RESEARCH IN HEALTH PSYCHOLOGY

RESEARCH THESIS

THE EFFECTS OF NOCTURIA ON SLEEP, MOOD AND QUALITY OF LIFE IN WOMEN

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A portfolio of evidence submitted in partial fulfilment of the requirements of the University of the West of England, Bristol, for the degree of Professional Doctorate in Health Psychology

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Declaration of contribution

All aspects of this research were Daljinder Chalmers own work.

Daljinder Chalmers was the lead researcher and provided the initial idea for this research and conducted the research design, recruitment, analysis and write up under the supervision of Dr Joe Walsh, Professor Tim Moss, Professor Nikki Cotterill, Dr Chris Alford and finally Dr Catrin Griffiths.

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Abbreviations

A'LEVELS – Advanced Level's

AASM – American Academy of Sleep Medicine

AJGP – Australian Journal of General Practice

AM – Ante Meridiem

ANOVA – Analysis of Variance

AS – Active Sleep

ATP -Adenosine Triphosphate

AUA-SI/IPSS - The American Urological Association Symptom Index/International Prostate Symptom Score

BA – Bachelor of Arts

BACH – Boston Area Community Health

BDI – Beck Depression Inventory

BMI – Body Mass Index

BNF – British National Formulary

BNSQ – Basic Nordic Sleep Questionnaire

BPH - Benign prostatic hyperplasia

BPO - Benign prostatic obstruction

BPS – British Psychology Society

BRFSS - Behavioural Risk Factor Surveillance System

BSc – Bachelor of Science

BTEC – Business and Technology Council

CM – CentiMetre

Corp - Corporation

COVID-19 – Coronavirus disease

CPS – Cycles per second

CRP – C-reactive protein

CRSD – Circadian rhythm sleep disorder

CVD – Cardiovascular disease

DASS - Depression and Anxiety Stress Scales

DoF – Degrees of Freedom

DPhil – Doctor of philosophy

DQS – Deep quiet sleep

ECG - Electrocardiogram

EEG – Electroencephalogram

EMAS - Endler Multidimensional Scales

EMG - Electronmyography

EOG - Electrooculography

FDA – Food and Drug administration

FINNO - Finnish National Nocturia and Overactive Bladder

FVC – Frequency volume chart

GCSE's – General Certificate of Secondary School's

GHQ-12 – General Health Questionnaire – 12 items

GSQS - Groningen Sleep Quality Scale

HADS – Hospital Anxiety and Depression Scale

HADS-A - Hospital Anxiety and Depression Scale - Anxiety

HADS-D - Hospital Anxiety and Depression Scale – Depression

HAS – Health and Sciences

hCG – Human Chorionic Gonadotrophin

HCPC – Health and Care Professions Council

HND – Higher National Diploma

HRQoL – Health Related Quality of Life

IBM – International Business Machines

ICIQ-FLUTS - Incontinence Modular Questionnaire for Female Lower Urinary Tract Symptoms

ICI-RS - International Consultation on Incontinence-Research Society

ICS – International Continence Society

ICSD – International Classification of Sleep Disorders

IgG1 - Immunoglobulin G1

IIRS – Initiative Insomnia Rating Scale

KG – Kilogram

KAIs – Korean American Immigrants

LQS – Light Quiet Sleep

LUTS - lower urinary tract symptom

M - Mean

MA – Master of Art

MBA – Master of Business Administration

MCS – mental component score

ML/H – Millilitre/per hour

MPhil – Master of Philosophy

MSc – Master of Science

N – Number

Na - Sodium

N/A – Not applicable

NIMH - National Institute of Mental Health

NNES-Q - Nocturia, Nocturnal Enuresis, and Sleep-interruption Questionnaire

NP – Nocturnal polyuria

NREM – Non rapid eye movement

NSQS – Nocturia sleep quality score

OAB – Overactive bladder

O'LEVELS – Ordinary Levels

OSA – Obstructive sleep apnoea

P - Probability

PCS – Physical component score

PhD – Doctor of Philosophy

PM – Post Meridiem

PMDD - Premenstrual Dysphoric Disorder

PMS - Premenstrual Syndrome

PRO - Patient-Reported Outcomes

PROMIS® - Patient-Reported Outcomes Measurement Information Systems

PSG - Polysomnography

PSQI – Pittsburgh Sleep Quality Index

QoL – Quality of Life

QoLS – Quality of Life Score

RAND – Research and Development

REC – Research Ethics Committee

REF – Research Excellence Framework

REM – Rapid eye movement

SD – Standard deviation

SES – Social Economic Status

SF-36 – Short-Form – 36 items

SHI – Sleep Health Index

SPSS – Statistical Package for Social Scientists

SRBD – Sleep Related Breathing Disorder

SRMD – Sleep Related Movement Disorder

SSRI's - Selective serotonin reuptake inhibitors

SSRS - Scandinavian Sleep Research Society

STAI - Spielberger State-Trait Anxiety Inventory

SWA – Slow wave activity

SWAN - Study of Women's Health Across the Nations

SWS – Slow Wave Sleep

Th - Thiamine

U.S. – United States

UK – United Kingdom

USA – United States of America

UWE – University of West of England

VA – Visual analogue

VMS – Vasomotor symptoms

WHO – World Health Organisation

WHOQOL-BREF – World Health Organisation Quality of life Brief Version

WIFI – Wireless Fidelity

α. - Alpha

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Dedication

To the star that will always shine bright in the night sky, my beautiful nan, Pritam Kaur, who sadly left this celestial plane on 9th March 2021.

Foreword: Undertaking the Professional Doctorate in Health Psychology

I have been undertaking the Professional Doctorate in Health Psychology at University of the West of England since November 2019, which has involved working towards and completing five areas of competency set out by the British Psychological Society.

Consultancy Skills in Health Psychology

has been completed, submitted, assessed, and passed by the University of the West of England and the BPS examination board in November 2020.

Psychological Interventions Health Psychology

has been completed, submitted, assessed, and passed by the University of the West of England and the BPS examination board in November 2020.

Teaching and Training in Health Psychology

has been completed, submitted, assessed, and passed by the University of the West of England and the BPS examination board in November 2021.

Professional Skills in Health Psychology

has been completed, submitted, assessed, and passed by the University of the West of England and the BPS examination board in September 2022. Work submitted included a logbook evidencing supervised practice to meet required competencies and a reflective essay.

Research

The **Research** competency is assessed in two parts: a systematic review and empirical research.

A systematic review was conducted in 2020 during the first academic year on the professional doctorate and explored the association between disordered sleep and the menopausal transition in women. The prevalence of sleep disturbance and sleep problems in women appears to increase dramatically during the menopause transition. However, results from studies of menopause and sleep, including population-based surveys of general menopausal symptoms, cross-sectional studies with objective indicators of disturbed and hormone-replacement trials

are inconsistent. The aim of the review was to investigate whether there is an association between disordered sleep and menopausal transition.

Results indicated that of the final 14 studies only five of the fourteen studies assessed the association between sleep disturbance and the menopausal stages using multi-variate analysis. This review has highlighted the difficulties in understanding where during the menopausal transition sleep is disrupted/disturbed. A good study should use both objective and subjective methods to measure both sleep and where in the cycle of the menopause the woman is. It is increasingly important to use appropriate biological markers to determine this to better understand why sleep tends to be more disturbed during oestrogen withdrawal during the menopause.

The systematic review has been completed, submitted, assessed and passed by the University of the West of England and the BPS examination board in October 2020. The systematic review is currently awaiting publication.

This doctoral thesis describes the research study conducted to fulfil part 2 of the research competency.

A flock of sheep that leisurely pass by,
One after one; the sound of rain, and bees
Murmuring; the fall of rivers, winds, and seas,
Smooth fields, white sheets of water, and pure sky;
I have thought of all by turns, and yet do lie
Sleepless! and soon the small birds' melodies
Must hear, first uttered from my orchard trees;
And the first cuckoo's melancholy cry.

William Wordsworth, *'To Sleep.'*

Abstract

Introduction: Historically nocturia has received more attention as a men's health issue, despite the high prevalence in women as well. Nocturia in women has been thought of as a symptom of other disorders such as overactive bladder or global polyuria, though nocturia often occurs without daytime symptoms. With a growing body of literature regarding its prevalence, determinants, and implications, nocturia in women can begin to be assessed as an entity in and of itself. The aims of the present study was to observe the impact of nocturia on women's health and wellbeing, specifically sleep, and to identify which age groups are more likely to void more than once per night and finally to identify if other factors such as occupation, parous status, ethnicity, exercise, can impact nocturia.

Method: A total of 180 women from the ages of 19 to 86 years took part in this cross-sectional survey study. The survey consisted of a range of validated and reliable instruments which measured sleep using the Pittsburgh Sleep Quality Index (PSQI) and the Groningen Sleep Quality Scale (GSQS), nocturia which was measured using the Nocturia Sleep Quality Scale (NSQS), quality of life which was measured using the 36-item Short-Form (SF-36) and mood which was measured using the Hospital Anxiety and Depression Scale (HADS). The study was advertised through a range of on-line platforms and accessed via a link through Qualtrics.

Results: The PSQI data revealed low scores for subjective sleep quality and above average global PSQI scores. Participants reported taking 30 minutes or more to fall asleep and with longer than usual time spent in bed. Participants reported a mean score of 5.36 for the GSQS which is just under the score of disturbed sleep and the component scores for the NSQS; Lost sleep time score and impacts score were similar to a population score with night-time voids ≥ 1 and disturbed sleep. For quality of life, low scores for the component physical function, physical problems, and role emotional was reported, physical health and mental health was reported as low and finally high scores for anxiety (HAD-A) and the total HADS score were reported.

Conclusion: It is important to take note of these possibilities and to understand that the present study has only scratched the surface and highlighted the importance of understanding and acknowledging that individuals diagnosed with nocturia do have disturbed sleep in many of the areas highlighted by the PSQI, NSQS and GSQS. Disturbed sleep is also very detrimental to the individual's psychological well-being, in particular their general health, mood and QoL. Future research needs to include objective measures to further explore the disturbed sleep patterns of such individuals and to collect normative data which would be highly useful in

exploring these factors and how they may affect the individuals sleep and psychological functioning.

1 Introduction and outline of thesis

The focus of this research is specifically on women across the life span. Historically nocturia has received more attention as a men's health issue, despite the high prevalence in women as well. Historically, nocturia in women has been thought of as a symptom of other disorders such as overactive bladder or global polyuria, though nocturia often occurs without daytime symptoms (Tikkinen et al, 2010a). With a growing body of literature regarding its prevalence, determinants, and implications, nocturia in women can begin to be assessed as an entity in and of itself. Many observational studies have demonstrated the relationship between the frequency of nocturnal voiding and the negative effect on QoL and wellbeing., (Kupelian et al., 2012; Tikkinen et al., 2010; Asplund & Aberg, 1992; Vaughan et al., 2009 and Vaughan et al., 2012). Foremost, nocturia is associated with disruption of sleep that can result in daytime fatigue, cognitive impairment, mood alterations, increased susceptibility to disease, decreased work performance, dizziness, an increased risk of falls, depression and mortality.

This programme of research to be described focuses upon participants who may identify as having disturbed sleep, poor quality of life, low mood and low general and health well-being due to their night-time voiding (nocturia). Although sleep and nocturia has received special attention in the literature, the details of the sleep problems associated with nocturia in women across the lifespan has not been appropriately defined, and the possible psychological consequences have not been the subject of previous systematic research. Clearly, such consequences are seen to be potentially serious in participants with nocturia or sleep problems as they may add to the overall level of debilitating effect associated with the condition.

The aims of the present research are:

To observe the impact of nocturia on womens' health and wellbeing

To identify which age groups are more likely to void more than once per night

To identify if other factors such as occupation, parous status, ethnicity, exercise, can impact nocturia

To identify participants who have started receiving treatment either for nocturia or another nocturia-related condition and if this improves their health and well-being scores

This thesis is divided into four parts: (1) introduction and outline of the thesis, (2) the literature review, (3) description of a cross-sectional survey of sleep disturbances and general health and well-being of women across the lifespan living with nocturia, (4) discussion of the present programme of research including issues arising and suggestions for future research and finally a list of appended items relevant to the main text of the thesis.

2 Literature review

2.1 Sleep

2.1.1 Definitions and theories of sleep

The opening paragraph of the first chapter in the Atlas of clinical sleep medicine (Kryger, Avidan and Berry, 2013) describes what sleep means to both a scientist and an artist. The former wanting to explore the "function, mechanisms and pathologies" (Shapiro, Sherman and Kryger, 2013, pg.1) whilst the latter having an intense fascination with concepts such as mythology, dreams, religious themes, and the parallels between "sleep and death, reward, abandonment of conscious control, healing, a depiction of innocence and serenity and the erotic," (Shapiro, Sherman and Kryger, 2013, pg.1).

The subject of sleep is revisited time and again across disciplines, yet why is the subject of sleep so fascinating? Sleep is in fact an adaptive inactivity in that it is generally a reduction or cessation of movement and sensory response (Siegel, 2010), a common and basic human function (Kryger, Avidan and Berry, 2013). Although Brinkman, Reddy & Sharma (2023) write that sleep is an extremely complicated process which consists of an active state of unconsciousness, where the brain is in a relative state of rest and is reactive to both primary and internal stimulus. The appeal of sleep lies in the fact that, although it is common, it is extremely complex (Kryger, 2013). Defining what sleep is as complex as the subject of sleep itself, but based on the points raised in this section, one possible definition which has been selected for the purpose of this study to best define sleep health is as follows:

> *"Sleep health is a multidimensional pattern of sleep-wakefulness, adapted to individual, social, and environmental demands, that promotes physical and mental well-being. Good sleep health is characterized by subjective satisfaction, appropriate timing, adequate duration, high efficiency, and sustained alertness during waking hours."* (Buysse, 2014).

Sleep medicine for most of its brief history has followed in the footsteps of medicine; that is, defining itself in terms of sleep disorders and sleep deficiencies (U.S. Department of health and Human Services, 2009; Czeisler, 2011). Thus, meaning that the model of sleep medicine has followed the practices and principles of disorders, diseases, and their treatments. Demonstrating the importance of sleep medicine within the context of both the scientific community and health care is challenging enough but defining sleep health and promoting it is a crucial component of population health (Buysse, 2014).

Despite numerous[1] textbooks on sleep, none define what sleep health is. Over the years, varying committees (Public Health (United States), Institute of Medicine (US), The centres for Disease Control and Prevention) have signified the importance of ensuring that sleep health, an unmet public health problem, is put at the forefront of all mission statements and reports, but no attempts are made to explain what this concept means. Furthermore, despite a recent article by Lim et al (2023) whereby a strong claim to promote sleep health in public health agendas across the globe, the authors explained that until sleep is recognised as a health priority by WHO, countries are less likely to include sleep in their national health agenda. Sleep health is a term that is infrequently used in literature, yet when it is used it is not defined (Buysse, 2014).

The National Institute of Mental Health (NIMH), in its workshop on Arousal and Modulatory Systems, defined sleep and wakefulness in this way:

> "*Sleep and wakefulness are endogenous, recurring, behavioural states that reflect coordinated changes in the dynamic functional organization of the brain and that optimize physiology, behaviour, and health. Homeostatic and circadian processes regulate the propensity for wakefulness and sleep.*" (National Institute of Mental Health, Arousal, and Regulatory Systems: Workshop proceedings, 2013).

According to Buysse (2014) definitions of sleep health should focus on characteristics of sleep which are clearly measurable and associated with physical, mental and neuro-behavioural well-being. Therefore, for the sake of this thesis one possible definition of sleep health is the following:

> *"Sleep health is a multidimensional pattern of sleep-wake-fulness, adapted to individual, social, and environmental demands, that promotes physical and mental well-being. Good sleep health is characterized by subjective satisfaction, appropriate timing, adequate duration, high efficiency, and sustained alertness during waking hours."* Buysse, 2014, p.12.

[1] Principles and Practice of Sleep Medicine (Kryger, Roth and Dement, 2011), Sleep Disorders Medicine (Chokroverty, 2009), Clinical Sleep Disorders (Carney, Berry and Geyer, 2005)

2.1.1.1 Theories of sleep

The exact reason as to *why* we sleep has not been fully elucidated (Brinkman, Reddy and Sharma, 2022). There are several prominent theories which have explored the brain and have attempted to identify a purpose for why we sleep; these theories include the Inactivity theory, Energy Conservation theory, Restoration theory, and the Brain Plasticity theory. For the purpose of the current thesis the three main theories of sleep that will be discussed in this chapter to examine the explanations provided to help understand why humans sleep are; the restoration theory, the evolutionary theory (or ecological theory) and the neurochemical theory, although note that the latter is more of a model based on the physiological control of sleep, i.e., how we sleep rather than a strict theory which explains why we sleep. Each theory will be discussed separately along with a brief explanation of what the theory entails and its basic principles, followed by evidence which either supports or refutes the theory. The brain plasticity theory is based on the assumption that sleep is required for neural organisation and growth of the brain's structure and function (Brinkman et al., 2023). So, from this perspective, sleep is explained more from a developmental perspective in that why infants and children require greater amounts of sleep compared to adults. So, for this reason, this theory will not be discussed here as the focus of the current research is based on adult women.

2.1.1.2 Restoration theory

Oswald (1970, 1976) suggested that both rapid eye movement (REM) and non-rapid eye movement (NREM) sleep serve the purpose of restoring and replenishing our bodies and brains. (Rapid eye movement and non-rapid eye movement sleep will be discussed in section 2.1.2 physiology of sleep). This illustrates that we sleep to restore ourselves physically and psychologically. Oswald has suggested that NREM is important for restoring bodily processes which may have deteriorated or may have been worn down by the day. REM sleep has been described by Oswald as the sleep which renews brain processes and replenishes neurochemicals used up in the day, and these are regenerated by protein synthesis.

Evidence which supports the restoration theory

There is empirical evidence available which supports Oswald's restoration theory (Bentley, 1999). Foetuses and babies have shown to sleep with REM and NREM sleep for a greater proportion of the day than older children or even adults (Bentley, 1999). It is during these earlier stages of development that the body of a developing foetus or a baby grows faster, and

neural connections are established (Ackerman, 1992). Adults will spend on average eight hours per night asleep, whereas new-borns have been shown to sleep for eighteen hours a day, half of which are spent in REM sleep. Adults spend only a quarter of their sleep in REM (Bentley, 1999). The amount of time spent in REM sleep corresponds with the large amount of activity which occurs in the developing brain, where protein synthesis is required for cell and synaptic growth. (Bentley, 1999). Oswald (1980) states that physical repair and brain-protein synthesis are both dependant on the growth hormone. Growth hormone is secreted after the first burst of delta activity in slow wave sleep (Slow wave sleep is discussed in section 2.1.2 physiology of sleep). Generally, infants have been shown to spend a great deal of time in slow-wave sleep (SWS), and thus have more delta wave activity. Delta-waves are the predominant waveforms of infants and analysis reveal that they are prominent in waking electroencephalogram (EEG's) of a five-year old (Taylor and Rutter, 2002). Delta waves tend to decline across the lifespan, with most of the decline seen in the mid-forties (Science Daily, 2008).

Brain waves are oscillating electrical voltages in the brain and measure a few millionths of a volt and are unique for everyone. There are five widely recognised brain waves, furthermore various regions of the brain do not necessarily emit the same brain wave frequency simultaneously. The main frequencies of human EEG waves are listed in Table 2.1 along with their characteristics.

Table 2.1 Characteristics of the Five Basic Brain Waves

Frequency band	**Frequency**	**Brain states**
Gamma (γ)	30-100 Hz	Concentration
Beta (β)	12-35 Hz	Anxiety dominant, active, external attention, relaxed
Alpha (α)	8-12 Hz	Very relaxed, passive attention
Theta (θ)	4-8 Hz	Deeply relaxed, inward focussed
Delta (δ)	0.5-4 Hz	Sleep

Abhang, Gawali & Mehrotra (2016).

More recently, evidence on the benefits of sleep has been linked to how the quantity and quality of sleep in your adulthood can be a significant factor on how healthily an individual ages. Research has shown that poor or insufficient sleep can in fact increase the risk of specific disorders such as high blood pressure (Agarwal, 2018), diabetes (Jemere et al, 2019), obesity (Fry & Rehman, 2022), stroke (Sonmez et al, 2019; Khot et al, 2019), and depression (Newson

& Dimitriu, 2023). Poor sleep has also been associated with cognitive decline and Alzheimer's disease too (Lucey, 2020; Holth et al, 2017; Wang & Holtzman, 2017). The age-old adage of how much sleep an individual should get is often a point of discussion (Grandner, 2023) however it is the quality that is just as important if not more (Neylan, 2023). Hall et al (2018) illustrated how poor sleep can increase inflammation in the body which can lead to a variety of diseases such as obesity, diabetes, heart diseases and some cancers, furthermore older adults who reportedly slept less than six hours or more than eight hours of sleep per night were reported to show increased inflammatory markers in their blood which in turn increased inflammation and were at higher risk of mortality.

Evidence which does not support the restoration theory

Extensive research into protein synthesis has shown that amino acids (the building blocks for protein and neurochemicals) are not stored by the body. Amino acids only last approximately four hours after a meal within the body (Poortmans, 2012). This shows that protein synthesis might be stopped halfway through the night's sleep because the amino acids run out or are depleted (Grønli et al, 2014). Interestingly, Empson (1970) suggests that the overall evidence does support sleep-as-synthesis but there are suggestions that high levels of brain activity in REM sleep are likely to consume all the glucose and oxygen available, which leaves no margin for growth or repair.

Studies within sleep deprivation have shown that we do not require to account for lost sleep, that is catching up on lost sleep time due to external factors such as commuting, working, shift-work, and other social factors such as watching television (Kitamura et al., 2016) but although we do appear to need REM sleep or core sleep. If the restoration theory proposes that sleep is required to restore function, then findings from sleep deprivation studies would be consistent and this is not the case (Bentley, 1999). It has also been proposed that some form of recovery and manufacture of biochemicals may also take place during the day when a person is relaxed (Bentley, 1999).

Another factor which further suggests that sleep may not be seen as a restorative period is that the more active you were during the day, the more you should sleep at night; however, there is no relationship for this notion. Shapiro et al (1981) recorded the sleep duration of marathon runners; after a race they showed a decrease in REM sleep but did show more slow-wave sleep

as would be expected by the restorative model. Further support is provided by Horne and Minard (1985), who found that participants engaged in several different physical activities showed no increases in sleep, although the participants did go to sleep a lot faster. Carlson (1986) has suggested that perhaps slow-wave sleep is important for recovery after vigorous activity.

Further evidence to dispute the restoration theory is provided by animal studies. If the restoration theory suggests that sleep serves a universal purpose, why are there so many variations in the way that animals sleep? For example, dolphins have evolved unique sleep patterns to overcome the real risk of drowning (Hecker, 1998). Those in the river Indus take naps for a few seconds at a time, this is repeated throughout the twenty-four-day cycle. This is probably also related to their need for vigilance at all times, as so much large debris is always sweeping down the river (Pilleri, 1979). A study in 1984 showed that marine dolphins sleep with only one hemisphere at a time, so half the cortex is always awake, this is presumably so that organisation of surfacing to breathe can occur (Mukhametov, 1984).

An alternative restoration theory

Maurice (1998) proposes an alternative point of view of the restoration theory, stating that REM sleep occurs because during sleep the fluid inside the eyes would not circulate and the eyes might become internally short of the oxygen supply borne in this fluid. Maurice states that moving the eyeballs creates small currents in this fluid and ensures the delivery of oxygen to the cornea. This does explain why foetuses have REM sleep and why periods of REM sleep become longer in adults as the night progresses. However, this alternative theory by Maurice does not explain why those participants who are experimentally deprived of REM sleep have no eye problems reported, and also have an increased amount of REM sleep when allowed to sleep naturally.

2.1.1.3 Evolutionary or ecological theory

Meddis (1975, 1979) put forward an explanation of why we sleep using an evolutionary or ecological perspective. The evolutionary/ecological theory proposes that sleep could be a time of increased safety as animals are immobile and therefore less likely to be noticed by predators. Meddis suggests that being still when it is too dark to see either food or threats acts as an advantage to some animals.

However not all species of animals fit into this concept. The theory does not consider those animals which are nocturnal in habit, these being owls who are specialised to see in low light conditions, and bats who are not dependant on light to find food or to be aware of their environment. Through evolution, these species have developed sleep patterns which fit with their way of life, this being that they sleep during the day in places of safety, such species sleep patterns still fit in with the evolutionary theory. There are also those species such as lions that have no predators (Lloyd et al., 1984). Lions appear to be relatively happy wherever they choose to sleep, and sleep whenever they can.

Other species which does not fit in with the theory are those species of animals which graze (Freiburg, 2020). Cows and antelopes spend most of their time grazing in herds. For these animals to remain still in such a wide-open field would pose great danger and therefore not remaining vigilant could be maladaptive, as they are constantly at risk from predators; this lack of sleep would support Meddis' theory concerning safety. On the other hand, we know that animals which graze usually graze upon vegetation which lack nutritional value, and in order

to survive such grazing animals must eat over the 24-hour period, so if they did not graze and stopped to sleep, they would lack nutrients and energy for the next day (Bentley, 1999).

The evolutionary/ecological theory is based on the idea that when humans lived truly wild, when our distant ancestors were evolving, those who were able to sleep at night survived better as they were less likely to become prey. Energy had been conserved when it was too dark to see and humans had been successfully hidden from predators. It was those groups of people who survived who were then able to pass on the ability to sleep through the night to ensure survival (Bentley, 1999).

The evolutionary or ecological theory fails to explain why after sleep deprivation humans sleep longer and begin to fall asleep in daylight. The theory proposes that we sleep to protect ourselves, if this was the case, we would find that animals who are likely to be attacked would sleep rather little. Generally, it is found that predators tend to sleep more than those species of animals that are preyed upon (Bentley, 1999).

Horne (1988) suggests that there are two types of sleep: core/essential sleep, and optional sleep (core sleep is discussed in section 2.1.2 physiology of sleep). Both types of sleep would have different adaptive functions; however, this theory as a whole is still basically conjecture and it is difficult to see how empirical evidence could be obtained (Bentley, 1999).

Meddis also suggests that babies tend to sleep longer to prevent exhaustion in their mothers from an evolutionary perspective. However, this concept does not explain the survival of the non-sleepy trait in babies, nor the variation in quantities and type of sleep-in people of all ages.

Empson (1989) has described Meddis's theory as a 'waste of time' theory, meaning that the theory suggests that sleep is a waste of time (Bentley, 1999). Empson suggests that sleep is universal among animals, even the most successful predators, and that sleep deprivation can on occasion be fatal; this suggests that sleep has some value. It is also important to consider in the animal kingdom whether being paralysed and senseless for hours is also of any value when animals are faced with dangers such as predation. It is advantageous being still and quite in the dark to avoid danger but being almost unconscious, unaware of one's surrounding shows vulnerability (Bentley, 1999).

It has been suggested by Horne that sleep may perform different functions in different species and different sizes of animals, such as aquatic animals, grazing animals and those with higher intellects (Bentley, 1999). There are evolutionary principles at work as dolphins appear to have developed sleep-adaptations specific to their environment. Sleep must be serving a purpose and each species evolve a means of sleeping in such a way that doesn't also threaten their survival (Bentley, 1999).

2.1.1.4 The neurochemical theory

The neurochemical approach suggests that sleep has a particular function within the brain, an almost specialised sort of restoration theory (Bentley, 1999).

Rapid Eye Movement (REM) Sleep

REM sleep appears to be related to a noradrenaline pathway going up through the brain. Studies have shown that as a feature of depression, sufferers have unusually large amounts of REM sleep. It has also been found that REM deprivation can relieve depression (Vogel, 1975). This suggests that there is a link between too much REM sleep and depression. Some drugs that are used to treat depression such as tricyclic antidepressants have also been found to reduce REM sleep. Tricyclics work by stimulating the noradrenergic pathways and the production of noradrenaline. Perhaps what the drug is doing is performing the functions of REM sleep and therefore less sleep is needed, and, for whatever reason, the reduced REM sleep alleviates depression (Bentley, 1999). Parallel studies have also been performed in non-human species whereby noradrenaline has been reduced in the brain and thus causing an increase REM sleep. Again, this provides support for the association between REM and noradrenaline, REM sleep has a neurological purpose to replenish the brain's noradrenaline levels which may have been depleted by daily activities, (Bentley, 1999).

Non-Rapid Eye Movement (NREM) Sleep

Serotonin, a neurotransmitter in the brain, has been shown to be linked with NREM or slow-wave sleep. If serotonin is removed with the use of certain drugs, this also has an impact on the amount of NREM sleep where it is also reduced. This suggests that a serotonin dependant pathway is required to have NREM sleep; this is again supported by studies with depressed patients. Patients with unipolar depression have the inability to fall asleep-they remain tired but awake every night well into the early hours of the morning and once sleep does come it lasts a very short time (Bentley, 1999). Once again, successful treatments of depression such

as selective serotonin reuptake inhibitors (SSRI's) such as Prozac increase the activity of serotonin in the brain and restore both the sleep patterns and the person's mood.

Sleep is linked to molecules which appear within all the cells including neurones, these are the source of energy for the cell to work-sort of molecular torch-batteries (Holmes, 1997). These molecules are called adenosine triphosphate (ATP) which are made up of adenosine (Adenosine plays an important role in biochemical processes, such as energy transfer, it is also an inhibitory neurotransmitter, believed to play a role in promoting sleep and suppressing arousal, with levels increasing with each hour an organism is awake). Adenosine could be the key to why we sleep, as in cats when adenosine levels rise above some critical level, they get sleepy and sleep longer in both REM and NREM sleep. Also, during sleep, levels of adenosine fall, to rise again during wakefulness (Carlson, 1997).

This supports the notion that we have NREM sleep in order to be able to go into REM sleep and we therefore need REM sleep to deal with adenosine to provide the brain with energy for the next day. This could suggest that sleep supports homeostasis, to balance various neurochemicals in our body (Bentley, 1999).

Finally, Hobson (1995) proposes a review of the main theories of sleep and puts forward a three-tier analysis of sleep; Firstly, behaviourally, sleep conserves energy for example when foraging for food or for finding a mate when conditions may likely to be difficult, or when there is a decrease in climatic temperature. This suggests that sleep is favourable in less hospitable conditions. It is also a time for pair-bonded or family groups to strengthen relationships by being together during the period leading up to sleep as well as when sleeping. Secondly, developmentally, the brain structures and connections can grow and mature before they are needed in action, this ties into the restoration theory. Thirdly, metabolically, various physiological changes such as alterations in blood pressure and release of hormones occur during sleep.

2.1.2 Physiology of sleep

Sleep is an altered state of consciousness, rather than a state of unconsciousness (Assefa et al, 2015), meaning that even those who are deep sleepers can still be roused from their sleep like state. Normal sleep consists of humans sleeping once per day, and within this period of sleep humans will experience a number of different states of consciousness. Dement and Kleitman's work within sleep medicine has shown that not only are there two types of sleep, each with associated brain wave studied through electroencephalogram (EEG) patterns, these two types of sleep also alternate in an ultradian rhythm (meaning less than a day, cycles which occur within a day), and that dreaming is associated much more strongly with one of those types.

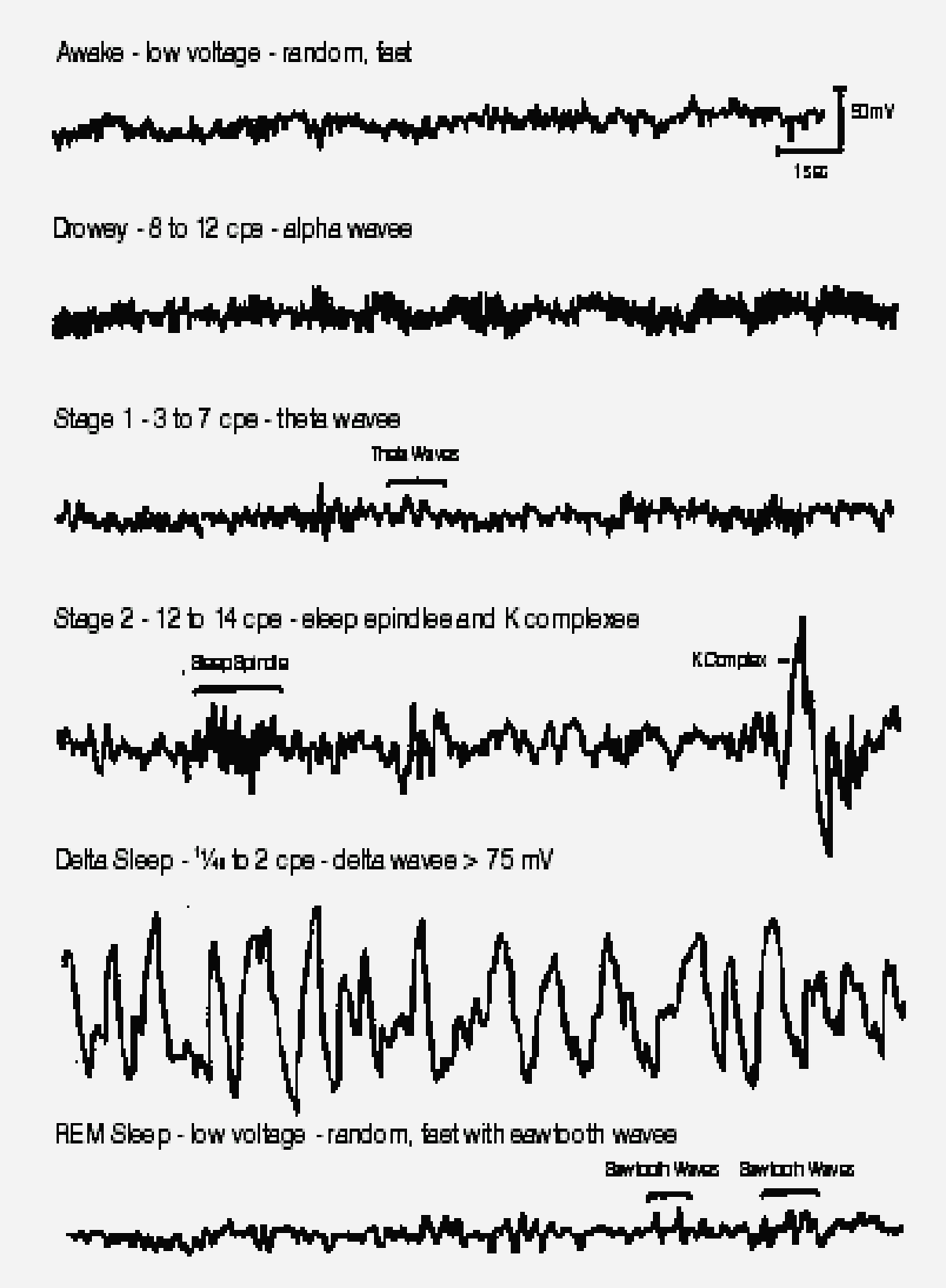
The two types of sleep being referred to here are rapid eye movement or REM sleep and non-rapid eye movement or NREM sleep, these will be discussed next. In the previous section these two components of sleep were discussed in relation to the neurochemical theory of sleep.

Stages of sleep

As we fall asleep, we go through four separate stages of NREM sleep (Patel et al, 2022). Each stage of sleep has its own corresponding EEG patterns, which are used to define the four stages in NREM sleep (also referred to as quiet sleep).

Stage 1 NREM

Stage 1 sleep is when we are falling asleep, and this usually takes fifteen minutes in healthy adults (Patel et al., 2022). Recordings show brain wave frequency slows down from the alpha waves of relaxation to even slower and more irregular theta waves (see figure 2.1). Once these patterns shown in figure 2.1 synchronise, a regular pattern emerges. The parasympathetic nervous system governs this stage; that is heart rate slows down and muscles relax. We may not be aware that we are falling asleep, and this state is very similar to deep meditation and relaxation. During this stage arousal occurs easily and full consciousness can occur quite easily (Patel et al, 2022). This first relaxed stage of sleep is also known as the hypnogogic state and hallucinatory images occurring here are linked to creativity.



cps – cycles per second. From: www.rtmagazine.com/issues/articles accessed 22nd June 2009.

Figure 2.1
Examples of waveforms that differentiate sleep stages.

Stage 2 NREM

This stage lasts for twenty minutes in typical adults; the brain waves get slower and larger with intermittent bursts of electrical activity observed through EEG recordings called sleep spindles, electrical activity (little is understood in terms of its purpose or function), k-complexes, these are tiny burst of activity which is usually associated with external stimuli which do not awaken us (environmental stimuli). Physiological changes such as a decrease in heart rate, blood pressure and body temperature continue to decrease, and quieter sound no longer disturb sleep.

Stage 3 NREM

There is a further decrease in heart and breathing rate and brain waves slow further, and now occur as delta waves. It is usually very difficult to be roused from this stage, like stage 2 sleep this stage lasts for only a few minutes.

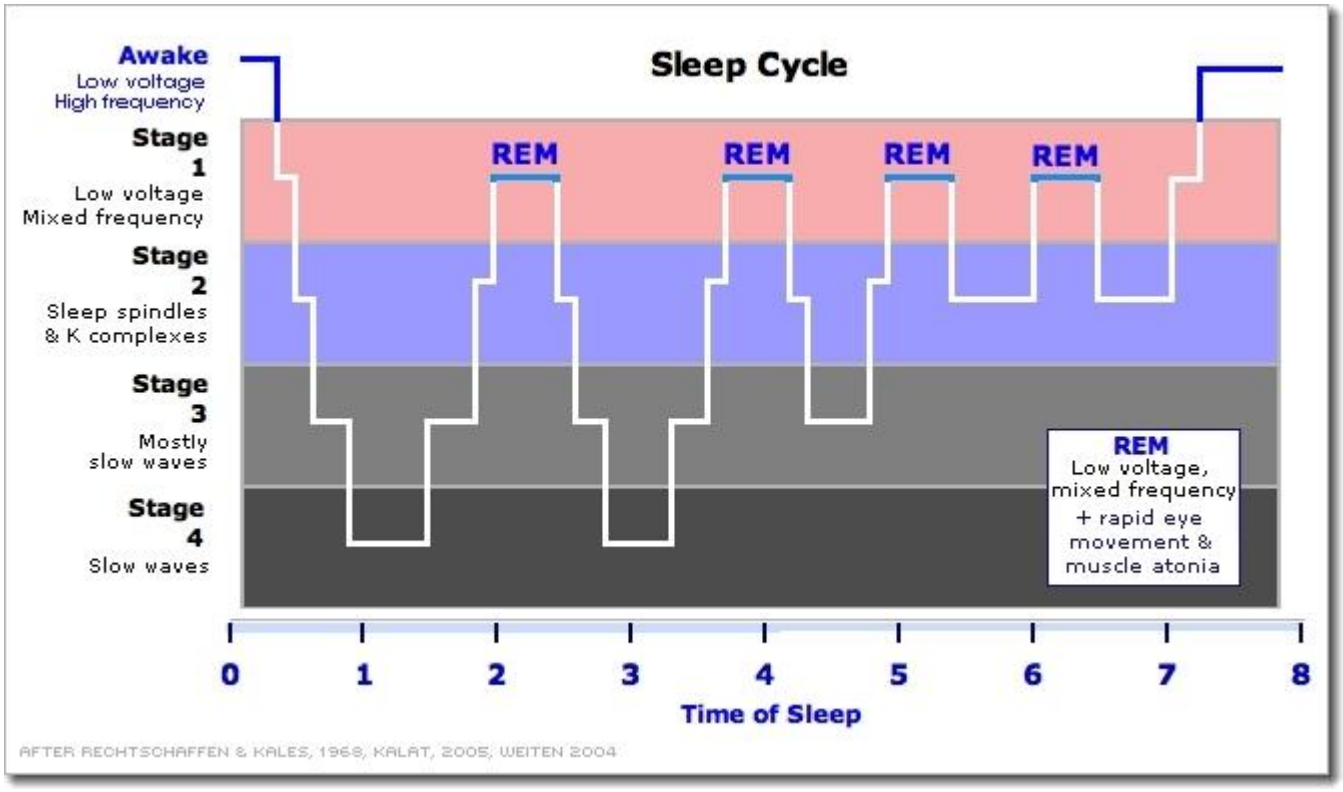
Stage 4 NREM

This stage is characteristic of the deepest sleep. Metabolic rate is at its lowest and it is very difficult to wake from this state – usually, only a significant noise can rouse the person from this stage, such as a baby crying. Brain waves are usually slow. This stage lasts for thirty to forty minutes and is the bottom of the 'sleep staircase' (Bentley, 1999). Although this stage is the deepest stage of quiet sleep, this is the stage at which sleepwalking is likely to occur and is not associated with dreaming (Jacobson and Kales, 1967). Sleep-talking also occurs in deep NREM sleep, although this can also happen but less often during REM sleep (Arkin 1970).

REM sleep

After half an hour into Stage 4 sleep, the EEG trace speeds up the 'sleep staircase' through Stages 3 and 2, thus showing the brain to be more active (Memar et al, 2018). The once-synchronised brain waves become desynchronised and more complex as well as faster; the brain's oxygen and glucose demand also increase. The eyes will also start to move rapidly under the closed eyelids, this state is known as REM sleep and the person is most difficult to rouse. Cerebral activity is high, but physical activity is low; the body will appear almost paralysed. The heart and lungs will match the brain activity even though the body is inactive. REM sleep lasts for about ten to fifteen minutes and this completes the first sleep cycle of the night.

Once REM sleep has elapsed, we then go down through Stages 2 to 4 again and this cycle repeats about every ninety minutes throughout the night, as the night progresses sleep in Stages 3 and 4 lessens until only Stage 1 and 2 of NREM plus REM sleep are returned to by the end of the night (see figure 2.2). This ninety-minute cycle is the ultradian rhythm of sleep. Recalling dreams often depends on which stage we were awoken from.



From: http://somnience.com/images/sleep_cycle.jpg accessed November 28 2022

Figure 2.2
The progression of sleep stages across a single night sleep in a normal adult.

Other terms for REM sleep

Dement and Kleitman (1957) made observations and noted that REM sleep is associated with high levels of brain activity, yet the body remains in a paralysed state. Dement and Kleitman coined the term 'paradoxical sleep' to describe this apparent contradiction. Modern researchers would prefer REM sleep to be renamed as Stage 5 sleep (Bentley, 1999). Table 2.2 shows the different terms that are used to describe REM and NREM sleep.

Table 2.2
Terms Synonymous with REM and NREM Sleep

REM	NREM
Dreaming	Nondreaming
Paradoxical	Orthodox
Fast	Slow
Active	Quiet
D-Sleep	S-sleep
Desynchronised	Synchronised

From: Anch et al (1988) Sleep: A Scientific Perspective, Prentice Hall, Englewood Cliffs, New Jersey.

Meddis (1979) referred to NREM sleep as quiet sleep and REM sleep as active sleep. These terms are coined due to the brain activity shown by the EEG traces. Meddis further subdivided quiet sleep into light quiet sleep (LQS) with synchronised slow patterns of EEG traces and deep quiet sleep (DQS) which is representative of larger, regular wave-like EEG traces. Stage 2 sleep would be seen as light quiet sleep and Stage 4 would be seen as deep quiet sleep. Stage 1 and REM sleep would be seen as Active sleep (AS). Table 2.3 displays the difference in physiological characteristic of NREM and REM sleep in humans.

