



**Dr Nicholas Mabbott PhD.**



# **THE WONDER OF SLEEP: BEYOND MIDNIGHT**

***Want more sleep?***

***Enjoy this opportunity to get your life back on track  
with amazing information on what sleep is all about,  
and how to get plenty of it!***



# The Wonder of Sleep: **Beyond Midnight**

*by*

**Dr Nicholas Mabbott Ph.D.**



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**Publisher:**

ASPG (Australian Self-Publishing Group)  
P.O. Box 159, Calwell, ACT Australia 2905  
Email: [publishaspg@gmail.com](mailto:publishaspg@gmail.com)  
<http://www.inspiringpublishers.com>

National Library of Australia Cataloguing-in-Publication entry

Author: Dr Nicholas Mabbott Ph.D.

Title: **The Wonder of Sleep: Beyond Midnight**

Genre: Adult Non-Fiction, Health & Wellness

ISBN: 978-1-922920-66-9 (print)

ISBN: 978-1-922920-67-6 (ePub2)

ISBN: 978-1-922920-68-3 (PDF eBook)

It was during my time as Chair of the New South Wales Mine Safety Advisory Council and we had engaged Nick remotely from Perth to review and advise on a proposed new NSW Mining Fatigue Guidelines. His initial work and advice were so good we arranged for him to attend in person in the Hunter Valley, north of Sydney, and run an all-day seminar for the Advisory Council members on the broader issues of what causes bodily fatigue and what personal and organisational steps can be taken to address it. It was one of the best work place seminars I have ever attended. This book highlights the great work he does, and the information may make a difference to the lives of people who take the time to read it and learn just how important sleep is to road and workplace safety. If it is about fatigue and Dr Nick Mabbott is not on your consulting or speakers list then you haven't got the A team on the job!

**Hon. Carl Scully ("NSW Govt minister 1995-2006 covering numerous portfolios including roads, transport and police").**

Sleep is so important for both our physical and mental health, and yet it's something that groups I work with often report they feel they have no way of improving. So many of us either don't get enough sleep, or the quality of sleep that we need to optimise our wellbeing. The first time I heard Dr Mabbott share his top techniques for improving sleep, I realised there was more I could do to better manage issues I was having with insomnia, and that most importantly, my health depended on me doing it. I applied his techniques, improved my sleep, and have shared them with my family and clients ever since. Anyone who wants to improve the quality of their sleep will benefit from reading

*The Wonder of Sleep: Beyond Midnight*

Dr Mabbott digests and presents the sleep research in a way that is accessible to all of us and that enables us to actively build strategies to protect our sleep. This book is a brilliant resource, especially for those whose sleep disturbance affects their mood, energy, and capacity to drive, work and live safely.

**Tasha Broomhall MSc(Psych) - Director, Blooming Minds**

Our transport facility has had a most productive association with Dr Nick Mabbott since 2013. Over the last several years we have conducted 16 two day Driver Forums nationally, where heavy vehicle drivers (employee/contractor) were brought together in a central location, along with other Operational staff. The primary aim of the forums was to improve driver safety and wellbeing. To assist in reaching this goal, a number of external and internal presenters delivered sessions on various subjects specifically targeting driver safety and wellbeing. Dr Nick presented at all the two day forums on Fatigue and Sleep Management, a session that always rated extremely well in the feedback from both drivers and other staff who were present. So much so that, as a result of good feedback, Dr Nick has delivered his presentation to other teams in our organisation.

**Ian Coxon Transport Compliance Manager**

The comments about our ability to make rational decision once we are fatigued resonated with me and has helped me to understand why I have constantly seen truck drivers making poor decisions when operating in the early hours of the morning. Based on our previous discussions on fatigue, I have changed the drivers' working hours. The drivers are reporting the roster change has made night operations much easier and we are now seeing a very low number of fatigue alerts from our In-cab Fatigue Camera Systems. Fatigue is a significant contributing factor in many accidents, so the better we understand the wonders of sleep, the better able we will be to reduce the risks associated with long distance haulage.

**Scott Morgan, Country Manager, Linfox Logistics Lao Company Limited.**

Dr Nick has been a regular presenter at Transafe WA's Road Transport Industry Safety Forums where he shares valuable insights into sleep science and hygiene that always fascinate our audiences. Nick combines expertise, passion and real care for people when delivering content. He successfully reads his audiences, generating participation and adapting content to suit. As a road safety organisation, we're certain Nick's presentations have resulted in behavioural change that has positively impacted the health and wellbeing of those who hear him speak.

**Ana Stachewicz Past Executive Officer, TransafeWA**

I have seen Nick present multiple times, starting way back in 2013. That was when I first heard about the Mabbott Method which explains how to fall asleep quickly every night. I immediately started using the Mabbott Method and have been falling sleep within ten minutes of going to bed nine times out of ten since then. I had had problems falling asleep all of my life so this has been a game changer for me. However the Mabbott Method is just a small component of the information Nick shares in his book which is packed full of information gained from Nick's over two decades of research. It explains all you need to know about sleep, why we sleep, what happens when we sleep and when we don't get enough sleep. I highly recommend this book if you want to be the best version of yourself.'

**Mr. Guy Bowden**

I meet Nick at a transport forum in Kalgoorlie, speaking with him I said how after 35 years as a shift worker my sleeping pattern and quality of sleep was non-existent. What advise could you give me? He said email me my details and he would be in touch. Nick set me up an evening and bedtime routine. Advising me on a few do's and don'ts. In less than six weeks I am getting quality sleep. I have lived my life without an alarm clock and now I over sleep. Nick Thanks for putting quality back in my life.

**Paul Fleeton, Supervisor, Sykes Transport, Kalgoorlie**

Prior to finding Dr Nick I was averaging 3 hours sleep a night, constantly exhausted and cutting into my days with naps. 6 weeks later I'm sleeping never less than 6 hours a night and not napping. I feel like I have my youth back. No drugs and no hypnosis. Dr Nick has added years to my life.

**Clayton – sleep coaching client 2020**





# Foreword - Sleep Health Foundation Australia

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Sleep is an essential biological function. Although our understanding of the function of sleep is far from complete, the important role that sleep has in maintaining brain function, cognition and emotional wellbeing, is becoming increasingly clear. It is therefore unsurprising that so many downstream health effects can be attributed to disturbed or inadequate sleep. Impaired sleep is associated with a cardiovascular risk, metabolic disorders, cognitive decline later in life, mental health complaints and emotional resilience as well as a range of fatigue related consequences including reduced productivity and accidents. The pervasive nature of disturbed or inadequate sleep in our community is emerging as one of our important public health priorities.

In 2019 the Australian Federal Government commissioned *Bedtime Reading*: a world first parliamentary inquiry into the sleep health awareness of Australians. This report identified optimal sleep to be the third pillar of a healthy lifestyle alongside exercise and nutrition. This recognition, among others is contributing to

the realization of sleep health as an important healthcare issue among the community.

Access to accurate information about sleep health is a necessary part of the process in advancing awareness and behavior change. To that end, the Sleep Health foundation Welcomes *The Wonder of Sleep: Beyond Midnight*. This evidence based resource is written for anyone with an interest in improving their understanding of sleep health, from the physiology of sleep to a broad selection of highly prevalent medical sleep disorders. Scientific evidence is combined with stories and anecdotes that makes for a readable and entertaining journey. Furthermore, this is a useful resource for healthcare professionals who may wish to incorporate advice around healthy sleep into their clinical practice. From the Sleep Health foundation we hope that you enjoy *The Wonder of Sleep: Beyond Midnight*.

## **Associate Professor Darren Mansfield**

Deputy chair Sleep Health Foundation

Deputy Director Monash Lung and Sleep

Head Sleep Service Monash Health

Director Epworth Sleep Centre

School of Psychological Sciences Monash University



# Preface

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**H**ow on earth did I get here? Ever wondered why sometimes when you reach your destination in the car, you can't remember how you got there? Get annoyed by waking to check the clock when you're worried you might miss the alarm? Pay good money for a nice hotel room and sleep like rubbish? Finally, would you like more sleep than you currently get? If you answered yes to any of these questions, you're in for a treat.

In my younger years, I spent many nights either short of sleep, or not getting sleep appropriate to my specific needs. I have been lucky to get away with what I have, and perhaps parts of my life could have taken a better direction, dependent on my sleep. I left high school at the age of 14 to work and help my family of 13 brothers and sisters survive the costs of living. Mum had her work cut out at home and Dad worked every conceivable hour of shiftwork or overtime that the Prison Services could offer a senior officer. At that stage, seven of the youngest children lived with my parents in a very modest house. I shared a bedroom with three brothers so you can imagine, as teenagers sleep was not always the main objective. We had many interesting things to do at night, and sleep wasn't one of them.

I worked for 18 years in a timber mill, in every position starting with sorting and stacking sawn timbers, then moving into the



processing area of cutting timber and breaking down logs. We had to be very aware of where we placed our fingers and other parts of the body as, back in the '70s and '80s, machinery had very few guards, and we could literally walk into a saw and be cut down the middle. That said, fingers were at the highest risk, and had the most exposure. Working in such an environment is dangerous to the alert worker. Imagine being tired and keeping the productivity up, while keeping the fingers away from harm. Many of my colleagues lost fingers. Some have lost fingertips, and some have lost several whole fingers and the odd thumb.

Even though my colleagues and I were acutely aware of the hazards in the workplace, sleep was not a priority, as we never understood the connection. We may not have been partying every night, but we did socialize late into the night. It was as if we might miss out on something if we went to sleep (the fear of missing out [FOMO]). The following day it was hit and miss as to whether we were fit for work. I even remember times when one of my colleagues would go to the toilet and on the way he'd say: *"If I'm not back in five minutes, come wake me up."* Not the most pleasant of duties. Nonetheless, we looked out for each other where we could.

At a mature age (34), I undertook my Bachelor of Psychology Degree at Murdoch University Western Australia. This is where I first learnt the basics of sleep and fatigue management studying under Assoc. Prof. Hartley, who was known internationally for his work in fatigue research in transportation. However, even after learning about circadian rhythms and sleep disorders, I still didn't fully understand how to get to sleep quickly and for the right amount of time. Once graduated, I worked at a road transport research agency, focusing originally on road safety and

eventually, workplace fatigue management. I became the National Key Account Manager for Mineral Resources for the business and thoroughly enjoyed my work. However, there were many nights that I could not switch off and go to sleep, even knowing what I knew about sleep. I used relaxation techniques such as 'Progressive Muscle Relaxation' to eventually get to sleep.

Years go by and I now sleep beautifully on most nights, having planned the right time to get to bed, time to sleep and allowing for at least seven and a half hours of sleep on most nights before the alarm goes off. I sometimes go for nine hours as a top-up if I only managed to get six hours the night before. What I have found out is that with self-experimentation and discussions with thousands of people, there seems to be a 'right time to sleep' for every individual.

After 27 years of learning about sleep and fatigue management and delivering training at worksites to well over 30,000 employees, supervisors and managers, I have picked up one very common theme. No matter where I deliver the training, or who the group is, a show of hands often indicates at least 30-40% would like more sleep if they could get it. Experience has shown that these people are often able to get this extra sleep once I help them understand what sleep is and how to get it. This book is aimed at every individual who would like more sleep. It is also for those who currently get adequate sleep but would like to better understand why we sleep and what benefits we get from it. You have probably picked this book up for one of these reasons and I hope it helps.



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*Part One:*

# THE SCIENCE OF SLEEP





## *Chapter One*

# Understanding Sleep

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**W**e can be the best version of ourselves by getting good sleep, coupled with a good diet and exercise - the three pillars of health. When we get good sleep, it makes us feel alive and vibrant and allows us to be happier, healthier and safer. The question of why we need sleep could be asked alongside other questions. Why do we eat? Why do we drink?

Sleep, just like eating and drinking, is a homeostatic response. It's the body's way of regulating all aspects of body function to keep regular and stable when the outside world is constantly changing. Maintaining a homeostatic balance helps individuals to better manage their health and is often done without thought. Whenever you are awake, your body's homeostatic response will ensure that sleep follows. However, unlike most homeostatic reactions, people may ignore, or be unable to follow the body's request - and need - for sleep. But if we limit our sleep, we underperform at most of our activities, making us less efficient at everything we do.

There are many sources of information claiming that there's been a decline in the length of people's sleep for several decades. I wonder if perhaps we are just asking more questions about sleep recently? In 2013, a study by Youngstedt, *et al.*

analysed 168 studies of sleep duration and found no significant changes to normal healthy adult sleep length over the past 50 years. This challenges the idea that humans are sleeping less than they used to. Whenever I deliver a session of my training on sleep and fatigue management, a high proportion of each audience claim they don't get the sleep they need and that they would like to get more than they currently do.

It appears that at least two important factors are driving this. First, our 24-hour society - the modern trend of working around the clock, as well as the lure of late-night socialising, gaming, and social media, all add to reduced sleep opportunities. Many people are focussing on getting just five or six hours of sleep, as getting the recommended seven to nine hours gets in the way of their busy lives. Further, many employees are living a distance away from work which means that the opportunity for adequate sleep length can be impacted by travel time. Second, we sometimes forget just how rewarding a good night of sleep can be. Thus, sleep is put on the back burner and sometimes paid back, in part, later. I call this 'sleep nonchalance'.

How much sleep we need is the subject of much conjecture. What I find troubling is the catastrophising of sleep and its relationship to health, mortality and incidents. I recently heard at a conference, that fatigue was a causal factor in the Chernobyl disaster and the grounding of the Exxon Valdez (among other disasters). Not the first time I've heard this. While I believe that fatigue played a minor role in each of these disasters, it is often overstated and catastrophised, to get the audience 'tuned in' to what's coming up in the presentation.

In 1986, a team of scientists were commissioned to examine the role of sleep and timing of such disasters. What they believed

was that the timing of some of the disasters were aligned with the “*temporal pattern of brain processes associated with sleep*”. They concluded that although fatigue could not be stated as a causal factor, it was certainly implicated as one of the many contributing factors of the incidents. Many of these disasters occurred between midnight and 8:00 am. This is a low period in the human circadian cycle, where a normal human should naturally sleep, as will be explained later. However, when fatigue is constantly cited as a ‘causal factor’ in so many disasters or health issues, it tends to desensitise people to the whole issue of sleep and fatigue.

My experience with people who have come together to learn about sleep and avoiding fatigue is that people prefer to hear about what is relevant to them. It’s unlikely that people reading this book have been impacted by some of the world’s biggest disasters. What is relevant, are everyday incidents that occur at home, in the workplace, or on the road.

How much sleep do we need, then? This is not for me or anyone else to say, as the sleep you need is determined by your genetics, your age and your health. A person’s range of sleep could be anywhere between four hours and ten hours. To find out how much sleep you need, you could take a week or two, in a perfect sleep environment (comfortable, safe, temperature controlled, dark, etc) and record your sleep with an electronic device (we’ll discuss these devices later too). Sleep without an alarm each night and have absolutely no appointments or need to be up early or to go to bed late. Spend all that time in bed when you feel sleepy and get out of bed when you wake up. Don’t lay around in bed if you are not sleeping. If you average the recorded sleep time over this period, you may just have the answer to your question. I can say that the last time I recorded my sleep length,

7 hours and 28 minutes was the average over a 2-week period. I should mention that this was measured during working weeks, but it likely would not change if I was on holiday.

When I speak of genetics, don't be confused with what has been occurring in your family's past. Your genetic material is about your body's make-up and less about how you behave. We sometimes follow our parent's traits regarding sleep, and I have known many people who sleep short amounts of time simply because their parents did.

I have met three people in the past who naturally only slept for four to five hours per night. They were not obese, had no indication of type II diabetes, rarely had excessive daytime sleepiness and were mentally healthy. For some reason, they didn't seem to need any more than what they were getting. One of these people contacted me several years later and suggested that his four hours was no longer adequate to get him through the day successfully. He reached out to me to help him learn to get longer sleep periods. This suggests that we may need different amounts of sleep through our adult lives.

Other people have averaged around four or five hours of sleep believing that this was adequate, when it clearly wasn't. They were of poor health, and sitting in a training room couldn't focus for long before they fell asleep several times through sessions. They looked extremely tired, with dark, sunken rings under their eyes. My observations over the years indicates that this look was associated with long periods of inadequate sleep.

I have had the supervisors of such people apologising for their behaviour in the training room, with statements such as "He's always tired", "He can't sit still without falling asleep", or "She fell asleep driving a haul truck recently". I have seen footage of truck

drivers being woken by driver monitoring systems after falling asleep (in some case, possibly life-saving interventions). Some of these tired drivers become extremely agitated at the system as it has woken them. They were surprised when they saw the footage of the sleep episode.

I have also met a few people who sleep nine or ten hours a night and were as equally healthy as the successful four-hour sleepers previously mentioned. Asked about their sleep they would mention that if they got less than nine hours of sleep, the next day they would feel shattered. There is a popular belief that the average sleep for a normal healthy adult is between seven and nine hours and I encourage this idea as a general rule. However, I believe that sleep is not a 'one size fits all' phenomenon. But if you don't get the sleep you need, things can go wrong. It's best to understand why we sleep in the first place, what benefits you can get from it, and how to make the best of your sleep opportunities.

### ***Sleep homeostasis***

The human homeostatic response is the body's way of regulating all aspects of body function to keep regular and stable when the outside world is constantly changing. For example, when out in the hot sun, skin receptors will feed information back to the brain in the form of a stinging sensation. Skin is burning! The person may also become thirsty. If the person heeds the warnings, they'll cover up exposed skin (or seek shelter from the sun) and will drink water. Failing to react to the warnings may result in extreme sunburn and dehydration. Dehydration, leading to heat stress can be fatal, while skin damage may lead ultimately to skin cancer.

