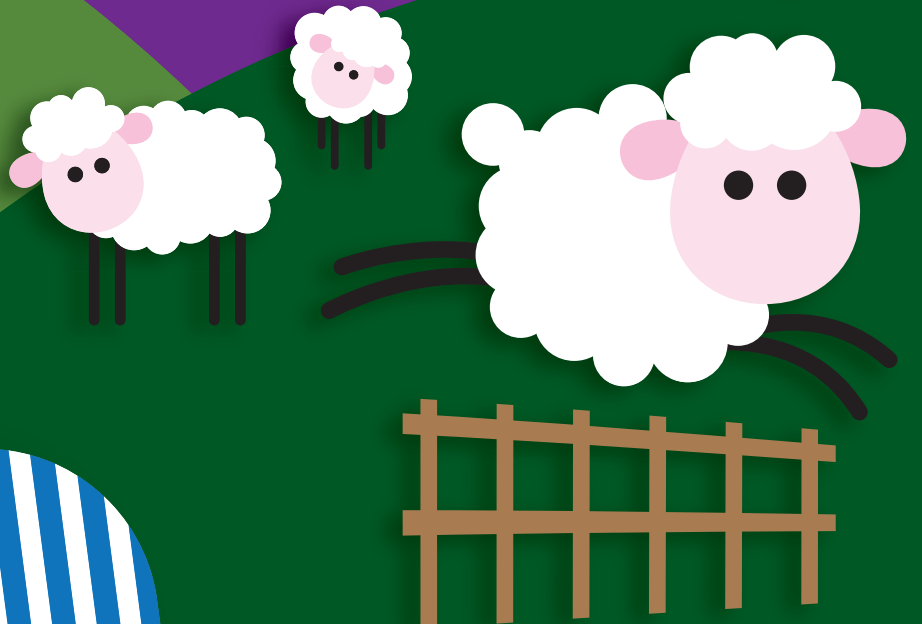


Waking up to the health benefits of sleep



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FOREWORD

Most people enjoy a good night of sleep after a long day. Many of us also know the importance of getting enough sleep before many of life's important events such as going for a job interview, embarking on a long drive or taking an exam. However, the true extent of the relationship between sleep and the public's health and wellbeing may be somewhat underestimated.

Getting enough sleep makes up a vitally important component of a healthy and balanced lifestyle, similar to being physically active, eating a healthy diet and staying within recommended alcohol consumption guidelines – although sleep often doesn't receive the attention it deserves. Worryingly, RSPH poll findings show that many people may be under-sleeping by up to an hour per night, which when accumulated over a week amounts to almost a full night's sleep lost.

There is now a wealth of evidence to conclude that lack of sleep and poor sleep are inherently bad for our health, being associated with a huge range of negative conditions including diabetes, depression, obesity, heart attack and cancer.

Given its importance to our overall health and wellbeing, we would like to see a societal shift so that individuals are given the opportunity to get a healthy amount of sleep and offered support when they are having difficulties with sleep.

In this report, '**Waking up to the health benefits of sleep**', we offer a comprehensive assessment of the importance of sleep and the damaging consequences that lack of, or poor quality sleep, can have on our health and wellbeing.

We also set out what we believe the public, government, employers and others can do to prioritise this area, give sleep the parity it deserves alongside other important public health considerations so that everybody has the opportunity to get the sleep they need to optimise their health and wellbeing.




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EXECUTIVE SUMMARY

 Sleep is as vital for survival and health as food and water. Sleep is involuntary and inevitable.



Our sleep cycle is regulated by two systems in the body: sleep wake homeostasis and the circadian or 24-hour body clock.



A wealth of evidence exists about the fundamental role sleep plays in protecting us from problems with our health and wellbeing. Poor sleep is linked to a wide range of physical, mental, behavioural and performance issues.



Despite this four in ten people aren't getting enough sleep, while one in five sleep poorly most nights, representing the second most common health complaint after pain.



Given sleep's pivotal role in the nation's health and wellbeing, it needs to be a key priority for the public's health.



There are certain people in society who are more at risk of poor sleep either because of where they work, their lifestyle or because they live with one of the six main families of sleep disorders.



People whose lifestyle affects their sleeping patterns include: new parents, commuters, shift workers, party animals, and young people. Sleep disorders include insomnia, with one in three people living with a sleep disorder; sleep-related breathing disorders; hypersomnolence; sleep-wake disorders; sleep-related motor disorders and parasomnias.



If a person is living with an insomnia disorder the two main treatments are either medication or Cognitive Behavioural Therapy (CBT).



There are a range of different solutions available to help improve people's sleep. One in ten of us take a drug to help us sleep, and there are over 10 million prescriptions written every year in England for sleeping pills.



Sleep hygiene are habits and practices that are conducive to sleeping well on a regular basis. There are a number of different treatments which have been put forward as sleep solutions, including wearables that help people monitor and assess their sleep, and phone apps which can offer calming sounds, breathing techniques and altered screen light to induce sleep.



We are calling for the introduction of a "slumber number" to inform the public how much sleep they should be getting as well as a national sleep strategy from Government which should be taken forward by a Minister.



Healthcare professionals, including GPs and nurses should screen patients for sleep problems, and use sleep as a hook for discussing more complex health issues. Healthcare professionals should also be trained in this area.



Given sleep's link with increased accidents at work, we would like to see employers review existing guidelines and, where necessary, develop new ones.



Sleep should be covered in the school curriculum under Personal, Social, Health and Economic (PSHE) education and school start times should be reviewed to better suit adolescent circadian rhythm.

1

BACKGROUND

over **half** (54%) of the public have felt stressed from poor sleep

What is sleep?

Sleep forms part of a natural rhythm of life - any single cell taken from our body, and placed in isolation in a laboratory dish, will maintain a stable 24-hour pattern, demonstrating that sleep is a force to be harnessed rather than challenged. Indeed, opposing or disrupting sleep and this rhythm of life can be very harmful.

Our sleep cycle is regulated by two systems in the body: sleep/wake homeostasis and the circadian, or 24 hour body clock.¹ The first tells our bodies when a need for sleep is building.¹ There is no set amount for everyone, and different people need different amounts at different stages of their lives.² The second regulates the timing of sleepiness and wakefulness, and is controlled by a group of brain cells that respond to light and dark.¹ Most adults feel some of the strongest urges to sleep between 2-4pm and 1-3am, although again this varies from person to person¹ and adolescents often go through 'sleep phase delay', which pushes these timings later into the day.¹

Our sleep can be broadly divided into five stages – four non-rapid eye movement stages (non-REM) and one rapid eye movement stage (REM). They range from light sleep in stage one to when our dreams occur in the final REM stage of sleep.³



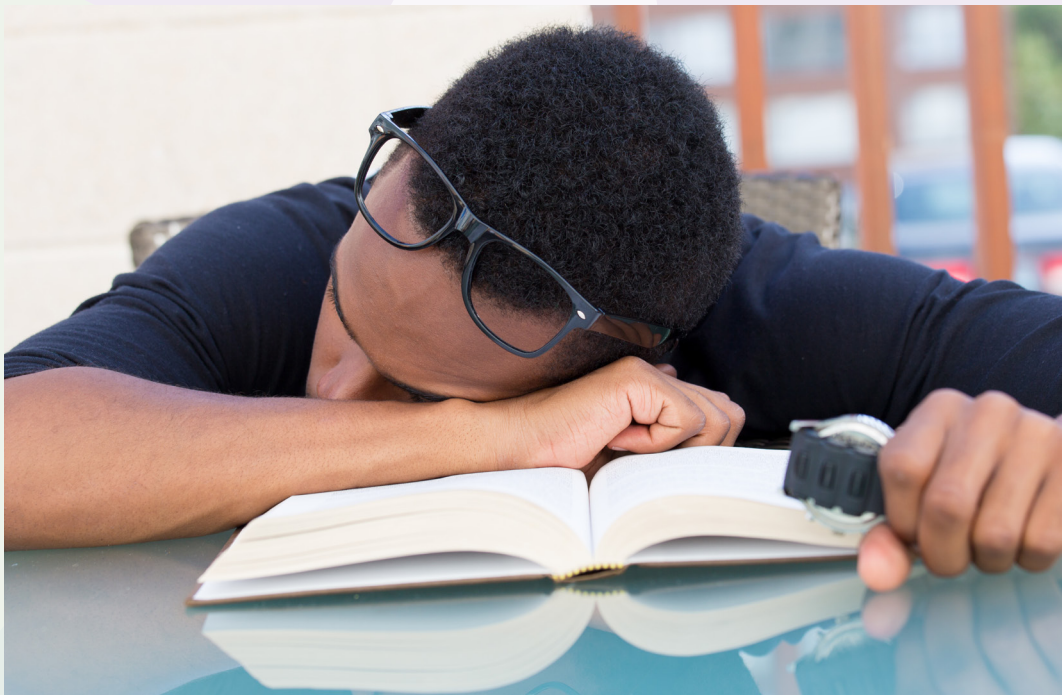
Why does sleep matter?

Sleep seems to be essential for all manner of creatures.⁴ Biological drives like hunger and thirst certainly are compelling, yet we are able to make behavioural choices and to choose what, when and even whether to eat and drink. Sleep, however is rather more involuntary, like breathing. Deliberately holding your breath will result in your body over-riding your action, forcing you to breathe out and resuming respiration. Sleep is likewise inevitable. Some studies have kept subjects awake for 40 hours and over.⁵ However, we cannot deliberately remain totally awake unassisted for long, extended periods of time.

What happens if we don't sleep?