Table 2.3
Differences in Physiological Characteristics of NREM & REM in Human Sleep using different measures

Measurement	NREM sleep	REM sleep
Scalp EEG*	Slow waves and spindles	Low voltage, mixed frequency
Hippocampal EEG	Variable	Rhythmic theta activities
Eye movements	None or few slow movements	Conjugate rapid movements
Chin electromyography (EMG)*	Decreased from wakefulness	Almost there
Body movements	A few gross movements	Twitches
Respiration	Regular, deep	Variable, shallow
Heart rate	Regular, slow	Variable, rapid
Blood pressure	Below waking level	Variable
Penile erection	Normally absent	Normally present
Mentation	Thought-like, repetitive	Dream-like dramatic
Galvanic skin response	Frequent	Rare

From: Freemon, (1972) Sleep Research: a critical review. Springfield.

2.1.3 Summary

Three of the main theories which propose an explanation for why we sleep have been described in this chapter; sleep as restoration, sleep as an evolutionary behaviour, and an extension of the restoration theory which is the neurochemical model of sleep.

The restoration theory proposed by Oswald suggests that both REM and NREM sleep restore and replenishes our brains and bodies. During sleep neurochemicals are resynthesised and the growth hormone is secreted. There is evidence for and against this theory. Non-human animal studies show mixed support for this theory.

The evolutionary/ecological theory suggests that sleep is a time of inaction so that prey can be safe from predators. Sleep in babies can be explained using the evolutionary theory. There are however observations which do not fit this model, Horne (1988) however did overcome this criticism by hypothesising that sleep performs different functions in different species.

The last theory described in this chapter, the neurochemical theory states that sleep has a specialised restorative function in the brain. It has been suggested that REM sleep is associated with a noradrenaline pathway and replenishes noradrenaline levels in the brain. NREM sleep is associated with serotonin levels and might require a critical level of serotonin to be switched on.

Finally, Hobson (1995) proposes a three-tier analysis of sleep which ties together the models described in this chapter.
In summary, sleep is not seen as just one phenomenon but usually several. Sleep can be divided into two main types, this being REM where we are known to dream and NREM sleep where the eyes are fairly still, and we hardly dream. NREM sleep consists of four stages, each stage is characteristic of its own electroencephalogram (EEG) pattern.

Research has shown that detrimental effects occur when various species are denied of sleep. These effects vary from being minor, short-term perceptual problems to major and lasting personality changes. However, little is known into exactly how much of these are specifically caused by total sleep deprivation or REM deprivation. It is also impossible to generalise

findings from various studies due to the nature of the methodology employed by researchers and the conditions in which observations are made.

Different concept has been proposed to explain and bridge the gap between theory and sleep deprivation studies in sleep, Horne has proposed core and optional sleep.

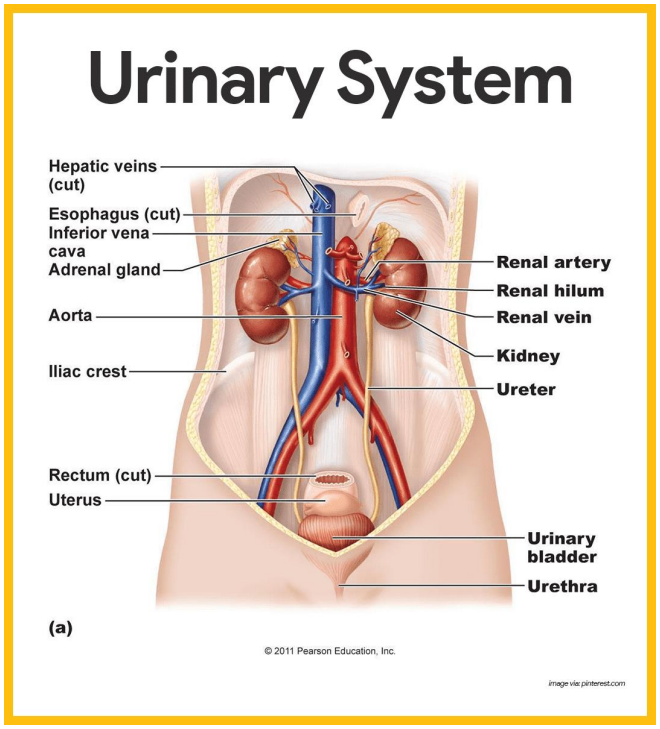
2.2 The renal system

Overview

This section begins by describing the overall structure and function of the renal system, followed by how the renal system is organised. This chapter will introduce the basic structure and development of the kidneys and urinary tract and discuss the common problem of urinary tract infection.

2.2.1 Overall structure and function

The kidneys are highly specialised organs that function to regulate the volume and chemical composition of the body fluids (National Kidney Foundation, 2024). This function allows the excretion of most water-soluble waste products in the urine. Once the urine is formed it is collected and stored in the bladder. The bladder then empties intermittently during the process known as micturition. When normal processes of embryological development are disturbed, defects can develop in the structure of the urinary tract which can in turn interfere with the normal production and flow of urine. Therefore, urinary tract infection may occur, and may be the initial clue that a structural abnormality of the urinary tract exists.



https://nurseslabs.com/wp-content/uploads/2017/04/Urinary-System-Urinary-System-Anatomy-and-Physiology.png.webp

Figure 2.3

Normal anatomy of the urinary tract

The urinary tract is made up of the kidneys, ureters, bladder, and urethra (Fig. 2.3). The kidneys are normally considered to be the upper urinary tract, whereas the remaining structures are the lower urinary tract. There are normally two kidneys, each placed retroperitoneally in the posterior abdominal wall on either side of the spine at the level of the upper lumbar vertebrae. Each kidney is 10-14 cm in length in adults and is surrounded by a fibrous capsule within perirenal fat. The renal hilus on the concave medial aspect of the kidney is the point of entry for the arteries, veins, and nerves, and exit for the urine drainage system. The urine formed by the kidney initially drains into the renal pelvis, which may be considered as the dilated portion of the ureter which links the kidney to the bladder. The ureters run the length of the ureter into the bladder. The ureters run medially and insert into the posterior base of the bladder, with the terminal end of the ureter tunnelled submucosally to form the vesicoureteric junction. The normal intrinsic musculature of the bladder surrounding the oblique course of the intravesical segment of the ureter is thought to be responsible for ureteric competence during bladder emptying, thus preventing the reflux of urine from the bladder back into the ureter.

The bladder itself is an elastic organ consisting of connective tissue and smooth muscle, known as detrusor, which is loosely arranged in outer longitudinal, middle circular and inner longitudinal layers. This muscle arrangement results in the bladders ability to empty during contraction. The dome of the bladder is covered by parietal peritoneum and is in apposition to other organs in the pelvis. The proximal urethra lies between the bladder neck and the pelvic diaphragm, and functionally consists of two sphincter mechanisms composed of both smooth and striated muscle. In Women, the pelvic diaphragm is responsible for most of the sphincter mechanism. Thus, the kidneys are bilateral and paired, whereas the bladder and urethra are centrally placed and form a single structure.

2.3 Nocturia

This section begins by providing a historical account of nocturia with definitions of what nocturia is in clinical terms, it then goes onto introduce the disease clinically and explore some of the epidemiological and risk factors which are associated with nocturia. It then describes the pathology of nocturia and how to recognise nocturia symptoms clinically and nocturia is clinically assessed. It then explores other factors which contribute towards the prevalence of nocturia and how nocturia is perceived across the lifespan.

2.3.1 Historical background and introduction

In 2002 an article by Van Kerrebroeck et al (2002) wrote that nocturia is a condition that has only recently began to be recognised as a clinical entity rather than a symptom of some other disorder, as well as being classed as some other lower urinary tract disorder. A variety of studies which have attempted to both define and investigate nocturia have varied in their descriptions, and these discrepancies have been highlighted in the literature (Robertson, 2000; Blise & Blaivas, 2000; van Kerrebroeck & Weiss, 1999). Regardless of the definition that is selected, studies which have investigated prevalence show that nocturia is a very common condition, particularly affecting older age groups (Chute, 1993; Malmsten, 1997; Swithinbank, 1998). Clinical interest in nocturia is growing, as highlighted by an increase in large epidemiological studies and analyses (Bosch et al, 2010; Coyne et al, 2009; Kupelian et al, 2012; Lightner et al, 2012; van Doorn et al, 2012), and through the Nocturia Think Tank initiative (Weiss et al, 2011) and through the work of the Consensus Statement from the Interdisciplinary Conference on Nocturia (Weiss et al, 2011).

In 2002 the International Continence Society (ICS) defined nocturia as the complaint that the individual has to wake at night one or more time(s) to void; each void is preceded and followed by sleep (Van Kerrebroeck et al (2002). Since the development and dissemination of the ICS definition, our understanding of what nocturia is, along with its characteristics and negative consequences, has evolved. This knowledge and understanding of voiding during sleep, and the impact that this has on an individual's health and wellbeing, has prompted a revision of the definition. The ICS changed the definition so that nocturia was seen as a complaint which suggested that the condition is bothersome rather than clinically important. Interestingly, one of the key factors in which a patient would consult a doctor is due to bothersome, the use of the word disorder rather than the word complaint highlights the importance and seriousness of nocturia in relation to a patient's health and wellbeing (Kerrebroeck and Andersson, 2014). Nocturia is often a disorder that can be caused by many possible serious underlying pathophysiologies.

Further, inclusion of the word *night* in the definition does exclude a large number of the population by increasing diagnostic specificity. A holistic definition would include the use of the words *sleep time* thus indicating an impact of the patients sleep at night. However, greater scientific interest lies within whether the time of sleep affects the risk of nocturia. A way in

which this could be examined is by comparing a proportion of shift workers with the general population to provide further understanding of the role of disrupted circadian rhythms in the aetiology of nocturia. Sleep deprivation is said to be associated with diuresis and natriuresis (Kamperis et al, 2010), but whether disrupted sleep patterns have an impact on diuresis remains uncertain (Kerrebroeck and Andersson, 2014).

A further important factor to consider in defining nocturia is the number of voids during the sleep period. Both Tikkinen et al (2010) and Yu et al (2006) highlight the fact that more than two nocturnal voids is considered a clinically meaningful threshold associated with significant negative outcomes for health and well-being. Another important factor to note is the timing of awakenings which has a significant bearing on the negative consequences of nocturia. Stanley (2005) has shown that awakenings during the first three to four hours of sleep which is considered to be deep sleep has greater negative impact on sleep quality, and therefore on health and well-being than awakening during periods of REM sleep.

Research by Kupelain et al (2012), Lightner et al, (2012) and Parthasarathy et al (2012) has shown an association between nocturia and morbidity. However, further research is required to understand whether nocturia is an indicator of another underlying disorder such as sleep apnoea[2] and diabetes, or if nocturia can bring about subsequent illnesses. Despite the fact that these associations with serious morbidities and growing recognition of the deleterious effects of nocturia on health and quality of life, nocturia remains an underreported, understudied, and very infrequently recognised problem in adults (Chen et al, 2017).

The essential feature of the definition is that it relates to the period of sleep to precede the episode and specifically excludes 'convenience' voids and these are voiding once awoken for other reasons. Lane (2016) goes onto say that there is often an implied assumption that there should be a return to sleep after the void – but the intention to return to sleep (whether achieved or not) would appear to be the salient feature (van Kerrebroeck et al, 2002).

[2] Obstructive sleep apnoea (OSA) is a relatively common condition where the walls of the throat relax and narrow during sleep, interrupting normal breathing. This may lead to regularly interrupted sleep, which can have a big impact on quality of life and increases the risk of developing certain conditions.

2.3.2 Epidemiology and risk factors

Several studies have to a greater or lesser extent reported the prevalence of nocturia. Most studies have relied on the use of questionnaires as study designs, and a plethora of data relating to both frequency, severity and bothersomeness of nocturia has been collected, despite the invariable bias of recall. As a result of the latter factor, a move towards using frequency diaries whereby volume is collected is more commonplace. The most well-known of these studies is the Finnish National Nocturia and Overactive Bladder (FINNO) study (Tikkenen et al, 2010). The study used frequency-volume charts (see figure 2.4) to assess both the frequency and the volumes of voided urine in a community setting across both men and women from the ages of 18 to 79. The findings indicated that nocturnal voiding frequency had a strong relationship with age, clinical benign prostatic hyperplasia (BPH), the use of diuretics and nocturnal polyuria[3].

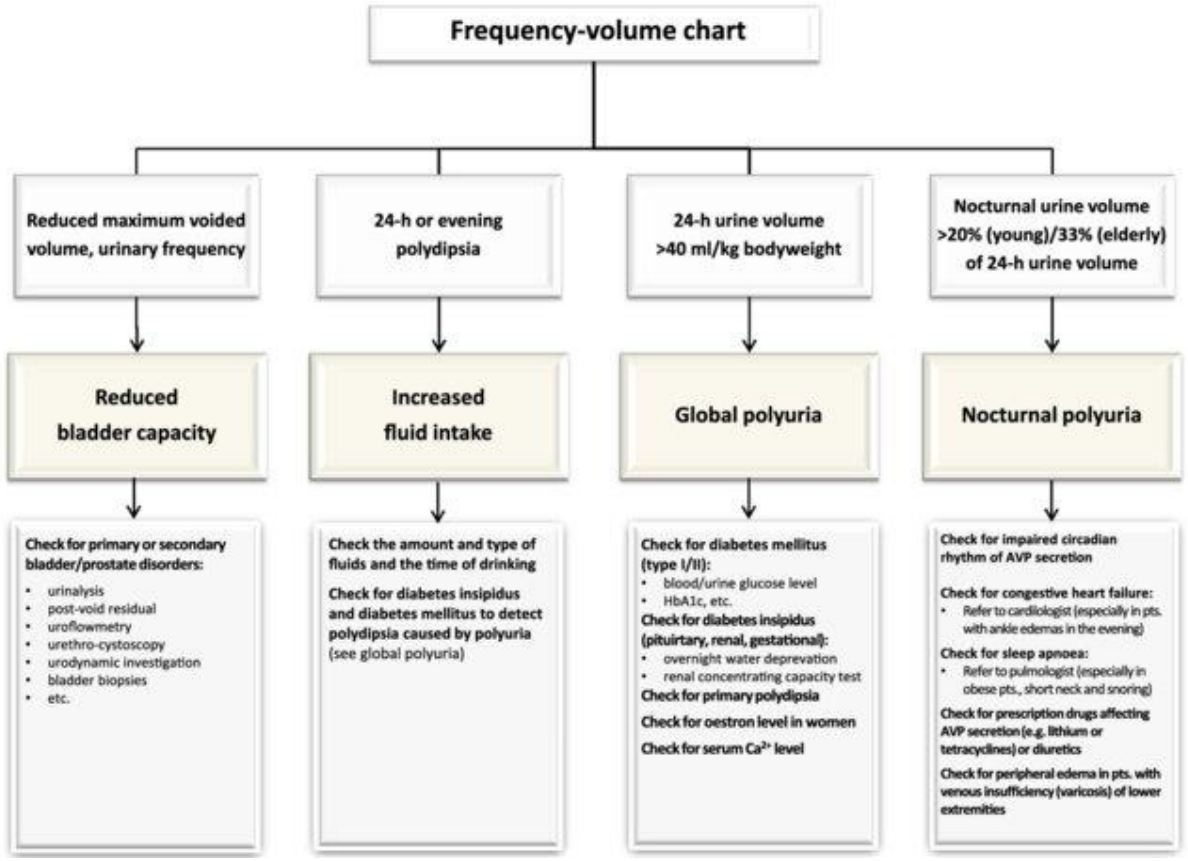


Figure obtained from Marschall-Kehreal, D accessed 2024)

Figure 2.4

Relevant information of frequency-volume charts (first line) which allows gross classification of the causes of nocturia (second line). Special investigations have to clarify the exact underlying pathophysiology of nocturia (third line)

[3] The total amount of urine production at night is greater than one-third of all urine produced in a 24-hour period.

The findings from the study revealed that between the ages of 50 and 59 years, approximately 11% of men and 15% of women voided at least twice per night, in those between 60 and 69 years 37% of men and 22% of women voided twice per night and in the 70 to 79 age group, 44% of men and 34% of women had similar symptoms, with a mean nocturnal urine production of 60 mL/hr. The authors were able to confirm that urine production exceeding 90mL/hr was considered to be abnormal. Furthermore, overall nocturia was just as common in men as women[4] but a more age specific analysis indicated that nocturia was more common in young women than in young men, whilst in the older age groups, prevalence was higher in men than women. The findings also revealed that parity was reached by the sixth or seventh decade, and the prevalence of nocturia increased at a steady rate with mean increases at 7.3% for men and 3.5% for women per year. The data reveals that there is a greater prevalence of nocturia among younger women, there is a higher rate of increase in nocturia among men but there does appear to be an equalisation of prevalence by middle age (Tikkenen et al, 2010).

Lane (2022) explains that although the prevalence of nocturia is now better understood, the case of incidence is less clearly understood or appreciated. There is a scarceness of such reports and partly the issue lies with the design of such studies. To understand the rate of incidence would mean repeated longitudinal assessments of a study group over time which are affected by the reversibility of the condition and sampling issues (Lane, 2022). Nevertheless, there exists some evidence which suggests that the incidence of nocturia ranges between 61 cases[5] in a younger cohort of patients (50's) and 93 cases per thousand in the older cohort of patients (60-70 years).

2.3.3 Pathology

The pathophysiology underlying the findings of the frequency volume chart (FVC) can be grouped into five main categories: global polyuria, nocturnal polyuria, reduced bladder capacity, sleep disorders, and circadian clock disorders (Cornu et al, 2012). These are discussed briefly here.

[4] One out of eight men and women reporting two episodes of nocturia a night.
[5] Per thousand patient years

Global polyuria may result from several different pathophysiologies. Polyuria due to polydipsia may simply be behavioural, however, high fluid intake may be secondary to dehydration due to poorly controlled diabetes mellitus (Gulur et al, 2011).

Nocturnal polyuria – the aetiology of nocturnal polyuria may be associated with water diuresis or solute diuresis with accompanying water. Numerous underlying factors may contribute to over production of urine at night and several of these factors may be present in a single patient. Often the causes of water diuresis include behavioural choices such as excessive intake of fluids (especially diuretic fluids such as caffeine and alcohol) in the evenings or lifestyle factors, further a circadian defect in the secretion of vasopressin; and a defect in vasopressin action may also be a cause. Alternatively, the cause can also be idiopathic in nature. Causes of solute diuresis include congestive heart failure, sleep apnoea[6], and renal insufficiency (van Kerrebroeck et al, 2002).

Reduced bladder capacity is often caused due to bladder storage problems due to a number of issues[7] (van Kerrebroeck et al, 2002 and Cornu et al, 2012).

Sleep disorders – often in addition to sleep apnoea, primary sleep disorders such as insomnia, restless leg syndrome, narcolepsy, and arousal disorders (e.g., sleepwalking and nightmares) can cause nocturia (Cornu et al, 2012). When patients have normal range FVC assessments then the sleep should be investigated further as a cause for nocturia. Secondary sleep disorders associated with nocturia maybe due to conditions such as cardiac failure, chronic obstructive pulmonary disease (COPD), endocrine disorders, and neurological disorders such as Parkinson disease, dementia, and epilepsy (Cornu et al, 2012). Other conditions that may result in disturbed sleep and associated nocturia are psychiatric conditions such as depression, anxiety, chronic pain disorders, alcohol or drug use consumption or withdrawal), along with various medications (cortico-steroids, beta-blockers, thyroid hormones, psychotropics, antiepileptics (Cornu et al, 2012). Research by Kupelian et al (2012) and Ancoli-Israel et al (2011) has shown that sleep disorders have been associated with nocturia, however it is not clear whether nocturnal urinary frequency is just a result of wakefulness. However,

[6] Obstructive sleep apnoea (OSA) is a causal factor and is often overlooked.
[7] Benign prostatic hyperplasia (BPH) and or overactive bladder syndrome (OAB).

sleep deprivation induces diuresis and sodium output (Kamperis et al, 2010). Van Kerrebroeck & Andersson (2014) encourage further research focussing on understanding the association and relationship between nocturia and sleep.

Circadian clock disorders – the circadian rhythms in fluid intake, urine production and storage are diurnal in humans and nocturnal in rodents, the underlying mechanisms are largely unknown. Research by Witjes et al (1997) has shown circadian variability in urinary flow values in men with bladder obstruction, the findings showed higher peak urinary flow with a smaller voided volume and thus shorter flow time in the early afternoon when compared with the late-evening, early morning, and midnight-to-morning periods. It is well known (van Kerrebroeck & Andersson, 2014) that there is a mismatch between urine production and storage in nocturia, particularly in elderly people and in children with nocturnal enuresis. Van Kerrebroeck & Andersson (2014) encourage further attention in understanding the role of the circadian clock in the pathophysiology of nocturia.

2.3.4 Recognising nocturia symptoms

Nocturia has been described as the 'Cinderella' of lower urinary tract symptoms (Lane, 2022). Nocturia is often disregarded and unacknowledged symptom complex, it is also often dismissed as a non-specific 'storage' symptom which opposes the significant impact on the overall health and wellbeing of an individual. However, in recent years, both its aetiology and management have been addressed in greater detail (Weiss et al, 2019a).

2.3.5 Clinically assessing nocturia

A thorough assessment is essential to determine the aetiology of a patient's nocturia. In addition to a thorough history, key quantitative data including number and times of voids, void volume, and fluid intake can be obtained from the frequency volume charts (FVC). The FVC is an effective tool to guide diagnosis and appropriate treatment of nocturia (van Kerrebroeck, 2010). The FVC can be structured so that it includes time of going to bed and time of rising.

Nocturia was originally observed and seen as a lower urinary tract symptom (LUTS) which indicates an overactive bladder (OAB) or benign prostatic obstruction (BPO). Recently, there has been growing indication that nocturia is a specific symptom with wide-ranging

pathophysiology[8]. During a 2017 meeting of the International Consultation on Incontinence-Research Society (ICI-RS) in Bristol, a nocturia think-tank discussed how to study the gaps in our knowledge to develop a practical patient orientated diagnostic and therapeutic algorithm for nocturia (Everaert et al, 2017). The think-tank revealed that the many and varied causes of the condition are underdiagnosed and that many clinicians of differing disciplines who saw patients with nocturia paid little to no attention to diagnosing and treating their excessive nocturnal voiding.

The guidelines for nocturia have historically been hidden within the broader LUTS guidelines and have been linked to OAB and BPO, despite the main cause being nocturnal polyuria (NP) (Weiss et al, 2011) and Oelke et al (2016) has reported that there can be a one-year delay between the onset of LUTS symptoms and the consultation of a medical professional. Furthermore, patients who display symptoms of nocturia are often treated by a range of healthcare providers because nocturia is prevalent in many other conditions, these being, cardiovascular, diabetes, and OAB and often the condition is ignored by most specialities and only rarely improves with treatment of other underlying conditions. Differing medical disciplines often use their own clinical guidelines and recommendations based on clinical evidence made available from prior research, and then diagnostic and therapeutic 'packages' are developed for each discipline which helps to formulate an approach to take care of nocturia clinically (Everaert et al, 2019).

There is no one treatment which can effectively treat nocturia in all contexts. Nevertheless, desmopressin[9] is the only evidence-based pharmaceutical therapy for nocturia, (Sakalis et al, 2017), however, the drug is limited in its use clinically (Oelke et al, 2016 and Callréus, 2007).

Callréus (2007) explains how patients with nocturia often have to face many hurdles prior to being diagnosed and treated with desmopressin, instead of OAB/BPO medication. Often the reasons for the reluctance to treat are often aligned to limited knowledge of side effects, anxiety

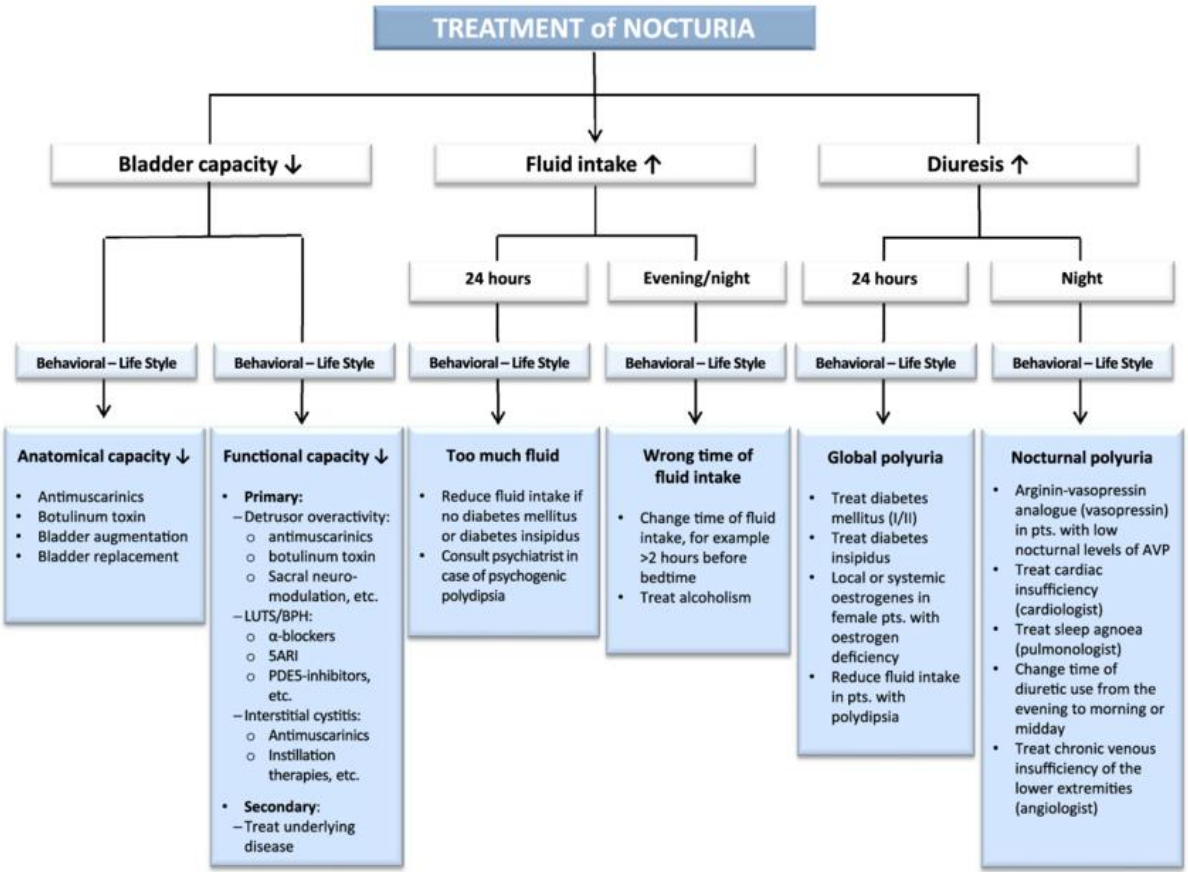
[8] This includes blood pressure changes, cardiac dysfunction, fluid shift into the lower limbs, polyuria, sleep apnoea, insomnia, pharmacotherapy, and polypharmacy.

[9] Desmopressin is used to control the symptoms of a certain type of diabetes insipidus ('water diabetes'; condition in which the body produces an abnormally large amount of urine). Desmopressin is also used to control excessive thirst and the passage of an abnormally large amount of urine that may occur after a head injury or after certain types of surgery. Desmopressin is also used to control bed-wetting. Desmopressin is in a class of medications called hormones. It works by replacing vasopressin, a hormone that is normally produced in the body to help balance the amount of water and salt.

around the safety of the drug and how to use it despite evidence available to show that hyponatremia[10] is extremely rare, even in older patients (Juul et al, 2017 and Kaminetsky et al, 2018).

The real-life diagnostic and therapeutic pathways for nocturia patients, based on underlying causes of nocturia (Callréus, 2007) are summarised in Figure 2.4

[10] Occurs when the sodium (Na) levels in blood are lower than normal.



Management algorithm for patients with nocturia/nocturnal polyuria (adapted from Oelke et al, 2017)

Figure 2.4

Treatment path of nocturia based on the underlying pathophysiology. Note that a patient may need more than one treatment of nocturia.

Several urological and non-urological causes of nocturia exist in some instances, nocturia can be due to a single aetiology, but often it is multifactorial. Clinicians can consider global over production of urine, isolated over production of nocturnal polyuria, decreased functional bladder capacity, and primary sleep disturbances (van Kerrebroeck et al, 2002 and Bosch & Weiss, 2013).

Sleep is that golden chain that ties health and our bodies together.

Thomas Dekker

2.4 Sleep and Health

While the insight that sleep and health are intricately linked has been well established by science for decades, further research to unravel the underlying mechanisms and unlocking the cause from effect had almost stalled. The problems are numerous (Hunter, 2021), starting with again defining poor sleep, measuring sleep without relying on self-reports to understanding if it is the lack of sleep or one of the many other factors that influence health and disease.

Despite the connection between sleep and health being recognised for centuries, it is only recently that both the treatment and study of sleep disorders has developed as a scientific discipline and medical speciality (Shepard, Buysse and Chesson, 2005). Sleep disorders may be associated with several serious health consequences, including heart disease, stroke, diabetes, cognitive dysfunction and depression as highlighted in a special issue of the Australian Journal of General practice (AJGP, 2019; Duns, 2019). Two of the most common sleep disorders that primary care physicians tend to see are those patients presenting with obstructive sleep apnoea (OSA), with a prevalence of up to 38% (Hamilton and Chai-Coetzer, 2019), and the second being insomnia, which is described as another common sleep disorder in the general population (Grima, Bei and Mansfield, 2019).

One method of trying to monitor if the state of sleep health is improving is through the monitoring work of the national Sleep Foundation. The *sleep in America* poll, quarterly *Sleep Health Index* (SHI) and other studies are a few ways in which progress can be measured. It is of no surprise then to know that science has been looking at how sleep heals or vice versa, and how the lack of sleep contributes to disease and illness (Archer et al, 2014). Extensive research has highlighted that night shift workers with irregular sleep patterns, jet lag, or lifestyles that result in mistiming of sleep which can disrupt the human transcriptome through alternation of circadian rhythms (Archer et al, 2014), which mediates many of the negative health impacts of sustained sleep disruption (Hunter, 2021).

Work by Zielinski and Krueger (2011) supports the notion that a wide range of literature indicates that enhanced waking activity occurring during prolonged wakefulness modulates the immune system. In fact, the sleep status of an animal can affect the ability of an animal to respond to infection and wound healing. Furthermore, impaired sleep is evident in diseases that involve enhanced inflammation, including cancer and type 2 diabetes (Zielinski et al, 2016). At the turn of the 20th century, pioneering work by Ishimori (1909) and Legendre and Pieron (1913) contributed greatly to improving understanding of how humoral factors regulate sleep.

The independent work of both researchers discovered that dogs injected with cerebral spinal fluid from sleep-deprived dogs exhibited enhanced sleep amounts. Their findings led to a search for a single molecule regulating sleep that was termed sleep promoting factor S. It was the work of Pappenheimer, Krueger, and colleagues who identified factor S in the brain and urine of rabbits and cats as muramyl peptide – a peptidoglycan component of bacteria (Pappenheimer et al, 1975; Krueger et al, 1982). This led to discovering and identifying numerous humoral factors including cytokines and hormones, which are activated by waking activity and pathogens, regulating sleep. These sleep-promoting humoral factors are activated, in part, through their respective pattern recognition receptors, thereby providing a link between the immune system and sleep regulation. Cytokines are proteins, glycoproteins, or peptide cell signalling molecules that are found throughout the central nervous system (CNS) and periphery that function in autocrine, paracrine, or endocrine fashion (Zielinski and Krueger, 2011). Cytokines play a role in the regulation of cognition, performance, appetite, pain, fatigue, sleepiness, sleep and vasohemodynamics. Cytokine dysregulation occurs in much pathology that involve sleep disturbances, including type 2 diabetes (Zeyda and Stulnig, 2009), cardiovascular disease (Woollard and Greissmann, 2010), and cancer (Fantini and Pallone, 2008). Cytokine dysregulation is implicated in most sleep-related pathologies including sleep apnoea and insomnia (Kapsimalis et al, 2008 and Varvarigou et al, 2011).

The notion of sleep as a period of physical restoration has been explained theoretically by numerous authors (Assefa et al, 2015). However, despite this concept of sleep being a time for growth and repair for the body, much remains unknown (Assefa et al, 2015). A relatively recent concept of why we sleep has been proposed by Schmidt (2014). Schmidt proposes that the Energy Allocation Model of Sleep which is based on the need to optimally allocate limited energy resources to essential biological processes. According to this theory, the sleep-wake cycle evolved to perform unique and essential biological processes during sleep to decrease the energy requirements of wakefulness and reduce total daily energy expenditure. Furthermore, sleep as a restorative process has been shown through which hormones are secreted whilst an individual sleeps.

A major argument in favour of the restorative theory to sleep is the observation that hormones released during sleep have predominant anabolic function, such as growth hormone, as opposed to hormones associated with wakefulness, which tend to have a catabolic effect, such as cortisol, which is suppressed during sleep, (Weitzman et al, 1974), with the amplitude of the circadian cortisol decline dampened by sleep restriction (Guyon et al, 2014). Growth hormone

pulses usually occur during slow wave sleep (SWS) and generally occur shortly after sleep onset in the first phase of SWS (Van Cauter and Plat, 1996), during sleep deprivation, these growth hormone pulses markedly diminish (Van Cauter et al, 1991). High levels of prolactin are noted during sleep (Spiegel et al, 1995) and the release of testosterone increases in males during sleep (Luboshitzky et al, 1999).

Sleep is thought to be necessary to conserve energy, with lower levels of energy expenditure noted during sleep, and sleep deprivation associated with increases in total daily energy expenditure. The lower metabolic rate of sleep may allow biological processes occurring during sleep to be completed at a overall energy cost compared to wake time (Assefa et al, 2015). However, the effects of sleep restriction on energy expenditure are not completely understood. Most studies suggest that short sleep duration is a risk factor for weight gain and the development of obesity (Klingenberg et al, 2012). Based on the review by Klingenberg et al although increased energy intake is the most prevailing explanation, short sleep duration does not seem to significantly affect total daily energy expenditure. Although there is limited evidence, other factors that could influence energy metabolism include up-regulation of thyroid hormones and glucocorticoids (Klingenberg et al, 2017). Multiple additional factors do also play a key role, as sleep deprivation alters appetite regulation and is associated with increased hunger, appetite, and food intake (Spiegel et al, 2004).

The role that sleep plays in immune functioning is not well understood, but recent studies have alluded to the fact that sleep is an adjuvant to enhance the early stage of the immune response (Lange et al, 2011). In a study by Lange et al (2011), 27 healthy men who either slept or stayed awake after a hepatitis A virus vaccination inoculations had their immune response compared. Those who slept doubled the frequency of antigen (AG)-specific T helper (Th) cells, increased the fraction of Th cytokine producing cells and increased Ag-specific Immunoglobulin G1 (IgG1). These effects were associated with high sleep slow-wave activity (SWA) during the post vaccination night. Other areas of the immune system, inflammation and the genes that mediate these responses may also be affected by sleep deprivation. Sleep loss affects the cellular and genomic mechanisms that contribute to inflammatory cytokine activity. After one night of sleep loss, monocyte production of interleukin 6 and tumour necrosis factor alpha in 30 healthy adults was greater than following uninterrupted sleep (Irwin et al, 2006).

Epidemiological studies have found that both long and short sleep duration are associated with increased risks of all-cause mortality (Cappuccio et al, 2010, 2011; Castro-Costa et al, 2011;

Gallicchio and Kalesan 2009; Lyytikainen et al., 2011; Magee et al., 2012). Tamakoshi and Ohno (2004) report that sleep duration shorter or longer than 7 hours is associated with a significantly elevated risk of all-cause mortality, with sleep duration of 7 hours being optimal and associated with the lowest mortality. Rod et al (2014) followed 9,098 healthy men and women over a 22-year period and explored the potential combined effect of both disturbed sleep and the quality of sleep on cause-specific mortality. In men, short sleep and disturbed sleep were not independently associated with cardiovascular disease mortality, but there was an indication of higher risk among men who experienced both. In women, short sleep and disturbed sleep were independently associated with cardiovascular disease mortality.

There have been multiple negative cardiometabolic health outcomes that have also been associated with reduced sleep time in multiple studies. In an epidemiological study of 30,934 participants from the 2009 Behavioural Risk Factor Surveillance System (BRFSS), sleep duration <5 hours (versus 7 hours) were related to body mass index (BMI), obesity, diabetes, hypertension, hypercholesterolemia, heart attack and stroke (Altman et al, 2012). However, the mechanisms underlying the association between sleep restriction and increased cardiovascular risks are not clear. One potential mechanism may be through activation of inflammatory processes during sleep loss. C-reactive protein (CRP) and other inflammatory markers associated with cardiovascular disease risk increase in healthy adults following sleep restriction (Van Leeuwen et al, 2009). Insufficient sleep is also associated with alterations in hypothalamic-pituitary-adrenal axis (Guyon et al, 2014) and the endocrine and metabolic effects of sleep restriction resemble normal ageing and, thus, may increase the severity of age-related chronic diseases (Spiegel, et al 1999). Sleep deprivation is also associated with increased blood pressure, urinary excretion of norepinephrine and heart rate, which suggest an increase sympathetic nervous system activity (Tochikubo et al, 1996). Furthermore, sleep restriction has been shown to have a negative impact on carbohydrate metabolism and endocrine function, with lower glucose tolerance thyrotropin concentrations, raised evening cortisol concentrations and increased activity of the sympathetic nervous system (Spiegel et al, 1999).

There has been consistent evidence supporting the fact that sleep disturbances such as difficulties falling asleep or maintaining sleep is associated with mental and somatic conditions which are usually characterised by an inflammatory nature such as cardiovascular disease (CVD) (Grandner et al, 2012), inflammatory bowel disease (Ballesio et al., 2021), depressive and anxiety disorders (Hertenstein et al, 2019). In the context of health psychology, a

substantial body of literature showed that positive affect may have a favourable impact on immune and inflammatory response and buffer proinflammatory effects of stress (Pressman and Cohen, 2005).

Although completely understanding the function of sleep in physical restoration remains elusive despite ongoing research, the clear adverse effect of both short term and chronic sleep restriction on function represents at least indirect evidence of the beneficial role of sleep in all of us. Adequate sleep is essential for health. Studies have shown that restricting sleep restriction below a person's individual optimal sleep time can cause a wide range of neurobehavioural deficits, and adverse effects on endocrine functions, metabolic and inflammatory responses (Banks and Dinges, 2007).

There is the importance of gaining good quality sleep in sustaining physical functioning and psychiatric well-being (Lee et al, 2009). Insomnia is a condition of poor quality of sleep or insufficient sleep. Individuals diagnosed with chronic insomnia can be identified by having any of the following symptoms for a prolonged period; 1) difficulty falling asleep, 2) awakening often during the night, 3) having difficulty getting back to sleep, or 4) awakening too early (Neylan, Reynolds and Kupfer, 2003). The prevalence of insomnia can vary from 16 to 21% due to variations in definitions used in research studies, population characteristics, and across various countries (Ohayon, 2002).

Ancoli-Israel and Roth (1999) reported that according to the national survey by the national Sleep Foundation in the US, approximately 9% of adult respondents have symptoms of chronic insomnia or sleep disturbances. Results of the survey in 2004 by Foley et al (2004) revealed that over 50% of older adults aged 55 to 84 years had sleep complaints such as trouble falling asleep or waking up repeatedly during the night. Other studies (Foley et al, 2004; Roth and Ancoli-Israel, 1999; Blackwell et al, 2006) have reported insomnia to be significantly associated with diminished cognitive function including decreased psychomotor function and delayed response time. Furthermore, individuals who suffer from insomnia are at an increased risk for accidents, psychiatric disorders, increased health care utilisation and reduced quality of life (Foley et al, 2004; Foley et al, 1995 and Hatoum et al, 1998).

Recently several studies have identified "sleep disparities" in the US population, with individuals from underrepresented minority groups and socioeconomically disadvantaged backgrounds reporting less sleep duration and/or worse sleep quality (Grandner et al, 2016). The evidence of these disparities in sleep also mirror the disparities observed in other health

conditions, such as hypertension (Knutson et al, 2009) inflammation (Grandner et al, 2013), obesity (Jean-Louis et al, 2015) and diabetes (Zizi et al, 2012).

Given the importance of sleep to general health, understanding what the mechanisms are behind these associations is essential (Grandner et al, 2019). Grandner (2017) goes onto state that the socio-ecological model of sleep health proposes that an individual's sleep experience is the multi-layered product of a complex set of individual-level factors, these being genetics and behaviour which operate within social-level factors such as work, family, and neighbourhood, which Grandner (2017) goes on to say are themselves embedded within societal-level factors, and these being public policy, technology, and 24/7 society. Gardner et al (2016) goes on to state that disparities in sleep, are therefore, likely to reflect the interconnected effects of all these factors. For example, individual levels factors such as poor health and negative health beliefs and/or negative attitudes about sleep are likely to unite with social-level factors such as shift work or increased family caregiving demands – and with societal-level factors such as institutionalised racism -to promote the development of sleep disparities.

An element that is important not just in sleep but in general health and that has remained understudied within sleep is acculturation. Acculturation represents a quantification of the degree to which an individual adopts one cultural identity, or another as exemplified by a set of beliefs, attitudes, and practices. Acculturation has been previously shown to play an important role in health. Lara et al (2005) has evaluated the role acculturation plays in health more so in psychological health. Hale et al (2014) studied acculturation and sleep among a multi-ethnic (Hispanic/Latina, Chinese, Japanese and, non-Hispanic white) sample of women as part of the Study of Women's Health Across the Nation (SWAN) using the Initiative Insomnia Rating Scale (IIRS), the authors found that Women who were US-born Hispanic/Latina, Chinese, and Japanese were more likely to report sleep complaints than their first-generation ethnic counterparts. There are also reported gender differences in acculturation and sleep and one specific study which has focussed on acculturative stress and habitual sleep is Park et al (2019) who studied a group of Korean American Immigrants (KAIs), they specifically focussed on understanding some of the socio-cultural stressors in the acculturation process. Stress is known to cause short sleep (Krittanawong et al., 2017) however little is known about how acculturative stress affects sleep differently in men and women. Park et al found that higher homesickness and lower civic engagement were associated with shorter sleep

in women and higher isolation with shorter sleep was reported in men suggesting gender specific association between acculturative stress and sleep duration.

2.5 Sleep in women

Research by Akerstedt et al (2002) and Lindberg et al (1997) has shown that women report more sleep difficulties and Jaussent et al (2011) and Singareddy et al (2012) report that women are at greater risk for being diagnosed as insomniacs in comparison to men. In the 2007 National Sleep Foundation poll, 30% of pregnant women and 42% of postpartum women reported rarely getting a good night's sleep in comparison with 15% among all women. Furthermore, only 25% of perimenopausal women and 30% of post-menopausal women reported getting a good night's sleep a few nights per month or less (Baker et al, 2009; Ferguson et al, 1995). Generally, there is a higher prevalence for insomnia, restless leg syndrome and dissatisfaction with sleep in women. However, objective measures of sleep such as actigraphy and polysomnography (PSG) do reveal shorter sleep onset latency, increased sleep efficiency and total sleep time in women compared to men (Carrier et al, 2001; Bixler et al, 2009 and Jean-Louis et al, 1999). However, a meta-analysis by Rediehs (1990) of sex-differences of sleep behaviours in older adults (aged 58 plus) revealed no sex differences in total sleep time. Although reports of sleep disturbance and insomnia are usually widespread amongst the general adult population, each tends to occur more frequently in women, especially during times of hormonal fluctuations (Nowakowski et al., 2013). Furthermore, other biopsychosocial factors such as discomfort during pregnancy, breastfeeding, and infant/childcare during postpartum period, and the potential ongoing nocturnal vasomotor symptoms (hot flashes and night sweats) during peri-menopuase and post-menopause, may complicate insomnia treatment and require special treatment considerations for sleep disturbances in women.