There are many other forms of homeostatic responses well known to people. The 'fight, flight or freeze' response of the

autonomic nervous system prepares people to run, fight or freeze in times of extreme emergency. During an emergency, sensory information to the brain warns of danger. The 'sympathetic' nervous response enables blood flow to the large muscles (to assist with running or fighting) while restricting activity of the gut and other organs less required during the process. The hormone adrenaline assists the brain to think quickly and clearly. Feedback to the brain that the emergency is over allows the 'parasympathetic' nervous response to return the body functions to their original state (with the exception that hyper-vigilance within the brain may endure for a prolonged period).

If we view sleep as a homeostatic response, we are better able to appreciate the requirement for lengthy and complete sleep, and to understand how either poor quality or quantity of sleep can affect many aspects of our lives. It is hoped that the contents of this book will help the reader to fully grasp how sleep is as important for homeostatic balance as food and water is.

To grasp the concept of sleep as a homeostatic regulator, think of this. Using a banking analogy, if you withdraw money from a bank, there is an expectation you will pay this back. This is referred to as a 'debt'. When you wake each morning, you start the withdrawal process from the 'sleep bank' and continue withdrawals to get through the day. Sleeping then generally pays back this debt and keeps the homeostatic (sleep bank) balance in check.

Obviously, if you don't pay the 'sleep debt' back in full, you carry some of it over to the next day. In the banking scenario, the bank may seek the help of a collection agency to hound you about repayments. The equivalent for sleep debt would be a prolonged, nagging feeling of lethargy and trouble keeping awake



through the working day. This includes when you are driving. The brain is asking for you to pay back the debt.

It's unlikely you will pay back the previous night of debt, plus the normal sleep required for today, in the one night. Therefore, some people look forward to weekends, when they sleep-in and catch up with whatever sleep they can. I personally have a problem with this. I feel the weekend should be for fun, socialising, getting chores done around the house and fun activities. It's a shame to waste these opportunities to catch up on sleep when you could have slept well all week and had heaps of energy for a great weekend. Like money, keep your repayments to a more manageable level, and keep yourself debt-free where you can.

So, what is sleep? There are many definitions – a few are included here to illustrate different views:

*“A natural periodic state of rest for the mind and body, in which the eyes usually close and consciousness is completely or partially lost, so that there is a decrease in bodily movement and responsiveness to external stimuli. During sleep the brain in humans and other mammals undergoes a characteristic cycle of brain-wave activity that includes intervals of dreaming”*

– **<http://www.thefreedictionary.com/sleep>**

*“A condition of body and mind which typically recurs for several hours every night, in which the nervous system is inactive, the eyes closed, the postural muscles relaxed, and consciousness practically suspended”*

– **<http://oxforddictionaries.com/definition/english/sleep>**

A more complex academic view would be<sup>3</sup>:

*“...a reversible behavioural state of perceptual disengagement from and unresponsiveness to the environment. It is also true that sleep is a complex amalgam of physiologic and behavioural processes. Sleep is typically (but not necessarily) accompanied by postural recumbence, behavioural quiescence, closed eyes, and all the other indicators one commonly associates with sleeping”.*

Sleep has already been well defined, so this book instead aims to investigate how we individuals may perceive sleep differently. As mammals, we all need sleep. The amount needed can depend on several factors, including age, body size, diet, physical health, mental health, sleep priorities, perceived levels of safety and whether the mammal is aquatic or terrestrial<sup>4</sup>. Normal, healthy adults tend to be active for approximately 15–17 hours during the day and should therefore sleep between seven and nine hours per night. However, there are many varied reasons for humans not to sleep well, as you will see. For example, we understand that someone who is starving is likely to easily remain awake to forage for food, and that someone who is at risk of physical harm will sleep on edge. Socially, we find hundreds of reasons not to sleep when we should, due to the fear of missing out (FOMO).

Parents nursing a newborn infant will not fully ‘switch off’ when sleeping, due to the new responsibilities and the perceived risk of not waking up if the infant cries for food or other comforts during the night. This is due to the brain not being able to fully get into deep sleep stages as it is aware of the anxiety regarding

baby's needs. This lack of quality deep sleep, can often leave us with feelings of tiredness, of always trying to catch up on sleep. The downside is that if you don't allow yourself sleep rebound opportunities, you are likely to catch up on sleep at inopportune times, such as when working or driving. Clearly safer to do this in bed!

### The drivers of sleep

Understanding what drives sleep in humans is important – sleep should not just be something we do when we are tired or when there's nothing left to do at night. There are two major drivers of sleep – circadian rhythms (based on daily rhythms) which manipulate the timing of our sleep, and a build-up of a product of energy metabolism, known as adenosine in the brain which triggers our homeostatic drive for sleep.

### Circadian rhythms

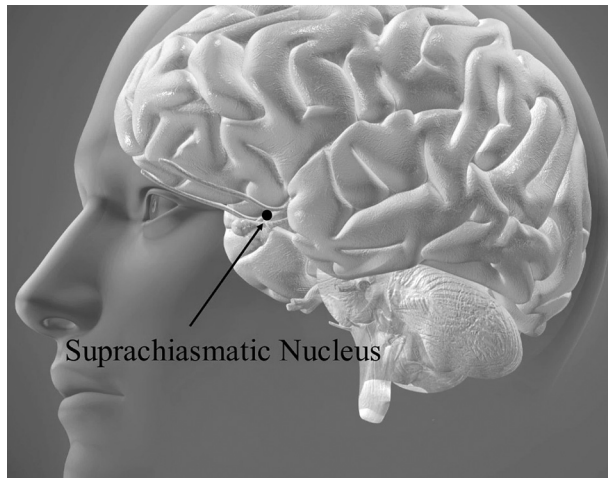
Humans have rhythms known as 'circadian rhythms' ('circa' and 'diem' – 'around' and 'a day'). We are either asleep or awake, or at times seemingly somewhere in between the two states. We are diurnal (e.g., creatures of the day); we sleep in darkness and are awake during the light of day. The opposite of this is nocturnal; whereby nocturnal creatures become active at night and generally sleep during the light of day. Considerable research has been directed in the past to the rhythms of humans and how we function on day and night cycles.

The rhythm allows humans to be active for approximately 15 to 17 hours during the day. They then sleep between 7 and 9 hours per night, though this is highly variable as previously mentioned. The rhythm is based on an endogenous entrainment oscillation

of around 24 hours ('endogenous' - proceeding from within, 'entrainment' - adjusting to the environment, showing plasticity to adjust for time changes such as when travelling, and 'oscillator' - a clock that keeps time). Research indicates humans cannot adapt to being fully nocturnal. Although some nightshift workers claim to manage well, most of us are clearly not well equipped to sleep during the day and work at night. I have met many people who say they sleep better during the day than they do at night. I playfully refer to them in class as 'unicorns'.

The circadian rhythms of a human encompass a whole range of changes within the body, including core body temperature, blood pressure, eating, urination, defecation, regulation of glucose and reaction time. The rhythmic timing within a human is kept constantly in tune by external stimuli which sets the internal clock. These external stimuli are known as timekeepers, and can include sunlight, darkness, the timing of meals, temperature changes and other time-based indicators. The internal clock is called the suprachiasmatic nucleus (SCN), or 'body clock' and is a cluster of approximately 80,000 nerve cells that are located behind the eyes next to the optic nerve in the brain (Figure 1). The SCN detects light travelling along the optic nerve and uses the light to calibrate the body clock towards the day and night cycle of that location.

If you have ever been camping, you may recall how good you felt after a few days of fun and good sleep - here we speak of the alcohol-free camping trips! On these trips, your circadian rhythms come into force, utilising daylight and the dark of night to control your sleep and wake cycles, making you feel more rested, as well as in tune with nature. In addition, our natural hormones as well as core body temperature changes work alongside our circadian



**Figure 1:** *The location of the SCN.*

rhythms to affect our desire to wake or continue sleeping. The two basic hormones in play are melatonin and cortisol. Working in opposition, melatonin assists with sleep onset, and cortisol assists with waking the body and enabling the body to get mentally and physically prepared for the day.

These variations are an equally important, and often overlooked trigger for effective sleep. For example, when we have a reduction in core body temperature, we tend to get sleepy. The drop in core body temperature between midday and 4 pm is often referred to as the post-lunch dip; it's when we feel sleepy, especially if we are not doing much physically or if we have not had enough sleep through the nights leading to this point. Many people blame their lunch for the sleepy feeling, when it is usually more to do with the 'dip' in core body temperature.

Another drop in core body temperature - referred to as the 'dead hour' by nightshift workers - usually occurs around 4 am,

at the point of lowest core body temperature, often as low as 36.0 Celsius. Nightshift workers tend to get very sleepy at this point, so well-designed shifts will have a break from work inserted around this time to recover from this low point in arousal, and to protect employees from having incidents.

There is also a drop in core body temperature each night which can indicate the correct time to be in bed ready for sleep. If you can identify this time correctly, you can be asleep in minutes; however, used incorrectly, you might find yourself waking up on the lounge after falling asleep watching television. If you then get up and go to bed, you often find that opportunity gone, and you'll have difficulty falling asleep for an hour or so. This is commonly referred to as a 'second wind'. Later, I'll discuss a theory on sleep timing that I refer to as the 'Mabbott method' of falling asleep at a specified time each night, which uses the combination of sleep debt, a release of melatonin, and the drop in core body temperature.

Figure 2 shows a circadian rhythm for a person who would go to bed at 10 pm for a 6 am wake time (based on an eight-hour sleep period).

Figure 3 illustrates how this changes for a person who goes to sleep at 8 pm for a wake time of 4 am (early starts are common in many resource industries).

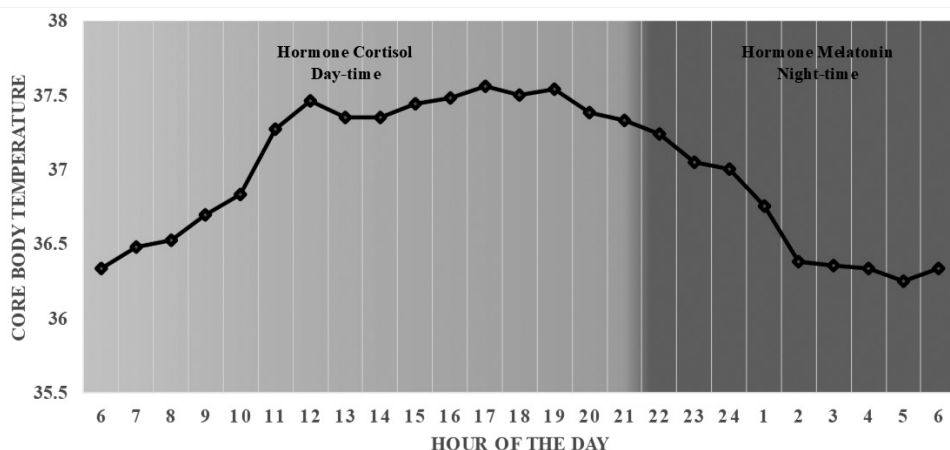
### ***Adenosine and the 'Glymphatic System'***

There are many types of cells in the brain, and we discuss two types in relation to sleep - neurons and glial cells. Neurons are the cells that connect throughout the brain and communicate everything the brain is capable of. Everything we think, feel and

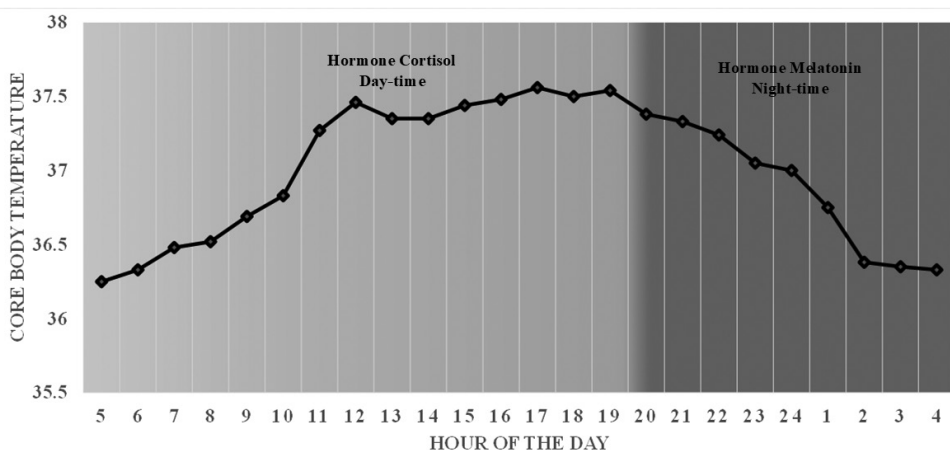


## The Wonder of Sleep: Beyond Midnight

imagine is a series of communications between neurons that are networked all over the brain and can serve different functions. Neurons do not physically touch each other to communicate messages. There is a small space between one neuron and the



**Figure 2:** Circadian rhythm for a person with a 6 am wake time.



**Figure 3:** Circadian rhythm for a person with a 4 am wake time.

next, known as a synapse. This space, or synaptic cleft as it is often referred to, allows a transmission of chemicals from one neuron to another. Chemical neurotransmitters are released from one neuron to the next, build up in the synaptic cleft, and are received by receptors on the next neuron. Once there is enough build-up of the neurotransmitter, the receiving neuron will fire off the message to the next receiving neuron/s. There are approximately 100 billion neurons in the normal, healthy adult brain.

## **Cleaning the brain when we sleep.**

Glial cells provide both metabolic support for neurons and assist with regulation of neural activity<sup>5</sup> within the central nervous system. It has recently been found<sup>6</sup> that during sleep, there is a process whereby the Glial cells of the brain have a channel that opens and removes toxins and other waste products. By pumping cerebrospinal fluid through your brain's tissues, the 'glymphatic' system flushes waste from your brain, back into your body's circulatory system. From there, the waste eventually reaches your liver, where its ultimately eliminated.

During sleep, the 'glymphatic' system becomes 10 times more active than during wakefulness. Here, the function of the previously mentioned glial cells is to remove brain toxins and deposit them in the lymphatic system for elimination from the body<sup>7</sup>. The brain cells also shrink in size and there are flushes of cerebrospinal fluid to assist in the removal of toxins.

It is important to understand that some of the toxins that are removed from the brain during sleep, such as beta-amyloid protein ( $\beta$ -amyloid (A $\beta$ )) and Tau protein, can build up in the brain from restricted sleep. Beta-amyloid is a sticky substance that creates

plaques between neurons and can restrict the communications between those neurons. Tau protein causes tangles within the fibres of neurons, sometimes rendering them damaged and useless. Studies have shown that long-term sleep restriction may possibly lead to forms of dementia such as Alzheimer's disease<sup>8</sup>. This suggests that therapies aimed at increasing sleep may serve to reduce risk of the disease<sup>9</sup>.

### **The brain's fuel recycling system.**

When we sleep, we refuel the brain! The two following studies indicates the dose-response of sleep in a homeostatic way. In a 2003 study of chronic versus total sleep deprivation<sup>10</sup>, 48 human participants were subject to 8-hour, 6-hour, or 4-hour sleep restriction for 14 days, or a 3-day total sleep restriction. The 4 and 6-hour restrictions resulted in cumulative, dose-dependent deficits in cognitive tasks, as did the total sleep restriction. Subjective sleepiness ratings suggested that subjects were unaware of the increasing cognitive defects, although they felt sleepy.

A similar study by Bonnet in 1991<sup>11</sup> investigated the effect that different lengths of naps/sleeps would have on two consecutive nights of sleep deprivation. Subjects were 104 young adult males, assigned to 0-hour, 2-hour, 4-hour, or 8-hour sleep conditions. All subjects slept a normal baseline sleep, followed by going to bed the next day at 12:00 (8-hours of sleep), 16:00 (4-hours of sleep), 18:00 (2-hours of sleep), or not at all. Except for those who did not sleep, all subjects were awoken at 20:00. All subjects then remained awake through the following two nights and went to bed at their normal times on the third night. Subjects underwent a schedule of computer-administered

performance tests prior to the naps/sleeps and during the sleep restricted period. Compared to those who did not sleep at all, subjects' performances rose in a dose-response fashion, indicating that each hour of sleep bought two hours of reasonable performance.

Perhaps the easiest way of thinking of the need for sleep, would be to liken it to fuelling your personal vehicle. Most drivers who can afford to, will keep a reasonable level of fuel in their vehicle's tank. This allows them the luxury of simply getting in the car and driving without having to worry about running out of fuel. Running out of fuel in a vehicle is very problematic, just like feeling sleepy in the afternoon when you are trying to get things done. When we pull into the service station for fuel, we fill up to last a while. When we sleep, we should do the same. Unless you have very little money, most people will not just put in \$40 or \$50 worth of fuel. You will fill it up. Similarly, if you only get 4-hours of sleep, you only have half a tank of brain fuel. You just won't last the day without losing performance. Here is the scientific reasoning for all this.

Adenosine Triphosphate (ATP) is an energy source at a molecular level which provides the energy for each neuron to function. As the name suggests, ATP is one molecule of adenosine, bonded with three molecules of phosphate. Humans use ATP in large amounts each day. During the process of supplying this energy to neurons, ATP is reduced to adenosine diphosphate (Ad) by supplying a phosphate molecule which releases energy when the phosphate bond is broken.

