The evolution of the National Survey of Sexual Attitudes and Lifestyles: Theoretical, conceptual, and methodological advances

Wendy Georgina Macdowall

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2 ABSTRACT

The British National Survey of Sexual Attitudes and Lifestyles (Natsal) has been conducted every ten years since 1990. So far there have been three surveys in which more than 45,000 people have been interviewed. Over its 30-year history, the survey has evolved in both scope and methodology, and the disciplines represented within the team have expanded. In this research paper style thesis, the evolution of Natsal is examined under three themes:

Theme one concerns advances in theoretical perspectives regarding the very nature of human sexuality and the fundamental question of whether, and to what extent, sexual behaviour is innate and fixed by our biology or is acquired and socially learned. The theoretical perspective adopted is obviously no trivial matter; the lens we apply to any situation governs how we understand the determinants of it and the approach we take to influence or change it.

Theme two centres on conceptual factors and, in particular, the emergence of sexual health as a concept relevant to public health, and within that the transition from a focus on sexual ill-health to sexual well-being. Although the term 'sexual health' is used globally in policy, practice and academia, it has a short history and its meaning, and application, has varied considerably.

Theme three relates to questions of methodology and the tools we use to try and measure and understand sexuality and advance sexual health, specifically the shift from single disciplinary perspectives to multi-disciplinarity.

Each of the three themes is illustrated through the three papers that form the body of the thesis.

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4 INTRODUCTION

In 1990, the first National Survey of Sexual Attitudes and Lifestyles (Natsal-1) was conducted in Britain. It has since been carried out every 10 years and so far, there have been three surveys in which more than 45,000 people have been interviewed, making it one of the largest and most detailed scientific studies of sexual behaviour in the world. The findings have had a major impact on policy and practice, and on the public debate about sex. Funding has been secured for a fourth Natsal and development work began in 2019.

For over 20 years now, the survey has been a major focus of my work. I joined the team in 1998 as a Research Fellow during the development stage for Natsal-2. Though I was part of the academic team, I also trained as an interviewer for the fieldwork agency (The National Centre for Social Research). Experience in the field gave me an invaluable insight into the challenges at the doorstep, but it also exposed me to the warmth and openness with which many people welcomed me into their homes, seemingly glad of the chance to contribute to the survey and curious as to what it would entail. Natsal is a team effort, but with successive iterations my responsibilities have grown. I was co-investigator on Natsal-3 (2010) as I am for Natsal-4 (on-going).

Over its 30-year history, the survey has evolved in both scope and methodology, and the disciplines represented within the team have expanded. This evolution has its roots in the emergence of sexology as a distinct field of scientific investigation, in the rise of a holistic conceptualisation of sexual health, and in increasing recognition of the importance of interdisciplinary perspectives in the context of public health.

Sexology has a relatively short history that can be traced back to the founding sexologists of the late 19th and early 20th century. Since that time, it can be seen to have gone through a number of distinct phases in which different theoretical and disciplinary perspectives have risen to prominence. Sexuality, however, cannot be studied in isolation from the social structures and strictures that regulate its expression; hence entwined in the history of sexology are the histories of major social institutions including those of the family, religion, and the law. These histories have both shaped, and been shaped, by each other and reflect major changes to, for example, the position of women in society, the power of the church, individual rights and laws that protect those rights. Of similar importance have been advances within other scientific fields including anthropology, sociology, psychology, physiology and endocrinology.

In investigating major evolutionary steps in the development of sexology (up to and including Natsal itself) three key, interconnected themes can be identified.

1. Theme one concerns advancements in *theoretical* perspectives regarding the very nature of human sexuality and the fundamental question of whether, and to what extent, sexual behaviour is innate and fixed by our biology or is acquired and socially learned.
2. Theme two centres on *conceptual* factors and, in particular, the emergence of sexual health as a concept relevant to public health, and within that, the transition from a focus on sexual ill-health to sexual well-being.
3. Theme three relates to questions of *methodology* and the tools we use to try and measure and understand sexuality and advance sexual health, specifically the shift from single disciplinary perspectives to multi-disciplinarity.

These three themes, which are illustrated in the three Natsal papers that form the body of this thesis, are explored below.

5 THEORETICAL PERSPECTIVES

5.1 OVERVIEW

At the very heart of attempts to understand human sexual behaviour is the question of the degree to which our sexuality is 'hard wired' and governed by our biology or is something that we acquire and is socially constructed. As I explore in this chapter, the nature-nurture pendulum has swung from a position of essentialist explanations focussing on innate factors that was adopted by the forefathers of sexology in the late 19th century through to social constructionist explanations adopted nearly one hundred years later. At the time of writing, the pendulum rests somewhere in between these polarised positions. We have come to appreciate that sexual behaviour is not solely a matter of nature *or* nurture, but rather it is shaped and influenced by many factors including our biology, our upbringing, our immediate social circumstances and the wider cultural and social environment in which we live.

The theoretical perspective adopted is obviously no trivial matter; the lens we apply to any situation governs how we understand the determinants of it and the approach we take to influence or change it. While the Gordian Knot of nature and nurture, fixedness and plasticity in human sexuality remains to be fully untangled, we do now have a much better understanding of the complexity and the potential to improve and promote sexual health through public health efforts such as sex education.

5.2 THE BIRTH OF SEXOLOGY

Historians point to Germany during the last two decades of the 19th century as the birthplace of sexology and the cradle of the 'modern-notion of sexuality' (Oosterhuis, 2012), and to the work of Richard von Krafft-Ebing (1840 - 1902) and Albert Moll (1862 - 1939) in particular. At the time, sex was essentially an issue of moral, legal, and religious consideration and was governed by the 'reproductive imperative'. This meant that the only sexual act that could be legitimately justified occurred between a man and a woman - within the sanctity of marriage - with the sole purpose of reproduction; any, and all other sexual acts were considered as unnatural, deviant and perverted (De Block & Adriaens 2013; Oosterhuis, 2012). Medical concern regarding matters of sexuality was centred on forensic medicine and the crimes of 'sexual perversion'. Predominant among sexual crimes brought to trial were cases of men accused of having sex with other men. As well as being a prominent psychiatrist, Krafft-Ebing was a leading forensic expert. Along with other prominent European psychiatrists of the day, he argued that 'perversions' were an '*innate morbid condition*' and, as such, should be regarded as a pathology or illness rather than a crime or sin (Oosterhuis,

2012). The cause of these diseases of the sexual instinct, Krafft-Ebing initially believed, was degeneration.

Degeneration theory emerged during the industrial revolution; it was a time of dramatic social change which saw the advent of the modern city and the rise of the urban poor. The modern city also made sex work, homosexuality and other 'sexual deviances' more visible and provided the conditions that allowed for the nascent emergence of sexual subcultures (Pretsell, 2019). So called 'degenerists' believed that civilisation was in decline, the evidence of this decline was clear for all to see in the slums and on the streets of rapidly expanding European cities. The cause of this decline, it was argued, lay in regressive changes in human biology that were passed from one generation to the next. Within degeneration theory, hereditary defects or '*taintedness'* in the family lineage led to an '*imbalance between the* [base] *sexual instinct and the* [higher] *inhibitory powers*' (which could be aggravated by masturbation) (De Block & Adriaens 2013; Pretsell, 2019; Money, 2003). Deviant sexual behaviour was not only thought to be a consequence of degeneration, but it was also seen as the cause of other degenerative illnesses, such as alcoholism, pauperism, and 'moral insanity'. The theory can be seen as the harbinger of the eugenics movement. While Krafft-Ebing, for most of his life, was an advocate of degeneration theory, Moll cautioned against it. Moll also argued against purely somatic explanations in medicine generally and sexology specifically, for example he was against the 'treatment' of homosexuality using transplantation of testes from heterosexual men (Sigusch, 2012) advocating rather for psychological methods including hypnosis (Oosterhuis, 2012).

5.3 Sexual modernity in the works of Krafft-Ebing and Moll

Oosterhuis (2012) identifies five features of sexual modernity that can be found in the works of Krafft-Ebing and Moll. The first of these features is the belief that sexuality is an integral facet of human nature. On the one hand, Krafft-Ebing and Moll endorsed the then prevailing view that the sexual instinct was a dangerous, near uncontrollable force, and that man was trapped in a perpetual battle to quell its expression in order that the moral and social order may be preserved. On the other hand, they also highlighted that sexuality can play a positive part in people's lives (Oosterhuis, 2012). Moll came to advance the idea that there were two distinct components to the sexual instinct. The first he called 'the detumescence drive' [the drive to discharge, to release]. This was individual in nature and somatic in origin; it reflected the need for physical satisfaction. The second he called 'the contrectation drive' [the so-called relationship drive or the love impulse]; this was social in nature and psychological in origin - it reflected the desire to be close to others "*to touch, to caress, or kiss the sexual object"* (Oosterhuis, 2012; Sigusch, 2012; Bullough, 1994, p46). In positing these two distinct drives, it has been suggested that Moll was the first to separate procreation and sexuality

(Schaffner, 2012). Moll went so far as to suggest that reproduction was an unintentional by-product of the detumescence drive, whose sole purpose was to be sated. This uncoupling of sexuality from the reproductive imperative, and the introduction of pleasure and relationships, is the second feature of modern sexuality identified by Oosterhuis (2012) in the works of Krafft-Ebing and Moll.

The third feature concerns the classification of sexual expression and the demarcation between the 'normal' and the 'abnormal' (Oosterhuis, 2012). In 1896, Krafft-Ebing published *Psychopathia Sexualis with Special Reference to the Antipathic Sexual Instinct: A Medico-Forensic Study*, which was a collection of clinical observations and case studies, in which he presented a taxonomy of non-procreative sexuality using four main categories: homosexuality, fetishism, sadism and masochism (Oosterhuis, 2012). In later editions, towards the end of his career, he considered the distinctions between the normal, the perverse and the criminal, and admitted that knowing where to draw the lines was difficult (De Block & Adriaens, 2013). Not long before his death Krafft-Ebing wrote that homosexuality was in his view neither an expression of degeneration nor an illness, but rather it could occur in otherwise 'normal' people. In doing so, Krafft-Ebing began a shift in thinking from an *exclusively* pathological standpoint to a consideration of 'perversion' as an integral part of the sexual instinct (Oosterhuis, 2012). Moll, along with fellow German Magnus Hirschfeld (1868 - 1935) and Englishman Henry Havelock-Ellis (1859 - 1939) – who emerged as sexological heavyweights of the early part of the twentieth century - reasoned that, much like any other human characteristic, sexuality showed natural variation and hence differences were not *against* nature but rather were simply part of its infinite variety.

The fourth characteristic of sexual modernity that Oosterhuis (2012) identifies in the works of Krafft-Ebing and Moll is the beginning of a change in thinking of 'sexual deviancy' as a temporary digression from the norm to it being an essential feature of who we are. As Foucault put it '*the sodomite had been a temporary aberration; the homosexual was now a species*' (Foucault, 1976, p43). The fifth, and final, feature that Oosterhuis (2012) identifies was a shift from purely physiological explanations of sexuality (and perversions) to those that place more weight on the psychological aspects and the interaction between body and mind (Oosterhuis, 2012). That said, it is Freud who comes to the fore when it comes to matters of sex and psychology (see section 5.5).

5.4 HOMOSEXUALITY AND THE EARLY SEXOLOGISTS

Homosexuality was the focus of many of the early sexologists' attention. An understanding of 'sexual inversion' (as it was known at the time) was seen to be the key to understanding sexuality more generally and for some sexologists the subject was personal. Moll's first published sexological work was on homosexuality, as was Hirschfeld's. Both of them, however, were antagonists (Sigusch,

2012). Moll was a believer in the scientific method and sought the truth '*without any presuppositions or political interests*' (Sigusch, 2012). Hirschfeld, on the other hand, was a reformer and political activist, whose motto was '*per scientiam ad iustitiam'* [through science to justice] (Sigusch, 2012). He was instrumental in establishing the 'Scientific Humanitarian Committee' (in 1897), which fought for the rights of homosexual men and in particular the abolition of Section 175 of the German legal code which criminalised sex between men. His life's work is thought to have been motivated by his own homosexuality (Bullough, 1994, p62) and by a number of salient events in his life including the parading of a 'sexual invert' in front of the class during his medical training. At first, Hirschfeld espoused the idea that homosexuals were the 'third sex', but subsequently he advanced his theory of 'sexual intermediaries', which held - as noted above - that there were many types of naturally occurring sexual variations and homosexuality was simply one. Havelock-Ellis (working with John Addington Symonds) published his first work on 'Sexual Inversion', and also concluded that homosexuality was a natural biological variant. However, the *cause* of the variation, specifically whether it was inborn or acquired, remained a matter of divergence.

5.5 SIGMUND FREUD AND PSYCHOANALYSIS

The birth of sexology coincided with that of psychoanalysis. Sigmund Freud (1856 - 1939), the founding father of psychoanalysis, began his professional career as a specialist in nervous diseases. He did not intend to study sex but his search to understand the aetiology of diseases of the nervous system ultimately led him to deduce that every neurosis had a sexual cause and hence his entire theory of psychoanalysis was based on sex (Bullough, 1994, p87). Freud believed that the sexual drive was a primary motivational 'energy'. He also believed that tension and pleasure were central to the human condition; all tension was caused by the build-up of sexual energy (which he called 'libido') and all pleasure came from its release. Through self-analysis, Freud arrived at 'three great truths'; firstly, that dreams are the shrouded realisation of unconscious desires; secondly, that everyone has an Oedipus complex; and thirdly, that children are sexual beings (Bullough, 1994, p88). He subsequently added two further concepts; the death instinct and the division of the human psyche into three systems; the id, the ego and the superego. In Freudian theory, the id - the source of the sexual drive and the reservoir of the libido - is the primitive, instinctual, animal part of the psyche from which the unconscious desires and motivations behind all human behaviour originate. According to Freud, the id is governed by what he called the 'pleasure principle', which directs all our actions toward the goal of achieving the maximum amount of pleasure possible. The function of the ego is to ensure that the id's primal urges are expressed in acceptable ways, it is governed by the 'reality principle'. The superego is the part of our psyche that has internalised the rules of those around us (for example, our parents and society). The three systems of the psyche are in constant

internal conflict. According to Freud, in the battle to free ourselves from sensuality, the sex drive is repressed and it is this repression that ultimately manifests itself as diseases of the nervous system (Bullough, 1994, p41).

Freud also developed a theory of childhood psychosexual development, in which he proposed that sexual maturity took place in five consecutive stages: oral, anal, phallic, latency, and genital. He argued that we are all born sexual beings but that the link between the sexual instinct and its objects and aims is not innate (the 'normal' object would be an adult partner of the opposite sex and the 'normal' aim would be vaginal intercourse) (Bullough, 1994, p88). As such, according to Freud, until about around the age of five, children experience *polymorphous perversity* and can gain erotic pleasure from any part of the body, and that deviant sexual behaviour emerges when sexual drives are misdirected in their object and/or aim. The cause of the misdirection lay in the nervous system.

It has been argued Freud's theories of sexuality came to overshadow those of his contemporaries, not necessarily because they offered more in terms of explanatory power but rather because psychoanalysis offered an option for treatment (Bullough, 1994, p61). If perversions were caused by hereditary defects then little could be offered by way of remedy. Freud also had a circle of enthusiastic acolytes who proselytised about his theories during his lifetime and long after his death in 1939.

5.6 PRE-WAR SEXOLOGY AND SEXUAL REFORM

While much of the sexological attention in the late 19th and early 20th centuries had centred on men, and male homosexuality in particular, the field was developing during a time of feminist protest against regressive laws governing sex work and against the subordinate legal status of women within society generally and marriage specifically (Hall, 2004). Feminists were challenging accepted notions of gender and sexuality. In 1921, Hirschfeld organised the '*First International Conference for Sexual Reform on a Scientific Basis*'. This congress helped to bring together those involved in different areas of sexual reform and create a network of campaigners and advocates. It was not until 1928 that the second congress took place, but it was at this conference that '*The World League for Sexual Reform* (WLSR)' was established. Founding members included Margaret Sanger (1879 – 1966), who was instrumental in the inception of the contraceptive movement. It was Sanger who opened the first contraceptive clinic in America and who, in 1921, founded the American Birth Control League (later to become The Planned Parenthood Federation). The WLSR was clear in its purpose:

> "*Is intended by its founders not to confine its activities to abstract research but above all to make the results of scientific research of practical service to mankind"*

(WLSR, Wellcome archive)

https://wellcomelibrary.org/item/b16237298#?c=0&m=0&s=0&cv=1&z=-0.0543%2C0.3828%2C0.7776%2C0.559

The League stood on a ten-point manifesto that reflected its reforming agenda and which included the 'whole sexual life'. Hence, in addition to advocating for the repeal of laws that criminalised homosexuality it called, amongst other things, for sexual equality, comprehensive sex education, contraception and abortion (See box 1). The League was disbanded in 1935. With the obvious exception of eugenic birth selection, it can be seen as having had a progressive agenda that still resonates today.

Box 1: The ten-point manifesto of the World League for Sexual Reform

1. *Economic, political, and sexual equality of men and women.*
2. *Marriage reform.*
3. *Birth control to make birth voluntary and responsible.*
4. *Eugenic birth selection.*
5. *Protection of unmarried mothers and "illegitimate children".*
6. *Rational understanding of intersex people and homosexuals.*
7. *Comprehensive sex education.*
8. *Reforms to eliminate the dangers of prostitution.*
9. *Treating sexual abnormalities medically, rather than "as crimes, vices or sins".*
10. *Legalization of sexual acts between consenting adults, while criminalizing sexual acts without consent, or acts upon minors and the mentally disabled. Distinguishing crime from vice.*

During the 1930s, with the rise of Nazism, and the deaths of Moll, Hirschfield and Freud, the dominance of Austro-German sex research waned, and leadership passed to the United States (US) (Bullough, 1994, p91).

5.7 A GROWING WIDER PERSPECTIVE

Until the ground-breaking studies of Kinsey in the mid-20th century, research into human sexuality in the US had been hampered by a prevailing conservative morality (Bullough, 1994, p96). However, significant advances in understanding the biology of sex and reproduction emerged in the first half of the century from the laboratory, which was relatively safe from 'moral admonishment' (Bullough,

1994, p120). These included the discovery of the X and Y chromosomes and advances in endocrinology (in particular the isolation of testosterone and oestrogen and elucidation of the female menstrual cycle). There were also advances in understanding of sexual behaviour that came from the study of animals, especially primates. Through his work with chimpanzees, comparative psychologist Robert Yerkes (1876 – 1956) observed that there was a complex range of biological and social factors involved in mating behaviour. For example, he found significant variation in mating behaviour between, and within, females, with intra-individual female variation depending on the male (i.e. even among 'lower' animals, mating behaviour was not biologically 'fixed', rather there appeared to be a social element). He also found that it was common for apes (and other animals) to touch and stimulate their mates' genitals, hence, contrary to the prevailing opinion at the time, such behaviour was not against nature (Bullough, 1994, p156).

The focus on social factors alluded to in primate studies were gaining traction through the work of anthropologists and historians, and findings emerging in these fields were also challenging some firmly held beliefs. There had been early advocates of this wider perspective. Bullough (1994, p56) argues that one of the most influential researchers using historical and anthropological data was the German dermatologist and venereal disease specialist Iwan Bloch (1872 - 1922). Bloch had called for the establishment of a 'sexual science' that was to include social, cultural, and historical perspectives. In his works he argued that 'perversions' were to be found in every culture and throughout history. This conclusion opposed the entrenched view that they were a modern phenomenon of the Victorian era. However, it was within the emerging field of anthropology, with its new research methods of participant observation and cross-cultural comparisons, that greater insight on social and cultural factors were emerging.

Two key figures in early anthropology were Bronislaw Malinowski (1884 - 1942) and Margaret Mead (1901 - 1978). At the time of the First World War, Malinowski spent several years on the Trobriand Islands (off the east coast of New Guinea) where he lived among the people he studied, getting to know them, speaking their language and immersing himself in their day-to-day lives. This new way of 'doing' anthropology was to become known as participant observation. In his book *Sex and Repression in Savage Society* (1927), which had a preface written by Havelock Ellis, Malinowski detailed the social organisation of sexuality among the islanders. Malinowski's work had been informed by Freudian theory, and Freud himself had believed that cultural anthropologists would come to establish the essential, universal, nature of his 'truths' about the unconscious and sexuality (Rivera, 2017). However, this was not to be the case; in fact it was quite the contrary as Malinowski reported that the Oedipus complex did not exist in the Trobriand Islands. Rather, he proposed that

Trobriand boys passed through a 'matrilineal complex', in which the sister is sexually desired, and the mother's brother is seen as the rival (Rivera, 2017).

Margaret Mead's famous work *Coming of Age in Samoa* (1928) explored adolescence and sexuality among young girls of the island. She reported that they experienced sexual freedoms unlike those in the West and concluded that culture is a primary influence on psychosexual development. While there have been critiques of the work of Malinowski and Mead, their findings that sexual behaviours and mores among so-called 'savage' or 'primitive' people diverged in major ways to those in the West fundamentally challenged the notion that human sexuality was 'hard-wired' by our biology. Hence, rather than being innate, human sexuality was malleable and varied (Bullough, 1994, p158). This variability was further emphasised by Ford and Beach, who in 1951 published *Patterns of Sexual Behavior*. The book presented their findings from a review of a vast collection of reports, books and pamphlets from around the world that had been amassed at Yale University (Bullough, 1994, p156). Together the collection highlighted the huge variation in behaviour, practices, customs, norms, values, roles, and rules in relation to sexuality among different populations and cultures. It must however be noted that much of the source material had been collected by amateur anthropologists and missionaries, hence it was neither free from bias nor moral judgement (Bullough, 1994, p158).

5.8 Alfred C. Kinsey and Masters and Johnson

Determined to turn the study of sex into a science, free from any 'moral interference', was Dr Alfred C. Kinsey (1894 - 1956). At first appearance, he seems an unlikely candidate for such a job, and it was one he came to by circumstance rather than design. Kinsey was a Harvard-trained professor of zoology, who specialised in gall wasps. In 1938, he was asked to co-ordinate a 'marriage preparation course' - the palatable term for what was essentially sex education - for the students at Indiana University where he worked. With no empirical data to draw on to answer his students' questions, he set about collecting the data himself. The focus within the US on animal research to this point led Kinsey to remark that we know more about the sexual behaviour of animals than about humans. With a small team, he collected sexual histories from over 18,000 people, including his own father (see section 7.3 for more detail regarding his methodology). Kinsey's findings were published in the books *Sexual Behaviour in the Human Male* (1948) and *Sexual Behaviour in the Human Femal*e (1953). While hugely controversial at the time, his findings came to normalise the diversity of human sexual behaviour, revealing as they did, for example, that masturbation, same-sex experience and pre-marital sex were far more common than had been thought.

Kinsey's work is important for many reasons. Firstly, he was interested in studying sex *in and of itself*. He held that sex was a legitimate subject for scientific investigation (Bullough, 1994, p172) and

he approached it much as he had done the study of gall wasps, namely methodologically and at scale. Secondly, he challenged what had up until that point been the medical (mainly psychiatric) dominance within the field and, as a biologist, he saw sexual behaviour much like any other animal behaviour and looked upon it without any moral judgement (Bullough, 1994, p172). Thirdly, Kinsey exposed not only the diversity of sexual behaviour but also its social patterning (Bullough, 1994, p178). While the anthropologists had highlighted the differences *between* societies, Kinsey emphasized the differences *within* them, reporting variation in sexual behaviour by, for example, indicators of socio-economic status including education and income. These findings added further weight to the argument that far from being an immutable constant, sexual behaviour was shaped by social and cultural forces. However, it has been argued that while Kinsey successfully managed to break with Freudian theory, he did not manage to supplant it with any sophisticated theory of his own (Escoffier, 2020).

Though Kinsey is most famous for his surveys of sexual behaviour, he was interested in all aspects of sex. One area he was actively pursuing before his death in 1956 (at the age of 62) was the physiology of sex. He had amassed a considerable amount of data on penial size and some on clitoral size, and had sought funding for a physiologist and a neurologist in order to take this work further (Bullough, 1994, p185). However, his plans to study the biology of sex did not come to fruition before he died and it is William Masters (1915 - 2001) and Virginia Johnson (1925 – 2013) who took up the mantle in this regard (Bullough, 1994, p185).

Much like Kinsey before them, Masters and Johnson became household names through their work on sex. Masters and Johnson, however, approached the study of sex very much from a therapeutic perspective. They held that the dearth of information regarding the physiology of the human sexual response was the greatest impediment to the treatment of sexual problems within marriage (Bullough, 1994, p196). In order to address this, they established a programme of work to examine and understand the anatomy and physiology of human sexual activity under laboratory conditions. Much of the work involved observing individuals engaging in sexual activity alone or with a partner. They were interested in how the whole body responded to sexual stimulation and took measurements, for example, of the heart, the lungs, as well as the sex organs themselves. Masters and Johnson's most influential findings were published in their book *Human Sexual Response* (1966). They proposed four separate stages of sexual arousal (excitement, plateau, orgasmic and resolution). They also described changes in vaginal and uterine tissues associated with arousal and orgasm and established that women can have multiple orgasms.

Kinsey had challenged the domination of psychiatry in the field of sex research, and Masters and Johnson were to open up the field yet further to include other medical specialities (including

gynaecologist and urologist) and ultimately they were instrumental in establishing a new profession of the sex therapist (Bullough, 1994, p196). Their approach to sexual therapy, however, did not rely on 'medical fixes', rather it was premised primarily on sex education; for them it was only when the fallacies and falsehoods about sexuality are revealed and resolved that there can be a secure foundation for sexual expression. They also highlighted that women were the subject of the double standard, as they had been taught to repress their sexuality. In their assessment of female 'frigidity' for example, they concluded that far from having a biological cause, the problem lay in the suppression of sexual feelings that society demanded of women.

5.9 REVOLUTIONS WITHIN PSYCHOLOGY

Locating the drivers of behaviour to sources *outside* the body was a growing trend within psychology too and it is here that this idea arguably took its most extreme form, in the shape of radical behaviourism. From its inception in the latter half of the 19th century, psychology had focused on the subjective 'inner life' which had been studied by drawing inferences from the introspective self-examination of research participants (Moore, 2011). The theory of behaviourism arose as a new approach to psychology in the first half of the 20th century (Moore, 2011). Behaviourism cast off 'mentalistic' explanations that traced behaviour to 'mysterious entities' (such as the psyche) located *inside* the body and attempted to shift the focus onto the observable and measurable (Moore, 2011). The theory held that *all* behaviour (sexual behaviour included) was acquired from the interaction of an individual with its environment, rather than any innate physiological, or internal mental, processes (Moore, 2011).

This 'behavioural revolution' started with John B. Watson (1878 - 1958) in the 1910s and classical 'stimulus – response' behaviourism. It went through several phases until arriving at the radical behaviourism of the mid-20th century (for a summary of these phases see Moore, 2011). Radical behaviourism is a school of thought largely associated with American psychologist B. F. Skinner (1904 – 1990). Skinner believed that all behaviour is learned through a system of rewards and punishments (what he called operant conditioning). A natural extension of this argument was his view that people are infinitely malleable as everything a person is, knows and does is because of their unique experiences. In contrast to other forms of behaviourism, Skinner accepted that not all types of behaviour were 'public' and observable, some behaviour was 'private' and accessible only to the individual (for example thoughts and feelings) (Moore, 2011). Considering 'private' phenomena as *behavioural* (as opposed to *mental*) allowed for the possibility of influencing and changing such behaviour. Indeed, one of the basic principles of radical behaviourism that Moore (2011) identifies is 'social activism', and the application of behavioural principles to address social

issues through, for example, strengthening adaptive behaviour. Skinner believed that language and speech were also conditioned and learned (just like any other human behaviour), a theory that he laid out in his 1957 book *Verbal Behaviour*. However, Noam Chomsky's derisive review of the book, and the debate on language acquisition that ensued, heralded the end of the behavioural revolution in psychology and the beginning of a cognitive one that revived attention on the mind. It was Chomsky's view that to define psychology as the science of behaviour is akin to defining physics as the science of meter readings (Miller, 2003).

5.10 Social constructionism and sexual scripts

The positivism of the behavioural revolution within psychology is evidenced in the primacy accorded to the observable and the measurable (Moore, 2011). It was by turning their backs on subjective 'mentalist' explanations and embracing the objective empirical study of human behaviour that the early behaviourists felt psychology could assume its position as a bone fide science (Moore, 2011). Within sociology, however, social constructionism was questioning the very nature of knowledge and 'problematising' reality; as Parker and Gagnon eloquently put it, "*the issues are not solely how do you know or what do you know, but whether you can know*" (Parker & Gagnon, 1995, p3). Social constructionism argues that concepts become 'real' because we - collectively - ascribe meaning to them and accept their reality; they do not exist in the world as objective 'truths'. By extension, the meanings we apply to concepts are contextually bound in terms of both time and place and so are labile. A linked theory within sociology is that of symbolic interactionism, which looks at how meaning is created and acted upon by people during their everyday social exchanges.

It was by drawing on insights from social constructionism and symbolic interactionism that William Simon and John Gagnon developed their influential theory of sexual scripting. They argued that even though much greater attention had been paid to sexuality since the second world war, little had been theoretically informed (Simon & Gagnon, 1986). They also argued that the archetypal view of sexual behaviour as a static constant was now essentially untenable, given what was known from social history. In scripting theory, they proposed a model that allows for the macro and the micro when studying sexuality. At the macro level it allows for flux in contextual factors (i.e. changing social and cultural landscapes) and at the micro level it allows for meta-psychological processes (i.e. the inner life) (Simon & Gagnon, 1986).

In scripting theory, scripts are the 'socially approved' (and socially constructed) models of behaviour concerning sexuality that people adopt and endorse through a process of socialization (Simon & Gagnon, 1986). Central to sexual script theory is the idea that these scripts are culturally bound and that the cultural norms stipulate the rules for what behaviours, feelings, and thoughts are

'appropriate' (Simon & Gagnon, 1986). These scripts become the guides people use to interpret and respond to sexual situations (Simon & Gagnon, 1986). In this way 'scripts' are the 'operating syntax' guiding behaviour which Simon and Gagnon propose occur at three levels, namely cultural, interpersonal and mental.

5.11 FOUCAULT, SEX AND POWER

The social construction of sexuality and the social and structural forces that manage and regulate its expression are at the heart of Foucault's influential work *The History of Sexuality: The Will to Knowledge* (Foucault, 1976). At the outset of his treatise, Foucault retells the tale of how it came to be that '*the image of the imperial prude is emblazoned on our restrained, mute, and hypocritical sexuality'* (Foucault, 1976, p3). He describes how the Victorian bourgeois not only led the internment of sexuality to the bedroom of the '*conjugal family*', but also oversaw its diminution to a single, legitimate form and purpose. The rest it assigned outside of nature (what Foucault called '*frauds of procreation*') to be denied and silenced.

Having set out this 'Repressive Hypothesis', Foucault then renders it problematic. He argues that far from being repressed and silenced, there has in fact been a '*discursive explosion*' (Foucault, 1976, p17). More precisely he argues that there has been a rise of *specific* discourses that have served to control and manage sexuality. He describes an '*institutional incitemen*t' to speak about sex. This first began in the confessional of the Church, and then moved to other agencies of power including science and medicine. Foucault termed the Western approach to sex *scientia sexualis* (the science of sexuality) which he contrasted to that of Eastern cultures, which he called *ars erotica* (erotic art). *Scientia sexualis* and *ars erotica* are both types of knowledge, and both involve divulging secrets; in the former these are the secrets of sexual shame to be extracted in the 'confession', in the latter these are the secrets of sexual pleasure to be passed down by the wise. By counting, classifying, and defining sex through scientific investigation, sexual discourses have come not just from morality but also rationality (Foucault, 1976, p24). This, he argues, may be a more '*devious and discreet form of power*', what he calls *biopower* (Foucault, 1976, p17). Foucault goes on to suggest that there are two main forms of biopower, both of which involve sex, these are discipline of the body and regulation of population. He further identifies four focal points: the sexuality of children, married couples, women and 'the perverse', all of which are to be managed and regulated.

Foucault's work is not without critique. It has been suggested that his history is too simplistic (Bullough, 1994, p245) and that he downplays the degree to which sexuality has been silenced and repressed (Parker & Gagnon, 1995, p5). Bullough (1994, p245) goes so far as to suggest that rather than a history, he was creating a narrative of the past that would enable him to accept his own

homosexuality. Notwithstanding these criticisms, what Foucault did was to underscore the importance of historical work in understanding sex in the present day (Bullough, 1994, p245).