Sleep deprivation has three consequences. Sleepiness is the first sign of insufficient sleep. Secondly, there is an inevitable intrusion of sleep into our ability to stay awake. When wakefulness is enforced, pressure builds and sleep cannot be avoided, irrespective of stimulation. 'Microsleeps' comprising a few seconds when the person may seem superficially awake become irresistible after continuous wakefulness, especially during the circadian or biological night.⁶

Thirdly, if we have insufficient sleep but remain awake there is marked deterioration in our performance, and are vulnerable to cognitive impairment.^{7/8} The term 'local sleep' therefore is now used to denote times when local populations of nerve cells in the brain may fall asleep.⁹ As well as indicating that sleep is not always a whole brain phenomenon, such findings suggest that local sleep related cellular repair may occur in regions of the brain which aren't as involved in particular tasks. The brain is always trying to compensate, but sleep loss poses a fundamental challenge.



2

SLEEP AND THE PUBLIC'S HEALTH

“Given sleep's pivotal role in the nation's health and wellbeing, it needs to be a key priority for the public's health.”

Does inadequate sleep affect our health?

A wealth of evidence supports the fundamental role sleep plays in protecting us from severe problems with our health and wellbeing: sleep-related accidents are a major cause of injury and death; poor sleep increases the risk of chronic illnesses including: high blood pressure, diabetes, depression, cancer, heart attack and stroke.¹⁰ It is related to obesity in both children and adults¹¹ and reduced quality of life and early death.¹² In older people it may be related to accelerated cognitive decline.¹³ Despite all of this evidence the number of people not getting enough sleep is now around four in ten,¹⁴ while one in five sleep poorly most nights, representing the second most common health complaint after pain,¹⁵ potentially having a significant impact on the nation's health. Given sleep's pivotal role in the nation's health and wellbeing, it needs to be a key priority for the public's health. A structured effort to improve the public's sleep is a missing link in public health strategy, with enormous potential pay-offs.


The purpose of sleep is not yet fully understood; but it likely involves saving energy, restoring the body and brain, and/or organising networks in the brain, for instance for learning and memory. One theory suggests that by reducing the energy used for some of the things our bodies do when we're awake, sleep frees up energy for these much needed brain functions, as well as processes essential to survival such as tissue growth and the function of the immune system.¹⁶ After just a short period of reduced sleep, people are more vulnerable to infection and respond less well to vaccination.^{17/18/19} Brain function worsens, in particular attention,¹⁶ drastically increasing the risk of accident and injury. In younger children and older adults, longer periods of sleep loss can significantly impair learning and cognitive processing. Those who consistently fail to get enough sleep face increased risk of high blood pressure, coronary heart disease, incident stroke,¹⁶ and all-cause mortality.²⁰ The underlying importance of sleep in tackling many of the unhealthy behaviours, chronic conditions and diseases related to lifestyle we are facing needs to be acknowledged. Here we look at the relationship between sleep and some of these.

Physical	Mental	Behavioural	Performance
Risk of...	Risk of...	Risk of...	
Cancer	Depression	Sleepiness	Impaired attention and concentration
Cardiovascular disease and stroke	Psychiatric relapse	Road traffic accidents	Decreased memory
Disorders of the Hypothalamic-Pituitary-Adrenal (HPA)	Mood fluctuation	Falls and fractures	Reduced multi-tasking
Metabolic abnormalities	Delirium	Repeat prescribing	Impaired decision-making
Weight gain & obesity	Impulsivity	Alcohol and drug dependency	Reduced creativity
Reduced immunity	Anger and frustration	Increased sedative and stimulant use	Reduced communication
Bodily sensations of pain	Higher risk of suicide	Less likely to attend appointments	Reduced socialisation
Thermoregulatory problems	Anxiety and hyperarousal	Longer stay in hospital	Less likely to be employed
Vulnerable seizure threshold	Chronic fatigue	Earlier admission to long-term care	More likely to be on benefits

Table 1: Some of the main consequences to the public's health of poor sleep

BEHAVIOURS


Poor diet and inactive lifestyles

 Short sleepers are more likely to be obese; and young children who do not get enough sleep are at greater risk of becoming obese as older children and adults.²¹ This may be because shortened sleep affects the hormones that regulate hunger and appetite, resulting in increased food intake.^{16/22} Poor sleep alters appetite regulating hormones, leptin and ghrelin,²³ which in turn can influence our food choices.²⁴ Getting a good night's sleep is an overlooked prescription for good health - including a healthy body weight.²⁵



Poor sleep has also been linked to negative eating attitudes and binge eating behaviours.²⁶ Lower energy levels can make people less likely to exercise,²⁷ and one survey found this lack of energy led people to avoid stopping to buy healthy foods after work, to avoid cooking, and to opt for more processed and sugary foods and snacks.²⁶ Together, poor diet and inactivity are contributing to our obesity epidemic, and sleep has a critical underlying role in both of these factors.

Smoking

 A similar link has been suggested between sleep and quitting smoking, although the relationship is complex. Insufficient sleep may make it difficult for a smoker to abstain by impairing attention and cognition, changing cravings, affecting mood or increasing the reward 'value' of cigarettes, and is therefore among the factors that make people more likely to relapse in tobacco treatment programmes.²⁸



Smokers may expect cigarettes to counter feelings of sleepiness, increasing the temptation to smoke,²⁷ and this may explain why young adults who sleep for longer seem to have more success at quitting.²⁹

The public ranked sleep the 2nd most important activity for health and wellbeing – behind not smoking

Accidents



The biggest killer of children and young people are transport collisions, and one in five crashes on major roads is related to sleep.³⁰



Road traffic collisions (RTCs) follow a 24-hour pattern, peaking between 2-7am in the morning and 2-4 pm in the afternoon; times when our circadian arousal signal is low. Sleep-related factors have a role in approximately 20% of all RTCs and sleep-related RTCs are linked to worse outcomes due to eyelid closures and failure to brake prior to collision.³¹



Driving simulators and on-the-road driving experiments reveal impaired driving performance (e.g. lane deviations, variable car position) after restricted or disturbed sleep.³² Extended shifts, particularly common in junior doctors, are associated with a marked rise in motor vehicle crashes and near-misses,³³ being problematic on the commute home from night-shift.³⁴

DISEASE

Cancer



There is considerable evidence that both regular travel across time zones and rotating pattern shiftwork are risk factors for cancer. Night-shift and rotating shift patterns induce circadian misalignment and sleep disturbance. For example, flight attendants, flying for five or more years have about double the risk of breast cancer compared to those flying for shorter periods.³⁵ The WHO International Agency for Research on Cancer concluded that “shiftwork involving circadian disruption is probably carcinogenic in humans”.³⁶ The relative risk associated with such occupational factors may lead to this vulnerability being seen as the equivalent to having a first degree relative with cancer.³⁷



For women between the age of 34 and 50, breast cancer is the biggest killer, which has been linked to disruption of circadian rhythm.³⁸ There is an emerging literature that suggests there may be similar links for prostate cancer in men.³⁹

Cardiovascular disease



Research indicates that shift work impacts negatively upon blood pressure, lipid profile, metabolic syndrome and, possibly, body mass index.^{40/41}



Research has also suggested that prolonged short sleep durations may lead to hypertension through extended exposure to raised 24-hour blood pressure and heart rate, elevated sympathetic nervous system activity, and increased salt retention.^{42/43}



Studies also suggest that the combination of insomnia and short sleep is associated with metabolic syndrome and type 2 diabetes.^{44/45}

Mental health

zzz Almost 4 in 5 long term poor sleepers suffer from low mood and are seven times more likely to feel helpless.⁴⁶ This can be a vicious cycle with stress, anxiety, depression and poor mental health contributing to difficulties sleeping. In the context of interpersonal relations, sleep quality has been linked to greater marital conflict and poorer relationships satisfaction.⁴⁷ The repercussions for mental health are particularly severe.



Persistent insomnia increases the risk of developing severe depression and suicidal behaviour. Depending on how severe the insomnia is, will determine how successful psychotherapeutic treatment for depression will be.

zzz Indeed, world authorities who publish diagnostic classifications of mental disorders now recognise that sleep problems may be implicated in the aetiology and maintenance of psychiatric disorder rather than being a mere symptom.⁴⁸ Moreover, analysis suggests that sleep disturbance (such as insomnia and nightmares) is associated with an almost threefold increase in completed suicides.⁴⁹ Research on the timing of suicidal injuries found that after adjusting for probability of being awake, suicide is four times more likely to occur during the circadian night. Being awake at night may therefore represent vulnerability for completed suicide.

COGNITIVE ABILITY

Reduced performance, decision making and memory



After about 17 hours our alertness sharply declines, to the point where our wakefulness is similar to the effects of a blood alcohol concentration of 0.05%. After 24 hours of not sleeping our alertness is equivalent to a blood alcohol concentration of 0.1% (the legal limit for drink driving [U.S]).^{50/51}

zzz Vigilant attention, complex attention and working memory are the cognitive processes most sensitive to sleep loss.⁵² Sleep deprivation prior to learning impairs the ability to build new memories⁵³ - this is true at all ages, but may be a particular vulnerability in older people. Sleep also plays a crucial role in consolidating our memory, which is markedly affected by inadequate sleep.

3

THE ZED LIST:

1 in 3 of the public
have felt depressed
from poor sleep

Whose health is most at risk from sleep deprivation?

Despite the importance of sleep, we live in a society where sleep deprivation is common. This is generally true in western culture where “we crave more, work more and expect more, ... and in the process abandon sleep.”⁵⁴ Perhaps the greatest awareness of the problem has been in the US, where it has been estimated that 50 to 70 million adult Americans have a chronic sleep disorder that contributes to poor health,⁵⁵ and that 1 in 3 adults are sleeping less than 7 hours per night, an amount at which physiological and neurobehavioural deficits manifest and become progressively worse under chronic conditions.⁵⁶

Sleep disturbance has been the most common expression of mental ill-health for men and women, of any age group, of any ethnic group, and in any region, for at least the past 15 years.⁵⁷ Recent studies have provided insight into the social patterning of sleep in the UK.^{58/59/60/61} This work, along with ESRC-funded social scientific investigations of sleep and wakefulness provides a rich source of information on how Britain is sleeping.