2.5.1 Women's sleep across the reproductive lifespan

The menstrual cycle of healthy women is characterised by cyclic changes in the production of oestradiol, progesterone, luteinising hormone, follicle stimulating hormone, prolactin, and growth hormone. Reproductive hormones have a vital role to play not just in reproductive function during the menstrual cycle, but also influence sleep and circadian rhythms. Women most commonly experience negative menstrual symptoms during the last few days of the cycle, as progesterone and oestrogen levels decline (Driver and Baker, 1998). Furthermore, Premenstrual Syndrome (PMS) and Premenstrual Dysphoric Disorder (PMDD) are characterised by emotional, behavioural, and physical symptoms that occur in the premenstrual phase of the menstrual cycle, with resolution at the onset of menses or shortly thereafter. Many women of reproductive age experience some premenstrual symptoms, but 3-8% of women have clinically relevant premenstrual symptoms that they perceive as distressing and that affect daily

function and meet diagnostic criteria (Ferguson et al, 1995, Halbreich et al, 2007 and Halbreich et al, 2007). Furthermore, menstrual cycles are associated with prominent changes in the reproductive hormones that may influence sleep and the differing phases of a women's life cycle are associated with unique features of sleep disruption (Mehta et al., 2015).

Women who report or who have PMS/PMDD typically report sleep-related complaints such as insomnia, frequent awakenings, non-restorative sleep, unpleasant dreams or nightmares, and poor sleep quality associated with their symptoms; and daytime disturbances such as sleepiness, fatigue, decreased alertness, and an inability to concentrate during the premenstrual week and during the first few days of menstruation (Baker et al, 2004; Cohen et al, 2002; Hachul et al, 2010; Lamarche et al, 2007; Smith et al, 2003 and Woosley et al, 2014) and urine leakage (The American College of Obstetricians and Gynaecologists, 2021). Those women who experience severe premenstrual syndrome report a significant decline in sleep quality which is associated with the late luteal phase of their cycle (Lee et al, 2008 and Moline et al, 2004). Nevertheless, these corresponding findings were not found in PSG sleep (Baker et al, 2007 and Baker et al, 2012). Zheng et al (2014) examined actigraphic sleep in participants from the Study of Women's Health Across the Nations (SWAN) and found that women in the later reproductive-age group, sleep efficiency declined across the menstrual cycle with the most pronounced decline in the last week of the menstrual cycle. Sharkey et al (2014) demonstrated that a steeper rate of rise of progesterone levels from the follicular phase through mid-luteal phase was associated with greater PSG wake after sleep onset and sleep fragmentation in the late luteal phase.

Sleep studies across the menstrual cycle are usually limited by small sample sizes, heterogeneous cycle lengths, lack of ovulation timing controls, and oral contraceptive use (Nowakowski et al, 2015). Despite the advancing research activity in sleep and women's health, there are areas however which deserve more focussed attention. There has been some interest on how the menstrual cycle impacts the sleep cycle, however these are limited (Nowakowski et al, 2015). Due to these methodological issues and the limited nature of these studies, much remains unknown about premenstrual/menstrual sleep.

2.5.2 Sleep and Pregnancy

During pregnancy, significant fluctuations in hormones can affect the sleep-wake cycle and lead to physiologic changes which in turn lead to disturbed sleep. Pregnancy itself causes a multitude of anatomic and physiological changes, essential to supporting and maintaining a

pregnancy but this can all contribute to sleep problems too. The main factors which contribute towards sleep disturbances in pregnancy are anxiety, urinary frequency, back ache, foetal movement, general abdominal discomfort, breast tenderness, leg cramps, heart burn and reflux, these are the most common symptoms. Interestingly, frequent urination during pregnancy in the first and second trimester is not an unusual symptom and symptoms do vary individually, however frequent urination is one of the more common early symptoms of pregnancy and as the foetus grows and the pregnancy progresses the urge to urinate may decrease as the Human Chorionic Gonadotrophin) hCG hormone level decreases and then the urge to urinate increases as the pregnancy progresses to the third trimester and the pressure on the bladder increases. The role of hCG is to increase blood flow to the pelvic area and kidneys which become more efficient during a pregnancy and one of the associated symptoms is the frequent need to urinate. Women report disturbed sleep quite early on during the pregnancy and this increases in frequency and duration as the pregnancy progresses, this disturbance is also due to the pregnancy related anatomic, physiologic, and hormonal changes occurring (Little et al, 2014 and Hertz et al, 1992).

Longer sleep and greater daytime sleepiness is reported by women in the first trimester, furthermore, cross sectional and longitudinal studies using either subjective and/or objective measures of sleep have consistently reported increased wakefulness after sleep onset and decreased sleep quality during the first trimester relative to pre-pregnancy (Hedman et al, 2002 and Santiago et al, 2001). The second trimester brings about improvement in daytime sleepiness, however the third trimester brings about an increase in sleep disruptions with typically 3-5 awakenings per night and more daily naps (Tsai et al, 2012), diminished daytime alertness and more disturbed dreams (Lara-Carrasco et al, 2014) and approximately 21% of women report disturbed sleep at levels which are consistent with a diagnosis of an insomnia disorder (Hedman et al, 2002 and Baratte-Beebe, 1999).

Other notable changes during the third trimester include decreased sleep efficiency, increased wake after sleep onset, an increase in total sleep time (which usually decreases by late pregnancy) an increase in stage 1 and 2 sleep, and decreased REM sleep (late pregnancy) has been noted by PSG recordings (K1zz1l1rmak et al, 2012; Driver & Shapiro, 1992; Pien & Schwab, 2004 and Von Känel et al, 2006). Research by Von Känel et al, (2006) and Vgontzas et al (2004) has shown that poor and insufficient sleep also brings about other health related changes physiologically such as an increase in circulating levels of inflammatory markers,

adverse pregnancy outcomes such as intrauterine growth restriction and preterm delivery can also occur (Irwin et al, 2006 and Dudley, 2000).

Factors such as the frequent need to urinate are often related to pregnancy and can cause most women to experience sleep disruptions (Baratte-Beebe, 1999). Some women can also experience difficulties in initiating sleep and/or returning to sleep, which maybe unrelated to perinatal factors. If a person experiences sleep disturbances for more than three nights per week over a period of three months with clinical impairment and distress, then usually a diagnosis of insomnia is often warranted. Dørheim et al (2009) and Swanson et al (2011) report that the prevalence of sleep disturbances among perinatal women to be as high as 58% with a probable diagnosis of perinatal insomnia to be estimated at 10% (Manber et al, 2013). Nowakowski et al (2013) also report daytime coping strategies such as napping, spending more time in bed, or increasing caffeine intake can often perpetuate sleep difficulties. Research has shown that the presence of insomnia has a significant impact on quality of life and daytime functioning and its management is essential.

2.5.3 Sleep in Postpartum

The effects of sleep disturbance during the postpartum period and its effects on maternal role functioning and mother-infant interactions is poorly understood (Nowakowski et al, 2013). Thirty percent of women have reported disturbed sleep either through actigraphy based studies or self-reports after the birth of their baby, the infants sleep patterns along with the drop in hormone levels all contribute. Studies longitudinal in design have shown that the first six months postpartum are often associated with a significant increase in wake after sleep onset and a decrease in sleep efficiency compared to the last trimester of pregnancy (Hertz et al, 1992; Lee et al, 2000; Mindell & Jacobsen, 2000; Montgommery et al, 2010 and Titotzky et al, 2010).

Swaine et al (1997) further explored postpartum sleep and noted although sleep begins to normalise around 3 to 6 months postpartum, other factors such as the mothers age, type of delivery, type of infant feeding, infant temperament, return-to-work issues, prior birth experiences and the number of children at home and the availability of night-time support from either partner or other family members can have an impact on both quality and quantity of sleep in new mothers. New mothers tend to compensate their sleep disruptions by napping more during early postpartum. Titotzky et al (2010) Observed the negative effects of poor and insufficient sleep during the postpartum period. Those mothers who reported poorer sleep

(lower self-reported sleep quality and a higher number of night-time waking due to infant awakenings) perceived their infants as having lower mood and as being more distressed and tearful. Furthermore, a poorer maternal-infant attachment was also predicted due to insufficient sleep and tending to the infant at night (Titotzky et al, 2010).

Other studies have also documented the association between sleep disturbances and depressive symptoms at a later time among perinatal women (later in pregnancy) (Skouteris et al, 2008, Park et al, 2013 and Kamysheva et al, 2010) or early in postpartum (Park et al, 2013, Dørheim et al, 2014; Wolfson et al, 2003; Bei et al, 2015 and Wilkie et al, 1992). Other studies (Doering et al, 2011; Okun et al, 2011 and Tsai et al, 2012) have also further studied the association between poor sleep and subsequent depressive symptoms and have reported that when sleep is disturbed during early postpartum period then this leads on to postpartum depression at a later postpartum time.

2.5.4 Sleep in menopause

Menopause is a natural process that occurs in women's lives as part of normal aging. It is defined as the cessation of menstruation due to the degeneration of ovaries and follicles accompanied by changing ovarian hormone levels (oestrogen and progesterone). The World Health Organisation (WHO) (1996) characterises menopause as the permanent cessation of menstrual periods that occur naturally or is induced by surgery, chemotherapy, or radiation.

Poor sleep quality and disturbed sleep is a common problem among middle-aged and older adults and is associated with decrements in learning, memory, and alertness; reduced immune function; and depression (Dotto, 1996). The prevalence of sleep disturbance and sleep problems in women appears to increase dramatically during the menopause transition (Kravitz, Ganz, Bromberger, Powell, Sutton-Tyrell & Meyer, 2003 and Wood & Mitchell, 2010). However, results from studies of menopause and sleep, including population-based surveys of general menopausal symptoms (Kuh, Wadsworth & Hardy, 1997), cross-sectional studies with objective indicators of disturbed sleep (Baker, Simpson & Dawson, 1996 & Shaver, Giblin, Lentz & Lee, 1988) and hormone-replacement trials (Montplaisir, Lorrain, Denesle & Petit, 2001) are inconsistent.

The main consistent findings that have emerged from epidemiological studies of sleep disturbances are that subjective reports of disturbed sleep are more prevalent in women rather than men and that the prevalence increases with aging (Brugge, Kripke, Ancoli-Israel & Garfinkel, 1989 and Ohayon, 2002) although there are no reported sex-differences in total sleep

time. The accurate diagnosis of sleep disorders is therefore of paramount importance from a social and economic standpoint. Polysomnography allows measurements of multiple channels of physiological parameters, including-but not limited to-electroencephalography (EEG), electrooculography (EOG), electromyography (EMG), electrocardiography (ECG) or heart rate, respiratory effort, air flow, and oxygen saturation. Additional recording channels may be added in selected situations. Furthermore, other related sleep medicine procedures such as cardiorespiratory sleep studies and multiple sleep latency and maintenance of wakefulness tests may also need to be considered.

Recent longitudinal studies have shown that the menopausal transition is associated with increases in depressive and vasomotor symptoms (VMS: hot flashes) (Alblooshi et al, 2023). An estimated eighty five percent of women undergoing the menopausal transition report at least one transitional-related symptom, typically VMS, depressed mood, or sleep disruption. Emerging evidence suggests that depressive symptoms and other indicators of negative affect (e.g., anxiety, irritability, hostility) and cognitive function (memory) are strong and independent consistent correlates of the association between menopausal transition stage and self-reported sleep complaints.

Rapid eye movement (REM) sleep, which typically makes up 20-25% of total sleep time, is thought to have an important influence on mood state and cognitive functioning, particularly memory consolidation. The timing of the first REM period, thought to be influenced by body temperature or previous sleep deprivation, usually begins about ninety minutes after falling asleep. Interestingly, it has been shown that women who ovulate (high levels of serum progesterone in the luteal phase) have shorter REM latency, more REM sleep, and more positive mood state compared to those who did not ovulate (low luteal progesterone) (Lee, McEnany and Zaffke 2000). Women who are transitioning from perimenopausal to post-menopausal state have very low levels to near zero levels of progesterone, which may affect REM cycles and associated cognitive effects.

The menopausal transition is characterised by further marked physiological factors such as hormonal and symptomatic changes, such as circulating oestradiol levels which decline while follicle stimulating hormone levels increase. Progesterone secreted in high amounts from the corpus luteum after ovulation and in very high amounts by the placenta during pregnancy, is both thermogenic and soporific and can modulate psychological mood state.

Subjective reports of sleep difficulties also increase during this time of physiologic and symptom-related changes (Harvey et al., 2008). Prevalence of sleep disturbance ranges from sixteen to forty-two percent in premenopausal women and thirty-five to sixty percent in post-menopausal women. This increase in subjective sleep difficulties is independently related to the menopausal transition and persists even after age and other covariates are controlled (Kravitz, Zhao, Bromberger et al, 2008 and Kravitz, Ganz, Bromberger Powell, Sutton-Tyrell & Meyer, 2003).

Nevertheless, whether difficulty sleeping increases among women in the late reproductive years and occurs due to symptoms of the menopausal transition, such as hot flashes, night sweats, weight gain and fatigue or whether the aging process itself causes an increase in sleep problems that is incorrectly attributed to menopause is not well understood. In addition, given the integral relationship between reproductive hormones such as oestradiol, which is secreted by the ovary to support developing follicles and any subsequent pregnancy, and inhibin B, which is a hormone produced by ovarian granulosa cells and falling levels, of which precede the menopausal decline in oestradiol levels and are markers of the early menopause, is also of interest.

However, how reproductive hormone levels affect sleep quality and disturbances has not been extensively examined. Despite the overwhelming consensus that women who pass through the menopausal phase report poor sleep; whether this is linked to age as a modulator (Stenuit & Kerkhofs, 2005), the decreased levels of oestrogen and melatonin (Jehan et al, 2017) sleep apnoea in relation to obesity (Banno, Ramsey, Walld & Kryger, 2008) and other factors which may contribute to this occurrence, a significant amount of research has been aimed at understanding the consequences of poor sleep in women in relation to their menopausal transition. In addition, numerous studies have examined whether poor sleep is due to the menopausal transition or other factors.

2.6 Living with nocturia and its psychological impact including disturbed sleep in women across the lifespan

2.6.1 Current study

The focus of this research is specifically on women across the life span. Historically nocturia has received more attention as a men's health issue, despite the high prevalence in women as well (Hsu et al, 2015). One of the main reasons for why nocturia has received more attention in men is because nocturia leads to increased mortality among elderly men (Kim et al, 2015) and LUTS occur concomitantly with an increase in prostate volume after 50 years of age (Homma et al., 2006 & Tikkinen et al., 2006). Historically, nocturia in women has been thought of as a symptom of other disorders such as overactive bladder or global polyuria, though nocturia often occurs without daytime symptoms (Hsu et al, 2015). With a growing body of literature regarding its prevalence, determinants, and implications, nocturia in women can begin to be assessed as an entity in and of itself.

According to a literature review of 45 studies, 43.9% of women in their 20s and 30s and 77.1% in their 70s and 80s experience at least one void per night (Bosch & Weiss, 2013). The prevalence of nocturia increases across age groups to more than 50% reporting two or more voids per night at age of 70 (Burgio & Johnson, 2010). Higher prevalence of nocturia in this age group is multifactorial, and possible contributing causative factors include impaired bladder voiding, reduced bladder capacity, decreased vasopressin levels at night, increased comorbid conditions, and sleep disturbances (Bosch & Weiss, 2013). The prevalence and severity of nocturia in women increases with age (Lin et al, 2005). Nonetheless 4.4% to 18% of women in their 20's and 30's report two or more voids per night, compared with 28.3% to 61.5% of women in their 70's and 80's (Bosch & Weiss, 2013). According to several population-based studies, age is the most significant risk factor for nocturia in both sexes (Comu et al 2012).

More recent studies corroborate these findings, a 2015 study that surveyed a total of 159 women aged 18–30 supports the 'hidden' prevalence of nocturia in healthy young nulligravid women (never given birth). Using the International Consultation on Incontinence Modular Questionnaire for Female Lower Urinary Tract Symptoms (ICIQ-FLUTS), the authors found that 94.3% of respondents suffered LUTS and 19.4% reported at least one void per night (Breda

et al, 2015). These findings suggest that researching nocturia in younger women, as well as older women, is an important under researched area to investigate.

2.6.2 Nocturia in women

Studies by Bosch & Weiss (2011) and Cornu et al (2012) support the fact that nocturia in women is a notable health concern, it is associated with significant morbidity and decreases in Health Related Quality of Life (HRQoL). Furthermore, nocturia is common among women; among adults, the prevalence of nocturia is generally greater in women, except in very late life (Kurtzman et al, 2016). Cornu (2012) further reveals that prevalence of nocturia is more common in parous women (women who have given birth) and shows a linear increase with age, occurring in more than 50% of women aged ≥ 80 years.

Interestingly although not surprising, nocturia is also more frequent during pregnancy and postpartum, as well as post menopausally as shown by Miotla et al (2017). Kutzman et al (2016) have shown that the proposed link between nocturia and menopause has been challenged, and recent nomenclature ("genitourinary syndrome of menopause") describing the genitourinary symptoms associated with menopause does not explicitly include nocturia. Data is limited regarding the exact aetiology of nocturia in women, a number of studies have identified risk factors for its occurrence, including urgency and snoring (Bosch &Weiss, 2011), high BMI (Asplund, 2007), age, hypertension, and heavy smoking (Yoshimura et al, 2004). Nocturia in women is a significant health concern that should not be overlooked. It affects women across the lifespan and carries notable comorbidities. One study has revealed that women do not tend to seek medical attention for nocturia (Kurtzman et al, 2016), however the reasons for this are yet to be explored. This highlights the need to further research this area to gain insight into what some of the reasons may be.

In addition, the profound effects of nocturia on perceived state of health was independent of heart disease, diabetes, age, and menopausal status as shown by Asplund & Aburg, (2000). Furthermore, data drawn from a survey of physicians and patients in France, Germany, Spain, UK, and USA to assess the impact of nocturia, revealed that women with nocturia and daytime symptoms had the worst outcomes of all the diagnostic subgroups on three patient reported outcome (PRO) scales (the OAB Questionnaire Short Form, the Nocturia Impact Diary, and the Work Productivity and Activity Impairment Questionnaire), (Everaert et al, 2018). Women

with regular nocturia report a pronounced deterioration in their sleep, QoL, and general health (Lose et al, 2001).

In the health literature, nocturia is still regarded as an older women's health issue due to poor bladder control, incontinence or other hormonal related disorders (Leslie et al., 2023). However, this section highlights that firstly, nocturia is not just an older person condition but it does in fact affect women across the lifespan. It is also important to note the risk factors associated with nocturia highlighted in this section are common health issues which can be prevented with moderate lifestyle changes. This further highlights the importance of ensuring women receive adequate education about their health and wellbeing.

2.6.3 Causes of nocturia

The multifactorial aetiology of nocturia complicates the diagnosis and treatment of nocturia. Numerous potential factors underlying nocturia have been identified including sleep disorders, bladder outlet obstruction, overactive bladder (OAB) syndrome, sleep apnoea syndrome, and other factors which may cause nocturia such as pregnancy, ageing, fluid intake and consumption of alcohol and caffeinated beverages, (van Kerrebroeck et al, 2002; Bosch & Weiss, 2013 and Miotla et al, 2017). Given the myriad of possible contributors to nocturia, the use of a frequency-volume chart, which provides an accurate assessment of nocturia, is fundamental to the identification of the underlying mechanisms involved and to help identify the appropriate treatment.

2.6.4 The potential impact of nocturia on sleep

Many observational studies have demonstrated the relationship between the frequency of nocturnal voiding and the negative effect on QoL and wellbeing (Bliwise et al, 2019). Foremost, nocturia is associated with disruption of sleep that can result in daytime fatigue, cognitive impairment, mood alterations, increased susceptibility to disease, decreased work performance, dizziness, an increased risk of falls, depression and mortality as noted by Asplund (2005). The effect of disturbed sleep per se can be best understood in the context of the normal physiology of sleep.

2.6.5 Nocturia and sleep quality

Sleep plays a vital role in physical and mental functioning (Harvard Medical School, 2020). It is increasingly recognised that disturbed sleep is a highly prevalent and chronic condition that merits greater awareness due to its associated wide-ranging and serious repercussions. There

are many reasons why sleep can be disrupted or shortened at night, including primary sleep disorders, intrinsic lightening of sleep and sleep fragmentation, changes in circadian rhythms, environmental stressors, genetics, or even voluntary curtailment. Patients frequently report sleep impairment associated with nocturia, although it is often overlooked as a cause of sleep problems. (Ancoli-Israel et al, 2011). Sleep disturbance is significantly bothersome in those with two or more nocturnal voids (Ancoli-Israel et al, 2011). A National Sleep Foundation survey in the USA in 2003 found that nocturia was the attributed cause of sleep disturbance every night or almost every night in 53% of those aged 55-84 years. Sleep disturbance due to nocturia was more than four times more prevalent than pain and cited as the next most frequent attributed cause (Bliwise et al, 2009) this further supports the importance of researching this area further to gain further insight into how nocturia can impact sleep.

2.6.6 Nocturia and sleep disturbances

The data from the United States National Sleep Foundation 2020 survey specifically assessed the prevalence of nocturia among older age groups self-reporting insomnia (Bliwise, 2008). Interestingly the results highlighted that more than half (53%) of respondents aged 55-84 years perceived nocturia as the cause of disturbed sleep 'every night or almost every night'; this was four-fold higher than the proportion reporting pain interestingly which was the next most common reason for sleep disturbance (12%). Nocturia was shown to be an independent predictor of self-reported insomnia and deterioration in sleep quality (Bliwise, 2008). These findings highlight the need for greater awareness of the impact of bladder sensations and ultimately nocturia on sleep, and the implications of repeated sleep disturbance on a person's daytime functioning (Bliwise, 2014).

2.6.7 Nocturia and potential health impacts

A wide range of potential adverse consequences upon health have been reported as being related to the presence of nocturia and its associations with poor sleep. Recently, a study by RAND (2020), evaluated the global impact of nocturia and their findings suggest that worldwide approximately 90 million people suffer from nocturia, approximately 1 in 10 of whom are under the age of 45 which can have adverse consequences to quality of life. Furthermore, the study also found that the sleep interrupting nature of nocturia greatly reduced daytime productivity, equal to that of other chronic conditions such as asthma, arthritis, inflammatory bowel disease, depression and gout. This can have serious consequences on the economy as this amounted to the equivalent of $79 billion per year lost worldwide in absence

or impaired ability to work (RAND, 2020). Thurs further supporting the need to investigate this condition along with the consequences on an individual's health and wellbeing and the impact that it can have on an individual's mental health.

2.6.8 Nocturia and depression

A systematic review which focussed on the relationship between nocturia and depression/anxiety by Breyer et al (2013) revealed that depression and nocturia frequently coexist. Interestingly, nocturia increased the odds of reporting depression, while depression similarly increases the likelihood of reporting nocturia, thus the findings suggest a bidirectional association of depression and anxiety with nocturia. Nocturia is shown to carry a greater risk of depression in men than women, the findings from the Boston Area Community Health (BACH) survey revealed that depression was almost three times higher in men with nocturia compared to those without and almost twice as high in women.

2.6.9 Nocturia and Quality of Life

The World Health Organisation (WHO) defines Quality of Life (QoL) as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns (WHO, 2020). It is well recognised that nocturia is associated with poorer QoL and may affect the ability to carry out normal activities of daily living (Bliwise, et al 2014).

Although several primarily observational, cross-sectional studies demonstrate relationships between nocturia and the conditions mentioned above, it is important to note that these studies have been unable to establish causality and a direct link (Weiss et al, 2012). Some of the most convincing evidence that nocturia is a cause for at least some health consequences has been obtained from clinical trials that demonstrate improvement in parameters such as QoL because of treatment for nocturia (Kaminetsky et al (2018). For example, desmopressin, a selective vasopressin receptor 2 (V2) agonist, has been shown to be effective, well-tolerated and to improve QoL in adults with nocturia. Two formulations, an orally disintegrating tablet, and a low-dose intranasal spray, showed treatment effects corresponded with significant improvements in patient QoL based on the Nocturia QoL questionnaire scores for bother/concern and sleep/energy; $P < .05$ and the night-time urination QoL questionnaire scores for overall impact and the night-time domain; significant as shown by Kaminetsky et al (2018).

In 2003-2004, a survey in Finland designed to evaluate the associations of nocturia and health-related quality of life (HRQoL) identified that the presence of at least two voids per night was associated with impaired HRQoL. Nocturia was statistically significantly associated with lower scores in 14 of the 15 domains reported by men and women in the HRQoL questionnaire. For every increase in nocturnal voids above one, further reductions in HRQoL scores were reported by Tikkinen et al (2010). Furthermore, these findings highlight the importance to further investigate this topic to have a greater understanding of how nocturia impacts on a individuals quality life for health professionals and how to best support this population.

The current research has highlighted the complexity of living with nocturia whether nocturia has been diagnosed or not. Furthermore, the literature has highlighted how nocturia is a multidimensional complicated condition, that is highly prevalent in women across the lifespan, which can have a significant impact upon women's health and is associated with anxiety, depression, poor work productivity, poor cognition, and poor quality of life. Further, the research has also highlighted the reluctance of many women to seek medical help for this condition. Yet, no research to date has explored the reasons that women might have for this reluctance and their knowledge about available treatments and levels of motivation for accepting relevant treatment.

There is a lack of research within this area specifically dedicated to gain better insight into how nocturia impacts sleep and the consequences this has on an individual's health and wellbeing. This research aims to investigate all these factors highlighted in here in this section as one complete study using objective methods to collect data.

The current study

The current study will use a quantitative, cross-sectional survey design using an online questionnaire for collecting data. This approach will use objective measures such as validated and reliable sleep questionnaires to measure the level of sleep disturbances and daytime measures (daytime sleepiness, sleep quality, sleep disturbances, quality of life, mood and depressive symptoms, and occupational status) and along with medication usage reported by the participant and how this may impact the individual.

3 A cross sectional survey of sleep disturbance and general well-being in women living with nocturia

3.1 Aims

The aims of this proposed study are:

1. To observe the impact of nocturia on women's' health and wellbeing.
2. To identify which age groups are more likely to void more than once per night.
3. To identify if other factors such as occupation, parous status, ethnicity, exercise, can impact nocturia.
4. To identify participants who have started receiving treatment either for nocturia or another nocturia-related condition and if this improves their health and well-being scores.

Quantitative hypotheses

H1: Participants who void once or more per night (suffer from nocturia) will have significantly poorer sleep (poorer quality of sleep, higher levels of disturbed sleep) along with higher scores of daytime sleepiness, lower QoL, and lower mood compared to those who void less during the night.

H2: Participants responding to treatment to help with their voiding will have significantly greater levels of QoL, improved sleep quality including subjective sleep quality, lower levels of low mood and depressive and anxiety symptoms (linked to poorer sleep) compared to those receiving no treatment.

3.2 Method

3.2.1 Design

This study adopted a cross-sectional design survey of women who anatomically identified as female to measure the relationship between the predictor variable (sleep disturbances) and outcome variables (quality of sleep, mood, and quality of life) among women voiding more than once per night or displaying symptoms of nocturia (considered here as voiding more than once per night after going to bed to sleep). A quantitative approach was selected as this allowed for large scale quantitative data to identify causal variables or correlational relationships (Muijs, 2010). A total of five outcome measures (Appendices 1) were used in this study to measure the chosen variables; sleep, sleep quality, nocturia and sleep, quality of life and mood (please see section on assessments 3.2.4) used in the questionnaire. A demographic questionnaire (Appendices 2) was also administered to collect data on age, gender, ethnicity, weight, BMI, smoking status, alcohol consumption, medications being taken in the last month, health history which included questions relating to medications taken and illnesses in the past month and over the course of the participants lifetime, physical activity levels, pelvic floor health, current menstruation status, occupation, whether the participant has had children and the delivery method and if participants reported parous status (yes/no) where possible, shorter questionnaires were considered to support completion rates, as research suggests the length of time taken to complete online surveys has a negative relationship with completion rates (Fan and Yan, 2010).

The survey was administered online via an online survey platform named Qualtrics (www.qualtrics.com). Online methods were chosen due to the design and to allow data collection to commence during potential government lockdown throughout the coronavirus (COVID-19) pandemic, ensuring the safety of participants and researchers whilst adhering to both university and government guidelines.

3.2.2 Ethical considerations and approval

Ethical approval was granted by the Research Ethics committee at the University of the West of England, UWE REC REF No: HAS.21.08.001 (Appendices 4). The researcher ensured that they followed the rules and regulations as set out by the British Psychology Society (BPS) and the Health and Care Professions Council (HCPC). The researcher ensured that they followed the strict guidelines for safely handling and storing research data using the student's UWE One

Drive account cloud. Furthermore, the code of human research ethics (British Psychological Society (BPS), 2021) and the BPS (2021) ethics guidelines for internet- mediated research were followed to ensure potential ethical issues were considered in the design and implementation of this study. No deception or covert data collection took place as part of this study. Participants were made fully aware of the purpose of the study through a participant information sheet (Appendices 5) and had the right to withdraw at any time (Appendices 6).

3.2.3 Procedure

3.2.3.1 Pilot study

Before data collection began for the study it was agreed by the researcher to undergo a pilot study to check the suitability and acceptability of the assessments. The researcher approached her peers to ask if they would be willing to take part and offer detailed feedback.

Initially a total of 10 participants from the student's professional doctorate in health psychology based at the university of West of England, Bristol cohort were approached via email and Whatsapp[11] which is a mobile messaging application downloaded on an individual's smart device.

Research suggests that conducting survey testing with a small number of participants can improve online questionnaire reliability (Dilman, Smyth and Christian, 2014) and ensure survey questions and instructions are clear to potential participants before publishing. Once ethical approval was granted and the survey design was complete, those participants who were willing to take part in the pilot were sent a link generated by the on-line questionnaire/survey builder Qualtrics which could be shared either via email, instant messaging platforms such as Whatsapp, imessages (Apple) and other messaging platforms offered by android and/or smart devices.

The main aim to conduct this pilot was to ensure that the questionnaire could be read and understood well by the participants, font sizes were appropriate, and that the questionnaire could be self-completed using a variety of electronic smart devices such as desktops, laptops, smart phones, and other resources which would allow for both WIFI connectivity and acceptability of items was also important along with the following questions:

[11] The professional doctorate in health psychology cohort have a Whatsapp group specifically created to assist with course related queries.

- Were the instructions and questions easy to understand?
- Do you think the questions are appropriate for the purpose of the study?
- Was there anything not asked that you as a respondent feel should have?

Four participants responded and no further changes were made following feedback from pre-testing. The author acknowledges that this is a small number of respondents to gain feedback for a pilot study however several factors could have impacted this which will be discussed here briefly. One of the reasons for such a small sample of testers in the first instance could be that the survey itself is relatively long in length, the time taken to complete the questionnaire was 20 minutes. Nevertheless, issues around both representativeness and response rates often feature heavily in survey-based research (Fincham, 2008), the former referring to how well the sample drawn for the questionnaire research compares with the population of interest, interestingly, the expectations for the survey research response rates are now higher (Fincham, 2008). According to Fincham (2008) response rates approximating 60% for most research should be the goal.

3.2.3.2 Procedure for current study

Recruitment took place through opportunity sampling using advertisements posted online showcasing the study, which provided a summary of the research along with contact details for the researcher should a participant wish to contact the researcher for further information (see Appendices 7). The advert also contained an anonymous link provided through Qualtrics to allow participants to access the questionnaire through their own devices at a time which was deemed as suitable for the individual. Once a participant clicked on the link, they were taken to the participant information sheet first and foremost followed by the inclusion and exclusion criteria to ensure that the participant was eligible to take part before consenting. Once the participant had confirmed that they were eligible and consent was provided by signing a text box displayed at the bottom of the consent page, they were asked to create an anonymous code to maintain confidentiality and enable the researcher to identify an individual's data should they wish to withdraw from the study at a later date. Qualtrics was also programmed to generate a second code to identify the individual.

The first section of the questionnaire detailed the demographic questions which the participant would see, the first question asked how the participant would describe their sex and they had the choice of three responses (male, female or prefer not to say), further information was provided as to why this question was being asked and the importance of the question in relation to the overall study. If a participant failed to respond or selected an alternative answer other

than female, they were thanked for taking part and taken to the debrief section. For those participants who selected female from the available options they were taken to the next set of questions within the demographic section these sets of questions were aligned to if the participant had given birth, the delivery method, the date of their last menstrual bleed, if they classed themself as menopausal, and date of birth along with their height, weight and their body mass index (participants were taken to a link to calculate their body mass index).

The next section included lifestyle questions pertaining to smoking status, consumption of alcohol, time of day beverages are consumed including the quantity and type, along with exercise taken and the type. The reasons for collecting this data as part of the study were that some of the literature highlighted that negative behaviours such as consuming alcohol and smoking would have an impact on both sleep and nocturia, positive behaviours such as exercising may have a positive impact on sleep depending on the type of activity and the time it was carried out. The time of day the last beverage is consumed also plays a pivotal role in nocturia and sleep. The remainder of the demographic questions focussed on work, qualifications along with ethnicity related questions. The final remainder of the questions asked if the participant is currently on any medication or taken any medication within the last month, participants were also asked if they had any childhood illnesses along with any illnesses in the past month or so. Questions relating to whether anyone in the family had sleep related issues was also asked. One of the main reasons for asking this question was to identify if there were causes to the disturbed sleep such as children, adolescents, bed partners or other family members which could have an impact on an individuals sleep. The main body of the questionnaire contained the five outcome questionnaires The Pittsburgh Sleep Quality Index (PSQI), the Groningen Sleep Quality Scale (GSQS), The Nocturia Sleep Quality Scale (NSQS), The Short-Form-36 item scale (SF-36) and the Hospital Anxiety Depression Scale (HADS) (Appendices 1). If participants did not complete all questions for a given measure a prompt was displayed to prompt participants with two options; 'continue without answering by selecting not applicable' or 'answer the questions.' At the end of the survey, participants were presented with the debrief sheet containing information for withdrawal and researcher contact details.

3.2.4 Recruitment and sample

An online power calculator: https://www.surveysystem.com/sscale.htm_confidence (G*Power 3.1) (Faul et al., 2007) was used to determine the sample size required. This was selected at

95%, with a confidence interval of 4 and a population of 200 determined a sample size of 150 participants required for the study. Whilst a power level of .80 is usually considered sufficient, the G*Power default level of power .95 was maintained to provide a more stringent analysis.

Participants were recruited during March 2022 through to May 2022 using opportunity sampling. An online questionnaire was published on Qualtrics which participants could access using an anonymous link. Participants were recruited via social networking sites (i.e., Twitter and Facebook), online forums (local neighbourhood forums), online community newsletters, university staff and the university participant pool.

Participants were eligible for the study if they were: UK based adults aged 18 years or over, anatomically female and either with or without a diagnosis of nocturia. Participants were only excluded if they identified as non-female anatomically along with the inability to read and write in English.

A total of 329 potential participants accessed the online survey. After exclusion due to not consenting to take part in the research, incomplete responses where participants did not complete all questions and participants withdrawal, a total of 180 participant responses were included for analysis, thus the final sample size was larger than the 150 participants required to obtain 0.95 power as described above. The average completion time for participants was 20 minutes.

3.2.5 Assessments

3.2.5.1 Demographic Questionnaire

Participants were asked a total of thirty-eight demographic questions to collect information on participants (Appendices 2):

Specific demographic questions included information on sex, age, height, weight, and BMI. Lifestyle questions included information on an individual's smoking status, alcohol consumption, time of last caffeinated/alcoholic/non-alcoholic drink, the number of non-alcoholic beverages consumed during the day, education level, occupation status, the number of hours worked, parous/non-parous status, date of last menstruation, if exercise is taken (including quantity and type), medication taken within last month and health history which included questions relating to medications taken and illnesses in the past month and over the course of the participants lifetime.

Sleep specific questions included: If anyone in the family has any sleep related issues and who has the sleep related issue.

The sociodemographic data was collected by asking participants to either enter text or use drop-down options and/or tick boxes relevant to their response.

3.2.5.2 Sleep Disturbances:

The Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman & Kupfer 1989).

The PSQI is a self-rated questionnaire which assesses sleep quality and disturbance over a one-month time interval. The PSQI has nineteen individual items which generate seven "component" scores, these being: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. There are five questions which are rated by the bedpartner or roommate, the latter five questions are used for clinical information only. The nineteen items are grouped into seven component scores, each are weighted equally on a 0-3 scale. The overall sum of scores from these components yields one overall global score which has a range of 0-21, the higher the score the worse the global sleep quality.

The clinical properties of the PSQI were initially assessed over an eighteen-month period with "good" sleepers which consisted of healthy participants and "poor" sleepers which consisted of depressed patients and those patients diagnosed with sleep disorders. The questionnaire is both internally reliable and valid. Good and poor sleepers were distinguished through a global PSQI score of more than 5 which had a diagnostic sensitivity of 89.6% and specificity of 86.5%. The clinical properties of the PSQI suggest its suitability for it to be used in psychiatric and clinical practice and in research facilities. The PSQI has a high internal consistency with an overall reliability coefficient (Cronbach's α) of 0.83 across the seven component scores. Individual items are also reported to have high reliability coefficient of 0.83.

3.2.5.3 Sleep Quality

Groningen Sleep Quality Scale (GSQS) or the Sleep Quality Scale (SSQ) (1988). (Mulder-Hajonides Van der Meulen, Wijnberg, Hollander, De Diana and Van den Hoofdakker, and Meijman and Mulder (1981).

The GSQS is an instrument used to measure subjective sleep quality. It covers the following sleep complaints:

- General sleep quality (3 items)
- Insufficient sleep (3 items)
- Trouble with falling asleep (2 items)
- Tossing and turning (1 item)
- Trouble with sleep on (3 items)
- Waking up unrested (2 items)

The scale was originally constructed to study the sleeping problems of depressive patients (Mulder-Hajonides van der Meulen and van den Hoofdaker, 1988). The scale was originally evaluated using a test population of shift-workers (Meijman et al, 1988). The 14 items of the GSQS scale fit a co-dimensional scaling model as proposed by Mokken (Mokken and Lewis, 1982).

The internal validity and reliability of the GSQS is satisfactorily high (Cronbach's $\alpha = 0.89$). The items on the scale are group in ascending order of severity as sleeping complaints. The higher the score on the scale represents lower subjective quality of sleep. A score of 1-2 is often found where participants under normal conditions experience unrestricted and undisturbed night sleep. Under conditions of day sleep, scores of 6 to 7 are not unusual. Higher sum scores represent more sleep problems

3.2.5.4 Nocturia

Development of the Nocturia Sleep Quality scale: a patient-reported outcome measure of sleep impact related to nocturia. (2019). Romano, Lewis, Barrett, Andersson, Williams, Ancoli-Israel, & Roth.

The NSQS is a recently developed, brief, patient-reported measure for assessing the impact of nocturia on sleep in adults. The tool is designed for patient self-report in a clinical or observational study setting and requires less than 5 minutes to complete.

The NSQS is intended for electronic administration, and the data collected for the psychometric evaluation were gathered by using the electronic version of the questionnaire (Appendices 1). However, paper-based versions of the NSQS have also been qualitatively appraised and tested with adults with nocturia.

The NSQS is a six-item, patient-reported measure of the impact of nocturia on nighttime sleep quality and is intended to assess change in the impact of nocturia on sleep after treatment in a

standardized manner. The NSQS requires only a few minutes to complete. The recall period for all items is “from the time you went to bed, with the intention to sleep, until you woke up to start your day.” The NSQS items employ a variety of response formats, including 5- and 6-point ordered rating scales. Therefore, for the computation of the NSQS composite scores, all item responses are scaled onto a 0 to 5 score range. Item 4 (How restful?) requires reverse scoring before it is combined with Items 1, 2, 3, 5, and 6.

In addition, all study participants should be reminded of the following whilst data collection is underway:

- Subjects are responding to the NSQS based on only the previous night’s sleep.
- The NSQS is intended for daily completion, and it is important that it be completed about the same time each morning (when arising for the day).
- If a subject forgets to complete the NSQS as directed, he or she may not complete missed questionnaires more than 24 hours late.

The NSQS is intended to capture the patient perspective and, as such, only the subject should respond to the NSQS items, and the subject should not be influenced by the opinions of others.

An NSQS Total score of 0 describes an individual with excellent sleep quality, and an NSQS Total score of 5 describes an individual with extremely poor sleep quality due to nighttime urination.

The NSQS is a reliable, valid, appropriate, and useful measure of the patient-perceived impact of nocturia on sleep. The internal consistency reliabilities of the NSQS composite scores were highly satisfactory (>0.70), as were the composite-level test-retest reliabilities (0.70), construct validity correlations,

3.2.5.5 Quality of Life

The 36-item Short-Form Health Survey (SF-36) (Ware & Sherbourne, 1992).

The 36-item short-form (SF-36) was constructed to survey health status and QoL in the Medical Outcomes Study. The SF-36 is designed for use in clinical practice and research, health policy evaluations and general population surveys. The SF-36 includes one multi-item scale that assesses eight health concepts. These are:

Physical Functioning, Role Limitations due to physical problems, Social Functioning, Bodily Pain, General Mental Health, Role Limitations due to emotional problems, Vitality, General Health Perceptions. The SF-36 is designed to be self-administered.

Summary measures of Physical and Mental Health, PCS and MCS, are calculated from the eight scales using algorithms recommended by the developers (Ware and Kosinski, 2001a). The PCS and MCS were constructed to simplify and improve the analysis of health outcomes by: reducing the number of variables analysed without much loss of information; measuring across a wider range of score levels than the scales; increasing the reliability of scores by pooling common reliable variance across scales; and improving the validity of scores in discriminating between physical and mental health outcomes by constructing orthogonal component summary scores (Ware et al., 1995).

The SF-36 consists of eight scaled scores, which are the weighted sums of the questions in their section. Each scale is directly transformed into a 0-100 scale on the assumption that each question carries equal weight. The lower the score the more disability. The higher the score the less disability i.e., a score of zero is equivalent to maximum disability and a score of 100 is equivalent to no disability. An interesting point of the document is that physical health scores are counted negatively when calculating combined mental health scores and vice versa. In other words, to score highly on mental health it is better to have worse physical health and vice versa. This is the result of the negative weights that resulted from the principal component analysis used.

The psychometric properties of the SF-36 have been reported as having satisfactorily high reliability for internal consistency (Cronbach's α 0.83 to 0.93) for the eight scales and 0.94 and 0.89 (Cronbach's α), respectively, for the physical (PCS) and mental (MCS) component summary measures.

3.2.5.6 Mood

The Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983).

The HADS is a 14-item reliable instrument for screening clinically significant anxiety and depression in patients attending a general medical clinic. To remove response bias the order of response is constructed so that to one item the first response indicates maximum severity and to another item the last response indicates maximum severity. There are four responses to each item to prevent the patient from opting for a middle response to all the items. The HADS is an

efficient screening instrument and the ranges of scores given minimises false positives and false negatives. The scale is useful for assessing change in a patient's emotional state as well as for assessing the presence or absence of clinically significant degrees of anxiety and depression.