5.12 GENDER AND IDENTITY

Two of Foucault's four focal points – namely women and 'the perverse' - became important sources of challenge and disruption in the late 1960s and early 1970s (Parker & Gagnon, 1995, p8). Further, it was historical studies, coupled with a social constructionist frame, that were important in driving the re-examination of the 'sexological orthodoxy' that feminists and sexual minority groups demanded (Bullough, 1994, p245) and continue to demand to this day.

Feminist concerns were not new to sex research (Bullough, 1994, p242). As noted above, sexology in the early part of the 20th century was developing during a period of feminist protest (which came to be known as the 'first wave of feminism'). Many of the issues that fell under 'sexual reform' during this first wave became the focus during the second wave that started nearly 50 years later (Bullough, 1994, p242). Feminists were again highlighting the inequality experienced by women and their subjugation via the institutions of marriage, family, and motherhood and they called for change (Bullough, 1994, p243). However, while many of the issues may have been familiar the intervening years had seen some major social changes and significant scientific advances.

First, there had been a profound change in public attitudes towards sexuality. Factors contributing to this change included the development of oral contraception, which increasingly removed sex from reproduction, and also the works of Kinsey, and Masters and Johnson (see section 5.8) (Bullough, 1994, p173). Second was the introduction, by John Money in 1955, of the notion of gender. Money had been studying 'hermaphrodites' (today known as intersex people) and found that he was unable to adequately describe his observations with the terminology available to him (Bullough, 1994, p211). He took the term gender from linguistics and used it to differentiate between the biological notions of male and female and the social notions of masculinity and femininity (Bullough, 1994, p210). Subsequently, Money further differentiated between gender identity (how people perceive themselves) and gender role (how gender is perceived by others). Concomitant with the emergence of gender as a concept was the recognition of its social construction. For feminists, this was a powerful argument with which to challenge the position that "*biology is destiny*" which had been used to keep women in a subordinate status to men (Bullough, 1994, p210).

Bridging activism and academia was the new field of feminist studies. Interpreting sexuality through a gender lens exposed and confronted a whole range of issues in sex research and ultimately led to a widening of its remit. These included the dominance of male researchers and models of 'normality'

based on the sexuality of men (Parker & Gagnon, 1995, p9). Also highlighted was the role of gender inequality, especially inequalities in power, in shaping the sexual practices of men and women (Parker & Gagnon, 1995, p9). Until the 1970s, sexual harassment, sexual coercion and sexual violence had not attracted much of the attention of either sexologists or historians (Bullough, 1994, p245). The second wave of feminism, however, was to change that and ultimately see all forms of sexual violence brought under the umbrella of sexual health. Combating gender-based violence (including sexual violence) has continued as a central theme in the subsequent third and fourth waves of feminism and become an important area of sexual health research (see Chapter 6 and Paper *Lifetime prevalence, associated factors and circumstances of non-volitional sex among women and men: Findings from the third British National Survey of Sexual Attitudes and Lifestyles (Natsal-3)* on page 79).

Also spanning activism and academia, and emerging around the same time as feminist studies, was lesbian and gay studies. There have been important intersections between the two disciplines, but also a number of divergences (Parker & Gagnon, 1995, p9). One area where lesbian and gay studies was to disrupt sexological thinking was in the relationship between identity and behaviour (Parker & Gagnon, 1995, p9). For example, the early sexologists had long been vexed by 'homosexuals' whose desire, identity and behaviour defied their categories (Parker & Gagnon, 1995, p9). In recent years, the field of lesbian and gay studies has grown to encompass other sexual and gender possibilities including bisexual, trans, intersex and queer. Further, queer theory has embraced all non-(hetero)normative forms of sexual activity and identity, as well as divergences between sex, gender and sexuality. Queer theory conceives gender and sexuality as multifaceted, fluid, and in flux, hence defying simple categorisation and classification.

5.13 HIV/AIDS AND THE NATSAL STUDIES

It is with the advent of HIV/AIDS in the early 1980s that Natsal enters the story. HIV exposed just how little was known about sexual behaviour in Britain (and elsewhere in the world). As the then Chief Medical Officer Donald Acheson said in his forward to the book detailing the results of the first Natsal, the emergence of HIV/AIDS "*focused our attention on our profound ignorance about many aspects of sexual behaviour*" (Wellings *et al*, 1994, pviii). Robust data were urgently needed with which to model the likely trajectory of the virus, to inform prevention efforts and plan services for those affected, and this opened the door to the study of sexual behaviour. As Wellings (1994, pix) put it, "*Without question, the HIV epidemic has provided the impetus, the rationale and the legitimation for this survey*".

The theoretical framework in which Natsal has been grounded from the first survey centred on the malleability of sexual behaviour and the centrality of social and cultural forces that shape and regulate its expression. As we have seen, this is a long way from the essentialist views that dominated until the latter half of the 20th century. In the face of the emerging threat posed by HIV/AIDS, it was in the diversity of sexual expression that "*the seeds of hope may be found in the selection of sexual health strategies*" (Wellings *et al*, 1994, p6). Before the introduction of anti-retrovirals there were no treatment options; the *only* potential way to mitigate the effects of the virus was by limiting transmission through preventive efforts. From the outset, school sex education was identified as an important - and for some the most important - way of responding to the epidemic (Iyer & Aggleton, 2015). Sex education as a *behaviour change* strategy is clearly of little value in the face of biological determinism.

5.14 SEX EDUCATION

The strategy of legitimation that is most often made in support of sex education is that of 'damage limitation' (Oakley, 2013; Iyer & Aggleton, 2015). The damage to be limited, and the reasons why, provide a 'window' through which to view the dominant academic, moral, political and cultural beliefs of the day. In their review of seven decades of papers on sex education in the Health Education Journal, Iyer & Aggleton (2015) chart significant changes in views regarding what constitutes 'normal' sexuality and find most papers focus on '*the dangers of disease, pregnancy, loss of reputation and moral character*'. However, there are alternative arguments to be marshalled in support of sex education, which include knowledge as a right (Oakley, 2013; Ingham, 2016), and positively framed legitimisations including those that include pleasure and empowerment (Ingham, 2006).

In Natsal-3, I led the analysis of data examining the associations between sex education and sexual health outcomes. The findings were published in the BMJ Open (Macdowall *et al*, 2015) and are included here as the first paper within this research paper style thesis (see page 55).

There were two key research questions I set out to answer. The first was whether there was evidence of social variation in young people's reporting of sex education. This question was rooted in the position that school sex education has the potential to confer benefits, and as such, any variation in provision might be one mechanism through which inequalities in sexual health outcomes may be mediated (and ultimately ameliorated). The second question was whether reporting school as your main source of sex education (as opposed to other sources such as friends, or the media) was positively associated with sexual health outcomes. I included a wide range of outcomes that reflected the broader conceptualisation of sexual health adopted within Natsal-3 (see Chapter 6).

Hence, in addition to STIs and pregnancy, I included non-volitional sex and sexual function alongside the age and circumstances of first sex.

The findings showed that there were differences in receipt of school sex education by markers of socio-economic status. For example, participants who had no qualifications (and among men, only those typically gained at 16 years) were less likely to report school as their main source of information than those with higher qualifications. Reporting school as the primary source of sex education was associated with later age at first intercourse and the lower reporting of a wide range of sexual health risk behaviours and outcomes. I found the range of positive associations to be greater for young women than young men. Lower reporting of some of the sexual health outcomes explored might, of course, be due to later age at first sex (and fewer years being sexually active). Remarkable in these data, however, is the number of associations that remain after adjusting for age at first sex, years sexually active, education level and family structure (for men, a lower likelihood of having unsafe sex in the past year, and for women a lower likelihood of first sex being defined as lacking sexual competence, ever diagnosis of an STI and distress about sex in the past year), which suggests that school-based sex education is associated with additional benefit independent of that relating to later age at first sex.

The Natsal team, led by myself and Clare Tanton - who led on the companion sex education paper that appeared in the same issue of the BMJ Open (Tanton *et al*, 2015) - made two submissions to the 2015 Education Select Committee Inquiry into Relationships and Sex Education (RSE), and our findings featured in the Committee's final report, which recommended that RSE be statutory. To coincide with the publication of the papers, we collaborated with the Sex Education Forum on organising the 'RSE: Coming of Age' event (hosted by The Wellcome Trust and funded as part of ESRC's Festival of Science) and on updating their evidence briefing which relied heavily on our Natsal findings (see https://www.sexeducationforum.org.uk/resources/evidence/sre-evidence).

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6 CONCEPTUAL PERSPECTIVES

6.1 OVERVIEW

In this chapter, I trace the emergence of the concept of 'sexual health' and show that although the term has come to be used widely, its history is recent, and its meaning and application has varied. I explore how the definition has evolved from a focus on sexual ill-health to sexual well-being and the thinking that has led to this shift. Lastly, I consider the implications of a holistic conceptualisation of sexual health for policy, practice and research, and how it was reflected in Natsal-3.

6.2 SEXUAL HEALTH AS A DISTINCT ELEMENT OF HEALTH

The term 'sexual health' is now used widely across the world in policy, practice and academic fora, however the concept only emerged on the international agenda in latter half of the 20th century and its meaning, and application, has varied considerably. 'Sexual health' is rooted in the concept of 'health' and given that health is well recognised to be problematic, so too, by extension, must be sexual health (Sandfort & Ehrhardt, 2004; Giami, 2002). A primary tension in conceptualisations of health centres on whether it is the *absence* of negative states (such as disease and/or dysfunction) or the *presence* of positive ones (such as wellbeing and/or autonomy). The enduring 1946 WHO definition of health as "…a *state of complete physical, mental and social well-being, not merely the absence of infirmity or disease*" (WHO, 1946) rejects the biomedical model and encompasses psychological and social components, but has long been criticised for being too broad and aspirational. Another tension is who gets to decide what it means to be 'healthy'. There is no objective reality of 'health'; it is a social construct that means different things to different people at different times.

We can see how these tensions in the conceptualisation of health are mirrored in those of sexual health. There is also a warning in the literature regarding the outwardly benevolent banner of health being used as justification to police and govern sexual behaviour (Sandfort & Ehrhardt, 2004; Giami, 2002). This resonates with Foucault's concept of 'biopower' of 'the State' over the human body. Foucault argues that power becomes 'encoded' into social practices and human behaviour and in doing so, the population slowly yields to the subtle conventions of the social order (Foucault, 1976). Giami (2002) also argues that the introduction of sexuality into the public health arena is an "*extension and an intensification of the medicalisation of sexuality*".

6.3 WHO AND DEFINITIONS OF SEXUAL HEALTH

The term 'sexual health' first appeared explicitly in a WHO document in 1975. The document was written following a meeting of an expert committee in 1974 to discuss the training of health

professionals in human sexuality. This document has been criticised for representing "*Western, middle class sexual values*" (Giami, 2002) and also for bearing the hallmarks of the medicalisation of sexuality (Tiefer, 1996). However, even at this nascent stage of the evolution of the concept, many of the ingredients of contemporary sexual health, and the challenges that remain to this day, are evident. First, there is a 'positive' definition of sexual health, one that echoes the WHO definition of health, including psychological and social alongside physical dimensions, plus a recognition that sexual health is more than the absence of disease and encompasses positive well-being (see table 1). Second, is the emergence of rights-based arguments and establishment of the importance of pleasure: "*fundamental to this concept* [sexual health] *is the right to sexual information and the right to pleasure*" (WHO, 1975, p6). Third, is the establishment that sexual health has a wider focus than "*procreation or sexually transmitted infections"* (WHO, 1975, p7). Lastly, there is the classification of the basic elements that sexual health includes:

1) *A capacity to enjoy and control sexual and reproductive behaviour in accordance with a social and personal ethic*
2) *Freedom from fear, shame, guilt, false beliefs and other psychological factors inhibiting sexual response and impairing sexual relationships*
3) *Freedom from organic disorders, diseases and deficiencies that interfere with sexual and reproductive functions* (WHO, 1975, p6)

Over a decade later, in 1987, the WHO Acting Director (Lifestyles and Health) questioned "whether there is a need for a separate sub-category of 'Sexual Health' and "*whether a definition of sexual health would be medical, moral, social or psychological",* suggesting a "*power element for any such definition*", (WHO, 1987) and that any attempts at a definition would be too normative. The 1987 document was never publicly endorsed by WHO (Giami, 2002). Hence, the 1975 definition continued to be used for several decades.

Table 1: WHO definitions of sexual health

Year	Event	Definition
1946	WHO defines health; recognises health is more than the absence of disease.	"…a *state of complete physical, mental and social well-being, not merely the absence of infirmity or disease" (WHO, 1946).*
1975	First definition of sexual health appears in a WHO document.	"*Sexual health is the integration of the somatic, emotional, intellectual and social aspects of sexual being, in ways that are positively enriching and that enhance personality, communication and love*" (WHO, 1975).
2000	PAHO/WHO, 2000.	*"Sexual health is the experience of the ongoing process of physical, psychological, and socio-cultural well-being related to sexuality. Sexual Health is evidenced in the **free** and **responsible** expression of sexual capabilities that foster harmonious personal and social wellness, enriching individual and social life. It is not merely the absences of dysfunction, disease and/or infirmity. For sexual health to be attained and maintained it is necessary that the **sexual rights** of all people be recognized and upheld" (*PAHO/WHO, 2000).
2002	WHO revised its definition, though it was not formally ratified by the World Health Assembly.	*"Sexual health is a state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity. Sexual health requires a positive and respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination and violence. For sexual health to be attained and maintained, the sexual rights of all persons must be respected, protected and fulfilled" (WHO, 2006).*
Present day	WHO continue to use 2002 working definition and stress "*it should be noted that this definition does not represent an official WHO position and should not be used or quoted as such. It is offered instead as a contribution to ongoing discussion about sexual health*".	

See: https://www.who.int/reproductivehealth/topics/sexual_health/sh_definitions/en

The next major milestone came in 2000, following a meeting of the Pan American Health Organisation and the WHO (PAHO/WHO) in Guatemala, from which emanated a report entitled *Promotion of Sexual Health: Recommendations for Action* (PAHO/WHO, 2000). This publication is notable for many reasons; firstly, it was written largely by sexologists from Central and South America (i.e. not through a Western, middle class lens); secondly, it drew heavily on the scientific literature (there were no references in the 1975 and 1987 documents); thirdly, it brought in parallel developments in medicine (including the evidence-based medicine movement); and finally, it saw the addition of new concerns related to sexuality (including sexual violence against women, gay and lesbian rights, and women's rights in terms of sexuality). Giami (2002) describes two major conceptual evolutionary steps taken in this document; namely the provision of definitions of sex and sexuality located in terms of responsibility and rights, and the development of sexual health on the principle of well-being.

In 2002, WHO convened a Technical Consultation on Sexual Health, one of the specific objectives of which was to consider the definition of the concept (WHO, 2006, p2). The revised definition of sexual health mirrored that of health as "a *state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity"* (see table 1). The definition also included the notion of sexual rights: "*For sexual health to be attained and maintained, the sexual rights of all persons must be respected, protected and fulfilled*". A wider range of sexual rights than had appeared in earlier documents included the right to services, to information, to bodily autonomy, to consensual sex and marriage, to choose if and when to have children and finally the right to "*pursue a satisfying, safe, and pleasurable sexual life*" (WHO, 2006, p5). The 2002 definition was not formally ratified by the World Health Assembly, and hence remained a 'working' one.

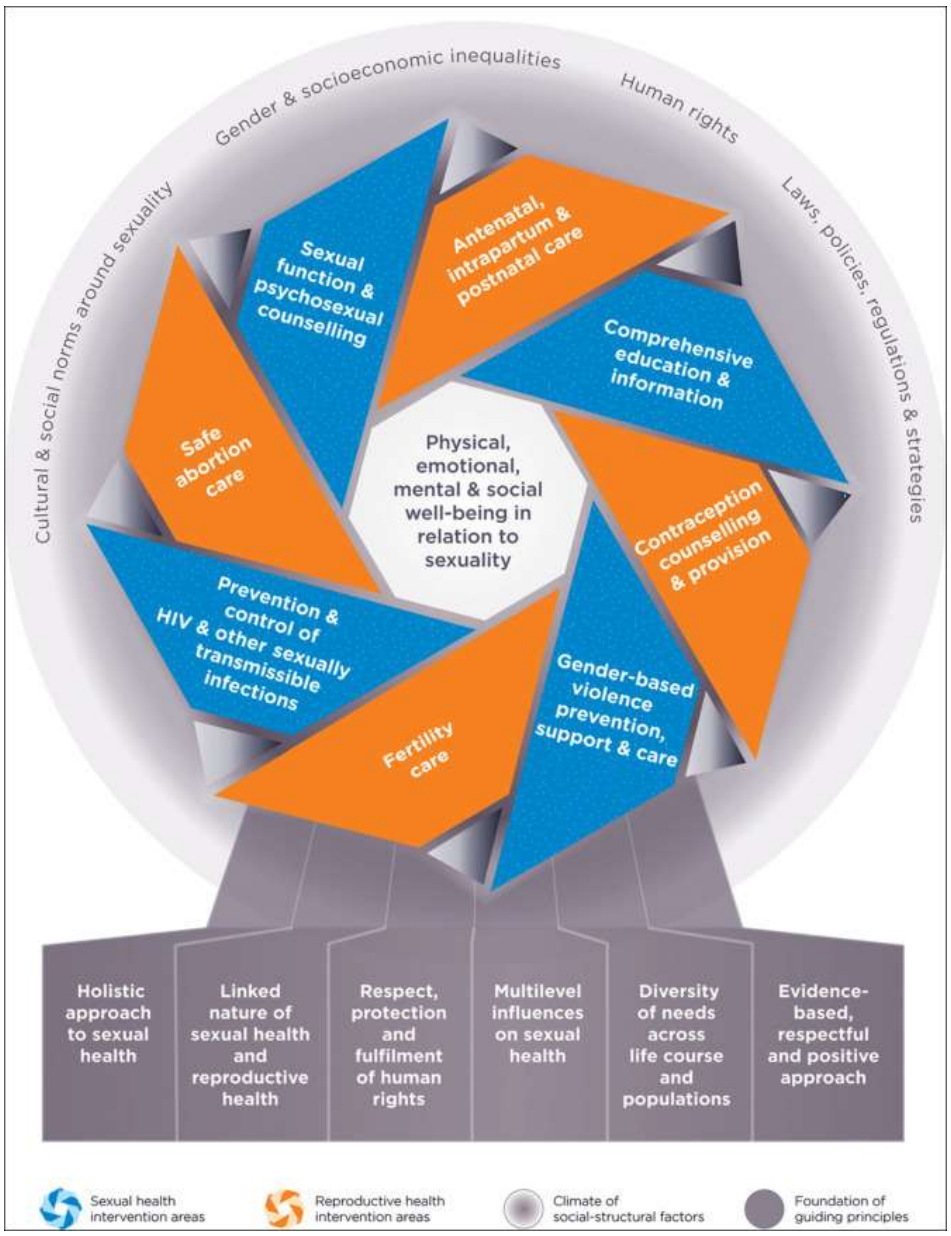
6.4 SEXUAL HEALTH AND REPRODUCTIVE HEALTH

One of the challenges in defining the concept of sexual health relates to the question of how, and in what ways, it overlaps with and/or diverges from that of reproductive health. The International Conference on Population and Development (ICPD), for example, situated sexual health as a sub-set of reproductive health (Stephenson *et al*, 2017). A subsequent conceptual framework of sexual *and* reproductive health (SRH) developed by WHO in 2010 presented the two as having overlapping concerns in common but also some that were separate and distinct (WHO, 2010). In this framework, the 'reproductive health outcomes' included contraception; antenatal, obstetric and post-natal care; infertility and mental health related to reproductive health. The 'sexual health outcomes' included sexual dysfunction and mental health related to sexual health, and the outcomes in common

included STIs; gender-based violence; unsafe abortion; stigma and harmful practices and traditions (WHO, 2010). Clearly which outcomes belonged under which heading and what their position meant in terms of translating the framework into policy and practice are matters for interpretation and debate. Importantly however, this framework also laid out core concepts that underlay *all* SRH outcomes, which include "*sexuality based on autonomy, wellbeing and fulfilment, promotion and protection of human rights*" (WHO, 2010). While this is essentially a rights-based argument, there is emerging evidence that having a 'positive' conceptualisation of sexuality underpinning *all* SRH efforts may translate into health improvements that are greater than those driven by concern with mitigating against negative biomedical outcomes (Hawkes, 2014). It is worth spending a moment to reflect on 'autonomy' which encapsulates notions of having 'freedom of choice', 'control', 'agency' and 'self-determination'. Autonomy, however, is also an ethical principle, and there will always be tensions regarding the upholding of autonomy and who has the competence and capacity to make 'autonomous' decisions for themselves. This tension is perhaps most overtly exposed in the sexuality of young people and people with special educational needs. There may also be cultural differences in constructions of autonomy and the status it is granted (Park & Chirkov, 2020).

More recently, in 2017 WHO convened a Working Group for Operationalizing Sexual Health; the resulting framework (see Figure 1) recognises and represents the interconnectedness of sexual and reproductive health (WHO, 2017). The expressed intention in the 2017 framework is that by showing how sexual health and reproductive health are entwined (as opposed to overlapping) it will be more difficult to 'overlook' the sexual health aspect and it will create "*broader awareness of comprehensive sexual health interventions and to ensure that sexual health and reproductive health both receive full attention in programming*" (WHO, 2017). The framework also recognises the social and structural factors at play, and in doing so has moved toward more of a socio-ecological model of SRH. As with the 2010 framework, core concepts that underlay *all* SRH intervention areas are presented, though these are expanded and framed as six 'guiding principles'. These principles, it is argued, should be incorporated into the design of all sexual and reproductive health interventions and can also function as criteria against which interventions can be assessed in evaluation (WHO, 2017).

Figure 1: WHO framework for operationalizing sexual health and its linkages to reproductive health



6.5 Framing of Natsal

While the concept of sexual health dates from 1970s, it was not until the 1990s that the exponential rise in references to sexual health in the academic literature was seen, which Sandfort and Ehrhardt (2004) attribute to both the advent of HIV/AIDs and the discovery of Viagra. Even though the explicit focus of Natsal-1 was HIV, the wider applicability of the data, and the need for the findings of this first national survey to be relevant to other areas of public health, was evident from the outset. This led to attempts to broaden the scope of the survey beyond information related to HIV in the

development of the questionnaire, and the areas of "*sexuality, **sexual health** and reproduction*" were specifically identified (Wellings *et al*, 1994, p4). So the concept of sexual health informed, but did not explicitly frame, the first Natsal survey. With remarkable foresight, in the introduction to *Sexual Behaviour in Britain* the authors recognise that *"Future historians may wonder at the absence of information of the psychological and pleasurable nature of sexual relationships"* (Wellings *et al*, 1994, p7). Their omission was attributed to the acceptability of enquiries of this nature among the general population and the sensitivities of publicly funded bodies that were supporting the survey (Wellings *et al*, 1994).

Natsal-3 ultimately came to be framed in terms of a holistic definition of sexual health (see Wellings and Johnson, 2013). Hence, as well as STIs and reproductive health, it included a new measure of sexual function (the Natsal -SF; Mitchell *et al*, 2012) and was the first Natsal survey to include questions about non-consensual sex. We asked participants, both women and men, about their experience of sex against their will, which we reported - in the most literal translation of the question - as non-volitional sex.

I led the analysis of non-volitional sex in women and men, which examined the circumstances surrounding the most recent occurrence, and the associations between ever having experienced completed non-volitional sex and several sociodemographic, behavioural, and health factors. The findings were published in T*he Lancet* (Macdowall *et al*, 2013) and are included here as the second paper within this research paper style thesis (see page 79).

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7 METHODOLOGICAL PERSPECTIVES

7.1 OVERVIEW

In this chapter, I chart major evolutionary steps in the emergence of the sex survey as a method within sexology and explore methodological advances within Natsal specifically. We see how the forerunner of the sexological questionnaire emerged in the latter half of the 19th century as a way to boundary the self-penned sexual autobiographies sent to sexologists of the day. The early sexologists predominantly came from a background in psychiatry, and the 'proto-questionnaire' they employed gave structure to the case studies they collated and published. The sex survey itself emerges with Magnus Hirschfeld at the beginning of the 20th century and his 'psychobiological questionnaire'. Hirschfeld amassed a huge amount of data; however it is not his name that is synonymous with the first major sex surveys but that of Alfred Kinsey. Kinsey came to challenge the sexological orthodoxy in many ways, one of which was the medical dominance of the field. His non-random approach to sampling, however, was a major weakness that ultimately led to his findings being disputed.

As noted in Chapter 5, it was with the urgent need for population level data in the face of HIV/AIDS that Natsal was born. Each iteration of the survey has shared a number of fundamental methodological characteristics but over its 30-year history the survey has evolved too, and the disciplines represented within the team have expanded. This trend is exemplified by the inclusion of a measure for testosterone (T) in Natsal-3 with which to explore the associations between levels of T and sexual behaviour and function. I led this methodologically novel and challenging work package, the findings from which are presented here as the third paper in this thesis.

7.2 THE BIRTH OF THE SEX SURVEY

In the period preceding World War Two, we have seen that the key figures in the development of sexology were European physicians, predominantly psychiatrists, and that the forefathers were forensic psychiatrists in particular (see section 5.2). Their focus was largely on trying to document, categorise and understand difference in relation to human sexuality. They reached for biological explanations for the diversity they observed. While concluding that diversity was natural they could only speculate about the origins of such variance; pointing to the psyche, to hereditary factors, and suggesting that 'internal secretions' may provide the answer (Bullough, 1994, p124). Their scientific method relied on the 'case study', and initially their cases were drawn from the courts and from psychiatric hospitals. Magnus Hirschfeld, it is argued, can be credited as the first to develop a sexological questionnaire (Pretsell, 2019). In 1898, Hirschfeld began to administer his

'psychobiological questionnaire' in his clinical practice. It originally consisted of 85 questions but by 1930 the number had increased to 137 (Pretsell, 2019). Hirschfeld's Jewish heritage, alongside the focus of his work and his strident quest for sexual reform, made him a target of the growing right wing in Germany. Ultimately his life's work was destroyed by the Nazis but it is estimated that before his death in exile in France up to 40,000 of his 'psychobiological questionnaires' were administered in total (Pretsell, 2019).

Questionnaires had been used as a tool to gather data in other areas of research. However, Pretsell (2019) argues that the history of questionnaire use in sexology is not the story of the simple adoption of a tried and tested research method, but rather it emerged over a number of years as a result of the interaction between sexologists and their 'assertive subjects'. Specifically, it evolved as a pragmatic way to handle the unsolicited - later to be solicited – sexual autobiographies sent to prominent figures of the day who were seen to be sympathetic to advancing the cause of greater tolerance and understanding of same sex love (Pretsell, 2019).

It is not however with a sexologist that this history starts, but rather with a lawyer, literary activist and 'sexual radical' called Karl Heinrich Ulrichs (1825- 1895). Ulrichs, it has been argued, was the first openly gay man in modern history (Bullough, 1994, p37). Between 1864 and 1879 he wrote twelve literary pamphlets on the 'Riddle of Man-Man Love' in which he argued that homosexuality was inborn - hence not against nature - and advocated for the rights of homosexual men (and women) to express what was natural and given to them by God. As such, Ulrichs has been recognised as the founder of the gay rights movement. It was Ulrichs who first proposed that homosexuals were the 'third sex', which he theorised was the result of a women's psyche in a man's body. Soon after his first works were published, Ulrichs started to receive 'confessional' letters from readers in which they shared their own sexual life stories (Pretsell, 2019). Ulrichs could see the potential value of these letters for his work. Hence, in subsequent publications, he invited his readers to write to him and, in an attempt to ensure that the letters contained the information that he was most interested in, he gave instructions on what themes to cover. There were four themes: 1) the habits and behaviours of homosexual men; 2) the 'gentle and fine character' of homosexual men; 3) bisexuality and lesbianism and 4) experience of persecution. Pretsell (2019) calls this a 'proto-questionnaire' and suggests it was the first tool of its kind to have been employed in the field of sexuality. Ulrichs's later publications drew heavily on the letters he received, hence giving voice to the storytellers and providing a window to their inner lives. As an advocate and reformer, Ulrichs ensured that his work reached leading physicians of the day and it is argued that his influence on the emerging field of sexology was profound (Pretsell, 2019).

As noted above, this emergent field of sexology was dominated by psychiatrists. While it might be expected that a central concern of psychiatrists would be the inner life, what the patient had to say was rendered unreliable by those, including Krafft-Ebing, who endorsed degeneration theory (Pretsell, 2019). At the same time, however, sexual case studies were not the same as standard medical case studies; the attending physician could not make their assessment through observation or physical examination: information needed to be elicited through conversation and self-report. The voice of the patient, de facto, attained higher status than in other types of case study, albeit that in the early years the lens of degeneration obscured it (Pretsell, 2019). Over his career, however, Krafft-Ebing became more benevolent towards his subjects, and his work ultimately came to undermine the pathologising nature of degeneration (Bullough, 1994, p41). His changing perspective, Pretsell (2019) suggests, can be traced to him leaving his role at a psychiatric asylum and moving into private practice, where he encountered wealthy and otherwise 'healthy' homosexual men. In adopting a more compassionate approach in his writings, Krafft-Ebing, like Ulrichs before him, started receiving unsolicited sexual autobiographies which he published, as case studies, alongside those drawn from his practice. The case studies followed a standard format: family history of degeneration; general health; sexual interests and behaviour; and a sexual biography including indications in childhood, early awareness, first experiences and current practices (Pretsell, 2019). Like Ulrichs, Krafft-Ebing came to appeal for more self-penned case studies, all of which contributed to *Psychopathia Sexualis*, the work he is most famous for, which was first published in 1886 (and in which he again appealed for more case studies). A year later, in 1887, Havelock-Ellis and Symonds published the first English text on homosexuality (*Sexual Inversion).* It was Symonds who collected the information on their subjects; influenced by Ulrichs and Krafft-Ebing he used a standard set of questions which he sent to potential case studies. Thus, Pretsell (2019) argues, the questionnaire developed as a way of '*taming*' the sexual autobiographies of a growing community of (mostly) men who wanted their voices and experiences heard and understood. It is through this process that Foucault (1976, p65) argues that the confessions of sexuality come to be "*constituted in scientific terms*".

As noted above, Hirschfeld began to administer his 'psychobiological questionnaire' in his clinical practice in 1898. Not long after, he conducted what would now be recognised as a sex survey. One of the first research activities of his newly established Scientific Humanitarian Committee was a survey of students at the Berlin Technical University and members of the Berlin Metal Workers Union in order to investigate the prevalence of homosexuality and bisexuality. Questionnaires were anonymised (with the use of codes) and participants were asked to circle which gender they were

attracted to. The findings, published in 1903, reported that 2.2% of the men surveyed were homosexual (Bullough, 1994, p67).

7.3 The Kinsey interview

It is Kinsey, however, and not Hirschfeld, who is most famously connected with the first sex surveys. Kinsey was a provocative figure for many reasons, and there has been controversy surrounding some of his methods (Bullough, 1994, p173). However, many of Kinsey's methodological concerns still resonate today.

Firstly, he was particularly worried about whether his participants would tell the truth (i.e. would they withhold information or exaggerate their answers). He was similarly concerned whether they would be able to accurately remember events from the past (Bullough, 1994, p173). In response, Kinsey felt that a personal interview was the method that was most likely to yield accurate data and he built into his interview a number of 'checks' which would highlight and help resolve any inconsistencies in the responses of participants. He also used 'cross checks' when, for example, a husband and wife were interviewed. Secondly, he was concerned with reliability, and he re-interviewed some people several years apart to find out if they gave the same answers (what we would now call test-retest reliability) (Bullough, 1994, p173). Thirdly, he was anxious about the potential for interviewer bias. With this in mind, he limited the number of interviewers to four (all men). The basic Kinsey interview was 350 items, with a maximum of 521. The questionnaire was memorised by the interviewers, and all questions asked in a factual, non-judgemental way. Answers were written down using symbols on a grid that could not be 'read' by anyone outside of the team (Bullough, 1994, p174).