Personal choices and societal work and lifestyle demands⁶² as well as disorder and disease⁶³ contribute to acute and chronic levels of both poor sleep and upsetting our body clock. There are certain people in society who are more at risk of poor sleep either because of where they live or work, their lifestyle, or perhaps because they are living with a sleep disorder. We look at who is most at risk from poor sleep in our Zed List. Those identified should be prioritised with support to better enable them to sleep better and ultimately improve their health and wellbeing.

*“we crave more, work more and expect more, ...
and in the process abandon sleep”*

(Foster & Wulff, 2005)



Over 1 in 3 have eaten
unhealthily due to
poor sleep

People whose lifestyle affects their sleeping patterns

New parents



The sleep patterns of new parents are significantly affected by the birth of their child. Studies have found that during pregnancy and in the months following a child's birth, parents suffer from sleep deprivation, interrupted sleep and fatigue during waking hours.^{64/65/66} The effects of lack of sleep, such as clumsiness, forgetfulness, disorientation and others are of particular concern when coupled with the responsibilities of being a new parent. Tasks such as co-sleeping, carrying the child, bathing, remembering medications and maintaining a safe environment all become precarious when under the influence of lack of sleep. It is therefore imperative that new parents manage to find a way, although this may pose some difficulty, of ensuring they are getting enough sleep.

Commuters



Over recent years, we have seen a substantial shift in working culture in the UK; moving from one of a 'job for life', across a diverse range of industries, to one of exceptional fluidity with employees increasingly based in office roles. Alongside this, we have also seen a growing number of people willing to travel longer distances to work. In 2008, the average commute in the UK was 53 minutes; by 2013, this figure had risen to 56 minutes. Lengthy commutes are particularly prevalent in the South East, with workers in London leading the way with an average commute of 79 minutes.⁶⁷

Longer commutes mean that many workers have less free time outside of work to dedicate to health promoting activities, including physical activity, cooking healthy meals and also, sleeping; a phenomenon known as 'time crunch' or 'time scarcity'. Studies have shown that when faced with this problem, workers are most likely to compensate by reducing their time spent sleeping; a pattern which may contribute to lower productivity at work and commuters increased risk of lower mental and physical wellbeing.⁶⁸



Shift workers



As summarised earlier, there is mounting evidence that the disruption of our body clock over the longer term increases the risk of breast, colorectal, endometrial and prostate cancers, and such data have led WHO to treat night shift work as a probable carcinogen. In addition, increased weight gain, type 2 diabetes and cardiovascular disease have been associated with shift work. 'Shift work sleep disorder' is characterised by insomnia, sleep that feels un-refreshing, difficulty concentrating, lack of energy, irritability and potentially depression.⁶⁹ Around 1 in 4 (28%) of the UK population are shift workers and men are more likely to undertake shift work than women.⁷⁰ Shift work sleep disorder is a relatively common but under diagnosed and undertreated condition with potentially serious social, economic and medical consequences for individuals.⁷¹ Employers have a duty of care to their employees to make sure they are not suffering from complications as a result of shift work sleep disorder and should ensure employees have enough time to catch up on quality sleep even during busy working periods.

Young people



Adolescents have biological changes and environmental and societal demands that impact on sleep. Teenagers are staying up later to interact with peers and engaging in behaviours that contribute to poor sleep hygiene and insufficient sleep. The National Sleep Foundation conducted an America-wide sleep study in 2006, finding that adolescents who had more than four electronic devices in their rooms were significantly more likely to report insufficient sleep on the weekdays and weekends compared to individuals who had 0-3 devices in their rooms.⁷² Importantly, this study showed that in the hour prior to sleep, adolescents aged 14 to 18 are more likely to watch television, use the internet, instant message, talk on the phone, and do homework than 11 to 14 year olds who play video games or read. The use of electronic devices is a particularly pertinent problem in adolescents as not only are students then prompted to stay up later, they are also being exposed to light in the late evening which shifts the biological clock. One recent study found that when individuals read a light emitting e-book in the hour prior to sleep, they took longer to fall asleep, had reduced evening sleepiness, a delay in their melatonin profile, and lower morning alertness comparative to when they read a printed book prior to sleep.⁷³ Further to poor sleep behaviours resulting in poorer quality sleep, adolescents are under increasing pressure concerning exams. Stress can result in shorter sleep, more fragmented sleep, and less deep sleep.⁷⁴



Party animals



Late nights and partying at the weekend are often coupled with alcohol and other drug use which can have an impact on sleep quality into the following week. University students have cited partying as a factor that negatively impacts their sleep.⁷⁵ Even a small amount of alcohol can interfere with an individual's normal sleep process.⁷⁶ By staying up past normal sleeping hours when partying, people run the risk of creating a sleep deficit that they often do not compensate for later in the week,⁷⁷ leaving themselves susceptible to the negative effects of sleep deprivation.



What are the sleep disorders people are living with?



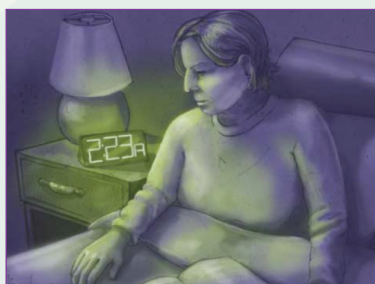
In addition to considering people's lifestyles, occupations or life circumstances it is even more important to consider individuals living with a diagnosable sleep disorder of which there are six main families. Here we take a look at them.

Insomnia disorders



Up to one-third of the population complains of poor sleep. However, persistent insomnia affects approximately 10-15% of the adult population, negatively impairing quality of life.^{78/79} In older adults, prevalence is around 25%. Historically considered 'secondary', compelling evidence now implicates insomnia as a key cause in poor mental and physical health and as a barrier to successful treatment. Research has found insomnia to be has been independently associated with the new-onset of stroke,⁸⁰ hypertension, diabetes,⁸¹ depression⁸² and perhaps even early mortality.⁸³

The Diagnostic and Statistical Manual of Mental Disorders, recommends that Insomnia Disorder needs to be recognised, whenever it presents, and treated if necessary alongside other co-morbid conditions such as depression, hypertension, cancer or sleep apnoea.⁸⁴ Recommendations on the assessment and treatment of insomnia can be found in chapters 4 and 5.



Sleep-related breathing disorders



Obstructive Sleep Apnoea (OSA) is defined by the number of obstructive apnoea and hypopnea episodes per hour of sleep, reflecting the degree of departure from normal breathing during sleep. During the period between 1988 and 1994 the prevalence of moderate-severe OSA was estimated as 8.8% in males aged 30-70 whereas between 2007 and 2010 prevalence had risen to 13% in males and 6% in females.⁸⁵

May in part be due to the increasing prevalence of obesity and the aging population as well as increased awareness and diagnosis. Obesity is a risk factor for OSA and OSA is also more common with increasing age.

In people over 65 years the prevalence of OSA is approximately 20%, with some estimates as high as 70%.^{86/87/88} Prevalence is higher in Asian and other non-white populations.

OSA is associated with hypertension, cardiovascular morbidity (notably elevated odds of stroke;) and mortality, sleepiness, impaired cognitive function, increased likelihood of motor vehicle crashes and occupational accidents and reduced health-related quality of life.^{84/89/90/91/92} Risk factors include excess body weight and use of alcohol, with some evidence also for smoking, nasal congestion and menopausal change.⁸⁴ It is estimated that treatment of OSA could lead to approximately 40,000 fewer road accidents per year in the UK.⁹³ The majority of these are caused by OSA patients being excessively sleepy.

OSA in older people is one of a few modifiable factors for improving quality of life. A recent study has shown that treatment of OSA in older people, not only improves daytime sleepiness but is also cost effective.⁹⁴

Central disorders of hypersomnolence



Narcolepsy is an autoimmune disorder caused by a gradual loss of neurons that produce hypocretin (orexin), a hormone that normally keeps us awake. The four classic symptoms of narcolepsy consist of: (1) sleep attacks—sudden irresistible urges to sleep; (2) cataplexy - (going limp) caused by anticipatory excitement, laughter, anger, or surprise; (3) hypnagogic hallucinations—frightening or menacing hallucinations that occur at sleep onset; and (4) sleep paralysis—often frightening and unpleasant generalised paralysis slightly before or at the time of falling asleep or on awakening.⁹⁵ Narcolepsy with cataplexy is rare. Studies show prevalence lies between 25 and 50 per 100,000 people.⁹⁶ The median age of onset is around 16 years old and the male:female ratio is approximately 1.6:1.⁹⁷



Circadian rhythm sleep-wake disorders



These comprise Advanced Sleep Phase Disorder, Delayed Sleep Phase Disorder, Free-Running Disorder, and Irregular Sleep-Wake Rhythm,⁹⁸ as well as Shift Work Disorder and Jet Lag Disorder.⁹⁹ There is a tendency for phase delay in adolescence (feeling sleepy late on) and for phase advance in later life (feeling sleepy early). Free-running sleep (getting later night on night is associated with blindness, and irregular schedules with dementia and some psychiatric disorders.

Sleep-related motor disorders



These comprise restless legs syndrome (RLS; Willis-Ekbom disease), periodic limb movement disorder, rhythmic movement disorders, sleep-related bruxism (teeth grinding), and sleep-related leg cramps.^{100/101/102} The prevalence of clinically significant RLS is 1.5% to 3.0%. RLS is a neurological conditioned characterized by an urge to move, usually associated with paraesthesia (tingling, numbness), that occurs or worsens at rest, especially in the evening and at night, and is relieved by activity. RLS symptoms have a major impact on sleep and patients reports daytime fatigue and/ or somnolence.