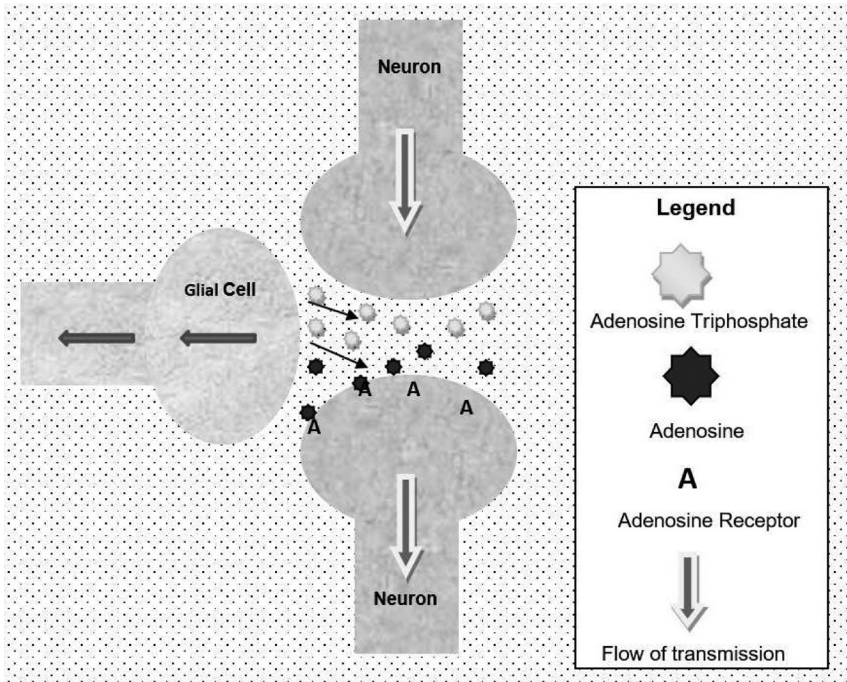
There are Ad receptors in each neuron, similar to those that receive neurotransmitters. However, in opposition to firing off, the build-up of Ad in the synaptic cleft acts to inhibit the firing of the

receiving neurons. In this case, the transmission of communication from one neuron to the next is lost. As this occurs over millions of connections, 'the longer you are awake, the 'dumber you get'. For example, at the end of a 16-hour day all most people are capable of is watching the television or interacting on social media; and we sometimes fall asleep doing this.

A large amount of the Ad builds in a location of the brain which normally produces wakefulness through the release of chemicals such as acetylcholine. This part of the brain is called the basal forebrain and is in front of the brain stem. This inhibition of the basal forebrain due to the slow build-up of Ad throughout the day reduces acetylcholine output and will produce a sleep drive<sup>12 13</sup>. As long as a person is awake, they are slowly building a drive to sleep, through the build-up of Ad<sup>14</sup>. Because you are using the phosphate molecules, you are running out of fuel!

During sleep, Ad is metabolized by adenosine deaminase to reduce the amount in the brain. In 2000, Mackie *et al.* suggested that *"Adenosine deaminase plays an important role in the mechanism that controls regional concentration of Ad in the brain and thus, it is a part of the sleep-wake regulatory mechanism"*<sup>15</sup>.

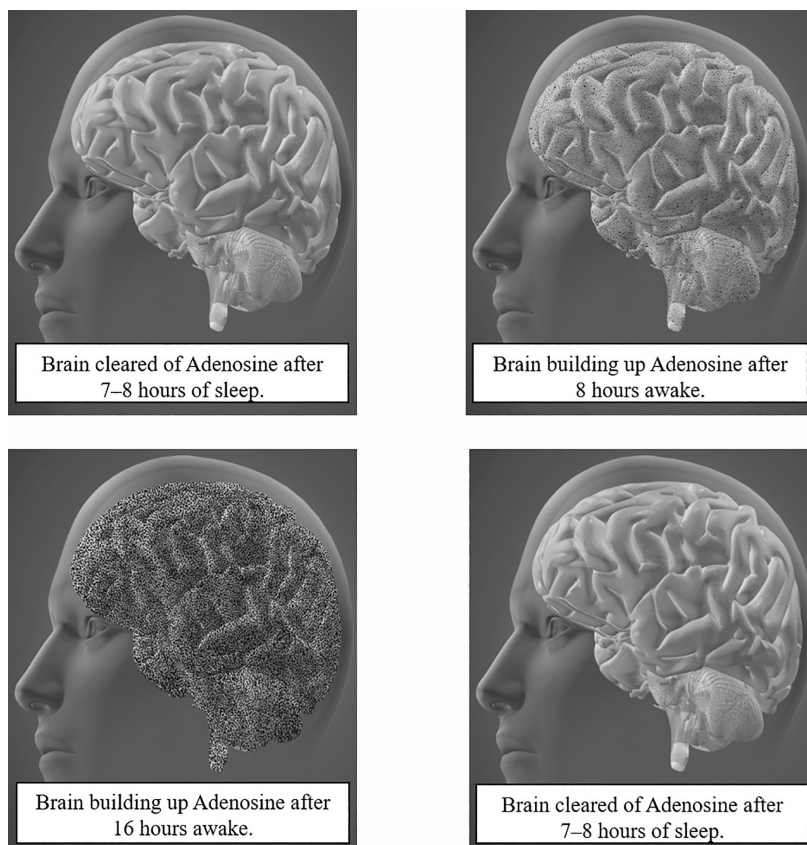
Figure 4 illustrates that the ATP (shown as light shaded dots) is transformed to become Ad (shown as dark shaded dots), which builds up in the space between neurons. Ad attaches to Ad receptors on the receiving neurons. When we sleep, we produce less Ad, and it is removed from the synapses, metabolised and recycled back to ATP for use as fuel for the neurons the next day. Remember, sleep is like filling up your gas tank for tomorrow.



**Figure 4:** Adenosine homeostasis.

The theory is that we start each day with a lot of ATP and very little Ad. Through the day we use the ATP as fuel and build up Ad. The result, after approximately 16 hours awake, is a feeling of tiredness and a drive for sleep. Figure 5 illustrates how this works, showing the transformation from starting the day with little Ad, to the beginning of Ad build-up (which will not yet be at a level to affect brain performance) after approximately eight hours. After 16 hours, Ad build-up becoming more widespread, thus triggering a sleep drive. This can be recycled with the right amount of sleep, which is approximately one hour of sleep for every two hours awake, although this is somewhat variable.





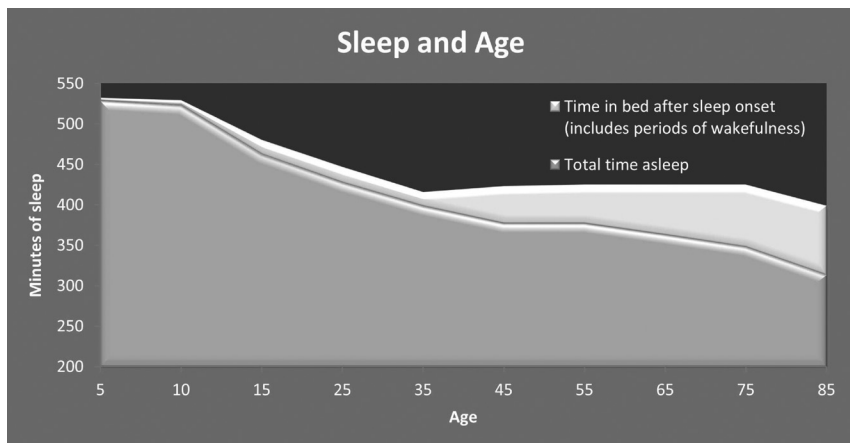
**Figure 5:** *Normal build up and removal of adenosine in the brain over the 16-hour day.*

### Age and sleep of healthy people

There are different sleep requirements for different ages of humans. Table 1 and Figure 6 are derived from an analysis of 65 studies representing over 3,500 people between five and 102 years old<sup>16</sup>, and illustrates changing sleep patterns over the lifespan. There are a few people who, interestingly, can survive well on much less sleep but it is very rare.

**Table 1:** *Sleep over the human lifespan.*

Age range	Hours of sleep	Interesting points
5-10 years	9 hours	Largest obtainers of deep sleep
Teenagers	8.5 hours	Often go to bed later, large reduction in deep sleep
20-25 young adult	8 hours	Deep sleep reduces and remains stable till around 60
25-75	7-7.5 hours	More awakenings after being asleep, less deep sleep after 60.
85+	7 hours	More awakenings after being asleep, very little deep sleep



**Figure 6:** *Sleep over the human lifespan.*

Don't be fooled into thinking that just because older people get less sleep, that this is what they should target. Research discussed later in this book will highlight the importance of getting up to 7.5 hours of sleep as you transgress past 65 years old.

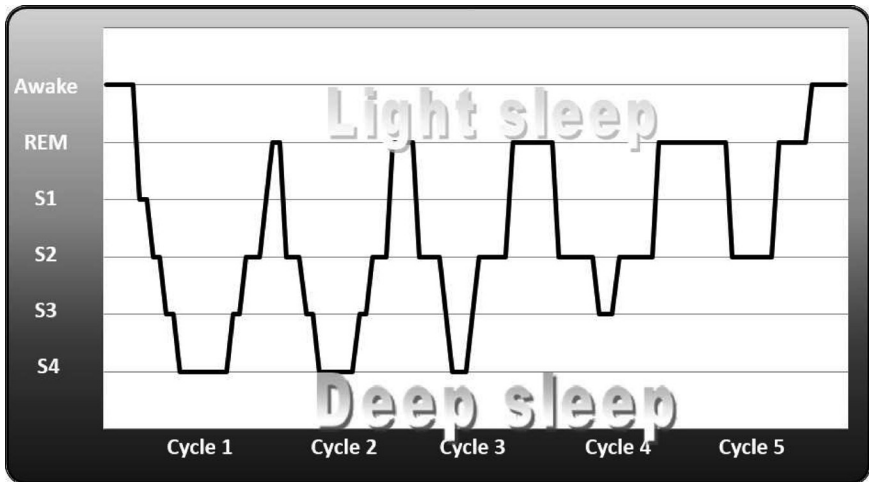
### ***Sleep architecture, or the stages and cycles of sleep.***

If you ask a layperson why we sleep, the most common response will be to rejuvenate or recharge the body. It's like the only reason we sleep is to have energy the following day! People are often stretched to come up with any other reason for sleeping apart from to take a break or recover from illness or injury. While both responses are true, this is a very small component of what occurs when we sleep. And, let's face it, people need more reasons to sleep if they're going to try to get more. What I have noticed over the past 27 years is that I have become a 'sleep salesman' in this regard. And it works!

Most people generally think of sleep as deep sleep or light sleep. While this is close to accurate, sleep occurs in stages and cycles. There are many changes that occur in the brain through the different stages of sleep, so it is useful to understand what is occurring in these different stages.

There are five stages of sleep that we all go through once we sleep – Stages one to four (also known as non-REM sleep) and the rapid eye movement (REM) stage. These are discussed in detail below. These stages then combine to make up sleep cycles which typically last about 90 minutes, give or take a few minutes. Figure 7 below shows the cycles of sleep as they proceed through the night for a normal healthy person. On the left of the diagram are the words/letters representing the different sleep stages, and the bottom axis shows the cycles through the night based on an average 7.5 hours of sleep. Note that most deep sleep (stages three and four) is obtained in the first half of the night, while most of the REM sleep occurs in the last half.

The large amount of deep sleep in the first half of the night means it is unusual to wake up during this period. The brain is



**Figure 7:** Five sleep cycles across the night of sleep.

undergoing the maintenance cycles and the sensory areas of the brain are relatively inactive, allowing many people to sleep through noises such as a television or a partner snoring. The heaviest snoring generally occurs during deep sleep, due to a relaxation of the muscles within the throat and tongue. Most parasomnias – such as sleepwalking and sleep talking – also occur through deep sleep.

The third cycle of sleep typically concludes with a longer portion of REM sleep and an associated increase in sensory awareness. This is often when a person notices they have a full bladder and must go to the toilet. If a person has consumed a fair amount of alcohol, they'll have the same issue but at the end of cycle two, where they have only been asleep for three hours – alcohol increases urination!

As we progress through each sleep cycle, the human brain becomes more active through increased REM sleep and is alert to noises, changes of temperature and light intensity. People

will often awaken during the third and fourth sessions of REM sleep due to the brain being almost as active as when awake. The chances of waking at these points will depend on factors such as light, noise, temperature, movement, stress, or having slept long enough to have cleared most of the Ad.

There are many occasions where normal healthy sleep becomes abnormal or reduced in quality and quantity. This often changes how the sleep stages are organised and play out through sleep periods. This will be shown in the next chapter. Meanwhile, let's see what happens in each of the stages of sleep.

### **Stage one sleep**

You've just spent the last 30 minutes relaxing and are now getting sleepy. Your drowsy eyes indicate it's time to put down that interesting novel as it's getting harder to read. The book goes down, lights go off, you fluff the pillow and rest your weary eyes. Life feels good. It's now time to let nature take its course and allow you the sleep you need in your safe haven - your bed.

Stage one sleep runs from 5 to 10 minutes and takes the individual from wakefulness to sleep. It generally occupies between two percent and five percent of our total daily sleep. It's understood that a person's eyes can still be open during this transition phase, an issue we will investigate later. This stage of drowsiness is often preceded by the rolling of eyes and a reduction of performance in both the occipital lobe at the back of the brain (responsible for vision) and the frontal lobe (responsible, among other things, for executive functioning, decision-making, judgement and several aspects of safety). At this point, a person will be increasing their risk of an accident if still working or operating a vehicle.

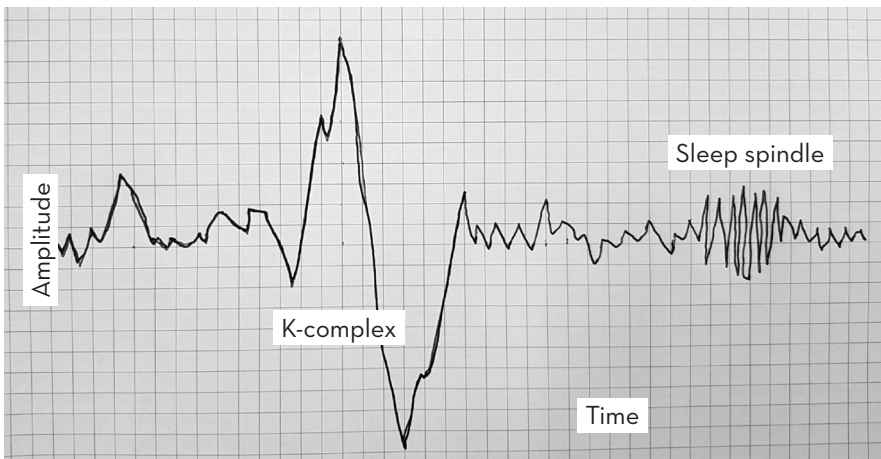
During stage one sleep, a person will not lay down short-term memory due to reduced function in the hippocampus (where short-term memories are formed); moments that have just occurred may be totally unrecallable. You might recall occasions while driving where you get to a certain point and stop to think – how did I get here? You would have managed somehow to follow the contours of the road, but you would have had a longer reaction time if anything had moved onto the road in front of you. A normal reaction time while driving is between one and two seconds. You could expect more like four or five seconds in stage one sleep. That is if you react at all! When I deliver training on fatigue management, I refer to this stage of sleep as ‘the lights are on, but no one’s home’. This is one of my common ‘Dr Nick terms’ used in training rooms to illustrate the disconnect noticed at this point of sleep onset.

Stage one sleep tends to be the ‘soft’ entry into stage two sleep, whereby one slowly withdraws from their immediate environment and drifts into a peaceful slumber. If a person went immediately into stage two sleep, you would expect to fall rapidly from wherever you are standing or sitting, such as a person who suffers from narcolepsy. At this point your muscles relax and you would simply flop and disconnect from the world unless your fall wakes you. There are occasions where your neck muscles will relax and your head may feel like it is falling, causing a jerk-response known as a hypnagogic jerk (*hypno* – hypnotised and *gogic* – going to sleep). These jerks are often noticeable on plane travel, in meetings, or on the lounge when you have disconnected from the family while watching television. Stage one sleep will be re-addressed later, when we discuss road safety and microsleeps.

## Stage two sleep

Stage two sleep runs for approximately 10 -15 minutes when first going to sleep and repeats several times throughout the night. In total, it occupies around half of the total sleep time. It is the point where humans clearly stop interacting with the environment. There is reduced function of several brain lobes, including the frontal lobe (higher order thinking), occipital lobe (eyes) and cerebellum (muscle-tone & coordination).

Stage two sleep has unusual brain wave patterns know as sleep spindles and K-complexes, and it is these brain waves that are easily recognised in the sleep laboratory as stage two sleep. A sleep spindle is a rapid rush of brain activity in a short space of time. This bunch of quick activity may cause the sleeping person to twitch and possibly even jerk a little. The K-complex is a sort of 'kick' in the sleep wave data. It is known to be a brain activity in reaction to an external stimulus, such as a noise or a bump by someone sharing the bed. Figure 8 is a hand-drawn illustration



**Figure 8:** *Sleep spindles and K-complexes.*

of the activity of stage two sleep, where K-complexes and sleep spindles are present.

Stage two sleep is where short-term memories are taken from a part of the brain known as the hippocampus and stored in long-term storage around the neocortex of the brain. The hippocampus is a small seahorse-shaped part of the brain, which is located approximately in line with, but above the ears. There is one on each side of the brain. The hippocampus houses structures that allow the formation and short-term storage of new memories. Acting something like a dash cam, the hippocampus needs to empty out the short-term memories overnight or they tend to be 'overwritten' the following day and are lost forever. The short-term memories move to the neocortex when we sleep. The neocortex is the uppermost region of the brain which stores long-term memory and provides humans with most of the clever things we are capable of.

This converting of short-term to long-term memories, and the storing of such, is known as learning, and sleep is an often-overlooked component of the learning process. It is well known that the best way to learn anything is to sleep well the night before, undertake learning the information, then sleep well again. If you can recall a time in your life where you pulled an all-nighter to study for an exam, you may remember that you got through the exam but committed hardly anything to long-term memory. The exam responses will have come from a mix of long-term memory from the neocortex, and short-term memory stored in the hippocampus that has not yet been committed to long-term. Later that day, it's likely that the short-term memories from the last night are overwritten with new memories. Basically, by not sleeping, you failed to hit the 'save' button.