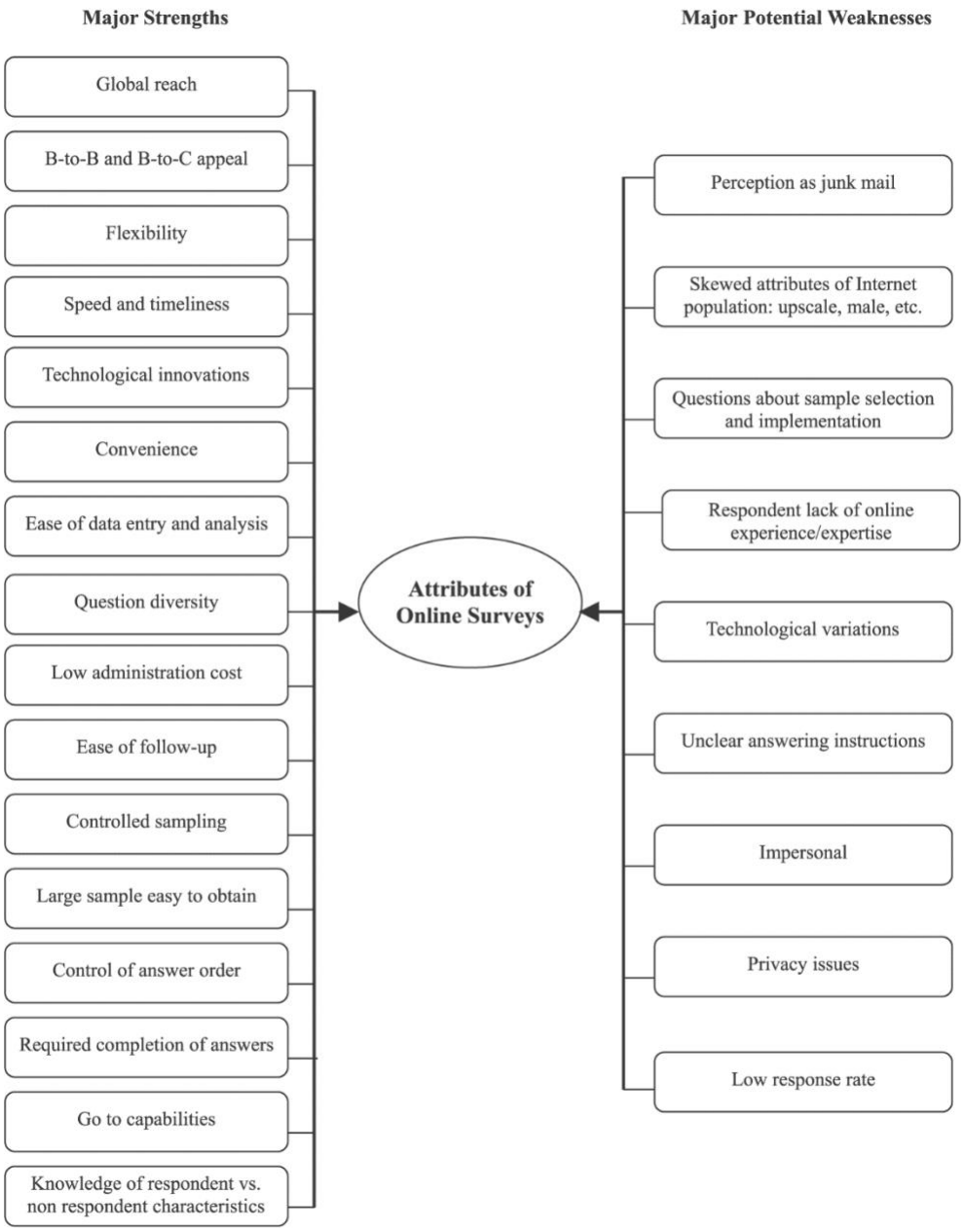
The HADS (Zigmond and Snaith, 1983) is a self-report scale consisting of two subscales, one measuring anxiety with seven items (HADS-A) and one measuring depression with seven items (HADS-D). The subject gives answers to each question on a 4-point (0–3) Likert scale and answering how he/she has been feeling in the past week. Items 1, 3, 5, 7, 9, 11, 13 belong to the anxiety subscale, while items: 2, 4, 6, 8, 10, 12, 14 belong to the depression subscale. The total score is obtained by summing the scores within each subscale. According to Pais-Ribeiro et al. (2018) interpretation, the score 0–7 represents "normal," 8–10 "mild," 11–14 "moderate," and 15–21 "severe." In the present study, the cut-off score of ≥8 and of ≥11 was used for HADS subscales (Botega et al., 1995; Bjelland et al., 2002; Honarmand and Feinstein, 2009; Brennan et al., 2010; Watson et al., 2014; Litster et al., 2016).

The two HADS subscales (anxiety and depression) report excellent internal consistencies (Cronbach's α value 0.82–0.83).

3.2.6 Justification for using the survey method and selected assessments.

The use of a survey as an instrument to collect large quantitative and qualitative data is widely accepted and used (Eysenbach & Wyatt, 2002). The term survey is generally used to describe the collection of information and is often used interchangeably with the term questionnaire which is a list of focussed questions (Hammer, 2017). Questionnaires can be used in healthcare settings to assess and monitor a patient's QoL and to then use this data to optimise patient care (Hammer 2017) such as the Patient-Reported Outcomes Measurement Information Systems (PROMIS®) (Ader, 2007). Numerous other valid and reliable instruments have been developed to either use in clinical practice or to gather patient data.

At the time of proposing the current study and considering the methods to collect data, the world was in lock-down due to the COVID-19 pandemic. Data collection would consist of an online survey so that the British governments lockdown rules were followed and adhered to Online surveys have numerous strengths and potential weaknesses as tabulated below (see figure 3.2).



Evans, J.R. and Mathur, A. (2005). The value of Online Surveys, Internet Research, 15(2): 196-219.

Figure 3.2

Strengths and weaknesses of the use of online surveys

Justifying the use of the assessments

This section will provide a detailed account of some of the other measures which measure sleep, sleep quality, nocturia, QoL and mood which were also considered as part of this research.

3.2.6.1 Sleep

The following section describes subjective methods of assessments in sleep and discusses their usefulness in research and clinical settings.

Questionnaires

Questionnaires can be a useful method for assessing sleep. Questionnaires can be designed to tailor both children and adults. Questionnaires can be used to obtain information about a wide range of sleep disorders and behaviours plus their severity. Questionnaires can be used to assess excessive sleepiness, quality of sleep, sleep disordered breathing. In this section questionnaires used to assess the quality of sleep will be mentioned. Questionnaires which measure excessive sleepiness and sleep disordered breathing will be measured in a different section.

"Sleep quality is an important clinical construct", (Buysse, Reynolds, Monk, Berman & Kupfer, 1988). Patients will often complain about their sleep and epidemiological studies have shown that fifteen to thirty-five percent of the adult population commonly complain about their quality of sleep, this being difficulty in falling asleep and difficulty maintaining sleep, (Karacan, Thornby, Anch, Holzler, Warheit, Schivab & Williams, 1976), (Karacan, Thornby & Williams, 1983), (Lugresi, Cirignotta, Zucconi, Mandini, Lenzi & Coccagna, 1983), (Welstein, Dement, Redington & Guilleminault, 1983) and (Mellinger, Balter & Uhlenhuth, 1985). Also, research has found that sleep quality which is poor can be an important marker for many sleep and medical disorders, (Kripke, Simons, Garfinkiel & Hammond, 1979).

Complaints of the quality of patient's sleep are particularly important in psychiatry, (Buysse et al, 1988). Some of the underlying factors which contribute to general complaints about the quality of sleep are anxiety and stress, (Karacan et al, 1983). The frequency of sleep quality disturbances is generally reported in most psychiatric disorders, these being depression, schizophrenia, anxiety disorders and psychoactive substance use disorders.

It is often difficult to define and objectively measure sleep quality, (Buysse et al, 1988). Objectively sleep quality includes quantitative measures such as duration of sleep, sleep latency, the number of arousals throughout the night, as well as those aspects of sleep quality

which can be subjectively collected and these being depth of sleep, restfulness of sleep, (Buysse et al, 1998). However, there are individual differences in what sleep quality is to patients and because sleep quality is rather a subjective matter it is often difficult to measure and define sleep quality quantitatively or even in laboratory settings. Usually, research which wishes to focus on a person's sleep quality will often be affected by the type of study being conducted and the tools used to measure the variable and usually large population surveys tend to focus on a few general questions about the individual's quality of sleep, (Bixler, Kale, Soldatos, Kales & Karacan, 1979; Karacan et al, 1983).

The two questionnaires considered to measure the quality of sleep for this research was either the Basic Nordic Sleep Questionnaire (BNSQ) or the Pittsburgh Sleep Quality Index (PSQI). Each will be discussed in turn.

The Basic Nordic Sleep Questionnaire

In 1998 the Scandinavian Sleep Research Society (SSRS) formed a task group for developing a standardised questionnaire which could be used as a basis for sleep questionnaires within the Nordic countries (Partinen & Gislason, 1995). The SSRS felt that there were many different types of questionnaires which used different wordings within epidemiological studies and making comparison between studies was very difficult (Partinen & Gislason, 1995). The other factor which caused problems was linguistic and cultural issues. It was important for the working task group to understand what the prevalence and incidence of sleep disorders was epidemiologically when the same wording was used, the severity and the occurrence of the problem in different countries (Partinen & Gislason, 1995). Questionnaires which had been used in different epidemiological studies concerning sleep apnoea and other sleep disorders were collected and the most commonly used questions across these questionnaires formed the basis of the new questionnaire-the BNSQ (Partinen & Gislason, 1995).

The main changes which occurred compared to the previous questionnaires were the development of a five-point scale (scale from 1 to 5) which emphasised how many nights/days per week something occurs. The BNSQ has been used widely across the world (Palomaki, Partinen, Juvela, & Kaste, 1989; Akerstedt & Torsvall, 1985; Young, Palta, Dempsey, Skatrud, Weber & Badr, 1993). The BNSQ has also been adopted for use in routine clinical patient questionnaires in hospitals in Finland and Iceland (Partinen & Gislason, 1995).

The Pittsburgh Sleep Quality Index

The authors of the PSQI developed the index to provide a reliable and valid test to measure sleep quality, to be able to identify from the test who the good sleepers are who the poor sleepers are, and to be able to provide a test which is easy to use by patients and easy to administer and interpret for clinicians and lastly to be able to provide a test which can briefly provide clinicians a useful assessment on a variety of sleep disturbances which may or may not affect sleep quality.

The PSQI consists of nineteen self-rated questions and five questions rated by the bed partner or roommate. The latter five questions are for clinical use only and are not tabulated in the scoring of the PSQI. The nineteen questions in the PSQI assess a variety of factors relating to sleep quality including the important components of sleep quality, these being sleep duration, sleep latency and the frequency and severity of specific sleep-related problems.

Diaries

Sleep diaries or sleep logs are usually kept by the individual. The sleep diary is a record of the individuals sleeping and waking times with related information, the diary is usually kept over several weeks. The diary is self-reported or can be used by the caregiver on the patient's behalf.

The sleep diary is a tool which is used by clinicians (Perlis, Jungquist, Smith & Posner, 2005). It is often a useful tool used to diagnose and treat circadian rhythm disorders and in monitoring whether the treatment used for the disorder is useful. Sleep diaries can often be used alongside actigraphy. Not only is the sleep dairy a useful tool for clinicians but it is also useful for the patient in order to understand the parameters which are affecting their sleep. This alone can often help individuals understand and self-diagnose their sleep.

3.2.6.2 Nocturia

There are a variety of Patient-Reported Outcome (PRO) instruments as mentioned earlier specifically designed to measure the impact of sleep disturbance in the general population or a patient-specific population including patients with LUTS. The American Urological Association Symptom Index/International Prostate Symptom Score (AUA-SI/IPSS) and the Nocturia, Nocturnal Enuresis, and Sleep-interruption Questionnaire (NNES-Q) address sleep disturbance in a more restricted lower urinary tract symptoms context and with a focus on nocturnal voiding, respectively (Barry, Fowler, O'leary et al, 2017; Bing, Moller, Jennum et al, 2006). However, the aforementioned measures are not specific to nocturia or were not specifically developed in accordance with the US Food and Drug Administration's guidance

for patient-focused outcome measurement (Food and Drug administration, 2006 and Food and Drug administration, 2019).

The authors point out that the administrative documents stipulate that PRO measures referenced in product labelling must accurately reflect the patient experience and be developed using extensive input from patients in the population of interest and based on appropriate methodology. The NSQS was developed to plug a gap in the literature but more importantly the scale was developed and refined on the basis of literature review, concept elicitation and cognitive debriefing interviews with patients and consultations with clinical experts (Romano, Lewis, Barrett et al, 2019). The NSQS was designed to assess the impact of nocturia on sleep in a clinical trial setting. Previous cognitive debriefing interviews conducted with patients who had nocturia have confirmed the comprehensiveness of the NSQS and its relevance, providing support for the content validity and ability of items to reflect patient perception of important, meaningful, and relevant nocturia-related sleep impact (Romano, Lewis, Barrett et al, 2019).

3.2.6.3 Quality of Life

Gill and Feinstein (1994) highlight that there are at least 150 instruments to measure QoL. For the present study five QoL measures were considered; the General Health Questionnaire-12 (GHQ-12) (Goldberg and Williams 1988), the Health-Related QoL Questionnaire (HRQOL) (Centers for Disease Control and Prevention, 2000), the Quality of Life Scale (QoLS) (Flanagan, 1978), the World Health Organisation Quality of Life Instrument (WHOQOL-BREF) (WHO, 2012), and finally the Global Quality of Life Scale (Hyland and Sodergren, 1996).

The authors previous experience of using a range of instruments to measure QoL was taken into consideration along with the aims and objectives of the current study to determine the most favourable scale,

Table 3.1 highlights the reasons for not selecting the five listed quality-of-life scales.

Table 3.1

Reasons for not selecting/opting out of the five quality of life scales listed.

Name of scale	Authors	Year developed	Aims of scale	Number of dimensions/items	How is it used	Reasons for opting out
General Health Questionnaire-12	Goldberg and Williams	1988	The scale was originally designed as a screen for risk for common mental disorders, but has also been used as a measure of general symptom load Positive mental health and minor psychological problems.	12 items (Originally intended as a unidimensional measure but now a multi-dimensional scale. Derived from the original 60-item version.	Mental health screening specifically for screening at risk sub-groups for developing severe psychopathologies.	Not screening participant specifically at risk of developing mental health related psychopathologies.
Health-Related QoL Questionnaire	Centers for Disease Control and Prevention	2000	Several studies have been published evidencing the validity of the HRQOL. Responses have also been shown to correlate as expected with other established measures related to health, such as the Medical Outcomes Study Short Form.	Combines three separate modules to assess perceptions of HRQOL rather than sub-scales.	Widely used by health professionals and was designed to bridge the gap between disciplines, such as sociology, psychology, and economics, about the drivers of QOL. It is for this reason that the questionnaire is fairly broad in its focus.	Similar to the SF-36 but with a health focus.

Name of scale	Authors	Year developed	Aims of scale	Number of dimensions/items	How is it used	Reasons for opting out
The Quality-of-Life Scale	Flanagan	1978	Moves away from the causal indicators of QoL and focusses on QoL *per se.*	16 domains (originally 15 domains).	Most widely and commonly used in the health-care sector – adapted for use in chronic illness groups.	Not focussing on a chronic condition but trying to ascertain if participants are voiding more than once per night in the first instance.
Global Quality of Life Scale	Hyland and Sodergren	1996	The aim was to construct a new type of scale measuring global quality of life (QOL) scale deriving from the Borg symptom scales and compared four versions of this new type of scale (H scale) with four category rating (CR) scales and four visual analogue (VA) scales.	Rather than adopting a multi-dimensional (or multi-domain) approach the authors argue respondents can mentally apply their own weighting system when assessing the various facets of their life. Users can make an overall judgement about their QoL by indicating a number on a scale ranging 100-0.	Can be used by anyone and anywhere.	Not keen on the idea of participants rating their own QoL score.

3.2.6.4 Mood

It is well established and recognised that both depression and anxiety are closely related (Beuke, Fischer and McDowall, 2003), but they may be associated with specific distinct causes and consequences (Ingram, 1989). Beuke et al argue that anxiety and depression should not be researched in isolation but jointly as argued previously (Ingram, 1989; Ingram & Hamilton, 1999). Additionally, even when both concepts are measured together, there appears to be methodological difficulties which can confuse their effects.

One of the reasons considered for measuring both anxiety and depression together is to avoid duplication of effort and to be able to interpret cross-relationships between the two concepts rather than not giving this a consideration (Eysenck, 2001). Theoretically, anxiety and depression are highly associated in both unselected and clinical populations (Clark & Watson, 1991a), further it has also been suggested that studying the two concepts separately is meaningless (Beuke et al, 2003). Nonetheless, this argument has been discounted. Ingram & Hamilton (1999) argue that the investigators are either interested in studying anxiety or

depression, and the two concepts are distinct enough to warrant a separate view (Williams, Watts, MacLeod, & Matthews, 1997).

Finally, experimental rigor is an important concept to bear in mind when measuring anxiety and depression and numerous studies in the mid to late eighties have illustrated this point with the classic emotional Stroop task where participants are asked to name the colours of neutral or emotionally valanced words.

In similar vain to selecting the quality of life scales, a similar approach was adopted with the mood related scales, the focus being to measure both anxiety and depression, the scales considered were: the Spielberger State-Trait Anxiety Inventory (STAI), (Spielberger, Gorsuch, Lushene et al, 1983), the Beck Depression Inventory (BDI), (Beck, Ward, Mendelson et al, 1961), the Endler Multidimensional Scales (EMAS), (Endler, Cox, Parker et al, 1992) and finally the Depression and Anxiety Stress Scales (DASS), (Lovibond & Lovibond, 1995). A similar decision algorithm was adopted in deciding which scale is to be utilised in the current study and the author decided upon the HADS questionnaire.

3.2.7 Consent

Participants were required to consent freely and voluntarily to participate and were given sufficient information to enable them to make an informed choice on whether to participate. Study advertisements (Appendices 7) were posted online to recruit as well as to provide a brief outline of the research explaining that full details were available in the link provided to access the study and to contact the researcher with any further questions. Individuals who accessed the study link were provided with full study details including the purpose of the research and what participation would consist of (Appendices 5). The benefits of taking part in the study were explained to be contributing to the research area and how nocturia is a multidimensional complicated condition, which is highly prevalent in women across the lifespan, which can have a significant impact upon women's health and is associated with anxiety, depression, poor work productivity and cognition and poor quality of life. Participants were made aware that once complete, the final research report would be made available on the University of the West of England's open-access research repository and that a copy could be made available to them if they requested. Furthermore, participants were informed that the research may also be submitted for publication in an academic journal upon completion.

A consent form (Appendices 6) was included as part of the questionnaire pack following the detailed participant information sheet to ensure transparency. Participants were encouraged to

download and keep a copy of both the participant information sheet and consent form. Questionnaires were only available to participants once they had provided consent to take part and confirmed they met the eligibility criteria. If a participant did not consent or in the instance where exclusion criteria applied, the questionnaires were not displayed, and they were taken to the end of the study page.

3.2.8 Withdrawal

Within the participant information sheet displayed to participants prior to consenting to take part in the research, it was explained that participation was entirely voluntary and that they were able to withdraw their consent by contacting the research team and providing the anonymous participant number which had been generated for them and asked to be noted with regards to any future correspondence. Due to timescales of the data collection and write up, participants were able to withdraw from the study up to one month after the date of which they completed the study which was made clear in the information sheet provided. At the end of the survey participants were shown a debrief sheet displayed at the end of the survey containing further information on any of the areas within the research and signposted to relevant services both locally and nationally (Appendices 8).

3.2.9 Risk

Risk is defined as the 'potential physical or psychological harm, discomfort or stress to human participants' as a result of research' (BPS, 2021). A risk assessment was carried out and submitted to the Research Ethics Committee within the ethics application (Appendices 9). Negligible risks were anticipated including possible distress as a result of potentially sensitive topics such as nocturia, living with nocturia, sleep quality and the impact upon an individual's quality of life, and potential loss of data. Control measures were put in place and no further action was necessary. It was made clear to participants that they were able to stop completing the questionnaires at any time if they felt uncomfortable.

3.2.10 Confidentiality

Careful consideration was taken to ensure personal data was kept confidential and secure. Qualtrics was used to distribute the questionnaire and manage data securely online. Participants accessed the study using an anonymous link to ensure participant confidentiality and anonymity and no identifiable information was collected from participants. To ensure data could be located in the event of an individual requesting to withdraw their data from the study,

participants were asked to create and write down an anonymous code, Qualtrics also created a unique code which could be matched up with the data entered alongside the individual participant code to allow for more clarity should a participant want to be excluded or withdrawn.

3.2.11 Debriefing

Participants were provided with a debrief sheet (Appendices 8) following completion of the questionnaire and asked to download a copy for their own reference and in case of the wish to withdraw later this contained further information where participants could seek further guidance and help should they wish to do so.

3.2.12 Data analyses

Data were analysed using SPSS version 28.0.0.0 (IBM Corp, 2021) and Jamovi 2023.

3.3 Results

The results section is divided into 8 main sections: Demographic characteristics of participants, lifestyle questions including sleep disorders from a family perspective, sleep disorders and behaviours, daytime sleepiness, nocturia status, QoL, and general health and well-being including mental health, and depression and anxiety.

3.3.1 Demographic characteristics

This section shows a breakdown of the demographic characteristics; age, height and weight, BMI, smoking status, and the percentage of participants who reported alcohol consumption and those who reported exercising per national guidelines along with parous status.

Table 3.1

3.3.1 General characteristics of participants.

Table 3.2 shows the participants age recorded in years with mean (M) and standard deviations (SD) reported along with the minimum age and maximum age of the participants recorded, it then goes onto show the weight (in kilograms), height (in centimetres) with minimum and maximum values recorded. Body mass index (BMI), smoking status, alcohol consumption, caffeinated beverages consumed along with exercise was also collected and reported and finally parous status too.

Variable	*M*	*SD*	*N (%)*	*Minimum*	*Maximum*
Age (Years)	42.76	13.31		**19**	**86**
Weight (Kilograms')	71.08			**44**	**200**
Height (Centimetres)	165.06			**125**	**198**
Body mass index* (BMI)					
<18.5			3.4		
18.5-25			**53.1**		
25-30			24.9		
>30			18.6		
Smoking status					
No			**90.6**		
Yes			9.4		
Alcohol consumption					
No			31.7		
Yes			**68.3**		
Caffeinated beverages consumption					
No			23.3		
Yes			**76.7**		
Exercise					
No			17.2		
Yes			**82.2**		
Parous status					
Never given birth			75 (41.7)		
Given birth			**105 (58.3)**		

*BMI Less than 20 — Under Weight, **BMI 20-25 — Normal Weight**
BMI 25-30 — Over Weight, BMI 30-40 — Obese, BMI Over 40 — Severely Obese

The youngest participant was aged 19 years and the oldest participant who took part was 86 years of age. Participants had a mean weight of 71.08 kg with a minimum score of 44 kg and a maximum score of 200 kg. Height scores varied between 125 cm to 198 cm. Majority (53.1%) of the participants were noted to sit within the 18.5-25 BMI category which is seen as being

normal weight values within the United Kingdom (UK). Majority of the participants (90.6%) reported a no smoking status, two thirds of participants (68.3%) reported to consume alcohol followed by 76.7% participants reporting to drink caffeinated beverages throughout the day. This group of participants were also reported to exercise daily (82.2%) and just over half the participants (58.3%) had reported in giving birth.

3.3.1.1 Ethnicity

The section shows the ethnic background of participants within this study

Table 3.3

Breakdown of participants ethnic groups

Table 3.3 shows the breakdown of which ethnic groups each participant belonged to.

Ethnicity	*Percentage N (%)*
White British English	**95 (52.8)**
Scottish	4 (2.2)
Welsh	**12 (6.7)**
Irish	1 (0.6)
Other	4 (2.2)
Any other White background	**11.7 (11.3)**
Mixed	1 (0.6)
Mixed White and Black Caribbean	1 (0.6)
Mixed White and Black African	1 (0.6)
Mixed White and Asian	1 (0.6)
Asian, Asian British, Asian English, Asian Scottish, or Asian Welsh (Indian)	**22 (12.2)**
Asian, Asian British, Asian English, Asian Scottish, or Asian Welsh (Pakistani)	1 (0.6)
Asian, Asian British, Asian English, Asian Scottish, or Asian Welsh (Bangladeshi)	1 (0.6)
Any other Asian background	2 (1.1)
Black, black British, Black English, Black Scottish or Black Welsh (Caribbean)	5 (2.8)
Black, black British, Black English, Black Scottish or Black Welsh (African)	1 (0.6)
Any other Black background	2 (1.1)
Chinese, Chinese British, Chinese English, Chinese Scottish, Chinese Welsh, or other ethnic group (Chinese)	1 (0.6)
Any other background	4 (2.2)
Total	180 (100)

Majority of the participants identified as White British English (52.8%), followed closely by Asian, Asian British, Asian English, Asian Scottish (12.2%), 11.7 % of participants identified as any other White background, and 6.7% as Welsh.

Occupational status

3.3.1.2 Socio-economic status

This section displays information relating to the participants social economic status (SES). This information was extracted from *The National Statistics Socio-economic Classification User Manual (Appendices 3) (Office for National Statistics SOC2010).* For the current study, patients and participants were asked to state their main occupation, this data was then coded into the categories below according to *The National Statistics Socio-economic Classification User Manual.*

Table 3.4

Social economic status of all participants

Table 3.4 shows the breakdown of the different employment background that the participants have stated in the questionnaire.

Occupation type	*Percentage N (%)*
Employees in large establishments	3 (1.7)
Lower supervisory occupations	1 (0.6)
Lower technical occupations	4 (2.2)
Semi-routine occupations	2 (1.1)
Routine occupations	1 (0.6)
Never worked and long-term unemployed	3 (1.7)
Full-time students	7 (3.9)
Retired	2 (1.1)
Higher managerial and administrative occupations	8 (4.4)
Higher professional occupations	**94 (52.2)**
Lower professional and higher technical occupations	**25 (13.9)**
Lower managerial and administrative occupations	9 (5.0)
Higher supervisory occupations	3 (1.7)
Intermediate occupations	3 (1.7)
Employers in small establishments	1 (0.6)
Own account workers	7 (3.9)
Not applicable	7 (3.9)
Total	180 (100)

What was interesting to note is that majority of the participants (52.2%) reported to work within the *higher managerial and administrative occupations* followed closely by 13.9% of

participants reporting to work within *lower professional and higher technical occupation.* Participants reported their occupation using the study questionnaire, and *The National Statistics Socio-economic Classification User Manual (Office for National Statistics SOC2010)* was used to then identify and group participants into the categories noted in Table 3.4.

3.3.1.3 Highest level of education achieved

Table 3.5

Breakdown of educational qualifications across all participants

Table 3.5 shows the highest level of education that the participants have reported.

Educational qualification type	*Percentage N (%)*
None or not applicable	3 (1.7)
O' Levels/GCSE's/BTEC	5 (2.8)
A 'Levels/NVQ/Equivalent	13 (7.2)
Apprenticeship	1 (0.6)
Certificate	13 (7.2)
HND/Equivalent	4 (2.2)
BSc/BA/Equivalent	**53 (29.4)**
MA/MSc/MPhil/Equivalent	**54 (30.0)**
Professional Doctorate/PhD/DPhil/Equivalent	**33 (18.3)**
MBA	1 (0.6)
Total	180 (100)

30% of participants within the study reported as being educated to a master's level qualification of equivalent, followed closely by just under thirty percent (29.4%) educated to a bachelor's level education or equivalent and 18% reported as being educated to a doctoral level education or equivalent. One participant reported to be educated to MBA level.

3.3.1.4 Lifestyle questions

This section will cover specific lifestyle questions that were asked as part of the data collection. The survey included a wide range of lifestyle questions but only questions on menopausal status, beverage consumption, time of day caffeinated beverage consumed, the type of physical activity undertaken by participants have been specifically selected and reported here and finally two questions which ask participants if they have had any specific illness, they have had in the last three months and ever had across their lifetime.

Menopausal status

Table 3.6

The menopausal status of participants across the study

Table 3.6 shows the percentage of women within a specific category according to their menopause status.

Menopausal status	*Percentage N (%)*
Premenopausal	3 (1.7)
Perimenopausal	10 (5.6)
Menopausal	**29 (16.1)**
Other	4 (2.2)
N/A	**134 (74.4)**
Total	180 (100)

Participants were provided with both a detailed description of what each phase of the menopause was and a link to the NHS website too detailing both description and symptoms of each phase. As part of the data collection, participants were also asked the date of their last menstruation to confirm the status. It is important to note that the response to this question is subjective and no further clinical tests were undertaken or performed to confirm the status.

A total of 180 participants (100%) of all participants provided a response to the question. Participants were offered five specific categories to respond to which are detailed in Table 3.6. The *not applicable* (*N/A*) category was aligned to the post-menopausal status and the *other* category was for those who had some form of medical intervention which ceased their menstrual cycle. Surprisingly, 74.4 % of participants selected the *N/A* category and 16.1% of participants identified as being *menopausal*.

Beverage consumption

Table 3.7

The percentage of participants who consume caffeinated beverages and the type of caffeinated beverage drank.

Question	*N (%)*
Do you drink caffeinated beverages?	
No	42 (23.3)
Yes	**138 (76.7)**
Total	180 (100)
Type of caffeinated beverage consumed	
Tea	**48 (26.7)**
Coffee	**79 (43.9)**
Energy drinks	2 (1.1)
Caffeinated cold beverages	9 (5.0)
Other	1 (0.6)
Not applicable/None	**41 (22.8)**
Total	180 (100)

A large proportion of participants (76.7%) reported to *drink caffeinated beverages*, when asked what type of caffeinated beverage was consumed, the majority of participants (43.9%) reported to drink *coffee* as their preferred caffeinated beverage followed closely by *tea* consumption (26.7%). Interestingly a similar number reported to *not drink caffeinated beverages* (23.3%) and chose *not applicable* when asked *type of caffeinated beverage consumed* (22.8%).

Time of day caffeinated beverage consumed

Table 3.8

What time of day the last caffeinated beverage was consumed, specifically AM or PM

Time of last beverage consumed	*N (%)*
AM	57 (31.7)
PM	**82 (45.6)**
N/A/None	41 (22.8)

It is interesting to observe that a large proportion of participants (45.6 %) reported to consumer their last caffeinated beverage within the PM range. Participants were asked the exact time of the day that they would have their caffeinated beverages.

Type of physical activity undertaken

Table 3.9

The type of physical activity undertaken by the participants

Type of physical activity	*N (%)*
Aerobic	**126 (70)**
Flexibility training	13 (7.2)
Resistance training	10 (5.6)
Other	1 (0.6)
None	**30 (16.7)**
Total	180 (100)

As part of the data collection process a series of questions aligned to undertaking and engaging in physical activity were asked. Questions focussed on type of activity undertaken, duration of activity and the number of days the activity was repeated. However, to remain focussed on the study question, the researcher decided to specifically include the type of activity undertaken by participants. Four broad categories were selected to then identify which type of activity could be labelled as either *aerobic*, *flexibility training*, *resistance training* and *other*. None as a category was included for those participants who did not engage in any type of physical activity.

70% of participants reported in undertaking some form of aerobic activity and 16.7% participants did not undertake any form of physical activity.

3.3.1.5 Current Illnesses or physical disorder that patients and participants have at present or have had in the past 3 months

Data for this section was compiled and categorised using the British *National Formulary, BNF 83, March -September 2022.* Participants were asked to state; *Current illnesses or physical disorders that they may have at present or have had in the past 3 months* and *Any illness or physical disorder that participants have ever had.* This data was then coded into the categories displayed below using the medical headings used in the BNF. Not all categories have been displayed only those that represented the illnesses/disorders that the participants have stated in the study questionnaire.

Table 3.10 shows the breakdown of the various disorders that the participants have stated in the last 3 months.

Table 3.10

Current illnesses or physical disorder that participants have at present or have had in the last 3 months.

Name any illness or physical disorder you have at present or have had in the last 3 months	*N (%)*
Skin disorders	3 (1.7)
Ear, nose, oropharynx disorders	**22 (12.2)**
Cardiovascular disorders	5 (2.8)
Gastro-intestinal system disorders	5 (2.8)
Obstetrics, gynaecology and urinary tract disorders	7 (3.9)
Musculoskeletal and joint diseases disorders	**14 (7.8)**
Endocrine system disorders	**13 (7.2)**
Central nervous System disorders	4 (2.2)
Psychiatric disorders	5 (2.8)
Respiratory disorders	**11 (6.1)**
Neurological	2 (1.1)
Infectious disease	1 (0.6)
Autoimmune disease	2 (1.1)
None stated	**89 (47.8)**
Total	180 (100)

A large percentage of participants (47.8%) reported not having any illness or physical disorder either at present or in the last three months of completing the survey. The category of *ear, nose oropharynx* related disorders were reported as the highest (12.2%) which was not a surprising occurrence as the data was collected soon after the height of the pandemic in 2022. Some participants also reported to have had *musculoskeletal and joint diseases disorders* (7.8%), e*ndocrine system disorders* (7.2%), and *respiratory disorders* (6.1%).

3.3.1.6 Illnesses or physical disorders that participants have ever had.

Table 3.11 shows the number of participants who have reported to have ever had any of the physical disorders as listed in the table below.

Table 3.11

Any illness or physical disorder that participants have ever had.

Name any illness or physical disorder you have at present or have had in the last 3 months	*N (%)*
Skin disorders	1 (0.60
Ear, nose, oropharynx disorders	2 (1.1)
Gastro-intestinal system disorders	3 (1.7)
Obstetrics, gynaecology and urinary tract disorders	**8 (4.4)**
Musculoskeletal and joint diseases disorders	5 (2.8)
Endocrine system disorders	**9 (5.0)**
Central nervous System disorders	1 (0.6)
Psychiatric disorders	7 (3.9)
Respiratory disorders	6 (3.3)
Neurological	3 (1.7)
Infectious disease	**10 (5.6)**
Childhood illnesses	1 (0.6)
Cardiovascular systems	1 (0.6)
None stated	**123 (68.3)**
Total	180 (100)

Surprisingly, 68.3% of participants reported as never having had any illness or physical disorder. However, those participants who did report to have had an illness or physical disorder fell into the following categories: *infectious diseases* (5.6%), followed by *endocrine system disorders* (5.0%) and finally *obstetrics, gynaecology and urinary tract disorders* (4.4%).

3.3.1.7 Sleep disorders from a family perspective

This section will provide insight into any observed and self-reported sleep disturbances within the family. Participants were also asked to report any sleep disturbances or disorders within their immediate family that they may be aware of, they were also asked to report who the family member was and what the problem is.

Table 3.12 show the different family members who have been observed with sleep disturbances or sleep disorders by the participants.

Table 3.12

Sleep disturbances in other family members as reported by participants

Does anybody in your family suffer from a sleep problem? *Who* is the problem?	*N (%)*
No	**118 (65.6)**
Mother	**15 (8.3)**
Father	6 (3.3)
Sibling	**10 (5.6)**
Grandparents	2 (1.1)
Other	**29 (16.1)**
Total	180 (100)

What is interesting to note is that approximately 65.6 % of participants reported nobody in their family to suffer from a sleep problem. However, there were 16.1% of participants who did select "*other*" person to have sleep problem. It was made clear in the survey that the "other" individual should not include a bed partner as this question is asked in the PSQI.

Further, those participants who did identify family members to suffer from a sleep problem were either *mother* (8.3%) and *siblings* (5.6%). Participants were also asked to identify what the sleep problem once in their family member, this is addressed in the Table 3.13.

Sleep disorders from a family perspective

Of the family members who were identified to have sleeping disorders, the participants were also what the sleep problem was. Table 3.13 shows both the number and percentage of participants family members with a specific sleep problem. The sleep problems have been grouped according to the classification of sleep disorders which is a manual published by the American Academy of Sleep Medicine.

Table 3.13

What the sleep problem is amongst family members identified by participants

What is the problem∗?	*N (%)*
Insomnia	**17 (9.4)**
Sleep disorders associated with other conditions	1 (0.6)
Other psychiatric or behavioural disorders	7 (3.9)
Sleep related breathing disorders (SRBD)	**13 (7.2)**
Circadian rhythm sleep disorders (CRSD)	4 (2.2)
Parasomnias	2 (1.1)
Sleep related movement disorders (SRMD)	2 (1.1)
Isolated symptoms, normal variants and unresolved issues	6 (3.3)
Other, not related to sleep issues	3 (1.7)
None	**125 (69.4)**
Total	180 (100)

∗The AASM International Classification of Sleep Disorders – Third Edition, Text Revision (ICSD-3-TR)

Approximately 69.4% of those who were identified to have some sleep problem reported having no problem, similar to the question in Table 3.12. Interestingly, just under ten percent (9.4%) of participants reported their family member as having *insomnia* followed closely by 7.2% to experience *sleep related breathing disorders (SRBD)*.

3.3.2 Sleep and disorders and behaviours

PSQI component scores

This section will focus on reporting the preliminary findings from the PSQI and the GSQS questionnaire.

The PSQI has seven component scores and one global score as reported in Table 3.14.

Table 3.14

The mean and standard deviations of the PSQI seven component scores and global score

PSQI Component	*Mean**	*Std. Dev*
Subjective sleep quality	**2.23**	**0.684**
Sleep latency	0.93	1.014
Sleep duration	0.95	0.917
Habitual sleep efficiency	0.87	1.080
Sleep disturbances	1.34	0.542
Use of sleeping medications	0.28	0.749
Daytime dysfunction	1.09	0.687
PSQI global score	**7.69**	**3.408**

*N=180

The PSQI consists of 19 self-rated questions and five questions are rated by the bed partner or roommate (but these questions have not been included in the analysis as they are for clinical use only). The 19 remainder questions assess a wide range of factors relating to sleep quality; this includes estimates of sleep duration and latency and of the frequency and severity of specific sleep-related problems. These 19 items are then grouped into seven component scores, each score is weighted equally on a 0 to 3 scale. *Subjective sleep quality* was notably higher in comparison to other component scores, mean 2.23 (SD = 0.684).

The seven component scores are then summed to yield a global PSQI score which has a range of 0 to 21. Higher global scores indicate worse sleep quality. A cut off score of > 5 for the *PSQI global score* indicates relatively poor sleep. PSQI total scores for the 180 participants ranged from 0 to 21 with a mean score of 7.69 (SD = 3.40).

Table 3.15

PSQI time variables for questions asking for answers on a time scale (bedtime, sleep latency, get up time and sleep duration), and range of scores with minimum, maximum scores.

Time (24HR) variables related to the PSQI	*Range/mode*	*Minimum*	*Maximum*	*Mean**	*Std. Dev*
Time to go to bed	23.40	**00.00****	**23.40**	18.46	8.06
Time it took to fall asleep	**30**	0 minutes	**480 minutes**	33.03	46.43
Getting up time	18.30	**02.00**	**20.30**	7.06	1.43
Sleep Duration	8.5	**2.5**	**11**	6.80	1.41
Number of hours spent in bed	16.30	**5.30**	**22.0**	8.30	1.50
Hours of sleep per night	8.5	2.50	11.0	6.76	1.4

*N=180
**Denotes midnight

This group of participants range for *time to go to bed* differed a great deal. Minimum time to go to bed was reported as midnight and the latest time (maximum score) was reported as 23.40 (using the twenty-four-hour clock) with a mean of 18.46 (SD = 8.06). On average it took participants *30 minutes to fall asleep* with some reporting 0 minutes to fall asleep and the maximum time reported as 480 minutes with a mean score of 33.03 (SD = 46.63). *Getting up time* varied a lot too from one participant reporting waking up at 0200 (in the morning) and one participant reporting waking up at 20.30 (in the evening) with a mean score of 7.06 (SD = 1.43). Interestingly, participants reported an average of 8.5 hours of *sleep duration* with a minimum score of 2.5 hours and a maximum score of eleven hours, mean score of 6.80 (SD = 1.14). However, the *number of hours spent in bed* revealed a different picture with on average 16.30 hours reported in bed with a minimum time of 5.30 hours and a maximum time of twenty-two hours. *Hours of sleep* were reported the same as sleep duration with a range of 8.5 hours, mean score of 6.76 (SD = 1.4).

The Groningen Sleep Quality Questionnaire

Sleep quality

The quality of sleep was assessed using the self-administered 15-item GSQS through the translated Groningen Sleep Quality Questionnaire (GSQQ). Participants were asked not to leave any item blank and to check the most correct responses. GSQS scores (GSQS) range from 0 to 14, a higher score indicating lower subjective quality of sleep. Originally, the scale was created to study sleep problems in depression. In a validation study with 80 depressed inpatients, the mean score on the scale was 6.0 ± 4.2 and Cronbach's alpha for internal consistency was 0.88 (Mulder-Hajonides van der Meulen and van den Hoofdakker, 1984; unpublished data).

Table 3.16

The Groningen Sleep Quality Questionnaire global score with mean and standard deviation reported.

Variable	*Mean**	*Std. Dev*
GSQS total score	5.36	2.60

*N=180

A score of 6 or higher indicates disturbed sleep during the previous night, whereas a score of 0 – 2 indicates normal refreshing sleep. The participants in this study scored a mean of 5.36 (SD = 2.60).

3.3.3 Nocturia

This section will focus on the results obtained from the Nocturia Sleep Quality Scale (NSQS). The NSQS is a newly developed patient-reported outcome focussed scale developed to capture the nocturia-specific impact on patients' sleep and to provide a patient-centred framework to evaluate treatment benefits with current and emerging nocturia treatments. The NSQS is a brief, 14-item patient-reported measure designed to assess the impact of nocturia on sleep. The tool is designed for use in a clinical trial setting and was developed in full alignment with the FDA PRO guidance. The developmental version of the tool consists of six items assessing hypothesised domains of a number of night-time awakenings, sleep quantity, and sleep quality. These items are designed to be both gender and culturally neutral. The scale is used to collect data over a specific time period and then to calculate average scores over a specific time period.

Table 3.17

The Nocturia Sleep Quality Scale composite scores and global score with minimum, maximum values and means and standard deviations reported.

Variable	*Minimum*	*Maximum*	*Mean**	*Std. Dev*
Lost sleep time score	2.33	8.67	3.68	1.66
Impacts score	2.33	9.67	6.25	1.50
Total score	5.17	18.67	10.56	2.72

*N=178 (NSQS were scored according to the instrument developers' guidelines (including missing data rules).

What is interesting to observe is the NSQS scores reported in table 3.17 are similar to the scores reported in the original development of the NSQS by Romano et al (2019). There are no cut-off scores reported to date and this is the second study to have used the NSQS. Further work by Williams et al (2021) recruited participants with night-time voids ≥ 2 and experienced sleep disturbance due to nocturia ≥ 2 to having to wake up during the night to urinate and experiencing disturbed sleep.