Parasomnias



These are generally classified into disorders relating to non-REM sleep, the arousal parasomnias (such as sleepwalking and night terrors) and the REM parasomnias such as nightmare disorder and REM sleep behaviour disorder. Recurrent and distressing nightmares are a hallmark feature of Post-Traumatic Sleep Disorder. In REM sleep behaviour disorder, the normal muscle paralysis of REM sleep is compromised and may represent an early sign of a neurodegenerative disorder such as Parkinson's Disease.¹⁰³

4

HOW CAN PEOPLE IMPROVE THEIR SLEEP?

Many people don't know where to turn when they have a sleep problem. This section provides some guidance on where the research evidence lies.

The first thing to consider is whether or not a sleep problem is actually insomnia. Here is what the diagnostic criteria for Insomnia Disorder say:

"...if you have had difficulty sleeping, 3 or more nights per week, for at least 3 months and your difficulty sleeping is troubling you, not only because of poor nights but also because of resultant poor days then you may have an Insomnia Disorder. This remains true whether or not you have other physical or mental health conditions."

Cognitive Behavioural Therapy

Treatments for Insomnia



Persistent insomnia may be treated, if medical intervention is needed, either with medication or with Cognitive Behavioural Therapy (CBT). The evidence suggests that both of these approaches can be helpful, but the long-term benefits of CBT outweigh sleeping pills and there are fewer side effects.^{104/105} Although clinical guidance is that psychological interventions should be offered as the first treatment option (HTA Technology Appraisal 77, 2004), lack of availability of CBT for insomnia has meant that people often have access only to sleeping pills. However, this may be changing with the advent of digital CBT (dCBT) delivered via web or smartphone, using highly personalised help driven by algorithms. A recent King's Fund report, "The digital revolution: eight technologies that will change health and care" highlighted that dCBT from www.sleep.com is a digital innovation that offers a scalable alternative to sleeping pills and has been tested to the highest clinical standards.^{106/107} It is the only UK intervention that has been rigorously tested using clinical trials methods.

Cognitive behavioural therapy (CBT)	Pharmacotherapy
Relaxation therapies	Benzodiazepines
Biofeedback	Benzodiazepine receptor agonists
Stimulus control therapy	Melatonin receptor agonists
Sleep restriction	Orexin antagonists
Intensive sleep retraining	*Sedative antidepressants
Cognitive restructuring	*Anti-histamines
Cognitive control	*Major tranquilisers
Mindfulness	
Paradoxical intention	
*Sleep hygiene advice	

* NOTE: Have limited or no clinical evidence base, although they may be offered in practice

Medication

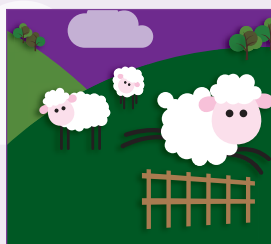
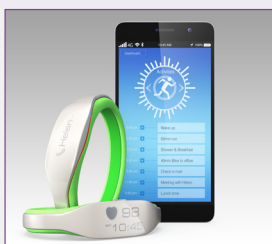
zzz There are more than 10 million prescriptions written every year in England for sleeping pills.¹⁰⁸ Benzodiazepines (benzos) are one group of drug that can be prescribed for insomnia. They work to enhance the effect of gamma-aminobutyric acid (GABA) on the brain which depresses the central nervous system inducing feelings of calmness and relaxation.¹⁰⁹ However, they can become highly addictive and it is estimated that over 1 million people in the UK are addicted to benzos with widespread misuse.^{110/111} 'Z drugs' are a group of nonbenzodiazepine drugs used to treat insomnia. They are a newer treatment and becoming more popular due to their side effects and habit-forming potential being less severe than benzos.¹¹²

Other medication individuals may take includes over-the-counter sleeping pills. These are usually a type of antihistamine medication that induces drowsiness in users. It is unclear how effective these type of pills are¹⁰⁴ but they are not recommended for those suffering from long-term insomnia and sleep disturbance.

Sleep Hygiene



Sleep hygiene is defined as habits and practices that are conducive to sleeping well on a regular basis. While sleep hygiene may not be an entirely effective intervention to cure insomnia or persistent poor sleep on its own,¹¹³ there is evidence that suggests individual sleep hygiene recommendations may improve sleep for some individuals but only those with minor or nonclinical sleep problems.¹¹⁴ Here we examine some common sleep hygiene techniques:



Diet

zzz There is a well-established link between the amount of sleep an individual gets and their eating behaviours. Insufficient sleep is linked to increased caloric intake, poor dietary habits, increased snacking, fewer vegetables consumed and obesity.^{115/116} While lack of sleep has been shown to influence subsequent dietary behaviours, there is currently little study regarding how changing nutrient intake can influence quality of sleep. However, that there may be a link between nutrients and sleep that is worth further exploration. Milk, for example, has been highlighted to contain nutrients with sleep-promoting properties that induce feelings of calmness and drowsiness.¹¹⁷ Eating healthily, combining the right nutrients, and avoiding certain foods and (caffeinated) drinks before bed may be one way in which individuals can improve their sleep. However, at present there is no research evidence to support this hypothesis.

Physical activity



Physical activity has been described by the Academy of Medical Royal Colleges as a ‘miracle cure’, improving numerous physical and mental conditions and preventing countless more.¹¹⁸ Physical activity, however, may be both helpful and harmful in relation to sleep. Evidence shows that adults of all ages reported sleeping significantly better after undertaking at least 150 minutes physical activity per week.¹¹⁹ Basically, healthy people sleep better. However, this is not to say that exercise is a treatment for insomnia. In fact, strenuous exercise in the evening usually delays sleep-onset by creating physiological arousal.¹²⁰

Apps



Smartphones have revolutionised the way in which we use the internet. Two-thirds (66%) of people in the UK now own a smartphone, up from 39% in 2012.¹²¹ This increase of pocket internet availability has paved the way for a market in apps focused on improving health and wellbeing. Sleep is a particular target of these apps, behind in number only to those apps focused on exercise regimes and caloric intake.¹²² There is a bewildering array of apps available offering calming sounds, breathing techniques and altered screen light to induce sleep in people who struggle to fall asleep. Other apps offer sleep analysis by detecting movement during individual’s sleep. However, at present, there is little supportive evidence for the efficacy of these apps, and they have been shown to be clinically inaccurate.¹²³

The most promising apps to improve sleep look to be those focused on dCBT interventions. Data are provided directly by the user alongside other personalised information that ensures delivery is person-specific (see ‘treatments for insomnia’). Design and personalisation of the apps may be likely to improve user engagement and therefore aid them to stay the entire course of therapy.¹²⁴

Wearables



There is a large market for wearables that claim to help people monitor and assess their sleep. They range from wristbands and headbands to small nodes that attach to users’ chests.¹²⁵ The available evidence suggests that although wearables may increase awareness of the importance of sleep, the quality and quantity of each night’s sleep is not correctly measured, and they may not have a direct effect on actually improving sleep.^{126/127}

Folklore



Outside of sleep as topic of academic research, there are numerous quack theories and old folklore that claim to be the secret to a great night’s sleep. Counting sheep is one of the most famous theories to induce sleep and often referenced in popular culture. However, research has shown that counting sheep may actually keep people awake longer.¹²⁸

5

HOW CAN WE SLEEP BETTER AS A SOCIETY?

If we want to prevent early deaths, live longer and in better health we need a much more proactive approach to promote sleep, treat sleep disorders and minimise the impact of sleep loss on other health behaviours. While there are individual actions people can take, such as those recommended in the last chapter the impact of these at population level may remain limited as many sleep problems or their solutions are out of individuals' immediate control. Given the importance of sleep to the public's health we need a more strategic and joined up approach. There are measures that Government, employers, schools, the NHS and individuals can take to ensure people achieve the healthy sleep they need and minimize the impact where sleep is impaired.

PUBLIC

Introduce "slumber number" as recommended hours of sleep each day



Every human requires a different amount of sleep throughout their life-cycle dependent on age - although exactly how much varies from person to person. Our public polling shows that many people are under-sleeping by roughly an hour, which when accumulated over a week means a sleep deficit of around one full night.

To provide the public with more accurate information, in consultation with our 'sleep panel', made up of experts in the field of sleep, we have devised a "slumber number" table for specific age groups to provide guidance for the public on exactly how much sleep they should be aiming to have.

Slumber Number

Age group (yrs)	Hours sleep per day
1 – 2	11 – 14
3 – 5	10 – 13
6 – 13	9 – 11
14 – 17	8 – 10
18 – 25	7 – 9
26 – 64	7 – 9
65+	7 – 8

*Adapted from National Sleep Foundation recommendations 2015

Public missing out on a night's worth of sleep every week

GOVERNMENT

UK Government to publish a national sleep strategy

zzz Given the role of sleep in protecting against physical and mental health problems, ageing, accident and injury; and in underpinning a range of key health behaviours; alongside the need for effective treatment of disorders of sleep such as insomnia and sleep apnoea, we urge the government to develop a national strategy for sleep. The cross-cutting nature of sleep underlines its primary importance, however it is yet to be embedded as a priority area, data on sleep behaviour are thin, and we need to target individuals across the life course, addressing the factors outside of individual control.

Minister to have cross-departmental responsibility for sleep policy

zzz The Public Health Minister has responsibility for a large number of hugely important public health issues such as physical activity, sexual health and obesity. There is a wealth of evidence that shows sleep is another equally important component of health protection and improvement. Its value to the health and wellbeing of the population means that sleep should have parity with other public health issues and should be officially recognised in the remit of government Ministers.