## Stage three and stage four – deep sleep

Stages three and four sleep are very similar in what they do; some organisations simply combine them and refer to them together as stage three sleep. Also referred to as deep sleep or slow wave sleep (due to the slow brain wave activity), these stages are characterised by a large reduction in the sensory functions of the brain such as hearing and smell. The eyes are closed at this point and the sensing of touch and external temperature are also reduced. At this point of sleep, one is hard to awaken and, as we are quite deaf and lose our sense of smell in deep sleep, it takes a very loud alarm to wake us. This is one of the reasons we should all ensure we have functioning smoke alarms. Deep sleep accounts for approximately 15–20% of our total sleep and it occurs mainly during the first half of normal, healthy sleep.

Important hormones such as human growth hormone (HGH) are released during deep sleep. HGH helps to stimulate growth and raise the concentration of glucose for energy through the waking period. HGH is released from the pituitary gland in the brain into the bloodstream where it stimulates the liver to produce insulin-like growth factor, or IGF-1. IGF-1 stimulates growth, repair and recovery of almost every cell within the body, preparing the cell for the next day's hard work.

It also prepares the cells to receive glucose through tiny perforations in the cell walls, aiding in energy production. If HGH is not released, this can lead to lethargy the following day. Studies have shown that just three nights without deep sleep – and its corresponding HGH release – can lead to serious metabolic changes. These studies will be discussed more thoroughly in the chapter on how sleep restriction affects physical health.

The hormone serotonin is also released during deep sleep, providing the brain with a flood of the most pleasant supplement naturally available. One of the easiest traits to recognise in a good sleeper might be happiness and an ability to be resilient to everyday challenges. Serotonin is a fundamental building block to having 'mental fitness'. Another way of putting this is to have a resilience to being upset when things go wrong. Rather than get angry at things such as a driver changing lanes in front of you then slowing down, you just work around it and don't let it upset your day. I wish more drivers on the road had more serotonin!

Have you ever been asked, why are you always so happy? If you have, it is likely that the release of serotonin – alongside an associated consistent deep sleep – are responsible. Of course, other factors play into happiness; however, given life's complexities and opportunities for grief, loss and sadness, serotonin is the best elixir for bouncing back and keeping happy. Many mental health practitioners understand that sleep and serotonin are therefore fundamental building blocks for building mental fitness and resilience.

Over the years I have trained well over 30,000 people face-to-face. The discussions in the training rooms have provided me with a multitude of awesome memories that have assisted with learning outcomes (for them and me), some laughs and some great memories. I'll call them 'Tales from the training room'.

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***Tales from the training room – Sleep to become a mental fitness junkie!***

During a fatigue management training session, a miner who was highly engaged and enlightened by the discussion of the hormone serotonin, asked me if he could get a

supplement for it. The reply, *“Not really, but you could try this - it’s known as a selective serotonin re-uptake inhibitor (SSRI). You will need a prescription but if you fulfil the criteria it shouldn’t be hard to get”*. Once it was mentioned that many anti-depressant medications are SSRIs, he was less keen on the supplement. Such is the ongoing issue with the stigma of anti-depressants. Perhaps we should change the label to ‘supplement’. The supplement for mental fitness junkies.

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Overall, deep sleep is highly beneficial to the body’s cell and organ maintenance, the regulation and balance of glucose and other hormones, the maintenance of a strong immune system, and of several other highly important systems such as mental fitness and resilience. The amount of deep sleep obtained in a sleep period can be dependent upon the pattern of sleep, and the length of sleep periods over previous nights.

### **Rapid eye movement sleep**

As seen in Figure 7 earlier, REM sleep generally concludes a 90-minute sleep cycle. It occupies around 20-25% of our total sleep. The first couple of REM stages run for a few minutes only; however, these increase in length the longer the sleep extends. Most of the REM sleep occurs towards the last half to one-third of the night, and usually when the core body temperature is at its lowest.

The brain becomes highly active during REM sleep, leading to the term paradoxical sleep because it is similar in activity to being awake. This is due to a part of the brain which sits around the top of the brainstem known as the pons. The pons sends

neuronal signals from near the centre of the brain through to the neocortex. It is widely thought that this process assists in the organising of newly formed, long-term memories which have been laid down in the earlier stages of sleep.

Imagine how many particles (or bits) of long-term memories you may have collected over the years. Everything from your first memories as a child, to primary and upper schooling, and through any further education and training you may have had over your life so far. Add to this everything you know about the world, all your social interactions, special moments and not so good moments. There are likely billions of pieces of information currently stored in your neocortex.

Now imagine how all of this has been sorted over the years. Obviously, there is a complex effort made to organise all this storage into something so amazing and relatively easy to recall. If not for the structure, placement and linking of these memories, it would be absolute chaos. I liken it to a task like bringing in the weekly groceries and sorting them out. If you put the frozen beans in the cupboard and the bananas in the freezer, it would be a waste of food. Organisation is key!

In REM sleep, information we need for the following day is organised to be easily found when we need it. Take, for example, a few questions that relate to information that we have logged in our long-term memory that can be either hard or easy to recall. The question “Who was your best friend at high school?” might be easily recalled due to the recency of retaining the friendship or keeping in touch with that person. The friend is kept there due to recency of thinking of them. On the other hand, it might be hard if you haven’t seen, heard or thought about that person in many years.

The ability to have the information at our ‘cognitive fingertips’ (another Dr Nick term, cognitive – conscious activity, fingertips – within reach when needed) will depend on how often the data has been recalled and re-used. It will also depend on how well REM sleep has been able to order and re-order complex information so that you have access to the data you need and when you need it.

Perhaps your old best friend is sitting on a dusty shelf somewhere in an otherwise highly active brain. Don't worry though, now that the idea has been put in your head, there is a chance that you might process this tonight and wake up with good thoughts of a dear friend – at 3 am! Such is what REM sleep can do for you. Indeed, REM sleep is important for rehearsal of working memory and for problem solving. Many people have gone to bed with a problem, only to find out they have the answer in the morning or part way through the night – during their REM sleep.

REM sleep is also vital for our safety. Almost everything we do that requires us to be safe involves careful thought, planning and execution in a set of well-defined, or well-ordered sequential tasks. These sequenced tasks, often referred to in the workplace as safe work instructions (SWIs), are usually developed over a long period of time and are created from the experience of what keeps workers safe and of what can lead to incidents and injury. SWIs are designed to be followed to the letter and are often reinforced with training and reminders on an ongoing basis to keep workers safe.

When we learn tasks, from simple things like riding a bike, through to operating complex machinery, REM sleep helps to keep the vital information ordered, sequenced and available to us when we need it. Consider how many SWIs you have collected in your storage brain over your lifetime. Like it or not, you have

an SWI for things such as crossing the road (doing it unsafely can result in your death), riding a motorbike or driving a vehicle, getting up a ladder to fix a gutter or retrieve a ball from the roof. You need a lot more SWIs when you enter the workplace.

No matter where you work, there will be a multitude of SWIs that need to be followed in your workplace. Further, if you work in a high-risk occupation, such as flying aircraft, surgery, construction, or electricity, for example, your list of SWIs will rise exponentially. Such is the reason we spend so much time in universities and the trades learning these skills to ensure they are embedded and always available.

If you give thought to how many SWIs you have collected over your life span, it could run into literally millions. Now, which ones do you need to have access to today? You probably won't need most of them, but you will still require many. And they need to be there, ready, available and at your cognitive fingertips before and during task operation. Cue REM sleep!

When you wake, you often swing your feet onto the floor and stand up. You go to the toilet and start a number of tasks like making coffee. Think about it – you didn't fall over when you got out of bed, you didn't pee all over the toilet seat (well, some of you may have) and you didn't get burnt or electrocuted making a coffee. Your SWIs have been working for you to keep you safe. Think of how many SWIs you apply on the road on your way to work!

As much of your work is repetitive, REM sleep will keep information fresh and ready each night you get it. With the right amount of REM sleep, all the SWIs you need should be there ready for use daily. Simply translated, you should be capable of working safely and you will be less likely to forget sequences or

parts of the task that could expose you to harm or injury. This is often overlooked in the analysis of incidents.

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***Tales from the training room –  
"Why on earth would you do that?"***

I worked in a timber mill for 18 years, straight from second year high school at the age of 14. You learnt about safety quickly in this occupation or you risked losing fingers. I worked with many other young men at the time and in my early twenties was working in a furiously fast, high-risk occupation. What does age have to do with it? Young men tend to play up a bit at nights and don't often get the sleep they need to work safely. We played pool and darts at the local pub and just sat and talked till late. We felt we didn't need more than five or six hours of sleep, so we ran the gauntlet every afternoon as we grew steadily fatigued through sleep restriction and the low point after lunch.

I remember it like it was yesterday. Steve and I were working side by side next to a large circular saw. A small piece of wood broke off a plank of wood as it travelled through the saw. This piece of wood was just touching the gullet of the saw (the side part of the saw where the teeth are). It vibrated and rocked as it precariously kept teetering against the saw teeth. The risk here is if the saw teeth connect with the wood, it may flick at high speed into an employee's face, doing considerable damage. The normal process, or SWI, is to let others working nearby know that you are stopping the saw. You hit the big red 'Stop' button and fill out a danger tag and hang it on the button so that no one turns it back on until safe to do so. When the saw stops, you take a piece

of timber and use that to remove the broken piece from the non-rotating saw teeth. The process might take up to a minute to do safely. Reverse the process to re-start the saw.

It was mid-afternoon and I watched in horror as Steve started moving his hand toward the rotating saw. It felt like slow motion and I remember yelling at him twice, “Don’t! Don’t!” I thought of grabbing his hand away but worried that I might push his hand into the saw, so I didn’t. I watched Steve reach for the piece of wood with his hand and the saw quickly took off the tip of his finger. It wasn’t as bad as it could have been but was so predictable from the instant he looked at the teetering piece wood. I believe the short sleep reduced his opportunity for REM sleep and he was simply short of having access to all his SWIs. Have you ever seen such an incident and thought, *‘why on earth would you do that?’*

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Because REM sleep is our ‘active’ state of sleep, this is also where most of our dreams occur. There are many different theories on why we dream. However, in the sleep sciences, it is generally concluded that dreams are brought to bear through the above-mentioned connecting, sorting and storing of memory information. It is believed that the content of dreams can be caused by the brain attempting to recognise or make sense of the information moving to and from different sections of the brain. Some dreams will display moments of recent memories, some emotive, some procedural. Largely, a dream may be making complete sense, only to be disrupted by something totally out of context to the flow of the dream. I get asked a lot about dreams when I deliver training to groups of employees. The following questions might help you understand them a little more.



## **Question: I dream a lot, is this bad?**

Generally, it's a good thing, as it suggests that you are sleeping long enough to get a lot of REM sleep. It may also suggest that you are waking long enough during, or at the end of a REM cycle, to remember part of a dream. How much you remember will depend on how long you remain awake to think of the dream. If you instantly go back to sleep, it is likely you will forget the dream's contents, as you must be awake to initially lay down memory. However, going straight back to sleep is good, as it allows you to revert to stage two and deep sleep, and finally back into REM sleep, continuing to cycle through the night.

If you can't get back to sleep, this is when dreaming a lot can be negative. It could be an indication of stress, fear or trauma which has impacted on your mental state. Worries about finance, relationships, health, children, employment (or lack thereof), COVID-19 lockdowns, and even what you need to remember tomorrow, can all be factors that may cause dreams that awaken you. Supervisors, schedulers, and other line managers often have this issue. Even the fear of missing an alarm will generally have you waking every REM stage (every 90 or so minutes) to check the time.

The COVID-19 pandemic in 2020/21 certainly caused many people to suffer from poor sleep, due to anxiety. Many people would wake during sleep, thinking of the issues at hand - health, finances, home-schooling, lack of freedom and a raft of other concerns. Many people, unaware of the consequences of sleep restriction, had issues with diet and weight gain. Soon, we'll see why this has occurred with a section on COVID-19 sleep.

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### **Question: I never dream – Why not?**

You probably do! There are some drugs which can reduce REM sleep, such as the tetrahydrocannabinol (THC) in cannabis. If you are not taking drugs that affect REM, the likely reason you are not experiencing dreams is that you are not waking up through REM sleep. To notice you are dreaming, you must traverse the boundaries of REM sleep into light wakefulness. If you don't wake through your four or five REM cycles over the night, it is likely you are waking up in stage two or deep sleep. If it's deep sleep, you will feel very groggy when you wake up. This is called sleep inertia and is due to the brain not being in an active state of cognition. Later in this book I'll teach you how to obtain your full five cycles of sleep, which should bring about some dreams for you.

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### **Question: Why do I wake up from a dream and find I can't move?**

This is called sleep paralysis. During REM sleep the motor neurons that normally drive body movement are inhibited, causing paralysis (atonia) of muscles. Being paralysed is beneficial as it stops you from acting out your dreams when you have them. The opposite to this is when the motor neurons are not inhibited, which allows you to punch, kick, bite, run and a whole lot of other harmful acts. This is known as REM behaviour disorder which will be discussed in the section on sleep disorders.

The best explanation of sleep paralysis is that you are waking with a 'start', usually due to a scary part of the dream. This might involve being chased or in a fight for your life. Your brain wakes

up due to the fear, but the inhibition of the motor neurons has not yet had the chance to normalise to wakefulness. Hence, sleep paralysis, which usually only lasts a few seconds but feels like an eternity due to the fear of your imminent demise within your dream.

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### **Immunocompetence throughout sleep.**

Sleep plays an integral role in the development of a strong immune system. The term immunocompetence is used to describe how the human body develops an immunity to an introduced pathogen – for example, a bacteria or other offending organism. An immune response can be triggered by the introduction of a live pathogen, such as ingested bacteria or inhaled influenza virus. Or it can be deliberately triggered through the introduction of a weakened or dead version of a virus or bacteria. This is known as a vaccination, which has gone a considerable way to eradicating some diseases totally (such as smallpox) or nearly eliminating them from some regions (in the case of measles, mumps and rubella).

In an experiment in 2003<sup>17, 19</sup> subjects were vaccinated with inactive Hepatitis A virus and were then divided into two groups. One group had normal sleep, while the other group had no sleep on the night of the vaccination and then remained awake until 9 pm the following night. The subjects in the normal sleep group had a nearly two-fold level of Hepatitis A immunity – or resistance to disease after a four-week period, compared to the sleep-restricted group. The authors suggested that sleep improves the formation of antigen-specific immune defence as noted by the difference between the normal sleep and sleep deprived groups.

Another study with adults being administered the standard three-dose Hepatitis B vaccination, again showed similar effects<sup>18</sup>. Their analyses revealed that shorter sleep duration was associated with a lower secondary antibody response independent of age, sex, body mass index, and response to the initial immunization. Shorter sleep also predicted a decreased likelihood of being clinically protected from hepatitis B at the end of the vaccinations.

A study reported in November 2020<sup>19</sup> investigated the effect that working nightshift might have on immune response to the meningococcal conjugate vaccine in healthy workers. 34 healthy workers were divided into dayshift and nightshift and received the meningococcal C meningitis vaccine. Nightshift workers showed decreased deep sleep and REM sleep duration and total sleep time. They had increased inflammatory mediators and a weak response to the vaccination, compared to the daytime workers. I often mention to people that if they are unwell or generally not sleeping well, they should put off the vaccination until they are sleeping better. It's probably best to do this when one is working dayshift only, and even better to do it on rest and recuperation days. This is even more important with high-risk groups, such as the elderly and children.

It's plain to see that sleep has a more important role than most people would think. When I deliver talks or awareness sessions, people are often amazed at how little they knew about sleep and just how important it is to their health and wellness, safety and productivity. The beauty of these sessions is that once people realise this, they can be easily encouraged to obtain more sleep than they currently had been getting. But first they must fully understand what can disturb or reduce total sleep and then learn how to control or overcome these issues.



## *Chapter Two*

# Getting Less Sleep Than We Should

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**L**ong ago, a person was said to be ‘burning the midnight oil’ if they had to use an oil lamp to light their work area after natural light had diminished. In modern times, many a workplace is illuminated through the night until daylight once again fills the sky. The 24-hour society is such that businesses and workplaces invest enormous resources into buildings, machinery and rolling stock. The rolling stock on a mine site would normally comprise multi-million-dollar pieces of machinery such as diggers, shovels, haul trucks, water carts, scrapers, graders, service trucks and light vehicles. One haul truck can cost between \$1-4 million and some of the larger operations can have up to 180 haul trucks.

As long as a piece of machinery is sitting idle, the workplace is not fully utilizing its worth. Thus, 24-hour operations are now the norm, and most mines will utilise two 12-hour shifts as opposed to the past 8-hour rotating rosters (three per day). This is a simple example of one of many workplaces now working around the clock, and it is unlikely that a change back to not working nights will be financially viable for most organizations now working 24-hour cycles.

Along with the 24-hour workplace, humans are now being entertained much later into the nights than ever before. Hotels, nightclubs, casinos, and a plethora of shopping centres and entertainment venues are now open 24 hours. Add to this, television and other forms of media such as internet, and you have a society that often either forgets to go to bed at the right time or simply doesn't plan a good night of sleep. Most people are totally unaware of their sleep requirements and indeed, their circadian rhythms.

In the previous chapter, we learnt that the metabolic product Ad is metabolised in the brain while we sleep. It was also suggested that it takes approximately one hour to metabolise the Ad from two hours of being awake. Quite simply, this fits the concept of the sixteen-hour day, followed by an eight-hour sleep. The suggestion of an eight-hour sleep has been around for many a decade. In fact, most journal articles, websites and conference presentation will recommend between seven and nine hours of sleep for a normal, healthy adult.

In 2015, results were published of a 'Joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society on the recommended amount of sleep for a healthy adult'<sup>20</sup>. This very large group of some of the best sleep and fatigue scientists in the world gathered to discuss and vote on what they believed, based on the available literature, to be the recommended range of sleep for a healthy adult. I have been lucky enough to have met and listened to some of these amazingly knowledgeable people.

