal glands and which typically starts approximately two years before puberty and typically peaks around age 20.

Adrenogenital syndrome see *congenital adrenal hyperplasia*.

Aetiology (etiology) the cause of a medical condition.

Agonist a drug other than the natural neurotransmitter that activates a receptor (see also antagonist).

AIS (see Androgen Insensitivity Syndrome).

Albuginea a tough fibrous tissue layer that surrounds the erectile corpora cavernosal tissue of the clitoris (and homologous structures in the penis) which is important in achieving rigidity (especially in the male) as it resists the expansion of the caverosal labyrynth as the latter fills with blood.

Alprostadil a vasodilatory drug usually used to treat (temporarily) erectile disfunction in men but which also has an effect when applied to the clitoris; dodecyl 2-[N,N-dimethyl amino] propionate plus dodecyl-2-[N,N-dimethyl amino] propionate hydrochloride [939].

Amenorrhea when one or more menstrual cycles do not happen.

Amydalae (-a sing.) pair of almond-shaped neurone clusters located submedially and deep within the temporal lobes of the cerebrum and part of the limbic system of the brain. They play a primary role in the memory processing, decision making, and emotional responses.

Androgen any of a class of steroid sex hormones (natural or synthetic) that regulate development and maintenance of male characteristics in vertebrates by binding to androgen receptors.

Androgen Insensitivity Syndrome (AIS) results from a dysfunctional allele of androgen receptor gene which is located on the X chromosome; despite being genetically XY (no doubly mutated XX females have been detected), some individuals with this condition exhibit full female morphology (called Complete AIS), though others may appear fully male but have reduced sperm production (mild AIS).

Donald Lambert Jesse Quicke

Androstenodione a weak androgen hormone that is intermediate in the biosynthesis of testosterone and estrone from dehydroepiandrosterone (DHEA).

Androstenone an androstene component of sweat that some people can smell and others can not.

Angle of clitoris where the clitoral body dorsally makes a right-angle bend 'diving' into deep tissue.

Antagonist a drug that blocks or dampens a biological response by binding to and blocking a receptor.

AFE zone see *Anterior fornix erogenous zone*.

Allopregnanolone a neurosteroid hormone synthesised from progesterone by cortical and hippocampus pyramidal neurons and pyramidal-like neurons of the basolateral amygdala. It has numerous actions including antidepressant, stress-reducing, rewarding, prosocial and antiaggressive, prosexual, sedative, cognitive, memory-impairment, analgesic and anesthetic. It is used mainly to treat postpartum depression.

Amygdala a grouping of cells located just antero-dorsal to the hyppocampus; shows activation during orgasm.

Anillingus stimulation of the anus by a sex partner's mouth/tongue.

Anterior fornix the space between the anterior wall of the cervix and the vaginal wall.

Anterior fornix erogenous zone it has been claimed that the anterior fornix is a particularly erogenous zone.

Apocrine glands exocrine glands (q.v.) that secrete a viscous sweat which contains lipids, steroids, proteins, carbohydrates, ammonia and salt, which is initially odourless but becomes odoriferous due to microbial action. They occur in the axillae, nipple-aroela complex, perineal region and parts of the genitals.

Aprostadil prostaglandin E1 (PGE1), a naturally occurring vasodilator used to treat erectile dysfunction *via* intracavernoal injection.

Asphyxophilia desire for a state of oxygen deficiency in order to enhance sexual excitement and orgasm – not infrequently this has lead to death.

Autoeroticism see *masturbation*.

Autonomic nervous system a largely unconscious part of the nervous system regulating things such as heart rate, digestion, respiratory rate, pupillary response, urination, and sexual arousal. It is subdivided into an excitatory sympathetic nervous system (SNS) and an inhibitory parasympathetic nervous system (PNS) that often interact antagonistically to produce varying degrees of physiological arousal.

Balanced design experimental design with equal numbers of observations in each category.

Ballooning expansion of the proximal and posterior vagina during the later stages of arousal, supposedly to create a receptacle for the semen once released [3].

Bartholin's glands (also called greater vestibular gland) a pair of exocrine glands whose ducts open posterolateral to the vaginal introius; function presumed lubricatory .

Bremelanotide analogue of α-melanocyte-stimulating hormone (α-MSH) used to treat erectile dysfunction in men.

Bulbocavernosus reflex contraction of the bulbocavernosus and anal sphincter muscles as a result of pinching or electrically stimulating the glans clitoris.

Bulbocavernosus muscle see *bulbospongiosus muscle*.

Bulb of vestibule see ***clitoral****bulb*.

Bulbospongiosus muscle a muscle whose two halves extend from just posterior to the clitoris to the central tendon of the perineum and which serves to constrict the vagina.

Bulbourethral gland in males another name for the Cowper's gland, in females sometimes used to refer to Bartholin's glands (*q.v.*).

CT scan (computed tomography scan, formerly known as computed axial tomography or CAT scan) .

Cervix the muscular and secretory ring forming the distal part of the uterus and which projects into the proximal part of the vaginal canal.

CGRP calcitonin gene-related peptide.

Climacteric the *menopause*.

Climaturia the release of urine in conjunction with orgasm.

Clitoris female homologue of the penis.

Clitoral artery Doppler evaluation of blood flow rate in the dorsal clitoral artery using colour Doppler untrasonography [620, 641].

Clitoral crus a pair of quite a large internal lobes forming an inverted, V-shaped erectile structure that extends from the body of the clitoris dorsal to the clitoral angle (q.v.) [pl. crura].