The multi-dimensional nature of sleep means that cross-departmental responsibility may be needed. Sleep has wide-reaching implications for disease, physical and mental health, healthy ageing, education, transport, employment, the NHS and business. Addressing all of these issues will need work across a number of departments under the direction of a Minister of State.

HEALTH AND CARE PROFESSIONALS

Health workers to screen for sleep problems



GPs and nurses are ideally placed to ask service users about diet, physical activity, alcohol and drug use and sexual activity, and could increasingly incorporate sleep health. This means that opportunities to prevent the health consequences from poor sleep are missed and many treatable sleep conditions go under-recognised. Clinical level insomnia is thought to affect a great number of people, and Cognitive Behavioural Therapy is effective but under-prescribed. At the same time, increased obesity and an aging population is forcing the issue of sleep deprivation and OSA up the health care agenda. Sleep should be embedded in all primary health care training as a fundamental determinant of local population health, and should be assessed as part of all routine assessments. Nowadays GPs regularly screen patients for depression using a brief questionnaire, and a similar approach would be helpful to screen for insomnia and other common sleep disorders such as OSA. The Sleep Condition Indicator (SCI) is a suitable measure for this purpose.¹²⁹ Developed on large UK sample, the SCI is based on current diagnostic criteria, and can be administered quickly in either its 8 or 2-item format.¹²⁴

Sleep could be used as a 'hook' for discussing more complex health issues

zzz Difficult to 'reach' populations such as men, those with dependencies, and people with severe psychiatric disorder may be likely to respond to assistance with their (very common and troublesome) sleep problems.¹³⁰ Having difficulty sleeping is less stigmatising than being depressed or having an alcohol problem, so help for insomnia may open a door to accepting assistance and building a constructive therapeutic relationship. Likewise sleep issues in older people can be treated to prolong and promote independent living.

A training agenda should be developed for all health and social care staff



The majority of professionals know little or nothing about sleep, its mechanisms, processes, functions, disorders or impact. In this respect the UK lags behind other countries. This lack of knowledge, in turn, means that staff receive minimal training and so have little to pass on to their trainees and staff. This should be addressed, and it should be popular to do so. One development is that the University of Oxford has launched in 2016 an online programme in sleep medicine that is specifically for health professionals seeking further knowledge and expertise in the management of sleep disorders. The course can be followed at MSc, postgraduate Diploma or CPD levels (<http://www.ndcn.ox.ac.uk/study/continuing-professional-development/the-oxford-online-programme-in-sleep-medicine>). Other centres across the UK are working hard to promote sleep health. The British Sleep Society also trains nurses, allied health professionals and doctors in the importance of sleep and its disorders and funded many UK bodies, including NIHR, Wellcome Trust and British Lung Foundation.

Insomnia should be properly evaluated and treated

zzz ONS psychiatric morbidity data demonstrate that sleep disturbance (more so than depression, anxiety, worry) is actually the most common form of mental disorder, in men/women, of all ages, ethnic groups and in all UK regions¹³¹ and prevalence is increasing.¹³² However, there is concern that insomnia may not receive the attention it warrants and that there may be an over-reliance on treating the disorder with sedatives and other pharmaceutical solutions. Such a treatment approach comes from the perspective that insomnia is merely a troublesome symptom, quite contrary to overwhelming evidence. NICE guidelines which call for non-pharmacological interventions to be offered first, with pills to be given in the short-term (only) as second line therapy. With mental disorders set to become the biggest cause of disability by 2030, the potential of evidence-based therapy for insomnia as a novel pathway to prevention/treatment is timely. Cognitive behavioural therapy (CBT) is lastingly effective for persistent insomnia and could be made available in an accessible format (e.g. small group, booklets, digital (web/mobile) therapy).^{133/134}
^{135/136} One option would be to add insomnia to the Improving Access to Psychological Therapies (IAPT) agenda and a simple UK-derived screening measure is now available.¹²⁴

EMPLOYERS

Sleep and public safety guidance should be reviewed



Sleep deprivation and sleep disorder are independently associated with risks of falls, fractures, and industrial and road traffic accidents.¹³⁷ The judgement of sleepy people is impaired and for example, drivers' awareness of their sleepiness while driving is not sufficient to prevent them from having RTAs.¹³⁸ It is encouraging that The Highway Code does include some guidance for sleepy drivers, however, there is a need to review existing guidance and potentially to develop new guidelines in this and other areas.

What about people working in the NHS? Medical professionals making mistakes



Within the healthcare system, sleep deprivation and its impact on patient safety is a well reported phenomenon. The European Working Time Directive was implemented in 2003 limiting the hours clinical staff could work to 48 hours per week. This was launched in the face of evidence that sleep deprivation due to long working hours adversely impacted patient safety.¹³⁹ After missing a night's sleep surgeons performing a simulated operation made 20% more errors and took 14% longer than those at the start of a shift, for example.¹⁴⁰ Even after a period of rest shift work impacts performance by reducing both the quality and quantity of sleep, and has been likened to travelling to San Francisco to work and returning to London for ant rest days. Clinical medicine places demands on short term memory, which has been found to decline significantly in emergency physicians after a night shift.¹⁴² The effects are particularly marked for junior doctors, who after a 24 hour on call shift are at greater risk of needle stick injuries or road accidents while driving home.¹⁴³


Health and Safety Executive to enforce employers' health and safety duties when it comes to sleep



Employers have a legal duty to make sure reasonable measures are in place to remove or control the risks of work activities, including hours worked and how they are scheduled. As evidence emerges that risks of sleep disruption due to shift work are severe, employers must be made to show they are up to date with best practice for reducing the health risks from sleep and face legal consequences if not. Employers who operate shift or long hours work should provide information to employees on how to achieve healthy sleep and signpost them to effective online self-help resources and health services.

EDUCATION

Sleep should be covered on the curriculum in secondary schools

 Although a non-statutory component of secondary education, the department of education advises all secondary schools to include a form of Personal, Social, Health, and Economic (PSHE) education within their curriculum.¹⁴⁴ The PSHE association state that PSHE should enable pupils to develop the knowledge, skills and attributes they need to keep themselves healthy and safe, and prepare for life and work in modern Britain.¹⁴⁵ Therefore, sleep education could be included within this PSHE remit to provide adolescents with the knowledge as to the importance of sleep for health and wellbeing alongside providing them with the tools to counteract potential sleep disturbances through poor sleep behaviour and stress, thus opening a window towards preventative sleep medicine for adolescents. It is well established that insufficient sleep associates with reduced attention, impaired learning, and poorer academic performance. A study within US College students found that students who had good sleep practices (i.e. maintaining a consistent sleep schedule, refraining from daytime napping) had better sleep quality.¹⁴⁶ Sleep education programs have been shown to significantly improve sleep onset latency, sleep efficiency and total sleep time which associated with an improvement in academic achievement in mathematics and English.¹⁴⁷

Research is required on school start times



Many adolescents experience ‘delayed sleep phase’, which is a biological drive to sleep and rise later,¹³⁸ and yet neither school start times nor attitudes to young people’s mood and energy levels reflect this. It is possible that current start times force teenagers awake early in their circadian cycle, causing chronic and severe sleep deprivation.¹³⁹ Studies have shown teenagers deprived of sleep are more vulnerable to poor communication, decreased concentration and cognitive performance, unintended sleeps, decreased motor performance, increased risk taking and depression.¹³⁹ Reducing levels of sleep deprivation among adolescents should be a key public health priority, as it impacts on a range of other health outcomes for young people into their adult lives and so research in this area is of the highest importance. Several schools in the UK have pushed back their opening hours to a time that may be better suited to the adolescent circadian rhythm.