Their literature review commenced with finding 5,314 publications, then reducing the number of these publications because they were not related directly to sleep. The final number

for panel review was 311 publications. After three rounds of voting, which included discussion of the publication findings at a conference, a summary of the voting was developed. The group reached the following conclusions:

- Consensus that six hours of sleep or less was inappropriate to support optimal health
- Consensus that seven to nine hours of sleep were appropriate to support optimal health
- Consensus that the appropriateness of nine or more hours of sleep on optimal health could not be ascertained with certainty
- Consensus could not be reached regarding the appropriateness of sleep durations in the six-to-seven-hour range, but the median vote indicated this duration was in the inappropriate range

In 2019, I delivered face-to-face training to over 5,200 people at workplaces and a further 3,300 (approximately) attendees at various conferences in Australia. When asked the question “Who here gets seven or more hours of sleep?”, roughly 20% will say they do by a show of hands. Another 20% say they get less than 6 hours of sleep, while the remaining majority of approximately 60%, will state that 6 hours of sleep is the norm for them. These are approximations from interactions with attendees of fatigue/sleep awareness sessions only and should not be used as statistics.

In most cases, this has little to do with their work, and more to do with their lifestyle. A vast number of Australians (and other nationalities around the world) are under slept. Globally, people have probably been under slept for a long time, but it is only

more recently that this has been researched. Some people wear short sleep as a badge of honour, while others are desperate for more sleep but don't know how to get it. I often receive sincere requests from people who want help getting more sleep. This indicates to me that people have almost forgotten how to sleep well, and some are desperate for more.

### ***Sleep debt.***

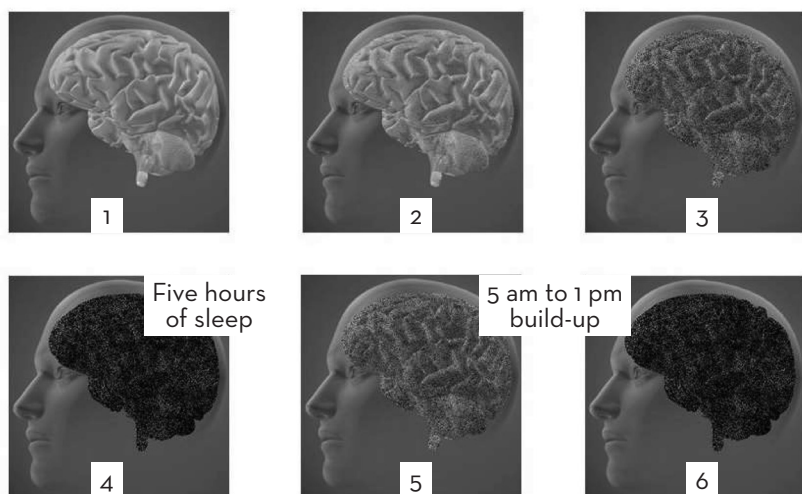
The theory of Ad metabolism allows us to better understand what a sleep debt is. Sleep debts are often realised during afternoon circadian low points or when driving some distance in a vehicle. Especially in a sedentary position! It can be a feeling of sleepiness, including trouble keeping the eyes open and not being able to focus on any specific task for too long. When this occurs, most people simply think they didn't get enough sleep the night before. Although this is often the case, most don't realise that the sleep drive they are experiencing is the brain attempting to go to sleep to reduce the build-up of Ad, or to pay back the sleep debt. A haul truck driver who had several fatigue events captured by a 'seeing-eye-machine' in his truck, was gobsmacked by the notion that his falling asleep at the wheel was most likely the brain attempting to catch up on his sleep restriction, after averaging five hours of sleep a night for the past four nights on a camping trip. So, what exactly is a sleep debt?

When we sleep for less time than we should, some Ad will be left behind and not metabolised and recycled back into fuel. For example, if we have a normal day but stay up late to watch television, play games or spend hours on social media, we can be awake for as long as twenty hours. What normally happens in this case is that you go to bed around midnight but still need to



wake up early, say around 5 am for work. You have only had the opportunity to get five hours of sleep, which will only give you 10 hours of performance. Plus, you will not have recycled all of the Ad and some will be left behind.

Starting the day with a lot of Ad in the brain is not that troublesome, although you will generally wake feeling tired. However, when you then add a further eight-hours awake (in the example of the 5 am alarm, through to 1 pm), your brain will now be the equivalent as it would be for an 18-hour day. At 1 pm, your brain is now ready to produce a sleep drive due to the large amount of Ad and low levels of the fuel ATP in the brain. Add to this, the earlier mentioned ‘post-lunch dip’, where people often get drowsy due to the lowering of core body temperature after lunch, and you have a sleep debt recipe for disaster. Basically, *‘the brain wants to sleep to get more fuel to make it through the day’*.



**Figure 9:** Build-up of sleep debt using the adenosine model over a 20-hour waking day.

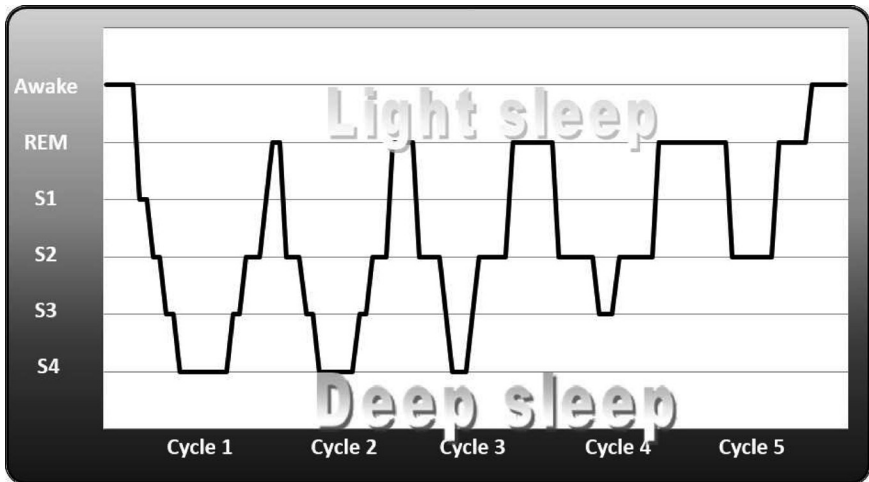
The sleepiness caused by the sleep debt makes us less efficient at work, less safe and with reduced motivation and lowered moods. Figure 9 above represents how a sleep debt is built from inadequate opportunities to recycle Ad within the brain. It is an extension from Figure 4 in chapter one.

The first three images show the normal build-up of Ad over a 16-hour day, from 0 hours awake – to 8 hours awake, then 16 hours awake. The fourth image shows the high level of Ad from being awake for 20 hours. The fifth image illustrates that only a portion of the Ad is removed or metabolised due to obtaining only 5 hours of sleep. Accordingly, it wakes at 5 am with a large amount of Ad build up remaining.

The final image (number six) shows how the Ad has built to a high level again by 1 pm, after being awake a further 8 hours. This, together with the drop in core body temperature after lunch, will cause a sleep drive to recycle more brain fuel. The sleep drive will be most profound when the person with the sleep debt is in a sedentary position. As Mahowold and Schenck<sup>21</sup> term it, *“Boring lectures, dimly lit rooms, heavy meals or long automobile drives do not cause sleepiness, they simply unmask it”*. This doesn’t suggest that good sleep is all you need to consider when you do long drives or extra-long shifts. It simply means that if you have a sleep debt, being in a sedentary position can bring on sleep onset.

### ***Sleep architecture changes in short sleep***

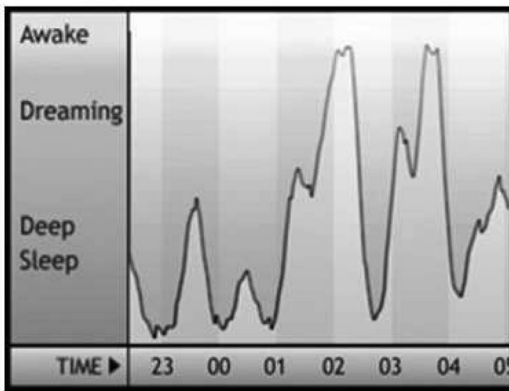
In chapter one, the architecture of sleep stages and cycles was illustrated and discussed. The diagram, which is repeated below in Figure 10, shows how most of the deep sleep is obtained in the first half of the night, while the REM sleep is obtained mainly in



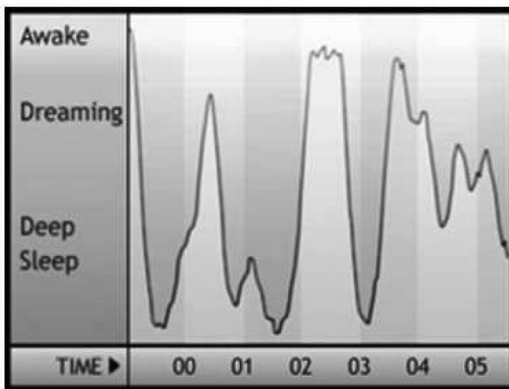
**Figure 10:** Sleep stages and cycles in a 7.5-hour sleep.

the last half of the night. A total of approximately two hours of deep sleep and two hours of REM sleep is required to maintain health, wellness and safety.

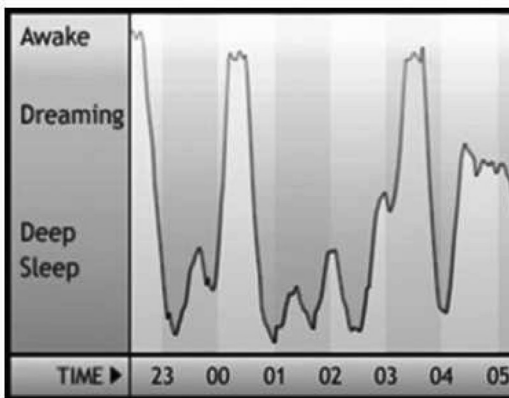
The above sleep stages and cycles are dependent upon a person obtaining around 7.5 hours of sleep, which is 5, 90-minute cycles. The cycles tend to change when an individual obtains less than the appropriate sleep. The graphs below are recordings of sleep as measured with a mobile phone sleep app. It should be stated that such apps are less than appropriate for plotting highly accurate sleep data. Nonetheless, they are cheap and allow a simple way of measuring sleep and the data often encourages people to try to get more sleep. Further, they are more reliable than subjective assessments of sleep, as many people usually underestimate their sleep. I recommend using phone apps within fatigue management training to encourage people to measure and get interested in their own sleep. Plotted sleep graphs from



**Sleep night 1:** Note the large amount of deep sleep but a lack of REM sleep (shown in the graph as 'dreaming'). It also shows being awake twice through the night for periods of around 15 minutes each.



**Sleep night 2:** The graph is showing what is known as 'REM rebound', whereby the brain attempts to get REM sleep early in the night to compensate for the lack of it the previous night. This decreases deep sleep opportunity.



**Sleep night 3:** This is similar to the first sleep, showing considerable deep sleep and only a small component of REM sleep. The only component of REM sleep is within the final cycle of sleep.

**Figure 11:** Six-hour sleep with sleep stage anomalies.

reduced sleep, such as those shown in Figure 11, have also been recorded in research, and similar outcomes as those below have been found.

There was a total of six graphs provided, which repeated through cycles of mainly deep sleep on one night, followed by mainly REM sleep on the next night, and so on. There was not a single night of six-hours of sleep that indicated close to the right amount of both deep sleep and REM sleep. How this would affect the man is discussed next.

The sleep is of a male aged around 55 years, with obstructive sleep apnoea, a condition whereby the sufferer has breathing cessations through the sleep period. It will be discussed fully in the next chapter. His apnoea is controlled well with continuous positive airway pressure (CPAP) therapy. He attempts, like so many others, to get around six hours of sleep per night and sometimes catches up a little on weekends. He goes to bed around 10.30 pm – 11 pm and wakes around 5 am – 5.30 am for work, Monday to Friday. When he first showed me the graphs, it became suddenly clear that sleep cycles can become disorganised due to limited sleep opportunity.

The first graph shows that almost 2 hours of deep sleep is obtained in the first 3 hours. After 3 hours he moves towards REM sleep, indicated on the left axis of the graph with the word 'dreaming'. He may have obtained 10-15 minutes of REM sleep at this point. He then awakens around 2 am for perhaps 15 minutes and goes back into deep sleep. Around 3 am he gets another brief period of REM sleep and awakens again, for a further 15 minutes. Following his re-entry to deep sleep again, he manages a very brief amount of REM sleep before waking up for work.

In total, he obtains a total of around 2 hours of deep sleep and maybe 45 minutes of REM sleep. He has obtained the 'health and wellness' component of his sleep through the deep sleep release of serotonin, melatonin, human growth hormone and many other complex hormones and nutrients. His short-term memory will have been transferred into long-term memory. He should wake feeling quite happy and healthy.

However, with the reduction in REM sleep to around 30-45 minutes in total, he has not sorted out all the new memories stored with the old. This may affect simple actions during the day, such as locating his car keys, remembering all components of SWIs in the workplace and applying the wrong rules to complex tasks. He is '*one sausage short of the safety barbecue!*'. He will also get tired during the afternoon when the brain recognises a high level of Ad in the brain, as not all has been metabolised and recycled overnight. At this point he is one full 90-minute cycle short of sleep.

Night two shows a reversal of sleep cycles. Starting sleep onset later, the man goes almost straight into deep sleep but instead of the normal 50-60 minutes of deep sleep, it is interrupted with a rapid onset of REM sleep. This REM sleep occupies around 30 minutes of what should be deep sleep, before moving back into deep sleep for approximately 1 hour. From that point, he spends around 30 minutes awake and most of the remaining sleep in REM sleep. We call this 'REM rebound' and it appears that the brain consciously 'catches up' on REM sleep to keep the man well organised with his long-term memories and available safety information.

When he awakens from night two, he may feel quite drowsy as he was re-entering deep sleep, where the brain is in maintenance

mode and quite inactive. Once he recovers from this, he will still feel quite sluggish and lethargic during the day due to the lack of human growth hormone and its effect on glucose tolerance and the production of energy. He may also be a little grumpy as he is short of the 'happy hormone', serotonin. The upshot is that the increase in REM sleep may enable a safer, more organised day at work. However, he is now two 90-minute cycles of sleep short. The effect of this sleep debt will be evident for most of the afternoon, where it is likely he'll have reduced cognitive ability for decision-making, slowed reaction times and a range of other impairment issues.

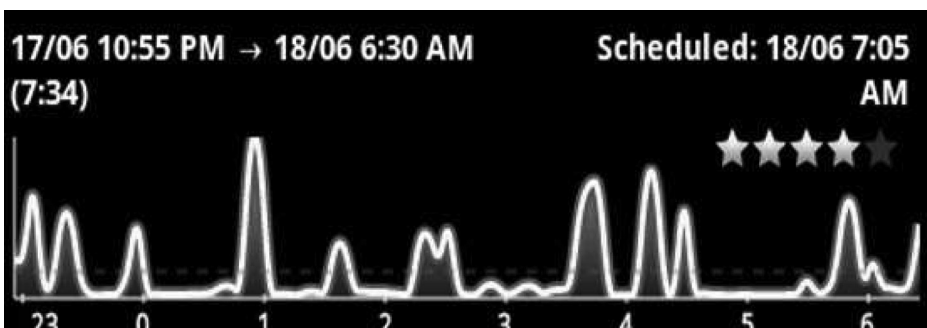
Night three reverts to a sleep plot similar to night one. The bulk of sleep is deep sleep, and the man only gets about 45 minutes of REM sleep right at the end of the night. He will awaken to another less-safe and less-organised day. He now has 4.5 hours of sleep debt and will be getting dangerous on the drive home from work. This sleep pattern was constantly repeated for 6 nights. The upshot of this is simple. Yes, you can live on 6 hours of sleep a night. However, every second day you might be happy and healthy but unsafe, and the other days, safe but unhappy and low in energy. Basically, you may never find the 'best version of yourself'! You will also probably catch up on some of the debt over the weekend, with sleep-ins and naps. However, the 6 full cycles of 90 minutes (or 9 hours in total) that is missing will not be paid back and will go to the bottom line. What is the 'bottom line' you might ask? This will be revealed in future chapters.

### **A normal night explained**

Around six years ago, I undertook the use of an app to measure my own sleep on an android phone. The app, known as 'Sleep

as android' measured sleep performance by bed movement (the phone inserted under the top sheet at the top corner of the bed). I was using this to measure my average sleep duration and to see if there were any anomalies. There will always be a few anomalies as there is rarely a perfect sleep. I was on the road a lot and sleeping in different beds at hotels, motels and workplace accommodation camps, I expected to see some interesting results. At the time I averaged 7 hours and 28 minutes over a 2-week period. Figure 12 below shows a graph of my sleep at a location that was new to me.

The output of my sleep for this night showed totals of approximately 2 hours of deep sleep and 2 hours of REM sleep, over 7 hours and 34 minutes of sleep. The first 30-minute period indicates that I was getting used to the strange bed (on the first night away from home), a phenomenon discussed in Matthew Walker's bestselling book *Why We Sleep*. Here he mentions research discussing how the left hemisphere of the brain doesn't go into deep sleep for the first cycle in a strange environment. It is thought to be a process whereby the brain understands that you are in a strange environment and keeps a look-out, by



**Figure 12:** 7.5 hours of sleep, showing around two hours of deep and two hours of REM sleep.



limiting sleep to only light sleep and by providing a reasonably heightened sense of hearing, smell and touch, for protection.

Following from this 'getting used to the strange bed' period, the graph shows good portions of deep sleep. There appears to be a 'spot-check' around 1 am, whereby I woke up, looked around to see where I was, then went straight back to sleep. Again, the brain keeping me safe. There are also good amounts of REM sleep through the night, and I wake up in REM sleep, unaided by an alarm. This was likely due to not requiring any more than the 7 hours and 34 minutes of sleep obtained. The 4 out of 5 star rating that I gave the sleep should have been 5. However, the stars on the mobile phone screen are very small and my fingers quite large. Basically, I missed the 5!