3.3.4 Quality of Life

The SF-36 was designed to be a brief yet comprehensive measure of general health status. The SF-36 questionnaire consists of eight scales yielding two summary measures: transformed physical and transformed mental health. The physical health measure includes four scales of physical functioning (10 items), role-physical (4 items), bodily pain (2 items), and general health (5 items). The mental health measure is composed of vitality (4 items), social functioning (2 items), role-emotional (3 items), and mental health (5 items). A final item, termed *self-reported health transition*, is answered by the participant but is not included in the scoring process. The SF-36 offers a choice of recall format at a standard (4 week) or acute (1 week) time frame. This study used the former timeframe. Likert scales and yes/no options are used to assess function and well-being on this 36-item questionnaire. To score the SF-36, scales are standardised with a scoring algorithm to obtain a score ranging from 0 to 100. Higher scores indicate better health status, and a mean score of 50 has been articulated as a normative value for all scales.

Table 3.18

SF-36 – Dimensions and transformed physical and mental minimum and maximum scores with means and standard deviations reported.

Variable	*Minimum*	*Maximum*	*Mean**	*Std. Dev*
Physical Function	10	30	**27.11**	**4.41**
Physical problems	0	4	**2.84**	**1.57**
Pain	0	100	73.86	22.97
General Health	0	100	69.90	19.77
Energy/Vitality	0	95	**46.15**	**20.18**
Social functioning	0	89	61.76	23.93
Role emotional	0	3	**1.91**	**1.22**
Mental health	0	100	64.49	19.80
Transformed physical	15	45.49	**36.22**	**5.21**
Transformed mental	14.84	60.47	**41.19**	**8.74**

*N=180

Dimensions aligned to physical components such as *physical function*, *physical problems* and *energy and vitality* have extremely low mean scores of 27.11 (SD = 4.41) and 2.84 (SD=1.57)

and 46.15 (SD = 20.18) respectively. Higher mean scores were reported on *pain* 73.86 (SD = 22.97), *general health* 69.90 (SD = 19.77), and *social functioning* 61.76 (SD= 23.93). Although higher scores do indicate better health status, a mean score of 50 for each dimension is indicative of normative scores.

Another surprising observation is the score for *role emotional* with a mean score of 191 (SD = 1.22).

The transformed physical and mental scores were both reported below the normative mean scores of 50 with *transformed physical health* being 36.22 (SD = 5.21) and *transformed mental health* being reported with a mean of 41.19 (SD = 8.74).

3.3.5 Mental health

Depression and anxiety

The Hospital and Anxiety Depression Scale (HADS)

The Hospital Anxiety and Depression Scale (HADS) is a frequently used self-rating scale developed to assess psychological distress in non-psychiatric patients. It consists of two subscales, Anxiety and Depression. The HADS aims to measure symptoms of anxiety and depression and consists of 14 items, seven items for the anxiety subscale (HADS Anxiety) and seven for the depression subscale (HADS Depression). HADS Anxiety focus mainly on symptoms of generalised anxiety disorder and HADS Depression is focused on anhedonia, the main symptom of depression. Each item is scored on a response-scale with four alternatives ranging between 0 and 3. After adjusting for six items that are reversed scored, all responses are summed to obtain the two subscales. Recommended cut-off scores according to Zigmond & Snaith (1983) are 8–10 for doubtful cases and ≥ 11 for definite cases.

Table 3.19

Total HADS anxiety score, total HADS depression score and global score showing minimum and maximum values with means and standard deviations reported.

Variable	*Minimum*	*Maximum*	*Mean**	*Std. Dev*
Total anxiety score	0	21	**8.77**	**4.32**
Total depression score	2	18	5.84	2.86
Global HAD score	4	39	14.61	6.45

*N=170 (only complete scores computed)

This study revealed participants to fall between the doubtful cases for the anxiety score with a mean of 8.77 (SD = 4.32) and a relatively low score for the depression score with a mean of 5.84 (SD = 2.86). The overall HADS global score achieved a mean of 14.61 (SD = 6.45).

3.3.6 Analysis of Results

This section will predominately focus on reporting the inferential statistics of the key variables selected to test the following hypotheses:

The aims of this proposed study are:

1. To observe the impact of nocturia on womens' health and wellbeing
2. To identify which age groups are more likely to void more than once per night
3. To identify if other factors such as occupation, parous status, ethnicity, exercise, can impact nocturia
4. To identify participants who have started receiving treatment either for nocturia or another nocturia-related condition and if this improves their health and well-being scores

Quantitative hypotheses

H1: Participants who void once or more per night (suffer from nocturia) will have significantly poorer sleep (poorer quality of sleep, higher levels of disturbed sleep) along with higher scores of daytime sleepiness, lower QoL, and lower mood compared to those who void less during the night.

H2: Participants responding to treatment to help with their voiding will have significantly greater levels of QoL, improved sleep quality including subjective sleep quality, lower levels of low mood and depressive and anxiety symptoms (linked to poorer sleep) compared to those receiving no treatment.

The study aimed to investigate the extent to which the dependant variable of health and wellbeing was predicted by the independent variables of lost sleep, impact of nocturia, global PSQI score and global HAD score. A multiple linear regression was employed to examine whether there was any variance in this outcome variable. Consideration was given to alternative forms of hypothesis and analysis, including Chi-square and moderation and mediation. Given the lack of available research that affords an understanding of the relationships between health, sleep and nocturia, it was decided that that the necessary requirements for the use of mediators and/or moderators in causal modelling were not met. Specifically, there is not enough evidence currently to specify the nature of the relationship (causal or otherwise) between sleep, women's health and well-being and nocturia. From this point onwards in the analysis of the results, Jamovi (version 2.3) was used to conduct the inferential statistics (The Jamovi Project, 2022).

3.3.6.1 Missing data

Missing data or missing values is defined as the data value that is not stored for a variable in the observation of interest. Missing data is comparatively common in almost all research and can have a significant effect on the conclusions that can be drawn from the data (Graham, 2009). There have been some studies which have predominately focused on handling the missing data, problems caused by missing data, and the methods to avoid or minimise such in medical research (Little et al., 2012; O'Neill, 2012). Missing data presents a variety of problems. First and foremost, the absence of data can reduce statistical power, second the lost data can cause bias in the estimation of parameters. Third, it reduces the representation of the samples and finally, it can lead to complicating the analysis of the study. Each of these distortions can threaten the validity and can lead to invalid conclusions.

There are a variety of methods which could be employed to handling the missing data amongst carefully planning and executing the study. It is not uncommon to have a considerable amount of missing data in a study (Kang, 2013). There are also a variety of techniques which can be used to handle missing data in a data set. Multiple imputation is a useful strategy for handling the missing data, with this technique, rather than substituting a single value for each missing data, the missing values are replaced with a set of plausible values which contain the natural variability and uncertainty of the right values. This option to replace values was not chosen as it requires stronger assumptions (Stuart et al, 2009). Initially, explorative analysis was carried out to ascertain the extent to which data was missing from the dataset. A total of 29 cases were marked as incomplete. Missing data where responses were incomplete were excluded from the final analysis.

3.3.6.2 Assumptions

Linear regression analysis was utilised to understand whether the predictor variables of lost sleep, impact of nocturia, global PSQI score and global HAD score impacted health and well-being. Initially, the data was scrutinised to examine whether the assumptions (normality, linearity, homoscedasticity, and non-multicollinearity) for regression were met (Field, 2017). Assumptions were tested for both the overall score (Global PSQI, Global HADS, GSQS total score, and the two measures of the SF-36 (transformed Physical Component Score[12] and transformed Mental Component Score[13]) and the two measures of the NSQS score (Lost sleep

[12] Physical Component Score – Referred to as PCS score from hereon with
[13] Mental Component Score - Referred to as MCS score from hereon with

time and impacts score). Assessment of assumptions was carried out on the data set prior to any further analysis took place to avoid oversensitivity to deviation from normality (Ghasemi and Zahediasl, 2012).

3.3.6.3 Normality

Normality assesses the degree to which a dataset is well modelled by normal distribution (Field, 2017). Frequency distributions tests were used to test for violation of normality for the predictor and criterion variables. Issues of non-normality are apparent when considering some of the frequency distributions. All the data points for each of the five tests used were screened for skewness and normality, the PCS and MCS scores for the SF-36 were initially fine but as an ANOVA was also going to be performed these were then transformed along with the PSQI global, GSQS, NSQS impact score and the HAD global score (see table 3.20). Frequency histograms along with box plots were performed to measure the level of skewness and kurtosis. Transformations such as square root were performed for negative distributions and Reflect and square root were performed for positive distributions. Once these transformations were performed- this corrected for skewness and kurtosis of the data.

Table 3.20

Descriptive data for transformed physical component and mental component scores for SF-36, NSQS lost sleep time and impact score, global PSQI scores, global HAD and global GSQS score. with scores for skewness and kurtosis.

	Transformed PCS	Transformed MCS	NSQSLost SleepTime_	NSQS_ Impacts_	Global_ PSQI_	Global HAD	GSQS Total
N	151	151	151	151	151	151	151
Mean	36.7	41.7	3.64	6.32	7.37	14.4	5.14
Std Dev	4.43	7.65	1.56	1.33	3.13	5.52	2.60
Max	45.5	56.4	7.67	9.67	15	30.0	12.1
**Skewness	-0.462*	-0.569*	0.883	-0.597	0.514	0.301	0.411
***Std. error skewness	0.197	0.197	0.197	0.197	0.197	0.197	0.197
****Kurtosis	-0.276	-0.210	-0.306	1.06	-0.383	-0.507	-0.340
*****Std. error kurtosis	0.392	0.392	0.392	0.392	0.392	0.392	0.392

*A negative value indicates left side of the distribution, which extend more towards negative values.
**Skewness between -0.5 & 0.5 = symmetrical data, skewness between -1 & -0.5 = negative skewness, skewness between 0.5 & 1 is positive skewness.
***The ratio of skewness to its standard error can be used as a test of normality (that is, you can reject normality if the ratio is less than -2 or greater than +2).
****A positive value for the kurtosis indicates a distribution more peaked than normal. In contrast, a negative kurtosis indicates a shape flatter than normal.
*****A test of normality, normality should be rejected if the ratio is less than -2 or greater than +2.

3.3.6.4 Linearity and Homoscedasticity

In order to ensure that data were suitable for a regression, further tests of linearity and homoscedasticity were conducted, this is to ensure that the relationship between the outcome and predictor variables are linear and homoscedastic. Linearity for the data was assessed using scatterplots (Hair 2006; Pallant 2001). The scatterplots did represent linear rather than curvilinear plots.

Table 3.21

Transformed scores for the physical score and the mental score for the SF-36 scores and transformed global PSQI scores.

	Transformed_Phys	**Transformed_Mental**	**Transformed_Global PSQI**
N	151	151	151
Mean	3.05	4.37	2.65
Standard deviation	0.728	0.858	0.582
Skewness	-0.123	0.134	0.0335
Std. error skewness	0.197	0.197	0.197
Kurtosis	-0.245	-0.422	-0.422
Std. error kurtosis	0.392	0.392	0.392

There are a number of authors and academics who propose that to employ the use of linear regression models, data should meet the "normality assumptions" this is a misconception (Li et al, 2012). Further, statistical guides do indicate that the requirement is for the residuals, or for the prediction error. This is the deviation of the model prediction results from observed results to be normally distributed, rather than independent and dependent variables (Dancey and Reidy, 2007; Field, 2017).

3.3.6.5 Multicollinearity

Farooq (2017) and Mishra (2016) define multicollinearity as a high correlation between measured variables and violates the supposition of independence of regressor variables in linear regression models. Multicollinearity is implied when linearly correlations between regressor variables indicate high incidences of correlation (Field, 2017). A high degree of multicollinearity amongst regressor variables has little impact upon the accuracy of regression coefficients, strong multicollinearity amongst these variables can lead to a failure to reject a false null hypothesis (type II error).

3.3.6.6 Model assumptions summary

In summary, the assumptions for linear regression are normality, linearity and homoscedasticity, and multicollinearity. There are no issues of multicollinearity, all data are linear and homoscedastic, and residuals are normally distributed. These indicate that it is appropriate to progress to regression modelling.

3.3.9 Correlations

Pearson's Correlations were calculated to determine the nature of the relationships between the potential predictor variable (NSQS Impacts score) and outcome variable (Minutes of exercise per week). These are outlined in Table 3.22. In addition, correlations between the global PSQI score and minutes of exercise per week undertaken by participants is also presented in Table 3.22.

Table 3.22

*Pearson's correlation matrix for the **NSQS Impact score** and the minutes of exercise undertaken per week.*

	Minutes of exercise undertaken per week	NSQS Impacts score
Minutes of exercise undertaken per week	-	-
NSQS Impacts score	**0.160***	-

**Significant difference, p<0.05*

The Pearson's Correlation revealed a significant result for the minutes of exercise completed by each participant and the NSQS Impacts score.

Table 3.23

*Pearson's correlation matrix for the **Global PSQI** score and the minutes of exercise undertaken per week.*

	Minutes of exercise undertaken per week	Global PSQI score
Minutes of exercise undertaken per week	-	-
Global PSQI score	-0.073	-

The Pearson's Correlation between the minutes of exercise completed by each participant and the Global PSQI score did not reveal any significant findings.

3.3.10 Linear Regression

Multiple linear regression was carried out to determine the effect of the two summary scales (PCS and MCS) from the SF-36 survey as the outcome variable. In Jamovi one predictor variable and one continuous outcome variable is needed with set measurement levels (scale of measurement[14]).

SF-36 Physical Health Model

The first multiple regression ascertained the extent to which the SF-36 PCS was predicted by the NSQS lost sleep time subscale, NSQS Impacts subscale score, Global HAD score and the Global PSQI score. The model was significant ($F(3.87,146)=0.09$, $p=0.005$) indicating that the results were unlikely to have arisen by chance, assuming the null hypothesis to be true. The adjusted R^2 of .071 indicated that 7.1% of the variance in SF-36 transformed physical health can be explained by the variance in predictor variables. The model indicates that the NSQS lost sleep time subscale score ($p=0.001$) was the most influential. This was the only significant predictor of the SF3-36 transformed physical health score. The results of this analysis are presented in Table 3.24.

Table 3.24

SF-36 Physical Health Regression Model

Model Summary	Variable	*SE*	*t*	*p*
$R^2 = 0.09$ Adjusted $R^2 = 0.071$ $F(4,146)=3.87$*	Intercept	0.3993	6.113	< .001
	NSQS Lost sleep time	0.0377	3.339	0.001
	NSQS Impacts	0.0433	0.184	0.854
	Global PSQI	0.1061	1.079	0.283
	Global HAD	0.0109	-1.271	0.206

**Significant, p<0.05*

[14] Level of measurement or scale of measure is a classification that describes the nature of information within the values assigned to variables (Jamovi, 2022).

SF-36 Mental Health Model

Table 3.25 summarises the predictor variables used in the second multiple regression to predict the SF-36 mental health subscale status. The model was significant (F(39.9,146)=0.52, p=0.001), with an adjusted R^2 of 0.50 indicating that the model accounted for 50% of the variance in mental health status. Two of the predictor variables (global PSQI score and global HAD score) were statistically significant at p= 0.005 and p= <0.001 predictors of mental health status.

Table 3.25

SF-36 Physical Mental Regression Model

Model summary	Variable	SE	*t*	*p*
R^2 =0.522 Adjusted R^2 =0.509 *F*(4,146)=<0.001	Intercept	0.34211	6.608	< .001*
	NSQS Impacts	0.03709	0.139	0.890
	NSQS Lost sleep time	0.03226	-0.533	0.595
	Global PSQI	0.09089	2.843	0.005
	HAD score	0.00937	10.796	< .001*

*Significant, p<0.01

3.3.11 One way Analysis of Variance (ANOVA)

The one-way analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups. The one-way ANOVA compares the means between the groups and determines whether any of those means are statistically significantly different from each other. The Classic one-way test assumes that all groups share a common standard deviation (or variance) even when their means are different.

Welch's ANOVA is an alternative to the traditional analysis of variance (ANOVA) and it is not sensitive to unequal variances such as the data for the present study. For this analysis, the participants age was divided into three distinct age-groups: 18-34, 35-49, 50 plus. Originally the age data was divided into the following age groups: 18-25, 26-36, 37-47, 48-58, 69-79, 80 plus. However, the number of participants in the older and younger age groups consisted of a small number of participants.

All data are presented in Table 3.26

NSQS Total score

The one-way Welch's ANOVA did not reveal any significant differences between the three age groups: 18-34 (M=10.08, SD=2.55), 35-49 (M=10.71, SD=2.23), 50 plus (M=10.57, SD=2.53) and the NSQS total score ($F_{2,\ 0.853}$, P>0.05).

Since the Levene statistic is non-significant, equal variance is assumed. To identify significant differences between specific groups, a pairwise comparison post-hoc test is usually conducted, in this case the Games-Howell multiple comparison method was selected, this is similar to a Tukey's method for the classic ANOVA. The Games-Howell test allows for the control of the joint error rate for the entire series of comparisons, and it also compares all possible pairs of groups within a collection of groups. No significant differences were detected between ages for the NSQS total score.

NSQS Lost sleep time

The one-way Welch's ANOVA did not reveal any significant differences between the three age groups 18-34 (M=3.35, SD=1.50), 35-49 (M=3.62, SD=1.53), 50 plus (M=3.86, SD=1.63) and the NSQS lost sleep time score ($F_{2,\ 1.144}$, P>0.05).

The Games-Howell test did not detect any significant differences between each of the age groups and the NSQS lost sleep time score.

NSQS Impacts score

The one-way Welch's ANOVA did not reveal any significant differences between the three age groups 18-34 (M=6.19, SD=1.36), 35-49 (M=6.51, SD=1.32), 50 plus (M=6.19, SD=1.32) and the NSQS Impacts score ($F_{2,\ 1.021}$, P>0.05).

The Games-Howell test did not detect any significant differences between each of the age groups and the NSQS Impacts score.

Table 3.26

Number, means and standard-deviations and standard error of each group

NSQS variable	*Age_group*	*N*	*Mean*	*SD*	*SE*
NSQS_Lost_sleep_time_score	18-34	36	3.35	1.50	0.250
	35-49	62	3.62	1.53	0.194
	50+	53	3.86	1.63	0.224
NSQS Impacts score	18-34	36	6.19	1.36	0.227
	35-49	62	6.51	1.32	0.167
	50+	53	6.19	1.32	0.181
NSQS Total score	18-34	36	10.08	2.55	0.425
	35-49	62	10.71	2.23	0.283
	50+	53	10.71	2.53	0.347

3.3.12 Independent samples t test

Further analysis was conducted on the data to explore if there was any statistical evidence to understand if the associated population means were significantly different between the NSQS lost sleep time score and NSQS Impacts score against the variable's occupation, ethnicity, parous status, and finally exercise.

In order to satisfy the test requirements one of the dependant variables must be continuous and an independent variable which should be categorical and has two categories only and data should be normally distributed with homogeneity of variance and the data for these two variables were both normally distributed and had equal variances across the groups and with no outliers. With this in mind, the variables occupation, ethnicity, education could not be further explored as they had more than two categories, further consideration was given to whether explore if participants either worked or did not work but from the total sample of 180 participants, only 9 participants did not work in any capacity and the 171 participants reported being employed. Ethnicity as a variable also contained more than two categories and was difficult to split into two broad categories. Furthermore, a large proportion of the sample (n=95) identified as White British English, the next largest group (n-22) identified as Asian, Asian British, Asian English, Asian Scottish out of a total of 180 participants.

However, in the present study the data is violated of the assumption of equal variances and therefore the Welch's test was performed on the data specifically focussing on the participants parous status, and exercise.

Parous status

In order to assess the difference between the NSQS Lost sleep time score and whether participants responded to either yes or no to their parous status (number of times a woman has given birth) a Welch's t was performed. The results revealed no significant differences (p>0.887) in lost sleep time if participants reported giving birth (N=89, M=3.66, SD=1.52), or not having given birth (N=62, M=3.62, SD=1.62), see Table 3.27.

Table 3.27

*Welch's t-test means standard deviations showing group differences in the **NSQS lost sleep** time score between participants who reported giving birth or have not given birth.*

Variables	*Levene's Homogeneity Test*		*Mean*	*SD*	*df*	*p*	*Cohens' D*
	f	*p*					
Have given birth	0.2233	0.637	3.66	1.52	126	0.887	-0.02359
Have not given birth			3.62	1.62			

In order to assess the difference between the NSQS Impacts score and whether participants responded to either yes or no to their parous status (number of times a woman has given birth) a Welch's t was performed. The results revealed no significant differences (p>0.982) in Impacts time if participants reported giving birth (N=89, M=6.32, SD=1.32), or not having given birth (N=62, M=6.32, SD=1.36), see Table 3.28.

Table 3.28

*Welch's t-test means standard deviations showing group differences in the **NSQS Impacts score** between participants who reported giving birth or have not given birth.*

Variables	*Levene's Homogeneity Test*		*Mean*	*SD*	*df*	*p*	*Cohens' D*
	f	*p*					
Have given birth	0.0137	0.097	6.32	1.32	129	0.982	-0.00366
Have not given birth			6.32	1.36			

Exercise

In order to assess the differences between the NSQS Lost sleep time score and whether participants exercised the minimum 120 minutes per week or more a Welch's t was performed. The results revealed no significant differences (p>.657) in lost sleep time if participants exercised <120 minutes per week (N=28, M=3.52, SD=1.51), or >120 minutes per week (N=123, M=3.67, SD=1.58) with respect to their lost sleep time score, see table 3.29.

Table 3.29

Welch's t-test means standard deviations showing group differences in the ***NSQS lost sleep time*** *score between participants who reported exercising <120 minutes per week in comparison to those participants reporting exercising >120 minutes per week.*

Variables	*Levene's Homogeneity Test*		*Mean*	*SD*	*df*	*p*	*Cohens' D*
	f	*p*					
<120 minutes of exercise per week	0.186	0.667	3.52	1.51	41.4	0.657	-0.0925
>120 minutes of exercise per week			3.67	1.58			

In order to assess the differences between the NSQS Impacts score and whether participants exercised the minimum 120 minutes per week or more a Welch's t was performed. The results revealed no significant differences (p>.172) in lost sleep time if participants exercised <120 minutes per week (N=28, M=5.92, SD=1.79), or >120 minutes per week (N=123, M=6.41, SD=1.19) with respect to their lost sleep time score, see table 3.29.

Table 3.30

Welch's t-test showing group differences in the ***NSQS Impacts score*** *between participants who reported exercising <120 minutes per week in comparison to those participants reporting exercising >120 minutes per week.*

Variables	*Levene's Homogeneity Test*		*Mean*	*SD*	*df*	*p*	*Cohens' D*
	f	*p*					
<120 minutes of exercise per week	12.483	<.001*	5.92	1.79	32.7	0.172	-0.3259
>120 minutes of exercise per week			6.41	1.19			

*a low p value suggests a violation of the assumption of equal variances.

Note, that the data in table 3.30 revealed significant results for participants who exercised less than 120 minutes per week and their NSQS Impacts score.

3.4 Summary

3.4.1 Overview

The reason for undertaking the present study was that it was concerned with topics of clinical importance to the care of individuals who have either been diagnosed with or experiencing symptoms relating to nocturia. It is evident from the literature review that there has been little previous work conducted within this area. Previous studies have tried to address the issues raised within this study which have been informative and of great importance. The findings from these studies have indicated a need for further research on the many points that they raise.

The present research programme has a number of individual features that distinguishes it from previous research, which has attempted to recruit individuals who may or may not be diagnosed with nocturia. These are as follows:

1. Investigation of a population-based sample of such adults rather than adults who have been referred for investigation to specialised sleep centres or Urologists.

2. Examination of the comparative profiles of sleep problems in adults' experiences from the symptoms of nocturia

3. Comprehensive assessment of self-reported sleep disorders and behaviours of these adults as reported through the use of validated questionnaire.

4. Investigations of associations between sleep disorders, daytime behaviour problems, excessive daytime sleepiness and psychological functioning in adults experiencing symptoms of nocturia

The main aims were, firstly, to observe the impact of nocturia on women's' health and wellbeing, secondly, to identify which age groups are more likely to void more than once per night, thirdly, to identify if other factors such as occupation, parous status, ethnicity, exercise, can impact nocturia and finally to identify participants who have started receiving treatment either for nocturia or another nocturia-related condition and if this improves their health and well-being scores.

There were two further experimental hypotheses proposed:

Quantitative hypotheses

H1: Participants who void once or more per night (suffer from nocturia) will have significantly poorer sleep (poorer quality of sleep, higher levels of disturbed sleep) along with higher scores of daytime sleepiness, lower QoL, and lower mood compared to those who void less during the night.

H2: Participants responding to treatment to help with their voiding will have significantly greater levels of QoL, improved sleep quality including subjective sleep quality, lower levels of low mood and depressive and anxiety symptoms (linked to poorer sleep) compared to those receiving no treatment.

4 Discussion

4.1 Summary of findings

Sleep and nocturia symptoms

The women in this study were shown to report *poor quality sleep*, an increase in *sleep disturbances* and an increase in *daytime dysfunction* as indicated by the PSQI component scores. Globally, women were reported higher scores indicating poorer sleep quality as indicated by the PSQI. Large variations were observed in the *time to go to bed*, on average it took almost 30 minutes for the sample population *time to fall asleep.* Large variations were observed amongst the sample population in *getting up time* despite no participant reporting shift work or reporting caring related activities. The range of *sleep duration* was reported between 2.5 hours to 11 hours, the *number of hours sleep per night* was reported as 8.5 hours on average and the average *number of hours spent in bed* was observed as 16.30 hours.

Similarly scores on the GSQS were observed as borderline *problematic* according to the GSQS categories indicating poorer sleep quality.

In similar vein, participants were observed as experiencing almost twice as higher lost sleep time scores on the NSQS and the impact of voiding per nocte on sleep was seen as almost three times higher than normative scores, globally, participants reported twice as high on the NSQS indicating extremely poor sleep quality.

Quality of life

Participants indicated better health on pain, general health, social functioning and mental health on the sub-scales of the SF-36.

Participants indicated worse health on physical functioning, physical problems, energy/vitality and role emotional on the sub-scales of the SF-36.

Overall, participants reported poorer physical health and better mental health on the two summary measures of the SF-36.

Mood

According to the HADS participants were reported to have higher levels of anxiety which is described as doubtful cases and within a normal range for depression related symptoms. Globally, participants were reported to have moderate scores on the HADS indicative of underlying anxiety and depressive symptoms.

Findings in relation to the aims of the proposed study

Aim 1:

Physical health and well-being

Higher scores on the NSQS *lost sleep time* sub-score were shown to predict poorer *physical health* (QoL - SF-36), although there was a small variation observed, this did account for the fact that poor physical health could be explained by experiencing lost sleep time due to night-time voiding.

Mental health and well-being

Higher scores reported globally on the PSQI, and HADS showing poor quality sleep and increased levels of anxiety and depression predicted poorer mental health (QoL - SF-36). However, the scores indicated 50% variation suggesting that either poor sleep and higher anxiety and depressive symptoms are causing overall poor mental health quality or vice versa.

Aim 2:

Age related differences in nocturia symptoms

Although no age-related differences between the three age groups (18-34, 35-49 and 50 plus) were observed, the impact of voiding at night was higher amongst these groups in comparison to lost sleep time.

Aim 3:

Does occupation, parous status, ethnicity and exercise impact nocturia?

There were no differences observed between women who reported to have given birth in comparison to those who had never given birth.

Interestingly, participants who reported exercising less than the recommended 120 minutes per week reported lower scores on the NSQS Impacts score in comparison to those who reported exercising more than 120 minutes per week reported higher scores on the NSQS Impact score.

There were no differences observed between quality of sleep and whether or not participants reported exercising less than 120 minutes or more than 120 minutes per week.

Occupation, ethnicity and education were not analysed due to the way in which the variables were categorised.

Aim 4:

Identifying participants who had started receiving treatment either for nocturia or another nocturia-related condition and if this improves their health and wellbeing scores.

The data for this aim was collected through free-text responses, allowing participants to share additional observations that were not covered by the questionnaire. No free-text data was collected as no participant completed this additional question.

Nocturia and sleep

The findings from the current study reveal interesting results. The first aim was to observe the impact of nocturia on womens' health and wellbeing. The findings have revealed that the NSQS results were similar to the research by Romano et al (2019), although there are no cut-off scores reported to date for the NSQS however, a study by Williams et al (2021) has reported that both the reliability and validity of the scale along with demonstrating that the NSQS is a valid measure of nocturia on patients sleep. William's findings are also encouraging in that it lays the groundwork for the use of the NSQS in future clinical trials.

The aim of the NSQS is to assess the impact of nocturia in a clinical trial setting, however the assessment has also been useful in understanding how participants acknowledge their nocturia status. Moreover, the literature has shown that nocturia interrupts sleep through the need to void (van Kerrebroeck , Abrams, Chaikin, et al. 2002), the current study relied on self-reported methods of nocturia through the use of the NSQS however there are other indicators within the results to suggest that both the quality and quantity of self-reported sleep was disturbed. Studies (Ancoli-Israel, Bliwise & Nørgaard, 2011; Belenky, Wesensten, Thorne et al, 2003; Van Dongen, Maislin, Mulllington et al, 2003; Banks & Dinges, 2007) have reported that those individuals who experience nocturia will also experience disturbed or bothersome sleep, similar to the findings of the current study, furthermore, other factors such as the individuals physical, emotional, and social well-being are also affected, similar to the findings of the current study, the authors go on to show that the disturbances can also encroach in to the individuals daytime functioning with symptoms of daytime sleepiness and poor cognitive performance.

Interestingly in the current study, sleep onset, sleep duration and time spent in bed by the participants ranged significantly, the importance of good sleep has only really began to be understood approximately a little over ten years ago (Ancoli-Israel, Bliwise and Nørgaard, 2011), the concept of adults requiring 7-8 hours per night has been endorsed through a variety of channels (non-scientific), a good night's sleep is important but new and emerging data reinforce the health issues associated with insufficient sleep.

There is an increasing number of studies which have described the negative effects of nocturia on sleep quality (Shao, Wu, Hsu et al, 2016). Shao et al (2016) have highlighted that in most

previous studies reporting an association between nocturia and sleep, these were often categorised using cut-off points, but the severity has not been quantified (Obayashi, Saeki, Kurumatani, 2015). The Shao et al study focussed on the correlation of nocturia number with sleep quality and daytime dysfunction, a comparison of each parameter of sleep between males and females, older (>65 years), younger (<65 years) were observed. Women were shown to have worse sleep quality in comparison to men with higher global PSQI scores too, this finding also supports the higher sleep aid prescriptions in the female population (Pillai, Cheng, Kalmbach et al, 2016). In the current study, the GSQS score was also just below 6 (a >6 for the GSQS indicates poor quality sleep), again indicative of poor sleep quality in the current sample. Nocturia has been recognised as a potential risk for sleep disturbance (Bliwise, Foley, Vitiello et al, 2009). Although data for the NSQS is scarce for now, one is confident that the severity of nocturia does tend to increase significantly with age and furthermore, the more severe the nocturia the worse the sleep quality and daytime dysfunction. What is surprising is that older participants did not necessarily report worse sleep disturbances or worse daytime dysfunction and one explanation for this could be that participants who are at work during the day are more likely to report daytime dysfunction compared to older participants. Foley et al (2007) reported that frequent napping in older participants and those who were retired reported frequent napping to compensate for their sleep disruption, in the current study, over 97 % of participants worked either full-time or part-time, however it is the 97 % of participants under 65 years of age who have reported daytime dysfunction, hence the importance of treating nocturia to help them to improve their daytime/work related performance.

Research has also highlighted the negative effect of nocturia which has been underestimated until very recently (Shao et al, 2016), firstly for its under-reported prevalence (Coyne, Zhou, Bhattacharyya et al, 2003) but also for the issues associated with poor physical function and psychiatric problems.

Nocturia and QoL

A range of studies by Stone and colleagues (Blackwell, Ancoli-Israel & Schneider et al, 2006; Stone, Ewing, Ancoli-Israel et al, 2006; Dam, Ewing, Ancoli-Israel et al, 2008; Stone, Ancoli-Israel, Blackwell et al, 2008; Stone, Ewing, Ancoli-Israel et al, 2009) have illustrated that less sleep at night and lower sleep efficiency in older men and women were linked to an increased risk of poor physical function, decreased cognitive function, more falls and mortality.

Nocturia is multifactorial in origin; nocturnal polyuria, low nocturnal bladder capacity or a combination of both are the main causes (Lose, Alling-Moller, Jennum, 2001). Disturbed sleep *per se* may also cause nocturia, in that when people are woken from their sleep due to noise, apnoea, pain or other environmental disturbances, there is a subsequently compelling desire to urinate (Lose et al, 2001). Research has also shown how poor sleep, disturbed sleep, and poor sleep quality can have a knock-on-effect on QoL (Hetta, 1999). A research paper in 2004 authored by Van Dijk et al noted the scarcity of studies on the impact of nocturia on QoL. Those studies which did report QoL only reported on the impairment of nocturia. Furthermore, Samuelsson et al (1997) studied women aged between 20-59 using the Gothenburg QoL-scale, in this study nocturia was correlated with poor health and sleep.

In the current study, four of the eight domains in QoL revealed very low scores; physical function, physical problems, energy/vitality and role emotional. Both the physical and mental scores were reported with low scores. Participants were shown to be both mentally and physically less healthy, the physical scores were lower than the mental health scores. However, the current study relied on self-reported nocturia, this itself warrants further research ensuring that a more clinical measurement is also considered to confirm findings. Van Dijk et al (2004) conclude that respondents who felt bothered by at least one void per night have more sleep problems and poorer QoL, furthermore, the effect of nocturia on QoL is mediated by sleep.

In the current study, the NSQS scores were similar to that of the work by Romano et al (2019) in that 50 % of the participants were female, and over 90 % of the total participants reported having disturbed sleep due to night-time voiding either two times, three times or four or more times. Although the frequency of voiding was not measured in the current study, Kupelian et al (2011) noted that most studies reporting nocturia and QoL focus on the reported outcomes associated with nocturia rather than the level at which the frequency of voiding significantly affects QoL. Coyne et al (2003) findings showed that there was a decrease in QoL just after one reported void and significant effects in QoL when participants reported two or more night-time voids in a study by Tikkinen et al (2010). Kupelian et al (2012) similarly measured QoL using the shorter SF-12 and noted that nocturia was associated with decreased physical and mental health component scores, it was also associated with increased depressive symptoms, these findings were higher amongst females then men. They concluded that nocturia is associated with decreased QoL and with an increased prevalence for depressive symptoms.

Nocturia and mood

Studies have shown that bothersome nocturia reduces QoL and can lead to embarrassment, social anxiety and/or poor self-esteem (Tikkinen et al, 2009; Kobelt et al, 2003). Furthermore, both the current study and other previously reported studies have shown that nocturia is also associated with daytime dysfunction, sleepiness, inability to concentrate, decreased motivation and poor self-rated health (Tikkinen et al, 2009; Kobelt et al, 2003; Kuepelian, 2009). These factors can lead some participants to be at a greater risk for depression (Breyer et al, 2014). Meeus et al (2012) have shown how depressed patients may report an increase in bothersome urinary symptoms as depressed patients may catastrophise symptoms. Research has also demonstrated that patients diagnosed with depression may also pose an impediment to effective treatment and are less likely to seek out help and be compliant with therapy (Jimenez et al, 2013).

In the current study, the total anxiety score reported from the HADS were noted as doubtful cases and a low score for depression, however the total HAD score was relatively high, the cut-off score for the total HAD was <15 (14.61) showing moderate care required. Research has shown that understanding nocturia and depression are frequently comorbid can have important implications for the treating clinician (Breyer et al, 2013). Furthermore, it has been recommended that clinicians use a brief self-administered scale such as the HADS to assess for the presenting patient's anxiety and depression (Steers et al, 2008).

In a study by Obayashi et al (2017) a total of 866 participants were followed over a 23-month period, and no depressive symptoms were present at baseline and nocturnal voiding was defined as frequency of >2 nocturnal voids. During the follow-up 75 participants reported the development of depressive symptoms, 239 participants exhibited higher incidence for depressive symptoms in comparison to the non-nocturia group (n=627). The authors noted that nocturia was significantly associated with higher incidence of depressive symptoms in the general elderly population and gender differences were noted too with men reporting higher rates of depressive symptoms in comparison to women.

What is interesting to note is that the mental health domains in the QoL measure were also reported as being extremely low. Furthermore, patients who screen positive for a mental health disorder may be more anxious about a diagnostic test (such as cystoscopy) and may require counselling (Breyer, 2013). Having this insight into a patient's emotional state will also promote improved communication between the patient and the physician and may also help

with adherence to medication. Screening patients will also allow them to be referred to appropriate healthcare providers who can deal with their specific concerns and worries and by doing this may also help managing the symptoms of nocturia and the issue itself. Clearly nocturia is not just another bothersome or annoying condition associated with the ageing process, it is a rather serious disorder and if left untreated can have far-reaching consequences both for the individual and society.

It is important to note that excessive urination during the night may also refer to the volume of urine voided or the number of trips to the toilet too, this normal frequency and volume for nocturnal urination has been poorly defined (Marinkovic, 2004). Marinkovic claims that it is the lack of distinction between what stipulates normal versus abnormal urination that causes the symptoms to be overlooked by medical practitioners. The author also points out that the problems associated with night-time voiding, such as loss of sleep, poor sleep, disturbed sleep and daytime dysfunction often go undetected and unreported until the patient finds it unbearable. An opportunity for participants to elaborate on any disturbed sleep was given as an option, however the free-text opportunity was not utilised by any one participant. The questionnaires used to collect the data on sleep and nocturia also do account for such disturbances, but none was detected in the analysis.

Understanding the findings from a health psychology perspective

The role of sleep in health over the past decade or so has exploded within sleep medicine but not so much in health psychology. It is often noted as a sub-symptom of a chronic condition rather than an important facet in the condition itself (Ellis, 2002). There is compelling evidence highlighted in this thesis that disturbances of sleep be it insomnia, or in this case nocturia can adversely influence the risk of both infectious and inflammatory diseases (Kripke et al, 2002; Mallon et al, 2002; Dew et al, 2003; Vgontzas et al, 2013).

From a health psychology perspective, sleep disturbance is a modifiable risk factor (Irwin, 2015). There is also substantial evidence to highlight how behavioural treatments have robust efficacy (Irwin et al 2006a; Morin et al, 2006a). Again, the research within this area focuses on the biological mechanisms underlying these issues and often the focus is treatment rather than prevention. But, if we are to focus on the importance of sleep from a health psychology perspective than perhaps understanding how sleep health (Buysse, 2014) affects the immune system in relation to both infectious and inflammatory disease risks, focussing on sleep and health from a psychoneuroimmunology (PNI) perspective.

As a trainee health psychologist, the importance of studying sleep in relation to specific inflammation related diseases; cardiovascular disease, cancer and major depression are a key starting point to help develop effective treatments that promote sleep and health but also understand and study how we can prevent specific conditions. We need to remember that sleep is a behaviour which as stated by Ellis (2002) "is prone to disruption, distortion and abuse," similar to other behaviours such as our diets, the amount of exercise we engage in, smoking and alcohol consumption, it is a behaviour that is modifiable.

Psychology, specifically health psychology has made little to no contribution to understanding sleep, but there is evidence to support the notion that the quantity and more importantly the quality is key to understanding sleep from a health perspective. A first step would be to acknowledge the importance of sleep in health and ensure that it is a subject that is taught to those who work within the health context.

4.2 Evaluation of methodology and suggestions for refinements in further studies

The response rates (100%) of the sample of individuals were relatively high recruited into the study. Individuals were informed of the importance of returning completed questionnaires, individuals were willing to participate and return the online questionnaires, most probably due to the nature of the research and an opportunity to discuss their sleep and nocturia problems. This is suggestive of the fact that those who had problems with their sleep and were experiencing disturbed sleep due to nocturia were more likely to respond, compared to those individuals and participants who felt that they did not have problems with their sleep.

In terms of questionnaire studies there are a number of limitations in general, mainly regarding the subjectivity of the data collected and the possibility of bias in the responses of the participants. In the current study there is no reason to assume that individuals and participants would be motivated to provide misleading and false information concerning their sleep, QoL and psychological functioning. The author's main concern, however, in terms of responding to the individual items is to the content of specific questions, particularly concerning mental health and depression. The results suggest that individuals did not report misleading information concerning their mental health. There was a lot of interest generated amongst the academic community when the study was advertised online, as it specifically focussed on women's health and sleep, however initially there was a phenomenal response to the research but due to incomplete responses- some of the original data could not be used.

Another problem concerning a survey design is in the interpretation of some of the individual items or particular questionnaires. The main concern was possible vagueness of item wording or ambiguity, regardless of attempts by the original author of the questionnaire to make it readily understandable and acceptable by those completing it. This was particularly the case in the interpretation of the GSQS and the NSQS questionnaire. There were no specific instructions how to score the individual items in the questionnaire. This lack of instruction[15] posed the problem of whether or not the items on both nocturia and sleep had been interpreted and scored appropriately. Although individuals who had participated in the survey had scored highly in some areas of the GSQS and NSQS, nevertheless, to further clarify any specific sleep disorders, clinical evaluation was needed to usefully diagnose sleep disorders[16].

Within the PSQI was a free response question for which the participants could voice their own personal problems concerning sleep. The author feels that this information could have been utilised, perhaps by using qualitative methods of analysis to gain a deeper understanding of the patient's perspective, in this case a simple thematic analysis.

The data collected from the questionnaires can be viewed to be useful for preliminary screening purposes only; these data can further lead to a more detailed enquiry including objectively measuring sleep and nocturia. This is most certainly the case where individuals reported disturbed sleep due to SDB and sleep disorders occurring during the night, e.g., bruxism, nightmares and sleep talking; these need a careful special investigation to justify a definite diagnosis.

Data was also collected on whether individuals experiencing night-time voiding had any other co-morbidity. Although there were no specific set of exclusion and inclusion criteria followed by the researcher, individuals did however report having other disorders and or diseases that may have impacted on their responses to some of the questions from the questionnaires. The data collected resulted from asking whether or not individuals had any current illnesses or physical disorders or have had in the past 3 months and any illness or physical disorder that participants have ever had. These, when the participants answered 'yes', could have been associated with sleep disturbances and many of the other responses on the assessments concerned with mental health, QoL, depression and cognitive functioning. It would be interesting to evaluate the relative contribution such factors make to the existence of general

[15] The researcher was successful in contacting the author of the NSQS to gain further insight into scoring.
[16] The data for both the GSQS and NSQS will be shared by the researcher with the authors of these questionnaires.

sleep problems and nocturia related issues in these individuals. Taking these factors into account, however, in the detail that some of them would have required would have meant going beyond the time and the resources available to the author.

Further data on height, weight, BMI, smoking status, ethnicity, education and occupation was collected. During the systematic review of the literature, it was noted that there were studies that dealt with some of these factors in relation to nocturia (nocturia and age, sex and occupation). It would have been interesting to see how these factors (occupation and education) contribute towards the individuals QoL, mental health and depression. Further data was also collected on whether or not an individual was aware of any family member (mother, father, sibling, partner, grandparents) who were known to have experienced sleep disturbances.

The issue concerning the statistical tests used to analyse the data is also important. Although the findings from the tests of differences and associations appear to be meaningful it would be interesting to see whether the same pattern of results emerge with a larger sample of individuals and offer up the need to replicate within the practice of open science In addition, some type 1 errors may have occurred due to the large number of comparisons conducted within the phase 1 data.

The findings show the importance of considering individuals sleep, QoL and psychological well-being as well as acknowledging their clinical diagnosis. It has been suggested by research that individuals do tend to under-report their disturbed sleep (Van Keimpema, Ariansz, Nauta and Postmus, 1995). In clinical practice, administering a simple sleep questionnaire should become routine as part of the clinical assessment of the patient's disease. Considering the patient's sleep problem will also help in improving the patient's overall condition.