While many of Kinsey's methodological concerns still resonate today, few of his analytical tools - such as his concept of the 'sexual outlet' and the actual Kinsey interview itself - were adopted more widely following the publication of his reports (Escoffier, 2020). One of his innovations that was embraced more widely however, was the 'Kinsey Scale'. Kinsey was interested in the objective measurement of behaviour rather than the more subjective labelling of identities. He developed the 'Kinsey Scale' in which he placed sexual attraction and sexual experience on seven-point scales from exclusively same sex to exclusively opposite sex. In doing so he recognised that sexuality occurred on a continuum rather than in binary.

The major methodological criticism of Kinsey's work related to his sampling methods, which were not random and depended on volunteers. This resulted in certain groups being overrepresented in his sample, for example there was a disproportionate number of prisoners and men who have sex with men. The reliance on volunteers also led to charges that only less inhibited people would take

part in his survey and their responses would provide a skewed picture of the sexual behaviour of the 'average' American (Bullough, 1994, p176). Ultimately, the validity of Kinsey's findings was brought into question due to the lack of representativeness of his sample (Bullough, 1994, p177).

7.4 NATSAL METHODOLOGY

The history of events leading up to the first Natsal was the subject of a Wellcome Trust funded Witness Seminar in 2011 (Overy *et al*, 2011). The Witness Seminar explored how the original team (Kaye Wellings, Julia Field, Anne Johnson and Jane Wadsworth) came together, and investigated the remarkable story of the search to secure funding. Following a successful pilot study that had been supported by the Economic and Social Research Council (ESRC), the proposal for the main survey was submitted to the Department of Health. After a long wait for news on the funding, a story broke in The Sunday Times under the headline 'Thatcher Halts Survey on Sex', in which it was reported that the survey had been blocked by the prime minister herself on the basis that such a study would be an unacceptable incursion into the private lives of the British public. Subsequently, it has been suggested that the survey was actually stopped at a junior ministerial level and that Thatcher may not have challenged the perception that she was responsible for the decision as it enhanced her reputation as the champion of "*conservative moral values*" (Overy *et al*, 2011). Within a month however, the Wellcome Trust had stepped in to fund the survey (Wellings, 1994, p11; Overy *et al*, 2011).

The key features of each Natsal survey to date are summarised in table 2 below. While there have been many methodological advances over successive iterations of the survey, there are three essential methodological features shared by them all.

Firstly, Natsal employs random probability sampling methods using the Post Office's small users Postcode Address File (PAF) as the sampling frame. At each randomly selected address, the fieldworker then randomly selects and invites one member of the household (in the age range) to participate. Natsal had an advantage from the start in being able to harness computer technology to create a random sample. As a result, participants are broadly representative of the general population. This has obvious and important advantages over other (non-random) sampling methods, such as convenience sampling, when it comes to providing robust population prevalence estimates of key behavioural and health outcomes and their associated factors.

Secondly, in all the Natsal surveys the data are collected via a personal interview, conducted face to face in the participant's home (or venue of their choice). Alternatives were considered for Natsal-1, including postal and telephone interviews (Wellings *et al*, 1994, p15). On the plus side, having an interviewer present would provide the opportunity to build rapport with the participant and mean

their questions could be answered. On the downside, an interviewer could potentially introduce interviewer bias, and reduce anonymity. Ultimately, it was felt that the volume and complexity of the data to be collected, and the sensitivity of the subject matter pointed towards a personal interview. Having an interviewer present also meant they could ensure privacy as there was concern that having other members of the household in the room during the interview might influence participants' responses (Wellings *et al*, 1994, p15).

Table 2: Methodological features of Natsal 1, 2 and 3

	Natsal-1	**Natsal-2**	**Natsal-3**
Fieldwork dates	1990-91	1999-2001	2010-2012
Age range	16-59	16-44	16-74
Sample size	18,876	12,110	15,162
Over-sampling	None	London Ethnic boost	Ages 16-34
Questionnaire	Pen and paper (PAPI)	Computer (CAPI/CASI)	Computer (CAPI/CASI)
Biological sampling	None	**Urine** • Chlamydia	**Urine** • Chlamydia • Gonorrhoea • HIV • HPV • Mycoplasma genitalium **Saliva** • Testosterone
Overall response rate	67.4%	65.4%	57.7%

Thirdly, all Natsal surveys have included a combination of interviewer-led and, for the more sensitive topics, self-completion questions. The Natsal-1 questionnaire was pen and paper (PAPI). From Natsal-2 the interview became computer-based and employed a combination of computer assisted personal interview (CAPI) and computer assisted self-interview (CASI). During the interview, the first section of the questionnaire is asked face to face with the use of show cards, then the computer is handed over to the participant for the CASI section. The acceptability and feasibility of adopting CAPI/CASI within Natsal and the potential advantages over PAPI were tested in a methodological experiment during the development phase for Natsal-2. The experiment found that there was no

consistent evidence that CASI resulted in greater reporting of risk behaviours than PAPI. However, there was higher internal consistency in the data and a reduction in item non-response with CASI (Johnson *et al*, 2001). Clearly, any changes in methodology between surveys is a factor that must be considered when interpreting trend data (Copas *et al*, 2002).

In Natsal-3, there was also a nested methodological study, this time investigating administering a shortened version of the questionnaire online (Erens *et al*, 2014). Four (non-random) volunteer Web panels were used; the findings from each panel were compared with each other and with those obtained from Natsal-3. The results highlighted that, as anticipated, participants in the Web surveys were less representative of the general population and key estimates of sexual behaviours differed, with estimates from the Web panel generally higher than those found in Natsal-3 (Erens *et al*, 2014). While Web surveys are comparatively quick and less costly than face-to-face interviews, it was concluded that - given the biased estimates - their use is not recommended if a key objective is to provide accurate prevalence estimates for the general population (Erens *et al*, 2014). When designing Natsal-4, we re-visited this conclusion in the light of new evidence that had emerged in the intervening years from other social and sexual surveys internationally; we also reviewed other potentially less costly methods of data collection including mixed mode (Mercer *et al*, 2019). We concluded that, given 1) major issues with the alternative options considered still needing to be overcome (including selection bias, response bias and lower response rates) and 2) the uncertainty around any potential cost-savings, Natsal-4 should retain the design used by the preceding three surveys (Mercer *et al*, 2019).

7.5 INTEGRATING BIOMEDICAL AND BEHAVIOURAL MEASURES

As can be seen in table 2, one area within Natsal where there have been advances with each iteration of the survey has been biological sampling.

In survey research, biomedical measures may be collected alongside behavioural ones for several reasons. Firstly, they can be used to verify self-reported data and are often considered the ultimate way of establishing 'the truth'. For example, in studies looking at smoking, cotinine (a metabolite of nicotine) can be measured to assess tobacco consumption. In the alcohol field, biosensors and breathalysers can be used to measure alcohol levels. In sex research, however, there is no biomedical measure that can be employed with which to corroborate self-reported sexual behaviour.

Another reason for including biomedical measures within surveys is to estimate the population prevalence of conditions/infections. Most germane in this regard within sexual health are sexually

transmitted infections (STIs). While STI data are routinely collected and reported in the UK, the figures are based on *diagnosed* cases and hence underestimate the true population prevalence for STIs, such as chlamydia, which can be asymptomatic. A further advantage is that within routine data little demographic or behavioural information is collected, which limits the possibilities for understanding patterns of infection and identifying risk and protective factors, all of which are important for informing service provision and prevention efforts. In Natsal-2, we introduced urine collection to test for chlamydia (Fenton *et al*, 2001). In Natsal-3, urine was again collected but the number of STIs we tested for increased to five and included chlamydia, gonorrhoea, HPV, mycoplasma genitalia, and HIV (Sonnenberg *et al*, 2013).

A third reason to include biomedical measures in survey research is to investigate both biological and social influences on behaviour and the interaction between the two. In sex research we have seen that there has been a long-standing dispute between essentialist and social constructionist perspectives. Calls have been made for greater integration of the two, as either position in their most zealous form provides an incomplete understanding of lived experience (Tolman & Diamond, 2001).

7.6 TESTOSTERONE MEASUREMENT

In Natsal-3, we collected saliva samples to measure testosterone (T) in order to explore the associations between levels of T and sexual behaviour and function. I led this novel and methodologically challenging work package, the findings of which constitute the third paper in this thesis. The stages we went through in turning the idea into a reality are covered below.

7.6.1 Bringing the team together and identifying the challenges ahead

The first two steps went hand in hand; it was through bringing the team together that we were able to identify the challenges that lay ahead. On the advice of Kaye Wellings, I started with a phone call to her friend David Baird, Emeritus Professor of Reproductive Endocrinology at the University of Edinburgh. David in turn directed me to Professor Fredrick (Fred) Wu at the University of Manchester. Fred had completed a fellowship with David in Edinburgh in the 1970s and had gone on to forge an international reputation in the field of endocrinology and androgens. I emailed Professor Wu and we arranged to speak. I told him about Natsal and our ambition to include the measurement of testosterone in the survey. In that first phone call, he highlighted some of the challenges concerning the biology of T and the biochemistry involved in its measurement.

The first challenge was that in clinical practice and clinical research, T is ordinarily measured using blood. To collect blood samples in Natsal would require nurses and so would be prohibitively expensive. There was, however, a potential solution in the form of a salivary test. This sounded

promising as saliva would be much simpler (and cheaper) to collect. But, and it was a big but, salivary tests had not been fully validated; it had yet to be established whether salivary T (Sal-T) reflects serum-T. This was further complicated by the fact that within serum there are different fractions of T, hence it was not a 'simple' matter of whether Sal-T was correlated with serum T but rather which fraction did it correlate with best (if any). There was a further challenge presented by women, which at the outset, Fred cautioned we might struggle to overcome. T levels are much lower in women and their Sal-T concentrations were likely to fall below the levels of detection in the available assays.

I found myself on a steep learning curve. Working across disciplinary boundaries has obvious benefits, but you do need to be able to speak each other's languages. I had studied some endocrinology and biochemistry in my undergraduate degree, and I had also done some laboratory work, so I was not starting from scratch, but this was specialist material with which I was not familiar. I quickly learned that in serum, most T (~98%) is carried in the blood stream bound to proteins; just under half of this is bound tightly to Sex Hormone Binding Globulin (SHBG) while the rest is bound more loosely to other proteins (mainly albumin) and the remaining 2% is unbound (so called 'free-T'). Free-T, plus the fraction of T that is bound loosely to albumin is called 'bioavailable T'. It is thought that bioavailable T and free-T are better indicators of androgen status than total T, and that Sal-T reflects free-T.

I also learned that the 'gold standard' method for measuring T was liquid chromatography/tandem mass spectrometry (LC-MS/MS). Fred however did not (initially) advocate this as the method to use within the main Natsal survey because of how costly and labour-intensive the assay was. Nonetheless, it was clear from the outset that any test we did ultimately use would need to be validated against LC-MS/MS. Fred told me about a colleague of his in Glasgow, Mike Wallace, who had a Sal-T radioimmunoassay (RIA) which he thought would be a good candidate to use in Natsal, and about another colleague in Manchester called Brian Keevil who had been working on an LC-MS/MS assay for T.

Aside from questions relating to the assay, there were other important issues to resolve if there was to be any hope we could include T measurement in Natsal. It is well established that serum T has a circadian rhythm with levels highest within the first couple of hours of waking and then falling through the day - did Sal-T show the same circadian rhythm too? If so, would we have to collect samples at the same time of day? Would one sample be enough? And then there were practical issues; how long could saliva samples last between collection and testing? What happened to the samples when you froze them and thawed them (and how many times could you do this without the sample being affected?).

The conclusion of this initial scoping work was that saliva was the only viable specimen we could possibly collect with which to measure T, but to use saliva we would have to validate the test so that we could have confidence in what we were measuring.

I worked with Fred on designing and costing a Sal-T validation study, which was submitted as part of the proposal for Natsal-3. Fred would lead this study in his laboratory in Manchester. Funding for including T in the main stage of Natsal was contingent on us establishing we had a reliable test.

7.6.2 Validating the salivary assay

The RIA assay we had initially planned to use was not taken forward to the validation study due to inadequate sensitivity and specificity. The only option was to use LC-MS/MS, but even with this 'gold standard' method, the sensitivity of the existing assay was not sufficient and needed to be improved if we were to be able to include women (due to the low concentrations of T in the female range). Brian was able to increase the sensitivity of the assay in his laboratory, and it was using this highly sensitive and specific LC-MS/MS assay that a series of four validation studies were conducted to explore: 1) the performance of the assay; 2) the correlations between Sal-T and serum-T; 3) intra-individual variations in T and 4) the stability of T in saliva. We published the findings of this validation study in *Annals of Clinical Chemistry* (Keevil *et al,* 2013).

In summary, we found the LC-MS/MS assay was sufficiently sensitive to accurately measure T in the saliva of women even at the lower end of the normal range. We also found that, in both men and women, Sal-T correlated significantly with serum-T (this correlation was stronger with free-T than total-T). Our results showed, for the first time, a diurnal variation in Sal-T, with concentrations highest in the morning and lowest in the evening. This pointed to the need to collect samples within Natsal at the same time of day (ideally in the morning when levels are highest). We also showed a lack of significant intra-individual variation in T indicating that a single Sal-T measurement should be adequate to provide an accurate measurement of a person's T levels. The Sal-T samples were stable for up to five days at room temperature and for extended periods of time during storage at −20℃, suggesting that posting saliva samples to a central laboratory should cause no problems in terms of sample deterioration.

We had shown that T could be reliably and accurately measured in the saliva of both men and women using LC-MS/MS and that Sal-T correlated well with serum-T. We prepared a report of the findings for the Wellcome Trust, and on its acceptance, funds were released for the inclusion of the test in Natsal-3.

7.6.3 Developing fieldwork procedures

The next stage was to work out the practicalities of incorporating the saliva test within the main Natsal survey and prepare all the necessary materials. The validation study had highlighted the need for samples to be provided in the morning. Given Natsal interviews take place throughout the day, at times most convenient to the participants, this meant samples would have to be self-collected. I set about developing a 'saliva self-collection pack'. I worked closely with Soazig Clifton at the fieldwork agency (NatCen Social Research) to ensure that the instructions for participants and interviewers alike were clear and concise, and that all the necessary supporting materials were in place. These included:

1. *Saliva test information leaflet* – this leaflet was given to participants before seeking consent. It contained details regarding the purpose of the study, what it would involve, what the sample would be used for, how confidentiality would be maintained, what would happen to any remaining saliva sample and where to seek further information.
2. *Saliva test consent form* – consent was sought, separately, to test the saliva for T (without return of results) and to store any remaining sample for future research.
3. *Saliva test fact sheet* – for interviewers to use with participants if they had further questions or queries.
4. *Instructions for interviewers* – these covered detailed instructions on the field work procedures, including introducing the saliva test, seeking informed consent and providing instruction to participants.
5. *Saliva self-collection pack* – containing: instruction leaflet (detailing how and when participants should provide their sample, see box 2 below); sample tube; mailing tube; return slip; postage paid and addressed envelope to return samples.

The full protocol for saliva sample collection, and all of the fieldwork documents, are included in Volume 2 (Appendices) of the Natsal-3 Technical Report available at http://www.natsal.ac.uk/media/2091/natsal-3-technical-report-vol-2-appendices-nov-2013.pdf

Prior to field work commencing I attended a series of 'Interviewer Briefings' around the country. In these briefings, NatCen interviewers who will be working on Natsal are trained in the specific fieldwork procedures for the survey. The briefings, however, also provide a chance for the fieldwork and academic teams to meet. For my part, it was a chance to share with the interviewers why we were including collection of saliva in the survey, and what we hoped to do with the findings. If interviewers were able to relay the importance and novelty of the work to potential participants then this could possibly help with response rates.

Box 2: Saliva collection instructions for Natsal-3 participants

Please follow these steps when providing your sample:

- You should provide your saliva sample first thing in the morning, **before 10am.**
- Do not brush your teeth or eat any food before you give your sample as this can contaminate it.
- Rinse your mouth out with tap water, twice, at least ten minutes before giving your sample.
- When you are ready, spit or drool into the sample tube (this is the smaller tube with the study label on it). You do not have to fill the whole tube, but please try to fill it at least half full, more if you can.
- Put the lid on the tube and make sure it is screwed tight.
- Place the sample tube into the safety container (this is the larger tube with the protective wadding inside).
- Complete the reply slip, telling us the time and date you provided your sample.
- Place your sample in the pre-paid envelope **along with the completed reply slip.**
- Send the sample; **please make sure that you provide and send the sample on the same day**

Do not worry if you forget to give your sample on the day after the interview, you can do it another day. The most important thing is that you send it to the laboratory on the same day you give it.

7.6.4 Mainstage fieldwork

All men and women aged 18-74 years, with the exception of those who regularly worked at night, were eligible to provide a saliva sample. Our target was to achieve 4,400 samples. Assuming a 75% response rate, we randomly selected 30% of participants aged 18-34 years and two-thirds of those aged 35-74 years. Due to lower than anticipated up-take, and in order to achieve the target number of samples, these proportions were increased in later waves of the fieldwork (Erens *et al*, 2013). With the aim of increasing the response rate, we also introduced a telephone reminder. At the end of the interview, participants were asked whether they would be willing for the interviewer to call them the next day in order to remind them to provide their sample and to answer any questions they may have. Of those who consented to give a sample, 76% also agreed to the follow-up call (Erens *et al*, 2013).

Table 3: Testosterone working group publications

Paper	Summary
MacDonald PR, Owen LJ, Wu FC, **Macdowall W**, Keevil BG; NATSAL team. A liquid chromatography-tandem mass spectrometry method for salivary testosterone with adult male reference interval determination. *Clin Chem*. 2011 May;57(5):774-5.	Development of the LC-MS/MS assay for salivary testosterone (Sal-T).
Keevil BG, MacDonald P, **Macdowall W**, Lee DM, Wu FC; NATSAL Team. Salivary testosterone measurement by liquid chromatography tandem mass spectrometry in adult males and females. *Ann Clin Biochem*. 2014 May;51(Pt 3):368-78.	Results of the validation study, covering 1) the performance of the assay; 2) the correlations between Sal-T and serum-T; 3) intra-individual variations in T and 4) the stability of T in saliva.
Keevil BG, Fiers T, Kaufman JM, **Macdowall W**, Clifton S, Lee D, Wu F. Sex hormone-binding globulin has no effect on salivary testosterone. *Ann Clin Biochem*. 2016 Nov;53(6):717-720.	Follow up data providing further validation in support of the measurement of Sal-T, highlighting its independence from variations in circulating sex hormone-binding globulin (SHBG), unlike serum total T which is positively correlated with SHBG.
Keevil BG, Clifton S, Tanton C, **Macdowall W**, Copas AJ, Lee D, Field N, Mitchell KR, Sonnenberg P, Bancroft J, Mercer CH, Johnson AM, Wellings K, Wu FCW. Distribution of Salivary Testosterone in Men and Women in a British General Population-Based Sample: The Third National Survey of Sexual Attitudes and Lifestyles (Natsal-3). *J Endocr Soc*. 2017 Jan 12;1(1):14-25.	First study to describe the sex- and age-specific distributions for Sal-T in a large representative population using LC-MS/MS. Distinct decline in Sal-T levels with increasing age in both sexes and seasonal variation were observed.
Clifton S, **Macdowall W**, Copas AJ, Tanton C, Keevil BG, Lee DM, Mitchell KR, Field N, Sonnenberg P, Bancroft J, Mercer CH, Wallace AM, Johnson AM, Wellings K, Wu FC. Salivary Testosterone Levels and Health Status in Men and Women in the British General Population: Findings from the Third National Survey of Sexual Attitudes and Lifestyles (Natsal-3). *J Clin Endocrinol Metab*. 2016 Nov;101(11):3939-3951.	Examines the associations between Sal-T and sociodemographic and general health factors. Sal-T levels found to be associated, independently of age, with a range of self-reported health markers, particularly BMI, in men but not women. The findings support the view that there is an age-related decline in Sal-T in men and women, which cannot be explained by an increase in ill health.

7.6.5 Saliva sample response rate

Of the 9,170 Natsal participants eligible to provide a sample, 71.0% agreed to do so. The reasons participants gave for declining included the procedure being too inconvenient, concerns about linking to DNA, reservations regarding confidentiality, and a feeling that they had done enough for the study already (Erens *et al*, 2013).

As anticipated, not all those participants who agreed to provide a sample did so. In all, the laboratory took delivery of 4,591 samples, which is 70.5% of those who agreed (and 50.1% of those eligible). Participants were sent a £5 gift voucher once their sample was received. Samples were only released for testing, however, once the NatCen Operations team had checked the signed consent forms. 463 samples were excluded due to issues related to sample quality (insufficient volume [n = 154]; sample discoloured/bloody [n = 91]; sample recorded as taken after 10:30am [n = 34]; period between sample being taken and received by the laboratory more than 5 days or unknown due to missing date of collection [n = 172]; not tested due to error [n = 12]) leaving 4,128 participants (45.0% of those invited) with a T result (1,675 men and 2,453 women). Of those who provided a useable sample, nearly all (97.6%) agreed that it could be stored for possible future analysis (Erens *et al*, 2013).

A number of factors were associated with providing a usable saliva sample including age at interview, ethnicity, self-reported general health and sexual function. A saliva weight (in addition to the main survey weight) was applied to the data prior to analysis; this corrected for unequal probability of selection and differential response to the saliva sample (Erens *et al*, 2013).

7.6.6 Testosterone working group publications

There have been a number of publications stemming from the 'T team'. These chart the stages of our work from developing and validating the Sal-T assay through to providing the first age- and gender-specific population distributions of Sal-T and elucidating the associations between Sal-T and sociodemographic and general health factors (see table 3 for a summary). Each step we went through paved the way for the analysis included in this thesis (See paper on page 109). Ultimately though, this work has a much wider application: the advent of a validated Sal-T assay, alongside population distributions, opens up the possibility of using Sal-T in investigating the potential importance of androgen exposure in many aspects of human health in large-scale population surveys.

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8 PAPER: ASSOCIATIONS BETWEEN SOURCE OF INFORMATION ABOUT SEX AND SEXUAL HEALTH OUTCOMES IN BRITAIN: FINDINGS FROM THE THIRD NATIONAL SURVEY OF SEXUAL ATTITUDES AND LIFESTYLES (NATSAL-3)

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Please note that a cover sheet must be completed <u>for each</u> research paper included within a thesis.

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Student ID Number	RPHP/349334	**Title**	Ms
First Name(s)	Wendy Georgina		
Surname/Family Name	Macdowall		
Thesis Title	THE EVOLUTION OF THE NATIONAL SURVEY OF SEXUAL ATTITUDES AND LIFESTYLES: THEORETICAL, CONCEPTUAL AND METHODOLOGICAL ADVANCES		
Primary Supervisor	Professor Kaye Wellings		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

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Associations between source of information about sex and sexual health outcomes in Britain: findings from the third National Survey of Sexual Attitudes and Lifestyles (Natsal-3).

Wendy Macdowall, Lecturer[1]

Kyle G. Jones, NIHR Research Methods Fellow[2]

Clare Tanton, Senior Research Associate[2]

Soazig Clifton, Honorary Research Associate[2 3]

Andrew J. Copas, Reader in Statistics[3]

Catherine H. Mercer, Senior Lecturer[2]

Melissa Palmer, Research Assistant[1]

Ruth Lewis, Research Fellow[1]

Jessica Datta, Lecturer [1]

Kirstin R. Mitchell, Lecturer[1]

Nigel Field, Senior Clinical Training Fellow[2]

Pam Sonnenberg, Reader in Infectious Disease Epidemiology[2]

Anne M Johnson, Professor of Infectious Disease Epidemiology[2]

Kaye Wellings, Professor of Sexual and Reproductive Health Research[1]

[1] Centre for Sexual and Reproductive Health Research, Department of Social and Environmental Health Research, London School of Hygiene and Tropical Medicine, London WC1H 9SH, UK

[2] Research Department of Infection and Population Health, University College London, London, WC1E 6JB, UK

[3] NatCen Social Research, London EC1V 0AX, UK

Corresponding author

Wendy Macdowall, Centre for Sexual & Reproductive Health Research, Department of Social and Environmental Health Research, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH, UK

Tel: +44(0)20 7927 2048

Email: wendy.macdowall@lshtm.ac.uk

Abstract

Objectives To examine variation in source of information about sexual matters by socio-demographic factors, and associations with sexual behaviours and sexual health outcomes.

Design Cross sectional probability sample survey.

Setting General population resident in Britain.

Participants 1,509 men and 1,899 women aged 17-24 years interviewed 2010-2012 for the third National Survey of Sexual Attitudes and Lifestyles.

Main outcome measures Main source of information (school lessons, a parent, other); age and circumstances of first heterosexual intercourse; unsafe sex and distress about sex in the past year; ever experience of sexually transmitted infection (STI) diagnoses, non-volitional sex, or abortion (women only).

Results Receipt from school lessons was associated with younger age, higher educational level, and having lived with both parents; receipt from a parent was associated with lower educational level (women only) and having lived with only one parent. Relative to other sources, receipt from school was associated with older age at first sex (adjusted hazard ratio 0.73 (95% CI 0.65 to 0.83) men; 0.73 (95% CI 0.65 to 0.82) women), lower likelihood of both unsafe sex (0.58 (0.44 to 0.77) men; 0.69 (0.52 to 0.91) women) and previous STI diagnosis (0.55 (0.33 to 0.91) men; 0.58 (0.43 to 0.80) women) and, in women only, with lower likelihood of lack of sexual competence at first sex; and experience of non-volitional sex, abortion and distress about sex life. Receipt from parents was associated with lower likelihood of unsafe sex in the past year (0.53 (0.28 to 1.00) men; 0.69 (0.48 to 0.99) women) and, in women only, previous STI diagnosis.

Conclusions Receipt of information about sex mainly from school was associated with lower reporting of a broad range of negative sexual health outcomes, particularly among women. Some of these associations were seen for parents, although they feature less prominently as a primary source. The findings emphasise the benefit of school and parents providing information about sexual matters and argue for a stronger focus on the needs of men.

Introduction

Over recent decades, school lessons have risen in prominence as the main source of information about sexual matters for both boys and girls in Britain (see companion paper by Tanton *et al*, 2015). Although guidance exists,[1, 2] there is no statutory programme of study for sex and relationship education (SRE) beyond that included in the National Curriculum Science[1] [3] and there are concerns about variations in the content and quality of provision.[4]

Disparities in the provision of SRE may be a mediating factor in social inequalities observed in sexual health.[5] Earlier first intercourse (before 16 years) – a known risk factor for subsequent negative sexual health outcomes – occurs more commonly among those of lower educational level and lower socio-economic status.[6] Sexually transmitted infections (STIs) disproportionately affect those living in more deprived areas[7] and certain ethnic minority groups;[8] and, among women, unplanned pregnancies are associated with lower educational levels[9] and experience of non-volitional sex with living in more deprived areas.[10]

Evidence suggests that school-based sex education delays the onset of sexual activity, and increases condom and contraceptive use among those already sexually active.[11-13] Opponents of school SRE tend to focus on the argument that teaching young people about sexual matters should be the responsibility of parents.[14] However, few young people cite a parent as a source of information about sex (see companion paper by Tanton *et al*, 2015) and the evidence of a positive relationship between provision of sex education by parents and sexual behaviour and sexual health outcomes is mixed.[15-17]

Existing research has mainly focused on whether school SRE, or parental communication about sex, improves bio-medical aspects of sexual health,[11] and thus reflects the framing of sexual health predominantly in terms of the prevention of adverse sexual health outcomes such as STIs and unintended conceptions. Pleas have, however, been made for the adoption of a broader concept of sexual health, one that includes outcomes relating to the quality and consensuality of sexual experience, not only as risk factors for outcomes such as STIs and unintended conception, but as important ends in themselves.[18]

The National Survey of Sexual Attitudes and Lifestyles (Natsal) is a large and comprehensive probability sample survey of the British population. Findings from the first survey conducted in 1990-

[1] At the time of writing a Government Education Select Committee is holding an inquiry into Personal, Social, Health and Economic Education (PSHE) and Sex and Relationships Education (SRE) in schools addressing: whether PSHE ought to be statutory; whether the current accountability system is sufficient to ensure that schools focus on PSHE; the overall provision of SRE in schools and the quality of its teaching; whether recent steps to supplement the guidance on teaching about sex and relationships are adequate; and how the effectiveness of SRE should be measured [http://www.parliament.uk/business/committees/committees-a-z/commons-select/education-committee/inquiries/parliament-2010/pshe-and-sre-in-schools].

91[19, 20] and the second in 1999-2001[21-24] have been extensively used to inform sexual and reproductive health policy in Britain.[25-27] Here, we use data from the third survey (Natsal-3), in 2010-12, to explore how sources of information about sexual matters vary by socio-demographic factors, and we examine associations between these sources and a wider range of sexual health outcomes than has previously been explored.

Methods

Natsal-3 is a multi-stage, clustered and stratified probability sample survey of 15,162 men and women aged 16-74 years resident in Britain. Postcode sectors were primary sampling units, addresses within them were selected at the second stage, and one eligible adult was randomly selected at the final stage. To allow detailed exploration of behaviours in the age group at highest risk of certain sexual health outcomes, individuals aged 16-34 were over-sampled. Addresses were randomly allocated to either the core sample (in which all individuals aged 16-74 were eligible) or one of two boost samples (boost 1, in which one person aged 16-34 was selected or boost 2 in which one person aged 16-29 was selected). The data was weighted to adjust for the unequal probabilities of selection and non-response. Participants were interviewed between September 2010 and August 2012 using computer-assisted personal interviewing (CAPI), including a computer-assisted self-interview (CASI) for the more sensitive questions. The response rate was 57.7% for the whole sample, 64.8% for boost 1 and 67.3% for boost 2. Further details of the methods are described elsewhere.[28]

Questions relating to learning about sex were asked face-to-face, in the CAPI section of the questionnaire (available at natsal.ac.uk). Participants were asked '*When you were growing up, in which of the ways listed on this card did you learn about sexual matters?*' and '*from which did you learn the most?*' In response to the latter, they were requested to select one main source. In this paper, we categorised main source of sex education as: school lessons, provision by a parent, and 'other' sources (which included first boyfriend/girlfriend/sexual partner, peers, siblings, internet sources, pornography, media sources, health professionals and other). All analyses were restricted to those aged 17-24 years at interview (1,509 men and 1,899 women). Participants aged 16 years were excluded as they could not be ascribed an educational level.

We examined the associations between a range of socio-demographic factors and main source of information about sexual matters, by gender, including: age at interview; educational level; religiosity (a combined variable of religion considered 'very' or 'fairly' important and attendance at religious services at least once every two weeks); family structure (whether lived with both, one, or neither natural parent(s) 'more or less continuously' until age 14); area-level deprivation (measured

using the Index of Multiple Deprivation [IMD], a multi-dimensional measure combining income, employment, health, education, access to housing and services, crime and living environment[29]); type of school attended (mixed or single sex); and country of residence (England, Scotland or Wales).

We then examined associations between the main source of information about sexual matters and key sexual behaviours and outcomes. These included: first heterosexual intercourse before age 16 years; lack of sexual competence at first heterosexual intercourse (defined as having not met the following self-reported four criteria: both partners 'equally willing', use of reliable contraception, autonomy of decision - not due to peer pressure, drunkenness, or drugs - and occurrence at the perceived 'right time'[22]); unsafe sex in the past year (defined as no condom used at the first occasion of sex with a new partner in the past year); distress about sex life in the past year (based on agreement with the statement: "I feel distressed or worried about my sex life"); and ever experience of STI diagnosis, non-volitional sex, and, for women, abortion. A composite variable of 'overall sexual health' was constructed, and participants were coded as having good overall sexual health if they did not report distress or worry about sex life in the past year, or ever having had experience of an STI diagnosis, non-volitional sex, or (for women only) abortion.

We performed all analyses using the survey commands in Stata v13.1[30], which account for the weighting, clustering and stratification of the Natsal-3 data. We assessed the association between socio-demographic factors and the primary source of information among participants aged 17-24 years using univariate logistic regressions. We used survival analysis methods to estimate the distribution of age at first heterosexual intercourse by primary source of information about sexual matters, censoring those who had not yet had sex at their age at interview. We conducted proportional hazards regression to calculate hazard ratios adjusting for year of birth, educational level, and family structure, to represent the effect of primary source of information on the rate of first heterosexual intercourse.