6

REFERENCES

1. Sleep Foundation. Sleep drive and your body clock <https://sleepfoundation.org/sleep-topics/sleep-drive-and-your-body-clock> (accessed March 2016).
2. NHS Choices. (2014). What is insomnia and how much sleep do we need? <http://www.nhs.uk/Livewell/insomnia/Pages/insomniaover-view.aspx> (accessed March 2016).
3. Robotham, D. Chakkalackal, L. Cyhlarova, E. (2011). Sleep Matters: the impact of sleep on mental health and wellbeing. Mental Health Foundation, London, published Jan 2011. Paper: ISBN 978-1-906162-65-8
4. Cirelli, C. Tononi, G. (2008). Is sleep essential? *PLoS Biol* 6(8): e216.
5. Adam, M. Reteym J. Khatami, R. Landolt, H.P. (2006). Age-Related Changes in the Time Course of Vigilant Attention During 40 Hours Without Sleep in Men. <http://www.journalsleep.org/articles/290110.pdf> (accessed March 2016).
6. Cajochen, C. Khalsa, S.B. Wyatt, J.K. Czeisler, C.A. Dijk, D.J. (1999). EEG and ocular correlates of circadian melatonin phase and human performance decrements during sleep loss. *Am. J. Physiol.* 277, R640-649.
7. Van Dongen, H.P. Maislin, G. Mullington, J.M. Dinges, D.F. (2003). The cumulative cost of additional wakefulness: dose-response effects on neurobehavioural functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep*, 26, 117-126.
8. Blenky, G. Wesensten, N.J. Thorne, D.R. Thomas, M.L. Sing, H.C. et al. (2003). Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose response study. *J. Sleep Res*, 12, 1-12.
9. Vyazovskiy, V.V. Olcese, U. Hanlon, E.C. Nir, Y. Cirelli, C. Tononi, G. (2011). Local sleep in awake rats. *Nature*, 472, 443-447.
10. Colten, H.R. Altevogt, B.M. (2006). Sleep disorders and sleep deprivation: an unmet public health problem. <http://www.ncbi.nlm.nih.gov/pubmed/20669438> (accessed March 2016).
11. Harvard School of Public Health. Obesity prevention source: Sleep. <http://www.hsph.harvard.edu/obesity-prevention-source/obesity-causes/sleep-and-obesity/> (accessed March 2016).
12. Centers for Disease Control and Prevention. Insufficient sleep is a public health problem. <http://www.cdc.gov/features/dssleep/> (accessed March 2016).
13. Lo JC, Groeger JA, Cheng GH, Dijk DJ, Chee MW. (2015). Self-reported sleep duration and cognitive performance in older adults: a systematic review and meta-analysis. *Sleep Med.* 2016 Jan;17:87-98. doi: 10.1016/j.sleep.2015.08.021. Epub 2015 Sep 25. Review. PMID:26847980
14. Artis, L. (2013). First ever Great British bedtime report launched. <http://www.sleepcouncil.org.uk/2013/03/first-ever-great-british-bedtime-report-launched/> (accessed March 2016).
15. Linton, S. et al. (2015). The effect of the work environment on future sleep disturbances: a systematic review. <http://www.sciencedirect.com/science/article/pii/S1087079214001208> (accessed March 2016).
16. Schmidt, M. (2014). The energy allocation function of sleep: a unifying theory of sleep, torpor, and continuous wakefulness. <http://www.sciencedirect.com/science/article/pii/S0149763414001997> (accessed March 2016).
17. Czeisler, C. (2015). Duration, timing and quality of sleep are each vital for health, performance and safety. <http://www.sciencedirect.com/science/article/pii/S2352721814000138> (accessed March 2016).
18. Lange, T. Perras, B. Fehm, H.L. Born, J. (2003). Sleep enhances the human antibody response to hepatitis A vaccination. <http://www.ncbi.nlm.nih.gov/pubmed/14508028> (accessed March 2016).
19. Cohen, S. Doyle, W.J. Alper C.M. Janicki-Deverts, D. Turner R.B. (2009). Sleep habits and susceptibility to the common cold. <http://www.ncbi.nlm.nih.gov/pubmed/19139325> (accessed March 2016).
20. Irish, L. Kline, C. Gunn, H. Buysse, D. Hall, M. (2015). The role of sleep hygiene in promoting public health: A review of empirical evidence. <http://www.sciencedirect.com/science/article/pii/S1087079214001002> (accessed March 2016).
21. Ruxton, C. Derbyshire, E. (2015). Does sleep affect weight management? *Complete Nutrition*. Vol 15. No. 1.
22. Hogenkamp, P.S. et al. (2013). Acute sleep deprivation increases portion size and affects food choice in young men. <http://www.ncbi.nlm.nih.gov/pubmed/23428257> (accessed March 2016).
23. Van Cauter, E. Spiegel, K. Tasali, E. Leproult, R. (2008). Metabolic consequences of sleep and sleep loss. *Sleep Medicine*, 9, S23-S28.
24. Greer, S.M. Goldstein, A.M. Walker, M.P. (2013). The impact of sleep deprivation on food desire in the human brain. *Nature Communications*, 4, 2259.
25. Ruxton, C. Derbyshire, E. (2015). Does sleep affect weight management? *Complete Nutrition*. Vol 15. No. 1.
26. Quick, V. Shoff, S. Lohse, B. White, A. Horacek, T. Greene, G. (2015). Relationships of eating competence, sleep behaviours and quality, and overweight status among college students. <http://www.sciencedirect.com/science/article/pii/S1471015315000811> (accessed March 2016).
27. Turgiss, J. Allen, S. Xiao, S. (2006). Asleep on the job: the causes and consequences of employees' disrupted sleep and how employers can help. <http://www.vielife.com/uploads/files/AsleepOnTheJob.pdf> (accessed March 2016).
28. Hamidovic, A. de Wit, H. (2009). Sleep deprivation increases cigarette smoking. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2706278/> (accessed March 2016).
29. Rapp, K. Buechele, G. Weiland, S. (2007). Sleep duration and smoking cessation in student nurses. <http://www.sciencedirect.com/science/article/pii/S0306460306003388?np=y> (accessed March 2016).
30. Department for Transport. Think! Fatigue. <http://think.direct.gov.uk/fatigue.html> (accessed March 2016).
31. Horne, J.A. Reyner, L.A. (1995). Sleep related vehicle accidents. *BMJ*, 310, 565-567.
32. Durmer, J.S. Dinges, D.F. (2005). Neurocognitive consequences of sleep deprivation. *Seminars in neurology*, 25, No. 1.
33. Barger, L.K. Cade, B.E. Ayas, N.T. Cronin, J.W. Rosner, B. et al. (2005). Extended work shifts and the risk of motor vehicle crashes among interns. *New England Journal of Medicine*, 352, 125-134.
34. Ftouni, S. Sletten, T.L. Howard, M. Anderson, C. Lenne, M.G. et al. (2013). Objective and subjective measures of sleepiness, and their associations with on road driving events in shift workers, *Journal of Sleep Research*, 22, 58-69.

35. Rafnsson, V. Tulinius, H. Jonasson, J.G. Hrafnkelsson, J. (2001). Risk of breast cancer in female flight attendants: a population-based study (Iceland). *Cancer Causes Control*, 12, 95-101.
36. International Agency for Research on Cancer. (2010). Monographs on the evaluation of carcinogenic risks to humans; Monograph 98. Painting, firefighting, and shiftwork. Lyon, France: IARC Publication.
37. Megdal, S.P. Kroenke, C.H. Laden, F. Pukkala, E. Schernhammer, E.S. (2005). Night work and breast cancer risk: a systematic review and meta-analysis. *European J. Cancer*, 41, 2023-2032.
38. David, S. Mirick, D.K. (2006). Circadian disruption, shift work and the risk of cancer: a summary of the evidence and studies in Seattle. <http://www.ncbi.nlm.nih.gov/pubmed/16596308> (accessed March 2016).
39. Sigurdardottir, L.G. Valdimarsdottir, U.A. Fall, K. Rider, J.R. et al. (2012). Circadian disruption, sleep loss, and prostate cancer risk: a systematic review of epidemiological studies. *Cancer Epidemiol. Biomarkers Prev.* 21, 1002-1011.
40. Esquirol, Y., Perret, B., Ruidavets, J.B., Marquie, J.C. et al. (2011) Shift work and cardiovascular risk factors: New knowledge from the past decade. *Archives of cardiovascular diseases* 104, 636-668.
41. Canuto, R., Garcez, A.S., Olinto, M.T.A. (2013) Metabolic syndrome and shift work: a systematic review. *Sleep Medicine Reviews*, 17, 425-431.
42. Gangwisch, J.E., Heymsfield, S.B., Boden-Albala, B., Buijs, R.M., et al. (2006) Short Sleep Duration as a Risk Factor for Hypertension: Analyses of the First National Health and Nutrition Examination Survey. *Hypertension*, 47, 833-839.
43. Vgontzas, A.N., Liao, D., Bixler, E.O., Chrousos, G.P. & Vela-Bueno, A. (2009a). Insomnia with objective short sleep duration is associated with a high risk for hypertension. *Sleep*, 32, 491-497.
44. Xi, B., He, D., Zhang, M., Xue, J. Zhou, D. (2014) Short sleep duration predicts risk of metabolic syndrome: A systematic review and meta-analysis. *Sleep Medicine Reviews*, 18, 293-297.
45. Vgontzas, A.N., Liao, D., Pejovic, S., Calhoun, S., Karataraki, M., Bixler, E.O (2009b). Insomnia with Type 2 Diabetes. *Diabetes Care*, 32, 1980-1985.
46. Sleepio. (2012). The Great British sleep survey. <https://www.sleepio.com/2012report/> (accessed March 2016).
47. Gordon, A., Chen, S. (2014). The role of sleep in interpersonal conflict: do sleepless nights mean worse fights? *Social Psychological & Personality Science*, 5, 168-175.
48. American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Publishing.
49. Pigeon, W.R., Pinquart, M., Conner, K. (2012) Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. *Journal of Clinical Psychiatry*, 73, e1160-1167
50. Dawson, D. Reid, K. (1997). Fatigue, alcohol and performance impairment. <http://www.nature.com/nature/journal/v388/n6639/abs/388235a0.html> (accessed March 2016).
51. Williamson, A.M. Feyer, A. (2000). Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. <http://oem.bmj.com/content/57/10/649.short> (accessed March 2016).
52. Lim, J., Dingus, D.F. (2010) A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychological Bulletin*, 136, 375-389
53. Yoo, S.S., Hu, P.T., Gujar, N., Jolles, F.A., Walker, M.P. (2007) A deficit in the ability to form new human memories without sleep. *Nature Neuroscience*, 10, 385- 392.
54. Foster, R.G., Wulff, K. (2005) The rhythm of rest and excess. *Nature reviews: Neuroscience*, 2005. 6, 407-414.
55. Colten, H.R., Altevogt, B.M. (2006) Sleep disorders and sleep deprivation: an unmet public health problem. Washington, DC: National Academies Press.
56. Centers for Disease Control and Prevention (CDC: 2011). Effect of short sleep duration on daily activities - United States, 2005-2008. *MMWR Morb. Mortal. Wkly. Rep.*, 60:239-52
57. Singleton N, Bumpstead R, O'Brien M, et al. (2001) Psychiatric morbidity among adults living in private households, 2000. London: The Office for National Statistics, HMSO.
58. Arber, S., Bote, M. and Meadows, R. (2009) Gender and socio-economic patterning of self-reported sleep problems in Britain. *Social Science and Medicine*, 68, 281-289.
59. Dregan, A. and Armstrong, D. (2009) Age, cohort and period effects in the prevalence of sleep disturbances among older people: The impact of economic downturn. *Social Science and Medicine*, 69: 1432-38.
60. Green, M.J., Espie, C.A., Benzeval, M. (2014) Social class and gender patterning of insomnia symptoms and psychiatric distress: a 20-year prospective cohort study. *BMC Psychiatry*, 14, 152
61. Green, M.J., Espie, C.A., Hunt, K., Benzeval, M. (2012) The longitudinal course of insomnia symptoms: inequalities by sex and occupational class among two different age cohorts followed for 20 years in the West of Scotland. *Sleep*, 35, 815-823.
62. Rajaratnam, S.M.W., Howard, M.E., Grunstein, R.R. (2013) Sleep loss and circadian disruption in shift work: health burden and management. *Med. J. Aust.*, 199, 11-15.
63. Luyster, F.S., Strollo, P.J., Zee, P.C., Walsh, J.K. (2012) Sleep: a health imperative. *Sleep*, 35, 727-734
64. Kennedy, H. Gardiner, A. Gay, C. Lee, K. (2007). Negotiating sleep: A qualitative study of new mothers. http://journals.lww.com/jpnjournal/Abstract/2007/04000/Negotiating_Sleep__A_Qualitative_Study_of_New.11.aspx (accessed March 2016).
65. Meltzer, L. Mindell, J. (2007). Relationship between child sleep disturbances and maternal sleep, mood, and parenting stress: A pilot study. <http://psycnet.apa.org/journals/fam/21/1/67/> (accessed March 2016).
66. Gay, C. Lee, K. Lee, S. (2004). Sleeping patterns and fatigue in new mothers and fathers. <http://brn.sagepub.com/content/5/4/311.short> (accessed March 2016).
67. Work Wise UK. <http://www.workwiseuk.org/> (accessed March 2016).
68. Hilbrecht, M. Smale, B. Mock, S. 2014. Highway to health? Commute time and wellbeing among Canadian adults. <http://www.tandfonline.com/doi/abs/10.1080/16078055.2014.903723> (accessed March 2016).