Clitoral-vaginal index a score (range 1-7) assessing the relative perceived importance of clitoral as compared to vaginal stimulation in achieving orgasm [805].

Clitoral bulbs a pair of erectile internal structures that form part of the clitoral complex, previously, and still, widely referred to as vestibular bulbs.

Clitoromegaly abnormally large clitoris that might reflect many conditions from intersex, congenital adrenal hyperplasia, exposure to abnormally high androgen levels during any life stage from foetus to adulthood, or maybe simple genetics [194].

Cloaca the combined opening of the urethra, intestine and reproductive tracts in embryos and as well as in adult monotreme mammals (not placentals), reptiles, birds, amphibians and cartilaginous fish.

Clonic rhythmic muscle contractions or spasms, often used in reference to types of epiletic seizures but also for the rhythmic contractions at orgasm.

Cofficient of variation the ratio of the standard deviation to the mean which is a standardised measure of dispersion.

Concordance (also **sexual concordance**) a term employed to mean matching between physiological and perceived levels of sexual arousal.

Congenital adrenal hyperplasia any of a group of inherited, autosomal recessive disorders characterised by enlargement of the adrenal glands resulting primarily from excessive secretion of androgenic hormones by the adrenal cortex, typically leading to clitoromegaly and hirsuitism and sometimes other genital abnormalities. .

Copulins volatile fatty acid secretions produced by the vagina that in some non-humans have been verified sex pheromones; perhaps their role in humans is subtler.

Coronal section medical term for a section through a body or organ in a plane parallel to the front of the body.

Corpora cavernosa (=corporal bodies) erectile trabecular tissue structures, *e.g*., those that form the body of the clitoris and those which form the bulk of, and are responsible erection of the penis (*sing*. corporum cavernosum).

Corpora spongiosa (*sing*. corporum spongiosum) erectile trabecular tissue structures with somewhat different histology from the **corpora cavernosa** (q.v.) which form the clitoral bulbs and in males, surround the penile urethra.

Cortisol a steroid hormone produced mainly by the adrenal glands and is released notably during stress situations; it has effects on mood, sugar metabolism, blood pressure and sleep/wake cycles.

CSI complete spinal cord injury.

Crossover study a repaeted measures experimental design/protocol in each subject receives each treatment (*e.g*. X and Y) at different times, with some receiving treatment X first and others treatment Y first.

Cross sectional study an experimental or correlational study design in which data are collected from a sample or subset of a population all at a given pont in time.

Crura (sing. **crus)** see *clitoral crus*.

Cunnilingus stimulation of a woman's genitals by their sex prtner's mouth/tongue.

Deep spot see *anterior fornix erogenous zone*.

Dehydroepiandrosterone a hormone produced by the adrenal glands. It is one of the most abundant hormones in normal human blood. One of its ettects is to stimulate the production of other hormones including testosterone and estrogen.

Detrusor muscle the smooth muscle forming the wall of the bladder which is normally relaxed but contracts to cause release of urine during urination.

DHEA see *dehydroepiandrosterone*.

Dehydroepiandrosterone an abundant circulating, steroid precursor of androgen and oestrogen sex hormones; it is synthesised by the adrenal glands, gonads and brain.

DNC see *dorsal nerve of clitoris*.

Doggy-style colloquial term for the sex position with woman on all fours and penetrated from behind, often referred to in sexological literature as rear entry position.

Domain (in sexual function questionnaires) scores from a subset of the questions in many larger questionnaires whose answers all provide information on one aspect (domain) .

Doppler ultrasonography a medical technique that compares the frequencies of sound waves reflected from body tissues and fluids to the probe enabling their relative movement to be measured and visualised (usually as colour Doppler images).

Dorsal nerve of clitoris the paired major sensory nerves innervating the clitoris.

Double blind an experimental design in which experimentor influence and subject bias are theoretically eliminated since neither the subject nor the experimentor interacting with them, knows what treatment/drug has been administered.

DSM Diagnostic and Statistical Manual of Mental Disorders, see [1186, 1184, 502].

Duplex ultrasonography two modes of ultrasound are used, Doppler and B-mode: the B-mode transducer (like a microphone) obtains an image of the vessel being studied; the Doppler probe evaluates the velocity and direction of blood flow in a vessel.

Dyspareunia painful sexual intercourse (in man or woman but commonest in the latter); cause may be physical or psychological and pain sensation may be localised or widespread on vulva or felt more internally.

Eccrine gland type of sweat gland involved in thermoregulation and not associated with hair follicles.

Edging the practice of extending the duration of being in the plateu phase of excitation as

long as possible until eventually having an orgasm.

Effect size how large the actual difference is in two (or more) statistically significantly different samples is.

Elastin a fibrous extracellular protein found in some connective tissues with rubber-like properties.

Endocannabinoids lipid-based neurotransmitters that are naturally produced within the body and bind to the same brain receptors as compounds (such as THC) derived from cannabis.

Endocrine refers to glands whose products are secreted inside the body, *e.g*., into the blood stream. For example, the thyroid gland which secretes thyroxin into the blood stream.

Endometriosis a condition in which tissue similar to endometrium grows outside your uterus, often *via* the os cervix on to the outer cervix. The condition is often painful.

Endometrium the innermost lining layer of the uterus into which, at the appropriate stage, the fertilised egg embeds.

Enuresis inability to control urination, also called incontinence.