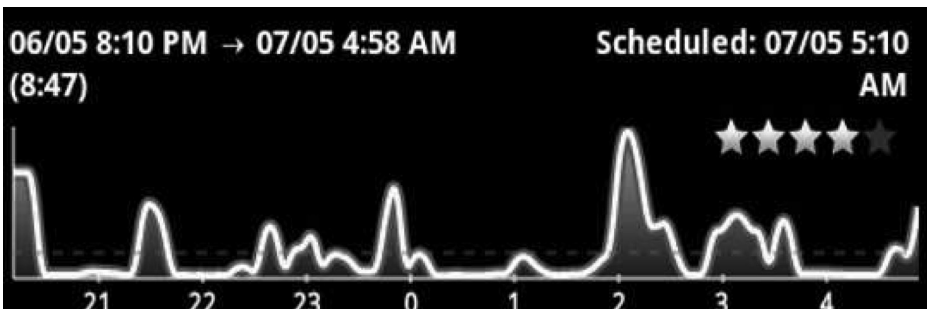
Australia's resource sectors often utilise a strategy whereby they fly employees into a camp situation for a week or two while on a working roster. Then, at the end of the roster, they fly the employees back home. This is used in remote operations where having communities would be problematic, or the location is too remote to have all the infrastructure required for comfortable community living. They call this fly-in, fly-out, or FIFO. A similar strategy, whereby the resource is situated closer to some towns, is drive-in, drive-out, or DIDO. Some also use buses to reduce the increased risk of having multiple fatigued drivers on the road.

Many of these FIFO and DIDO workers also agree that the first night of sleep coming back into work and sleeping in the camp is a less than adequate sleep. Some help to alleviate this by bringing their own pillow, and even the odd mattress topper. Because I have been on the road so much through my training delivery years, I believe I have probably overcome this by now and have little trouble sleeping in most environments. I do sleep

around a lot. No, not like that! I mean different hotels, motels and camp accommodation. Perhaps my left hemisphere has adapted through neuroplasticity (the brain's ability to adapt and change/rewire)!

## What does catch-up sleep look like?

Although I intend to get the appropriate sleep on most nights, I am still human, and stuff just happens! Take the following example when I flew from Perth on the west coast of Australia to Brisbane on the east coast. The time difference of two hours ahead and a late arriving flight didn't give me enough time to get more than six hours of sleep. The following morning, I had a six-hour drive to complete and my background in road safety prompted me to ensure I planned more than the normal number of breaks on the drive. I will add that I don't wait until getting tired to take a break from driving. Rather, I believe that if you take breaks while you still feel energetic, you tend to go much further before feeling tired. I took a total of four planned stops in places that interested me for different reasons. The drive was completed without incident or the slightest feeling of fatigue. That night I had the opportunity to pay back the sleep debt of



**Figure 13:** *Just under nine hours of catch-up sleep.*

one and a half hours, or one sleep cycle that I missed the night before. Figure 13 shows that I took it!

This sleep of 8 hours and 47 minutes goes close to replacing the 90-minute deficit from the previous night. Similar to the gent who averaged 6 hours of sleep per night, there appears to be some early REM sleep around the 10.30 to midnight point (shown as O). This would be REM rebound as highlighted in each second sleep of the 6-hour sleeper. The difference here is that because I had the additional 90 or so minutes of sleep, there was a chance to also get more deep sleep toward the end of the night (around 4 am). This provided a good balance of both deep and REM sleep to put me in a good position for an excellent next day. I firmly believe you can catch up on sleep that is recently missed. I also believe you only have around a week to do so.

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### ***Tales from the training room – PoTA***

I attended the Queensland Minerals Industry Health and Safety Conference in Townsville annually between 2000 and 2005. I was presenting my work on an Australian Coal Association Research Program-funded project on developing a fatigue monitoring system for open cut haul truck operators. I also presented the outcomes of an NSW Joint Coal Board Health and Safety Trust funded project, on road traffic crashes for coal miners driving to and from work in the New South Wales Coal Mining industry.

At one of these conferences, I heard a man speak of his interviews with employees who had been involved in accidents but managed to get out of the line of fire in time to avoid injury. Others had been injured in each of the accidents. He asked those who escaped injury, “How did you

manage to avoid injury when others got hurt?” The answer was a very common one: “My arse was twitching!” Although somewhat crude, this statement assumes that each of these people involved had the foresight (arse-twitching) while observing the actions leading to the event, to understand that something wasn’t right and to get out of the way just in case. It’s almost like a sixth sense in safety.

The presenter named this sixth sense: PoTA – Phenomenon of Twitching Arse. I have used this acronym in training to help people understand that well-slept people are better able to be more observant and apply PoTA on the road and in the workplace. How this relates to my previously mentioned catch up sleep was exactly that – PoTA.

On my way driving to the workplace after the catch-up sleep shown previously, an errant vehicle was on my side of the road driving toward me on a 100 kph posted road. I believe my catch-up sleep enabled my PoTA to be at a high enough level for me to decelerate and slowly move my vehicle off the road to the left in time to watch the driver (possibly travelling home from nightshift), go past me still occupying my lane at full speed. I am not the kind of person who would say at this point, “Good sleep saved my life!” or find other ways of catastrophising the issue. More to the point, my good sleep enabled me to get an early-enough warning through my high level of vigilance to avoid a collision. And in a hire car, no less.

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## **Catch-up sleep and Mondayitis**

It has already been mentioned that many people get less sleep than they should. Studies have shown that many people sleep

less on work or school days and attempt to catch up during weekends or time off. Let's do the math on this. If you sleep 6 hours per night as a normal, healthy adult who requires around 7.5 hours (5 sleep cycles), you will be 1.5 hours short each night. Multiply this by the 5 nights and you are approximately 7.5 hours short by Saturday morning.

Catch-up sleep can only occur if you obtain more than the normal 7.5 hours of sleep. Thus, getting a 9-hour sleep will add 1 sleep cycle of 90 minutes to your catch-up plan. Let's imagine you sleep 9 hours on both Saturday and Sunday night. You will have caught up 3 of the 7.5 hours of sleep and still have 4.5 remaining. Drag this into the next working week. It simply doesn't work, and the sleep loss will 'go to the bottom line'. That is, it will affect your physical and mental health, as has been shown in so many studies worldwide. In fact, a recent study in France<sup>22</sup> showed that in a snapshot of the population (12, 637 adults), 35.9% slept less than 6 hours during the week. People attempting to catch up sleep on weekends with extra sleep and naps only compensated for severe sleep debt in 1 in 4 people.

I personally remember a case brought to me by the WA police Major Crash Division a few years ago. It was a gentleman who, of his own volition, stated he only averaged 5 hours of sleep per night. He stayed up late watching TV and had to get up at 5 am for work. He had a particularly long run of 12-hour workdays for approximately 2 months straight, and early one evening, crashed his car on the way to picking up some take-away dinner. The crash had all the hallmarks of a fatigue crash. Professor Jim Horne and Dr Louise Reyner from the UK have mentioned these hallmark traits in a few of their published papers. They are: Single-vehicle crash, run-off road or crashed

into a stationary object, weather was fine and dry, the vehicle had no defects that would cause the crash, visibility good, and several seconds to react and avoid the crash. Unfortunately, a life was lost in the fatigue-related crash.

Interestingly, when the Public Prosecutor and I were discussing the amount of sleep and sleep debt that the driver accrued (assuming he was a normal, healthy adult requiring 7.5 hours of sleep per night), we calculated around 140 hours of debt over the 2 months. Knowing what we know about how sleep debt affects a person; it was understandable that the man had only driven approximately 5 minutes and 35 seconds before he crashed. That aside, if he had 140 hours of sleep debt, how on earth could he function normally at work each day?

A 2012 study using rats<sup>23</sup> indicated that when rats were sleep restricted in the short-term, they tended to catch up on sleep. However, when the sleep restriction was chronic (over several days), the animals no longer expressed compensatory increases in daily sleep time or sleep intensity. Perhaps this is why many people state that they are OK on small amounts of sleep over long periods, yet fall asleep at traffic lights, on long drives, in classrooms or in front of the TV. This is a serious issue when driving vehicles or when requiring sustained vigilance on tasks.

There are sometimes problems with catch-up sleep. Due to the time pressures of work, humans have been waking earlier than it is natural to waken (i.e., with the sun). Let's use an example of someone who wakes at 5 am each workday, Monday to Friday, and sleeps in on the weekend. A weekday 5 am alarm time provides a sleep wave at night around 9.10 pm. How this works will be explained fully later. However, people

who sleep around six hours per night will be going to bed later and are not sleeping until around 11 pm to 11.30 pm. Come the weekend (Friday night), most will still go to bed late and use the opportunity to sleep in in the morning. They may still wake around 5 am due to the circadian rhythm developed over the week. But using the time available, might get back to sleep until, say, around 8 am. Repeat this on Saturday night into Sunday morning and a new circadian rhythm starts to develop. The sleep onset time after an 8 am waking is around 00.10 am. You may go to bed earlier but will not feel sleepy till around 00.10 am. This is referred to as a delayed circadian phase (synonymous with adolescents).

Sunday night, the plan will be to go to bed early (say 9 pm) for the 5 am rise on Monday morning. Sleep onset will be almost impossible due to the new rhythm of the delayed circadian phase. It will be considered 'insomnia' when it is in fact 'going to bed too early' for the new delayed phase. You may finally get to sleep after midnight and obtain five hours of interrupted sleep. The interruptions will be due to the anxiety of knowing that sleep will be short, and you may miss hearing the alarm. REM sleep will protect you from missing the alarm by waking you every REM phase (i.e., each 90 minutes) to check the time. The result of this is referred to as 'Mondayitis'. It is a very poor start to a week of further sleep debt.

If you want to catch up on sleep, I recommend going to bed earlier and waking at the usual time. Keeping a consistent wake time is important for a strong and consistent circadian rhythm. Your series of yawns and feeling sleepy early in the evening will be the best indicator of the sleep onset time for a catch-up sleep. This is the human homeostatic response to catching up

on sleep. You could then sleep for nine hours and wake at the normal time required for work or whatever you do. You will notice an increased amount of energy and motivation to start the day, and you will appreciate the feeling of 'awesome'. Although sometimes you need around 3 good sleeps of 7.5 hours or so to feel the amount of 'awesome' that I often notice when I am sleeping consistently well.





## *Chapter Three*

# The War Against Sleep

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**T**he industrialised world, coupled with 24-hour access to shopping and socialising, reduces people's desire or opportunity for adequate sleep. Further, some of the personal sleep issues are caused by personal circumstances, some by sleep disorders and others by pure lack of interest (or care) about sleep. Many famous (and infamous) people, have romanticised or worn short sleep as a badge of honour, leading others to perceive the overrated importance of sleep. This can have tragic short-term and long-term impacts on society. Let's bullet-point the personal sleep issues and work through them.

- Reduced time between working shifts
- Call-outs
- Shiftwork
- Sleep disturbances
- Sleep nonchalance
- Alcohol and drugs
- Diet
- Exercise
- Sleep disorders
- Poor mental health

## ***Workplace Causation***

### **Reduced time between working shifts**

The resources sector, among a few other groups such as rail and aviation, have taken the lead on ensuring their employees have adequate opportunities to obtain the correct amount of sleep between working shifts. This is likely due to the catastrophic losses that are seen when major incidents occur. Most fatigue management plans stipulate that a minimum ten-hour break is required between finishing one shift and commencing another. In camp situations for FIFO and DIDO workers, the ten-hour break is more than enough to obtain seven to eight hours of sleep. However, there are some situations whereby a residential employee may live an hour or two from the workplace and wants to commute each day, instead of living closer to the workplace.

The time taken to drive to and from home may severely reduce the time that can be used for sleep. Table 2 shows how at least ten hours is required to get the appropriate amount of

**Table 2:** *Time required at home prior to sleep.*

Task	Assumption	Running time
Greet family	15 minutes	0.25 hours
Children's bedtime	15 minutes	0.50 hours
Shower and any chores	15 minutes	0.75hours
Dinner	30 minutes	1.25 hours
Downtime with partner	30 minutes	1.75 hours
Sleep onset	Up to 30 minutes	2.25 hours
Wake at 4.15 am, shower, eat, drive at 5 am	45 minutes	3 hours

sleep each night in a family situation. With the best intentions, this will be hard to do. Your family is often unaware of how your sleep restriction affects you during your working day, and this will affect the pressure they put upon you to stay up later with them.

The above table shows that it is easy to use up 3 hours of time at home without committing time to anything other than normal duties. Out of 10 hours, this only provides around 7 hours opportunity for sleep. As sleep is compiled into 90-minute cycles, 7.5 hours of sleep would be more appropriate than 7 hours, but sacrifices would need to be made to obtain that amount.

You may recall from earlier, when the graphs of the six-hour sleep on consecutive nights showed a pattern of getting enough deep sleep on night one, but not enough REM sleep. My comments were around the man having a reduced level of safety for the day. This next case illustrates how a similar scenario of reduced safety may have played out for a young nurse working in the maternity section of a hospital in the USA, when she didn't have the opportunity to get the sleep she needed.

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### ***Case of not enough time between shifts – simple mistake, fatal outcome***

A sixteen-year-old girl (Jasmine Gant) attended St. Mary's hospital Wisconsin in July 2006 to give birth. Jasmine lost her life that day, most likely because of sleep restriction of the attending nurse. The nurse, Julie Thao, worked a double shift on July 4 and was too tired to drive home, so slept the night at the hospital<sup>24</sup>. After working 20 hours in the previous 28-hour period, nurse Thao wrongly administered a dose of epidural medicine intravenously to Miss Gant.

Gant was to receive penicillin for a streptococcal infection through the intravenous line. Within minutes, the epidural medication, normally used to numb the pain from the waist down in childbirth, caused cardiac arrest. The sleep restriction may have been responsible for the oversights that led to Miss Gant's death. According to the report, nurse Thao *"...failed to use the five rights of medication administration, she failed to put a wristband and scan the patient and cross check the medication being administered to the patient."* The only positive was that the son was delivered without harm.

This could possibly be one of the worst examples of how simple things can go fatally wrong when sleep restriction alters a worker's perception and decisions. According to the Wall Street Journal<sup>25</sup>, *"Errors made by doctors, nurses and other medical caregivers cause 44,000 to 98,000 deaths a year. Hospital infections, many considered preventable, take another 100,000 lives. And mistakes involving medications injure 1.3 million patients annually in the US."*

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## Call-outs

Many workplaces require employees, especially highly skilled ones, to sometimes come back to work after they have already gone home for the day. Common reasons for this would be breakdowns, incidents or unexpected demands. The immediate issues are twofold. Firstly, the employee hasn't yet gone to bed but may have woken early that morning, extending the period awake. Research pivotal to understanding extended wakefulness and sleep was conducted by Dawson and Reid in 1997<sup>26</sup>. They had people consume alcohol up to a blood alcohol concentration

of 0.10%. The subjects performed cognitive psychomotor performance tests at various points in the alcohol condition, and the results plotted. In another condition, the same subjects were to have extended wakefulness, with several of the same cognitive psychomotor performance tests.

Their results suggested that: *“The performance decrement for each hour of wakefulness between 10 and 26 hours was equivalent to the performance decrement observed with a 0.004% rise in blood alcohol concentration.”* This equated to an employee awake for 17 to 19 hours having the performance equivalent of someone with a blood alcohol content of 0.05%, and an employee awake around 24 hours, has an equivalent performance of a blood alcohol content around 0.10%. This is twice and five times the risk of a road traffic crash, respectively.

A possible control for this concern around call-outs would be for the person making the call to the employee to risk-assess the time of night for the call-out against the time that employee commenced work during the day. This would provide hours awake for that period. The second issue is in regard to the employee's sleep. The problem is knowing that you're going to bed and may have your sleep broken by a phone call. If you do get to sleep, it is likely you will sleep lightly, as the left hemisphere of the brain may not go into deep sleep (due to the anxiety of perceived sleep disruption). What this means is that your sleep may be lighter than normal and of lesser quality. As a control for this, I suggest that a person on call-out has two non-call-out days following the first one. This will provide the opportunity to catch up on any sleep restriction or sleep of poor quality.

In many cases, the employee may have initiated sleep by the time of the call-out. If this is the case, the possibilities are that

either they will wake in a REM stage of sleep and feel quite awake quickly, or they will wake through a deeper stage of sleep. If the latter is the case, the person would require a period of time (I suggest no less than 20 minutes) to prepare to drive. This is a call that would need to be made by the employee based on how they feel at the time. The person asking the employee in to work should reinforce the decision to make sure they are feeling ok before driving.

Another useful control is to investigate the use of technologies that can assess the performance level of an individual. There are apps that can be used on mobile phones and tablets that can obtain a baseline measure of the individual over time and test their performance against this when required (such as a wake-up call-out). The employee could perform a test and determine if they should be driving, or not. Although these tests are not without error, they are likely considerably more accurate than a decision made by an impaired person.

Importantly, any employee who gets called out to work either when they have been awake a long time, or have had their sleep broken, should be assessed for fatigue risk prior to commencing work. This would require the supervisor to be well-versed at managing fatigued employees and knowing the employee well enough to know how they are feeling. The supervisor should not be fatigue impaired themselves. Further to this, they should be provided a taxi to and from the workplace as an added safety measure. A rule of not appearing at work for at least the next ten hours post-work should apply, and the employee should only work to the normal end of shift time for that day, to allow them to keep some form of circadian rhythm.

## Shiftwork

The International Agency for Research on Cancer (IARC), which is part of the World Health Organisation, has recently, for the second time in two decades, stated that shiftwork “*may be a carcinogen*”. This means that there is enough evidence through animal studies to suggest that changing sleep times in conflict with normal sleep times influences cancer development within animals. There is not yet enough evidence to say the same is true for humans, due to the lack of human studies in the same area.