We examined the associations between reporting school lessons, a parent, or an 'other' main source of information and sexual behaviours and sexual health outcomes in multivariable logistic regression. In the multivariable analysis we ran two models, which adjusted for those socio-demographic variables found to be significantly associated with main source of sex education in our univariate analysis. In the first we included all participants aged 17-24 years and adjusted for age, educational level, and family structure. In the second, we restricted the analysis to sexually experienced 17-24 year olds and adjusted for educational level, family structure, age at first intercourse and number of years sexually active. The latter approach was taken to assess the association between main source of information and sexual health outcomes independently of age

at first sex, and informally represents the 'direct effect' of source of sex education on outcomes aside from any effect mediated through age at first intercourse.

Ethics

Natsal-3 was granted ethical approval by the Oxfordshire Research Ethics Committee A (reference: 09/H0604/27).

Results

Main source of information and demographic factors

Overall, similar proportions of men and women reported lessons at school as their main source of information about sexual matters (37.5% (34.8 to 40.2) and 39.5% (37.0 to 42.0) respectively). Considerably fewer participants cited a parent, and here there was a gender difference; the proportion of women doing so being twice that of men (14.6% (12.9 to 16.4) and 7.3% (5.9 to 9.0) respectively). The remainder - just over half of men (55.3% (52.4 to 58.1)) and just under half of women (46.0% (43.4 to 48.5)) - reported their main source as being other than school or a parent [table 1].

The likelihood of citing school as a main source was higher among those of younger age; men and women aged 21-24 years were less likely to report school compared to those aged 17-20 years [table 1]. It was also higher among men and women studying for, or who had achieved qualifications post 16 - and for women among those with qualifications typically gained at 16 - as opposed to those with none, and among those living with both natural parents as opposed to only one (and for men who lived with neither).

The likelihood of citing a parent as the main source was, in women, higher among those without qualifications, compared with those with or likely to obtain them, and among those who lived with one natural parent as opposed to two or neither [table 1].

The likelihood of citing an 'other' main source of sex education was higher among those aged 21-24 than those aged 17-20. Among men, it was also higher among those with minimum or no qualifications, and those living with neither natural parent.

Main source of information was not associated with religiosity, area level deprivation, whether the school attended was mixed or single sex or country of residence [table 1].

Sexual behaviour and outcomes and main source of information

The survival analysis showed that, after adjusting for age at interview, education, and family structure, participants who reported school as their main source of sexual information had first

intercourse at comparatively later ages than did those whose main source was 'other' (men who reported lessons from school had a hazard ratio of 0.73 (95% CI 0.65 to 0.83) for having first sex relative to men who reported an 'other' source, the corresponding ratio for women was 0.73 (0.65 to 0.82)) (Figure 1a and b). No association was found between citing a parent as a main source and age at first intercourse. Note this regression analysis is informal because the assumption of proportional hazards is not met. Specifically, whilst citing school as main source of sex education is associated with a lower rate of having first sex relative to other sources at younger ages it is associated with a higher rate at higher ages. By age 20 (more clearly among women) the proportion that have had sex seems unrelated to source of sex education.

Men for whom school was the main source of information were less likely than those reporting an 'other' main source to have had unsafe sex in the past year (odds ratio 0.58 (95% CI 0.44 to 0.77)) or ever being diagnosed with an STI (0.55 (0.33 to 0.91)) [table 2]. Among sexually experienced men, the association with unsafe sex in the past year remained strong (0.66 (0.49-0.89)), but was attenuated for ever being diagnosed with an STI (0.72 (0.43 to 1.22)).

Men citing a parent as their main source were less likely to have reported unsafe sex in the past year than those citing an 'other' main source (0.53 (0.28 to 1.00)) - an association that remained in the analysis of sexually active men (0.49 (0.25 to 0.95) - but were no less likely to have been diagnosed with an STI [table 2].

Among women, reporting school as the main source of information was associated with a decreased likelihood of all the negative sexual health indicators explored in the multivariable analysis [table 2]. Amongst sexually active women, the associations with lack of sexual competence at first intercourse (0.70 (0.54 to 0.90)), ever experiencing STI diagnosis (0.71 (0.50 to 0.99)), distress about sex life in past year (0.70 (0.47 to 1.03)) and good 'overall sexual health' (1.64 (1.28-2.10)) remained, while those with unsafe sex in the past year (0.81 (0.60 to 1.08)), ever experience of abortion (0.84 (0.56 to 1.27)) and non-volitional sex (0.76 (0.49 to 1.18)) were in the same direction but were attenuated.

Among women, reporting a parent as the main source of information was also associated with all the sexual health factors explored in the multivariable analysis, with the exception of sex before age 16 years and distress about sex life [table 2]. The adjusted odds ratios were similar to those amongst women reporting school as a main source, though the confidence intervals were slightly wider reflecting the smaller number of women reporting a parent. Amongst sexually active women citing a parent, the associations remained largely unchanged: sexual competence at first intercourse (0.75 (0.53 to 1.05)) unsafe sex (0.71 (0.48 to 1.04)); abortion ever (0.65 (0.38 to 1.11)); STI ever (0.57

(0.38 to 0.86)); non-volitional sex (0.55 (0.30 to 1.04)) and good 'overall sexual health' (1.59 (1.12-2.26)).

Discussion

Highlights

We found differences in the reporting of a range of sexual health indicators according to the main source of information about sexual matters. Receipt of information mainly from school, as opposed to other sources, was associated with lower reporting of a wide range of sexual health risk behaviours and outcomes. Receipt of information from a parent, as opposed to other sources, was associated with lower reporting of some but not all of these. For both school and parents, the range of outcomes where positive associations were found was wider in women than men.

Strengths & weaknesses of the study

The strength of this study lies in the size and nature of the sample, which was selected using probability sampling and so is broadly representative of the British population. Another strength is the range of demographic and sexual health factors included in the survey that allow examination of both how learning about sex varies by markers of social inequality and the associations between sources of information and a broader range of sexual health factors than has been investigated hitherto.

Several limitations, however, should be considered. Although the sample reflects the wider British population in terms of demographic characteristics, it is possible that individuals who agree to take part in a survey of this nature may differ from those who do not. Since this was an observational, cross-sectional study, we are not able to infer causality, or, for some outcomes, temporality. Relatedly, we cannot know whether some antecedent factor may predispose young people both to seek higher academic achievement and to privilege school-based information. It is also important to note that the recall of the experience of learning about sexual matters may be recast with time, though we limited our analysis to 17-24 year olds in order to minimize the potential bias associated with this. We must also acknowledge that a possible consequence of singling out one main source of sex education for the purpose of analysis, is that the nuances of learning about sexual matters from multiple sources are lost.

Strengths & weaknesses with respect to other studies and important differences in results

Our finding that school as the main source of sex education is associated with later age at first sex is consistent with that from other observational and intervention studies.[11, 13, 31] As may be expected, associations with lower reporting of some of the sexual health factors we explored (for men ever

diagnosis of an STI, and for women unsafe sex in the past year and ever experience of abortion or non-volitional sex) appear to be operating through later age at first intercourse. More surprising - and in contrast to research that has taken a similar approach elsewhere[31] - is the number of associations that remain after adjusting for age at first sex, years sexually active, educational level, and family structure, (for men a lower likelihood of having unsafe sex in the past year, and for women a lower likelihood of first sex being defined as lacking sexual competence, ever diagnosis with an STI and distress about sex in the past year), which suggests that school-based sex education is associated with additional benefit independent of that relating to later age at first sex.

As noted above, it has been suggested that variations in the provision of SRE may be a mediating factor in social inequalities observed in sexual health.[5] Unlike researchers from the United States,[32] we did not find area (neighbourhood) level deprivation to be associated with reporting school as a main source of sex education, though neighbourhood-level deprivation at the time of interview may have been different from that when growing up. We did, however, find school as a main source to be associated with educational level. Participants who had no qualifications (and among men only those typically gained at 16 years) were less likely to report school as their main source. Multiple, possibly inter-related, factors may help to explain this association. The Office for Standards in Education (Ofsted) found a strong correlation between a school's scores for performance generally and SRE specifically[4]. So it could be argued that 'good' SRE is an indicator of a 'good' school; one that better fosters the educational *and* personal and social development of young people. It has also been suggested that young people with lower psycho-social well-being do less well at school and are less engaged,[33] traits which are both associated with increased risk of negative sexual health outcomes.[6, 9, 34] Those 'missing out' on school-based SRE may be less of a concern in policy terms if they instead report a parent; indeed among women those with no academic qualifications were more likely to do so, but this was not the case for men.

Studies exploring the relationship between parental communication and age at first sex have produced somewhat equivocal findings.[16, 17] Some have suggested that parents may initiate, or intensify, communication about sexual matters once they think their children have become sexually active.[35] This may explain the absence of an association between parents as a main source of information and later age at first intercourse. We did, however, see positive associations with other sexual health outcomes, notably safe sex. There is evidence that wider aspects of parenting, including good communication generally, parental monitoring and family 'connectedness' are positively associated with sexual health outcomes,[16] and that parents may wield an effect through their influence on risk behaviours, such as alcohol use[16, 17] and/or by moderating peer pressure.[35] As such, an exclusive focus on communication about sex may serve to underestimate the role of

parents. However, the complex interplay of individual and family-related factors and their relative contribution to sexual health outcomes is poorly understood.

Meaning of the study, possible explanations and implications for clinicians and policy makers

We found learning about sex mainly from school to be associated with the 'stalwarts' of sex education (age at first intercourse, safe sex and STIs) in both men and women. Our finding that receipt of information mainly from school was associated with a wider number of sexual behaviours and outcomes among women than men, has implications for policy and practice and may be seen to warrant greater attention to the broader framing of sexual health in sex education, particularly for men. It has been suggested that sex education is overly focused on 'girls' issues' (the so called 'three Ps'; periods, pills and pregnancy)[36] and it is important that '*issues such as relationships, consent, contraception and infections, are considered from a young man's perspective*."[37] According to our study, men are also less likely than women to report a parent as a main source of sex education, and, as with school, doing so is associated with fewer positive outcomes than in women.

Unanswered questions and future research

More nuanced research into the content, context and mode of delivery of sex education by both school and parents is necessary in order to guide recommendations for policy and practice. Also needed is longitudinal research to explore temporality in relation to learning about sex and sexual trajectories, along with further intervention research, specifically exploring how best to meet the needs of young men and support parents in communicating about sexual matters in a timely manner. Multi-faceted research exploring the relative contribution of different factors at play (including those related to community, school, family, peers and partners) and how they interact to mediate and/or moderate risk would be an important contribution to our understanding about how young people learn about sex and navigate early sexual experiences.

Conclusion

Our findings emphasise the benefit of school and parents providing information about sexual matters and argue for a stronger focus on the needs of men. Parents, in particular, need to recognise their role, which is important not just in relaying information about sexual matters but also more generally in moderating risks faced by young people.

What is already known on this subject:

- School sex education is associated with older age at first intercourse and other positive sexual health outcomes.
- Most studies have only explored a limited range of biological outcomes
- Less is known about parents as a source of information, and what research there is has provided mixed, often contradictory findings.

What this study adds:

- Receipt of information mainly from school is associated with lower reporting of a wide range of sexual health risk behaviours and outcomes and influence operates not only through later age at first intercourse.
- The range of associated outcomes is greater for women than men.
- Where associations are seen for both men and women, it is with the 'traditional' aspects of sexual health (such as safer sex, STIs), which points to the need for broader framing of sex education, particularly for men.
- Parents as a main source are not associated with later age at first intercourse but are with safe sex (and for women STIs).

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Competing interests

AMJ has been a Governor of the Wellcome Trust since 2011. All other authors declare that they have no conflicts of interest.

Contributors

WM, CT, KGJ, JD, RL, KW, AMJ and CHM conceived this Article. WM wrote the first draft, with further contributions from KGJ, CT, SC, AJC, CHM, MP, RL, JD, KRM, NF, PS, AMJ and KW. KGJ did the statistical analysis, with support from CHM and AJC. KW, AMJ, WM, CHM and PS - initial applicants on Natsal-3 - wrote the study protocol and obtained funding. KW, AMJ, WM, CHM, CT, SC, KRM, JD, NF, and PS designed the Natsal-3 questionnaire, applied for ethics approval, and undertook piloting of the questionnaire. CT, SC, RL and CHM managed data. All authors interpreted data, reviewed successive drafts, and approved the final version of the Article.

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Role of the sponsor

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Transparency

The lead author (CT) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Data sharing

The Natsal-3 data are due to be archived with the UK Data Archive in 2015, before then, researchers are welcome to contact the Natsal-3 team to seek advance access to the corresponding data, and are directed to the Natsal website for further information (www.natsal.ac.uk).

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Table 1a: Main source of information about sexual matters by socio-demographic factors, men

	Other[1]					School					A parent					
	%	95% C.I.	OR	95% C.I.	p-value[2]	%	95% C.I.	OR	95% C.I.	p-value[2]	%	95% C.I.	OR	95% C.I.	p-value[2]	Denominators
All men, 17-24 years old	55.3%	(52.4-58.1)	-	-	-	37.5%	(34.8-40.2)	-	-	-	7.3%	(5.9-9.0)	-	-	-	*1509, 1108*
Age at interview					0.0041					0.0001					0.0610	
17-20	51.0%	(47.1-55.0)	1.00			43.1%	(39.2-47.0)	1.00			5.9%	(4.5-7.8)	1.00			*825, 564*
21-24	59.7%	(55.4-63.8)	1.42	(1.12-1.80)		31.7%	(28.0-35.6)	0.61	(0.48-0.78)		8.7%	(6.4-11.6)	1.51	(0.98-2.32)		*684, 544*
Academic qualifications					0.0031					0.0037					0.1919	
Studying for/attained further academic qualifications	51.7%	(48.1-55.3)	1.00			41.5%	(38.1-44.9)	1.00			6.9%	(5.3-8.9)	1.00			*957, 716*
Academic qualifications typically gained at age 16	59.1%	(53.5-64.4)	1.35	(1.03-1.77)		33.0%	(28.2-38.2)	0.69	(0.53-0.91)		8.0%	(5.2-12.1)	1.18	(0.69-2.00)		*416, 285*
No academic qualifications	72.3%	(59.4-82.3)	2.44	(1.35-4.41)		24.5%	(14.7-37.8)	0.46	(0.24-0.87)		3.2%	(1.3-7.9)	0.45	(0.17-1.22)		*96, 71*
Religion important and practiced regularly					0.8036					0.3190					0.2022	
No	55.4%	(52.4-58.3)	1.00			37.1%	(34.3-39.9)	1.00			7.6%	(6.1-9.4)	1.00			*1391, 1013*
Yes	54.1%	(44.5-63.5)	0.95	(0.64-1.42)		41.9%	(32.9-51.5)	1.22	(0.82-1.83)		4.0%	(1.5-10.4)	0.51	(0.18-1.44)		*118, 94*
Family background until age 14					0.0200					0.0241					0.2003	
Lived with both natural parents	53.7%	(50.3-57.1)	1.00			39.4%	(36.3-42.7)	1.00			6.8%	(5.3-8.8)	1.00			*1032, 799*
Lived with one natural parent	57.5%	(52.2-62.6)	1.17	(0.91-1.49)		33.4%	(28.7-38.3)	0.77	(0.60-0.98)		9.2%	(6.2-13.3)	1.37	(0.84-2.24)		*436, 283*
Lived with neither	78.2%	(60.2-89.5)	3.09	(1.34-7.13)		21.8%	(10.5-39.8)	0.43	(0.19-0.99)		0.0%	-	NA	-		*41, 26*
Region					0.7919					0.8044					0.2040	
England	55.2%	(52.1-58.2)	1.00			37.7%	(34.8-40.7)	1.00			7.1%	(5.6-9.0)	1.00			*1300, 954*
Wales	52.8%	(42.4-62.8)	0.91	(0.59-1.39)		34.6%	(26.4-43.9)	0.88	(0.58-1.31)		12.6%	(6.3-23.8)	1.89	(0.85-4.19)		*90, 59*
Scotland	57.7%	(47.4-67.4)	1.11	(0.72-1.70)		36.8%	(27.9-46.7)	0.96	(0.63-1.47)		5.5%	(2.7-10.8)	0.76	(0.35-1.64)		*119, 95*
Quintiles of multiple deprivation					0.4910					0.8631					0.3730	
1 [least deprived]	52.1%	(45.0-59.2)	1.00			40.6%	(33.8-47.7)	1.00			7.3%	(4.1-12.7)	1.00			*269, 190*
2	54.8%	(48.7-60.8)	1.11	(0.76-1.64)		36.6%	(30.7-42.9)	0.84	(0.56-1.27)		8.6%	(5.4-13.4)	1.19	(0.55-2.61)		*287, 212*
3	51.6%	(44.9-58.2)	0.98	(0.67-1.43)		38.7%	(32.5-45.3)	0.93	(0.62-1.37)		9.7%	(6.4-14.4)	1.37	(0.64-2.91)		*279, 197*
4	57.9%	(51.5-64.0)	1.26	(0.86-1.86)		36.0%	(30.0-42.4)	0.82	(0.55-1.23)		6.1%	(3.7-9.9)	0.83	(0.37-1.85)		*324, 260*
5 [most deprived]	58.3%	(52.2-64.1)	1.28	(0.88-1.87)		36.4%	(31.1-42.1)	0.84	(0.58-1.22)		5.3%	(3.1-8.8)	0.71	(0.31-1.61)		*350, 248*
Last school attended					0.7647					0.5731					0.6364	
Mixed school	55.1%	(52.1-58.1)	1.00			37.7%	(34.9-40.6)	1.00			7.2%	(5.7-8.9)	1.00			*1387, 1015*
Single sex school	56.7%	(46.3-66.5)	1.07	(0.70-1.64)		34.8%	(25.8-45.0)	0.88	(0.57-1.37)		8.5%	(4.2-16.3)	1.20	(0.56-2.59)		*121, 93*

[1] Includes first boyfriend/girlfriend/sexual partner, peers, siblings, internet sources, pornography, media sources, health professionals and other

[2] Chi[2] test of heterogeneity

Table 1b: Main source of information about sexual matters by socio-demographic factors, women

	Other[1]					School					A parent					
	%	95% C.I.	OR	95% C.I.	p-value[2]	%	95% C.I.	OR	95% C.I.	p-value[2]	%	95% C.I.	OR	95% C.I.	p-value[2]	Denominators
All women, 17-24 years old	46.0%	(43.4-48.5)	-	-	-	39.5%	(37.0-42.0)	-	-	-	14.6%	(12.9-16.4)	-	-	-	*1899, 1088*
Age at interview					0.0041					0.0052					0.8286	
17-20	42.2%	(38.8-45.7)	1.00			43.0%	(39.6-46.5)	1.00			14.7%	(12.5-17.3)	1.00			*968, 531*
21-24	49.5%	(45.9-53.2)	1.34	(1.10-1.64)		36.1%	(32.7-39.6)	0.75	(0.61-0.92)		14.4%	(12.1-17.0)	0.97	(0.74-1.28)		*931, 557*
Academic qualifications					0.7822					0.0628					0.0307	
Studying for/attained further academic qualifications	45.6%	(42.6-48.7)	1.00			40.6%	(37.6-43.7)	1.00			13.7%	(11.7-16.1)	1.00			*1199, 720*
Academic qualifications typically gained at age 16	44.1%	(39.3-48.9)	0.94	(0.75-1.18)		40.4%	(35.6-45.4)	0.99	(0.78-1.26)		15.6%	(12.5-19.1)	1.16	(0.84-1.59)		*518, 266*
No academic qualifications	47.3%	(38.1-56.7)	1.07	(0.73-1.57)		29.5%	(21.8-38.6)	0.61	(0.41-0.92)		23.2%	(16.0-32.4)	1.90	(1.17-3.08)		*133, 64*
Religion important and practiced regularly					0.8944					0.8546					0.6811	
No	46.0%	(43.4-48.6)	1.00			39.6%	(37.0-42.2)	1.00			14.4%	(12.7-16.3)	1.00			*1757, 991*
Yes	45.3%	(35.7-55.3)	0.97	(0.65-1.46)		38.7%	(30.1-48.1)	0.96	(0.65-1.43)		16.0%	(9.8-25.0)	1.13	(0.63-2.02)		*139, 96*
Family background until age 14					0.9069					0.0360					0.0003	
Lived with both natural parents	46.3%	(43.0-49.6)	1.00			41.6%	(38.5-44.8)	1.00			12.1%	(10.2-14.2)	1.00			*1163, 709*
Lived with one natural parent	45.1%	(41.0-49.4)	0.95	(0.77-1.18)		35.1%	(31.0-39.3)	0.76	(0.61-0.95)		19.8%	(16.6-23.4)	1.79	(1.35-2.38)		*676, 353*
Lived with neither	44.9%	(31.1-59.6)	0.95	(0.53-1.69)		44.5%	(30.8-59.0)	1.12	(0.63-2.00)		10.6%	(4.5-23.2)	0.86	(0.35-2.13)		*59, 24*
Region					0.8625					0.2827					0.2689	
England	45.8%	(43.0-48.7)	1.00			39.8%	(37.1-42.5)	1.00			14.4%	(12.6-16.4)	1.00			*1605, 938*
Wales	48.7%	(38.2-59.3)	1.12	(0.73-1.73)		31.6%	(22.5-42.3)	0.70	(0.44-1.12)		19.7%	(13.2-28.4)	1.46	(0.90-2.39)		*114, 56*
Scotland	45.5%	(39.2-51.9)	0.98	(0.74-1.30)		41.4%	(34.0-49.2)	1.07	(0.77-1.49)		13.2%	(8.6-19.5)	0.90	(0.55-1.47)		*180, 93*
Quintiles of multiple deprivation					0.3180					0.8963					0.4657	
1 [least deprived]	42.1%	(36.4-48.0)	1.00			40.8%	(35.1-46.7)	1.00			17.1%	(13.4-21.7)	1.00			*319, 182*
2	50.5%	(44.7-56.3)	1.40	(1.01-1.94)		37.4%	(31.9-43.3)	0.87	(0.62-1.21)		12.1%	(8.7-16.5)	0.66	(0.42-1.06)		*329, 185*
3	45.1%	(39.1-51.1)	1.13	(0.80-1.60)		39.3%	(33.6-45.3)	0.94	(0.66-1.33)		15.7%	(11.9-20.3)	0.90	(0.59-1.37)		*357, 217*
4	45.0%	(39.5-50.5)	1.12	(0.81-1.56)		41.1%	(35.6-46.8)	1.01	(0.72-1.42)		13.9%	(10.6-18.1)	0.78	(0.51-1.20)		*422, 250*
5 [most deprived]	47.1%	(41.8-52.5)	1.23	(0.89-1.69)		38.7%	(33.5-44.2)	0.92	(0.66-1.28)		14.1%	(10.8-18.2)	0.80	(0.52-1.21)		*472, 253*
Last school attended					0.1859					0.5724					0.2410	
Mixed school	45.2%	(42.4-48.0)	1.00			39.9%	(37.2-42.6)	1.00			15.0%	(13.2-16.9)	1.00			*1692, 954*
Single sex school	51.1%	(42.9-59.3)	1.27	(0.89-1.81)		37.3%	(29.4-45.9)	0.90	(0.61-1.31)		11.6%	(7.6-17.4)	0.75	(0.46-1.22)		*203, 132*

[1] Includes first boyfriend/girlfriend/sexual partner, peers, siblings, internet sources, pornography, media sources, health professionals and other

[2] Chi[2] test of heterogeneity

Table 2a: Sexual behaviours and outcomes by main source of information about sexual matters, men

	Of all men[1]				Of sexually experienced men[2]			
	Other	School	A parent	p-value[6]	Other	School	A parent	p-value[6]
First sex before age 16				<0.0001				0.0001
% (95% C.I.)	35.9% (32.4-39.6)	20.7% (17.3-24.6)	40.3% (29.7-51.9)		41.4% (37.4-45.5)	26.8% (22.5-31.7)	44.0% (32.5-56.2)	
AOR (95% C.I.)	1.00	0.47 (0.35-0.64)	1.12 (0.69-1.82)		1.00	0.50 (0.37-0.69)	1.04 (0.63-1.73)	
Denominators	793, 583	548, 399	102, 73		695, 508	411, 309	89, 66	
Lack of sexual competence at first heterosexual sex[3]				0.7668				0.8434
% (95% C.I.)	45.0% (41.0-49.1)	40.5% (34.6-46.6)	47.6% (36.2-59.2)		45.0% (41.0-49.1)	40.5% (34.6-46.6)	47.6% (36.2-59.2)	
AOR (95% C.I.)	1.00	0.93 (0.69-1.26)	1.13 (0.68-1.89)		1.00	0.98 (0.72-1.33)	1.15 (0.69-1.91)	
Denominators	689, 504	407, 306	89, 66		689, 504	407, 306	89, 66	
Unsafe sex[4]				0.0003				0.0052
% (95% C.I.)	28.5% (25.1-32.1)	18.3% (15.3-21.9)	18.9% (11.5-29.5)		32.5% (28.8-36.4)	23.6% (19.6-28.2)	20.4% (12.3-32.1)	
AOR (95% C.I.)	1.00	0.58 (0.44-0.77)	0.53 (0.28-1.00)		1.00	0.66 (0.49-0.89)	0.49 (0.25-0.95)	
Denominators	782, 574	554, 403	102, 73		675, 494	406, 305	87, 65	
Ever diagnosed with an STI				0.0553				0.3840
% (95% C.I.)	9.5% (7.6-11.9)	4.8% (3.2-7.1)	8.2% (3.6-17.7)		10.5% (8.3-13.2)	6.3% (4.2-9.3)	9.2% (4.0-19.6)	
AOR (95% C.I.)	1.00	0.55 (0.33-0.91)	0.65 (0.24-1.75)		1.00	0.72 (0.43-1.22)	0.65 (0.23-1.85)	
Denominators	792, 582	560, 407	104, 74		684, 501	410, 308	89, 66	
Non-volitional sex, ever				0.66915				0.9410
% (95% C.I.)	1.0% (0.5-2.1)	0.7% (0.2-1.9)	1.5% (0.3-7.0)		1.2% (0.6-2.5)	0.9% (0.3-2.5)	1.7% (0.3-7.8)	
AOR (95% C.I.)	1.00	0.65 (0.18-2.29)	1.35 (0.24-7.74)		1.00	0.94 (0.24-3.65)	1.31 (0.22-7.62)	
Denominators	777, 571	552, 401	103, 73		672 ,493	405, 301	88, 65, 43	
Distressed/worried about sex life				0.3971				0.6328
% (95% C.I.)	11.1% (8.9-13.9)	10.8% (8.2-14.0)	6.2% (3.1-12.1)		9.6% (7.4-12.3)	8.2% (5.8-11.4)	6.2% (2.9-12.4)	
AOR (95% C.I.)	1.00	0.95 (0.64-1.42)	0.59 (0.27-1.27)		1.00	0.84 (0.52-1.36)	0.71 (0.31-1.61)	
Denominators	762, 557	516, 378	102, 73		684, 501	410, 308	89, 66	
Overall sexual health[5]				0.3934				0.6792
% (95% C.I.)	80.6% (77.2-83.6)	84.2% (80.5-87.3)	83.8% (74.0-90.4)		81.4% (78.0-84.4)	85.6% (81.7-88.9)	82.8% (72.1-90.0)	
AOR (95% C.I.)	1.00	1.22 (0.88-1.70)	1.34 (0.71-2.55)		1.00	1.18 (0.81-1.72)	1.17 (0.59-2.32)	
Denominators	745, 544	511, 374	101, 73		670, 490	405, 304	88, 65	

[1] Odds ratio is adjusted for age (continuous) and educational level
[2] Odds ratio is adjusted for educational level, age at first sex (continuous) and years sexually active (continuous), except for "First sex before age 16" which is adjusted for educational level and age (continuous)
[3] Not met the following four criteria: partners equally willing, use of reliable contraception, autonomy of decision, and that it happened at the 'right time'. Excludes those who have not experienced heterosexual sex.
[4] No condom used at the first occasion of sex with a new partner in the past year
[5] Composite of: not experiencing non-volitional sex, never having an STI, and lack of distress about sex life in past year
[6] Chi^2 test of heterogeneity

Table 2b: Sexual behaviours and outcomes by main source of information about sexual matters, women

	Of all women[1]				Of sexually experienced women[2]			
	Other	School	A parent	p-value[6]	Other sources	School	A parent	p-value[6]
First sex before age 16				0.0001				0.0032
% (95% C.I.)	33.4% (30.0-37.0)	23.5% (20.3-27.0)	33.6% (27.8-40.0)		37.5% (33.7-41.3)	30.0% (26.1-34.3)	39.7% (33.0-46.7)	
AOR (95% C.I.)	1.00	0.56 (0.43-0.72)	0.84 (0.62-1.14)		1.00	0.63 (0.48-0.82)	0.92 (0.66-1.27)	
Denominators	823, 462	706, 408	273, 151		748, 414	565, 321	235, 127	
Lack of sexual competence at first heterosexual sex[3]				0.0021				0.0131
% (95% C.I.)	56.3% (52.3-60.1)	47.1% (42.6-51.6)	52.5% (45.5-59.4)		56.3% (52.3-60.1)	47.1% (42.6-51.6)	52.5% (45.5-59.4)	
AOR (95% C.I.)	1.00	0.65 (0.51-0.83)	0.75 (0.54-1.06)		1.00	0.70 (0.54-0.90)	0.75 (0.53-1.05)	
Denominators	741, 409	564, 320	234, 127		741, 409	564, 320	234, 127	
Unsafe sex[4]				0.0141				0.1437
% (95% C.I.)	26.1% (22.9-29.5)	20.4% (17.3-23.9)	21.4% (16.5-27.3)		29.9% (26.4-33.7)	26.3% (22.4-30.5)	25.2% (19.5-31.9)	
AOR (95% C.I.)	1.00	0.69 (0.52-0.91)	0.69 (0.48-0.99)		1.00	0.81 (0.60-1.08)	0.71 (0.48-1.04)	
Denominators	828, 465	714, 411	278, 155		736, 405	555, 315	234, 127	
Ever had an abortion				0.1014				0.2692
% (95% C.I.)	10.5% (8.4-13.0)	6.9% (5.2-9.0)	7.7% (5.1-11.4)		12.1% (9.8-14.9)	8.5% (6.4-11.2)	9.3% (6.2-13.7)	
AOR (95% C.I.)	1.00	0.70 (0.47-1.04)	0.64 (0.38-1.08)		1.00	0.84 (0.56-1.27)	0.65 (0.38-1.11)	
Denominators	833, 470	723, 417	279, 155		740, 409	560, 319	235, 127	
Ever diagnosed with an STI				0.0004				0.01
% (95% C.I.)	20.8% (17.8-24.1)	12.5% (10.0-15.5)	13.8% (10.1-18.4)		23.8% (20.5-27.3)	16.2% (13.0-20.0)	16.6% (12.3-22.2)	
AOR (95% C.I.)	1.00	0.58 (0.43-0.80)	0.54 (0.36-0.82)		1.00	0.71 (0.50-0.99)	0.57 (0.38-0.86)	
Denominators	833, 468	717, 414	277, 154		740, 407	557, 317	234, 127	
Non-volitional sex, ever				0.0320				0.1325
% (95% C.I.)	9.1% (7.2-11.4)	5.9% (4.3-8.1)	6.3% (3.9-10.1)		10.5% (8.3-13.2)	7.5% (5.4-10.3)	7.2% (4.4-11.6)	
AOR (95% C.I.)	1.00	0.61 (0.40-0.94)	0.58 (0.32-1.03)		1.00	0.76 (0.49-1.18)	0.55 (0.30-1.04)	
Denominators	813, 457	699, 404	272, 151		721, 397	538, 307	229, 124	
Distressed/worried about sex life				0.1757				0.0762
% (95% C.I.)	11.4% (9.1-14.2)	8.6% (6.5-11.4)	11.3% (7.5-16.8)		11.2% (8.7-14.3)	7.3% (5.2-10.0)	10.4% (6.5-16.3)	
AOR (95% C.I.)	1.00	0.70 (0.47-1.03)	1.00 (0.58-1.70)		1.00	0.60 (0.38-0.94)	0.94 (0.52-1.68)	
Denominators	812, 453	666, 380	264, 145		739, 407	557, 317	234, 127	
Overall sexual health[4]				0.0001				0.0024
% (95% C.I.)	60.1% (56.3-63.8)	71.1% (66.9-74.9)	68.5% (61.9-74.4)		57.3% (53.3-61.2)	68.5% (63.9-72.8)	66.5% (59.4-72.9)	
AOR (95% C.I.)	1.00	1.64 (1.28-2.10)	1.59 (1.12-2.26)		1.00	1.50 (1.14-1.96)	1.64 (1.13-2.38)	
Denominators	789, 440	641, 367	256, 141		717, 393	534, 306	228, 124	

[1] Odds ratio is adjusted for age (continuous) and educational level

[2] Odds ratio is adjusted for educational level, age at first sex (continuous) and years sexually active (continuous), except for "First sex before age 16" which is adjusted for educational level and age (continuous)

[3] Not met the following four criteria: both partners equally willing, use of reliable contraception, autonomy of decision, and that it happened at the 'right time'. Excludes those who have not experienced heterosexual sex.