Epicenter see *anterior fornix erogenous zone*.

Eumenorrheic with normal or regular menstruation.

Evoked potential a combined neuronal electrical signal originating in the brain or spinal cord in response to (peripheral) stimulation.

Exaptation when a feature of an organism takes on a new function that is different from that for which it originally evolved.

Exocrine refers to glands whose products are secreted to the outside of the body, *e.g*. sweat glands.

Extrafusal fibres normal striated muscle fibres with purely contractile function (cf *infrafusal fibres* q.v.).

Fallopian tubes anither name for the oviducts or salpinges.

Fascia a fibrous membrane covering, supporting and separating tissues.

Fellatio stimulation of a man's penis by their sex partner's mouth/tongue.

Female Genital Mutilation (FGM) refers to a variety of different degrees of surgical removal of parts of the external genitals of babies, young girls, adolescents, or even post pubertal women, most commonly carried out in African countries and most commonly in tribal, low hygiene situations, and sometimes resulting in death through blood loss or infection. Western medicine generally recognises three levels ….

Female prostate see *Skene's glands*.

Female Sexual Functioning Index (FSFI) a widely used, self-reported, 19 question, validated measure of the quality of a woman's sexual physiology, behaviour, emotion, specifically covering domains of desire, arousal, lubrication, orgasm, satisfaction and pain.

Ferriman-Gallwey score an indirect measure of androgen levels in women based on the fact that androgens increase body hairiness (hirsutism). The baseline score differs a little between races.

FGM see *Female genital mutilation*.

FMRI (functional Magnetic Resonance Imaging) technique to visualise regions (usually of the brain) with relatively high levels of metabolic activity at a given time. It is based on detecting zones where cells are using blood glucose as an energy source for pumping ions and thus depleting the local blood supply of oxygen ('burning' the glucose). It has a resolution of 4 to 5 mm. The MRI response lags the change in neuronal activity by approximately 2 seconds.

Follicle stimulating hormone a dimeric glycoprotein hormone synthesized and secreted by cells in the anterior pituitary gland that regulates development, growth, pubertal development, and various reproductive processes in both sexes, notably germ cell maturation.

Follicular phase the longest part of the menstrual cycle starting at the beginning of a woman's period until ovulation, when the developing follicle releases its fully developed ovum. .

Fordyce spots (lobules) aggregated groups of sebaceous glands, forming slightly raised, white-cream coloured spots on lips, labia minora and perineum, of no medical signigicance.

Fornix anterior and posterior gaps between the cervix and vaginal wall.

Fossa navicularis a boat-shaped depression between the posterior of the vagina/hymen and the frenulum labiorum pudendi, *i.e*. where the posterior traces of the labia minori converge. It is where the opennings of Bartholin's glands are.

Fourchette the thin fold of skin at the back of the vulva that is at the anterior of the perineum; it is sometimes formed of the posteriorly-uniting labia or their remnants, sometimes not.

Frankenhauser uterovaginal plexus part of the inferior hypogastric plexus.

Free nerve endings sensory nerve endings which do not have an obvious associated auxillary structure such as a capsule.

Frenulum of clitoris the pair tissue flaps that run from the inner anterior divide of the labia minora to the submedial postero-dorsal (*i.e*., towards the woman's head) part of the glans clitoris. These contain/comprise the typically swollen clitoral infra-frenulum.

Frenulum of labia minora the 'lip' at the posterior of the vestibule where the posterior parts of the labia minora, in many women, unite.

FSFI see *Female Sexual Function Index*.

FSH see *follicle stimulating hormone*.

FSIAD female sexual interest/arousal disorder.

FSOD female sexual orgasmic disorder.

G-spot/Gräfenberg spot a supposed small area of relatively high erotic sensitivity along the anterior vaginal wall.

Glandipudendal reflex see bulbocavernosus reflex.

Glandopreputial glands (female) eccrine glands on the inner surface of the prepuce (male and female).

Greater vestibular glands see *Bartholin's glands*.

Gushing see *squirting* and *female ejaculation*.

Gyrus a ridge on the cerebral cortex.

H-area a purported highly sensive erotic/hypersexual area in the vagina [897].

Halban's fascia often described as a fibro-connective tissue strips between vagina and bladder/urethra in which there are large numbers of blood vessels and muscles and nerve endings, and has been postulated as the site of vaginal orgasm [1463]; also called 'anterior wall erotic complex' [1464]. Whether it is a true fascia rather than a fibro-muscular layer has been disputed [1465].

Heliospectin a peptide neurotransmitter originally isolated from the Gila monster, a North American venomous lizard.

Hilum the place where nerves and blood vessels enter a structure.

Hippocampus a complex brain structure, shaped rather like a sea horse from which it gets its name, embedded deep in the brain's temporal lobe and which plays a major role in learning and memory.

Hypersexuality also called nymphomania in women, refers to people who crave and seek out sexual intercourse and other sexual gratification much more than that which is considered 'normal' by their society, or the norm of what women do in that society. This allows a lot of leeway in what is considered as hypersexuality.

Hypertrophy excessive growth, *e.g.* of labia minora.

Hypogastric nerve part of the sympathetic nervous system originating from in vertebrae T10 to L2 and exiting the spinal column *via* T12 to L3. .

Hysterectomy the most frequently performed major gynaecological operative procedure in

which the uterus is removed either entirely (total hysterectomy) or sometimes with sparing of the cervix (supravaginal hysterectomy).