69. Sleep Foundation. (2016). Shift work disorder - symptoms. <https://sleepfoundation.org/sleep-disorders-problems/shift-work-sleep-disorder-symptoms> (accessed March 2016).
70. NHS Choices. 2014. Shift workers more likely to report poor health. <http://www.nhs.uk/news/2014/12December/Pages/Shift-workers-more-likely-to-report-poor-health.aspx> (accessed March 2016).
71. Schwartz, J.R. Roth, T. (2006). Shift work sleep disorder: burden of illness and approaches to management. <http://www.ncbi.nlm.nih.gov/pubmed/17181377> (accessed March 2016).
72. Sleep Foundation. (2006). 2006 teens and sleep. <https://sleepfoundation.org/sleep-polls-data/sleep-in-america-poll/2006-teens-and-sleep> (accessed March 2016).
73. Chang, A. Aeschbach, D. Duffy, J. Czeisler, C. (2015). Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. <http://www.pnas.org/content/112/4/1232.abstract> (accessed March 2016).
74. National Institute of Neurological Disorders and Stroke. (2014). Brain basics: Understanding sleep. http://www.ninds.nih.gov/disorders/brain_basics/understanding_sleep.htm (accessed March 2016).
75. Stenzel, J. (2015). Sleep Quality and Negative Associated Behaviors of College Students: A Cross-Sectional Study. <http://digitalcommons.brockport.edu/spectrum/vol3/iss1/10/> (accessed March 2016).
76. Drinkaware. (2013). Alcohol and sleep. https://www.drinkaware.co.uk/media/307247/alcohol_and_sleep.pdf (accessed March 2016).
77. Fellman, M. (2007). Chronically sleep deprived? You can't make up for lost sleep. <http://www.northwestern.edu/newscenter/stories/2007/07/turek.html> (accessed March 2016).
78. Kyle, S.D., Morgan, K., Espie, C.A. (2010). Insomnia and Health-Related Quality of Life. *Sleep Medicine Reviews*, 14, 69-82.
79. Morin CM, Bootzin RR, Buysse DJ, Edinger JD, Espie CA, Lichstein KL. (2006) Psychological and behavioral treatment of insomnia: Update of the recent evidence (1998-2004). *Sleep*, 29, 1398-414.
80. Ming-Ping, W., Huey-Juan, L., Shih-Feng, W., Chung-Han, H., Jhi-Joung, W., Ya-Wen, H. (2014). Insomnia subtypes and the subsequent risk of stroke. *Stroke*, published online 3 April, doi: 10.1161/STROKEAHA.113.003675
81. Vgontzas, A.N., Liao, D., Bixler, E.O., Chrousos, G.P. & Vela-Bueno, A. (2009a). Insomnia with objective short sleep duration is associated with a high risk for hypertension. *Sleep*, 32, 491-497.
82. Baglioni C, Battagliese G, Feige B, et al. (2011) Insomnia as a predictor of depression: A meta-analytic evaluation of longitudinal epidemiological studies. *Journal of Affective Disorders*, 135, 10-19.
83. Vgontzas, A.N., Fernandez-Mendoza, J., Duanping, L., Bixler, E.O. (2013). Insomnia with objective short sleep duration: The most biologically severe phenotype of the disorder. *Sleep Medicine Reviews*, 17, 241-254
84. American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Publishing.
85. Peppard, P. Young, T. Barnet, J. Palta, M. Hagen, E. Hla, K. (2013). Increased prevalence of sleep-disordered breathing in adults. <https://aje.oxfordjournals.org/content/early/2013/04/13/aje.kws342.full> (accessed March 2016).
86. Ancoli-Israel, S. (1989). Epidemiology of sleep disorders. <http://europepmc.org/abstract/med/2665916> (accessed March 2016).
87. Young, T., Peppard, P.E., Gottlieb, D.J. (2002) Epidemiology of obstructive sleep apnea: a population health perspective. *Am. J. Respir. Crit. Care Med.*, 165, 1217-1239.
88. Hader, C. Schroeder, A. Hinz, M. Micklefeld, G.H. Rasche, K. (2005). Sleep-disordered sleeping in the elderly: Comparison of women and men. http://www.jpp.krakow.pl/journal/archive/09_05_s4/articles/10_article.html (accessed March 2016).
89. Punjabi, N.M., Caffo, B.S., Goodwin, J.L., Gottlieb, D.J., Newman, A.B., et al. (2009) Sleep-disordered breathing and mortality: a prospective cohort study. *PLoS Med* 6, e1000132.
90. Gottlieb, D.J., Yenokyan, G., Newman, A.B., O'Connor, G.T., Punjabi, N.M., Quan, S.F., et al (2010) Prospective Study of Obstructive Sleep Apnea and Incident Coronary Heart Disease and Heart Failure: The Sleep Heart Health Study. *Circulation*, 122, 352-360.
91. Tregear, S., Reston, J., et al (2009) Obstructive sleep apnea and risk of motor vehicle crash: systematic review and meta-analysis. *J. Clin. Sleep. Med.*, 5, 573-581.
92. Redline, S., Yenokyan, G., Gottlieb, D.J., Shahar, E., O'Connor, G.T., et al. (2010) Obstructive Sleep Apnea Hypopnea and Incident Stroke: The Sleep Heart Health Study. *Am. J. Respir. Crit. Care Med.* 182, 269-277.
93. British Lung Foundation. (2015). Obstructive sleep apnoea. https://www.blf.org.uk/sites/default/files/OSA_Toolkit_2015_BLF_0.pdf (accessed March 2016).
94. McMillan, A. Bratton, D.J. Faria, R. et al. (2015). A multicentre randomised controlled trial and economic evaluation of continuous positive airway pressure for the treatment of obstructive sleep apnoea syndrome in older people: PREDICT. <http://www.ncbi.nlm.nih.gov/books/NBK299273/> (accessed March 2016).
95. Mitler, M.M., Hajdukovic, R., et al. (1990) Narcolepsy. *J. Clin. Neurophysiol.*, 7, 93-118.
96. Longstreth, W.T., Koepsell, T.D., Ton, T.G., Hendrickson, A.F., Van Belle, G. (2007) The epidemiology of narcolepsy. *Sleep*, 30, 13-26.
97. Silber, M.H., Krahn, L.E., Olson, E.J., Pankratz, V.S. (2002) The epidemiology of narcolepsy in Olmsted County, Minnesota: a population-based study. *Sleep*, 25, 197- 202.
98. Sack, R.L., Auckley, D., Auger, R.A., Carskadon, M.A., Wright, K.P., Vitiello, M.V., Zhdanova, I.V. (2007a) Circadian Rhythm Sleep Disorders: Part I, Basic Principles, Shift Work and Jet Lag Disorders: an AASM review. *Sleep*, 30, 1460-1483.
99. Sack, R.L., Auckley, D., Auger, R.A., Carskadon, M.A., Wright, K.P., Vitiello, M.V., Zhdanova, I.V. (2007b) Circadian Rhythm Sleep Disorders: Part II, Advanced Sleep Phase Disorder, Delayed Sleep Phase Disorder, Free-Running Disorder, and Irregular Sleep-Wake Rhythm: an AASM review. *Sleep*, 30, 1484-1501.
100. Allen, R.P., Walters, A.S., Montplaisir, J., Hening, W., Myers, A., Bell, T.J., Ferrini-Strambi, L. (2005) Restless legs syndrome prevalence and impact: REST general population study. *Arch. Intern. Med.*, 165, 1286-1292.
101. Silber, M.H. (2013) Sleep-related movement disorders. *Continuum (Minneapolis)*. 19(1 Sleep Disorders):170-84.
102. Lechsziner, G., Gringras, P. (2012) Restless legs syndrome. *BMJ*, 344, e3056.