[4] No condom used at the first occasion of sex with a new partner in the past year

[5] Composite of: not experiencing non-volitional sex, never having an STI, never having an abortion and lack of distress about sex life in past year

[6] Chi^2 test of heterogeneity

Figure 1a: Kaplan-Meier estimates of the probability of having first heterosexual sex at, or before, each age by main source of information, men aged 17-24

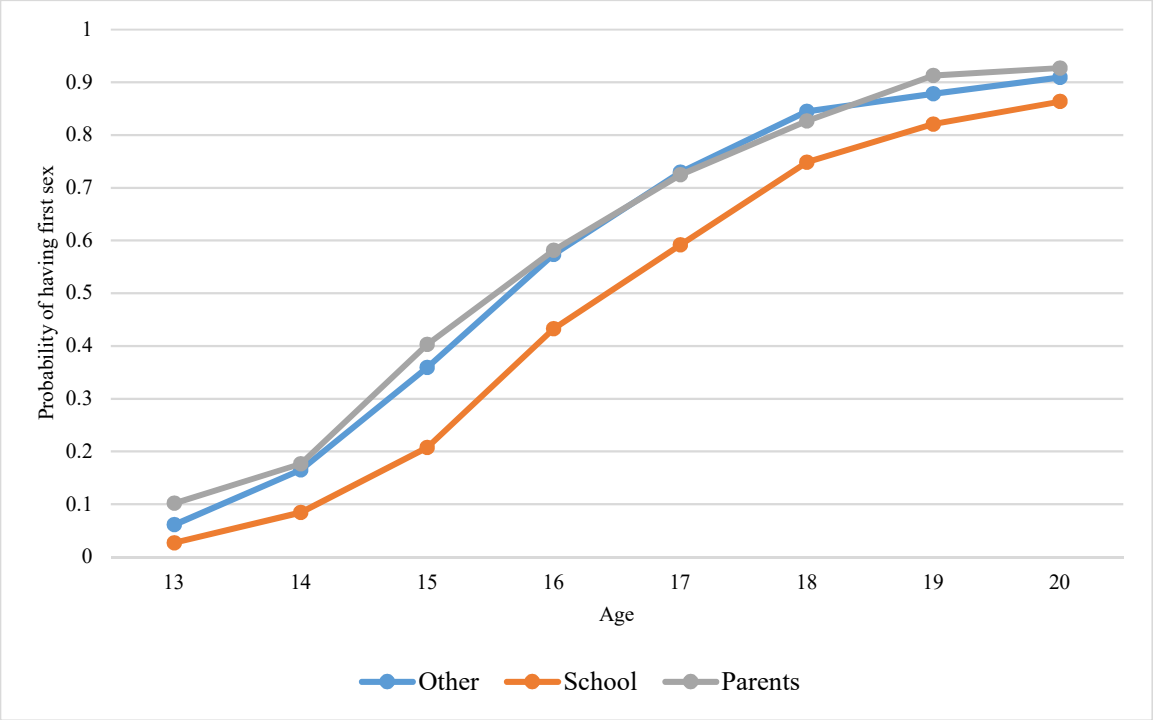
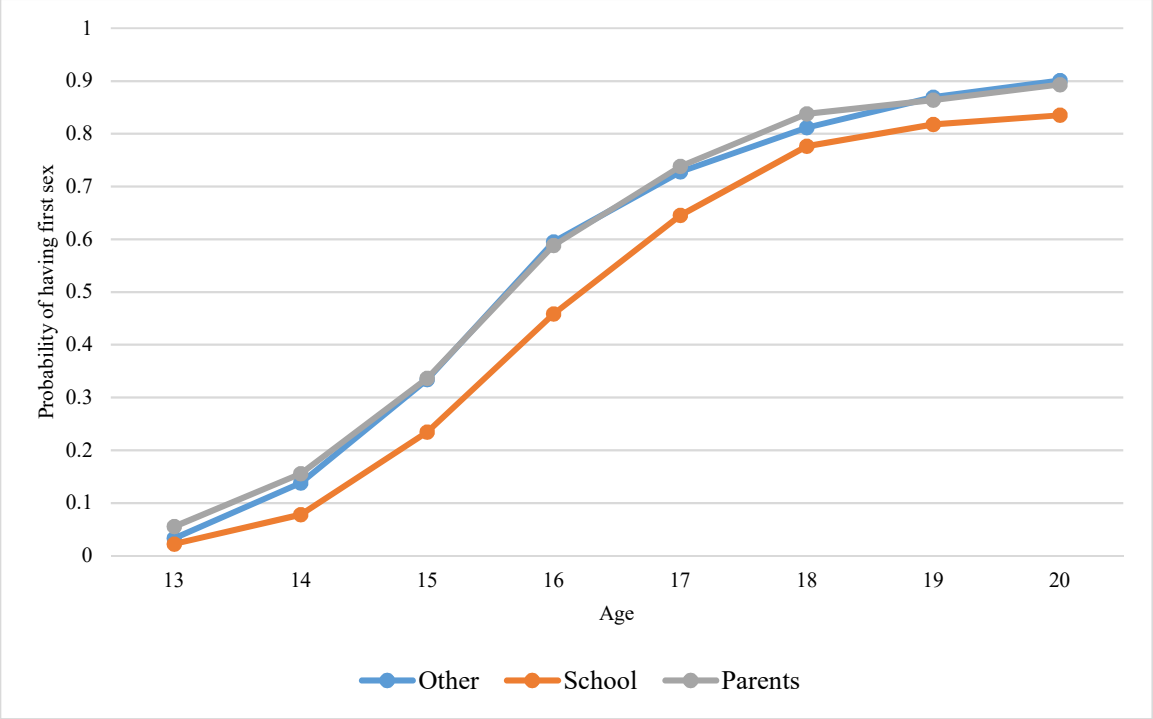


Figure 1b: Kaplan-Meier estimates of the probability of having first heterosexual sex at, or before, each age by main source of information, women aged 17-24



9 PAPER: LIFETIME PREVALENCE, ASSOCIATED FACTORS AND CIRCUMSTANCES OF NON-VOLITIONAL SEX AMONG WOMEN AND MEN: FINDINGS FROM THE THIRD BRITISH NATIONAL SURVEY OF SEXUAL ATTITUDES AND LIFESTYLES (NATSAL-3)

RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed <u>for each</u> research paper included within a thesis.

SECTION A – Student Details

Student ID Number	RPHP/349334	**Title**	Ms
First Name(s)	Wendy Georgina		
Surname/Family Name	Macdowall		
Thesis Title	THE EVOLUTION OF THE NATIONAL SURVEY OF SEXUAL ATTITUDES AND LIFESTYLES: THEORETICAL, CONCEPTUAL AND METHODOLOGICAL ADVANCES		
Primary Supervisor	Professor Kaye Wellings		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

<u>SECTION B – Paper already published</u>

Where was the work published?	The Lancet		
When was the work published?	December 2013		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion	N/A		
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SECTION E

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Date 05/05/2020

Lifetime prevalence, associated factors and circumstances of non-volitional sex among women and men in Britain: Findings from the third National Survey of Sexual Attitudes and Lifestyles (Natsal 3)

Wendy Macdowall,[1] Lorna J. Gibson,[1] Clare Tanton,[2] Catherine H. Mercer,[2] Ruth Lewis,[1] Soazig Clifton,[3] Nigel Field,[2] Jessica Datta,[1] Kirstin R. Mitchell,[1] Pam Sonnenberg,[2] Bob Erens,[4] Andrew J. Copas,[2] Andrew Phelps,[5] Philip Prah[2], Anne M. Johnson,[2] Kaye Wellings*[1]*

*Joint senior authors

[1]**London School of Hygiene & Tropical Medicine**

Centre for Sexual & Reproductive Health Research, Department of Social & Environmental Health Research, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH (*Wendy Macdowall MSc, Lorna J. Gibson MPhil, Ruth Lewis PhD, Jessica Datta MSc, Kirstin Mitchell PhD, Kaye Wellings FRCOG*)

[2] **Research Department of Infection and Population Health, University College London**

Mortimer Market Centre, off Capper St, London, WC1E 6JB, United Kingdom (*Clare Tanton PhD, Catherine H. Mercer PhD, Nigel Field MBPhD, Pam Sonnenberg PhD, Andrew J. Copas PhD, Phil Prah MSc, Anne M. Johnson MD*)

[3] **NatCen Social Research, and Research Department of Infection and Population Health, University College London**

NatCen Social Research, 35 Northampton Square, London, EC1V 0AX, United Kingdom (*Soazig Clifton BSc*)

[4] **London School of Hygiene & Tropical Medicine, and Research Department of Infection and Population Health, University College London**

Health Services Research & Policy, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London, WC1H 9SH (*Bob Erens MA*)

[5]**NatCen Social Research**

35 Northampton Square, London, EC1V 0AX, United Kingdom (*Andrew Phelps BA*)

Corresponding author

Wendy Macdowall MSc

London School of Hygiene & Tropical Medicine

Centre for Sexual & Reproductive Health Research, Department of Social & Environmental Health Research, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH

Tel: +44(0)20 7927 2048

wendy.macdowall@lshtm.ac.uk

Lifetime prevalence, associated factors and circumstances of non-volitional sex among women and men in Britain: Findings from the third National Survey of Sexual Attitudes and Lifestyles (Natsal 3)

Key messages

1. Non-volitional sex is more commonly – but not exclusively - reported by women; one in 10 women (9.8%) experienced completed non-volitional sex since the age of 13 years compared with one in 71 men (1.4%).
2. Non-volitional sex is predominately an experience of younger age; the median age at most recent event was 18 years for women and 16 years for men.
3. Prevalence varies by socio-demographic factors, including family structure and (in women) age, education and deprivation.
4. Experiencing non-volitional sex is associated with a range of poor physical, mental and sexual health outcomes, and with a number of potentially harmful health behaviours in both women and men.
5. In the majority of instances, the perpetrator is someone known to the individual. However, the nature of the relationship with the perpetrator varies considerably with the age at which the event occurs.
6. Less than half of women (42.2%) and a third of men (32.6%) indicated that they told someone about the event and fewer still reported it to the police (12.9% of women and 8.0% of men).
7. The findings point to the need for intervention at an early age to prevent sex that is non-consensual and for greater efforts to be made to both counter myths and de-stigmatise reporting. For those who have suffered sex against their will, the findings support the need for training of health and other professionals to enable them to better detect and handle cases of sexual violence and for integrated services to help mitigate the harmful effects.

Research in context

Systematic review

The first global systematic review of the prevalence and health effects of violence against women estimated that 35.6% of women have experienced physical violence, sexual violence or both at some time in their lives, with regional estimates ranging from 27.2% in Europe to 45.6% in Africa, and concluded that the experience is strongly associated with poorer physical, sexual and reproductive, and mental health outcomes (1). Less is known about the prevalence and associated outcomes in men (2). So far, information on sexual violence in Britain has relied on data from the annual crime survey (3). Crime surveys are limited in scope with regard to exploring potential factors associated with the experience and measurement of sexual violence in the context of crime is thought to underestimate prevalence (4, 5). Natsal-3 is the first of the Natsal surveys to ask questions on sexual violence. We asked women and men about their experience of *sex against their will*, which, in the most literal interpretation of the question, we report as non-volitional sex.

Interpretation

Our estimates for the prevalence of non-volitional sex in women and men are higher than those for the more narrowly defined experience of 'rape' found in the 2011/12 Crime Survey for England and Wales (CSEW) (3) but are similar to estimates from non-crime population surveys in other high-income countries (5, 6). Our findings concur with those of the CSEW is in the low level of reporting to the police and in the nature of the relationship with the perpetrator, who is most often someone known to the individual. We found strong associations between experiencing non-volitional sex and health and behavioural factors in both women and men.

Summary

Background Sexual violence is increasingly recognised as a public health issue. Information about prevalence, associated factors and consequences for health in the population of Britain (England, Scotland and Wales) is scarce.

Methods Between Sept 6, 2010, and Aug 31, 2012 we did a probability sample survey of women and men aged 16-74 years living in Britain. We asked participants about their experience of sex against their will since age 13 and the circumstances surrounding the most recent occurrence. We explored associations between ever experiencing non-volitional sex and a range of socio-demographic, health and behavioural factors. We used logistic regression to estimate age-adjusted odds-ratios to analyse factors associated with the occurrence of completed non-volitional sex in women and men.

Findings We interviewed 15,162 people. Completed non-volitional sex was reported by 9.8% (95% CI: 9.0-10.5) of women and 1.4% (1.1-1.7) of men. Median age (interdecile range) at most recent occurrence was 18 years (14, 32) for women and 16 years (13, 30) for men. Completed non-volitional sex varied by family structure and (in women) by age, education and area-level deprivation. It was associated with poor health, longstanding illness or disability, and treatment for mental health conditions, smoking and use of non-prescription drugs in the past year in both sexes, and with binge drinking in women. Completed non-volitional sex was also associated with reporting first heterosexual intercourse before 16 years of age, same-sex experience, more lifetime sexual partners, ever being diagnosed with a sexually transmitted infection and low sexual function in both sexes, and, in women, with abortion, and pregnancy outcome before 18 years of age. In most cases, the person responsible was known to the individual, although the nature of the relationship differed by age at most recent occurrence. Participants who were younger at interview were more likely to have told someone about the event and to have reported it to the police than were older participants.

Interpretation These data provide the first population prevalence estimates of non-volitional sex in Britain. We showed it to be mainly an experience of young age and strongly associated with a range of adverse health outcomes in women and men.

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Introduction

Sexual violence is a violation of fundamental human rights and recognition of the global magnitude of the problem has grown during the past two decades (1). It encompasses a range of acts, from verbal harassment to forced penetration, and different degrees of coercion, from intimidation to physical force (7). It can be experienced by people of all ages as a single event or part of a pattern of victimisation lasting months or years. The potential health effects are similarly broad ranging, and include physical, sexual and reproductive, and mental health sequelae (1, 8, 9). As the human, economic and wider social costs are becoming better understood, (1, 7, 9, 10) sexual violence is increasingly recognised as a global public health issue that needs urgent attention (1, 11).

So far, most research has focussed on the experience of women and on sexual violence within the contexts of so called “date rape” (12) and of intimate partner violence (IPV) (1, 8, 9), which also includes physical and emotional violence and controlling behaviours (7). Less is known about other forms of sexual violence or about sexual violence in isolation from other forms of abuse within IPV (1, 9). Less still is known about men as victims (2).

Measurement of the prevalence of sexual violence - rape in particular - and by extension its consequences for health, is challenging for many reasons (13); sexual violence is highly stigmatised and is among the few crimes in which the victim may also be blamed (13). Furthermore, people who have been victims of what is legally defined as rape might not acknowledge it as such (14). General agreement exists that the use of the term rape should be avoided in research because it is highly subjective and likely to lead to under-reporting; neutral and behaviourally specific terms are preferred (13, 15).

The Natsal surveys are large probability surveys of sexual attitudes and lifestyles in the British population. Findings from the first survey in 1990-91 (16, 17) and the second in 1999-2001(18-21) have been used extensively to inform sexual and reproductive health policy in Britain (22-24). Natsal-3 is the first Natsal to include questions about sexual violence and the first population-based survey in Britain to explore the issue outside the context of crime. We asked participants about their experience of sex against their will, which we report as non-volitional sex. We present population estimates for the prevalence of attempted and completed non-volitional sex in women and men occurring since the age of 13 years, the circumstances surrounding the most recent occurrence, and the associations between ever having experienced completed non-volitional sex and several socio-demographic, behavioural and health factors.

Methods

Between Sept 6, 2010, and Aug 31, 2012 we interviewed women and men aged 16-74 years living in Britain. We interviewed participants using computer-assisted personal interviewing (CAPI), including a computer-assisted self-interview (CASI) for the more sensitive questions. Details of the methods used are described elsewhere (25-28).

We asked women and men about their experience of sex against their will - since age 13 - in the CASI section of the questionnaire, where heterosexual sex was defined as including '*vaginal, oral or anal*' and same sex sex as including '*oral (or* for men only *anal) sex or any other contact involving the genital area*'. Only participants who reported that they had had heterosexual intercourse or sex with someone of the same sex since age 13 were routed to these questions. The first question was worded, "*Has anyone tried to make you have sex with them, against your will?*". Participants who responded 'yes' were defined as having experienced 'attempted non-volitional sex', and were then asked "*Has anyone actually made you have sex with them, against your will*?", which was used to define the experience of 'completed non-volitional sex'. Participants reporting completed non-volitional sex were asked their age at the most recent occurrence and the nature of their relationship with the person responsible (*someone you were, or had been, in a relationship with* [which we refer to as a 'current or former intimate partner']*; someone known to you as a family member or friend; someone known to you but not as a family member or friend; someone you didn't know; and other*). We also asked whether they had told anyone about the experience, and if they had reported it to the police. Once the CASI section was complete, responses were 'locked' into the computer and could not be accessed by the interviewer. At the end of the interview, we provided all participants with a leaflet detailing organisation providing relevant help and advice.

Statistical analysis

We calculated age-specific lifetime population prevalence estimates for reported attempted and completed non-volitional sex and analysed the associations between non-volitional sex and a range of factors. Socio-demographic factors included age at interview, family structure (at age 14), education and area-level deprivation (using the Index of Multiple Deprivation (IMD), a multi-dimensional measure combining income, employment, health, education, access to housing and services, crime and living environment) (29). Health and behavioural factors included self-reported: health status; longstanding illness or disability; treatment for depression or for other mental health conditions in the past year; smoking history; frequency of drinking over 6 or 8 units of alcohol per day for women and men respectively (so called binge drinking) (30), and non-prescription drug use in the past year. Sexual health factors included: age at first heterosexual intercourse; ever same sex

experience involving genital contact; lifetime number of opposite or same-sex sexual partners; ever STI diagnosis; low sexual function (measured using the 17 item Natsal-SF, which comprises components on problems with sexual response, sexual function in the relationship context, and self-appraisal of sex life (31)) and, for women, pregnancy under age 18 and number of abortions ever.

We did all analyses with the survey commands in STATA (version 12.1) which incorporated the weighting, clustering and stratification of the Natsal-3 dataset. We used logistic regression to estimate age-adjusted odds ratios (aAOR) in order to explore factors associated with experiencing completed non-volitional sex among women and men.

Ethics

Natsal-3 was granted ethical approval from the Oxford A NHS Research Ethics Committee (reference: 09/H0604/27). Participants provided oral informed consent for interviews.

Role of funding source

The sponsors played no role in the study design, data interpretation, data collection, data analysis, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

We interviewed 15,162 people (8,869 women [median age at interview 43 years] and 6,293 men [median age at interview 42 years]). The response rate was 57.7% and the co-operation rate was 65.8% (of all eligible addresses contacted). 14,283 participants (8,409 women and 5,874 men,) were routed into the CASI section of the questionnaire where they were asked the questions regarding their experience of non-volitional sex. Of those, 1.7% of women and 1.3% of men reported that they did not know whether this had happened to them, and 2.6% of women and 2.9% of men did not answer the question. We excluded these participants from the analysis. Compared with responders, a higher proportion of item non-responders were of lower educational level, were in the highest quintile of deprivation, and were of older age (over 55 for men and over 65 for women) (data not shown).

Prevalence of attempted and completed non-volitional sex

Attempted non-volitional sex was reported by 19.4% (95% CI: 18.4-20.4) of all women (table 1) and 4.7% (4.1-5.4) of all men (table 2). Half of women (50.5%) and almost a third of men (29.8%) who reported attempted non-volitional sex went on to report completed non-volitional sex, such that completed non-volitional sex was reported by 9.8% (9.0-10.5) of women and 1.4% (1.1-1.7) of men. The mean and median age (interdecile range) at the last occurrence of completed non-volitional sex

was 20.6 and 18 years (14, 32) for women, and 19.2 and 16 years (13, 30) for men. The mean and median number of years (interdecile range) since the last occurrence was 22.5 and 22 years (5-40) for women, and 23.2 and 22 years (5-48) for men.

Factors associated with attempted and completed non-volitional sex

The prevalence of reported experience of attempted and completed non-volitional sex varied by several socio-demographic characteristics in both women and men (tables 1 and 2). In women, ever having experienced either event was reported less often by the youngest (aged 16-24) and oldest (aged 65-74) participants. In men, the reported prevalence was similar across all age groups. There were marked differences in the prevalence of attempted and completed non-volitional sex by family structure. Non-volitional sex was more commonly reported by women and men who grew up in single parent or 'other' households or in care, and by women who lived with one natural parent and one step parent. The strong association seen between completed non-volitional sex and growing up in care should be interpreted with caution in view of the small number of participants in the sample for whom this was the case. In women, completed non-volitional sex was associated with currently living in areas of greater deprivation and, conversely, with higher educational attainment; the associations for both these variables in men were in the same direction but not statistically significant.

Non-volitional sex and health indicators

The reporting of attempted and completed non-volitional sex was higher amongst women who rated their overall health as bad/very bad or fair (table 1) and among men who rated their health as fair (table 2), compared to those rating it as good/very good. Both experiences were also more common among women and men reporting a longstanding illness or disability, or treatment for either depression or another mental health condition in the year prior to interview, compared to those who did not.

In women and men reporting past or current smoking, or use of illicit drugs in the year prior to interview, and in women who reported binge drinking at least weekly, experience of attempted and completed non-volitional sex was higher than in those not reporting these behaviours (tables 1 and 2).

Attempted and completed non-volitional sex also varied by a number of sexual behaviour indicators and by a range of sexual health indicators (tables 1 and 2). Both were higher in women and men reporting first heterosexual intercourse before age 16, same-sex experience, higher lifetime number of sexual partners, ever being diagnosed with a sexually transmitted infection (STI), low sexual function, and, in women, reporting abortion and pregnancy under 18.

We found strong associations after adjusting for age (aAORs) with completed non-volitional sex and all these behavioural and health factors (tables 1 and 2), with the exception of binge drinking in men. All associations, including those with the socio-demographic characteristics described above, were sustained for women after further adjustment for family structure, deprivation and education (see Web Appendix). It was not possible to make the same adjustment for men due to the small number reporting completed non-volitional sex.

Circumstances surrounding most recent occurrence of completed non-volitional sex

In most instances, the perpetrator was known to the respondent, either as a current or former intimate partner (40.6% women, 22.9% men), a family member or friend (20.4% women, 30.2% men) or known but not as a family member or friend (20.8% women, 29.7% men). In only a few instances was the person responsible a stranger (14.8% women, 15.3% men). The nature of the relationship with the perpetrator varied with the age at last occurrence (figure 1) except where that person was a stranger. The proportion of instances in which a family member or friend was identified as the perpetrator decreased with increasing age, from 45.3% amongst women aged 13-15 years to 5.8% amongst those aged over 25 years at the most recent occurrence. Where intimate partners were the perpetrators, the reverse pattern was seen; 11.4% of women aged 13-15 years at the most recent occurrence identified the person responsible as someone with whom they were or had been in a relationship, which increased to 71.5% of those aged 25 and over. The respective figures for men are not shown given the small numbers.

Of participants reporting completed non-volitional sex, fewer than half told someone about the event, though women were more likely to have done so than men (42.2% compared to 32.6%). Women were also more likely than men to report to the police (12.9% and 8.0% respectively). The proportion of women who either told someone or reported the event to the police varied by age at interview (figure 2) and by perpetrator (figure 3). Reporting to the police increased with decreasing age at interview and was higher when the perpetrator was a stranger (20.9% reported the act when committed by a stranger compared with 9.4% when committed by a current or former intimate partner). Again, the corresponding figures for men are not shown given the small numbers.

Discussion

Our data show that one in five women and one in 20 men in Britain report experiencing attempted non-volitional sex and one in 10 women and one in 71 men report experiencing completed non-volitional sex since the age of 13. We have used the term ‘non-volitional sex’ as the most literal translation of the question asked. Irrespective of the degree of coercion or force used, it represents a violation of sexual autonomy and is therefore a form of sexual violence. Worldwide, prevalence

estimates of sexual violence vary considerably (1). Direct comparisons, however, are difficult because of differences in the framing of surveys, the measures used, the methodologies employed and the population under study (8, 32). The American Intimate Partner and Sexual Violence Survey and the French "Context of Sexuality in France", which, like Natsal 3 are national probability sample surveys, found similar levels of reporting (5, 6).

In Britain, the only population data come from the Crime Survey for England and Wales (CSEW) (3) where the prevalence of ever experiencing completed 'rape', 3.8% among women and 0.2% among men, is lower than our estimates for non-volitional sex. Limiting Natsal 3 data to participants aged 16-59 and to occurrences after age 16 (as per CSEW), our estimates remain higher at 7.5% for women and 0.8% for men. The difference is likely to be due to a combination of differences in methodology, question wording, and context. The questions in the CSEW are designed to specifically measure rape as legally defined, as opposed to the broader definition of non-volitional sex used here. However, asking about experiences in a crime survey may result in under-reporting as participants might only include events they perceive as illegal (4) and, as noted in the introduction, many people who have experienced what would legally be defined as rape do not acknowledge it as such (14). Where our data do concur with the CSEW (3) is in the nature of the relationship with the perpetrator, who is most often someone known to the individual and we also show similar low levels of reporting to the police (3).

As reported elsewhere (1, 5, 6) we found non-volitional sex to be predominantly an experience of young age, with the median age at the most recent occurrence being 18 years in women and 16 years in men. Two groups known to be vulnerable to sexual victimisation, which is also corroborated in our data, are men who have had sex with men (5, 33-35) and individuals who grow up in care (36) (though the latter must be interpreted cautiously given the small numbers and we do not know whether participants encountered abuse whilst in care; men and women may have been placed in care because of sexual abuse in the home or they may have been more vulnerable to sex against their will in their other relationships (37)).

We see strong and consistent associations in our data between experience of completed non-volitional sex and poor mental and physical health status and potentially harmful health behaviours. Since reporting of these experiences was proximate to the time of interview (or the preceding 12 months), we know them to have been experienced subsequent to occurrence of non-volitional sex, but they may also have occurred prior to the event, and so direction of effect cannot be established. The association between IPV and mental health, especially among women, is now well established in the literature (1, 10, 38, 39). However, there is also strong evidence that people with mental health conditions are more vulnerable to sexual assault (40, 41). Longitudinal studies (42) suggest the

relationship between IPV and depression is bidirectional, although sexual violence has not been examined in isolation from other forms of violence. Sexual violence and depression also share common risk factors for which we were not able to adjust, in particular, childhood exposure to abuse and socio-economic disadvantage (42); we did not ask about the former and the information we have regarding the latter refers to current conditions and not those at the time of the event. Furthermore, there is the potential for cumulative effects of related experiences. Disability, for example, has been identified as a risk factor for sexual violence (40, 43, 44) and victims of sexual violence with a disability - especially those with pre-existing mental illness - are more likely to experience mental health problems following violent incidents compared to those without, so compounding the harm (40). In addition, research suggests that, in the context of IPV, few women suffer from sexual abuse alone (8, 38, 45).

Similarly, we cannot establish the direction of effect in respect to the marked associations found in our study between experience of non-volitional sex and a range of indicators of sexual behaviour and sexual health, including first heterosexual intercourse before 16, number of sexual partners, STI diagnosis, and low sexual function in both sexes, and with abortion and first pregnancy under 18 in women. Many of these associations may be the direct result of non-volitional sex, or they may be linked indirectly through a common cause, such as reduced sexual agency, increased risk behaviours or both (1).

The strength of this study lies in the size and nature of the sample, which is randomly selected and nationally representative, and in its methodology, in particular the use of computer-assisted self-interview (CASI) (46) to maximise reporting and confidentiality of responses. Arguably, a further strength relates to the fact that the questions regarding experience of non-volitional sex were asked in the context of a sexual behaviour survey, as opposed to a crime or general health survey.

A number of limitations, however, must be considered. Firstly, our data rely on answers to a single, broadly worded question, and its interpretation by participants may have differed by age and sex. Secondly, the question as worded covers a wide range of experiences which we are unable to distinguish between; we did not ask about frequency, severity, the number of perpetrators or their sex, or other details such as the involvement of drugs or alcohol (though it should be noted the law governing rape in the UK does not require the victim to have physically resisted and covers circumstances where the victim does not have the capacity to consent (47)). Thirdly, the data are susceptible to biases associated with both response and reporting. In relation to the former, it is possible that the figures we report are under-estimates of non-volitional sex because those most at risk may be under-represented; vulnerable groups such as the homeless and people living in institutions are excluded because of the sampling strategy (26) and those currently in abusive

relationships may have been less likely to take part. Although people not included in the sampling frame might be at higher risk of sexual violence, it is also the case that they make up a small proportion in the population (48) as such we believe the effect on estimates at the population level is likely to be minimal. Within the survey, only participants who reported that they had had heterosexual intercourse or sex with someone of the same sex since age 13 were routed into the CASI where we asked the questions about non-volitional sex. We have assumed that participants not routed into the CASI have not experienced sex against their will; however, it is possible that some participants who did not report sex, may have experienced *attempted* non-volitional sex but did not have the opportunity to report it. It may also be the case that participants whose only sexual experience was forced may have not reported it and, as such, would not have been routed to the questions. In addition, given the sensitive nature of the topic, participants may have chosen not to disclose the experience; this non-disclosure may also have been related to increasing age at interview. It is possible too that people who report poor health are more likely to recall or report experience of negative events, (10) though research suggests that disclosure is more likely to be affected by methodological issues than by personal characteristics of the participants (15, 49).

A number of important implications for research, policy, and practice stem from these findings. In terms of research, longitudinal data are needed to establish the direction of effects and qualitative data are needed to better understand the associations observed. We also know less about the perpetrators and about effective means of prevention. In terms of policy and practice, firstly, non-volitional sex is predominately an experience of young age and research suggests that those who suffer sexual abuse early in life are more likely to be revictimized (6), which emphasises that early intervention is essential. The UK Government plans to promote the teaching of “sexual consent and the importance of healthy relationships in schools” (50), however non-biological aspects of sex and relationship education are currently not compulsory and as such implementation may be hindered. Secondly, these data suggest that some people are more vulnerable to sex against their will than others, which supports the case for targeted intervention. Thirdly, while there is some evidence in these data that the younger participants in the survey were more likely to speak to someone about the occurrence of non-volitional sex, and to report it to the police, there remains considerable silence around the issue. There is a need to raise awareness of the issue and to de-stigmatise reporting.

The clustering of adverse sexual health risks argues for vigilance in a public health context for links between risk factors, and for the adoption of a holistic view of sexual health in both preventive and therapeutic intervention. Furthermore, the wide range of health and sexual health-related variables associated with non-volitional sex calls for integrated services for victims. Health professionals must

be cognisant and ask specifically about experience of sexual violence when people present for other issues, especially given that effects may be long lasting. Lastly, our data argue for greater efforts to counter myths and misconceptions, the stereotype of the perpetrator as a 'stranger in the bushes', for example. The strategies needed to achieve these broader ends go beyond the realms of public health and extend to all areas of society.

Authors' contributions

The paper was conceived by WM, CHM, SC, RL and KW. WM wrote the first draft with further contributions from LJG, CT, CHM, RL, SC, NF, JD, KW, PS, BE, KRM, AMJ and KW. Statistical analysis was done by LJG, with support from CHM, PP and AJC. KW and AMJ (Principal Investigators), with BE, WM, CHM, AJC and PS initial applicants on Natsal-3, wrote the initial study protocol and obtained funding. Questionnaire design, ethics applications, and piloting were undertaken by these applicants and SC, AP, CT and NF. AP, BE and SC were responsible for data collection and delivery. Data management was undertaken by NatCen Social Research (AP, SC) and UCL (CHM, CT) and LSHTM (RL). All authors contributed to data interpretation, reviewed successive drafts, and approved the final version of the manuscript.