4.3 Feasibility

In general, the questionnaires used were shown to have face validity and were acceptable to the individuals taking part in the study. The questionnaires themselves were initially piloted to confirm that they were user friendly. One of the main problems, however, that did arise from the study was that individuals complained about the size of the questionnaire. Generally, the questionnaire was accepted, and the author assisted those individuals who did not wish to complete the questionnaires by going into detail on the importance of the study. Another problem that the author was aware of was that only those individuals who were literate and had access to a computer/smart phone and had basic knowledge of using it equipment were included in this study, other groups were not included and overall, this was an issue with the

researcher as she aimed to have both a wide inclusive and diverse population. This matter was discussed at length during the supervisory session but due to the pandemic the supervisory team felt that an online questionnaire would be accessible and widely received. Every effort was made to ensure that no bias from the author found its way into these dictated responses. The researcher is aware that the method in which individuals were recruited, and the platform used to capture the data was restrictive and limiting.

4.4 Future research

It is expected that in research such as that described in this thesis, which is concerned with a relatively unexplored field, that many issues will arise which need further investigation. A number of research possibilities have already been identified and many more could be suggested regarding sleep disorders in general, and those related to disturbed sleep-in individuals diagnosed with nocturia:

Clinically, at the point of assessment, it is important for the clinician to consider points such as has the disturbed sleep been present prior to the onset of the disease or has it progressed with the onset of disease by the presenting patient. There are certain medications prescribed by clinicians which can have adverse impact on an individual's sleep, this question was included as part of the initial data collection but not included for analysis. There are some clinics within the secondary care system which also offer sleep studies for patients who are referred to the service for suspected sleep related disorders this is a service which should be fully utilised and used by clinicians. To further pursue this area of research specific topics should focus on understanding what is the range of sleep disorders in nocturia? and to some extent what are their effects on the management of individuals diagnosed with nocturia. Furthermore, an impact based study specifically focussing on understanding the barriers to seeking treatment and what could be done further in terms of decreasing symptoms associated with poor QoL, low mood and disturbed sleep within the nocturia population. Some of the suggestions made would require the expertise of both a physician and psychologist with a special interest in sleep medicine to work together. Assessments of the severity of the sleep problems in general and also treatment evaluations have to take into account cognitive and behavioural aspects (not just physical considerations) because they are what matter most to the individual's well-being. Skills relating to psychological functioning are essential in preventative and treatment programmes for the sleep disorders which are not physical in origin and also in aspects of management of those which are, these being counselling and being able to manage anxiety in

such individuals. The present findings confirm the high levels of anxiety felt by such individuals. It is also important to state that the standard measures of urinary output function do not necessarily relate to the severity of psychological functioning.

The psychologist's role is also particularly important in the investigation of the relationship between sleep disturbances and physical functioning. One of the basic problems with certain sleep problems is whether sleep disturbances cause daytime problems or whether the sleep problem is caused by behaviour that is already disturbed (Medic et al., 2017). When the sleep problem is behavioural in nature this issue may be settled by careful developmental studies of the sequence of events by treating one problem to see the effect it has on another.

It is important to take note of these possibilities and to understand that the present study has only scratched the surface and highlighted the importance of understanding and acknowledging that individuals diagnosed with nocturia do have disturbed sleep in many of the areas highlighted by the PSQI, NSQS and GSQS. Disturbed sleep is also very detrimental to the individual's psychological well-being, in particular their general health, mood, and QoL. Future research needs to include objective measures to further explore the disturbed sleep patterns of such individuals and to collect normative data which would be highly useful in exploring these factors and how they may affect the individuals sleep and psychological functioning.

References

Abhang, P.A., Gwali, B.W. & Mehrotra, S.C. (2016). Introduction to EEG-and speech-based emotions recognitions. Elsevier.

Ackerman, S. (1992). Discovering the brain. National Academy Press.

Ader, D. N. (2007). Developing the Patient-Reported Outcomes Measurement Information System (PROMIS). Medical Care, 45, S1-S2.

Aggarwal, B., Makarem, N., Shah, R., Emin, M., Wei, Y., St-Onge M.P. & Jelic, S. (2018). Effects of Inadequate Sleep on Blood Pressure and Endothelial Inflammation in Women: Findings from the American Heart Association Go Red for Women Strategically Focused Research Network. J Am Heart Assoc; 9;7(12): e008590. doi: 10.1161/JAHA.118.008590. PMID: 29886425; PMCID: PMC6220553.

Akerstedt, T., Knutsson, A., Westerholm, P., Theorell, T., Alfredsson, L., & Kecklund, G. (2002). Sleep disturbances, work stress and work hours: a cross-sectional study. Journal of psychosomatic research, 53(3), 741–748. https://doi.org/10.1016/s0022-3999(02)00333-1

Alblooshi, S., Taylor, M., & Gill, N. (2023). Does menopause elevate the risk for developing depression and anxiety? Results from a systematic review. Australasian Psychiatry, 31(2), 165–173. https://doi.org/10.1177/10398562231165439

Altman, N. G., Izci-Balserak, B., Schopfer, E., Jackson, N., Rattanaumpawan, P., Gehrman, P. R., Patel, N. P., & Grandner, M. A. (2012). Sleep duration versus sleep insufficiency as predictors of cardiometabolic health outcomes. Sleep medicine, 13(10), 1261–1270. https://doi.org/10.1016/j.sleep.2012.08.005

Ancoli-Israel, S., & Roth, T. (1999). Characteristics of insomnia in the United States: results of the 1991 National Sleep Foundation Survey. I. Sleep, 22 Suppl 2, S347–S353.

Ancoli-Israel, S., Bliwise, D. L., & Nørgaard, J. P. (2011). The effect of nocturia on sleep. Sleep Medicine Reviews, 15(2), 91–97. https://doi.org/10.1016/j.smrv.2010.03.002

Archer, N.A., Laing, E.E., Möller-Levet, C.S., et al. (2014) Mistimed Sleep Disrupts Circadian Regulation of the Human Transcriptome. Proceedings of the National Academy of Sciences of the United States of America, 111, E682-E691. https://doi.org/10.1073/pnas.1316335111

Arkin, A. M., Hastey, M. S. and Reiser, M. F. (1966). Posthypnotically stimulated sleep-talking. J. Nerv. Ment. Dis., 142: 293-309.

Asplund R. (2007). Pharmacotherapy for nocturia in the elderly patient. Drugs & aging, 24(4), 325–343. https://doi.org/10.2165/00002512-200724040-00005

Asplund, R. (2005). Nocturia: Consequences for sleep and daytime activities and associated risks. European Urology Supplements, 3(6), 24–32. https://doi.org/10.1016/S1569-9056(05)80004-1

Asplund, R., & Åberg, H. (1992). Health of the Elderly with regard to Sleep and Nocturnal Micturition. Scandinavian Journal of Primary Health Care, 10(2), 98–104. https://doi.org/10.3109/02813439209014044

Asplund, R., & Aberg, H. E. (2000). Nocturia and health in women aged 40-64 years. Maturitas, 35(2), 143–148. https://doi.org/10.1016/s0378-5122(00)00111-0

Assefa, A.Z., Diaz-Abad, M., Wickwire, E.M. & Scharf, S.M. (2015). The Functions of Sleep[J]. AIMS Neuroscience; 2(3): 155-171. doi: 10.3934/Neuroscience.2015.3.155

Australian Journal of general Practice. (2019). Urological Society of Australia and New Zealand.

Baker, E. K., & Richdale, A. L. (2015). Sleep Patterns in Adults with a Diagnosis of High-Functioning Autism Spectrum Disorder. Sleep, 38(11), 1765–1774. https://doi.org/10.5665/sleep.5160

Baker, F. C., & Driver, H. S. (2004). Self-reported sleep across the menstrual cycle in young, healthy women. Journal of psychosomatic research, 56(2), 239–243. https://doi.org/10.1016/S0022-3999(03)00067-9

Baker, F. C., Kahan, T. L., Trinder, J., & Colrain, I. M. (2007). Sleep quality and the sleep electroencephalogram in women with severe premenstrual syndrome. Sleep, 30(10), 1283–1291. https://doi.org/10.1093/sleep/30.10.1283

Baker, F. C., Waner, J. I., Vieira, E. F., Taylor, S. R., Driver, H. S., & Mitchell, D. (2001). Sleep and 24 hour body temperatures: a comparison in young men, naturally cycling women and women taking hormonal contraceptives. The Journal of physiology, 530(Pt 3), 565–574. https://doi.org/10.1111/j.1469-7793.2001.0565k.x

Baker, F.C., Turlington, S.R., & Colrain, I. (2012). Developmental changes in the sleep electroencephalogram of adolescent boys and girls. Journal of Sleep research, 21(1), 59-67.

Ballesio, A., Zagaria, A., Baccini, F., Micheli, F., Di Nardo, G., & Lombardo, C. (2021). A meta-analysis on sleep quality in inflammatory bowel disease. Sleep medicine reviews, 60, 101518. https://doi.org/10.1016/j.smrv.2021.101518

Banks, S., & Dinges, D. F. (2007). Behavioral and physiological consequences of sleep restriction. Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine, 3(5), 519–528.

Baratte-Beebe, K. R., & Lee, K. (1999). Sources of midsleep awakenings in childbearing women. Clinical nursing research, 8(4), 386–397. https://doi.org/10.1177/10547739922158377

Beck, A.T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961) An inventory for measuring depression. *Archives of General Psychiatry, 4*, 561-571.

Beebe, B., & Lachmann, F. (2020). Infant research and adult treatment revisited: Cocreating self- and interactive regulation. *Psychoanalytic Psychology*, *37*(4), 313–323.

Bei, B., Coo, S., Baker, F. C., & Trinder, J. (2015). Sleep in Women: A Review. Australian Psychologist, 50(1), 14–24. https://doi.org/10.1111/ap.12095\

Belenky, G., Wesensten, N. J., Thorne, D. R., Thomas, M. L., Sing, H. C., Redmond, D. P., Russo, M. B., & Balkin, T. J. (2003). Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study. Journal of sleep research, 12(1), 1–12. https://doi.org/10.1046/j.1365-2869.2003.00337.x

Bentley, E. (1999). Awareness: Biorhythms, sleep, and dreaming. Routledge modular psychology. London, Psychology Press.

Beuke, C. J., Fischer, R., & McDowall, J. (2003). Anxiety and depression: Why and how to measure their separate effects. Clinical Psychology Review, 23(6), 831–848. https://doi.org/10.1016/S0272-7358(03)00074-6

Beuke, C. J., Fischer, R., & McDowall, J. (2003). Anxiety and depression: Why and how to measure their separate effects. Clinical Psychology Review, 23(6), 831–848. https://doi.org/10.1016/S0272-7358(03)00074-6

Beuke, Carl & Fischer, Ronald & Mcdowall, John. (2003). Anxiety and depression: Why and how to measure their separate effects. Clinical psychology review. 23. 831-48. 10.1016/S0272-7358(03)00074-6.

Bing, M. H., Moller, L. A., Jennum, P., Mortensen, S., & Lose, G. (2006). Validity and Reliability of a Questionnaire for Evaluating Nocturia, Nocturnal Enuresis and Sleep-Interruptions in an Elderly Population. European Urology, 49(4), 710–719. https://doi.org/10.1016/j.eururo.2005.11.034

Bing, M. H., Moller, L. A., Jennum, P., Mortensen, S., & Lose, G. (2006). Validity and Reliability of a Questionnaire for Evaluating Nocturia, Nocturnal Enuresis and Sleep-Interruptions in an Elderly Population. European Urology, 49(4), 710–719. https://doi.org/10.1016/j.eururo.2005.11.034

Bishop, F. L. (2015). Using mixed methods research designs in health psychology: An illustrated discussion from a pragmatist perspective. British Journal of Health Psychology, 20(1), 5–20. https://doi.org/10.1111/bjhp.12122

Bixler, E. O., Kales, A., Soldatos, C. R., Kales, J. D., & Healey, S. (1979). Prevalence of sleep disorders in the Los Angeles metropolitan area. The American journal of psychiatry, 136(10), 1257–1262. https://doi.org/10.1176/ajp.136.10.1257

Bixler, E. O., Vgontzas, A. N., Lin, H. M., Liao, D., Calhoun, S., Vela-Bueno, A., Fedok, F., Vlasic, V., & Graff, G. (2009). Sleep disordered breathing in children in a general population sample: prevalence and risk factors. Sleep, 32(6), 731–736. https://doi.org/10.1093/sleep/32.6.731

Bjelland, I., Dahl, A. A., Haug, T. T., & Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale. An updated literature review. Journal of psychosomatic research, 52(2), 69–77. https://doi.org/10.1016/s0022-3999(01)00296-3

Blackwell, T., Yaffe, K., Ancoli-Israel, S., Schneider, J. L., Cauley, J. A., Hillier, T. A., Fink, H. A., Stone, K. L., & Study of Osteoporotic Fractures Group (2006). Poor sleep is associated with impaired cognitive function in older women: the study of osteoporotic fractures. The journals of gerontology. Series A, Biological sciences and medical sciences, 61(4), 405–410. https://doi.org/10.1093/gerona/61.4.405

Bliwise, D.L. (2008). Invited Commentary: Cross-Cultural Influences on Sleep—Broadening the Environmental Landscape, *American Journal of Epidemiology*, 168, 12(15): 1365–1366,

Bliwise, D. L. (2014). Cataloging Nocturia (Circa 2014). Sleep, 37(4), 631–633. https://doi.org/10.5665/sleep.3556

Bliwise, D. L., Foley, D. J., Vitiello, M. V., Ansari, F. P., Ancoli-Israel, S., & Walsh, J. K. (2009). Nocturia and disturbed sleep in the elderly. Sleep medicine, 10(5), 540–548. https://doi.org/10.1016/j.sleep.2008.04.002

Bliwise, D. L., Rosen, R. C., & Baum, N. (2014). Impact of nocturia on sleep and quality of life: A brief, selected review for the International Consultation on Incontinence Research Society (ICI-RS) nocturia think tank: Nocturia Impact on Sleep and QOL. Neurourology and Urodynamics, 33(S1), S15–S18. https://doi.org/10.1002/nau.22585

Bliwise, D. L., Wagg, A., & Sand, P. K. (2019). Nocturia: A Highly Prevalent Disorder With Multifaceted Consequences. Urology, 133, 3–13. https://doi.org/10.1016/j.urology.2019.07.005

Bosch, J. L., & Weiss, J. P. (2010). The prevalence and causes of nocturia. The Journal of urology, 184(2), 440–446. https://doi.org/10.1016/j.juro.2010.04.011

Bosch, J. L., & Weiss, J. P. (2013). The prevalence and causes of nocturia. The Journal of urology, 189(1 Suppl), S86–S92. https://doi.org/10.1016/j.juro.2012.11.033

Bottega, Emanuela; Palese, Alvisa MNS, BCN, RN; Regattin, Laura. Research Reports and Evidence Translation Projects. Clinical Nurse Specialist 22(2):p 102, March 2008. | DOI: 10.1097/01.NUR.0000311739.64531.f8

Brennan, C., Worrall-Davies, A., McMillan, D., Gilbody, S., & House, A. (2010). The Hospital Anxiety and Depression Scale: a diagnostic meta-analysis of case-finding ability. Journal of psychosomatic research, 69(4), 371–378. https://doi.org/10.1016/j.jpsychores.2010.04.006

Breyer, B. N., Shindel, A. W., Erickson, B. A., Blaschko, S. D., Steers, W. D., & Rosen, R. C. (2013). The association of depression, anxiety and nocturia: a systematic review. The Journal of urology, 190(3), 953–957. https://doi.org/10.1016/j.juro.2013.03.126

Brinkman, J.E., Reddy, V. & Sharma, S. Physiology of Sleep (2022). [Updated 2023 Apr 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482512/

Brinkman, J.E., Reddy, V. & Sharma. S. (2024). Physiology of Sleep. [Updated 2023 Apr 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; Available from: https://www.ncbi.nlm.nih.gov/books/NBK482512/

Brugge, K.L., Kripke, D.F., Ancoli-Israel, S., et al. (1989). The association of menopausal status and age with sleep disorders. Sleep Res;18:208.

Burgio, K. L., Johnson, T. M., 2nd, Goode, P. S., Markland, A. D., Richter, H. E., Roth, D. L., Sawyer, P., & Allman, R. M. (2010). Prevalence and correlates of nocturia in community-dwelling older adults. Journal of the American Geriatrics Society, 58(5), 861–866. https://doi.org/10.1111/j.1532-5415.2010.02822.x

Buysse, D. J. (2014). Sleep Health: Can We Define It? Does It Matter? Sleep, 37(1), 9–17. https://doi.org/10.5665/sleep.3298

Buysse, D. J., Reynolds, C. F., 3rd, Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry research, 28(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Callréus, T., Agerskov Andersen, U., Hallas, J., & Andersen, M. (2007). Cardiovascular drugs and the risk of suicide: a nested case-control study. European journal of clinical pharmacology, 63(6), 591–596. https://doi.org/10.1007/s00228-007-0293-5

Cappuccio, F. P., Cooper, D., D'Elia, L., Strazzullo, P., & Miller, M. A. (2011). Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. European heart journal, 32(12), 1484–1492. https://doi.org/10.1093/eurheartj/ehr007

Cappuccio, F. P., D'Elia, L., Strazzullo, P., & Miller, M. A. (2010). Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. Sleep, 33(5), 585–592. https://doi.org/10.1093/sleep/33.5.585

Carlson, J. (1997). Editorial. The Family Journal, 5(3), 197-197. https://doi.org/10.1177/1066480797053001

Carrier, J., Land, S., Buysse, D. J., Kupfer, D. J., & Monk, T. H. (2001). The effects of age and gender on sleep EEG power spectral density in the middle years of life (ages 20-60 years old). Psychophysiology, 38(2), 232–242.

Castro-Costa, E., Dewey, M. E., Ferri, C. P., Uchôa, E., Firmo, J. O., Rocha, F. L., Prince, M., Lima-Costa, M. F., & Stewart, R. (2011). Association between sleep duration and all-cause mortality in old age: 9-year follow-up of the Bambuí Cohort Study, Brazil. Journal of sleep research, 20(2), 303–310. https://doi.org/10.1111/j.1365-2869.2010.00884.x

Chute, C. G., Panser, L. A., Girman, C. J., Oesterling, J. E., Guess, H. A., Jacobsen, S. J., & Lieber, M. M. (1993). The prevalence of prostatism: a population-based survey of urinary symptoms. The Journal of urology, 150(1), 85–89. https://doi.org/10.1016/s0022-5347(17)35405-8

Clark, L. A., & Watson, D. (1991). Tripartite model of anxiety and depression: Psychometric evidence and taxonomic implications. *Journal of Abnormal Psychology, 100*(3), 316–336.

Cohen, S., Doyle, W. J., Alper, C. M., Janicki-Deverts, D., & Turner, R. B. (2009). Sleep habits and susceptibility to the common cold. Archives of internal medicine, 169(1), 62–67. https://doi.org/10.1001/archinternmed.2008.505

Cohen, S., Doyle, W. J., Alper, C. M., Janicki-Deverts, D., & Turner, R. B. (2009). Sleep habits and susceptibility to the common cold. Archives of internal medicine, 169(1), 62–67. https://doi.org/10.1001/archinternmed.2008.505

Cornu, J. N., Abrams, P., Chapple, C. R., Dmochowski, R. R., Lemack, G. E., Michel, M. C., Tubaro, A., & Madersbacher, S. (2012). A contemporary assessment of nocturia: definition, epidemiology, pathophysiology, and management--a systematic review and meta-analysis. European urology, 62(5), 877–890. https://doi.org/10.1016/j.eururo.2012.07.004

Coyne, K. S., Wein, A. J., Tubaro, A., Sexton, C. C., Thompson, C. L., Kopp, Z. S., & Aiyer, L. P. (2009). The burden of lower urinary tract symptoms: evaluating the effect of LUTS on health-related quality of life, anxiety and depression: EpiLUTS. BJU international, 103 Suppl 3, 4–11. https://doi.org/10.1111/j.1464-410X.2009.08371.x

Coyne, K. S., Zhou, Z., Bhattacharyya, S. K., Thompson, C. L., Dhawan, R., & Versi, E. (2003). The prevalence of nocturia and its effect on health-related quality of life and sleep in a community sample in the USA. BJU INTERNATIONAL.

Czeisler, C.A. (2011). Impact of sleepiness and sleep deficiency on public health – utility of biomarkers. Journal of clinical sleep medicine; Supplement 7(5) S6-S8.

Dam, T.T.L., Ewing, S., Ancoli-Israel, S., Ensrud, K., Redline, S., Stone, K. and Osteoporotic Fractures in Men Research Group, 2008. Association between sleep and physical function in older men: the osteoporotic fractures in men sleep study. Journal of the American Geriatrics Society, 56(9), pp.1665-1673.

Dancey, C.P. & Reidy, J. (2007). Statistics without maths for psychology. 4th ed. Harlow: Pearson Prentice Hall.

Dauvilliers, Y., & Bassetti, C. L. (2017). Idiopathic Hypersomnia. In Principles and Practice of Sleep Medicine (pp. 883-891.e4). Elsevier. https://doi.org/10.1016/B978-0-323-24288-2.00091-X

De Gennaro, L., & Ferrara, M. (2017). Brain Correlates of Successful Dream Recall. In Principles and Practice of Sleep Medicine (pp. 523-528.e4). Elsevier. https://doi.org/10.1016/B978-0-323-24288-2.00050-7

De Zambotti, M., Colrain, I. M., & Baker, F. C. (2015). Interaction between Reproductive Hormones and Physiological Sleep in Women. The Journal of Clinical Endocrinology & Metabolism, 100(4), 1426–1433. https://doi.org/10.1210/jc.2014-3892

Dekker, T. (1570-1623). Cradle Song.

Dement, W., & Kleitman, N. (1957). The relation of eye movements during sleep to dream activity: an objective method for the study of dreaming. *Journal of Experimental Psychology*, *53* (5), 339.

Dew, M.A., Hoch, C.C., Buysse, D.J., Monk, T.H., Begely, A.E., et al. (2003). Healthy older adults' sleep predicts all-cause mortality at 4 to 19 years of follow-up. Psychosom Med, 65, 63–73.

Dillman, D.A., Smyth, J.D., & Christian, L.M. (2014). Internet, phone, mail and mixed-mode surveys: The tailored design method (4th ed). Hoboken, nj: John Wiley & Sons, Inc.

Doering, J., & Durfor, S. L. (2011). The process of "persevering toward normalcy" after childbirth. MCN. The American journal of maternal child nursing, 36(4), 258–265. https://doi.org/10.1097/NMC.0b013e31821826e7

Dørheim, S. K., Bondevik, G. T., Eberhard-Gran, M., & Bjorvatn, B. (2009). Sleep and depression in postpartum women: a population-based study. Sleep, 32(7), 847–855. https://doi.org/10.1093/sleep/32.7.847

Dotto L. (1996). Sleep stages, memory and learning. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne, 154(8), 1193–1196.

Driver, H.S., Shapiro, C.M. (1992). A longitudinal study of sleep stages in young women during pregnancy and postpartum. Sleep; 15:449-453.

Dudley, M., Roy, K., Kelk, N., & Bernard, D. (2001). Psychological correlates of depression in fathers and mothers in the first postnatal year. Journal of Reproductive and Infant Psychology, 19(3), 187–202. https://doi.org/10.1080/02646830124397

Duns, G. (2019). Sleep and Health.

Ellis, J. (2002). Health psychology and sleep: a forgotten agenda. Health psychology Update, 11(2) 3-7.

Empson, J. A., & Clarke, P. R. (1970). Rapid eye movements and remembering. Nature, 227(5255), 287–288. https://doi.org/10.1038/227287a0

Endler, N. S. (1997). Stress, anxiety and coping: The multidimensional interaction model. *Canadian Psychology / Psychologie canadienne, 38*(3), 136–153.

Evans, J. R., & Mathur, A. (2005). The value of online surveys. Internet Research, 15(2), 195–219. https://doi.org/10.1108/10662240510590360

Everaert, J., Podina, I. R., & Koster, E. H. W. (2017). A comprehensive meta-analysis of interpretation biases in depression. Clinical psychology review, 58, 33–48. https://doi.org/10.1016/j.cpr.2017.09.005

Everaert, K., Anderson, P., Wood, R., Andersson, F. L., & Holm-Larsen, T. (2018). Nocturia is more bothersome than daytime LUTS: Results from an Observational, Real-life Practice Database including 8659 European and American LUTS patients. International journal of clinical practice, 72(6), e13091. https://doi.org/10.1111/ijcp.13091

Everaert, K., Hervé, F., Bosch, R., Dmochowski, R., Drake, M., Hashim, H., Chapple, C., Van Kerrebroeck, P., Mourad, S., Abrams, P., & Wein, A. (2019). International Continence Society consensus on the diagnosis and treatment of nocturia. Neurourology and Urodynamics, 38(2), 478–498. https://doi.org/10.1002/nau.23939

Eysenbach, G., & Wyatt, J. (2002). Using the Internet for Surveys and Health Research. Journal of Medical Internet Research, 4(2), e13. https://doi.org/10.2196/jmir.4.2.e13

Eysenck, M. W. (2001). *Principles of cognitive psychology* (2nd ed.). Psychology Press.

Fantini, M. C., & Pallone, F. (2008). Cytokines: from gut inflammation to colorectal cancer. Current drug targets, 9(5), 375–380. https://doi.org/10.2174/138945008784221206

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior research methods, 39(2), 175–191. https://doi.org/10.3758/bf03193146

Feinberg, I., Hibi, S. & Carlson, V.R. (1977). Changes in EEG amplitude during sleep with age. In: Nandy K, Sherwin I, eds. The aging brain and senile dementia. New York: Plenum; 85-98.

Ferguson, K. A., Ono, T., Lowe, A. A., Ryan, C. F., & Fleetham, J. A. (1995). The relationship between obesity and craniofacial structure in obstructive sleep apnea. Chest, 108(2), 375–381. https://doi.org/10.1378/chest.108.2.375

Field, A. (2017). Discovering Statistics using IBM SPSS statistics. 5th Edition. Sage, London.

Fincham, J. E. (2008). Response Rates and Responsiveness for Surveys, Standards, and the Journal. American Journal of Pharmaceutical Education, 72(2), 43. https://doi.org/10.5688/aj720243

Flanagan, J. C. (1978). A research approach to improving our quality of life. *American Psychologist, 33*(2), 138–147.

Foley, D. J., Monjan, A. A., Brown, S. L., Simonsick, E. M., et al. (1995). Sleep complaints among elderly persons: An epidemiologic study of three communities. *Sleep: Journal of Sleep Research & Sleep Medicine, 18*(6), 425–432. https://doi.org/10.1093/sleep/18.6.425

Foley, D. J., Vitiello, M. V., Bliwise, D. L., Ancoli-Israel, S., Monjan, A. A., & Walsh, J. K. (2007). Frequent Napping Is Associated With Excessive Daytime Sleepiness, Depression, Pain, and Nocturia in Older Adults: Findings From the National Sleep Foundation '2003 Sleep in America' Poll. The American Journal of Geriatric Psychiatry, 15(4), 344–350. https://doi.org/10.1097/01.JGP.0000249385.50101.67

Foley, D., Ancoli-Israel, S., Britz, P., & Walsh, J. (2004). Sleep disturbances and chronic disease in older adults: results of the 2003 National Sleep Foundation Sleep in America Survey. Journal of psychosomatic research, 56(5), 497–502. https://doi.org/10.1016/j.jpsychores.2004.02.010

Freemon, F.R. (1972). Sleep research: a critical review. Springfield.

Freiberg A. S. (2020). Why We Sleep: A Hypothesis for an Ultimate or Evolutionary Origin for Sleep and Other Physiological Rhythms. Journal of circadian rhythms, 18, 2. https://doi.org/10.5334/jcr.189

From the Arts. (2017). In Principles and Practice of Sleep Medicine (p. vii). Elsevier. https://doi.org/10.1016/B978-0-323-24288-2.00186-0

Front Matter. (2017). In Principles and Practice of Sleep Medicine (pp. i–ii). Elsevier. https://doi.org/10.1016/B978-0-323-24288-2.00173-2

Front-matter. (2020). In Nocturia (pp. i–iii). Elsevier. https://doi.org/10.1016/B978-0-12-820097-1.00009-3

Fry, A. & Rehman, A. (2023). Obesity and sleep. Physical health and sleep. https://www.sleepfoundation.org/physical-health/obesity-and-sleep

Gallicchio, L., & Kalesan, B. (2009). Sleep duration and mortality: a systematic review and meta-analysis. Journal of sleep research, 18(2), 148–158. https://doi.org/10.1111/j.1365-2869.2008.00732.x

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: a guide for non-statisticians. International journal of endocrinology and metabolism, 10(2), 486–489. https://doi.org/10.5812/ijem.3505

Gill, T. M., & Feinstein, A. R. (1994). A critical appraisal of the quality of quality-of-life measurements. JAMA, 272(8), 619–626.

Goldberg, D. P., and Williams, P. (1988). A Users' Guide to The General Health Questionnaire.London: GL Assessment.

Graham J. W. (2009). Missing data analysis: making it work in the real world. Annual review of psychology, 60, 549–576. https://doi.org/10.1146/annurev.psych.58.110405.085530

Grandner M. A. (2017). Sleep, Health, and Society. Sleep medicine clinics, 12(1), 1–22. https://doi.org/10.1016/j.jsmc.2016.10.012

Grandner, M. A., Bromberg, Z., Hadley, A., Morrell, Z., Hutchison, S., & Freckleton, D. (2023). Performance of multisensory smart ring to evaluate sleep: In-lab and home-based evaluation of generalized and personalized algorithms. *Sleep.* 46(1): zasc152.

Grandner, M. A., Jackson, N., Gerstner, J. R., & Knutson, K. L. (2013). Dietary nutrients associated with short and long sleep duration. Data from a nationally representative sample. Appetite, 64, 71–80. https://doi.org/10.1016/j.appet.2013.01.004

Grandner, M. A., Khader, W. S., Warlick, C. D., & Fernandez, F. (2019). Acculturation and sleep: Implications for sleep and health disparities. Sleep, 42(3). https://doi.org/10.1093/sleep/zsz059

Grandner, M. A., Seixas, A., Shetty, S., & Shenoy, S. (2016). Sleep Duration and Diabetes Risk: Population Trends and Potential Mechanisms. Current diabetes reports, 16(11), 106. https://doi.org/10.1007/s11892-016-0805-8

Grima, N. A., Bei, B., & Mansfield, D. (2019). Insomnia theory and assessment. Australian journal of general practice, 48(4), 193–197. https://doi.org/10.31128/AJGP-12-18-4780

Grønli, J., Soulé, J., & Bramham, C. R. (2014). Sleep and protein synthesis-dependent synaptic plasticity: impacts of sleep loss and stress. Frontiers in behavioral neuroscience, 7, 224. https://doi.org/10.3389/fnbeh.2013.00224

Gulur, D. M., Mevcha, A. M., & Drake, M. J. (2011). Nocturia as a manifestation of systemic disease: NOCTURIA AS A MANIFESTATION OF SYSTEMIC DISEASE. BJU International, 107(5), 702–713. https://doi.org/10.1111/j.1464-410X.2010.09763.x

Guyon, A., Balbo, M., Morselli, L. L., Tasali, E., Leproult, R., L'Hermite-Balériaux, M., Van Cauter, E., & Spiegel, K. (2014). Adverse effects of two nights of sleep restriction on the hypothalamic-pituitary-adrenal axis in healthy men. The Journal of clinical endocrinology and metabolism, 99(8), 2861–2868. https://doi.org/10.1210/jc.2013-4254

Hair, J., Black, W., Babin, B., Anderson, R. and Tatham, R. (2006) Multivariate Data Analysis. 6th Edition, Pearson Prentice Hall, Upper Saddle River.

Halbreich, U., Alarcon, R. D., Calil, H., Douki, S., Gaszner, P., Jadresic, E., Jasovic-Gasic, M., Kadri, N., Kerr-Correa, F., Patel, V., Sarache, X., & Trivedi, J. K. (2007). Culturally sensitive complaints of depressions and anxieties in women. *Journal of Affective Disorders, 102*(1-3), 159–176.

Halbreich, U., Borenstein, J., Pearlstein, T., & Kahn, L. S. (2003). The prevalence, impairment, impact, and burden of premenstrual dysphoric disorder

(PMS/PMDD). Psychoneuroendocrinology, 28 Suppl 3, 1–23. https://doi.org/10.1016/s0306-4530(03)00098-2

Hale, L., Troxel, W. M., Kravitz, H. M., Hall, M. H., & Matthews, K. A. (2014). Acculturation and Sleep among a Multiethnic Sample of Women: The Study of Women's Health Across the Nation (SWAN). Sleep, 37(2), 309–317. https://doi.org/10.5665/sleep.3404

Hall, M. H., Brindle, R. C., & Buysse, D. J. (2018). Sleep and cardiovascular disease: Emerging opportunities for psychology. *American Psychologist, 73*(8), 994–1006. https://doi.org/10.1037/amp0000362

Hamilton, G. S., & Chai-Coetzer, C. L. (2019). Update on the assessment and investigation of adult obstructive sleep apnoea. Australian journal of general practice, 48(4), 176–181. https://doi.org/10.31128/AJGP-12-18-4777

Hammer M. J. (2017). Ethical Considerations for Data Collection Using Surveys. Oncology nursing forum, 44(2), 157–159. https://doi.org/10.1188/17.ONF.157-159

Harrington, Y. A., Parisi, J. M., Duan, D., Rojo-Wissar, D. M., Holingue, C., & Spira, A. P. (2022). Sex Hormones, Sleep, and Memory: Interrelationships Across the Adult Female Lifespan. Frontiers in Aging Neuroscience, 14, 800278. https://doi.org/10.3389/fnagi.2022.800278

Harvard University. (2020). The 2020 Sleep and Health Benefit. The division of sleep medicine. https://sleep.hms.harvard.edu/news-events/sleep-and-health-benefit/previous-sleep-and-health-benefits/2020-sleep-and-health

Hatoum, H. T., Kong, S. X., Kania, C. M., Wong, J. M., & Mendelson, W. B. (1998). Insomnia, health-related quality of life and healthcare resource consumption. A study of managed-care organisation enrollees. PharmacoEconomics, 14(6), 629–637. https://doi.org/10.2165/00019053-199814060-00004

Hecker, B. (1998). How do whales and dolphins sleep without drowning? Retrieved from http://www.scientificamerican.com/article/how-do-whales-and-dolphin/

Hedman, C., Pohjasvaara, T., Tolonen, U., Suhonen-Malm, A. S., & Myllylä, V. V. (2002). Effects of pregnancy on mothers' sleep. Sleep medicine, 3(1), 37–42. https://doi.org/10.1016/s1389-9457(01)00130-7

Hertenstein, E., Feige, B., Gmeiner, T., Kienzler, C., Spiegelhalder, K., Johann, A., Jansson-Fröjmark, M., Palagini, L., Rücker, G., Riemann, D., & Baglioni, C. (2019). Insomnia as a predictor of mental disorders: A systematic review and meta-analysis. Sleep medicine reviews, 43, 96–105. https://doi.org/10.1016/j.smrv.2018.10.006

Hertz, G., Fast, A., Feinsilver, S. H., Albertario, C. L., et al. (1992). Sleep in normal late pregnancy. *Sleep: Journal of Sleep Research & Sleep Medicine, 15*(3), 246–251

Hetta, J. (1999). The impact of sleep deprivation caused by nocturia. BJUI; 84(S1), 27-28.

Hobson,J. A., & McCarley, R. W. (1977). The brain as a dream state generator: An actition-synthesis hypothesis of the dream process. American Journal of Psychiatry, 134, 1335-1348.

Holth, J.K., et al., (2017). Altered sleep and EEG power in the P301S tau transgenic mouse model. Ann. Clin. Transl. Neurol. 4, 180–190.

Homma, Y. (2005). Classification of nocturia in the adult and elderly patient: A review of clinical criteria and selected literature. BJU International, 96(s1), 8–14. https://doi.org/10.1111/j.1464-410X.2005.05655.x

Homma, Y., Yamaguchi, O., & Hayashi, K. (2006). Epidemiologic survey of lower urinary tract symptoms in Japan. Urology, 68(3), 560–564. https://doi.org/10.1016/j.urology.2006.03.035

Honarmand, K., & Feinstein, A. (2009). Validation of the Hospital Anxiety and Depression Scale for use with multiple sclerosis patients. Multiple sclerosis (Houndmills, Basingstoke, England), 15(12), 1518–1524. https://doi.org/10.1177/1352458509347150

Horne JA, (1983). Staff LHE. Exercise and sleep: body-heating effects. Sleep; 6:36-46.

Horne JA. (1983). Human sleep and tissue restitution: some qualifications and doubts. Clin Sci; 65:569-78.

Horne JA. (1981). The effects of exercise upon sleep: a critical review. Biolog PsychoI; 12:241-90.

Horne, J. A., & Minard, A. (1985). Sleep and sleepiness following a behaviourally 'active' day. Ergonomics, 28(3), 567–575. https://doi.org/10.1080/00140138508963171

Hsu, A., Nakagawa, S., Walter, L. C., Van Den Eeden, S. K., Brown, J. S., Thom, D. H., Lee, S. J., & Huang, A. J. (2015). The Burden of Nocturia Among Middle-Aged and Older Women. Obstetrics & Gynecology, 125(1), 35–43. https://doi.org/10.1097/AOG.0000000000000600

https://www.jamovi.org

Hunter, C. L., Goodie, J. L., Oordt, M. S., & Dobmeyer, A. C. (2017). Women's health. In C. L. Hunter, J. L. Goodie, M. S. Oordt, & A. C. Dobmeyer, Integrated behavioral health in primary care: Step-by-step guidance for assessment and intervention. (pp. 221–237). American Psychological Association. https://doi.org/10.1037/0000017-014

Hunter, P. (2021). Getting on top of sleep: Research begins to unravel the molecular mechanisms that link sleep and health. EMBO Reports, 22(5), e52957. https://doi.org/10.15252/embr.202152957

Hwang, E.C., KIM, S.O., NAM, D.H., Yu, H.S., Hwang, I., Jung, S.I., Kang, T.W., Kwon, D.D. and Kim, G.S., 2015. Men with hypertension are more likely to have severe lower

urinary tract symptoms and large prostate volume. LUTS: Lower Urinary Tract Symptoms, 7(1), pp.32-36.

Ingram, R. E., & Wisnicki, K. S. (1988). Assessment of positive automatic cognition. *Journal of Consulting and Clinical Psychology, 56*(6), 898–902.

Ingram, Rick. (2003). Origins of Cognitive Vulnerability to Depression. Cognitive Therapy and Research. 27. 77-88. 10.1023/A:1022590730752.

Irish, Leah A., Kline, Christopher E., Rothenberger, Scott D., Krafty, Robert T., Buysse, Daniel J., Kravitz, Howard M., Bromberger, Joyce T., Zheng, Huiyong, Hall, Martica H. (2014**).** A 24-hour approach to the study of health behaviors: Temporal relationships between waking health behaviors and sleep**.** Annals of Behavioral Medicine*;* 47(2), 189-197.

Irwin, M.R. (2015). Why sleep is important for health: a psychoneuroimmunology perspective. Annu Rev Psychol, 3(66),143-72.

Irwin, M.R., Cole, J.C. & Nicassio, P.M. (2006a). Comparative meta-analysis of behavioral interventions for insomnia and their efficacy in middle-aged adults and in older adults 55+ years of age. Health Psychol, 25, 3–14.

Irwin, M. R., Wang, M., Campomayor, C. O., Collado-Hidalgo, A., & Cole, S. (2006). Sleep deprivation and activation of morning levels of cellular and genomic markers of inflammation. Archives of internal medicine, 166(16), 1756–1762. https://doi.org/10.1001/archinte.166.16.1756

Ito, H., Aoki, Y., Oe, H., Taga, M., Tsuchiyama, K., & Yokoyama, O. (2019). Low and high body mass index values are associated with female nocturia. Neurourology and Urodynamics, 38(8), 2250–2254. https://doi.org/10.1002/nau.24126

Jagan A. Pillai, James B. Leverenz, (2017). Sleep and Neurodegeneration: A Critical Appraisal. Chest; 151(6), 1375-1386.

Jaussent, I., Bouyer, J., Ancelin, M. L., Akbaraly, T., Pérès, K., Ritchie, K., Besset, A., & Dauvilliers, Y. (2011). Insomnia and daytime sleepiness are risk factors for depressive symptoms in the elderly. Sleep, 34(8), 1103–1110. https://doi.org/10.5665/SLEEP.1170

Jean-Louis, G., Grandner, M.A., Youngstedt, S.D. et al. (2015). Differential increase in prevalence estimates of inadequate sleep among black and white Americans. BMC Public Health; 15, 1185. https://doi.org/10.1186/s12889-015-2500-0

Jean-Louis, G., Kripke, D. F., Ancoli-Israel, S., Klauber, M. R., & Sepulveda, R. S. (2000). Sleep duration, illumination, and activity patterns in a population sample: effects of gender and ethnicity. Biological psychiatry, 47(10), 921–927. https://doi.org/10.1016/s0006-3223(99)00169-9.

Jehan, S., Zizi, F., Pandi-Perumal, S. R., Wall, S., Auguste, E., Myers, A. K., Jean-Louis, G., & McFarlane, S. I. (2017). Obstructive Sleep Apnea and Obesity: Implications for Public Health. Sleep medicine and disorders : international journal, 1(4), 00019.

Jemere, T., Mossie, A., Berhanu, H. et al (2019). Poor sleep quality and its predictors among type 2 diabetes mellitus patients attending Jimma University Medical Center, Jimma, Ethiopia.BMC Res Notes 12, 488.

Jessica, L., Paterson., Jillian, Dorrian., Sally, A., Ferguson., Sarah, M., Jay., Nicole, Lamond., P.J., Murphy., Scott, S., Campbell., Drew, Dawson. (2011). Changes in structural aspects of mood during 39-66 h of sleep loss using matched controls. Applied Ergonomics, 42(2):196-201. doi: 10.1016/J.APERGO.2010.06.014

Jimenez, D. E., Bartels, S. J., Cardenas, V., & Alegría, M. (2013). Stigmatizing attitudes toward mental illness among racial/ethnic older adults in primary care. International journal of geriatric psychiatry, 28(10), 1061–1068. https://doi.org/10.1002/gps.3928

Juul KV, Malmberg A, van der Meulen E, Walle JV, Nørgaard JP. (2017). Low-dose desmopressin combined with serum sodium monitoring can prevent clinically significant hyponatraemia in patients treated for nocturia. BJU Int;119(5):776–784. doi: 10.1111/bju.13718

Kales, A., Hoedemaker, F. S., Jacobson, A., Kales, J. D., Paulson, M. J., & Wilson, T. E. (1967). Mentation during sleep: REM and NREM recall reports. *Perceptual and Motor Skills*, *24*(2), 555–560. https://doi.org/10.2466/pms.1967.24.2.555

Kaminetsky, J., Fein, S., Dmochowski, R., MacDiarmid, S., Abrams, S., Cheng, M., & Wein, A. (2018). Efficacy and Safety of SER120 Nasal Spray in Patients with Nocturia: Pooled Analysis of 2 Randomized, Double-Blind, Placebo Controlled, Phase 3 Trials. The Journal of urology, 200(3), 604–611. https://doi.org/10.1016/j.juro.2018.04.050

Kamperis, K., Hagstroem, S., Rittig, S & Djurhuus, J.C. (2008). Combination of the enuresis alarm and desmopressin: second line treatment for nocturnal enuresis. J Urol; 179:1128–1131. doi: 10.1016/j.juro.2007.10.088.