Ictal orgasm an orgasm associated with a seizure such as an epileptic fit.

Immunoglobulins (=antibodies) glycoproteins produced by white blood cells which bind to antigens and initiate immune response.

Inferior hypogastric plexus is a paired complex of nerves located at the sides of the rectum and vagina in females.

Infrafusal fibres modified striated muscle fibres that constitute the sensory muscle spindles which detect changes in the muscle length and receive sensory and motor innervation.

Insula part of the brain's cerebral cortex folded deep within the lateral sulcus within each hemisphere and believed to be involved in consciousness and to have roles linked to emotion and regulation of homeostasis, and mediating feelings of pleasure and pain.

Interstitial cells of Cajal pacemaker cells regulate slow waves in the intestinal tract but which have also been demonstrated in the vaginal wall where they probably also regulate slow wave electrical and smooth muscle activity [1466].

Introitus the entrance from the vestibule into the vagina.

Kegel exercises muscle training exercises aimed at increasing the strengths of the pelvic floor muscles including/especially the pubococcygeus muscle.

Labia majora the outer paired tissue folds, normally hirsute, either side of the female genital midline, extending from the mons veneris to the posterior fourchette, running parallel to the labia minor and composed of fatty tissue. [sing. labium majorum].

Labia minora thin, sensitive, paired folds of erectile tissue at the lateral margin of the vestibule, just internal to the *labia majora* (q.v.). [sing. labium minorum].

Lacunae an unfilled space, here usually referring to the vascular spaces in erectlile tissue.

Latency girls girls aged between about 6 and 13 years old, defined by Freud and other psychologists as when they repress sexual feelings after their early Oedipus complex parental sexual emotional attachments.

Lesser vestibular glands there is much confusion in the literature concerning this term. Skene’s glands (q.v.); also small glands that open into the vestibule between the urethra and anterior of vaginal introitus and secrete mucus during sexual arousal. also called minor vestibular glands.

Levator ani a horizontal complex of three muscle pairs that form the floor of the pelvic cavity and provide support for the internal organs.

Lichenification general term for the development of painful and/or itchy areas of epidermal

thickening, hyperkeratosis, epidermal atrophy, hypergranulosis, spongiosis, and acanthosis, variously affecting the labia, interlabial sulcus, clitoris, prepuce, perineum, and perianal area. It often results from excessive friction or scratiching. Physicians recognise three main types.

Likert scale a scale for ranking answers with subjective relative levels.

Limbic system various brain structures located around where the cerebral hemispheres join the brain stem; it does not have a precise definition or boundary, though it is involved generally in cognitive, emotional and somatosensory functions.

Lymphedema (lymphoedema and lymphatic edema) localised swelling caused by a compromised lymphatic system which hinders or blocks drainage of interstitial fluid and its return to the bloodstream.

Longitudinal study a research study in which subjects are monitored over a period of weeks to years.

Luteal phase the part of the menstrual cycle between ovulation and the beginning of menstruation, approximately days 14 to 28. During this phase luteinizing hormone and follicle-stimulating hormone levels decrease and the ruptured ovarian follicle, from which the egg was released, closes forming the *corpus luteum*. .

Meatus the opening of a duct or tube, such as where the urethra and vagina open on the floor of the vulva.

Meissner corpuscle a morphological type of encapsulated sensory nerve ending in the skin sensitive to vibrations (10–50 Hz) and fine, discriminatory touch such as indentations < 10μm.

Menarche first period (menstruation) of a girl; the age at which this occurs.

Mens another name for a woman's monthly periods; the part of the menstrual cycle when there is a discharge of blood and shed uterine endothelium from the vagina.

Merkel cells specialised mechano-sensory cells scattered throughout the epidermis that form close associations with sensory nerve endings and which themselves secrete various peptides. Need special staining techniques for visualisation.

Mesolimbic system a reward pathway in the brain that is dominated by dopamine as a neurotrasmitter and connects the midbrain (ventral tegmental area) to the basal ganglia (ventral striatum) of the forebrain. See also *nucleus accumbens*.

Meta-analysis a statistical analysis that combines the results of multiple scientific studies.

Microbiocoenosis a community of interacting microorganisms living in a particular place.

Microbiota the range of microorganisms that live in a certain place.

Minor vestibular gland an imprecise term sometimes used for the *Skene's glands* (q.v.) and

sometimes for other small unitary mucous glands on the vestibule mucosa.

Mons veneris (mount of Venus) the largely fatty anterior, slightly protruding part of the female genitalia.

Montgomery tubercles in the areola these are small bumps containing oil-producing sebaceous glands, which usually develop during pregnancy but may be present without pregnancy. Their secretion has a protective function.

MRI (Magnetic Resonance Imaging) It relies on very strong magnetic field causing alignment of the protons in the body, then when a brief pulse of appropriate radio frequency radiation is sent, it causes some protons to become misaligned with the magnetic field. After the brief radio pulse these revert back to alignment in the magnetic field re-emitting the absorbed radio energy, which is then detected by the MRI machine and used to create an accurate 3-D image. Also see *fMRI*, *T1-weighted MRI* and *T2-weighted MRI*.

Mucosa (= mucous membrane) a membrane that consists of one or more layers of epithelial cells overlying a layer of loose connective tissue and lines various invaginations such as the urethra, vagina, inside the nose, inside the mouth and lip. It is mostly of endodermal origin and is continuous with the skin at body.