Conflicts of interest

AMJ is a Governor of the Wellcome Trust since 2011. The other authors declare that they have no conflicts of interest.

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Table 1: Population prevalence of attempted and completed non-volitional sex, by demographic, health and behavioural factors, women

	Attempted non-volitional sex		Completed non-volitional sex					
	%[1]	95% CI[2]	%[1]	95% CI[2]	aAOR[3]	95% CI[2]	p-value	Denominators[4]
All	19·4%	(18·4-20·4)	9·8%	(9·0-10·5)				8511,7332
Age group at interview							<0·0001	
16-24	16·4%	(14·7-18·3)	6·9%	(5·8-8·1)	1·00			2078,1172
25-34	19·1%	(17·4-20·9)	9·7%	(8·5-11·2)	1·46	(1·16-1·85)		2382,1320
35-44	21·7%	(19·3-24·4)	12·5%	(10·5-14·7)	1·93	(1·48-2·52)		1171,1406
45-54	22·6%	(20·0-25·4)	12·2%	(10·3-14·3)	1·87	(1·44-2·44)		1079,1387
55-64	19·8%	(17·3-22·5)	10·2%	(8·4-12·4)	1·54	(1·16-2·04)		987,1179
65-74	14·5%	(12·0-17·4)	4·9%	(3·6-6·7)	0·70	(0·49-1·00)		814,867
Family structure[5]							<0·0001	
with natural/adoptive parents	17·8%	(16·7-18·9)	8·5%	(7·7-9·3)	1·00			6383,5795
with one natural/one step	25·9%	(22·3-29·8)	14·5%	(11·6-18·0)	1·85	(1·41-2·43)		764,569
with single parent	24·2%	(21·2-27·4)	12·9%	(10·5-15·7)	1·62	(1·25-2·09)		1132,776
in care	45·3%	(32.6-58.8)	36·6%	(24.7-50.4)	6·22	(3·52-11·00)		78,60
other	21·0%	(14·6-29·4)	14·3%	(8.8-22.3)	1·79	(1·03-3·11)		152,129
Index of Multiple Deprivation[6] (quintiles)							0·0019	
1 (least deprived)	17·9%	(15·8-20·2)	7·7%	(6·3-9·2)	1·00			1567,1484
2	18·7%	(16·6-21·1)	8·2%	(6·8-10·0)	1·09	(0·81-1·45)		1647,1505
3	22·0%	(19·7-24·4)	11·6%	(9·8-13·6)	1·59	(1·20-2·10)		1681,1447
4	19·9%	(17·8-22·1)	11·1%	(9·5-13·0)	1·52	(1·16-1·99)		1776,1471
5 (most deprived)	18·5%	(16·6-20·7)	10·3%	(8·8-12·0)	1·40	(1·07-1·83)		1840,1425
Education at age 17+[7]							0·0111	
no academic qualifications	14·5%	(12·7-16·5)	7·9%	(6·5-9·4)	1·00			1450,1414
academic qualifications typically gained at age 16	20·2%	(18·5-22·0)	11·0%	(9·7-12·5)	1·46	(1·14-1·87)		2759,2430
studying for/attained further academic qualifications	21·4%	(19·9-23·0)	9·8%	(8·7-11·0)	1·27	(0·98-1·66)		3841,3167
Self-reported health status							<0·0001	
good/very good	17·9%	(16·9-19·0)	8·5%	(7·7-9·3)	1·00			7003,5957
fair	24·8%	(22·0-27·8)	14·0%	(11·9-16·3)	1·82	(1·46-2·25)		1149,1033
bad/very bad	29·3%	(24·2-34·9)	19·9%	(15·6-25·0)	2·83	(2·05-3·91)		359,342
Longstanding illness or disability							<0·0001	
no	17·1%	(15·9-18·2)	7·7%	(6·9-8·6)	1·00			5881,4879
yes	24·1%	(22·3-25·9)	13·8%	(12·4-15·4)	2·06	(1·71-2·47)		2629,2453
Treatment for depression in past year[8]							<0·0001	
not mentioned	17·4%	(16·4-18·4)	8·3%	(7·5-9·0)	1·00			7376,6414
mentioned	33·4%	(30·3-36·6)	20·2%	(17·7-23·0)	2·82	(2·33-3·41)		1133,916
Treatment for other mental health condition in past year[9]							<0·0001	
not mentioned	18·8%	(17·8-19·8)	9·3%	(8·6-10·1)	1·00			8293,7174
mentioned	47·1%	(39·5-54·9)	31·0%	(24·3-38·7)	4·42	(3·12-6·25)		216,156
Smoking history							<0·0001	
never	15·4%	(14·2-16·7)	6·4%	(5·6-7·3)	1·00			4422,3915
ex-smoker	23·7%	(21·6-26·0)	13·2%	(11·5-15·1)	2·24	(1·81-2·78)		1796,1707
current	24·3%	(22·2-26·5)	14·0%	(12·4-15·8)	2·36	(1·93-2·88)		2293,1710
Frequency of binge drinking[10]								
never/rarely	18·2%	(17·0-19·4)	9·0%	(8·1-9·9)	1·00		<0·0001	5475,4907
monthly	20·4%	(17·8-23·2)	8·8%	(7·1-10·9)	1·00	(0·76-1·31)		1134,857
at least weekly	25·3%	(22·1-28·8)	15·6%	(12·9-18·6)	1·89	(1·48-2·42)		942,774
Non-prescription drug use in past year							<0·0001	
no	18·5%	(17·5-19·5)	9·3%	(8·5-10·1)	1·00			7572,6727
cannabis only	37·0%	(31·7-42·6)	20·6%	(16·2-25·7)	2·65	(1·92-3·66)		439,288
any hard drug	32·6%	(27·0-38·7)	15·2%	(10·8-21·1)	1·85	(1·22-2·81)		332,204
First heterosexual intercourse before age 16							<0·0001	
no	16·9%	(15·9-18·0)	7·4%	(6·7-8·2)	1·00			6588,5986
yes	31·5%	(29·1-34·1)	20·9%	(18·8-23·2)	3·55	(2·96-4·25)		1832,1267
Ever had same sex experience[11]							<0·0001	
no	17·9%	(17·0-19·0)	8·6%	(7·9-9·4)	1·00			7912,6877
yes	41·3%	(36·7-46·1)	27·5%	(23·4-32·0)	4·10	(3·23-5·21)		599,455
Number of sexual partners (lifetime)[12]							<0·0001	

	1	8·3%	(6·9-10·0)	1·9%	(1·3-2·8)	1·00		1586,1598
	2	13·8%	(11·4-16·6)	5·0%	(3·5-7·1)	2·79	(1·57-4·93)	878,803
	3-4	15·3%	(13·4-17·4)	7·6%	(6·3-9·2)	4·41	(2·77-7·03)	1525,1353
	5-9	24·7%	(22·5-27·0)	12·3%	(10·7-14·1)	7·69	(4·89-12·09)	2003,1687
	10+	35·7%	(33·1-38·3)	21·2%	(19·0-23·6)	14·98	(9·55-23·52)	1918,1477
Number of abortions							<0·0001	
	0	17·3%	(16·3-18·3)	8·2%	(7·5-9·0)	1·00		7317, 6332
	1	32·5%	(29·0-36·3)	18·0%	(15·1-21·2)	2·44	(1·94-3·06)	862,727
	2+	37·9%	(31·4-44·8)	27·3%	(21·6-33·8)	4·18	(3·03-5·77)	285,226
First pregnancy under age 18[13]							<0·0001	
	no	18·7%	(17·6-19·7)	8·8%	(8·1-9·6)	1·00		7261,6521
	yes	32·6%	(28·6-36·8)	23·9%	(20·3-27·9)	3·23	(2·57-4·07)	711,521
STI[14] **diagnosis ever (excluding thrush)**							<0·0001	
	no	16.9%	(15.9-17.9)	8·2%	(7·5-9·0)	1·00		7084,6246
	yes	34·5%	(31·6-37·4)	18·6%	(16·3-21·2)	2·60	(2·15-3·13)	1339,1007
Low sexual function[15]							<0·0001	
	no	17·8%	(16·6-19·0)	8·6%	(7·7-9·5)	1·00		5378,4571
	yes	31·4%	(28·4-34·5)	16·8%	(14·6-19·4)	2·18	(1·77-2·68)	1201,1135

[1] row percentages
[2] 95% Confidence Interval
[3] odds ratio for a woman's risk of experiencing completed non-volitional sex (relative to not), age-adjusted except for 'Age Group'
[4] unweighted, weighted denominators: all participants
[5] living circumstances when participant was age 14
[6] a measure of relative deprivation for the UK, divided in quintiles (30)
[7] denominator excludes women aged 16 at interview
[8] received treatment from a health professional for depression, in the year prior to interview
[9] received treatment from a health professional for a mental health condition other than depression, in the year prior to interview
[10] more than 6 units on one occasion (31)
[11] involving genital contact
[12] total number of same and/or opposite sex partners, excluding those with no partners
[13] denominator excludes women aged 16-17 at interview
[14] Sexually Transmitted Infection
[15] score using derived Natsal-3 sexual function measure (32), excluding those without a valid score

Table 2: Population prevalence of attempted and completed non-volitional sex, by demographic, health and behavioural factors, men

	Attempted non-volitional sex		Completed non-volitional sex					
	%[1]	95% CI[2]	%[1]	95% CI[2]	aAOR[3]	95% CI[2]	p-value	Denominators[4]
All	4·7%	(4·1-5·4)	1·4%	(1·1-1·7)				6049,7196
Age group at interview							0·0728	
16-24	3·7%	(2·8-4·9)	0·8%	(0·5-1·4)	1·00			1688,1208
25-34	4·4%	(3·4-5·7)	1·7%	(1·1-2·7)	2·07	(1·03-4·16)		1474,1328
35-44	4·2%	(3·0-5·9)	1·4%	(0·8-2·4)	1·67	(0·78-3·60)		788,1394
45-54	5·9%	(4·3-8·0)	1·8%	(1·0-3·1)	2·11	(0·95-4·67)		764,1360
55-64	5·8%	(4·2-8·1)	1·6%	(0·9-3·0)	1·95	(0·89-4·28)		725,1120
65-74	4·1%	(2·7-6·1)	0·4%	(0·1-1·3)	0·47	(0·13-1·69)		610,786
Family structure[5]							0·0002	
with natural/adoptive parents	4·3%	(3·6-5·0)	1·1%	(0·8-1·5)	1·00			4697,5888
with one natural/one step	5·4%	(3·5-8·3)	1·2%	(0·4-3·1)	1·04	(0·36-2·98)		460,454
with single parent	7·2%	(5·2-9·9)	2·6%	(1·6-4·4)	2·39	(1·27-4·51)		739,698
in care	9·9%	(3.0-27.7)	9·9%	(3.0-27.7)	9·64	(2.77-33.58)		34,30
other	9·2%	(4·8-16·9)	3·8%	(1·5-9·3)	3·44	(1·25-9·43)		119,125
Index of Multiple Deprivation[6] (quintiles)							0·1024	
1 (least deprived)	3·3%	(2·3-4·8)	0·5%	(0·2-1·2)	1·00			1187,1488
2	5·0%	(3·8-6·6)	1·5%	(0·9-2·6)	3·05	(1·10-8·44)		1206,1532
3	4·8%	(3·6-6·4)	1·7%	(1·1-2·8)	3·40	(1·25-9·21)		1172,1398
4	4·7%	(3·6-6·2)	1·3%	(0·8-2·1)	2·55	(0·94-6·90)		1205,1426
5 (most deprived)	5·9%	(4·4-7·7)	1·8%	(1·2-2·7)	3·54	(1·40-8·97)		1279,1351
Education at age 17+[7]							0·2731	
no academic qualifications	3·4%	(2·4-4·7)	0·9%	(0·4-1·7)	1·00			1056,1372
academic qualifications typically gained at age 16	3·9%	(3·0-5·0)	1·3%	(0·9-2·0)	1·54	(0·64-3·66)		1873,2262
studying for/attained further academic qualifications	6·0%	(5·1-7·1)	1·7%	(1·2-2·3)	1·97	(0·83-4·63)		2785,3284
Self-reported health status							0·0183	
good/very good	4·4%	(3·8-5·1)	1·2%	(0·9-1·5)	1·00			4971,5868
fair	6·4%	(4·6-8·8)	2·5%	(1·6-4·0)	2·28	(1·28-4·04)		838,1037
bad/very bad	5·3%	(3·1-9·0)	1·2%	(0·5-3·0)	1·13	(0·41-3·09)		238,287
Longstanding illness or disability							0·0046	
no	4·0%	(3·4-4·8)	1·1%	(0·8-1·5)	1·00			4285,4911
yes	6·2%	(5·1-7·5)	2·0%	(1·4-2·8)	2·02	(1·24-3·28)		1763,2284
Treatment for depression in past year[8]							<0·0001	
not mentioned	4·3%	(3·7-5·0)	1·1%	(0·8-1·5)	1·00			5635,6753
mentioned	11·0%	(8·0-14·8)	5·1%	(3·2-8·0)	4·80	(2·75-8·37)		413,442
Treatment for other mental health condition in past year[9]							0·0225	
not mentioned	4·6%	(4·1-5·3)	1·3%	(1·0-1·7)	1·00			5893,7043
mentioned	8·6%	(5·1-14·2)	3·4%	(1·6-7·3)	2·67	(1·15-6·20)		155,152
Smoking history							0·0001	
never	3·7%	(3·0-4·6)	0·6%	(0·3-1·0)	1·00			2935,3403
ex-smoker	5·1%	(4·0-6·5)	1·5%	(1·0-2·3)	2·63	(1·23-5·64)		1371,1906
current	6·2%	(4·9-7·6)	2·6%	(1·8-3·6)	4·44	(2·27-8·68)		1743,1886
Frequency of binge drinking[10]							0·4245	
never/rarely	4·7%	(3·9-5·6)	1·5%	(1·1-2·0)	1·00			3362,4195
monthly	5·3%	(3·8-7·3)	1·5%	(0·8-2·7)	1·02	(0·52-2·02)		1020,1127
at least weekly	4·1%	(3·1-5·5)	0·9%	(0·5-1·7)	0·64	(0·32-1·28)		1242,1403
Non-prescription drug use in past year							0·0005	
no	4·3%	(3·7-5·1)	1·1%	(0·8-1·5)	1·00			4729,5985
cannabis only	4·6%	(3·1-6·8)	2·1%	(1·1-3·8)	2·10	(0·97-4·56)		654,612
any hard drug	10·7%	(8·0-14·2)	3·7%	(2·2-6·1)	3·78	(1·92-7·43)		510,471
First heterosexual intercourse before age 16							0·0102	
no	3·7%	(3·1-4·3)	1·1%	(0·8-1·5)	1·00			4408,5375
yes	7·6%	(6·1-9·3)	2·1%	(1·5-3·0)	1·91	(1·17-3·13)		1576,1738
Ever had same sex experience[11]							<0·0001	
no	3·8%	(3·3-4·4)	0·8%	(0·6-1·2)	1·00			5700,6795
yes	20·0%	(15·7-25·2)	10·1%	(7·1-14·3)	13·31	(7·93-22·35)		349,400
Number of sexual partners (lifetime)[12]							0·0153	

	1	1·7%	(0·9-3·0)	0·4%	(0·1-1·9)	1·00		757,937
	2	2·3%	(1·3-4·0)	0·3%	(0·1-1·2)	0·70	(0·09-5·59)	477,579
	3-4	3·2%	(2·0-5·0)	0·9%	(0·3-2·2)	2·13	(0·35-12·86)	852,1043
	5-9	4·3%	(3·3-5·6)	1·9%	(1·2-2·9)	4·71	(0·94-23·72)	1378,1707
	10+	7·7%	(6·4-9·1)	2·0%	(1·4-2·7)	4·99	(1·04-23·96)	2049,2477
STI[13] diagnosis ever (excluding thrush)							0.0001	
	no	3·7%	(3.1-4.3)	1·1%	(0·8-1·4)	1·00		5245,6217
	yes	11·1%	(8·7-14·0)	3·2%	(2·0-4·9)	2·97	(1·74-5·07)	733,893
Low sexual function[14]							0·0206	
	no	4·1%	(3·4-4·9)	1·2%	(0·8-1·6)	1·00		3900,4774
	yes	7·3%	(5·6-9·4)	2·2%	(1·4-3·5)	1·97	(1·11-3·50)	912,1175

[1] row percentages
[2] 95% Confidence Interval
[3] odds ratio for a man's risk of experiencing completed non-volitional sex (relative to not), age-adjusted except for 'Age Group'
[4] unweighted, weighted denominators: all participants
[5] living circumstances when participant was age 14
[6] a measure of relative deprivation for the UK, divided in quintiles (30)
[7] denominator excludes men aged 16 at interview
[8] received treatment from a health professional for depression, in the year prior to interview
[9] received treatment from a health professional for a mental health condition other than depression, in the year prior to interview
[10] more than 8 units on one occasion (31)
[11] involving genital contact
[12] total number of same and/or opposite sex partners, excluding those with no partners
[13] Sexually Transmitted Infection
[14] score using derived Natsal-3 sexual function measure (32), excluding those without a valid score

Figure 1: Perpetrator by age at most recent occurrence of completed non-volitional sex, women only (Bands indicate 95% CI)

Denominator is weighted number (n) of women reporting completed non-volitional sex ever.

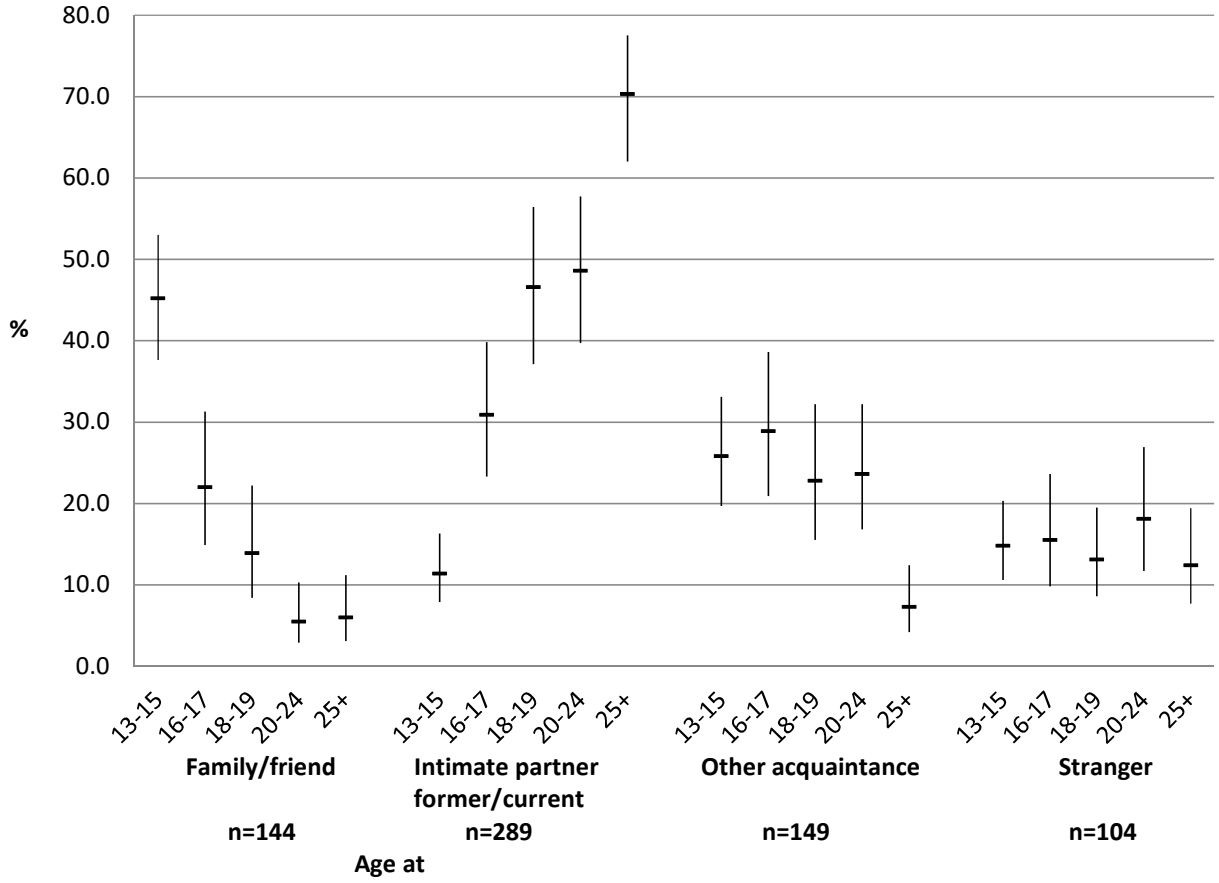


Figure 2 Communication regarding most recent occurrence of completed non-volitional sex by age at interview, women only

Denominator, women reporting completed non-volitional sex ever.

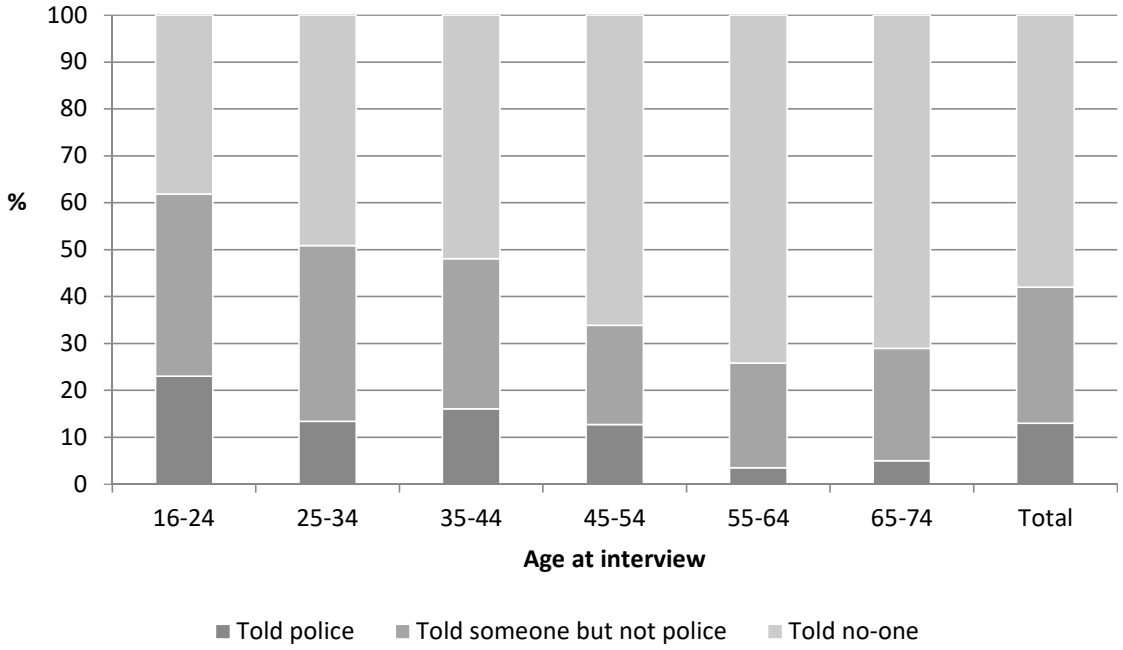
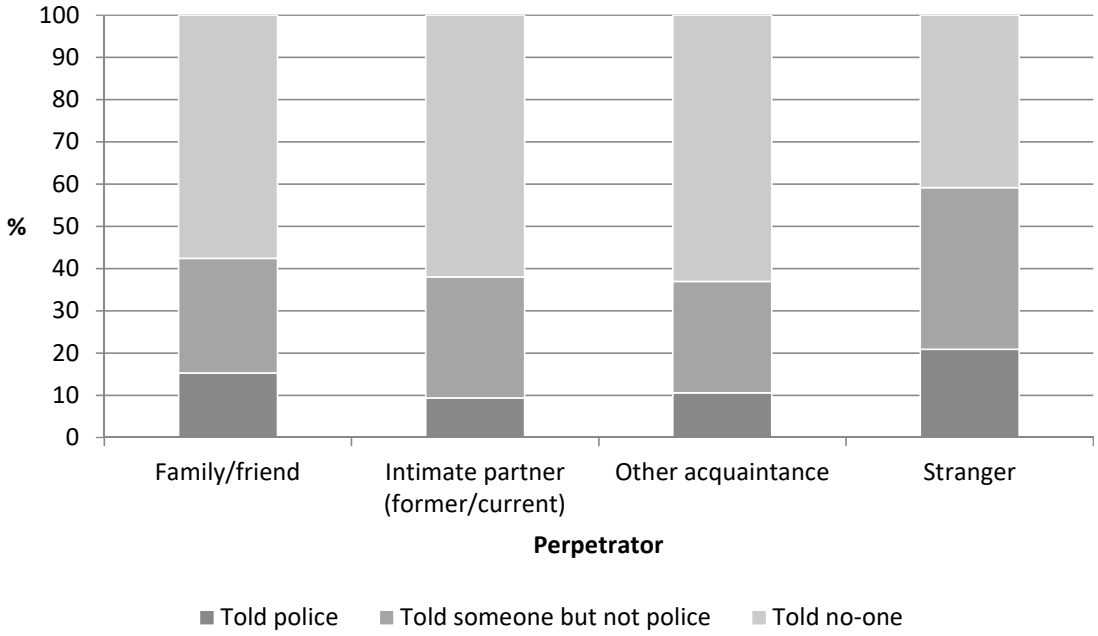


Figure 3 Communication regarding most recent occurrence of completed non-volitional sex by perpetrator, women only

Denominator, women reporting completed non-volitional sex ever.



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10 PAPER: SALIVARY TESTOSTERONE AND SEXUAL FUNCTION AND BEHAVIOUR IN MEN AND WOMEN: FINDINGS FROM THE THIRD BRITISH NATIONAL SURVEY OF SEXUAL ATTITUDES AND LIFESTYLES (NATSAL-3)

RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed <u>for each</u> research paper included within a thesis.

SECTION A – Student Details

Student ID Number	RPHP/349334	**Title**	Ms
First Name(s)	Wendy Georgina		
Surname/Family Name	Macdowall		
Thesis Title	THE EVOLUTION OF THE NATIONAL SURVEY OF SEXUAL ATTITUDES AND LIFESTYLES: THEORETICAL, CONCEPTUAL AND METHODOLOGICAL ADVANCES		
Primary Supervisor	Professor Kaye Wellings		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

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SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I devised the analysis plan and wrote the paper.

SECTION E

Student Signature

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Supervisor Signature

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Salivary testosterone and sexual function and behaviour in men and women: Findings from the third British National Survey of Sexual Attitudes and Lifestyles (Natsal-3)

W. G. Macdowall, S. Clifton, M. J. Palmer, C. Tanton, A. J. Copas, D. M. Lee, K. R. Mitchell, C. H. Mercer, P. Sonnenberg, A. M. Johnson, and K. Wellings.

W. G. Macdowall (Corresponding author)

Department of Public Health, Environments and Society, Faculty of Public Health and Policy, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH

wendy.macdowall@lshtm.ac.uk

0207 927 2048

ORCID: 0000-0001-5868-8336

S. Clifton

Institute for Global Health, University College London, Mortimer Market Centre, London WC1E 6JB

NatCen Social research, 35 Northampton Square, London EC1V 0AX

ORCID: 0000-0002-4171-0805

Twitter: @SoazigClifton

M. J. Palmer

Department of Public Health, Environments and Society, Faculty of Public Health and Policy, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH

C. Tanton

Department of Global Health and Development, Faculty of Public Health and Policy, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH

ORCID: 0000-0002-4612-1858

A. J. Copas

Institute for Global Health, University College London, Mortimer Market Centre, London WC1E 6JB

ORCID: 0000-0001-8968-5963

D. M. Lee

Faculty of Health, Psychology and Social Care, Manchester Metropolitan University, Manchester, M15 6GX

ORCID: 0000-0003-3472-0789

@DrDaveLee

K. R. Mitchell

MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Glasgow G3 7HR

ORCID: 0000-0002-4409-6601

Twitter: @KMitchinGlasgow

C. H. Mercer

Institute for Global Health, University College London, Mortimer Market Centre, London WC1E 6JB

ORCID: 0000-0002-4220-5034

P. Sonnenberg

Institute for Global Health, University College London, Mortimer Market Centre, London WC1E 6JB

ORCID: 0000-0002-1067-1583

A. M. Johnson

Institute for Global Health, University College London, Mortimer Market Centre, London WC1E 6JB

ORCID: 0000-0003-1330-7100

K. Wellings

Department of Public Health, Environments and Society, Faculty of Public Health and Policy, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH

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Salivary testosterone and sexual function and behaviour in men and women: Findings from the third British National Survey of Sexual Attitudes and Lifestyles (Natsal-3)

Abstract

Using data from the third British National Survey of Sexual Attitudes and Lifestyles (Natsal-3) we examined associations between salivary testosterone (Sal-T) and sexual function and behaviour. Single morning saliva samples were self-collected from a subsample of participants aged 18-74 years and analysed using mass spectrometry. 1,599 men and 2,123 women were included in the analysis (40.6% of those invited to provide a sample). We adjusted for confounders in a stepwise manner: in model 1 we adjusted for age only; model 2 for age, season and relationship status, and model 3 we added BMI and self-reported health. In the fully adjusted models, among men, Sal-T was positively associated with both partnered sex (vaginal sex and concurrent partners) and masturbation. Among women, Sal-T was positively associated with masturbation, the only association with partnered sex was with ever experience of same-sex sex. We found no clear association between Sal-T and sexual function. Our study contributes towards addressing the sparsity of data outside the laboratory on the differences between men and women in the relationship between T and sexual function and behaviour. To our knowledge, this is the first population study, among men and women, using a mass spectrometry Sal-T assay to do so.

Keywords

Salivary testosterone, probability survey, sexual function, sexual behaviour, Britain.

Introduction

The role of testosterone (T) in human sexual function, desire and behaviour is an area of intense interest and investigation.

Among men, overt T deficiency - caused by pituitary or testicular disease (male hypogonadism) - is known to result in a wide range of symptoms including erectile dysfunction and reduced sexual desire which can be treated with testosterone replacement therapy (TRT) (Bhasin et al., 2018; Rastrelli, Corona, & Maggi, 2018; Rastrelli, Corona, Tarocchi, Mannucci, & Maggi, 2016). Less clear, however, is the relationship between levels of T across the normative range and aspects of sexual function and behaviour. In community studies among men, T has been associated with frequency of morning erections (O'Connor et al., 2011; Wu et al., 2010), sexual thoughts (O'Connor et al., 2011; Wu et al., 2010) and masturbation (O'Connor et al., 2011). Associations with erectile function have been found in some studies (Cunningham et al., 2015; Gades et al., 2008; O'Connor et al., 2011) but not others (Marberger, Wilson, & Rittmaster, 2011). T has also been implicated in partnering and parenting; partnered men tend to have lower levels of T compared to those who are single (Grebe, Sarafin, Strenth, & Zilioli, 2019) - a finding that is supported in longitudinal studies that have assessed T levels before and after divorce and remarriage (Holmboe et al., 2017) - and men who are fathers tend to have lower T than those who are not (Grebe et al., 2019). These findings have often been interpreted from the evolutionary perspective of the Challenge Hypothesis in which it is argued that there are trade-offs between high T and challenge, and low T and parenting (Wingfield, Hegner, Dufty, & Ball, 1990). The Challenge Hypothesis infers that men with higher T will be more motivated to seek out sexual partners, may change sexual partners more frequently and have greater interest in extra-dyadic sex. However, the direction of association is unclear and it has also been suggested that it is not relationship status per se that is important but rather orientation towards investment in establishing and maintaining monogamous partnerships, with some evidence suggesting that men in long-term relationships who have a positive orientation to extra-dyadic sex have levels of T that are similar to men who are single (Edelstein, Chopik, & Kean, 2011).

The role of T in women's sexuality is even less well understood. Previous research on the relationship between hormonal status and sexual behaviour in women has tended to focus on aspects of female reproductive biology such as menstruation, pregnancy and menopause and often excluded T (van Anders, 2013). The 'presumed tie' between T and masculinity, and the predominant framing of T as 'a driver of male reproductive tactics' has likely influenced the focus of research (van Anders, 2013). T, however, has received more attention in recent years driven in part by the search for therapeutic solutions to problems of female sexual response. T is implicated in women's sexuality, though few large community studies have been conducted (Davis, Davison, Donath, & Bell,

2005; Randolph, Zheng, Avis, Greendale, & Harlow, 2015). The clinical significance of 'low T' and the role of TRT in treating low sexual desire, however, is subject to ongoing debate with some suggestion that the focus on T is misplaced and it should rather be on oestrogen (Cappelletti & Wallen, 2016).