Kamperis, K., Rittig, S., Bower, W.F. & Djurhuus, J.C. (2012). Effect of indomethacin on desmopressin resistant nocturnal polyuria and nocturnal enuresis. J Urol; 188:1915–1922. doi: 10.1016/j.juro.2012.07.019.

Kamperis, K., Rittig, S., Jørgensen, K. A., & Djurhuus, J. C. (2006). Nocturnal polyuria in monosymptomatic nocturnal enuresis refractory to desmopressin treatment. American journal of physiology. Renal physiology, 291(6), F1232–F1240. https://doi.org/10.1152/ajprenal.00134.2006

Kamysheva, E., Skouteris, H., Wertheim, E. H., Paxton, S. J., & Milgrom, J. (2010). A prospective investigation of the relationships among sleep quality, physical symptoms, and depressive symptoms during pregnancy. Journal of affective disorders, 123(1-3), 317–320. https://doi.org/10.1016/j.jad.2009.09.015

Kang, H. (2013). The prevention and handling of the missing data. Korean Journal of Anesthesiology, 64(5), 402. https://doi.org/10.4097/kjae.2013.64.5.402

Kapsimalis, F., Basta, M., Varouchakis, G., Gourgoulianis, K., Vgontzas, A., & Kryger, M. (2008). Cytokines and pathological sleep. Sleep Medicine, 9(6), 603-614. https://doi.org/10.1016/j.sleep.2007.08.019

Karacan, I., Thornby, J. I., Anch, M., Holzer, C. E., Warheit, G. J., Schwab, J. J., & Williams, R. L. (1976). Prevalence of sleep disturbance in a primarily urban Florida County. Social science & medicine, 10(5), 239–244. https://doi.org/10.1016/0037-7856(76)90006-8

Karacan, I., Thornby, J.I. & Williams, R.L. (1983). Sleep disturbance: a community survey. In Guilleminault, C., and Lugaresi, E., Eds. Sleep/Wake disorders: natural history, Epidemiology, and Long-term Evolution. New York: Raven Press, pp 37-60.

Katsuhisa Banno, Clare Ramsey, Randy Walld, Meir H. Kryger, (2009). Expenditure on Health Care in Obese Women with and without Sleep Apnea, Sleep, 22(2) 247–252.

Khot, S.P. & Morgenstern, L (2019). Sleep and stroke. Stroke; 50(6) 1612-1617.

Kitamura, S., Katayose, Y., Nakazaki, K., Motomura, Y., Oba, K., Katsunuma, R., Terasawa, Y., Enomoto, M., Moriguchi, Y., Hida, A., & Mishima, K. (2016). Estimating individual optimal sleep duration and potential sleep debt. Scientific Reports, 6(1), 35812. https://doi.org/10.1038/srep35812

Kızılırmak, A., Timur, S., & Kartal, B. (2012). Insomnia in pregnancy and factors related to insomnia. The Scientific World Journal, 2012, 197093. https://doi.org/10.1100/2012/197093

Klingenberg, C., Wheeler, K. I., McCallion, N., Morley, C. J., & Davis, P. G. (2017). Volume-targeted versus pressure-limited ventilation in neonates. The Cochrane database of systematic reviews, 10(10), CD003666. https://doi.org/10.1002/14651858.CD003666.pub4

Klingenberg, L., Sjödin, A., Holmbäck, U., Astrup, A., & Chaput, J. P. (2012). Short sleep duration and its association with energy metabolism. Obesity reviews : an official journal of the International Association for the Study of Obesity, 13(7), 565–577. https://doi.org/10.1111/j.1467-789X.2012.00991.x

Knutson, K. L., Van Cauter, E., Rathouz, P. J., Yan, L. L., Hulley, S. B., Liu, K., & Lauderdale, D. S. (2009). Association between sleep and blood pressure in midlife: the CARDIA sleep study. Archives of internal medicine, 169(11), 1055–1061. https://doi.org/10.1001/archinternmed.2009.119

Kobelt, G., Borgström, F., & Mattiasson, A. (2003). Productivity, vitality and utility in a group of healthy professionally active individuals with nocturia. BJU international, 91(3), 190–195. https://doi.org/10.1046/j.1464-410x.2003.04062.x

Kravitz, H. M., Ganz, P. A., Bromberger, J., Powell, L. H., Sutton-Tyrrell, K., & Meyer, P. M. (n.d.). Sleep difficulty in women at midlife: A community survey of sleep and the menopausal transition.

Kravitz, H. M., Ganz, P. A., Bromberger, J., Powell, L. H., Sutton-Tyrrell, K., & Meyer, P. M. (2003). Sleep difficulty in women at midlife: a community survey of sleep and the menopausal transition. Menopause (New York, N.Y.), 10(1), 19–28. https://doi.org/10.1097/00042192-200310010-00005

Kravitz, H. M., Zhao, X., Bromberger, J. T., Gold, E. B., Hall, M. H., Matthews, K. A., & Sowers, M. R. (2008). Sleep disturbance during the menopausal transition in a multi-ethnic community sample of women. Sleep, 31(7), 979–990.

Kripke, D. F., Brunner, R., Freeman, R., Hendrix, S. L., Jackson, R. D., Masaki, K., & Carter, R. A. (2001). Sleep Complaints of Postmenopausal Women. Clinical journal of women's health, 1(5), 244–252. https://doi.org/10.1053/cjwh.2001.30491

Kripke, D.F., Simons, R.N., Garfinkel, L. & Hammond, E.C. (1979). Short and long sleep and sleeping pills: is increased mortality associated? Archives of general psychiatry, 36: 103-116.

Krittanawong, C., Tunhasiriwet, A., Wang, Z., Zhang, H., Farrell, A. M., Chirapongsathorn, S., Sun, T., Kitai, T., & Argulian, E. (2019). Association between short and long sleep durations and cardiovascular outcomes: a systematic review and meta-analysis. European heart journal. Acute cardiovascular care, 8(8), 762–770. https://doi.org/10.1177/2048872617741733

Krueger, J. M., Pappenheimer, J. R., & Karnovsky, M. L. (1982). The composition of sleep-promoting factor isolated from human urine. The Journal of biological chemistry, 257(4), 1664–1669.

Kryger, M. H. et al. (eds.) (2023) Atlas of clinical sleep medicine. Third edition. St. Louis, Missouri: Elsevier Inc.

Kryger, M., Avidan, A.Y., Berry, R. (2013). Atlas of Sleep Medicine. 2nd Edition, Elsevier.

Kryger, M.H. (2013). The mystery of sleep: Why a good night's sleep is vital to a better and healthier life. Yale University press. New Haven and London.

Kubota, K. (1989). Kuniomi Ishimori and the first discovery of sleep-inducing substances in the brain. Neurosci Res;6(6):497-518.

Kuh, D. L., Wadsworth, M., & Hardy, R. (1997). Women's health in midlife: the influence of the menopause, social factors and health in earlier life. British journal of obstetrics and gynaecology, 104(8), 923–933. https://doi.org/10.1111/j.1471-0528.1997.tb14352.x

Kupelian, V., Fitzgerald, M. P., Kaplan, S. A., Norgaard, J. P., Chiu, G. R., & Rosen, R. C. (2011). Association of nocturia and mortality: results from the Third National Health and Nutrition Examination Survey. The Journal of urology, 185(2), 571–577. https://doi.org/10.1016/j.juro.2010.09.108

Kupelian, V., Wei, J. T., O'Leary, M. P., Norgaard, J. P., Rosen, R. C., & McKinlay, J. B. (2012). Nocturia and Quality of Life: Results from the Boston Area Community Health Survey. European Urology, 61(1), 78–84. https://doi.org/10.1016/j.eururo.2011.05.065

Kurtzman, J. T., Bergman, A. M., & Weiss, J. P. (2016). Nocturia in women. Current Opinion in Urology, 26(4), 315–320. https://doi.org/10.1097/MOU.0000000000000287

Lamarche, L. J., & De Koninck, J. (2007). Sleep disturbance in adults with posttraumatic stress disorder: a review. The Journal of clinical psychiatry, 68(8), 1257–1270. https://doi.org/10.4088/jcp.v68n0813

Lane, T. (2016). Nocturia. Surgery (Oxford); 34(7), 347-351.

Lane, T. (2022). Nocturia. Surgery (Oxford); 40(8), 526-530.

Lange, T., Dimitrov, S., Bollinger, T., Diekelmann, S., & Born, J. (2011). Sleep after vaccination boosts immunological memory. Journal of immunology (Baltimore, Md. : 1950), 187(1), 283–290. https://doi.org/10.4049/jimmunol.1100015

Lara-Carrasco, J., Simard, V., Saint-Onge, K., Lamoureux-Tremblay, V., & Nielsen, T. (2014). Disturbed dreaming during the third trimester of pregnancy. *Sleep Medicine, 15*(6), 694–700.

Lara, M., Gamboa, C., Kahramanian, M. I., Morales, L. S., & Bautista, D. E. (2005). Acculturation and Latino health in the United States: a review of the literature and its sociopolitical context. Annual review of public health, 26, 367–397. https://doi.org/10.1146/annurev.publhealth.26.021304.144615

Lee, K. A., Zaffke, M. E., & McEnany, G. (2000). Parity and sleep patterns during and after pregnancy. Obstetrics and gynecology, 95(1), 14–18. https://doi.org/10.1016/s0029-7844(99)00486-x

Lee, M., Choh, A. C., Demerath, E. W., Knutson, K. L., Duren, D. L., Sherwood, R. J., Sun, S. S., Chumlea, Wm. C., Towne, B., Siervogel, R. M., & Czerwinski, S. A. (2009). Sleep disturbance in relation to health-related quality of life in adults: The fels longitudinal study. The Journal of Nutrition, Health and Aging, 13(6), 576–583. https://doi.org/10.1007/s12603-009-0110-1Lee, W., Nagubadi, S., Kryger, M. H., & Mokhlesi, B. (2008). Epidemiology of Obstructive Sleep Apnea: a Population-based Perspective. Expert review of respiratory medicine, 2(3), 349–364. https://doi.org/10.1586/17476348.2.3.349

Legendre R, Piéron H. (1912). De la propriété hypnotoxique des humeurs développée au cours d'une veille prolongée C.R. Société de Biologie de Paris; 70; 210-212

Leslie, S. W., Sajjad, H., & Singh, S. (2023). Nocturia. In StatPearls. StatPearls Publishing.

lI, x., Wong, W., Lamoureux, E.L. & Wong, T.Y. (2012). Are linear regression techniques appropriate for analysis when the dependant (outcome) variable is not normally distributed. Investigative opthamology & visual science; 53, 3082-3083.

Lightner, D. J., Krambeck, A. E., Jacobson, D. J., McGree, M. E., Jacobsen, S. J., Lieber, M. M., Roger, V. L., Girman, C. J., & St Sauver, J. L. (2012). Nocturia is associated with an increased risk of coronary heart disease and death. BJU international, 110(6), 848–853. https://doi.org/10.1111/j.1464-410X.2011.10806.x

Lim, D. C., Najafi, A., Afifi, L., Bassetti, C. L., Buysse, D. J., Han, F., Högl, B., Melaku, Y. A., Morin, C. M., Pack, A. I., Poyares, D., Somers, V. K., Eastwood, P. R., Zee, P. C., & Jackson, C. L. (2023). The need to promote sleep health in public health agendas across the globe. The Lancet Public Health, 8(10), e820–e826. https://doi.org/10.1016/S2468-2667(23)00182-2

Lin, L. M., Rosenberg, P. A., & Lin, J. (2005). Do procedural errors cause endodontic treatment failure?. Journal of the American Dental Association (1939), 136(2), 187–231. https://doi.org/10.14219/jada.archive.2005.0140

Lindberg, E., Janson, C., Gislason, T., Björnsson, E., Hetta, J., & Boman, G. (1997). Sleep disturbances in a young adult population: can gender differences be explained by differences in psychological status?. Sleep, 20(6), 381–387. https://doi.org/10.1093/sleep/20.6.381

Little, R.J.; D'Agostino, R.; Cohen, M.L.; Dickersin, K.; Emerson, S.S.; Farrar, J.T.; Frangakis, C.; Hogan, J.W.; Molenberghs, G.; Murphy, S.A.; et al. (2012). The prevention and treatment of missing data in clinical trials. N. Engl. J. Med. 367, 1355–1360.

Lose, G., Alling-Møller, L., & Jennum, P. (2001). Nocturia in women. American journal of obstetrics and gynecology, 185(2), 514–521. https://doi.org/10.1067/mob.2001.116091

Lovibond, S. H., & Lovibond, P. F. (1995). *Depression Anxiety Stress Scales (DASS--21, DASS--42)* [Database record]. APA PsycTests.

Luboshitzky, R., Herer, P., Levi, M., Shen-Orr, Z., & Lavie, P. (1999). Relationship between rapid eye movement sleep and testosterone secretion in normal men. Journal of andrology, 20(6), 731–737.

Lucey, B.P. (2020). It's complicated: The relationship between sleep and Alzheimer's disease in humans. Neurobiology of Disease;144.

Lugaresi, E., Cirignotta, F., Zucconi, M., Mandini, S., Lenzi, P.L. & Coccagna, G. (1983). Good and poor sleepers: an epidemiological survey of the San marion population. In Guilleminault, C., and Lugaresi, E., Eds. Sleep/Wake disorders: natural history, Epidemiology, and Long-term Evolution. New York: Raven Press, pp1-12.

Lyytikäinen, P., Rahkonen, O., Lahelma, E., & Lallukka, T. (2011). Association of sleep duration with weight and weight gain: a prospective follow-up study. Journal of sleep research, 20(2), 298–302. https://doi.org/10.1111/j.1365-2869.2010.00903.x

Macrea, M., Katz, E. S., & Malhotra, A. (2017). Central Sleep Apnea. In Principles and Practice of Sleep Medicine (pp. 1049-1058.e5). Elsevier. https://doi.org/10.1016/B978-0-323-24288-2.00109-4

Magee, L., & Hale, L. (2012). Longitudinal associations between sleep duration and subsequent weight gain: a systematic review. Sleep medicine reviews, 16(3), 231–241. https://doi.org/10.1016/j.smrv.2011.05.005

Mallon, L., Broman, J.E. & Hetta, J. (2002). Sleep complaints predict coronary artery disease mortality in males: a 12-year follow-up study of a middle-aged Swedish population. J Intern Med, 251, 207–16.

Malmsten, U. G., Milsom, I., Molander, U., & Norlén, L. J. (1997). Urinary incontinence and lower urinary tract symptoms: an epidemiological study of men aged 45 to 99 years. The Journal of urology, 158(5), 1733–1737. https://doi.org/10.1016/s0022-5347(01)64113-2

Manber, R., Buysse, D. J., Edinger, J., Krystal, A., Luther, J. F., Wisniewski, S. R., Trockel, M., Kraemer, H. C., & Thase, M. E. (2016). Efficacy of Cognitive-Behavioral Therapy for Insomnia Combined With Antidepressant Pharmacotherapy in Patients With Comorbid Depression and Insomnia: A Randomized Controlled Trial. The Journal of clinical psychiatry, 77(10), e1316–e1323. https://doi.org/10.4088/JCP.15m10244

Marschall-Kehrel, D. & Harms, T.W. (2009). Structured desmopressin withdrawal improves response and treatment outcome for monosymptomatic enuretic children. J Urol; 182:2022–2026. doi: 10.1016/j.juro.2009.03.068

Maurice, D.M. (1998). The Von Sallman Lecture 1966: An ophthalmological explanation of REM sleep. Exp. Eye Res; 66, 139-145.

Meddis R. (1975). On the function of sleep. Animal behaviour, 23(3), 676–691. https://doi.org/10.1016/0003-3472(75)90144-x

Meddis, R. (1979). The evolution and function of sleep. - In: Brain, behaviour and evolution (D. A. OAKLEY & H. C. PLOTKIN, eds). London: Methuen, p. 99-125.

Medic, G., Wille, M., & Hemels, M. (2017). Short- and long-term health consequences of sleep disruption. Nature and Science of Sleep, Volume 9, 151–161. https://doi.org/10.2147/NSS.S134864

Meeus, W., van de Schoot, R., Keijsers, L., & Branje, S. (2012). Identity statuses as developmental trajectories: a five-wave longitudinal study in early-to-middle and middle-to-late adolescents. Journal of youth and adolescence, 41(8), 1008–1021. https://doi.org/10.1007/s10964-011-9730-y

Mehta, N., Shafi, F., & Bhat, A. (2015). Unique Aspects of Sleep in Women. Missouri medicine, 112(6), 430–434.

Meijman, T. F., Thunnissen, M. J. & Devriesgriever, A. G. H. (1990). The after-effects of a prolonged period of day-sleep on subjective sleep quality. Work Stress, 4: 65–70.

Mellinger, G.D., Balter, M.B. & Uhlenhuth, E.H. (1984). The experience of insomnia and daytime and nighttime functioning. Psychiatry research, 12:235-250.

Memar, P., & Faradji, F. (2018). A Novel Multi-Class EEG-Based Sleep Stage Classification System. IEEE transactions on neural systems and rehabilitation engineering: a publication of the IEEE Engineering in Medicine and Biology Society, 26(1), 84–95. https://doi.org/10.1109/TNSRE.2017.2776149

Mindell, J. A., & Jacobson, B. J. (2000). Sleep disturbances during pregnancy. Journal of obstetric, gynecologic, and neonatal nursing : JOGNN, 29(6), 590–597. https://doi.org/10.1111/j.1552-6909.2000.tb02072.x

Miotla, P., Cartwright, R., Futyma, K., Bogusiewicz, M., Skorupska, K., Winkler, I., & Rechberger, T. (2017). Can botox improve night-time overactive bladder symptoms in women?. Neurourology and urodynamics, 36(3), 648–652. https://doi.org/10.1002/nau.22983

Moline, M. L., Broch, L., Zak, R., & Gross, V. (2003). Sleep in women across the life cycle from adulthood through menopause. Sleep medicine reviews, 7(2), 155–177. https://doi.org/10.1053/smrv.2001.0228

Montgomery, P., & Dunne, D. (2007). Sleep disorders in children. BMJ clinical evidence, 2007, 2304.

Moriarty, D. G., Zack, M. M., & Kobau, R. (2003). The Centers for Disease Control and Prevention's Healthy Days Measures - population tracking of perceived physical and mental health over time. Health and quality of life outcomes, 1, 37. https://doi.org/10.1186/1477-7525-1-37.

Morin, C.M., Bootzin, R.R., Buysse, D.J., Edinger, J.D., Espie, C.A. & Lichstein, K.L. (2006a). Psychological and behavioral treatment of insomnia: update of the recent evidence (1998–2004). Sleep, 29,1398–414.

Muijs, D. (2010). Doing Quantitative Research in Education with SPSS. 2nd Edition, SAGE Publications, London. https://doi.org/10.4135/9781849203241

Mukhametov, L.M,. Supin, A.Ya. & Polyakova, I.G, (1984). Sleep in Caspian seals (*Phoca caspica*). J. High Nerve Activity 34, 259–264

Mulder-Hajonides Van Der Meulen, W., Wijnberg, J., Hollander, J., De Diana, I. and Van Den Hoofdakker, R. (1981). Measurement of subjective sleep quality. In: Proceedings of the International European Sleep Congress. Elsevier, Amsterdam.

Newsom, R. & Dimitrui, A. (2023). Depression and sleep. Sleep Foundation.org https://www.sleepfoundation.org/mental-health/depression-and-sleep

Neylan, T. C., Reynolds, C. F. III, & Kupfer, D. J. (2003). Sleep disorders. In R. E. Hales & S. C. Yudofsky (Eds.), *The American Psychiatric Publishing textbook of clinical psychiatry* (4th ed., pp. 975–1000). American Psychiatric Publishing, Inc.

Neylan, T.C. & Walsh, C.M. (2024). Wake, NREM, and REM sleep measures predict incident dementia, *Sleep*; (47)3.

Nowakowski, S., Levy-Meeks, M. E., Dawson, D. B., Meers, J. M., Stout-Aguilar, J. S., Kilic, G. S., & Borahay, M. A. (2020). Association of preoperative sleep pattern with posthysterectomy pain: a pilot study. Journal of clinical sleep medicine: JCSM : official publication of the American Academy of Sleep Medicine, 16(11), 1901–1908. https://doi.org/10.5664/jcsm.8730

Nowakowski, S., Meers, J., & Heimbach, E. (2013). Sleep and Women's Health. Sleep medicine research, 4(1), 1–22. https://doi.org/10.17241/smr.2013.4.1.1

O'Neill, R. T., & Temple, R. (2012). The prevention and treatment of missing data in clinical trials: an FDA perspective on the importance of dealing with it. Clinical pharmacology and therapeutics, 91(3), 550–554. https://doi.org/10.1038/clpt.2011.340

Oates, J., Carpenter, D., Fisher, M., Goodson, S., Hannah, B., Kwiatowski, R., Prutton, K., Reeves, D., & Wainwright, T. (2021). *BPS Code of Human Research Ethics*. British Psychological Society.

Obayashi, K., Saeki, K., & Kurumatani, N. (2015). Quantitative association between nocturnal voiding frequency and objective sleep quality in the general elderly population: the HEIJO-KYO cohort. Sleep medicine, 16(5), 577–582. https://doi.org/10.1016/j.sleep.2015.01.021

Obayashi, K., Saeki, K., Negoro, H., & Kurumatani, N. (2017). Nocturia increases the incidence of depressive symptoms: A longitudinal study of the HEIJO - KYO cohort. BJU International, 120(2), 280–285. https://doi.org/10.1111/bju.13791

Oelke, M., Anderson, P., Wood, R. & Holm-Larsen, T. (2016). Nocturia is often inadequately assessed, diagnosed and treated by physicians: results of an observational, real-life practice database containing 8659 European and US-American patients. The Intl Jour of Clin pRAC, 70(11):940-949.

Oelke, M., De Wachter, S., Drake, M. J., Giannantoni, A., Kirby, M., Orme, S., Rees, J., Van Kerrebroeck, P., & Everaert, K. (2017). A practical approach to the management of nocturia. International Journal of Clinical Practice, 71(11), e13027. https://doi.org/10.1111/ijcp.13027

Ohayon M. M. (2002). Epidemiology of insomnia: what we know and what we still need to learn. Sleep medicine reviews, 6(2), 97–111. https://doi.org/10.1053/smrv.2002.0186

Ohayon, M. M., & Schatzberg, A. F. (2002). Prevalence of depressive episodes with psychotic features in the general population. The American journal of psychiatry, 159(11), 1855–1861. https://doi.org/10.1176/appi.ajp.159.11.1855

Okun, M. L., Schetter, C. D., & Glynn, L. M. (2011). Poor sleep quality is associated with preterm birth. Sleep, 34(11), 1493–1498. https://doi.org/10.5665/sleep.1384

Oswald 1. (1974). Sleep. Harmondsworth, Middlesex: Penguin Books:143-52.

Oswald, I. (1970). Sleep (A pelican original book). London, Penguin Books.

Oswald, I. (1976). The function of sleep, *Postgraduate Medical Journal*; 52(603), 15–18, https://doi.org/10.1136/pgmj.52.603.15

Oswald, I. (1980) Sleep as a Restorative Process: Human Clues. Vol. 53. [Online]. Elsevier.

Pallant, J. (2001). SPSS survival manual: A step by step guide to data analysis using SPSS for Windows version 10. Buckingham: Open University Press.

Palomäki, H., Partinen, M., Juvela, S. and Kaste, M. (1989). Snoring as a risk factor for sleep-related brain infarction. Stroke, 20: 1311–1315.

Pappenheimer, J. R., Koski, G., Fencl, V., Karnovsky, M. L., & Krueger, J. (1975). Extraction of sleep-promoting factor S from cerebrospinal fluid and from brains of sleep-deprived animals. Journal of neurophysiology, 38(6), 1299–1311. https://doi.org/10.1152/jn.1975.38.6.1299

Park, E. M., Meltzer-Brody, S., & Stickgold, R. (2013). Poor sleep maintenance and subjective sleep quality are associated with postpartum maternal depression symptom severity. Archives of women's mental health, 16(6), 539–547. https://doi.org/10.1007/s00737-013-0356-9

Park, H., Chiang, J. J., Irwin, M. R., Bower, J. E., McCreath, H., & Fuligni, A. J. (2019). Developmental trends in sleep during adolescents' transition to young adulthood. Sleep Medicine, 60, 202–210.

Parthasarathy, S., Fitzgerald, M., Goodwin, J. L., Unruh, M., Guerra, S., & Quan, S. F. (2012). Nocturia, sleep-disordered breathing, and cardiovascular morbidity in a community-based cohort. PloS one, 7(2), e30969. https://doi.org/10.1371/journal.pone.0030969

Partinen, M. & Palomaki, H. (1985). Snoring and cerebral infarction. The Lancet; (326)8468, 1325-1326.

Partinen, M., & Gislason, T. (1995). Basic Nordic Sleep Questionnaire (BNSQ): a quantitated measure of subjective sleep complaints. Journal of sleep research, 4(S1), 150–155. https://doi.org/10.1111/j.1365-2869.1995.tb00205.x

Patel, A. K., Reddy, V., Shumway, K. R., & Araujo, J. F. (2024). Physiology, Sleep Stages. In Stat Pearls. Stat Pearls Publishing.

Pengo, M. F., Won, C. H., & Bourjeily, G. (2018). Sleep in Women Across the Life Span. Chest, 154(1), 196–206. https://doi.org/10.1016/j.chest.2018.04.005

Perlis, M. L., McCall, W. V., Jungquist, C. R., Pigeon, W. R., & Matteson, S. E. (2005). Placebo effects in primary insomnia. Sleep medicine reviews, 9(5), 381–389. https://doi.org/10.1016/j.smrv.2005.05.001.

Pien, G. W., & Schwab, R. J. (2004). Sleep disorders during pregnancy. Sleep, 27(7), 1405–1417. https://doi.org/10.1093/sleep/27.7.1405

Pilleri ,G. (1979). The blind Indus dolphin, *Platanista indi*. Endeavour 3, 45–56.

Poortmans, J. R., Carpentier, A., Pereira-Lancha, L. O., & Lancha, A., Jr (2012). Protein turnover, amino acid requirements and recommendations for athletes and active populations. Brazilian journal of medical and biological research = Revista brasileira de pesquisas medicas e biologicas, 45(10), 875–890. https://doi.org/10.1590/s0100-879x2012007500096

Pressman, S. D., & Cohen, S. (2005). Does positive affect influence health?. Psychological bulletin, 131(6), 925–971. https://doi.org/10.1037/0033-2909.131.6.925

RAND. (2020). Assessing the burden of nocturia in the workplace. The associations between nocturnal voiding, subjective well-being, work engagement and productivity. Journal of Medical Economics.

Rediehs, M. H., Reis, J. S., & Creason, N. S. (1990). Sleep in old age: focus on gender differences. Sleep, 13(5), 410–424.

Robertson, G., Rembratt, A. & Eriksson, K.E. (2000). Desmopressin in the Treatment of Disorders of Urine Output in Humans. Arch Int Med.

Rod, N. H., Kumari, M., Lange, T., Kivimäki, M., Shipley, M., & Ferrie, J. (2014). The joint effect of sleep duration and disturbed sleep on cause-specific mortality: results from the Whitehall II cohort study. PloS one, 9(4), e91965. https://doi.org/10.1371/journal.pone.0091965

Romano, C. D., Lewis, S., Barrett, A., Andersson, F. L., Williams, V., Ancoli-Israel, S., & Roth, T. (2019). Development of the Nocturia Sleep Quality Scale: A patient-reported outcome measure of sleep impact related to nocturia. Sleep Medicine, 59, 101–106. https://doi.org/10.1016/j.sleep.2019.02.006

Sakalis, V. I., Karavitakis, M., Bedretdinova, D., Bach, T., Bosch, J. L. H. R., Gacci, M., Gratzke, C., Herrmann, T. R., Madersbacher, S., Mamoulakis, C., Tikkinen, K. A. O., Gravas, S., & Drake, M. J. (2017). Medical Treatment of Nocturia in Men with Lower Urinary Tract Symptoms: Systematic Review by the European Association of Urology Guidelines Panel for Male Lower Urinary Tract Symptoms. European urology, 72(5), 757–769. https://doi.org/10.1016/j.eururo.2017.06.010

Samuelsson, E., Victor, A. & Tibblin, G. (1997). A population study of urinary incontinence and nocturia among women aged 20-59 years. Acta Obst et Gyn Scand; 76(1), 74-80.

Santiago, J. R., Nolledo, M. S., Kinzler, W., & Santiago, T. V. (2001). Sleep and sleep disorders in pregnancy. Annals of internal medicine, 134(5), 396–408. https://doi.org/10.7326/0003-4819-134-5-200103060-00012

Schmidt, M. H. (2014). The energy allocation function of sleep: a unifying theory of sleep, torpor, and continuous wakefulness. Neuroscience and biobehavioral reviews, 47, 122–153. https://doi.org/10.1016/j.neubiorev.2014.08.001

Shao, I. H., Wu, C. C., Hsu, H. S., Chang, S. C., Wang, H. H., Chuang, H. C., & Tam, Y. Y. (2016). The effect of nocturia on sleep quality and daytime function in patients with lower urinary tract symptoms: a cross-sectional study. Clinical interventions in aging, 11, 879–885. https://doi.org/10.2147/CIA.S104634

Shapiro, C. M., Bortz, R., Mitchell, D., Bartel, P., & Jooste, P. (1981). Slow-wave sleep: a recovery period after exercise. Science (New York, N.Y.), 214(4526), 1253–1254. https://doi.org/10.1126/science.7302594

Shapiro, C.M, Sherman, D. & Kryger, M.H. (2013). 'Sleep in art and literature', in MH Kryger (eds), Atlas of clinical sleep medicine, Elsevier Health Sciences, London.

Sharkey, K. M., Crawford, S. L., Kim, S., & Joffe, H. (2014). Objective sleep interruption and reproductive hormone dynamics in the menstrual cycle. Sleep medicine, 15(6), 688–693. https://doi.org/10.1016/j.sleep.2014.02.003

Shaver, J., Giblin, E., Lentz, M., & Lee, K. (1988). Sleep Patterns and Stability in Perimenopausal Women. Sleep, 11(6), 556–561. https://doi.org/10.1093/sleep/11.6.556

Shepard, J. W., Buysse, D. J., Chesson, A. L., Dement, W. C., Goldberg, R., Guilleminault, C., Harris, C. D., Iber, C., Mignot, E., Mitler, M. M., Moore, K. E., Phillips, B. A., Quan, S. F., Rosenberg, R. S., Roth, T., Schmidt, H. S., Silber, M. H., K.Walsh, J., & White, D. P. (2005). History of the Development of Sleep Medicine in the United States. Journal of Clinical Sleep Medicine, 01(01), 61–82. https://doi.org/10.5664/jcsm.26298

Siegel, J. M. (2010). Sleep in Animals: A State of Adaptive Inactivity.

Singareddy, R., Vgontzas, A. N., Fernandez-Mendoza, J., Liao, D., Calhoun, S., Shaffer, M. L., & Bixler, E. O. (2012). Risk factors for incident chronic insomnia: a general population prospective study. Sleep medicine, 13(4), 346–353. https://doi.org/10.1016/j.sleep.2011.10.033

Skalski, M., Przydacz, M., Sobański, J. A., Cyranka, K., Klasa, K., Datka, W., Golabek, T., Chlosta, P., & Dudek, D. (2019). Coexistence of lower urinary tract symptoms (LUTS) with depressive symptoms in patients suffering from depressive disorders. *Psychiatria Polska, 53*(4), 939–953.

Skouteris, H., Germano, C., Wertheim, E. H., Paxton, S. J., & Milgrom, J. (2008). Sleep quality and depression during pregnancy: a prospective study. Journal of sleep research, 17(2), 217–220. https://doi.org/10.1111/j.1365-2869.2008.00655.x

Smith, J. A., & Osborn, M. (2003). Interpretative Phenomenological Analysis. Qualitative Psychology.

SOC2010 volume 3: the National Statistics Socio-economic classification (NS-SEC rebased on SOC2010).

Sonmez, I. & Karasel,S. (2019). Poor Sleep Quality I Related to Impaired Functional Status Following Stroke. Journal of Stroke and Cerebrovascular Diseases, (28)11.

Spiegel, K., Leproult, R., & Van Cauter, E. (1999). Impact of sleep debt on metabolic and endocrine function. Lancet (London, England), 354(9188), 1435–1439. https://doi.org/10.1016/S0140-6736(99)01376-8

Spiegel, K., Leproult, R., L'hermite-Balériaux, M., Copinschi, G., Penev, P. D., & Van Cauter, E. (2004). Leptin levels are dependent on sleep duration: relationships with sympathovagal balance, carbohydrate regulation, cortisol, and thyrotropin. The Journal of clinical endocrinology and metabolism, 89(11), 5762–5771. https://doi.org/10.1210/jc.2004-1003

Spielberger, C. D. (1983). *State-Trait Anxiety Inventory for Adults (STAI-AD)* [Database record]. APA PsycTests.

Stanley, N. (2005). The Underestimated Impact of Nocturia on Quality of Life. European Urology Supplements, 4(7), 17–19. https://doi.org/10.1016/j.eursup.2005.07.002

Stenuit, P., & Kerkhofs, M. (2005). Age modulates the effects of sleep restriction in women. Sleep, 28(10), 1283–1288. https://doi.org/10.1093/sleep/28.10.1283

Stone, K.L, Ancoli-Israel, S., Blackwell, T, et al. (2008). Actigraphy-Measured Sleep Characteristics and Risk of Falls in Older Women. Arch Intern Med;168(16):1768–1775. doi:10.1001/archinte.168.16.1768

Stone, K.L., Ewing, S.K., Ancoli-Israel, S., Ensrud, K.E., Redline, S., Bauer, D.C., Cauley, J.A., Hillier, T.A. and Cummings, S.R. (2009). Self-reported sleep and nap habits and risk of mortality in a large cohort of older women. Journal of the American Geriatrics Society, 57(4), 604-611.

Stuart, E. A., Azur, M., Frangakis, C., & Leaf, P. (2009). Multiple imputation with large data sets: a case study of the Children's Mental Health Initiative. American journal of epidemiology, 169(9), 1133–1139. https://doi.org/10.1093/aje/kwp026

Swanson, L. M., Arnedt, J. T., Rosekind, M. R., Belenky, G., Balkin, T. J., & Drake, C. (2011). Sleep disorders and work performance: findings from the 2008 National Sleep Foundation Sleep in America poll. Journal of sleep research, 20(3), 487–494. https://doi.org/10.1111/j.1365-2869.2010.00890.x

Swithinbank, L.V., Donovan, J.J., James, M.C., Yang, Q. & Abrams, P. (1998). Female urinary symptoms: age prevalence in a community dwelling population using a validated questionnaire. Neurourol Urodyn; 16: 432-4.

Taylor, E & Rutter, M. (2002). Child and adolescent psychiatry. Oxford: Blackwell Science.

Blackwell, T., Yaffe, K., Ancoli-Israel, S., Schneider, J.L., Cauley, J.A, Hillier, T.A., Fink, H.A. & Stone, K.L. (2006). For the Study of Osteoporotic Fractures Group, Poor Sleep Is Associated With Impaired Cognitive Function in Older Women: The Study of Osteoporotic Fractures, The Journals of Gerontology: Series A, (61)4, 405–410,

The American college of Obstetrics and Gynaecologists, virtual conference (2021). https://events.jspargo.com/acog21/public/enter.aspx

The Committee for Establishment of the Clinical Guidelines for Nocturia of the Neurogenic Bladder Society. (2010). Clinical guidelines for nocturia: Guidelines. International Journal of Urology, 17(5), 397–409. https://doi.org/10.1111/j.1442-2042.2010.02527.x

The National Institute of Mental Health Arousal and Regulatory systems: Workshop Proceedings (2012). https://www.nimh.nih.gov/research/research-funded-by-nimh/rdoc/arousal-and-regulatory-systems-workshop-proceedings

The National Kidney Foundation (2024). https://www.kidney.org/spring-clinical

The National sleep foundation. (2020). Sleep in America ® Poll 2020. Americans feel sleepy 3 days a week, with impacts on activities, mood and acuity.

The U.S. Department of health and Human Services. (2009). https://ocrportal.hhs.gov/ocr/breach/breach_report.jsf

Tikkinen KAO, Johnson II TM, Tammela TLJ, et al. (2010). Nocturia frequency, bother, and quality of life: how often is too often? A population-based study in Finland. Eur Urol; 57:488–98.

Tikkinen, K. A. O., Auvinen, A., Huhtala, H., & Tammela, T. L. J. (2006). Nocturia and Obesity: A Population-based Study in Finland. American Journal of Epidemiology, 163(11), 1003–1011. https://doi.org/10.1093/aje/kwj139

Tikkinen, K. A. O., Auvinen, A., Johnson, T. M., Weiss, J. P., Keränen, T., Tiitinen, A., Polo, O., Partinen, M., & Tammela, T. L. J. (2009). A Systematic Evaluation of Factors Associated With Nocturia—The Population-based FINNO Study. American Journal of Epidemiology, 170(3), 361–368. https://doi.org/10.1093/aje/kwp133

Tikkinen, K. A. O., Johnson, T. M., Tammela, T. L. J., Sintonen, H., Haukka, J., Huhtala, H., & Auvinen, A. (2010). Nocturia Frequency, Bother, and Quality of Life: How Often Is Too Often? A Population-Based Study in Finland. European Urology, 57(3), 488–498. https://doi.org/10.1016/j.eururo.2009.03.080

Tikotzky, L., Sadeh, A., Volkovich, E., Manber, R., Meiri, G., & Shahar, G. (2015). Infant sleep development from 3 to 6 months postpartum: links with maternal sleep and paternal involvement. Monographs of the Society for Research in Child Development, 80(1), 107–124. https://doi.org/10.1111/mono.12147

Tikotzky, Liat & Sadeh, Avi & Glickman-Gavrieli, Tamar. (2010). Infant Sleep and Paternal Involvement in Infant Caregiving During the First 6 Months of Life. Journal of pediatric psychology. 36. 36-46. 10.1093/jpepsy/jsq036.

Tochikubo, O., Ikeda, A., Miyajima, E., & Ishii, M. (1996). Effects of insufficient sleep on blood pressure monitored by a new multibiomedical recorder. Hypertension (Dallas, Tex. : 1979), 27(6), 1318–1324. https://doi.org/10.1161/01.hyp.27.6.1318

Tsai, S. Y., Lin, J. W., Kuo, L. T., & Thomas, K. A. (2012). Daily sleep and fatigue characteristics in nulliparous women during the third trimester of pregnancy. Sleep, 35(2), 257–262. https://doi.org/10.5665/sleep.1634

U.S. Department of Health and Human Services FDA Center for Drug Evaluation and Research, U.S. Department of Health and Human Services FDA Center for Biologics Evaluation and Research, & U.S. Department of Health and Human Services FDA Center for Devices and Radiological Health (2006). Guidance for industry: patient-reported outcome measures: use in medical product development to support labeling claims: draft guidance. Health and quality of life outcomes, 4, 79. https://doi.org/10.1186/1477-7525-4-79

U.S. Department of Health and Human Services FDA Center for Drug Evaluation and Research, U.S. Department of Health and Human Services FDA Center for Biologics Evaluation and Research, & U.S. Department of Health and Human Services FDA Center for Devices and Radiological Health (2009). Guidance for industry: patient-reported outcome measures: use in medical product development to support labeling claims.

University of Chicago. (2008). Brain Waves Pattern Themselves After Rhythms Of Nature. ScienceDaily. ScienceDaily, www.sciencedaily.com/releases/2008/02/080215151203.htm

van Breda, H. M., Bosch, J. L., & de Kort, L. M. (2015). Hidden prevalence of lower urinary tract symptoms in healthy nulligravid young women. International urogynecology journal, 26(11), 1637–1643. https://doi.org/10.1007/s00192-015-2754-1

Van Cauter, E., & Plat, L. (1996). Physiology of growth hormone secretion during sleep. The Journal of pediatrics, 128(5 Pt 2), S32–S37. https://doi.org/10.1016/s0022-3476(96)70008-2

Van Cauter, E., Blackman, J. D., Roland, D., Spire, J. P., Refetoff, S., & Polonsky, K. S. (1991). Modulation of glucose regulation and insulin secretion by circadian rhythmicity and sleep. The Journal of clinical investigation, 88(3), 934–942. https://doi.org/10.1172/JCI115396

Van Dijk, L., Kooij, D. G., Schellevis, F. G., Kaptein, A. A., Boon, T. A., & Wooning, M. (2004). Nocturia: Impact on quality of life in a Dutch adult population. BJU International, 93(7), 1001–1004. https://doi.org/10.1111/j.1464-410X.2004.04769.x

Van Dongen, H. P., Maislin, G., Mullington, J. M., & Dinges, D. F. (2003). The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and

sleep physiology from chronic sleep restriction and total sleep deprivation. Sleep, 26(2), 117–126. https://doi.org/10.1093/sleep/26.2.117

van Doorn, B., Blanker, M. H., Kok, E. T., Westers, P., & Bosch, J. L. (2013). Prevalence, incidence, and resolution of nocturnal polyuria in a longitudinal community-based study in older men: the Krimpen study. European urology, 63(3), 542–547. https://doi.org/10.1016/j.eururo.2012.10.004

van Keimpema, A. R., Ariaansz, M., Nauta, J. J., & Postmus, P. E. (1995). Subjective sleep quality and mental fitness in asthmatic patients. The Journal of asthma: official journal of the Association for the Care of Asthma, 32(1), 69–74. https://doi.org/10.3109/02770909509089502

Van Kerrebroeck P. E. (1999). A treatment algorithm for the overactive bladder. BJU international, 83 Suppl 2, 29–30. https://doi.org/10.1046/j.1464-410x.83.s2.6.x

Van Kerrebroeck, P., & Andersson, K. (2014). Terminology, epidemiology, etiology, and pathophysiology of nocturia. Neurourology and Urodynamics, 33(S1). https://doi.org/10.1002/nau.22595

Van Kerrebroeck, P., & Andersson, K.-E. (2014). Terminology, epidemiology, etiology, and pathophysiology of nocturia: Epidemiology and Pathophysiology of Nocturia. Neurourology and Urodynamics, 33(S1), S2–S5. https://doi.org/10.1002/nau.22595

Van Kerrebroeck, P., Abrams, P., Chaikin, D., Donovan, J., Fonda, D., Jackson, S., Jennum, P., Johnson, T., Lose, G., Mattiasson, A., Robertson, G., Weiss, J., & Standardisation Sub-committee of the International Continence Society (2002). The standardisation of terminology in nocturia: report from the Standardisation Sub-committee of the International Continence Society. Neurourology and urodynamics, 21(2), 179–183. https://doi.org/10.1002/nau.10053

van Leeuwen, W. M., Lehto, M., Karisola, P., Lindholm, H., Luukkonen, R., Sallinen, M., Härmä, M., Porkka-Heiskanen, T., & Alenius, H. (2009). Sleep restriction increases the risk of developing cardiovascular diseases by augmenting proinflammatory responses through IL-17 and CRP. PloS one, 4(2), e4589. https://doi.org/10.1371/journal.pone.0004589

Varvarigou, V., Dahabreh, I. J., Malhotra, A., & Kales, S. N. (2011). A review of genetic association studies of obstructive sleep apnea: field synopsis and meta-analysis. Sleep, 34(11), 1461–1468. https://doi.org/10.5665/sleep.1376

Vaughan, C. P., Eisenstein, R., Bliwise, D. L., Endeshaw, Y. K., Nagamia, Z. J., Wolf, R. A., & Johnson, T. M. (2012). Self-rated sleep characteristics and bother from nocturia: Sleep characteristics of men bothered by nocturia. International Journal of Clinical Practice, 66(4), 369–373. https://doi.org/10.1111/j.1742-1241.2011.02868.x

Vaughan, C. P., Endeshaw, Y., Nagamia, Z., Ouslander, J. G., & Johnson, T. M. (2009). A multicomponent behavioural and drug intervention for nocturia in elderly men: Rationale

and pilot results. BJU International, 104(1), 69–74. https://doi.org/10.1111/j.1464-410X.2009.08353.x

Vgontzas, A. N., Zoumakis, E., Bixler, E. O., Lin, H. M., Follett, H., Kales, A., & Chrousos, G. P. (2004). Adverse effects of modest sleep restriction on sleepiness, performance, and inflammatory cytokines. The Journal of clinical endocrinology and metabolism, 89(5), 2119–2126. https://doi.org/10.1210/jc.2003-031562

Vgontzas, A.N., Fernandez-Mendoza, J., Liao, D. & Bixler, E.O. (2013). Insomnia with objective short sleep duration: the most biologically severe phenotype of the disorder. Sleep Med Rev, 17, 241–54.