103. Schenck, C.H., Bundle, S.R., Ettinger, M.G., Mahowald, M.W. (1986) Chronic behavioral disorders of human REM sleep: a new category of parasomnia. *Sleep*, 9, 293-308.
104. Wilson, S.J., Nutt, D.J., Alford, C., et al. (2010) British Association for Psychopharmacology consensus statement on evidence-based treatment of insomnia, parasomnias and circadian rhythm disorders. *J. Psychopharmacol.* 24, 1577–1600.
105. Riemann, D., Perlis, M.L. (2009) The treatments of chronic insomnia: A review of benzodiazepine receptor agonists and psychological and behavioral therapies. *Sleep Med. Rev.*, 13, 205-214.
106. Espie, C.A., Kyle, S.D., Williams, C., et al. (2012). A randomized, placebo-controlled trial of cognitive behavioural therapy for chronic insomnia disorder delivered via an automated media-rich web application. *Sleep*, 35, 769-81.
107. Pillai, V. et al. (2015). The Anxiolytic Effects of Cognitive Behavior Therapy for Insomnia: Preliminary Results from a Web-delivered Protocol. <http://www.jsimedcentral.com/SleepMedicine/sleepmedicine-2-1017.pdf> (accessed March 2016).
108. NHS Choices. (2015). Sleeping pills and their alternatives. <http://www.nhs.uk/Livewell/insomnia/Pages/treatment.aspx> (accessed March 2016).
109. Royal College of Psychiatrists. (2013). Benzodiazepines. <http://www.rcpsych.ac.uk/healthadvice/treatmentswellbeing/benzodiazepines.aspx> (accessed March 2016).
110. Takatsuki, K. (2011). Life addicted to prescription drugs. <http://www.bbc.co.uk/news/health-14299501> (accessed March 2016).
111. Kapil, V. Green, J.L. Le Lait, C. Wood, D.M. Dargan, P.I. (2014). Misuse of benzodiazepines and Z-drugs in the UK. <http://www.ncbi.nlm.nih.gov/pubmed/25061118> (accessed March 2016).
112. Sleepdex. (2016). Sleep medications: The Z-Drugs. <http://www.sleepdex.org/nonbenzo.htm> (accessed March 2016).
113. Morgenthaler, T. et al. (2006). Practice Parameters for the Psychological and Behavioral Treatment of Insomnia: An American Academy of Sleep Medicine Report. http://www.aasmnet.org/Resources/PracticeParameters/PP_BTInsomnia_Update.pdf (accessed March 2016).
114. Irish, L.A. Kline, C.E. Gunn, H.E. Buysse, D.J. Hall, M.H. (2015). The role of sleep hygiene in promoting public health: A review of empirical evidence. <http://www.ncbi.nlm.nih.gov/pubmed/25454674> (accessed March 2016).
115. Chaput, J. (2014). Sleep patterns, diet quality and energy balance. <http://www.sciencedirect.com/science/article/pii/S0031938413002862> (accessed March 2016).
116. Haghghatdoost, F. Karimi, G. Esmailzadeh, A. Azadbakht, L. (2012). Sleep deprivation is associated with lower diet quality indices and higher rate of general and central obesity among young female students in Iran. <http://www.ncbi.nlm.nih.gov/pubmed/22951155> (accessed March 2016).
117. Peuhkuri, K. Sivhola, N. Korpela, R. (2012). Diet promotes sleep duration and quality. <http://www.ncbi.nlm.nih.gov/pubmed/22652369> (accessed March 2016).
118. Academy of Medical Royal Colleges. (2015). Exercise - The miracle cure. <http://www.aomrc.org.uk/general-news/exercise-the-miracle-cure.html> (accessed March 2016).
119. Loprinzi, P. Cardinal, B. (2011). Association between objectively-measured physical activity and sleep, NHANES 2005–2006. <http://www.sciencedirect.com/science/article/pii/S1755296611000317> (accessed March 2016).
120. Noland, H. Price, J. Dake, J. Telljohann, S. (2009). Adolescents' Sleep Behaviors and Perceptions of Sleep <http://onlinelibrary.wiley.com/doi/10.1111/j.1746-1561.2009.00402.x/abstract;jsessionid=110C53D6E2BFFA8764FFEC0460652053.f04t02?userIsAuthenticated=false&deniedAccessCustomisedMessage=> (accessed March 2016).
121. OfCom. (2015). The UK is now a smartphone society. <http://media.ofcom.org.uk/news/2015/cmr-uk-2015/> (accessed March 2016).
122. Sama, P. Eapen, Z. Weinfurt, K. Shah, B. Schulman, K. (2014). An Evaluation of Mobile Health Application Tools. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4114419/> (accessed March 2016).
123. Bhat S , Ferraris A , Gupta D , Mozafarian M , DeBari VA , Gushway-Henry N , Gowda SP , Polos PG , Rubinstein M , Seidu H , Chokroverty S. (2014). Is There a Clinical Role For Smartphone Sleep Apps? Comparison of Sleep Cycle Detection by a Smartphone Application to Polysomnography. <http://europepmc.org/abstract/med/25766719> (accessed March 2016).
124. Gretton, C. Honeyman, M. (2016). The digital revolution: eight technologies that will change health and care. <http://www.kingsfund.org.uk/publications/articles/eight-technologies-will-change-health-and-care> (accessed March 2016).
125. Kosir, S. (2015). Ten sleep wearables to look for in 2015. <https://www.wearable-technologies.com/2015/05/ten-sleep-wearables-to-look-for-in-2015/> (accessed March 2016).
126. Behar, J. Roebuck, A. Domingos, J. Geder, E. Clifford, G. (2013). A review of current sleep screening applications for smartphones. <http://iopscience.iop.org/article/10.1088/0967-3334/34/7/R29/pdf> (accessed March 2016).
127. Forbes Oste, H. (2015). Wearables as Social Technology for Cognitive Enhancement. <http://forbesoste.com/wp-content/uploads/2014/10/ForbesOste-wearables-socialTech-cognitive-enhancement.pdf> (accessed March 2016).
128. Harvey, AG and Payne, S. (2002). "The management of unwanted pre-sleep thoughts in insomnia: distraction with imagery versus general distraction." • *Behaviour Research and Therapy*, 40:3 (267-277). DOI:10.1016/S0005-7967(01)00012-2.
129. Espie, C.A., Kyle, S.D., Hames, P., Gardani, M., Fleming, L., Cape, J. (2014) The Sleep Condition Indicator: a clinical screening tool to evaluate Insomnia Disorder. *BMJ Open*, 4, e004183.
130. Gaynor, K., Brown, J.S.L. (2013) Self-referrers to community workshops: Who are they and why do some participants not consult with their GP about their mental health difficulties? *Journal of Mental*, 22, 467-73.
131. Singleton N, Bumpstead R, O'Brien M, et al. (2001) *Psychiatric morbidity among adults living in private households, 2000*. London: The Office for National Statistics, HMSO.
132. Calem M., Bisla J., et al. (2012) Increased Prevalence of Insomnia and Changes in Hypnotics Use in England over 15 Years: Analysis of the 1993, 2000, and 2007 National Psychiatric Morbidity Surveys. *Sleep* 35, 377-384.
133. Wilson, S.J., Nutt, D.J., Alford, C., et al. (2010) British Association for Psychopharmacology consensus statement on evidence-based treatment of insomnia, parasomnias and circadian rhythm disorders. *J. Psychopharmacol.* 24, 1577–1600.

134. Morgan, K., Gregory, P., Tomeny, M., David, B.M., Gascoigne, C. (2012) Self-help treatment for insomnia symptoms associated with chronic conditions in older adults: a randomized controlled trial. *J. Am. Geriatr. Soc.*, 60, 1803-1810.
135. Espie, C.A., MacMahon, K.M., Kelly, H., et al. (2007) Randomized clinical effectiveness trial of nurse-administered small group cognitive behaviour therapy for persistent insomnia in general practice. *Sleep*, 30, 574 - 584.
136. Espie, C.A., Hames P. and McKinstry, B. (2013) Use of digital (internet and mobile) media for delivery of cognitive-behavioral insomnia therapy. *Sleep Med. Clin.*, 8, 407-419
137. Grandner, M.A., Pack, A.I. (2011) Sleep Disorders, Public Health, and Public Safety. *JAMA*, 306, 2616-2617.
138. Nabi, H., Gueguen, A., Chiron, M. et al. (2006) Awareness of driving while sleepy and road traffic accidents: prospective study in GAZEL cohort. *BMJ*, 333, 75.
139. Douglas, Neil J. "Sleep, performance and the European working time directive." *Clinical Medicine* 5.2 (2005): 95-96.
140. Taffinder, N. J., et al. "Effect of sleep deprivation on surgeons' dexterity on laparoscopy simulator." *The lancet* 352.9135 (1998): 1191.
141. Harrington, J. Malcolm. "Health effects of shift work and extended hours of work." *Occupational and Environmental medicine* 58.1 (2001): 68-72.
142. Machi, Mari S., et al. "The relationship between shift work, sleep, and cognition in career emergency physicians." *Academic Emergency Medicine* 19.1 (2012): 85-91.
143. Lockley, Steven W., et al. "Effects of health care provider work hours and sleep deprivation on safety and performance." *The Joint Commission Journal on Quality and Patient Safety* 33. Supplement 1 (2007): 7-18.
144. Department of Education. (2013). Guidance: Personal, social, health and economic (PSHE) education. <https://www.gov.uk/government/publications/personal-social-health-and-economic-education-pshe/personal-social-health-and-economic-pshe-education> (accessed March 2016).
145. PSHE Association. <https://www.pshe-association.org.uk/> (accessed March 2016).
146. Brown FC, Buboltz WC, Soper B. Relationship of sleep hygiene awareness, sleep hygiene practices, and sleep quality in university students. *Behav. Med.* 2002;28:33-38
147. American Academy of Sleep Medicine. (2009) Better Sleep Is Associated With Improved Academic Success. *ScienceDaily*. www.sciencedaily.com/releases/2009/06/090610091232.htm (accessed March 2016).