It is well established that sexual function and behaviour are influenced by social factors (Baumeister, Catanese, & Vohs, 2001) and the strength of this influence appears to be greater among women than men (Bancroft, 2009; Baumeister et al., 2001). Important gender differences in the role of T in sexual desire and response have also been posited (Bancroft & Graham, 2011). It has further been suggested that the moderating effect of social factors on the influence of hormonal status on sexual function and behaviour may be greater among women than men (Pringle et al., 2017; van Anders, 2012), though this has rarely been examined outside of the laboratory.

The challenges to empirical investigation in this area, and to the interpretation of findings, are many. Firstly, measures of T, and assays employed, differ between studies. In clinical research and practice, T is most commonly assessed through the collection of blood samples from which Total-T can be measured and Free-T calculated (Vermeulen, Verdonck, & Kaufman, 1999). Free-T can be measured directly by equilibrium dialysis but this is not routinely used. Total-T includes the element that is bound to carrier proteins - specifically Sex Hormone Binding Globulin (SHBG) and albumin - plus the small proportion (~1-2%) that is 'free' (unbound). The bioavailability of T is influenced by levels of SHBG, which in turn varies by several factors including age, Body Mass Index (BMI), and use of hormonal contraception (Camacho et al., 2013; Wu et al., 2008; Zimmerman, Eijkemans, Coelingh Bennink, Blankenstein, & Fauser, 2014). Free-T is considered to be the biologically active fraction and hence to potentially be a better indicator of T status. In population research, salivary T (Sal-T) is an attractive alternative to serum-T, given the relative ease of sample collection. Sal-T, though not identical to, correlates fairly well with serum Free-T (Fiers et al., 2014; Keevil et al., 2014) and is unaffected by levels of SHBG (Keevil et al., 2016).

Secondly, there are methodological differences between studies, many of which have involved clinical or convenience samples. Where large community-based studies have been carried out, they have tended to be among older men, and have been conducted in the context of examining the impact of ageing on disease processes (Cumming et al., 2009; Gray, Feldman, McKinlay, & Longcope, 1991; Lee et al., 2009). The little research that has been conducted using community samples of women (Davis et al., 2005) has faced measurement problems due to the low concentration of T in women, coupled with poor specificity of immunoassay methods (Davis et al., 2019). Important too is confounding, most notably by age and health, both of which are associated with levels of T (Davison, Bell, Donath, Montalto, & Davis, 2005; Keevil et al., 2017; Wu et al., 2008) - and its main carrier

protein SHBG (Maggio et al., 2008; Wu et al., 2008) - and with sexual function and activity (Field et al., 2013; Mitchell et al., 2013).

A third challenge is presented by variation in how sexual function, desire, and behaviour are conceptualised and measured in studies, and a lack of attention to psychosocial factors influencing human sexuality. Sexual behaviour is a complex phenomenon that is socially constructed and operates within wider cultural strictures that may limit its expression and set gendered expectations on what is 'appropriate' and 'socially accepted'. Even outwardly seemingly biological processes, such as erectile response, are known to be influenced by a complex range of psychosocial factors (Feldman, Goldstein, Hatzichristou, Krane, & McKinlay, 1994; Rosen, 2001; Seidman & Roose, 2001) posing challenges to isolating the contribution of T.

In this paper we analyse data from the third National Survey of Sexual Attitudes and Lifestyles (Natsal-3) to examine associations between Sal-T and aspects of sexual function and behaviour. The research questions guiding the analysis focus, firstly, on whether the strength of association might vary according to the facet of sexual function and behaviour being assessed, the hypothesis being that such variation might reflect the relative strength of hormonal and social influences on each. For example, in terms of sexual behaviour, we hazarded that solitary sex may be more strongly associated than dyadic sex with Sal-T, given the stronger influence of social context on the latter. Secondly, we were interested in whether the strength of associations with Sal-T varied between men and women, the hypothesis being that - since social context is more strongly implicated in women's sexual behaviour – dyadic sex might be more weakly associated with Sal-T than with solitary sex among women.

Methods

Participants and procedures

Full details of the Natsal-3 methods, including details of the saliva sample collection and testing, are described elsewhere (Erens et al., 2013; Erens et al., 2014). In summary, Natsal-3 is a probability sample survey of 15,162 people (6,293 men and 8,869 women) aged 16-74 years resident in Britain. Interviews took place between September 2010 and August 2012 using a combination of computer-assisted personal interviewing (CAPI) and computer-assisted self-interview (CASI) for the more sensitive questions. The response rate was 57.7%.

Single morning saliva samples were self-collected from a subsample of men and women aged 18-74 years, who did not regularly work night shifts. Consenting participants were given a self-collection pack and asked to provide their sample before 10am, to minimise diurnal variation in T (Keevil et al., 2014). Premenopausal women were not asked to provide their samples at any particular point in

their menstrual cycle on the basis that variation in T across the cycle is relatively small compared to other sources of variation, and was not a focus of our research (van Anders, Goldey, & Bell, 2014). Participants were asked not to brush their teeth, eat or chew before giving the sample, and to spit directly into a plain polystyrene tube. Samples were posted to the laboratory where they were prepared and frozen at -80° C until analysis using liquid chromatography tandem mass spectrometry (LC-MS/MS). The LC-MS/MS Sal-T assay was developed using strict validation criteria (Keevil et al., 2014), with a lower limit of quantification of 6.5 pmol/L. Full details of the laboratory methods, including the validation of the assay, have been published elsewhere (Erens et al., 2013; Keevil et al., 2014).

Altogether, 9,170 eligible participants were invited to provide a saliva sample, 6,515 (71.0%) agreed to do so and 4,591 samples were received by the laboratory and matched to the survey data (50.1% of those invited). 463 samples were excluded due to issues with sample quality (Keevil et al., 2017) leaving 4,128 participants (45.0% of those invited) with a testosterone result (1,675 men; 2,453 women). Overall, there was no difference in the proportion of men and women with a useable T result (data not shown); the higher number of women included in the analysis reflects the higher number of women in the Natsal sample as a whole. Participants who reported clinical conditions or taking medication likely to affect testosterone levels were excluded from the analysis (currently taking medication for epilepsy (15 men; 15 women) or prostate disease (43 men); treatment in the past year for an ovarian, testicular, or pituitary condition (16 men; 23 women) or for polycystic ovaries (35 women); pregnant at interview (42 women); current receipt of HRT (62 women); ever receipt of HRT together with having had a hysterectomy (proxy measure for having had ovaries removed; 181 women); missing data for these questions (3 men; 15 women)) resulting in 1,599 men and 2,123 women being included in the analysis. These exclusions aimed to minimise confounding of the relationship between testosterone and sexual function and behaviour caused by these factors which are known to influence testosterone levels. Women taking hormonal contraception (oral contraceptive pill, Mirena coil, injections, implants, or the contraceptive patch) in the past year were included in analyses to avoid biases possibly resulting from excluding this substantial proportion of women (29% of all women with a valid saliva sample, but up to 73% of women in the youngest age group (18-24 years)). However, additional sensitivity analyses were carried out excluding these women, to assess the extent to which their inclusion affected associations with sexual function and behaviour.

Measures

Variables selected for this analysis included capacity for sexual expression, that is, aspects of sexual function. We also included measures of solitary expression, i.e. masturbation and of partnered sexual expression and sexual attitudes.

Sexual function measures

Sexual function was assessed using the Natsal-SF; a psychometrically validated 17 item (16 items per gender) measure comprising three components. The first component includes problems with sexual response, the second, captures sexual function in the relationship context and the third, self-appraisal of sex life. Participants who had at least one sexual partner in the year prior to interview were given a score on the Natsal-SF, and those in the lowest quintile of the sex-specific distribution were considered to have 'low' sexual function (see Mitchell *et al, 2012* for details of the measure and its scoring) (Jones et al., 2015; Mitchell, Ploubidis, Datta, & Wellings, 2012). We also used a number of individual items from within the Natsal-SF. Using the past year as the reference period, participants who had at least one sexual partner in that time were asked if they had experienced any of the following for a period of three months or more: lacked interest in having sex; lacked enjoyment in sex; had an uncomfortably dry vagina (women only) and had trouble getting or keeping an erection (men only). In the self-appraisal component of the measure, participants who had *ever* been sexually active, were asked to respond to the statement *"I feel distressed or worried about my sex life"*; we considered those who agreed, or agreed strongly, with this statement as being distressed. 'Sex' was defined as vaginal, oral, or anal intercourse with an opposite-sex or same-sex partner, and 'sex life' as sexual thoughts, sexual feelings, sexual activity and sexual relationships.

Sexual behaviour and attitudinal measures

We looked at a range of sexual behaviour measures over three different time periods. We measured frequency of sex and engaging in different sexual practices, namely, vaginal sex, receiving oral sex, giving oral sex, anal sex, and genital contact without intercourse in the *four weeks prior to interview*. We measured number of sexual partners; concurrent (overlapping) partners; reporting a same sex partner and paying for sex (men only*) in the past five years.* Number of partners and ever having same sex experience (with genital contact) were measured *over the lifetime*. Other measures included in the analysis were: recency and frequency of masturbation; sexual attraction (opposite sex only, or any same sex) and attitudes towards different sexual behaviours. The attitudinal questions were asked in the CAPI section of the questionnaire, after the CASI, with the use of show cards. First, participants were asked their views about different types of sexual relationships including "*A married person having sexual relations with someone other than his or her partner?"* and "*A person having one-night stands?*" (response options were: Always wrong; mostly wrong;

sometimes wrong; rarely wrong; not wrong at all and depends/don't know). Next, participants were asked how far they agreed, or disagreed, with a number of statements including: "*It is natural for people to want sex less as they get older* "and "*Men have a naturally higher sex drive than women*" (response options were: Agree strongly; agree; neither agree nor disagree; disagree; disagree strongly and don't know). The full Natsal questionnaire is available at http://www.natsal.ac.uk/natsal-3/questionnaire.aspx.

Statistical analyses

Statistical analyses were carried out using STATA (version 13.1) accounting for the complex survey design (stratification, clustering, and weighting of the sample). We applied weighting to correct for unequal probability of selection and differential response (by age, sex, and region) to the survey itself; and to correct for unequal probability of selection and differential response to the saliva sample. The factors we found to be associated with providing a saliva sample included age at interview, ethnicity, self-reported general health, and sexual function; the saliva weighting significantly reduced these biases (Erens et al., 2013).

Throughout, we censored very high Sal-T values so that, for each 10-year age group stratified by sex, values above the 99th percentile were assigned a value equal to that of the 99th percentile. The Sal-T data for men were normally distributed, however the distribution for women was positively skewed and so values were transformed on the natural log scale for analysis. Accordingly, for men we present linear regression coefficients representing differences in mean testosterone in pmol/l, whereas for women we present ratios of geometric mean Sal-T obtained from exponentiated coefficients. Interval regression was used to assign values to the range 0 to 6.5pmol/l for 3 men, and 0.5 (to allow log transformation) to 6.5pmol/l for 62 women with testosterone levels below the limit of detection (<6.5pmol/l) (Clifton et al., 2016; Keevil et al., 2017).

Descriptive statistics are presented as mean T (standard error), with multivariable linear regression used to assess differences in mean T by the sexual function or behaviour variables of interest.

In our earlier analyses, we identified a number of factors that are significantly associated with mean Sal-T levels which may confound the relationship between Sal-T and sexual function and behaviour (Clifton et al., 2016; Keevil et al., 2017). In summary, among both men and women mean Sal-T decreased with increasing age, and seasonal variation was observed (with mean Sal-T lowest in the summer for men and highest in the summer for women). Among men only, we found variation in mean Sal-T by relationship status independent of age, with the highest levels among those who were not currently in a steady relationship, and lowest levels among those who were married or cohabiting. Also among men only, and independent of age, we found negative associations between

mean Sal-T and BMI and self-reported general health. In the current analysis, to assess how these potential confounders affected the associations - and to determine whether any aspects of sexual function and/or behaviour were associated with Sal-T independent of these factors - we ran a number of multivariable linear regression models. In the first model we adjusted only for age, using both linear and quadratic terms to account for a non-linear relationship of testosterone with age (Keevil et al., 2017). In the second, we adjusted for age and additionally for season and relationship status. Lastly, we added the key health factors previously identified (Clifton et al., 2016) – BMI and self-reported general health - to the models. In this way, any identified associations between Sal-T and sexual function and behaviour would not be explained by these confounding factors.

Ethics

The Natsal-3 study was approved by the Oxfordshire Research Ethics Committee A (reference: 10/H0604/27). Written informed consent was obtained for anonymised testing of saliva samples, without return of results.

Findings

Mean Sal-T was higher among men than women (223.5pmol/L and 37.1pmol/L respectively) and differences in associations with Sal-T and sexual behaviour were observed between the two (Tables 1 and 2).

Sexual function

In the unadjusted analysis, Sal-T was lower in men who reported erectile difficulties and women who reported experiencing an uncomfortably dry vagina (for at least three months in the past year) but after adjustment for age (model 1) these associations did not persist. In both instances, the additional adjustments in models 2 and 3 made little difference to the coefficients, pointing to age as the key confounder.

No association was observed, in either men or women, between Sal-T and overall low sexual function measured using the Natsal-SF or between Sal-T and the individual problems of sexual response we investigated (i.e. lacking enjoyment in sex, distress about sex life, and, among men, lacking interest in sex). Among women, there was a significant association between Sal-T and reporting lacking interest in sex in the age-adjusted model (model 1) but this was attenuated after further adjustments for relationship status, season, BMI and general health status (model 3). In the fully adjusted model the geometric mean ratio was 0.92 (95% confidence interval 0.84, 1.00; p=.0592) for women reporting lacking interest in sex (for at least 3 months in the past year) compared to those who did not.

Sexual behaviour and attitudes

Among men, in terms of partnered sexual behaviour, the strongest association with Sal-T was with reporting concurrent – i.e. overlapping - sexual partners. The linear regression coefficient in the fully adjusted model (model 3) for those reporting concurrent partnerships in the past 5 years compared to those not was 20.87 (4.47, 37.26; p=.0127). This was followed in strength of association by vaginal sex and receiving oral sex from a partner (adjusted coefficients 13.44 (1.53, 25.35; p=.0271) and 11.20 (-0.05, 22.46; p=.0510)), respectively for those reporting these sexual practices in the past four weeks versus those not. Higher levels of Sal-T were also associated with recency and frequency of masturbation. Men who had masturbated longer than a year ago had lower mean Sal-T compared to men who had masturbated more recently; adjusted coefficient -21.82 (-36.97, -6.67; p=.0269) (for last occasion of masturbation longer than a year ago, compared to the last 7 days).

Among men, a weak association was also observed between higher Sal-T and having had a same-sex partner in the past 5 years (adjusted coefficient for same-sex partner in the past 5 years versus not: 22.30 (-0.75, 45.34; p=.058)), though the proportion reporting a same-sex partner in the past 5 years was low (3.0%, (2.2%, 4.0%)). Significant associations were also seen between Sal-T and two attitudinal statements: acceptance of one-night stands and of non-exclusivity in marriage, with men endorsing these more permissive attitudes to sex having higher mean Sal-T than those who did not.

Among women, Sal-T was most strongly associated with masturbation and the association was stronger than seen among men. Women who had masturbated longer than a month ago had lower mean Sal -T compared to women who had masturbated more recently; adjusted geometric mean ratio 0.84 (0.75, 0.95; p=.0.0077) (for last occasion of masturbation longer than 4 weeks but less than a year, compared to the last 7 days). Frequency, as well as recency, of masturbation was associated with Sal-T in women; mean Sal-T was higher in women who had masturbated on two or more occasions in the last 7 days compared to those who had masturbated only once (adjusted geometric mean 1.24 (1.05, 1.46; p=.0009)). Sal-T was also significantly higher among women reporting ever experience of same-sex sex compared to those who did not (1.15 (1.01, 1.31; p=.0378)). In the sensitivity analysis, in which we excluded women who had used hormonal contraception in the last year, these associations were attenuated but remained significant.

Discussion

To our knowledge, this is the first population level study, of both men and women, using a validated salivary measure to explore the associations between Sal-T and aspects of sexual function and behaviour.

We found no clear associations in our data between Sal-T and either overall sexual function (as measured by the Natsal-SF) or individual problems with sexual response in men or women. Among women, our data showed solitary sex to be more strongly associated than partnered sex with Sal-T; levels of Sal-T were higher in those who masturbated more recently and more frequently. We found no association between Sal-T and heterosexual partnered sexual activity among women, as measured by occurrence of vaginal sex in the past month, and nor did we find an association with number of partners or concurrency. The only measure of partnered sex associated with Sal-T among women was ever experience of same-sex behaviour.

Among men, Sal-T was associated with masturbation but not *more* strongly than it was with partnered sex. Associations were seen between higher levels of Sal-T and recent occurrence of heterosexual partnered sex and with concurrency of sexual partners in the last five years, but not with number of sexual partners. The association with concurrency was reflected in men's attitudes towards 'casual' sexual encounters, which were similarly linked with higher levels of Sal-T.

Contextualisation and interpretation

The absence of an association between T and overall sexual function in men in our large dataset is unsurprising given the measure of overall sexual function used in Natsal-3 which, as indicated above, took account not only of individual problems with response, but also the relational context which is heavily influenced by psychosocial factors. The absence of any association with individual aspects of sexual function (erectile difficulties, lacking enjoyment in sex, distress about sex life, lacking interest in sex) is maybe more surprising. The dominant narrative assumes T is the 'biological driver' of sexual desire in men. The fact that men have both higher levels of T and report higher levels of interest in sex than women seems to speak to this narrative (van Anders, 2012). Much of the evidence linking T with sexual desire in men has, however, come from clinical studies among those with overt T deficiency in the context of investigating the effects of TRT (Corona et al., 2017). There is little empirical evidence (van Anders, 2012), including that now provided by our study, that T levels in men within the normal range are associated with sexual desire. In the European Male Aging Study (EMAS), which focuses specifically on older men - though like Natsal draws on a large sample of community dwelling individuals - only weak associations were found between aspects of sexual function and T. These included 'overall sexual function' (O'Connor et al., 2011) and erectile dysfunction and frequency of both sexual thoughts and morning erections, though the associations with these latter three sexual symptoms were attenuated when adjustments were made for age, BMI and co-existing health conditions (Wu et al., 2010). Further, the findings from EMAS highlight the non-linear relationship between T and aspects of sexual function and point to symptom-specific T 'thresholds'; only under the 'threshold' does the probability of experiencing the sexual symptom

increase (O'Connor et al., 2011; Wu et al., 2010). Hence, among older men, androgen deficiency is only likely to be a key pathogenic component in problems of sexual function when T levels are overtly subnormal (Wu et al., 2010). In older men with unequivocal age-related hypogonadism, TRT has been associated with modest improvements in sexual function (Matsumoto, 2019; Snyder et al., 2016). Evidence of the value of T supplementation for 'low T' within the normal range as a therapeutic solution to problems such as erectile dysfunction and low libido, however, is lacking (Huo et al., 2016).

The few large community studies that have been conducted in women have identified associations between androgens and sexual function though in unadjusted analyses (Davis et al., 2005), or among women in menopausal transition (Randolph et al., 2015). In our unadjusted model, we did find an association between Sal-T and sexual desire in women which remained significant after adjustment for age (with women lacking interest in sex having lower Sal-T than those who did not) but was attenuated after further adjustments for relationship status, season, BMI and general health status highlighting the importance of contextual factors. The current global consensus is that there is insufficient evidence regarding the use of T for the treatment of sexual function in premenopausal women, but among postmenopausal women T may yield benefits in terms of increasing sexual desire (as well as other components of sexual function including arousal and orgasmic function) (Davis et al., 2019). Evidence from controlled trials among postmenopausal women indicate that oestrogen only therapies are too associated with increases in sexual desire and that these effects can be enhanced when oestrogen is coupled with T (Cappelletti & Wallen, 2016).

Our data support our prior assumption that the relative influence of hormonal status and social context, and hence the strength of associations between Sal-T and sexual behaviour, would vary between men and women. Attempts to understand why dyadic sex, especially partner concurrency, is more strongly associated with T among men than women have drawn on evolutionary theories asserting that it may have greater reproductive advantage for men (Puts et al., 2015; van Anders, Steiger, & Goldey, 2015). Yet associations between T and dyadic and solo sex may also be differentially moderated in men and women by gendered social norms regulating sexual behaviour (van Anders et al., 2015). Variation in the extent to which men and women may be differentially socialised to non-exclusivity features regularly in explanations as to why men report larger numbers of sexual partners than women in research (Jonason & Fisher, 2009; Mitchell et al., 2019).

Sal-T's marked link with masturbation among women, in the absence of an observed link with aspects of partnered behaviour, may be seen as consistent with the notion of a stronger moderating effect of social factors on hormonal influences on women's behaviour. It has been proposed that masturbation may be a 'truer' measure of sexual desire, as although socially censured, it is neither

constrained by social surveillance nor dependent on social relations. The suggestion in our data of a stronger link with solitary than partnered sexual activity among women accords with evidence reported elsewhere; albeit from either laboratory studies and/or those utilising smaller convenience samples (Randolph et al., 2015; van Anders, 2012). Interpretation of these findings has drawn on the bi-directionality of the association between T and sexuality (Goldey & van Anders, 2011) and on the different meanings and motivations attached to solitary and partnered sex. For example, qualitative research among women points to solitary sexuality as primarily erotic and partnered sexuality as nurturant (Goldey, Posh, Bell, & van Anders, 2016). Women self-identifying as heterosexual have been shown to be more likely to reach orgasm in solitary compared with partnered sex (Carvalheira & Leal, 2013) and the experience of orgasm has been found to increase levels of T (van Anders, Hamilton, Schmidt, & Watson, 2007).

Our finding of higher mean Sal-T in women with ever experience of same sex sex is illuminated by a recent systematic review, investigating whether lesbian and bisexual women may have different levels of sex hormones compared to heterosexual women. The review found tentative evidence of higher T among sexual minority women, though the heterogeneity of studies and problems with confounding made it hard to draw definitive conclusions (Harris, Bewley, & Meads, 2020).

Strengths and weaknesses

This study has a number of strengths. Firstly, Natsal-3 is a large population- based study, of men and women, covering a wide age range and capturing multiple aspects of sexual function, behaviour and attitudes. Secondly, Sal-T was measured by the 'gold standard' method of mass spectrometry using samples collected at the same time of day in order to account for the diurnal variation in testosterone. Thirdly, we were able to adjust for known confounders identified in our earlier analysis (Clifton et al., 2016; Keevil et al., 2017), so that independent associations between Sal-T and sexual function and behaviour could be established. A number of limitations need also to be considered. Firstly, non-participation bias is likely to have occurred both in relation to recruitment to the main survey and providing a saliva sample. There were known differences between those who did and did not return a saliva sample, though statistical weighting was used to minimise these biases. The second limitation is that, with the exception of items relating to appraisal of sex life, the Natsal-SF (which included the questions about the individual problems with sexual response) was only asked of people who were sexually active in the past year and so excluded those who may not have had sex in over a year because of sexual difficulties. The third limitation relates to the adjustments made. While we did adjust for variables identified from our previous analyses as linked with both Sal-T and sexual function and behaviour (Clifton et al., 2016; Keevil et al., 2017) there are, however, likely to be other confounders that we have not adjusted for. A further limitation relates to the complexity of

the phenomena under investigation and the challenge in establishing causal direction when using cross-sectional data and single saliva samples given evidence that the relationship between T and sexual behaviour is bi-directional (Escasa, Casey, & Gray, 2011). We also have to recognise the limitations of a peripheral measure of T in assessing T status. In men and women, it is thought that a large proportion of androgens (and oestrogens) are produced *within* cells where they exert their action and circulating androgens do not reflect this 'intracrine' androgen synthesis (Labrie, 1991). Relatedly, different forms of the androgen receptor are thought to vary in their sensitivity to T (Wåhlin-Jacobsen et al., 2018). Hence, circulating T is only part of a complex picture.

Our study contributes towards addressing the deficit in terms of attention paid to the role of T in women's sexuality (Bancroft & Graham, 2011) and the sparsity of data on the differences between men and women in the relationship between T and sexual function and behaviour. Our data tend to confirm that differences between men and women need to be understood by examining them in the context of both social and hormonal influences on sexual function and behaviour.

Table 1: Associations between mean Sal-T and sexual behaviours and sexual function among men.

	% of sample [weighted]												Denominators	
	%	95% CI	Mean Sal-T Pmol/L	*SE*	Crude Coeff.*	95% CI	adjusted Coeff. 1*	95% CI	adjusted Coeff. 2*	95% C.I	adjusted Coeff. 3*	95% C.I	*unwt*	*wt*
All men	**100%**		**223.5**	*3.33*	-	-	-	-	-	-	-	-	***1599***	***1866***
Sexual function														
Problems achieving/maintaining an erection for at least 3 months in past yr^						p= 0.0018		p=0.888		p=0.949		p=0.843		
No	86.8	[84.6, 88.7]	233.5	*3.90*	-	-	-	-	-	-	-	-	*1010*	*1315*
Yes	13.2	[11.3, 15.4]	203.4	*8.39*	-28.60	[-46.53, -10.67]	1.21	[-15.65, 18.08]	0.55	[-16.34, 17.44]	1.73	[-15.44, 18.89]	*198*	*200*
Lacked interest in having sex for at least 3 months in past yr^						P= 0.753		P=0.897		p= 0.733		p=0.615		
No	84.8	[82.2, 87.0]	229.7	*3.90*	-	-	-	-	-	-	-	-	*1011*	*1285*
Yes	15.2	[13.0, 17.8]	228.5	*8.89*	-2.77	[-20.01, 14.48]	0.98	[-13.78, 15.74]	2.53	[-12.05, 17.12]	3.55	[-10.29, 17.38]	*197*	*231*
Lacked enjoyment when having sex for at least 3 months in past yr^						P=0.547		P=0.885		p=0.100		p=0.855		
No	95.2	[93.3, 96.6]	229.2	*3.70*	-	-	-	-	-	-	-	-	*1156*	*1442*
Yes	4.8	[3.4, 6.7]	235.7	*15.00*	9.48	[-21.40, 40.36]	-2.10	[-30.62, 26.41]	0.01	[-28.13, 28.14]	-2.50	[-29.28, 24.28]	*52*	*73*
Distressed or worried about sex life: agree strongly/agree						P=0.821		P= 0.876		P= 0.747		P=0.864		
No	88.6	[86.6, 90.3]	224.9	*3.49*	-	-	-	-	-	-	-	-	*1354*	*1602*
Yes	11.4	[9.7, 13.4]	227.1	*9.85*	-2.28	[-22.02, 17.46]	-1.38	[-18.73, 15.96]	-2.87	[-20.25, 14.52]	1.46	[-15.27, 18.20]	*196*	*206*
Sexual function^						p=0.218		p=0.951		p=0.943		p=0.921		
Normal	79.8	[77.0, 82.2]	232.1	*4.06*	-	-	-	-	-	-	-	-	*929*	*1214*
Low	20.2	[17.8, 23.0]	219.5	*7.71*	-10.57	[-27.36, 6.23]	-0.47	[-15.52, 14.58]	-0.54	[-15.38, 14.30]	0.72	[-13.67, 15.12]	*283*	*308*
Sexual behaviour														
Masturbation														
Last occasion of masturbation						P<0.0001		P=0.0248		P=0.0343		P=0.0269		
In last 7 days	49.7	[46.4, 52.9]	244.3	*4.36*	-	-	-	-	-	-	-	-	*746*	*917*
Between 7 days and 4 weeks	17.9	[15.7, 20.2]	216.5	*6.38*	-29.11	[-44.20, -14.02]	-6.05	[-20.40, 8.29]	-4.38	[-18.88, 10.12]	-6.26	[-20.43, 7.92]	*290*	*244*
Between 4 weeks and 1 year	15.2	[12.9, 17.9]	218.1	*10.08*	-33.52	[-50.65, -16.39]	-1.15	[-16.21, 13.92]	0.16	[-15.10, 15.42]	-0.26	[-15.46, 14.95]	*239*	*215*
Longer than 1 year ago / never	17.2	[15.0, 19.7]	180.1	*7.49*	-62.88	[-79.07, -46.68]	-25.16	[-42.06, -8.26]	-23.34	[-39.89, -6.78]	-21.82	[-36.97, -6.67]	*280*	*436*
No. of occasions of masturbation in past 7 days						P<0.0001		p=0.0800		p=0.1508		p=0.0485		
0	50.6	[47.4, 53.9]	204.5	*4.75*	-23.22	[-41.98, -4.46]	-8.25	[-24.94, 8.43]	-7.36	[-23.90, 9.17]	-7.16	[-22.94, 8.63]	*809*	*917*
1	13.5	[11.4, 15.9]	223.9	*8.74*	-	-	-	-	-	-	-	-	*189*	*244*
2	11.9	[10.1, 13.9]	227.5	*7.06*	1.94	[-20.47, 24.34]	-7.93	[-29.04, 13.17]	-8.01	[-28.87, 12.84]	-9.79	[-29.65, 10.07]	*189*	*215*
3+	24.1	[21.5, 26.8]	262.6	*6.37*	36.23	[15.17, 57.29]	9.21	[-9.21, 27.64]	7.86	[-10.52, 26.25]	9.94	[-7.38, 27.27]	*359*	*436*
Sexual behaviour in the past 4 weeks														
No. of occasions of sex#						P=0.0003		p= 0.2626		p=0.122		p=0.299		
0-2	54.9	[51.7, 57.9]	211.9	*4.16*	-	-	-	-	-	-	-	-	*903*	*964*
3-4	18.5	[16.1, 21.2]	237.0	*7.32*	25.51	[9.22, 41.79]	11.71	[-2.94, 26.35]	14.96	[-0.17, 30.09]	10.80	[-3.92, 25.51]	*234*	*325*
5+	26.6	[23.8, 29.6]	242.9	*7.33*	26.45	[11.36, 41.55]	7.00	[-6.96, 20.97]	10.12	[-4.23, 24.47]	7.59	[-6.16, 21.35]	*352*	*467*
Vaginal sex						P=0.0101		p=0.246		P=0.0090		p=0.0271		
No	36.2	[33.5, 39.0]	215.7	*4.95*	-	-	-	-	-	-	-	-	*692*	*669*
Yes	63.8	[61.0, 66.5]	230.3	*4.43*	16.38	[3.92, 28.85]	6.33	[-4.37, 17.03]	16.10	[4.03, 28.16]	13.44	[1.53, 25.35]	*884*	*1179*
Received oral sex#						P<0.0001		p=0.1436		p= 0.0860		p=0.0510		
No	60.3	[57.3, 63.3]	212.7	*3.82*	-	-	-	-	-	-	-	-	*1024*	*1112*
Yes	39.7	[36.7,42.7]	243.8	*5.68*	27.79	[15.17, 40.41]	8.69	[-2.96, 20.33]	10.29	[-1.46, 22.04]	11.20	[-0.05, 22.46]	*549*	*732*
Gave oral sex#						p=0.0006		p=0.483		p=0.287		p=0.1565		
No	59.8	[56.8, 62.8]	215.3	*3.75*	-	-	-	-	-	-	-	-	*1019*	*1103*
Yes	40.2	[37.2, 43.2]	239.4	*5.70*	22.09	[9.54, 34.64]	3.95	[-7.09, 15.00]	6.16	[-5.18, 17.50]	7.84	[-3.01, 18.68]	*555*	*741*