Neuropeptide a short amino-acid chain (peptide) that acts as a neurotransmitter. Sensory perception from the genital and perineal region, including the skin, prepuce, glans clitoris, connective tissue septa of the corpora cavernosa, and the vagina, is mediated mainly by neuropeptides.

Neuropeptide Y a neuropeptide (*q.v.*) that causes vasoconstriction and if released by vaginal wall neurones will impede the outflow of blood increasing engorgement and hence lubrication.

Neurotransmitter a chemical released from the presynaptic ending of a nerve (neurone) that diffuses acoss the narrow synaptic gap to a target receptor cell (another neurone, a muscle cell or a gland cell).

Nitrergic of neurones that use nitric oxide as their neurotransmitter.

Nitric oxide a colourless gas that is soluble in water; it ia also a neurotransmitter that plays a crucial role in the relaxation of smooth muscle fibles in erectile tissus (*e.g.* corpus cavernosum and corpus sponguiosum of the clitoral complex).

NNOS (neuronal nitric oxide synthase) enzyme specific to neuronal tissue that catalyses the production of the cell signalling molecule nitric oxide (NO) from $_{L}$-arginine [98].

NO see *nitric oxide*.

Nocturnal orgasm see *sleep orgasm*.

Nucleus accumbens part of the basal fore brain on either side, anterior to the hypothalamus and part of the mesolimbic system (*q.v.*), and plays an important role in processing rewarding

and reinforcing stimuli such as sex, exercise and addictive drugs.

Nucleus tractus solitarii a tract of purely sensory neurones in the medulla oblongata which is part of the brain stem, located below the pons (q.v.). It receives input from various sources including the vagus nerve.

Nymphae see *labia minora*.

O-spot a zone of the posterior wall of the vagina 2 – 4 cm blow the posterior fornix, purported by some to be erogenous and whose stimulation can contribute to the orgasmic response.

Onanism see *masturbation*.

Orgasm "a variable transient peak sensation of intense pleasure, creating an altered state of consciousness, usually accompanied by involuntary, rhythmic contractions of the pelvic striated circumvaginal musculature, often with concomitant uterine and anal contractions and myotonia that resolves the sexually-induced vasocongestion, usually with an induction of well-being and contentment" [38]. Other definitions are summarised in [715: p. 2].

os cervix the opening of the endoicervix canal on the vaginal surface of the cervix.

Pacinian corpuscles mechanosensory nerve endings found in hairless (glabrous) mammalian skin (also called lamellar corpuscles).

Parasympathetic nervous system part of the automomic nervous system which involves neurones originating from some cranial nerves, the vagus nerve, and the pelvic splanchnic nerves which originate in the spinal cord in the last thoracic (T12) and first lumbar vertebrae (L1) but exit *via* sacral vertebrae foramens. It is often referred to as mediating 'rest-and-digest' or 'feed and breed' type activities. May be antagonistic to the **sympathetic** system **q.v.**

Paraurethral glands (female prostate) small glands that open through anastomosing and simple ducts into the urethra, especially postero distally. Often called Skene's glands but these appear as interpreted here to be different structures.

Paraurethal sulcus/recess a short sulcus running anterio-posterior, a few mm lateral to the (usually protruding) papilla that surrounds the urethral meatus proper. Within this there appear to be the openning(s) of what most workers refer to as Skene's glands (*q.v.*).

Pars intermedia of the brain the boundary between the anterior and posterior lobes of the pituitary; it is normally very reduced or absent in adults.

Pars intermedia of the clitoral complex tissue lying immediately behind the body of the clitoris. See [1465] for detailed description.

PC muscles/exercises see *pubococcygeus & Kegel exercises*.

PCOS see *polycystic ovarian syndrome*.

Peptidergic refers to neurones or synapses where the neurotransmitters are peptides.

Perineal body a fibromuscular mass in the centre of the perineum where parts of several important muscle groups merge including the external anal sphincter, bulbospongiosus, antero-medial part of the levator ani and superficial and deep transverse perineal muscles. Its damage during childbirth can have serious consequences such as various organ prolapses.

Perineal nerve the nerve tract that innervates external genitalia other than the clitoris and the distal part of the vagina.

Perineometer an instrument to measure the streng og pelvic muscle contraction, specifically of the pubococcygeus muscle that passes either side of the vagina. It usually comprises an intravaginal balloon connected to a pressure sensor, but there is an electronic version for recording electrical activity in the muscle.

Perineum the area between the fourchette (posterior of vestibule where the labia minora sometimes meat) and the anus.

Peritoneum the smooth muscle (serous) membrane that lines the abdominal cavity (coelom) and supports many of the abdominal organs.

Periurethral gland see *paraurethral glands*

PET see *positron emission tomography*.

Photoplethysmograph or **photoplethysmometer** (see plethysmograph).

PIEZO2 a mechanotransducer protein. Antibodoes against this protein can be used to selectively stain mechanosensory nerve endings.

Pituitary a tiny (c. 0.5 g) but important endocrine gland which protrudes from the bottom of the hypothalamus. The anterior pituitary releases hormones regulating processes such as stress, growth, reproduction, and lactation, and so help control growth, blood pressure, energy management, all functions of the sex organs, thyroid glands and metabolism as well as some aspects of pregnancy, childbirth, breastfeeding, water/salt concentration at the kidneys, temperature regulation and pain relief.

Placebo in an experiment with one or more treatments, a type of control in which the subject is given a treatment that appears indistinguishable from the experimental treatment but is actually inactive.