There are several common sayings about shiftwork. “Shiftwork reduces your life by ten years,” or “Start shiftwork and put on ten kilos,” are good examples. Academics at conferences sometimes criticize employers for allowing shiftwork to occur, and research has often associated shiftwork with increasing safety risk and poor mental and physical health outcomes. While this is largely true, shiftwork is here to stay, and many industries would suffer a rapid demise if they stopped shiftwork occurring. As we have become so reliant on 24-hour services and productivity around the clock, economies would suffer greatly without shiftwork. Further, you could never get sick or injured at night if we stop shiftwork! Who would look after you?

Shiftwork does affect both the quantity and quality of sleep for the masses. Much of my early work has been in the Pilbara in Western Australia and in Central Queensland, whereby shiftworkers would often say they average 4.5 hours of sleep for each day of sleep between nightshifts and an average of six hours per night on dayshift. Given that many of them in the Pilbara at that point worked seven days, followed by seven nights, the build-up of sleep debt was not good.

Many started nightshifts with a sleep debt built from not obtaining adequate sleep for the preceding dayshifts. The normal 6 hours of sleep on dayshift would provide a debt of around 10.5 hours (7 x 1.5 hours of debt per dayshift) by the start of nightshift. From there, add around 3 hours of sleep debt per day of sleep between the 7 nights and a further 18 hours (6 days of 4.5 hours sleep) of debt is accumulated. The 2 sets of accumulated debt totals around 28.5 hours. This inordinate amount of sleep debt would be likely to cause the mental and physical health issues discussed regarding the effects of shiftwork. In fact, a discussion with an internationally known endocrinologist, whose work will be discussed later, suggested that these workers may be going home after two weeks as type 2 diabetics, if they were as sleep restricted as they said they were.

Shiftwork has always created health and safety issues, and it always will, unless a different stance is taken on the subject. I help multitudes of shiftworkers get better sleep than they had previously, and I will address what I believe is required in a section on shiftwork later in this book. For now, it is sufficient to say that generally, shiftwork causes circadian disruption and often sleep restriction.

By early 2020, many of the mines in Australia had reduced their rosters to seven days, seven off, seven nights, seven off. This 'week-about' roster was viewed as a much more restful roster for most employees. This had to be modified somewhat during the COVID-19 pandemic, as travel both intra- and interstate, was a major health risk and many state borders required periods of self-isolation when they returned. Many sites went to 14-day and 28-day rosters to reduce travel through airports. As the rosters were even-time (i.e., employees had equal time off following the



roster to recover), this allowed for employees to, in effect, self-isolate once they were back home. This reduction in COVID-19 contamination risk immediately raised the risk of fatigue for employees.

The more responsible workplaces spent considerable time reviewing the increased fatigue risk and ensured countermeasures were in place. This was a busy time for me, assisting mines to assess the risk. Feedback on the extended rosters with all of the fatigue controls in place were generally positive, including one production manager who reported, “I’ve never seen such well-rested shiftworkers”. The numerous controls used to manage the 14 nightshifts (including reducing the working hours to 10, leaving 14 hours of rest and sleep) worked well, as they were planned to do. I have included a special chapter on shiftwork at the end of this book for those who would like to perform better and be safer while working through the night.

## ***Sleep Disturbances***

### **Children**

Easily the most common sleep disturbance discussed in my sleep and fatigue management training sessions are those caused by babies, infants and children, to the point that some FIFO/DIDO employees state that they go away to work for a week or two to ‘get a break from their kids’. Any good parent, or carer, understands that their sleep can be severely impacted by the responsibility of providing care for their children through the night.

The brain of humans has developed such that a parents’ brain will reduce deep sleep when they are concerned for the infant’s safety or health. In fact, it is unlikely that a new parent will get

adequate deep sleep for at least the time it takes to be confident the infant can make enough noise to wake them if needed.

Luckily, most young parents seem to be resilient to a certain amount of sleep disturbances through consecutive nights. Much more so than older parents, in most cases. However, there are still limits to the amount of sleep restriction a parent can endure before things start to break down. A later chapter will be dedicated to parents with children and how to improve sleep outcomes.

Children may often wander into a parent's bedroom if they are unable to self-soothe and get back to sleep. These breaks in sleep for the adult are not so serious if the adult can get back to sleep rather quickly. However, some parents might take the child into the bed with them and co-sleep with the child. Short-term, this is not a big issue, but it can lead to years of having older children want to co-sleep, rather than self-soothe. I have found this to be the case often when people approach me and discuss sleep issues with children who can only now sleep with a parent.

I was lucky enough to be invited to Laos a few years ago to help a logistic company ensure they were providing 'best practice' fatigue management strategies to their employees. The employees would be bussed to a camp for the week of driving and would be bussed back to their homes when finished the roster. The drivers slept at camp each night.

The drivers discussed how at home their whole family slept in the one bed. This could include one or two children, the parents and even a grandparent. There did not appear to be any major issues with this in Laos, however, many sleep research professionals advise to do this as little as possible. My own experience from when my babies were small was that if a child

came into my bed, I slept terribly, worried about rolling onto the child and suffocating her. I don't recommend the practice at all and especially if one or more of the parents drive or perform high-risk tasks the following day.

## **Neighbourhood noise**

Other sleep disturbances can be caused by animals or neighbourhood noises (traffic, people, etc). A recent trip to a community in the north of Australia had an issue with older children out late at night, fighting or having fun, but generally making a lot of noise. This made it hard for residents to sleep. My offering around obtaining better sleep were based on the things that the people themselves could do to return to sleep, such as reading a book or meditating. Further emphasis was placed on the community helping the children to better understand sleep and use it to their advantage.

## **Pets**

Dogs and cats should sleep on their own patch, be it a pet bed or rug, but not in the master's bed. Disturbances have long been described by adults affected by their dog jumping on the bed, getting between the adults for a snuggle, with the adults forced to sleep on the edge of the bed. I simply say to those people (tongue in cheek), "Find a way to stop this from happening or train your dog to drive your car as he/she gets the best sleep." Basically, let sleeping dogs lie...in their own beds.

## **Pain**

Illness, pain, menopause and a whole range of medical issues can cause poor sleep and awakenings through the night. Many

people in training rooms have mentioned having trouble getting to sleep or staying asleep due to pain. Later in this book you will find what I believe is the formula for getting to sleep easily and quickly, which may even get you to sleep if in pain. If pain medication is required to get sleep, then it is likely worth it, as good sleep may assist people to have a higher tolerance for pain. Speak to your medical provider about what can be done to assist with sleep. Don't forget, there are specialists to assist with pain management, and psychologists who can help to refocus your thoughts away from some of your issues.

A few years ago, I witnessed an exercise physiologist named Kingsley Flett, who later became a good friend, assist ageing truck drivers get better sleep and a more rapid sleep onset with two simple exercises. Many of the truck drivers suffered aching backs, either from heavy lifting or poor posture when driving. The lower back pain caused delayed sleep onset or multiple awakenings through the night. One exercise was a stretching of the Psoas muscle, which attaches to the lower spine.

The other exercise (I believe it may be called a trunk-rolling exercise) was where Kingsley had the gents lie on their back with their knees raised and soles of the feet flat on the floor. Elbows out and flat on the floor, with the hands by their heads. The exercise was to gently roll the legs and knees (kept together) from side to side. After a while, the spine increased flexibility and Kingsley asked the men to roll their heads in the opposite direction of their knees. Kingsley referred to the increase in fluid to the spinal joints as a 'lube-job'. Done before bedtime, many drivers reporting getting to sleep easier than previous nights, with some reporting excellent sleep through the night. Please

consult a professional to ensure you get the right stretches or treatment to assist with pain and sleep, and do not attempt the exercises based on the information provided here.

### Menopause

The symptoms generally associated with menopause are caused by a reduction in oestrogen levels and can include hot flushes, night sweats, joint pain, sleep disturbance, anxiety, mood change, bone loss, and weight gain. It is well known that hormone replacement therapy (HRT) will aid in the reduction of these symptoms, however, there is little scientific research to say that sleep is improved by using HRT. This doesn't mean that it doesn't work. Merely that it hasn't yet been scientifically established.

HRT is now available in many forms, such as tablets, gels, patches or a pellet inserted under the skin. It is worthwhile discussing HRT with a specialist or GP, especially if your sleep is suffering. The basic problems sleeping while going through menopause include:

- Waking due to a hot flush
- The disturbance affecting the sleeping partner
- It's hard to cool down enough to get straight back to sleep
- The sleep disruption may cause a sleep debt to develop

It is important to try and maintain good sleep as it will increase resilience to daily issues, decrease the poor moods associated with menopause and will assist with overall general health. This, in turn may reduce the menopause period as the body is likely to transition better through menopause when the individual

is healthy. To get the best possible sleep while going through menopause and having hot flushes, try the following:

- Have a cool room - a remote controlled fan aimed directly at you could be turned on without having to get out of bed
- Use light (preferably cotton) sleep-wear and light blankets that allow you to keep as cool as possible
- Leave the sheets and blankets at the foot of your bed untucked so you can slip your feet out to help cool down
- Maintain a good circadian cycle, with consistent wake up times and bed times
- Be willing to have a shower if you feel you have been sweating a lot. This may help you to feel more comfortable about going back to sleep
- Ensure good sleep hygiene with a dark, cool and comfortable room

It is also wise to speak with others going through menopause to see if they have any other ways of reducing the discomfort caused by hot flushes and menopause generally.

## Sleep nonchalance

*"Until I'm six feet under baby I don't need a bed, gonna live while I'm alive, I'll sleep when I'm dead. Till they roll me over and lay my bones to rest, gonna live while I'm alive, I'll sleep when I'm dead, sleep when I'm dead, sleep when I'm dead. Gonna live while I'm alive, I'll sleep when I'm dead,"* - sings Jon Bon Jovi on his 1992 album *Keep the Faith*. It's kind of hard to get that tune out of your head once you've heard it. The lyrics are synonymous with many people's attitudes toward ensuring they get the most out of life.

For these people, sleep appears to get in the way of life, and it is not seen as important as everything else.

*“There are giants out there in the canyons, and a good captain can’t fall asleep.”* Billy Joel discussing the lot in life for a captain of a shipping vessel, the Downeaster Alexa, from his 1989 *Stormfront* album. This reflects countless business owners and corporate people who believe that if you want to run a successful company, sleep comes second to work. And only if there’s time left to get some at the end of a long day. Many corporate leaders, CEOs, and some political leaders, wear a badge of honour regarding how successful they have become because they have made the sacrifice of sleep. This was the case with the ‘Iron Lady’ Margaret Thatcher, Prime Minister of the United Kingdom (1979-1990), when she stated, “Sleep is for the weak!” Margaret was known to get around four hours of sleep on average per night. There is some debate on whether this short sleep over her adulthood may have contributed to the strokes and dementia that plagued her final years.

I often reflect on my own past work when I was a Senior Research Scientist with ARRB Transport Research for a total of eight and a half years. Much of my work was dedicated to road/driver safety and much of that had driver fatigue as a component of the research. Like thousands of others, I sometimes believed that my work was more important than seven to eight hours of sleep every night. I worked into the late night and sometimes early morning. What I discovered after quality-controlling documents the following day, was that there were many errors. This was important as some of the reports were for agencies such as the Australian Transportation Safety Bureau, the National Transport Commission and many State and Territory road authorities.

What I eventually learned was that after 16 hours awake, my work turned to rubbish and I suffered the next day, when after lunch I would struggle through the ‘post-lunch dip’ and become less productive than I wanted to be. I have worked out that 16 hours awake every day is best for peak performance and anything beyond 16 hours becomes a ‘false economy’ – that is, you waste time mis-performing and follow up with a sleep debt the next day. I haven’t done this since around 2004. I often wonder just how much better some of these famous CEOs could be if they chose to get adequate sleep instead of putting work above sleep.

## **Early rises for sports training**

I provided some sleep and fatigue management awareness sessions for Athletics WA some years ago. Most of the athletes were in their adolescent years, so required an average of around nine hours of sleep to be at their best. There were two major issues with sleep that may have affected their performances and held them back from being the best version of themselves. Early awakenings for training and use of electronics at night.

Most of the training for swimming and other water sports required athletes to be in the water around 6 am. Alarms were set between 4 am and 5 am, in order to be there on time. For an adolescent to get the required nine hours of sleep, this meant a bedtime of either 7 pm or 8 pm. This is way too early for adolescents. Especially those who enjoy being on social media or other forms of electronic screen time in the evening.

Professor Philippa Gander<sup>27</sup> from Massey University, New Zealand, and her colleagues, investigated the sleep of athletes with early training start times in 2020. They monitored the sleep/wake behaviour of 13 swimmers and 19 rowers, who wore



wrist-worn Actigraphs (devices that can measure body movement and plot sleep performance) and completed sleep diaries over a two-week training period.

They found that most of the athletes had a sleep onset time around 10:15 pm. On early morning training days, they averaged six hours and 44 minutes of sleep, compared to getting eight hours and 45 minutes on non-training days. The sleep for non-training days was within the recommended sleep length for adolescents. On weekends where no training was undertaken, athletes went to bed later, woke later and slept longer than on week nights. They also used electronic devices on 90% of the nights, which can sometimes impact sleep quality.

Personally, I imagine they would have performed better on their non-training days due to getting closer to the nine hours sleep required, than they would have on training days with shorter sleep. I have often wondered just how much better their personal bests may have been if they understood sleep needs better and training was set at a more reasonable hour to allow longer sleep.

### **Alcohol and drugs**

Broadly, the three categories illustrated here will be publicly available legal drugs, prescription drugs and illicit drugs. A common question asked in training sessions is “How does alcohol affect sleep?” What is widely known is that when you are very tired, a drink or two will have you asleep in no time. Alcohol will allow you to relax a little, which can assist sleep onset. I believe that one or two standard drinks may not affect your sleep too much at all, although I don’t recommend drinking that much for health reasons.

After consuming alcohol, you may wake after two or three cycles of sleep (in REM sleep) to go to the toilet. If you can get straight back to sleep then no damage is done. Once you consume up to five or six standard drinks, it may start to affect your sleep quality to the point that deep sleep and REM sleep are reduced in both quality and quantity. You will urinate once or twice through the night and will become a little dehydrated. Overall, your sleep will be affected.

When you drink much more than five or six standard drinks in a night, it is likely that your sleep almost becomes redundant. Quality and quantity of all sleep stages will be affected, you will become dehydrated and in worse-case scenarios, you will not transfer short-term into long-term memories. This can be the case for episodic heavy drinkers and for long-term alcoholics. Some recovering alcoholics have mentioned to me that they have literally years of memory gaps due to periods of heavy drinking which has affected their sleep. This reminds me of when the band Eagle's lead guitarist, Joe Walsh, said in an interview, "I only got drunk once - for twenty years". In a more recent interview (in his alcohol-restricted days), he was asked how he enjoyed his last tour. He replied, "Great, I remember this one!"

A further, very interesting effect of alcohol on sleep is the strange occurrence of urinating in places such as cupboards, corners and even refrigerators. Normally this is undertaken by men, however, some women have also admitted to doing such. This does not appear in research.

I have also met women who have been affected by drinking alcohol while going through menopause, although this also does not appear to be documented in literature. The alcohol is said to

increase the number of hot flushes a woman may have during the night of sleep. This can seriously affect their sleep. In summary, I think a glass of wine with dinner or a couple of occasional drinks with friends will have little impact on your sleep, unless you are personally affected by even small amounts of alcohol. You'll have to work that one out.

## Caffeine

Caffeine is commonly used to help either keep awake or to prolong performance, usually till the end of a work shift or long drive. Caffeine has a half-life of around six hours and therefore takes a long time to be removed from the body, sometimes impacting on sleep maintenance through the night (causing awakenings). A half-life is the time it takes for around half of the level of drug to be removed from the blood. It is useful to note that it takes around 20-30 minutes to enter the bloodstream, and people can get to sleep shortly after ingesting caffeine. However, after three to 4.5 hours of sleep, the remaining caffeine can stimulate the brain during the REM phase of sleep, causing sleep disruption. Let me throw in a couple of case studies of caffeine usage at the high end.

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### ***Tales from the training room – The Texas Haul Truck Driver***

An interesting character who was a haul truck driver in the iron ore region of Western Australia, spoke out during a training session at a mine. Having a little fun with his strong Texan drawl, “Hey Dr Nick, do you think four cups of coffee per shift (12 hours) is OK?”

I said: “Yes, it’s probably not going to cause any problems”.

His reply to this, “What if the cup is 1.5 litres?”

I said: “Houston, we have a problem!”

I went on to explain the half-life of caffeine. One level teaspoon of instant coffee has around 80 micrograms of caffeine and one heaped dessertspoon will have around 240 micrograms. Our Texan friend used 4 heaped dessertspoons of instant coffee per giant mug of coffee, or around 960 micrograms. If the first cup was consumed around 6 am, then 6 hours later (lunchtime) he will still have around 480 micrograms of caffeine in his blood. By 6 pm, his caffeine would reduce to around 240 micrograms. But by 9 am, he has had his second cup. By lunchtime, his third cup, and around 3 pm, his fourth. I don’t think you need to do the math to realise his sleep was possibly affected by caffeine.

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### ***Tales from the training room – Brisbane office worker***

After a training session in Brisbane, a lady came to me with an interesting question. “I had a caffeine addiction for five years and I have little memory of that five-year period – why?” Upon investigation, we got to what may be the root cause – caffeine’s effect on sleep. The woman worked in an office with a good quality coffee machine, and she became addicted to caffeine. To the point that she would consume around 20 cups per day. We spent a bit of time working out her caffeine levels through the day and into the night. When she went to bed at 10 pm most nights, she still had the equivalent of approximately 18 cups of instant coffee running through her veins. This addiction over the five years may

have amounted to a failure to commit short-term to long-term memory each night, similar to that of the previously mentioned long-term alcoholic.