Anal sex#						p=0.0104		p=0.1576		p=0.194		p=0.1487		
No	95.3	[93.8, 96.4]	223.4	*3.43*	-	-	-	-	-	-	-	-	*1504*	*1756*
Yes	4.7	[3.6, 6.2]	258.2	*12.88*	33.90	[8.00, 59.81]	15.31	[-5.93, 36.54]	14.15	[-7.21, 35.52]	15.02	[-5.37, 35.41]	*70*	*87*
Genital contact without intercourse#						p=0.0032		p=0.655		p=0.273		p=0.242		
No	53.5	[50.5, 56.6]	216.2	*4.30*	-	-	-	-	-	-	-	-	*930*	*986*
Yes	46.5	[43.4, 49.5]	235.1	*4.83*	17.97	[6.03, 29.90]	2.53	[-8.56, 13.62]	6.39	[-5.04, 17.82]	6.54	[-4.42, 17.50]	*642*	*856*
Sexual behaviour in the past 5 years														
Number of sexual partners#						P<0.0001		p=0.232		p=0.466		p=0.702		
0	9.3	[7.8, 11.0]	207.7	*10.35*	-	-	-	-	-	-	-	-	*209*	*169*
1	58.0	[55.1, 60.9]	210.6	*3.80*	5.78	[-15.97, 27.52]	-0.55	[-18.22, 17.13]	9.28	[-10.50, 29.07]	3.49	[-16.93, 23.91]	*828*	*1057*
2	10.6	[8.9, 12.6]	244.6	*9.76*	40.95	[12.84, 69.06]	12.05	[-10.99, 35.09]	17.17	[-7.06, 41.39]	10.95	[-13.32, 35.23]	*161*	*193*
3-4	10.8	[9.1, 12.7]	261.4	*10.91*	58.75	[28.69, 88.80]	14.25	[-11.46, 39.96]	20.23	[-6.45, 46.92]	13.98	[-12.80, 40.76]	*179*	*196*
5+	11.3	[9.5, 13.3]	268.5	*11.10*	62.72	[33.56, 91.87]	15.83	[-9.92, 41.58]	18.86	[-7.42, 45.15]	12.60	[-14.15, 39.35]	*184*	*206*
Concurrency&						P<0.0001		p=0.0046		p=0.0095		p=0.0127		
No	86.7	[84.6, 88.5]	220.3	*3.43*	-	-	-	-	-	-	-	-	*1338*	*1580*
Yes	13.3	[11.5, 15.4]	262.7	*9.58*	40.30	[21.20, 59.41]	24.24	[7.48, 41.01]	22.27	[5.46, 39.09]	20.87	[4.47, 37.26]	*226*	*243*
Paid for sex						p=0.7969		P=0.7506		P=0.778		p=0.554		
No	96.3	[95.0, 97.4]	225.2	*3.41*	-	-	-	-	-	-	-	-	*1512*	*1771*
Yes	3.7	[2.6, 5.0]	230.3	*19.59*	5.12	[-33.88, 44.12]	5.87	[-30.34, 42.07]	5.31	[-31.67, 42.30]	10.66	[-24.62, 45.94]	*56*	*67*
Same-sex partner[s]						p=0.102		p= 0.0457		p=0.0999		p=0.058		
No	97.0	[96.0, 97.8]	222.8	*3.40*	-	-	-	-	-	-	-	-	*1537*	*1823*
Yes	3.0	[2.2, 4.0]	251.9	*14.74*	25.12	[-5.01, 55.24]	24.8	[0.47, 49.12]	20.88	[4.00, 45.76]	22.30	[-0.75, 45.34]	*58*	*56*
Sexual behaviour, lifetime														
Number of sexual partners#						p=0.330		p=0.404		p=0.254		p=0.252		
0/1	14.7	[12.6, 17.1]	229.8	*7.72*	-	-	-	-	-	-	-	-	*237*	*265*
2	8.5	[7.0, 10.3]	224.2	*11.40*	1.36	[-25.55, 28.27]	7.23	[-14.60, 29.05]	8.01	[-13.0, 29.02]	4.73	[-15.71, 25.18]	*129*	*153*
3-4	15.7	[13.6, 18.2]	232.7	*7.49*	8.33	[-12.17, 28.84]	9.28	[-8.91, 27.46]	10.68	[-7.88, 29.23]	9.72	[-9.00, 28.44]	*237*	*285*
5-9	25.4	[22.9, 28.0]	231.5	*6.47*	6.49	[-12.14, 25.12]	15.56	[-1.00, 32.13]	17.23	[0.62, 33.85]	17.74	[1.04 - 34.44]	*375*	*459*
10+	35.8	[32.8, 38.8]	218.4	*5.31*	-7.33	[-24.45, 9.79]	5.12	[-10.61, 20.85]	4.65	[-11.35, 20.64]	6.25	[-9.62, 22.12]	*566*	*647*
Ever had same sex experience with genital contact						p=0.699		p=0.475		p=0.951		p=0.911		
No	93.3	[91.7, 94.6]	223.3	*3.46*	-	-	-	-	-	-	-	-	*1472*	*1752*
Yes	6.7	[5.4, 8.3]	229.2	*10.69*	4.31	[-17.57, 26.19]	6.40	[-11.15, 23.95]	2.66	[-15.12, 20.44]	0.95	[-15.72, 17.62]	*123*	*126*
Sexual attraction														
Ever felt sexually attracted to:						p=0.349		p=0. 3439		p=0.690		p=0.940		
Opposite sex only	93.2	[91.8, 94.3]	222.1	*3.45*	-	-	-	-	-	-	-	-	*1437*	*128*
Any same-sex attraction	6.8	[5.7, 8.2]	239	*12.15*	9.78	[-10.70, 30.26]	7.81	[-8.37, 23.99]	3.29	[-12.90, 19.45]	0.59	[-14.76, 15.94]	*155*	*1877*
Attitudes														
One-night stands						p=0.0022		p=0.0067		p=0.0121		p=0.026		
Other	82.1	[79.5, 84.3]	218.4	*3.44*	-	-	-	-	-	-	-	-	*1300*	*1544*
'Not wrong at all'	17.9	[15.7, 20.5]	246	*8.20*	24.95	[8.98, 40.92]	18.52	[5.15, 31.89]	16.82	[3.69, 29.96]	14.42	[1.70, 27.13]	*298*	*338*
Non-exclusivity in marriage						p=0.899		p=0.0161		p=0.0415		p=0.0512		
Other	46.5	[43.4, 49.6]	222.7	*4.84*	-	-	-	-	-	-	-	-	*758*	*877*
'Always wrong'	53.5	[50.4, 56.6]	224.2	*4.44*	-0.79	[-13.05, 11.47]	-13.10	[-23.76, -2.44]	-13.70	[-24.20, -3.19]	-10.01	[-20.07, 0.05]	*841*	*1008*
'Men have a naturally higher sex drive than women'						p=0.811		p=0.795		p=0.926		p=0.837		
Other	90.5	[88.7, 92.1]	223.2	*3.54*	-	-	-	-	-	-	-	-	*1450*	*1707*
Strongly agree	9.5	[7.9, 11.3]	226.1	*10.28*	2.67	[-19.20, 24.55]	-2.70	[-23.00, 17.61]	-0.97	[-21.45, 19.51	2.09	[-17.90, 22.09]	*149*	*179*
'It is natural for people to want sex less as they get older'						p=0.656		p=0.690		p=0.634		p=0.339		
Other	95.7	[94.3, 96.7]	223.9	*3.41*	-	-	-	-	-	-	-	-	*1527*	*1804*
Strongly agree	4.3	[3.3, 5.7]	214.5	*13.53*	-6.43	[-34.72, 21.86]	4.23	[-16.57, 25.02]	5.08	[-15.85, 26.01]	9.10	[-9.58, 27.77]	*72*	*82*

unwt=unweighted denominators, wt=weighted denominators. SE=standard error of mean. Denominator: all men excluding those taking medication for epilepsy or prostate disease, or who received treatment for a testicular or pituitary condition in the past year. *Linear regression. Adjusted coeff 1=adjusted for age and age-squared; adjusted coeff2=adjusted for age, age-squared, season, and relationship status; adjusted coeff3=adjusted for age, age-squared, season, relationship status, BMI, and self-reported general health; #opposite- and/or same-sex; ^Only asked of those who had sex in the past year, those who did not have sex in the past year are excluded from denominator. &Overlap between any partners in past 5 years

Table 2: Associations between mean Sal-T and sexual behaviours and sexual function among women

	% of sample [Wt]	95% CI	Mean Sal-T pmol/L	*SE*	Crude ratios*	95% CI	adjusted ratios* 1	95% CI	adjusted ratios* 2	95% C.I	adjusted ratios* 3	95% CI	*Denominators* unwt	wt
All women	**100%**		**37.09**	*0.86*									*2123*	*1899*
Sexual function														
Uncomfortably dry vagina for at least 3 months in past yr^					p=0.0115		p=0.189		p=0.147		p=0.154			
No	86.0	[84.0, 87.8]	38.8	*0.99*	1.00	-	1.00	-	1.00	-	1.00	-	*1310*	*1252*
Yes	14.0	[12.2, 16.0]	32.6	*1.71*	0.87	[0.78, 0.97]	0.93	[0.84, 1.04]	0.92	[0.83, 1.03]	0.92	[0.84, 1.03]	*230*	*204*
Lacked interest in having sex for at least 3 months in past yr^					p=0.0070		p=0.0312		p=0.0554		p=0.0592			
No	66.6	[63.8, 69.2]	40.0	*1.21*	1.00	-	1.00	-	1.00	-	1.00	-	*1029*	*969*
Yes	33.4	[30.8, 36.2]	33.8	*1.13*	0.88	[0.81, 0.97]	0.91	[0.83, 0.99]	0.92	[0.84, 1.00]	0.92	[0.84, 1.00]	*511*	*487*
Lacked enjoyment when having sex for at least 3 months in past yr^					p=0.337		P=0.383		p=0.373		p=0.390			
No	87.6	[85.5, 89.4]	38.3	*0.97*	1.00	-	1.00	-	1.00	-	1.00	-	*1339*	*1275*
Yes	12.4	[10.6, 14.5]	35.0	*1.83*	0.95	[0.85, 1.06]	0.95	[0.86. 1.06]	0.95	[0.86, 1.06]	0.95	[0.86, 1.06]	*201*	*181*
Distressed or worried about sex life: agree strongly/agree					P=0.505		P= 0.810		P=0.787		P=0.747			
No	88.7	[86.7, 90.4]	37.1	*0.91*	1.00	-	1.00	-	1.00	-	1.00	-	*1858*	*1622*
Yes	11.3	[9.6, 13.3]	40.6	*2.95*	1.05	[0.91, 1.22]	1.02	[0.89, 1.16]	1.02	[0.89, 1.17]	1.02	[0.90, 1.17]	*210*	*207*
Sexual function^					p= 0.132		p= 0.398		p=0.334		p=0.353			
Normal	79.0	[76.6, 81.3]	38.4	*1.04*	1.00	-	1.00	-	1.00	-	1.00	-	*1209*	*1156*
Low	21.0	[18.7, 23.4]	36.2	*1.66*	0.92	[0.83, 1.02]	0.96	[0.87, 1.06]	0.95	[0.87, 1.05]	0.95	[0.87, 1.05]	*336*	*306*
Sexual behaviour														
Masturbation														
Last occasion of masturbation					P<0.0001		P=0.0030		P= 0.0062		P=0.0077			
In last 7 days	17.2	[15.2, 19.5]	45.3	*2.55*	1.00	-	1.00	-	1.00	-	1.00	-	*362*	*318*
Between 7 days and 4 weeks	19.2	[17.2, 21.5]	39.5	*1.91*	0.92	[0.81, 1.04]	0.93	[0.82, 1.05]	0.93	[0.83, 1.05]	0.93	[0.93, 1.05]	*396*	*355*
Between 4 weeks and 1 year	21.6	[19.5, 23.8]	34.6	*1.38*	0.79	[0.70, 0.89]	0.84	[0.74, 0.94]	0.84	[0.75, 0.95]	0.84	[0.75, 0.95]	*460*	*398*
Longer than 1 year ago / never	41.9	[39.2, 44.7]	34.2	*1.49*	0.74	[0.66, 0.83]	0.82	[0.73, 0.92]	0.83	[0.74, 0.93]	0.83	[0.74, 0.93]	*862*	*774*
Number of occasions of masturbation in past 7 days					P<0.0001		p=0.0005		p=0.0008		p=0.0009			
0	83.1	[81.0, 85.1]	35.5	*0.91*	0.91	[0.79, 1.04]	0.96	[0.85, 1.09]	0.97	[0.85, 1.10]	0.97	[0.86, 1.10]	*1718*	*1526*
1	8.8	[7.5,1 0.2]	40.5	*3.26*	1.00	-	1.00	-	1.00	-	1.00	-	*186*	*161*
2+	8.1	[6.8, 9.7]	48.4	*3.48*	1.28	[1.07, 1.52]	1.23	[1.04, 1.46]	1.24	[1.05, 1.46]	1.24	[1.05, 1.46]	*172*	*149*
Sexual behaviour in the past 4 weeks														
Number of occasions of sex#					P=0.0011		p=0.6410		p=0.600		p=0.602			
0-2	59.2	[56.5, 61.8]	35.7	*1.20*	1.00	-	1.00	-	1.00	-	1.00	-	*1258*	*1048*
3-4	15.8	[14.0, 17.9]	36.6	*2.13*	1.04	[0.93, 1.17]	0.97	[0.87, 1.09]	0.97	[0.86, 1.08]	0.96	[0.86 - 1.08]	*286*	*281*
5+	25.0	[22.5, 27.7]	39.3	*1.50*	1.18	[1.08, 1.28]	1.03	[0.94, 1.13]	1.03	[0.93, 1.13]	1.02	[0.92 - 1.13]	*440*	*443*
Vaginal sex					P=0.0597		p= 0.304		P=0.211		p= 0.200			
No	41.3	[38.9, 43.7]	36.2	*1.45*	1.00	-	1.00	-	1.00	-	1.00	-	*974*	*766*
Yes	58.7	[56.3, 61.1]	37.7	*1.05*	1.07	[1.00, 1.16]	0.96	[0.89, 1.04]	0.95	[0.87, 1.03]	0.94	[0.86, 1.03]	*1120*	*1089*
Received oral sex#					P<0.0001		p= 0.0937		p= 0.0905		p=0.0995			
No	68.2	[65.7, 70.5]	35.1	*1.07*	1.00	-	1.00	-	1.00	-	1.00	-	*1463*	*1262*
Yes	31.8	[29.5, 34.3]	41.5	*1.40*	1.20	[1.11, 1.30]	1.07	[0.99, 1.16]	1.07	[0.99, 1.17]	1.07	[0.99, 1.16]	*628*	*589*
Gave oral sex#					P<0.0001		p=0.0777		p= 0.0927		p=0.101			
No	66.2	[63.8, 68.6]	35.1	*1.07*	1.00	-	1.00	-	1.00	-	1.00	-	*1421*	*1226*
Yes	33.8	[31.4, 36.2]	41.0	*1.35*	1.20	[1.11, 1.30]	1.07	[0.99, 1.16]	1.07	[0.99, 1.16]	1.07	[0.99, 1.16]	*671*	*625*

Anal sex#					p=0.0773		p=0.163		p=0.199		p=0.209			
No	96.7	[95.6, 97.6]	36.8	*0.86*	1.00	-	1.00	-	1.00	-	1.00	-	*2037*	*1792*
Yes	3.3	[2.4, 4.4]	46.7	*5.00*	1.24	[0.98, 1.58]	1.18	[0.94, 1.49]	1.17	[0.92, 1.48]	1.16	[0.91 - 1.48]	*55*	*61*
Genital contact without intercourse#					p=0.0007		p=0.529		p=0.626		p=0.663			
No	58.5	[55.9, 61.0]	35.8	*1.11*	1.00	-	1.00	-	1.00	-	1.00	-	*1306*	*1088*
Yes	41.5	[39.0, 44.1]	39.5	*1.44*	1.15	[1.06, 1.24]	1.03	[0.95, 1.11]	1.02	[0.94, 1.11]	1.02	[0.93 - 1.11]	*789*	*772*
Sexual behaviour in the past 5 years														
Number of sexual partners#					p=0.0001		p=0.677		p=0.719		p=0.731			
0	13.1	[11.6, 14.7]	36.0	*3.01*	1.00	-	1.00	-	1.00	-	1.00	-	*361*	*239*
1	61.6	[59.2, 64.0]	35.8	*0.98*	1.14	[1.02, 1.28]	0.99	[0.89, 1.11]	1.00	[0.88, 1.14]	1.00	[0.88, 1.14]	*1177*	*1129*
2	10.4	[9.0, 12.0]	39.2	*2.43*	1.28	[1.10, 1.48]	0.98	[0.84, 1.15]	0.97	[0.83, 1.14]	0.97	[0.83, 1.14]	*222*	*190*
3-4	7.7	[6.4, 9.3]	38.0	*2.24*	1.26	[1.10, 1.46]	0.92	[0.78, 1.07]	0.93	[0.79, 1.09]	0.92	[0.79, 1.08]	*157*	*142*
5+	7.2	[5.9, 8.6]	48.4	*3.44*	1.51	[1.25, 1.83]	1.05	[0.86, 1.29]	1.04	[0.84, 1.27]	1.03	[0.84, 1.27]	*161*	*131*
Concurrency&					p=0.0873		p=0.620		p=0.548		p=0.535			
No	92.0	[90.5, 93.2]	36.9	*0.89*	1.00	-	1.00	-	1.00	-	1.00	-	*1906*	*1685*
Yes	8.0	[6.8, 9.5]	41.1	*2.73*	1.12	[0.98, 1.29]	0.97	[0.84, 1.11]	0.96	[0.84, 1.10]	0.96	[0.84, 1.09]	*173*	*147*
Same-sex partner[s]					p=0.0027		p=0.0257		p= 0.0581		p=0.0540			
No	97.2	[96.4, 97.9]	36.7	*0.87*	1.00	-	1.00	-	1.00	-	1.00	-	*2055*	*1846*
Yes	2.8	[2.1, 3.6]	50.9	*5.50*	1.35	[1.11, 1.65]	1.24	[1.03, 1.49]	1.20	[0.99, 1.44]	1.20	[1.00, 1.45]	*67*	*52*
Sexual behaviour, lifetime														
Number of sexual partners#					p=0.0546		p= 0.107		p= 0.111		p=0.106			
0/1	23.6	[21.3, 26.0]	37.9	*2.46*	1.00	-	1.00	-	1.00	-	1.00	-	*439*	*429*
2	11.7	[10.1, 13.5]	40.0	*2.63*	1.00	[0.86, 1.17]	1.02	[0.88, 1.17]	1.02	[0.89, 1.17]	1.02	[0.89, 1.17]	*234*	*213*
3-4	19.3	[17.3, 21.4]	34.2	*1.62*	0.91	[0.80, 1.02]	0.89	[0.79, 1.00]	0.89	[0.79, 0.99]	0.89	[0.79, 0.99]	*378*	*351*
5-9	25.0	[22.8, 27.3]	38.0	*1.31*	1.06	[0.96, 1.18]	0.99	[0.89, 1.09]	0.98	[0.89, 1.08]	0.98	[0.89, 1.08]	*516*	*455*
10+	20.4	[18.6, 22.3]	36.8	*1.68*	0.98	[0.87, 1.10]	0.91	[0.82, 1.01]	0.91	[0.81, 1.01]	0.90	[0.81, 1.01]	*498*	*371*
Ever had same sex experience with genital contact					p=0.0054		p=0.0325		p=0.0424		p=0.0378			
No	94.4	[93.3, 95.4]	36.6	*0.89*	1.00	-	1.00	-	1.00	-	1.00	-	*1983*	*1793*
Yes	5.6	[4.6, 6.7]	44.6	*3.18*	1.22	[1.06, 1.39]	1.15	[1.01, 1.32]	1.15	[1.00, 1.31]	1.15	[1.01, 1.31]	*140*	*106*
Sexual attraction														
Ever felt sexually attracted to:					p=0.0063		p=0.477		p=0.569		p=0.530			
Opposite sex only	88.1	[86.5, 89.6]	36.2	*0.92*	1.00	-	1.00	-	1.00	-	1.00	-	*1826*	*1663*
Any same-sex attraction	11.9	[10.4, 13.5]	42.6	*2.33*	1.15	[1.04, 1.27]	1.04	[0.94, 1.14]	1.03	[0.93, 1.14]	1.03	[0.93, 1.14]	*285*	*224*
Attitudes														
One-night stands					p=0.0692		p=0.152		p=0.453		p=0.485			
Other	90.5	[89.0, 91.8]	36.8	*0.92*	1.00		1.00	-	1.00	-	1.00	-	*1909*	*1718*
'Not wrong at all'	9.5	[8.2, 11.0]	40.3	*2.21*	1.11	[0.99, 1.25]	1.08	[0.97 - 1.20]	1.04	[0.93, 1.17]	1.04	[0.93, 1.16]	*214*	*181*
Non-exclusivity in marriage					p=0.203		p=0.970		p= 0.970		p=0.930			
Other	38.5	[36.0, 41.1]	34.9	*1.13*	1.00		1.00	-	1.00	-	1.00	-	*856*	*731*
'Always wrong'	61.5	[58.9, 64.0]	38.4	*1.22*	1.05	[0.97, 1.14]	1.00	[0.93, 1.08]	1.00	[0.93, 1.07]	1.00	[0.93, 1.08]	*1266*	*1167*
'Men have a naturally higher sex drive than women'					p=0.488		p=0.485		p=0.464		p=0.451			
Other	86.7	[84.7, 88.5]	36.8	*0.82*	1.00		1.00	-	1.00	-	1.00	-	*1864*	*1647*
Strongly agree	13.3	[11.5, 15.3]	39.0	*3.07*	1.04	[0.93, 1.16]	1.04	[0.94, 1.15]	1.04	[0.94, 1.15]	1.04	[0.94, 1.15]	*259*	*252*
'It is natural for people to want sex less as they get older'					p=0.0051		p=0.0824		p=0.120		p=0.128			
Other	93.1	[91.8, 94.2]	37.6	*0.91*	1.00		1.00	-	1.00	-	1.00	-	*1972*	*1768*
Strongly agree	6.9	[5.8, 8.2]	30.5	*2.15*	0.82	[0.72, 0.94]	0.89	[0.78, 1.01]	0.90	[0.79, 1.03]	0.90	[0.79, 1.03]	*151*	*131*

unwt=unweighted denominators, wt=weighted denominators. SE=standard error of mean. Denominator is: all women excluding those taking medication for epilepsy, received treatment for an ovarian or pituitary condition or polycystic ovaries in the past year, women currently receiving HRT, or who had ever received HRT and reported a hysterectomy (to approximate oophorectomy), or who were pregnant at the time of interview. *Ratio of geometric means, obtained from exponentiated age-adjusted linear regression coefficients of log-transformed data for women. Adjusted ratio 1=adjusted for age and age-squared; adjusted ratio 2=adjusted for age, age-squared, season, and relationship status; adjusted ratio 3=adjusted for age, age-squared, season, relationship status, BMI, and self-reported general health, #opposite- and/or same-sex, ^Only asked of those who had sex in the past year. &Overlap between any partners in past 5 years.

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11 DISCUSSION

In this research-paper style thesis, the evolution of Natsal is considered under three interconnected themes, each of which is illustrated through the papers forming the body of the thesis.

The first theme concerns theoretical perspectives underlying research into sexuality and in particular the nature-nurture, essentialist-constructionist debate that has long been waged. As we have seen, the forefathers of sexology in the late 19th century held that sexuality was a matter of biology. Much of their early efforts focused on attempting to establish what was 'normal' and 'natural' at a time when the prevailing opinion was that all sexual acts outside of marriage and for the purpose of reproduction were regarded as deviant and perverted, and either crimes or illnesses. They reasoned that - much like any other human characteristic - sexuality showed natural biological variation, and hence differences were not *against* nature but rather were part of its diversity. The essentially 'fixed' character of sexuality came to be challenged by anthropologists and historians, who highlighted differences between cultures and across time. The irony is that Freud had believed that it would be through cross-cultural studies that the universality of his 'truths' about sexuality would be established, but instead they came to refute them (Rivera, 2017). Kinsey went on to emphasise the differences *within* society adding further weight to the argument that far from being an immutable constant, sexual behaviour was shaped by social and cultural forces. However, while Kinsey broke with Freudian theory, he did not supersede it with any overarching theory of sexuality of his own (Escoffier, 2020). Indeed, during the latter half of the 20th century Simon & Gagnon (1986) argued that little of the work since the Second World War had been theoretically informed. Building on social constructionism - and looking to the ways in which societies are organised - they proposed a new theory called 'sexual scripting', in which 'scripts' are the 'socially approved' (and socially constructed) models of behaviour concerning sexuality that people adopt and endorse through socialisation (Simon & Gagnon, 1986). A social constructionist perspective maintains that it is by way of 'meaning making' that sexual expressions, experiences and identities are established, and not via biology (Tolman & Diamond, 2013).

The theoretical framework in which Natsal has been grounded from the first survey has centred on sociocultural influences, the malleability of sexual behaviour, and its potential for modification. This position does not negate biological influences, nor exclude their investigation within social research, as evidenced by our inclusion of a measure of testosterone in Natsal-3. There does still remain, however, a tension between essentialist and constructionist positions and calls have been made for the integration of both perspectives into a single theory; one that endeavours to identify and

incorporate biological and sociocultural influences (Tolman & Diamond, 2001). Such a theory would need to include a wider range of biological factors than have been touched on here, so in addition to physiological, psychological and hormonal influences it would also need to encompass genetics, neuroscience and neuroendocrinology (amongst others). It would also need to include a wide range of social, cultural and political factors, and take a life course approach. More recently, Tolman and Diamond (2013) revised their position, and suggested that a unified "meta" theory of sexuality is not likely to be realised. Instead, they called for theoretical diversity and argue that it is in the very tension between the essentialist and constructionist perspectives that the most fertile ground for advancement in understanding of sexuality lies. Hence, rather than trying to resolve debates, social scientists should continue to confront them in the service of "*broadening, challenging, questioning and ultimately enhancing what is known about sexuality and how it is known*" (Tolman & Diamond, 2013).

Weeks (1985), however, has earlier argued that ultimately, the basic problem does not rest on whether sexuality (particularly non-normative sexuality) is inborn or acquired, but rather on the cultural meanings assigned to them and what effect those meanings have on the people concerned (Weeks, 1995). Further, Tolman and Diamond (2013) suggest that the continued essentialist-constructionist machinations have less to do with which side of the divide is "right" and more to do with the status of research questions themselves as meaningful and answerable.

The second theme explored in this thesis concerns conceptual perspectives and in particular, the emergence of sexual health as a concept relevant to public health, the expansion of topics that fall under its umbrella and lastly the transition from a focus on sexual ill-health to sexual well-being. We have seen how 'sexual health' is rooted in the subjective and highly contested concept of 'health' (Sandfort & Ehrhardt, 2004; Giami, 2002) and that a primary tension in conceptualisations of health – and by extension sexual health –lies in whether it is the *absence* of negative states or the *presence* of positive ones. This tension is reflected in sexual health interventions, such as sex education, which have tended to focus on prevention of harms rather than promotion of benefits. This is by no means unique to sexual health. Within public health more generally, health 'promotion' has most usually translated into risk reduction and disease prevention. Within sexual health, until more recently the 'harm' to be prevented has centred on sexually transmitted infections and unintended pregnancies. These two foci, in turn, are illustrative of a further tension: the relationship between *sexual* health and *reproductive* health, and how the two concepts are related. We have seen that there has been a shift from the view that sexual health is a sub-set of reproductive health (United Nations, 1994), to a model that saw them as overlapping concepts yet with areas that are distinct and separate (WHO, 2010), to, most recently, a model that sees them as intertwined and sharing the same foundations

(WHO, 2017). In this latest model from WHO, a holistic view of sexuality - which emphasises that it is more than just the absence of ill health but includes "*the attainment of physical, emotional, mental and social well-being in relation to sexuality*" is both a means and an end. It forms one of the foundational principles and it is also positioned at the heart of the model as the ultimate objective of sexual health (WHO, 2017). Natsal-3 was framed in terms of a holistic definition of sexual health (Wellings & Johnson, 2013). Hence, as well as STIs and reproductive health, it included a new measure of sexual function (the Natsal -SF, Mitchell *et al*, 2012) and was the first Natsal survey to include questions about non-consensual sex (Macdowall *et al*, 2013).

The final theme concerns methodology and the tools we employ to try and measure and understand sexuality, specifically the shift from single disciplinary perspectives to multi-disciplinarity. We have seen how the forerunner of the sexological questionnaire emerged in the latter half of the 19th century as a way to 'tame' the self-penned sexual autobiographies sent to sexologists of the day. The sex survey itself emerged with Magnus Hirschfeld at the beginning of the 20th century though it is Alfred Kinsey's name with which it has become synonymous. It was with the urgent need for population level data in the face of HIV/AIDS that Natsal was born. We have seen how each iteration of the survey has shared a number of fundamental methodological characteristics but over its 30-year history, the survey has evolved methodologically too and the disciplines represented in the team have expanded; a trend which is exemplified by the inclusion of a measure for testosterone (T) in Natsal-3.

The three themes that have been explored here will continue to run through the next iteration of the survey, the fieldwork for which was due to begin in 2020 but has been postponed in the light of the COVID-19 pandemic. It will be interesting to see how the pandemic interrupts, challenges, and changes sexual mores and practices. One of the areas we had already planned to investigate in Natsal-4, and which will be even more germane post-COVID-19, is the increasing integration of digital technologies into our sexual lives; integration which has most likely been accelerated by the pandemic. We are in the middle of a digital revolution, and in writing this thesis, I have been struck with parallels this conjures with the industrial revolution. The industrial revolution saw the rise of the modern city with more people living together than ever before, it made sex work, homosexuality and other 'deviances' visible. The internet is bringing people together in a virtual way just as the modern city did in a physical way; once more sexual behaviours previously not visible have become more visible, and much of the language (particularly in relation to internet pornography) which includes fears of poisoning young minds, mental ill health, depravity and deviancy, is similar to that in Victorian times. There is also a conceptual debate regarding the nature of some of the technology-related behaviours (such as sexting, porn use, meeting partners online, etc) and whether they are

'inherently problematic'. Technology was heavily implicated as the likely culprit in the interpretation of nearly all of the 'negative' findings from Natsal-3, both directly (through easy availability of sexually explicit material, and partners etc) but also indirectly by deflecting us from 'real' human interaction. As I take this work forward in Natsal-4, I am mindful of the 'framing' of the research as this is obviously central to the research process: it provides the lens through which the research is conducted; what is measured, reported and how findings are interpreted. Tolman and Diamond (2013) argue that the stakes are much higher in sexual research than other areas of research, especially within societies where scientific knowledge has an elevated status and serves as the foundation for ideology and social policy. This in turn places a special responsibility on sex researchers to question their own – implicit or explicit - theoretical and ideological assumptions; not only with regard to the sexual phenomena under investigation, but also to the methodologies used to study it. This responsibility extends to the interpretation and dissemination of findings (Tolman &Diamond, 2013). In writing this thesis, I have come to feel this responsibility more keenly. Over the course of its lifetime, hundreds of papers reporting on Natsal findings have been published, many which have gone on to have a considerable impact on policy and practice and the public debate about sex. The three papers forming this PhD, and on which I led the analysis, reporting and dissemination of findings are no exception. For example, the sex education paper which was published in BMJ Open in 2015 has, to date, been cited in 16 policy documents. Most notably the findings featured extensively in the final report of the 2015 Education Select Committee Inquiry into Relationships and Sex Education (RSE), which recommended that RSE be statutory (House of Commons, 2015). The paper on non-volitional sex in The Lancet in 2013, has to date been cited 96 times, and featured prominently in the media coverage that followed the first tranche of papers (published as a series of six in The Lancet). Dissemination encompassed public, media, policy and practice audiences and included being interviewed on Radio 4's Women's Hour and writing an opinion piece for *The Guardian* newspaper. I have also been invited to speak at various conferences and comment on other research (Macdowall, 2015). My work in this area has also led to closer links with policymakers. I am currently working with the Home Office on interpretation of data sources related to sexual violence and identifying research priorities, and I am a member of a Home Office stakeholder group feeding into policy regarding child sexual abuse. The testosterone paper was published in the Journal of Sex Research (JSR) in Oct 2021 and received the largest Altimetric Attention Score for a JSR article in 2021 (330 on 3rd Dec 2021). The findings were reported in high-profile outlets including those which directly target the medical community. This work has paved the way for the application of Sal-T in investigating the potential importance of androgen exposure in

many aspects of human health in large-scale population surveys, and has a much wider application in research internationally.

As I have looked back over the evolution of sexology and questioned and critiqued the theoretical and methodological perspectives of others, I have wondered how future researchers will look back at Natsal and do the same, as ultimately Natsal itself will be seen as just part of the evolution of research into sexual behaviour and take its place in the ongoing history of empirical sexology. I feel enormously fortunate, not only to be able to observe and document the evolution of Natsal, but also to have played a part in it.

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