Plethysmograph a device that records blood pressure such as pulse strength and amplitude. In sex research it is common to use a plethysmometer inside the vagina to measure the magnitude of the pulse in the vaginal as a measure of vaginal blood flow and hence of sexual arousal state. As the pressure of the pulse is rather low, it is easiest to measure using the light reflectance change of blood in the vaginal wall tissue using a photoplethysmograph. Clitoral pulse amplitude can also be measured this way [588].

Plexus a complex mesh of blood vessels or nerves.

Polycystic ovary syndrome (PCOS) a common endocrine disorder of women of reproductive age that may affect up to 25% of women in some populations. It is characterised by may have infrequent or prolonged menstrual periods, the ovaries may develop numerous small fluid-filled follicles and fail to regularly release eggs, and also production of excess androgens. Its exact cause remains uncertain.

Pons part of the brain stem situated above the medulla elongata and below the midbrain (Fig. **14.2)**.

Pontine concerning the pons of the brain (q.v.).

Positron emission tomography (PET) a method for visualising certain physiological functions such as metabolism or blood flow by injecting radioactive tracers whose emissions are detected. It is sometimes used for brain activity imaging *via* its blood flow which increases locally with glucose metabolism, in which case the tracers used are oxygen-15 of fluorine-18 which acumulate briefly where the glucose is being used.

Posterior fornix the space between the posterior wall of the cervix and the posterior wall of the vagina.

Pre-menstrual syndrome emotional and physical symptoms that may occur one to two weeks before menstruation. The symptoms vary but often include irritability and mood changes, acne, breast tenderness, bloating (abdominal swelling) and tiredness.

Prepuce the loose fold of skin covering the glans of either the clitoris or penis.

Preputium see *prepuce*.

Progesterone a steroid sex hormone that is involved in the menstrual cycle as well as pregnancy and embryogenesis. It is released by the *corpus luteum* of the ovary which formas after release of the egg.

Prolactin a peptide secreted from the pituitary gland in mammals and is involved in many functions. Its secretion is regulated by endocrine neurons in the hypothalamus. It gets its name from its role in stimulating the mammary glands to produce milk (lactation). During pregnancy increased serum concentrations cause enlargement of the mammary glands.

Prospective study an investigation whose participants are enrolled before they develop the disease or the outcome that is being investigated.

Prostaglandins physiologically lipid compounds with powerful vasodilatory activity. They each have precisely 20 carbon atoms including a five carbon ring.

Prostate-specific antigen (PSA) an exzyme (gamma-seminoprotein or kallikrein-3) secreted by male prostate gland and which causes liquification of semen.

Prostatic acid phosphatase (PACP) an enzyme largely specific to the male prostate gland (also present in female paraurethral glands).

Ptosis drooping of the breat that increases naturally with age, pregnancy, breast-feeding.

Pubic symphysis a secondary cartilaginous joint between the left and right superior rami of the pubis (pubic bone).

Pubococcygeus muscle a 'hammock-like' muscle occurring in both sexes that extends from the coccyx to the pubic bone at the front, forming a support for all the abdominal organs. It is perforated along the midline by the internal parts of the clitoris, urethra, vagina and rectum.

Puborectalis muscle part of the levator ani and is shaped like a belt encasing the pelvic organs.

Pubourethral ligaments a fan of thin fibrous threads that originate from the posteroventral part of the pubic bone and extend to the urethra.

Pudenda a general term for male and female external genitalia although in recent years the term has been appropriated to refer to only female genitals.

Pudendal nerve a major nerve in both men and women that originates from S2 to S4 sacral spinal nerve roots in the sacral plexus, and runs to most of the pelvic muscles and genitals; it is quite variable between individuals and may divide into 2 or more branches innervating anal and urethral sphincters (motor) and much of the genitals (sensory).

Pudendo-anal reflex pinching of or electrical stimulation of the clitoris causes contractions of the anal sphincter muscle [439].

R/K selection spectrum natural selection of combinations of traits that trade-off between quantity and quality of offspring. r-strategists are selected for producing large numbers of offspring in unstable environments where the likelihood of all of the majority of them surviving to adulthood is low. K-strategists are selected for producing smaller numbers of offspring under stable conditions where survoval probability is higher, and parental investment usually greater bercause individual offspring have a higher probability of surviving.

Radical hysterectomy surgical procedute fro removing cancer that involves removal of the uterus, cervix, tissue around the cervix and the upper part of the vagina.

Raphe a ridged junction of continuous biological tissue, sometimes used to describe the superficial clitoral body.

Rete malpighii the innermost layer (stratum) of the epidermis.

Rete peg an inward fold of the epidermis into the dermal cell layer as seen in histological sections.

Retrograde neurotransmitters neurotransmitters that are synthesised in the postsynaptic neuron and released at the synapse. They then bind to receptors on the axon terminal of the presynaptic neuron. Retrograde signaling can initiate a signaling cascade that focuses on the presynaptic neuron.

Root of the penis/clitoris in the male, it is where the crura diverge on either side of the urethral bulb; in females it is where the nerves from each of the erectile bodies come together. at the juncture of the crura; it is very sensitive. The posterior portion of the clitoral root is near the urethra.

Ruffini corpuscles (or **endings)** slowly responding pressure receptors found in both hairy and hairless mammalian skin where they record low-frequency vibration or pressure. They adapt slowly to pressure that results from stretching of the skin and also respond to the sustained presence of pressure.