Vogel, G.W. (1975). A Review of REM Sleep Deprivation. *Arch Gen Psychiatry*; 32(6):749–761.

von Känel, R., Dimsdale, J. E., Mills, P. J., Ancoli-Israel, S., Patterson, T. L., Mausbach, B. T., & Grant, I. (2006). Effect of Alzheimer caregiving stress and age on frailty markers interleukin-6, C-reactive protein, and D-dimer. The journals of gerontology. Series A, Biological sciences and medical sciences, 61(9), 963–969. https://doi.org/10.1093/gerona/61.9.963

Wang, Y., et al., (2017). The release and trans-synaptic transmission of tau via exosomes. Mol. Neurodegener. 12, 5.

Ware, J. E., Jr, & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Medical care, 30(6), 473–483.

Watson, T. M., Ford, E., Worthington, E., & Lincoln, N. B. (2014). Validation of mood measures for people with multiple sclerosis. International journal of MS care, 16(2), 105–109. https://doi.org/10.7224/1537-2073.2013-013

Weiss J. P. (2012). Nocturia: focus on etiology and consequences. Reviews in urology, 14(3-4), 48–55.

Weiss, J. P., Monaghan, T. F., Epstein, M. R., & Lazar, J. M. (2019). Future Considerations in Nocturia and Nocturnal Polyuria. Urology, 133, 34–42. https://doi.org/10.1016/j.urology.2019.06.014

Weiss, J. P., van Kerrebroeck, P. E., Klein, B. M., & Nørgaard, J. P. (2011). Excessive nocturnal urine production is a major contributing factor to the etiology of nocturia. The Journal of urology, 186(4), 1358–1363. https://doi.org/10.1016/j.juro.2011.05.083

Weiss, J. P., Wein, A. J., Van Kerrebroeck, P., Dmochowski, R., Fitzgerald, M., Tikkinen, K. A. O., & Abrams, P. (2011). Nocturia: New Directions. Neurourology and Urodynamics, 30(5), 700–703. https://doi.org/10.1002/nau.21125

Weiss, J.P., Blaivas, J.G., Stember, D.S & Brooks, M.M. (1998). Nocturia in adults: Etiology and classification. Neurourol Urodynam; 17: 467–472.

Weitzman, E. D., Nogeire, C., Perlow, M., Fukushima, D., Sassin, J., McGregor, P., & Hellman, L. (1974). Effects of a prolonged 3-hour sleep-wake cycle on sleep stages, plasma cortisol, growth hormone and body temperature in man. The Journal of clinical endocrinology and metabolism, 38(6), 1018–1030. https://doi.org/10.1210/jcem-38-6-1018

Welstein, L., Dement, W.C. Redington, D. & Guilleminault, C. (1983). Insomnia in the San Francisco Bay Area: A telephone survey. Sleep/Wake Disorders: natural history, Epidemiology, and Long-term evolution. New York: Raven Press, PP.73-85.

WHOQOL Group study protocol for the World health Organisation project to develop a quality of life assessment instrument (WHOQOL). Qual Life Res; 2: 153-159.

Wilkie, G., & Shapiro, C. M. (1992). Sleep deprivation and the postnatal blues. Journal of psychosomatic research, 36(4), 309–316. https://doi.org/10.1016/0022-3999(92)90067-c

Williams, P., & Lord, S. R. (1997). Effects of group exercise on cognitive functioning and mood in older women. Australian and New Zealand journal of public health, 21(1), 45–52. https://doi.org/10.1111/j.1467-842x.1997.tb01653.x

Williams, V., Qin, S., Romano, C. D., Lewis, S., Williams, N., Yarr, S., Juul, K. V., & Andersson, F. L. (2021). Psychometric evaluation of the Nocturia Sleep Quality Scale based on data from a prospective observational study. Journal of Clinical Sleep Medicine, 17(4), 691–701. https://doi.org/10.5664/jcsm.9010

Witjes, J. A., Babjuk, M., Bellmunt, J., Bruins, H. M., De Reijke, T. M., De Santis, M., Gillessen, S., James, N., Maclennan, S., Palou, J., Powles, T., Ribal, M. J., Shariat, S. F., Der Kwast, T. V., Xylinas, E., Agarwal, N., Arends, T., Bamias, A., Birtle, A., Black, P. C. & Horwich, A. (2020). EAU-ESMO Consensus Statements on the Management of Advanced and Variant Bladder Cancer-An International Collaborative Multistakeholder Effort: Under the Auspices of the EAU-ESMO Guidelines Committees. European urology, 77(2), 223–250. https://doi.org/10.1016/j.eururo.2019.09.035

Wolfson, A. R., & Carskadon, M. A. (2003). Understanding adolescents' sleep patterns and school performance: a critical appraisal. Sleep medicine reviews, 7(6), 491–506. https://doi.org/10.1016/s1087-0792(03)90003-7

Woollard, K. J., & Geissmann, F. (2010). Monocytes in atherosclerosis: subsets and functions. Nature reviews. Cardiology, 7(2), 77–86. https://doi.org/10.1038/nrcardio.2009.228

Woosley, J. A., & Lichstein, K. L. (2014). Dysmenorrhea, the menstrual cycle, and sleep. Behavioral medicine (Washington, D.C.), 40(1), 14–21. https://doi.org/10.1080/08964289.2013.829020

Wordsworth, W. (1815). Poems Volume II, XVI To Sleep.

World Health Organization. Research on the menopause in the 1990s: report of a WHO scientific group. (1996). Geneva: World Health Organization.

XL Chen, YH Liu, DK Chan, Q Shen, H Van Nguyen (2010). Characteristics associated with falls among the elderly within aged care wards in a tertiary hospital: a retrospective. Chin Med J; 123, 1668-1672.

Yoshimura, K., Terada, N., Matsui, Y., Terai, A., Kinukawa, N., & Arai, Y. (2004). Prevalence of and risk factors for nocturia: Analysis of a health screening program. International journal of urology : official journal of the Japanese Urological Association, 11(5), 282–287. https://doi.org/10.1111/j.1442-2042.2004.00791.x

Young, T., Palta, M., Dempsey, J., Skatrud, J., Weber, J. & Badr, S. (1993). The occurrence of sleep-disordered breathing among middle-aged adults. N. Engl J. Med; 328, 1230-1235.

Yu, H.-J., Chen, F.-Y., Huang, P.-C., Chen, T. H.-H., Chie, W.-C., & Liu, C.-Y. (2006). Impact of nocturia on symptom-specific quality of life among community-dwelling adults aged 40 years and older. Urology, 67(4), 713–718. https://doi.org/10.1016/j.urology.2005.10.054

Zeitzer, J. M., Bliwise, D. L., Hernandez, B., Friedman, L., & Yesavage, J. A. (2013). Nocturia Compounds Nocturnal Wakefulness in Older Individuals with Insomnia. Journal of Clinical Sleep Medicine, 09(03), 259–262. https://doi.org/10.5664/jcsm.2492

Zeng, V. Y., Milligan, G., Piercy, J., Anderson, P., & Andersson, F. L. (2019). Impact of nocturia on patients' health-related quality of life and healthcare resource utilisation compared with OAB and BPH: Results from an observational survey in European and American patients. International Journal of Clinical Practice, 73(12). https://doi.org/10.1111/ijcp.13408

Zeyda, M., & Stulnig, T. M. (2009). Obesity, inflammation, and insulin resistance--a mini-review. Gerontology, 55(4), 379–386. https://doi.org/10.1159/000212758

Zhao, W., Van Someren, E. J. W., Li, C., Chen, X., Gui, W., Tian, Y., Liu, Y., & Lei, X. (2021). EEG spectral analysis in insomnia disorder: A systematic review and meta-analysis. Sleep Medicine Reviews, 59, 101457. https://doi.org/10.1016/j.smrv.2021.101457

Zielinski, M. R., & Krueger, J. M. (2011). Sleep and innate immunity. Frontiers in bioscience (Scholar edition), 3(2), 632–642. https://doi.org/10.2741/s176

Zielinski, M. R., McKenna, J. T., & McCarley, R. W. (2016). Functions and Mechanisms of Sleep. AIMS neuroscience, 3(1), 67–104. https://doi.org/10.3934/Neuroscience.2016.1.67

Zigmond, A.S, & Snaith, R.P. (1983). The hospital anxiety and depression scale. Acta Psychiatr Scandi, 67:361-370.

Appendix

Appendices 1 Outcome measures (PSQI, GSQS, Nocturia, SF-36, HADS).

Appendices 2 Demographic questionnaire

Appendices 3 The Office for National Statistics link to the ONS standard occupational classification hierarchy

Appendices 4 Ethical approval

Appendices 5 PIS

Appendices 6 Consent form

Appendices 7 – Study advert

Appendices 8 – Debrief.

Appendices 9 – Risk assessment

Appendices 1 Outcome measures adopted for the present study

The Pittsburgh Sleep Quality Index (PSQI)

The following questions relate to your usual sleep habits during the past month only. Your answers

should indicate the most accurate reply for the majority of days and nights in the past month.

Please answer all questions.

1. During the past month, what time have you usually gone to bed at night?

BED TIME _____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

NUMBER OF MINUTES

_____

3. During the past month, what time have you usually gotten up in the morning?

GETTING UP TIME

_____

4. During the past month, how many hours of actual sleep did you get at night? (This may be

different than the number of hours you spent in bed.)

HOURS OF SLEEP PER NIGHT

_____

For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you . . .

a) Cannot get to sleep within 30 minutes

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

b) Wake up in the middle of the night or early morning

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

c) Have to get up to use the bathroom

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

d) Cannot breathe comfortably

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

e) Cough or snore loudly

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

f) Feel too cold

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

g) Feel too hot

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

h) Had bad dreams

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

i) Have pain

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

j) Other reason(s), please describe_____

_____

How often during the past month have you had trouble sleeping because of this?

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

6. During the past month, how would you rate your sleep quality overall?

Very good _____

Fairly good _____

Fairly bad _____

Very bad _____

7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

8. During the past month, how often have you had trouble staying awake while driving, eating

meals, or engaging in social activity?

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

9. During the past month, how much of a problem has it been for you to keep up enough

enthusiasm to get things done?

No problem at all _____

Only a very slight problem _____

Somewhat of a problem _____

A very big problem _____

10. Do you have a bed partner or room mate?

No bed partner or room mate _____

Partner/room mate in other room

_____

Partner in same room, but not same bed _____

Partner in same bed

_____

If you have a room mate or bed partner, ask him/her how often in the past month you

have had . . .

a) Loud snoring

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

b) Long pauses between breaths while asleep

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

c) Legs twitching or jerking while you sleep

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week____

d) Episodes of disorientation or confusion during sleep

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

e) Other restlessness while you sleep; please describe_____

Not during the Less than Once or twice Three or more

past month_____ once a week_____ a week_____ times a week_____

Developed by Buysse,D.J., Reynolds,C.F., Monk,T.H., Berman,S.R., and Kupfer,D.J. of the University of Pittsburgh using National Institute of Mental Health Funding.

Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ: Psychiatry Research, 28:193-213, 1989.

The Groningen Sleep Quality Scale (GSQS)

Circle True or False for each question.

I had a deep sleep last night True False

I feel like I slept poorly last night True False

It took me more than half an hour to fall asleep last night True False

I felt tired after waking up this morning True False

I woke up several times last night True False

I feel like I didn't get enough sleep last night True False

I got up in the middle of the night True False

I felt rested after waking up this morning True False

I feel like I only had a couple hours of sleep last night True False

I feel I slept well last night True False

I didn't sleep a wink last night True False

I didn't have any trouble falling asleep last night True False

After I woke up last night, I had trouble falling asleep again True False

I tossed and turned all night last night True False

I didn't get more than 5 hours sleep last night True False

Scoring:

The first question doesn't count toward the total score.

One point if answer is "True" for questions 2, 3, 4, 5, 6, 7, 9, 11, 13, 14, 15

One point if answer is "False" for questions 8, 10, 12

Maximum score of 14 points indicates poor sleep the night before.

NOTE: The Groningen Sleep Quality Scale is a tool that can be used to understand your patterns in overall sleep quality. Answer these 15 questions for at least 14 days in a row to help understand your individual sleep patterns.

The nocturia Sleep Quality Scale (NSQS Items)

Instructions: When responding to each item, please consider from the time you went to bed, with the intention to sleep, until you woke up to start your day.

1. How many times did you wake last night due to the need to urinate?
   ☐$_0$ Never ☐$_{1.25}$ 1 time ☐$_{2.5}$ 2 times ☐$_{3.75}$ 3 times ☐$_5$ 4 or more times
2. Thinking over the entire night, how much time (in total) were you awake because you needed to urinate?
   ☐$_0$ None ☐$_1$ Less than 30 minutes ☐$_2$ 30 minutes to 1 hour ☐$_3$ 1 to 2 hours ☐$_4$ 2 to 3 hours
   ☐$_5$ More than 3 hours
3. How much earlier than planned did you get up for the day because you were awakened by the need to urinate?
   ☐$_0$ Not at all ☐$_1$ Less than 30 minutes ☐$_2$ 30 minutes to 1 hour ☐$_3$ 1 to 2 hours
   ☐$_4$ 2 to 3 hours ☐$_5$ More than 3 hours
4. Considering the number of times you were awakened to urinate, how restful was your sleep?
   ☐$_0$ Not at all restful ☐$_{1.25}$ Slightly restful ☐$_{2.5}$ Somewhat restful ☐$_{3.75}$ Quite a bit restful
   ☐$_5$ Extremely restful
5. Considering the number of times you were awakened to urinate, how tired did you feel when you got up this morning?
   ☐$_0$ Not at all tired ☐$_{1.25}$ Slightly tired ☐$_{2.5}$ Somewhat tired ☐$_{3.75}$ Quite a bit tired
   ☐$_5$ Extremely tired
6. How would you rate the overall quality of your sleep last night due to being awakened to urinate?
   ☐$_0$ Excellent ☐$_{1.25}$ Good ☐$_{2.5}$ Fair ☐$_{3.75}$ Poor ☐$_5$ Very poor

The SF-36 Survey

INSTRUCTIONS: Please answer every question. Some questions may look like others, but each one is different. Please take the time to read and answer each question carefully by circling the number that best represents your response.

1. In general, would you say your health is?

Excellent (1)	Very Good (2)	Good (3)	Fair (4)	Poor (5)

2. <u>Compared to one year ago</u>, how would you rate your health in general <u>now</u>?

Much better now than one year ago (1)	Somewhat better now than one year ago (2)	About the same as one year ago (3)	Somewhat worse now than one year ago (4)	Much worse now than one year ago (5)

3. The following questions are about activities you might do during a typical day. Does <u>your health now limit you</u> in these activities? If so, how much: (circle one number on each line)

	Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
A. **Vigorous activities**, such as running, lifting heavy objects participating in strenuous sports	1	2	3
B. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3
C. Lifting or carrying groceries	1	2	3
D. Climbing **several** flights of stairs	1	2	3
E. Climbing **one** flight of stairs	1	2	3
F. Bending, kneeling, or stooping	1	2	3
G. Walking **more than a mile**	1	2	3
H. Walking **several hundred yards**	1	2	3
I. Walking **one hundred yards**	1	2	3
J. Bathing or dressing yourself	1	2	3

4. During the <u>past 4 weeks</u>, how much of the time have you had any of the following problems with your work or other regular daily activities <u>as a result of your physical health?</u> (Circle one number on each line)

	All the time	**Most** of the time	**Some** of the time	A **little** of the time	**None** of the time
A. Cut down on the **amount of time** you spend on work or other activities	1	2	3	4	5
B. **Accomplished less** than you would like	1	2	3	4	5
C. Were limited in the **kind** of work or other activities	1	2	3	4	5
D. Had **difficulty** performing the work or other activities (for example, it took extra effort)	1	2	3	4	5

5. During the <u>past 4 weeks</u>, how much of the time have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u> (such as feeling depressed or anxious)? (Circle one number on each line)

	All the time	**Most** of the time	**Some** of the time	**A little** of the time	**None** of the time
A. Cut down on the **amount of time** you spend on work or other activities	1	2	3	4	5
B. **Accomplished less** than you would like	1	2	3	4	5
C. Did work or activities **less carefully than usual**	1	2	3	4	5

6. During the <u>past 4 weeks</u>, to what extent has your <u>physical health or emotional problems</u> interfered with your social activities with family, friends, neighbours, or groups? (Circle one)

Not at all (1)	Slightly (2)	Moderately (3)	Quite a bit (4)	Extremely (5)

7. How much <u>bodily</u> pain have you had during the <u>past 4 weeks</u>? (Circle one)

None (1)	Very Mild (2)	Mild (3)	Moderate (4)	Severe (5)	Very Severe (6)

8. During the <u>past 4 weeks</u>, how much did <u>pain</u> interfere with your normal work (including both work outside the home and housework)? (Circle one)

Not at all (1)	Slightly (2)	Moderately (3)	Quite a bit (4)	Extremely (5)

9. These questions are about how you feel and how things have been with you <u>during the past 4 weeks</u>. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the <u>past 4 weeks</u>… (Circle one number on each line)

	All the time	**Most** of the time	**Some** of the time	**A little** of the time	**None** of the time
A. did you feel full of life?	1	2	3	4	5
B. have you been very nervous?	1	2	3	4	5
C. have you felt so down in the dumps nothing could cheer you up?	1	2	3	4	5
D. have you felt calm and peaceful?	1	2	3	4	5
E. did you have a lot of energy?	1	2	3	4	5
F. have you felt downhearted and depressed?	1	2	3	4	5
G. did you feel worn out?	1	2	3	4	5
H. have you been happy?	1	2	3	4	5
I. did you feel tired?	1	2	3	4	5

10. During the <u>past 4 weeks</u>, how much of the time has your <u>physical health or emotional problems</u> interfered with your social activities (like visiting friends, relatives, etc.)?

All of the Time (1)	Most of the Time (2)	Some of the Time (3)	A Little of the Time (4)	None of the Time (5)

11. How TRUE or FALSE is each of the following statements for you? (Circle one number on each line)

	Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
A. I seem to get sick a little easier than other people	1	2	3	4	5
B. I am as healthy as anybody I know	1	2	3	4	5
C. I expect my health to get worse	1	2	3	4	5
D. My health is excellent	1	2	3	4	5

The Hospital Anxiety and Depression Scale (HADS)

Patients are asked to choose one response from the four given for each interview. They should give an immediate response and be dissuaded from thinking too long about their answers. The questions relating to anxiety are marked "A", and to depression "D". The score for each answer is given in the right column. Instruct the patient to answer how it currently describes their feelings.

A	**I feel tense or 'wound up':**	
	Most of the time	3
	A lot of the time	2
	From time to time, occasionally	1
	Not at all	0

D	**I still enjoy the things I used to enjoy:**	
	Definitely as much	0
	Not quite so much	1
	Only a little	2
	Hardly at all	3

A	**I get a sort of frightened feeling as if something awful is about to happen:**	
	Very definitely and quite badly	3
	Yes, but not too badly	2
	A little, but it doesn't worry me	1
	Not at all	0

D	**I can laugh and see the funny side of things:**	
	As much as I always could	0
	Not quite so much now	1
	Definitely not so much now	2
	Not at all	3

A	**Worrying thoughts go through my mind:**	
	A great deal of the time	3
	A lot of the time	2
	From time to time, but not too often	1
	Only occasionally	0

D	**I feel cheerful:**	
	Not at all	3
	Not often	2
	Sometimes	1
	Most of the time	0

A	**I can sit at ease and feel relaxed:**	
	Definitely	0
	Usually	1
	Not Often	2

	Not at all	3

D	**I feel as if I am slowed down:**	
	Nearly all the time	3
	Very often	2
	Sometimes	1
	Not at all	0

A	**I get a sort of frightened feeling like 'butterflies' in the stomach:**	
	Not at all	0
	Occasionally	1
	Quite Often	2
	Very Often	3

D	**I have lost interest in my appearance:**	
	Definitely	3
	I don't take as much care as I should	2
	I may not take quite as much care	1
	I take just as much care as ever	0

A	**I feel restless as I have to be on the move:**	

	Very much indeed	3
	Quite a lot	2
	Not very much	1
	Not at all	0

D	**I look forward with enjoyment to things:**	
	As much as I ever did	0
	Rather less than I used to	1
	Definitely less than I used to	2
	Hardly at all	3

A	**I get sudden feelings of panic:**	
	Very often indeed	3
	Quite often	2
	Not very often	1
	Not at all	0

D	**I can enjoy a good book or radio or TV program:**	
	Often	0
	Sometimes	1
	Not often	2
	Very seldom	3

	Scoring (add the As = Anxiety. Add the Ds = Depression). The norms below will give you an idea of the level of Anxiety and Depression.	
	0-7 = Normal	
	8-10 = Borderline abnormal	
	11-21 = Abnormal	

Reference:

Zigmond and Snaith (1983)

Appendices 2 Demographic questionnaire

The following information will be kept confidential and shall only be used for research purposes. All details are required for study purposes.

CONFIDENTIAL

Please complete clearly in **BLACK** ink/biro or by typing.

Personal Details

Participant ID number: (given by researcher)

Please provide relevant contact details where you can be contacted to collect any missing data.

1. How would you describe your sex*?
    a. Female
    b. Male
    c. Prefer not to say

*It is important for the purpose of this study that you are anatomically female.

Please continue

The next set of questions from 2 to 5 would be considered personal and intrusive, these questions have been developed using the current scientific evidence available to help further understand this area of work.

2. Have you given birth?
    a. Yes_____(please state delivery method)
    b. No

3. Do you have children?

a. Yes_____(please state how many)

b. No

4. When was the date of your last period?

DD/MM/YEAR_____

If you do not have regular periods, please move onto question 5.

5. Are you menopausal? If yes, please give the date of your last period

6. Date of Birth (DD/MM/YY_____

7. What is your Height in CM_____

8. What is your Weight in KG_____

9. What is your Body Mass Index (BMI)_____

Lifestyle questions:

10. Do you currently smoke?

If yes, how many packs do you smoke per day?

11. Do you drink alcohol?

If yes, how many units per day _____or per week_____

Time of last alcoholic drink taken AM/PM

12. Do you drink caffeinated beverages?

a. Yes

b. No

13. If you have answered yes to question 12 then please state, the following:
    a. Type of beverage
    b. Quantity consumed
    c. Time of last caffeinated beverage

14. Do you consume other drinks (non-alcoholic and non-caffeinated drinks) throughout the day?
    a. Yes (please state amount and time last drink is consumed)
    b. No

15. Do you exercise?
    a. Yes
    b. No

16. How often do you exercise per week (please state type of exercise and duration)

Work and qualifications:

Please tick the appropriate response

17. Are you retired? Yes_____No_____

Do you currently work? Yes_____No_____

If yes, do you work Full-time____Part-time_____

Current occupation:

18. What is your highest level of qualification?

_____

Ethnic background:

19. Ethnic Background

Please choose **one** section from A to E, **then tick the appropriate box** to indicate your ethnic background.

A. White

British

English

Scottish

Welsh

Other

Irish

Any other White background, please specify:

B. Mixed

White and Black Caribbean

White and Black African

White and Asian

Any other mixed background, please specify:

C. Asian, Asian British, Asian English, Asian Scottish or Asian Welsh

Indian

Pakistani

Bangladeshi

Any other Asian background, please specify:

D. Black, Black British, Black English, Black Scottish or Black Welsh

Caribbean

African

Any other Black background, please specify:

E. Chinese, Chinese British, Chinese English, Chinese Scottish, Chinese Welsh, or other ethnic group

Chinese

Any other background, please specify:

Past medical history

Name any illness or physical disorder that you have at present or have had in the last 3 months?

Name any serious illness or physical disorder that you have ever had

Details of any treatment or medication that you are taking at present or have had in the last 3 months. Please include dose received.

Details of any treatment or medication that you have ever had for any serious illness.

Does anybody in your family have a sleep problem? Who and what is the problem?

Thank you for completing this questionnaire. Your help is greatly appreciated.

If you have any concerns or questions, please ask the researcher Dally Chalmers (daljinder2.chalmers@live.uwe.ac.uk).

Appendices 3

The Office for National Statistics link to the ONS standard occupational classification hierarchy:

ONS Standard Occupational Classification (SOC) Hierarchy (onsdigital.github.io)

Appendices 4 Ethical approval

RESC Decision letter Full approval Version 17 27/08/2021

Faculty of Health & Applied
Sciences
Glenside Campus
Blackberry Hill
Stapleton
Bristol BS16 1DD
Tel: 0117 328 1170
UWE REC REF No: HAS.21.08.001
15th October 2021
Daljinder Chalmers
Dear Daljinder

Application title: Sleep disturbances and psychological functioning (including cognitive function, mood, and quality of life) in women experiencing nocturia across the lifespan, a mixed method study.

Thank you for responding to the conditions raised in my letter to you of 2nd September 2021.

I can now confirm full ethics approval for your project, but please note that despite the easing of lockdown in England and across the devolved nations, you must continue to follow guidance as set by the UK Government and the relevant devolved administrations. If you have any questions about how this may affect starting your research project or for further information, please contact res.admin@uwe.ac.uk.

In the UK, face-to-face research and fieldwork can be undertaken but there should still be consideration of whether the activities could be delivered in an alternative way. There must still be appropriate mitigations related to Covid-19 risks included within risk assessments, including account taken of requirements from stakeholders. If you wish to undertake face-to-face research or

fieldwork, you will need Senior Management approval from your Faculty, in line with Faculty requirements.

At the present time overseas travel on UWE business is not permitted. Please see the guidance at https://intranet.uwe.ac.uk/tasks-guides/guide/coronavirus-advice#part6. If you are planning any overseas activities involving personnel already located in the country concerned, then you must first contact researchgovernance@uwe.ac.uk. Please see COVID guidance: FAQs on conducting face-to- face activity and fieldwork (PDF).

The following standard conditions apply to all research given ethical approval by a UWE Research Ethics

Committee:

1. You must notify the relevant UWE Research Ethics Committee in advance if you wish to make significant amendments to the original application: these include any changes to the studyRESC Decision letter Full approval Version 17 27/08/2021

protocol which have an ethical dimension. Please note that any changes approved by an external research ethics committee must also be communicated to the relevant UWE committee.

2. You must notify the Research Ethics Sub-Committee if you terminate your research before completion.

3. You must notify the Research Ethics Sub-Committee if there are any serious events or developments in the research that have an ethical dimension.

Please ensure that before proceeding with your research:

• you have sought contractual advice from the UWE Contracts Team Amy.Charles@uwe.ac.uk if your research involves external funding and/or contracts with partner organisations;

• You have sought advice from the UWE Data Protection Team (dataprotection@uwe.ac.uk) if, in relation to collecting and/or sharing personal data, a third party (i.e. any person or institution extraneous to UWE) is involved in the research project.

Please note: The RESC is required to monitor and audit the ethical conduct of research involving human participants, data and tissue conducted by academic staff, students and researchers. Your project may be selected for audit from the research projects submitted to and approved by the RESC and its committees.

We wish you well with your research.

Yours sincerely

Dr Julie Woodley

Chair

Faculty Research Ethics Committee

c.c. Dr Catrin Griffiths

Dr Chris Alford

Appendices 5 Participant Information Sheet

Participant Information Sheet

Study title: **Sleep disturbances and psychological functioning (including cognitive function, mood, and quality of life) in women experiencing nocturia across the lifespan, a mixed methods study.**

You are being invited to take part in a research study. Before you decide whether to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

Thank you for reading this.

What is the purpose of the study?

The overall aim of this study is to understand whether waking up more than once per night to urinate (nocturia) affects sleep quality across the lifespan, and how this can impact day-to-day behaviour, for example mood and cognitive functions like memory and attention and overall quality of life (QoL). This study is being conducted as part of a Professional Doctorate in Health Psychology at the University of West England, Bristol.

Who is organising and funding the research?

The research is organised by me, Daljinder R Chalmers, as my doctoral research project. This project is not externally funded.

Why have I been chosen to participate?

You have been invited to take part because you are a woman aged 18 years or older who has identified as waking up during the night to void more than once per night. If you are waking up more than once per night to go to the toilet (to pass urine) and this is having an impact on your day to day functioning, then I would love to hear from you.

Do I have to participate?

It is up to you to decide whether or not to take part. If you decide to take part you are still free to change your mind at any time and without giving a reason by contacting me, Dally Chalmers within 4 weeks of taking part. I will then identify your survey responses using your participant code and delete your record.

What will happen during the recruitment phase?

If you wish to take part in this study, you can contact me (Dally Chalmers) via email and I can send you a link where you can download all the documents and return them to me through a portal. *Alternatively*, if you do not wish to receive a link, I can send an electronic copy of the questionnaire pack via email. This will contain the recruitment poster, this participant information sheet the consent form, the debrief sheet and the questionnaire. You will then read

and ensure that you are completely happy to take part and return the consent form via email signed and dated. Once I have received this you can then complete the questionnaire and return it to me via email.

What are the potential disadvantages of participation?

Although I do not anticipate any problems, some participants may find the questionnaire time consuming. Furthermore, reviewing participants sleep habits including going to the toilet to pass urine during the night may cause some participants to have concerns and worries. A post study further information and support sheet will be provided to all participants which will provide further information and links to websites for sleep and related health issues.

What are the possible benefits of taking part?

Although there are no direct benefits to individuals taking part in the study, the information I learn from your data will be valuable in increasing knowledge in the area of living and coping with nocturia on a day-to-day basis. Furthermore, insight about women's experience of living with the constant need to go to the toilet to pass urine during the night and why some women seek to receive support and why others are reluctant to do so will also further help within this area. To date, no research to date has explored the reasons that women might have for this reluctance and their knowledge about available treatments and levels of motivation for accepting relevant treatment.

What if something goes wrong?

If you change your mind about taking part in the study, you can withdraw four weeks after participation by contacting me via the email address stated below and providing your participant code.

If you have a problem that I have been unable to resolve, or you wish to discuss this study in greater detail or wish to complain then please contact my doctorate supervisors:

Dr Tim Moss tim.moss@uwe.ac.uk or

Dr Chris Alford chris.alford@uwe.ac.uk

Will my participation/performance be confidential?

All data will be kept anonymous and will only be identified via an anonymous participant code and when collated for analysis will be assigned a participant number unique to each participant. Consent forms, which will have your name on them, will be stored separately. Once your data have been entered into a (password protected) computer file, your scores will only be associated with a participant number. Hard copies of the data will be stored in a locked cabinet in a secure office. Once the data are analysed, the paper copies will be destroyed. Your anonymous data will be destroyed once I have completed my doctoral award.

What will happen to the results of the experiment?

The plan is that the results of the study will be published in scientific journals for health professionals and presented at conferences. Participants will not be identified in any report or publication. A summary of the results will be made available to all interested participants at the end of the study. A summary of anonymous results may be shared with researchers from other institutions, including those outside the UK, for auditing or secondary analysis. It will not be possible to identify participants from these data.

Who has reviewed the study?

This study has been approved by University of West of England Faculty Research Ethics Committee HAS code (R5008), which means that it conforms to UK standards for the protection of the participants, researchers and the university.

Contact for Further Information

If you have any concerns or questions, please ask the researcher, Dally Chalmers (Lead researcher) who works as a full-time trainee health psychologist and a part-time doctoral researcher.

Email: daljinder2.chalmers@live.uwe.ac.uk

Address: Department of Health and Social Sciences, Faculty of Health and Applied Sciences, University of the West of England, Frenchay Campus, Coldharbour Lane, Bristol, UK, BS16 1QY

Consent Form

Study title: Sleep disturbances and psychological functioning (including cognitive function, mood, and quality of life) in women experiencing nocturia across the lifespan, a mixed method study.

This consent form will have been given to you with the Participant Information Sheet via email. Please ensure that you have read and understood the information contained in the Participant Information Sheet and asked any questions before you sign this form. If you have any questions please contact a member of the research team, whose details are set out on the Participant Information Sheet.

If you are happy to take part in in this survey, please sign and date the form. You will be given a copy to keep for your records. For participants completing this form online you would have received an email with the consent form attached to sign and return to the lead researcher via email – daljinder2.chalmers@live.uwe.ac.uk

- I confirm that I am over 18 years of age.
- I have read and understood the information in the Participant Information Sheet which I have been given to read before being asked to sign this form;
- I have been given the opportunity to ask questions about the study;
- I have had my questions answered satisfactorily by the research team;
- I agree that anonymised quotes may be used in the final Report of this study;
- I understand that my participation is voluntary and that I am free to withdraw up to 4 weeks after participation, without giving a reason;
- I agree that the data collected from me and about me may be held for as long as it retains research value and processed by the researcher for the purposes of research and publication.
- I agree to the University processing my personal data as described below:
- "The personal information collected in this research project (e.g. online using Qualtrics survey software) will be processed by the University (data controller) in accordance with the terms and conditions of the Data Protection legislation. We will hold your data securely and not make it available to any third party unless permitted or required to do so by law. Your personal information will be used/processed as described on the participant information sheet. You have a number of rights in relation to your personal data. For data protection queries, please write to the Data Protection Officer, UWE Frenchay Campus, Coldharbour Lane, Bristol, BS16 1QY, or dataprotection@uwe.ac.uk."
- I agree to take part in the research

Name (Printed)…….

Signature……. Date…….

Appendices 6 Consent form

Study title: Sleep disturbances and psychological functioning (including cognitive function, mood, and quality of life) in women experiencing nocturia across the lifespan, a mixed method study.

This consent form will have been given to you with the Participant Information Sheet via email. Please ensure that you have read and understood the information contained in the Participant Information Sheet and asked any questions before you sign this form. If you have any questions please contact a member of the research team, whose details are set out on the Participant Information Sheet.

If you are happy to take part in in this survey, please sign and date the form. You will be given a copy to keep for your records. For participants completing this form online you would have received an email with the consent form attached to sign and return to the lead researcher via email – daljinder2.chalmers@live.uwe.ac.uk

- I confirm that I am over 18 years of age.
- I have read and understood the information in the Participant Information Sheet which I have been given to read before being asked to sign this form;
- I have been given the opportunity to ask questions about the study;
- I have had my questions answered satisfactorily by the research team;
- I agree that anonymised quotes may be used in the final Report of this study;
- I understand that my participation is voluntary and that I am free to withdraw up to 4 weeks after participation, without giving a reason;
- I agree that the data collected from me and about me may be held for as long as it retains research value and processed by the researcher for the purposes of research and publication.
- I agree to the University processing my personal data as described below:
- "The personal information collected in this research project (e.g. online using Qualtrics survey software) will be processed by the University (data controller) in accordance with the terms and conditions of the Data Protection legislation. We will hold your data securely and not make it available to any third party unless permitted or required to do so by law. Your personal information will be used/processed as described on the participant information sheet. You have a number of rights in relation to your personal data. For data protection queries, please write to the Data Protection Officer, UWE Frenchay Campus, Coldharbour Lane, Bristol, BS16 1QY, or dataprotection@uwe.ac.uk."
- I agree to take part in the research

Name (Printed)…….

Signature……. Date…….

Appendices 7 Study advert

Calling all

females

aged 18+

Do you go to the toilet twice or more per night?

Want to complete a survey which explores how night time waking to urinate affects sleep, cognition and quality of life?

The aim of this study is to understand whether going to the toilet more than once per night (nocturia) affects sleep in women across the lifespan and its impact on quality of life, mood and memory. You will also be given the opportunity to discuss treatment options and plans too.

The research will consist of completing a questionnaire online.

For more information about this study, or if you are interested in taking part please contact:

Dally Chalmers

Trainee health psychologist

daljinder2.chalmers@live.uwe.ac.uk

Appendices 8 Debrief

Debriefing Sheet

Study title: Sleep disturbances and psychological functioning (including cognitive function, mood, and quality of life) in women experiencing nocturia across the lifespan, a mixed method study.

Nocturia is defined as waking up one or more times at night to void (to evacuate urine), and is a common affliction identified among the elderly (Fitzgerald et al, 2007 & Burgio et al, 2010). The focus of this research is specifically on women across the life span. Historically nocturia has received more attention as a men's health issue, despite the high prevalence in women as well (Hsu et al, 2015). Living with nocturia whether this is diagnosed or not is a complex issue. Furthermore, a thorough literature search has highlighted how nocturia is a multidimensional complicated condition, which is highly prevalent in women across the lifespan, which can have a significant impact upon women's health and is associated with anxiety, depression, poor work productivity and cognition and poor quality of life. Research has also highlighted the reluctance of many women to seek medical help for this condition. Yet, no research to date has explored the reasons that women might have for this reluctance and their knowledge about available treatments and levels of motivation for accepting relevant treatment.

Once again, your participation is greatly appreciated. If you have any further questions, please ask the lead researcher Dally Chalmers via email on daljinder2.chalmers@live.uwe.ac.uk. Furthermore, you are permitted to request the withdrawal of your data from the study within two weeks of the experimental session. If you seek to make a complaint regarding your treatment within the experiment you may contact the student's supervisory team via email:

Dr Catrin Griffiths catrin.griffiths@uwe.ac.uk

Dr Chris Alford chris.alford@uwe.ac.uk

If you would like to read more on the topics covered in this study, the following references may be of interest:

Agarwal, A, Eryuzlu, L.N. & Cartwright, R. (2014). What is the most bothersome lower urinary tract symptom? Individual- and population-level perspectives for both men and women. Eur Urol. (65), 1211–1217.

Ancoli-Israel, S., Bliwise, D.L. & Nørgaard, J.P. (2011). The effect of nocturia on sleep. Sleep Med Rev. 15:91–97.

Asplund, R. & Aberg, H.E. (2000). Nocturia and health in women aged 40-64 years. Maturitas. 35:143–148.

Asplund, R. (2005). Nocturia: consequences for sleep and daytime activities and associated risks. Eur Urol. 3:24–32.

Bliwise, D.L. (2008). Invited commentary: cross-cultural influences on sleep--broadening the environmental landscape. *American Journal of Epidemiology*. 168: 1365-6.

If you would like to know more about sleep, mood and nocturia the following websites may be of interest:

http://www.nhs.uk/LiveWell/sleep/

http://www.sleepcouncil.org.uk/

https://sleepfoundation.org/

Home | Mind, the mental health charity - help for mental health problems

Home - Nocturia UK

If you would like any further advice or would like to see a specialist concerning any issues which may have been raised during this study then please see the following links for further help:

http://www.nhs.uk/LiveWell/Pages/Livewellhub.aspx

Your own local GP/Nurse prescriber.

https://www.covwarkpt.nhs.uk/iapt

https://www.mind.org.uk/

https://www.menopausematters.co.uk/

University of the West of England
BRISTOL

Appendices 9 Risk assessment

GENERAL RISK ASSESSMENT FORM

Ref:

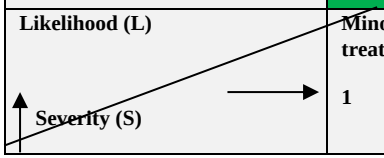
Hazards Identified ***(state the potential harm)***	**Existing Control Measures**	**S**	**L**	**Risk Level**	**Additional Control Measures**	**S**	**L**	**Risk Level**	**By whom and by when**	**Date completed**
There is a risk that participants might become upset during the study	• Informed Consent: Participants will be informed about the nature study and what entails and given the choice to opt out or partake at will • Sources of support (emotional/psychological) will be provided to participants in the information sheet and debrief sheet • In such an instance when participants get upset, the participant information sheet along with the debrief sheet does offer participants the option to either contact the student or the study supervisors or withdraw from the study, the participant also has the option to contact any one of the organisations listed on the debrief sheet.	1	2	2						
There is a risk that the researcher may feel upset after the data has been collected electronically	• The assistance of supervisor or the UWE well being centre • The activity will be discontinued • The researcher will seek support from her supervisor or any available lecturer	1	2	2						

There is a risk of poor data handling	• All data will be store and used in line with GDRP regulations • All data will be stored safely on a password protected laptop) • All data will be saved on the UWEOneDrive • All data will be anonymised • Any paper data will be sorted in a locked filling cabinet that only the researcher has access to	1	2	2						

Describe the activity being assessed:	**Assessed by:**	**Endorsed by:**
A series of self-report online questionnaires using Qualtrics software, The focus of this research is to understand how living with nocturia may affect sleep, quality of life, mood, memory and what the barriers are to accessing health care services. Participants are required to have access to a device that can receive the internet (e.g. computer/smart phone). The questionnaire can be completed anywhere if the participant has internet access. The researcher will not be present during the completion of the study questionnaire (lone working). The questionnaires are adapted from valid and reliable psychometric questionnaires and are appropriate research instruments. Participants will be given an anonymous code and cannot be identified from their data.	Dr Catrin Griffiths and Dr Chris Alford	Dr Tim Moss
Who might be harmed: **Participants and the researcher** **How many exposed to risk:** 10	**Date of Assessment:** **02/08/2021**	**Review date(s):** 02/08/2021

RISK MATRIX: (To generate the risk level).

Very likely **5**	**5**	**10**	**15**	**20**	**25**
Likely **4**	**4**	**8**	**12**	**16**	**20**
Possible **3**	**3**	**6**	**9**	**12**	**15**
Unlikely **2**	**2**	**4**	**6**	**8**	**10**
Extremely unlikely	**1**	**2**	**3**	**4**	**5**

1					
Likelihood (L)  **Severity (S)**	**Minor injury – No first aid treatment required** **1**	**Minor injury – Requires First Aid Treatment** **2**	**Injury - requires GP treatment or Hospital attendance** **3**	**Major Injury** **4**	**Fatality** **5**

ACTION LEVEL: (To identify what action needs to be taken).

POINTS:	RISK LEVEL:	ACTION:
1 – 2	NEGLIGIBLE	No further action is necessary.
3 – 5	TOLERABLE	Where possible, reduce the risk further
6 - 12	MODERATE	Additional control measures are required
15 – 16	HIGH	Immediate action is necessary
20 - 25	INTOLERABLE	Stop the activity/ do not start the activity