SAD see *sexual arousal disorder*.

Sagittal section a medical term for a longitudinal section through an organism or structure along the midline separating right and left halves.

Sebaceous glands minute exocrine glands (*q.v.*) that open into hair follicles releasing an oily or waxy (sebum) secretions.

Selective Serotonin Re-uptake Inhibitor (SSRI) a class of drugs used predominantly as antidepressants. Their mode of action is largely based on increasing the duration that the neurotransmitter serotonin 'hangs about' at serotonergic synapses and so increases its effect.

Serotonin (= 5-hydroxytryptamine, 5-HT) is a monoamine neurotransmitter with widespread activity in the brain including, modulating mood, cognition, reward, learning, memory, as well as many physiological processes such vasoconstriction .

Sex flush (= sex rash) a blushlike, but more extensive, reddening of parts of the skin which can occur at any stage of sexual arousal or during orgasm; it usually includes the neck, chest and shoulder blades but can extend to the stomack, thighs, buttocks and soles of feet.

Sexsomnia see *sleep orgasm*.

Sexual arousal disorder (SAD) is characterised by a lack or absence of desire to have sexual or fantasies and/or absence of arousal in a situation that would normally produce it and/or absence of sexual response such as lubrication or erection.

Sexual function index see *female sexual function index* .

Sildenafil citrate popularly known by the trade name Viagra, chemical sexual arousal stimulant that works by inhibiting Type V-phosphodiesterase enzyme thereby increasing nitric oxide (NO) mediated vascular and nonvascular smooth muscle relaxation. Relaxation of smooth muscles in veins and erectile tissues muscles increases blood flow and in the case of the penis and clitoris, leads to turgitity/erection.

Sinusoid literally like a sinus; a large, terminal, irregular, anastomosing blood vessel lined by reticuloendothelium but with little or no adventitia.

Skene's glands exocrine glands located around the female the urethra and having ducts opening into the vulval floor close to the urethral meatus and also inside the urethra;

homologous to the male prostate gland. Despite a vast number of autopsies and lots of more modern *in vivo* studies, there is still an enormous amount of discussion about this structure and function.

Sleep orgasm an orgasm that occurs while someone is asleep usually as part of a sex dream.

Smooth muscle an involuntary muscle which lacks sarcomeres (as opposed to striated muscle, which has sarcomeres and therefore a striated appearance).

Sphincter a circular (ring-shaped) muscle that closes a tubular such as the anus or urethra. Most normally remains constricted until stimulated to relax and allow passage of contents of the tube. Some can be relaxed voluntarily and are innervated by the somatic nervous system (*e.g*. external anal sphincter), others are controlled by the autonomic nervous system (*e.g*. internal anal sphincter).

Spinnbarkeit test determination of proximity to ovulation by stretching cervical mucus (usually between two microscope slides) to form a thread until it breaks, the longer the thread that can be formed before it breaks the closer to ovulation.

Spongious nerve the terminal and main projection of the neurovascular bundle (anteroinferior terminal portion of the inferior hypogastric plexus) and provides nitrergic innervation to the vestibular bulbs.

Squirting involuntary (and perhaps voluntary) expulsion of a substantial amount of urine during sexual activity (see also female ejaculation).

SSRI see *selective serotonin reuptake inhibitor*.

Suspensory ligaments of clitoris a composite body ofligaments that attach to part of the anterior clitoral body and run to the pubic symphysis [211] and anterior abdominal wall [210]. Comprises a thin anterior superficial band from the abdominal wall, an intermediate slightly more coherent band also from the abdominal wall and a deep tough ligament connecting to the pubic symphysis.

Sympathetic nervous system part of the automomic nervous system which involbes neurones originating from the spinal cord and often referred to as mediating 'fight or flight' type actions. May be antagonistic to the **parasymapathetic** system **q.v.**

Symphysis (pubic symphysis) secondary cartilaginous connection between the left and right superior rami of the pubis which is normally approximately 4 – 5 mm wide and is composed of fibrocartilage. During human pregnancy the symphysis widens by at least 2 – 3 mm allowing the pelvic bones to be more flexible for delivery. .

Syntribation a masturbation method (predominantly used by females) in which the thighs are tensed and squeezed together strongly.

T1-weighted MRI short radio pulses and tissues with short T1 relaxation times (*e.g*. subcutaneous fat and fatty bone marrow) appear bright.

T2-weighted MRI long radio pulses (> 2000 ms) and tissues with long T2 relaxation times (> 80 ms) appear bright – such tissues have high water content, *e.g*. muscle, blood.

Tenting positional shift in the upper vagina and uterus during arousa: the uterus is drawn upwards and the cervix consequenly withdraws a bit.

Testosterone a steroid hormone released by testes, ovaries and adrenal glands, predominantly associated with the development of male traits, but also the most abundant female sex steroid. In women it is important for tissue and bone health as well as having a role in sexual arousal.

Thalamus a deep, central brain region located above the brain stem and surrounding the third ventrical. Its primary function is to relay sensory signals to the cerebral cortex, so virtually all genital sensory information enters it *via* the spinothalamic tract of the spinal cord.

Thelarche the age at which breast development begins.

Thermography similar to photography but based on infra-red rather than visible radiation.

Transudation, vaginal the process by which water and some solutes originating directly from the blood stream pass from vessels and capillaries in the vaginal wall, saturating the thin intervening tissue and emerge from the vaginal wall providing the large part of vaginal lubrication.

Trabeculae predominantly structural tissue elements in the form of a small beams, struts or rods, usually composed of dense collagenous tissue that subdivides the whole tissue into a number of separate compartments, which in the case of cavernosal tissue results in its spongy appearance.

Tyrosine hydroxylase a marker for adrenergic nerves.

Tyson glands, see *Fordyce spots*.

Ultrasonography an imaging technique based on the reflection of ultrasonic vibrations from a source back to a receiver; the source and receicer need to be in close physical contact with the skin connected by a specialist lubricant (see also *Doppler ultrasonography*).

Urethra the mucosa-lined, muscular excretory duct running from the bladder to its outlet, the urethral meatus, allowing passage of urine.

Urinary stress incontinence unwanted leakage of urine resulting from activities that put pressure on the bladder, from coughing and sneezing to sex.

Uterovaginal plexus a part of the sympathetic nervous system's inferior hypogastric plexus and comprises two parts, a vaginal part which is distributed to the walls of the vagina and innervates the erectile tissue of the vestibule, and to the cavernous nerves of the clitoris, and a uterine part which accompanies the uterine artery to the side of the uterus.

Uterus the womb, wherein after conception, the early embryo attaches and develops to form a baby.

Vaginal sponge area a relatively large zone along the anterior vaginal wall and surrouding the distal ureter which by some interpretations includes the G-spot, and ends a short distance before the fornix.

Vagino-levator reflex distension of the vagina causes electromyographic activity in the levator ani muscle [452].

Vaginisimus involuntary muscle spasms that interfere with vaginal penetration as in intercourse often resulting in pain with attempts at sex.

Vagus nerve the 10th cranial nerve. Its left branch innervates many of the viscera including heart, lungs and digestive system, as well as the uterus and cervix *via* its inferior and superior cardiac branches. Also called the pneumogastric nerve.

Vasopressin a peptide hormone synthesised in the hypothalamus from where it is transported inside nerve axons to the posterior pituitary where it is released into the blood stream. It increases blood volume, heart output and arterial pressure as well as causing vasoconstriction.

Vesico-uterine pouch a fold in the peritoneum overlying the uterus and bladder.

Vestibule the part of the vulva between the inner base of labia minora, extending to the clitoral frenulum and posteriorly to include the fourchette, and into which the urethra, vagina and some gland ducts open. Based on embryology it appears to be the only part of the female external genitalia that is of endodermal origin. Its border is defined as the line of Hart.

Viagra see *sildenafil citrate*.

VIP (vasoactive intestinal polypeptide) a vasodilator neuropeptide (*i.e*. a peptine released from specific neurones) which increases the blood flow by dilating the arterial supply, which in the case of the vagina leads to lubrication (specifically neurogenic transudate).

VIPergic (sometimes **vipergic)** of neurones that are activated by VIP.

Virilisation developments in a female that are characteristic of male development and are caused by hormone imbalance, specifically exposure to excess androgens and may include enlarged clitoris (clitoromegaly *q.v.*), hirsutism, male-pattern baldness, deeper voice, irregular or no menstruation. Cause can be genetic (*e.g*. congenital adrenal hyperplasia which usually causes greater genital and growth abnormalities requiring surgery as well as hormone treatment), some intra-urterine androgen exposure, or taking anabolic steroids, among others.

Vulva the whole region of female genitalia from the outer edge of the labia majora laterally and from the clitoris to the anterior margin of the perineum longitudinally.

Vulvovaginal glands*see Bartholin's glands*.

Yohimbine an α-2 adrenergic blocker derived from bark of the African tree *Corynanthe* (=*Pausinystalia) johimbe* (Rubiaceae).

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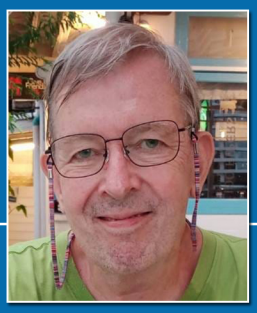

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Over his career, the author has published more than 300 scientific papers in peer reviewed journals as well as authoring and co-authoring seven scientific books including on mimicry, statistical computing for biologists, and wasps. Over the past few years he has been ranked consistently among the top 2% of world scientists. As an undergraduate he studied zoology at Oxford University, and then did his PhD on the neurophysiology of snail brains as a model system at the University of Nottingham (U.K.). This was followed by postdocs on the ecological genetics of sea anemones and on the neuropharmacology of spider venoms. However, most of his research career was spent working on the evolution, functional anatomy and taxonomy of a vast group of insects called parasitoid wasps. This was initially at the University of Sheffield (U.K.) and then jointly at Imperial College London and the Natural History Museum, London, where he was appointed Professor of Systematics. He is a leading world expert on these insects, and was awarded the distinguished research medal of the International Society of Hymenopterists in 2021. He took early retirement in 2013 and moved to Thailand where he has continued to be an active research scientist and author.

Prof. Quicke became interested academically in the topic of this book when a friend asked him to write a short article on human female orgasms for a web site. Researching this field he found that apart from 'How to' books there was no single, comprehensive published work on the subject and indeed a lot of contradictions in the academic literature. Here, he presents an in-depth treatment, aimed at the reasonably educated lay reader through to students and postgraduates in universities. More than 1,400 scientific papers and works are cited, dating back to Aristotle, and it is copiously illustrated with photographs, diagrams and graphs."