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Some people simply like the taste or culture of coffee and tea, while others will use it for its properties of reducing the impact of feeling lethargic. Caffeine does this by attaching to the Ad receptors in the brain, which reduces the sleep promoting drive caused when the Ad receptors are becoming full of Ad. For some people this will have an alerting effect, while in others it simply allows them to go on for a little longer. The effects are variable between different individuals and can also be variable for one person on different days and situations. It may or may not have an influence on performance. There are no guarantees, and people are foolish to rely on caffeine consumption rather than appropriate sleep.

The reason I say this is that some workers have come to rely on power drinks that have caffeine, guarana and taurine in them. I have seen employees start nightshift with a can or two of these power drinks – using the caffeine as a crutch to get them safely through the shift. It may help you a bit, but it may not. Employees have a duty of care to obtain adequate sleep and arrive at work fully rested where possible. When they are not well rested, they should discuss fatigue management options with their supervisor, to safely manage themselves.

In a recent car crash (double fatality), the driver was said to have stopped prior to the crash and told his friend (from another vehicle), that he was extremely tired. His friend bought him a power drink, which was consumed and within twenty minutes, the driver fell asleep at the wheel, veered off the road and when

he woke to the noise of gravel, over-corrected back onto the bitumen surface almost sideways at approximately 110 kilometres per hour. The vehicle rolled several times and the driver, and his wife sadly died in the accident, leaving two young children behind. When you are tired and want to continue a drive, a 20-minute powernap is a safer option. These naps will be discussed later in this book.

Guarana has around twice the caffeine content of coffee beans and is used as a stimulant. It is easily obtained in soft drinks and can cause problems due to people consuming high doses. Guarana can cause increased heart rate and elevated blood pressure and in the past has caused heart palpitations and other undesirable effects. It can also be used as a mixer with alcohol, causing extended drinking binges as the Guarana reduces the normal sleepy effects of the alcohol. In extreme cases, people continue to drink and risk alcohol poisoning.

## **Pre-workout supplements**

These are used to 'hit the ground running' in the gym. Pre-workout supplements generally increase blood flow, adrenaline and stimulation prior to the workout, so a 'warm-up' is unnecessary. In regulated doses, for people who are both healthy and well educated on the use of the products, there appears to be little evidence to cause concern. However, there are some people who abuse the products, having taken too high a dose or using it to stay awake on nightshifts. For these and other reasons, any pre-workout supplement containing ingredient Dimethylamylamine (DMAA) has been banned from manufacture, storage, distribution and possession as from August 2012 in Australia, following on from bans in both Canada and New Zealand.

## Prescription Drugs

Many prescription drugs have chemicals that can cause sleep issues such as sleep onset insomnia or maintenance insomnia. It is always useful to discuss any prescribed drug with both the prescribing general practitioner and the pharmacist. Pharmacists are an awesome source of information on the effects, contraindications or side effects of medications. They tend to enjoy sharing this with anyone who is interested. It's a good idea to let them know if you work in safety-critical work and require healthy sleep to perform safely.

Anti-smoking drugs are commonly prescribed to assist with withdrawal from smoking. The author has heard a few reports from people who have used bupropion-based drugs such as Zyban and have had serious side-effects. Generally, they state that their dreams turn into episodes of bloodied murders, with one person stating that he was dreaming that he was the intended victim of one such murder. The Australian Adverse Drug Reaction Advisory Committee<sup>28</sup> reported that 285 (36%) of the 780 reports it received in association with bupropion through mid-May 2001 involved psychological disturbances.

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### ***Tales from the training room – I found out what I was capable of!***

A gentleman once told the training group that he used to take a number of different illicit drugs. He also smoked cigarettes and thought he would give that up as it's bad for your health. The doctor prescribed Zyban and he commenced his smoking cessation plan. This went well for a few days. One evening he had an argument with his wife

before bed. They went to bed grumpy with each other. Somewhere during his sleep, he woke feeling like something was wrong. Rising on one arm, he looked at his wife to see her glaring at him. "What's wrong with you?" he asked. "Look on your bedside table!", she yelled. There on the table was a kitchen knife and a bundle of hair which once was her pony tail. He had literally got out of bed, got a knife from the kitchen, and hacked off her pony tail. This shook him to the core. He gave up using Zyban and ceased use of all drugs from then going forward, stating, "I found out what I was capable of." Years later, they are still married, and he is a changed man! She has a shorter hair style.

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Champix and nicotine patches have also been said to affect sleep through very colourful and often bizarre dreams. My experience with discussions of Champix users is that if you don't have the bizarre dreams, the Champix is very useful in assisting with cessation. However, a larger number of people say they have to give up Champix so they can get back to having normal sleep. It is very important to ensure that the practitioners treating you are very aware of your risks associated with sleep disturbance using any of these products. Also make sure you discuss any side effects with the practitioners as soon as possible. One noted side effect from Champix is to have suicidal ideations.

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### ***Tales from the training room – "Next minute I wanted to hang myself!"***

A woman in her forties was in attendance at one of my training sessions and spoke sincerely about her



experience with using Champix to cease her nicotine addiction. She was going along nicely and had started to reduce her cigarette use. One day she was at home in the lounge just chilling and watching television, when her thoughts were interrupted by a serious urge to go out to her shed and hang herself. She thought deeply about this urge and quickly acted to avoid it. She went for a walk which appeared to clear the urges she had. The next step was to stop using Champix immediately, with no following episodes of suicidal ideation. If this case has you feeling down in any way, please stop reading and speak to a mental health professional.

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### **Sleeping medications**

As the term indicates, these medications are used to assist with getting to sleep and maintaining sleep over the night (or during the day for nightshift workers). Although many people find the use of the product very beneficial, there are many stories about sleep sex, driving cars, eating and fighting while asleep. As with any prescription medications, always let your practitioners know what your risks associated with disturbed sleep are before taking the medication, advise them of any side effects and ensure your employer is informed if you present to work adversely affected by the medication.

Research has indicated that the long-term use of sleeping medications can have serious consequences to health. If sleeping medications are required long-term, it is good advice to also seek the help of a sleep practitioner who may be able to find non-pharmaceutical ways of assisting your sleep. Short-term use of

sleep medications can be used without too many issues. I always say in training sessions, “Any sleep is better than no sleep.” That said, many sleep issues can be treated with behavioural treatments, which is certainly my preferred method of assisting people with different forms of insomnia.

If someone requires the use of an over-the-counter medication to get to sleep after the first nightshift, as it can be hard getting to sleep during the day, I encourage that. There are many over-the-counter medications such as herbal melatonin (non-prescription), Restavit, Sleep-Aid, and a raft of different pills and potions. If you want to experiment with any of these mild medications, always start small (say, a quarter of a pill) and adjust upward if necessary. Many people have started using a whole pill and found they woke very drowsy.

## Illicit Drugs

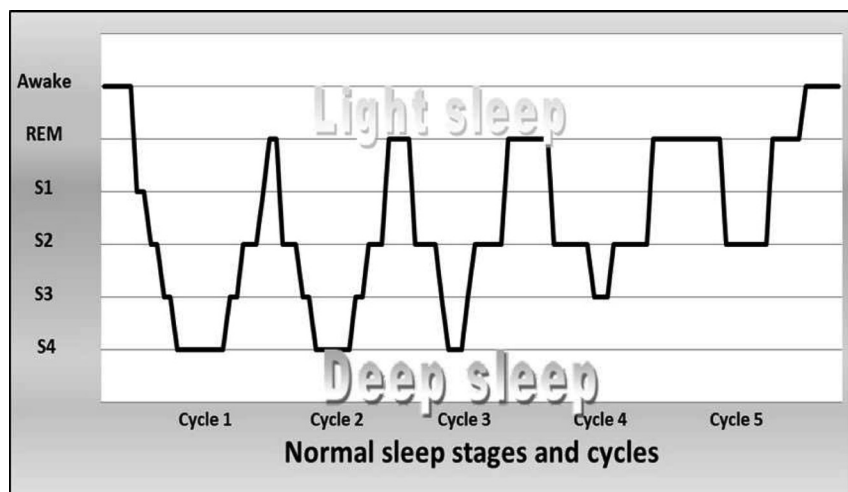
Although illicit drugs are mainly used for recreation purposes, stimulants are often used to remain awake for longer, and usually to enable a longer work period. For example, research into stimulants used on Western Australian heavy transport routes in 1999, found that around one-third of all long-distance heavy vehicle drivers in the study used either “*over-the-counter stimulants, prescription stimulants or illicit stimulants, due to the long hours of driving.*”<sup>29</sup> Stimulants, depressants and hallucinogenic drugs can affect sleep stages and cycles differently. Table 3 below shows the main classes of drugs, which will be discussed regarding their effect on sleep. Figure 14 follows to remind you of the normal sleep patterns shown in chapter one.

**Table 3:** *Classes of drugs.*

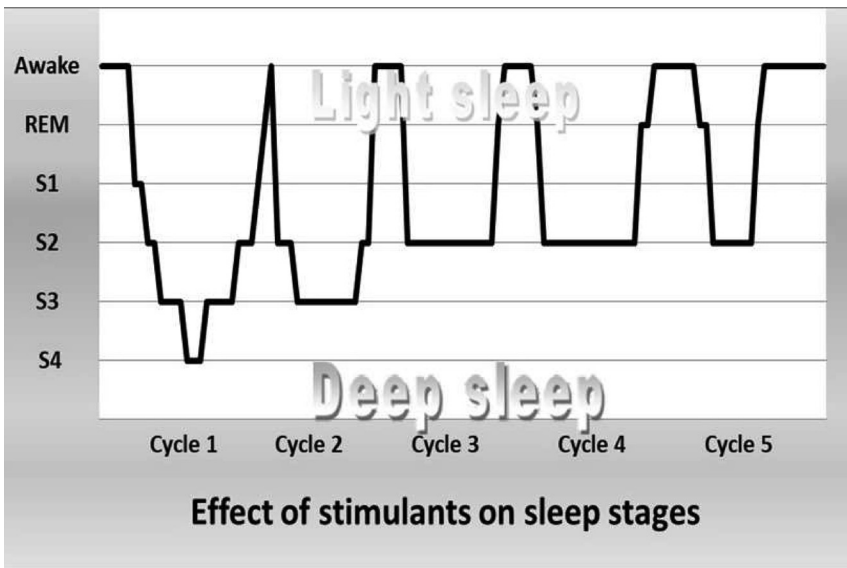
Stimulants	Depressants	Hallucinogens
Ecstasy, Speed Methamphetamine Amphetamine Dexamphetamine Phentermine Cocaine	Cannabis & Kronic GHB Inhalants Heroin Morphine Methadone	Bufotenin Psilocybin LSD PCP (Phencyclidine) Ketamine Mescaline

Stimulants remaining in the brain after sleep onset may have the effect of causing waking through the night, especially through REM sleep phases. There is also a reduced capacity to obtain deep sleep as indicated in Figure 15. Note the light sleep obtained.

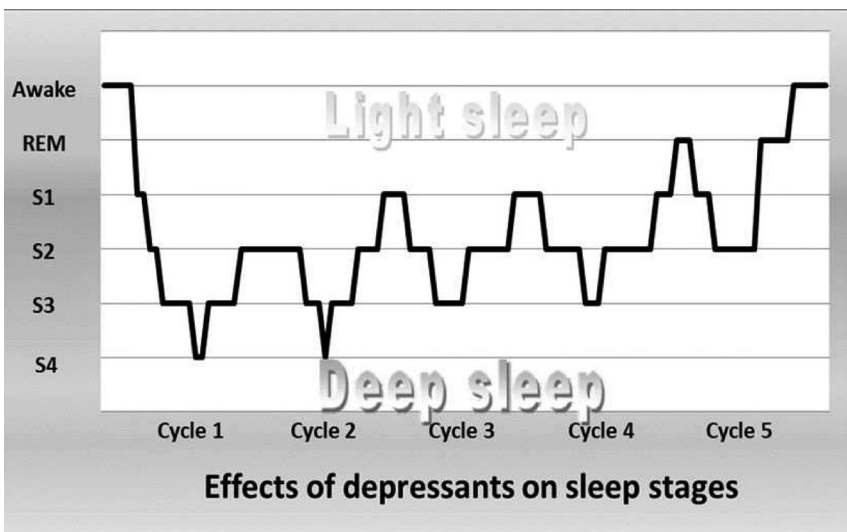
The effect that depressant drugs have on sleep stages and cycles is shown above in Figure 16. Note the compressed sleep, with little REM sleep



**Figure 14:** *Normal sleep stages and cycles without the effects of drugs.*



**Figure 15:** *Effect of stimulant drugs on sleep stages and cycles.*



**Figure 16:** *Effect of depressant drugs on sleep stages and cycles.*

Support for these sleep stage changes can be seen in people who use large amounts of cannabis. They are said to obtain very little REM sleep and can have issues with long-term memory retention. When giving up the use of cannabis, many users have suffered ‘REM rebound’, which is the brain attempting to pay back some of the long-lost REM sleep. Often this ‘REM rebound’ causes a multitude of dreams to the point that the person attempting to give up feels the need to re-commence smoking cannabis.

### Diet

While some foods can have a small effect on stimulating people (largely proteins and simple carbohydrates), other foods can have an effect on making a person feel a little sleepy. These are usually foods and drinks such as dairy products and lower glucose index (low GI) foods. Some people believe that a heavy lunch makes them feel sleepy. However, this can more often be a combination of timing (reduction of the core body temperature around 1 pm, known as the post-lunch dip), and having a sleep debt built up over the last night or two.

Where food and drinks affect sleep are when consumption is too close to bedtime, or the meal is a spicy one and it unsettles the stomach. The evening meal shouldn’t be too large as the body is not in need of a lot of calories to take to sleep. Rather, a small and healthy meal will have you sleeping normally and should neither affect sleep onset or sleep quality.

Gut health is also important for good sleep. There are a growing number of research projects that are investigating what foods may assist in obtaining good sleep and what foods might reduce sleep in quantity and quality. Overall, the basic outcomes thus far

appear to be that fibre and proteins tend to provide good sleep, and that simple carbohydrates and sugars provide worse sleep outcomes.

Diet is one of the three main pillars of health. I am not a dietician and will not make any attempts to influence people on diets. I have read some very good work by experts who appear to agree that a Mediterranean-style diet is one of the healthiest and best for long life, including the ageing brain. There have been mentions among these that red wine could be included but at very moderate measures. I do suggest that you make efforts to research what foods are healthy for you and your family and try not to be persuaded by fad diets. Some of these have been the subject of much scrutiny.

## **Exercise.**

Exercise is another pillar of health and used correctly, it can enable better sleep, improved health and provide benefits for people with several ailments. I can say from experience that too much strenuous exercise too close to bedtime can offset sleep. Whenever I get the opportunity to play indoor beach volleyball, I find that for each hour of play, there is nearly one hour of sleep delay. That could be a combination of the increase in dopamine and adrenaline from the pure physicality of the game, and it may also be that this is having its main affect during my first sleep wave. My first sleep wave seems to last around five minutes and it is easy to not even notice it if you are still pumped from highly competitive games. The 'sleep wave' I refer to will be better explained in the chapter on the 'Mabbott Method' later.

Exercise in the morning can be one of the best starts to a great day. It gets you pumped, releases beneficial endorphins and

sets up a good day. But that is not all it does, and there is much more to exercise than most people understand. Read Dr Norman Doidge's books on *The Brain's Way of Healing* and *The Brain That Changes Itself* and you will be amazed at how the brain can generate new brain cells when you exercise. This 'neurogenesis' of new brain cells could be one of the reasons that Alzheimer's sufferers and others with degenerative cognitive disorders can have bursts of memory returned, and moments of returning to their former being, after exercising, dancing and singing.

The main issue with exercise and sleep is if an injury occurs causing pain at bedtime, or when exercise is taken too close to bedtime. This can be a problem for nightshift workers who prefer to exercise before bedtime in the morning after a nightshift. Or some will wake after approximately 4.5 hours of sleep (common in people attempting to sleep during the day) and go to the gym and exercise to pass the time. This will almost certainly void any attempts to get further sleep prior to the following shift of work. Possibly the biggest issue may be that the exercise will heat the core body temperature, where a decline in core body temperature improves your chances of getting to sleep.

## Sleep Disorders

There are more than 80 classified sleep disorders according to the International Classification of Sleep Disorders (3<sup>rd</sup> Ed.)<sup>30</sup> They are grouped into six sections, namely:

- Insomnia
- Sleep Related Breathing Disorders
- Central Disorders of Hypersomnolence
- Circadian Rhythm Sleep-Wake Disorders

- Parasomnias
- Sleep Related Movement Disorders

The most common disorders that I find with people I educate are gastroesophageal reflux disorder, restless legs syndrome, sleep apnoea, and different forms of insomnia. They will be addressed in chapter four. These disorders have a huge effect on people's sleep, which can sometimes lead to mental and physical health issues. Not to mention the increased safety risk of fatigue incidents both at work and on the road.

## **MENTAL HEALTH**

### **Depression**

We all have moments or periods in our life when things get us down or we just find it hard to go on the way things are. However, if you have a depressed mood or loss of interest or pleasure in nearly all activities, which persists for two weeks or more, you may be suffering depression. Unfortunately, depression has carried with it a stigma that has caused many people to hide or conceal the disorder. Ultimately, this reduces the chances of gaining the much-needed help that has benefitted so many people who have chosen to use it.

Table 4 illustrates some of the symptoms of depression. Normally, one requires several of the symptoms before a clinical diagnosis will be made. It is important to note that the table is not a diagnostic tool for the disorder. A registered professional should always be consulted when considering a diagnosis of depression. Efforts to self-test can cause unwanted grief with incorrect assessments. Your GP, or local psychological help group can be a good starting point.



**Table 4:** *Symptoms of depression.*

Emotional symptoms	Cognitive symptoms	Behavioural symptoms	Physical symptoms
Low mood	Pessimistic	Sleeping problems	Aches and pains
Irritability	Poor focus	Isolating oneself	Diarrhoea/constipation
Short temper	Guilty	Procrastinating	Loss of sex drive
Lonely and isolated	Worthless	Aversion to activity	Poor personal grooming
Unhappy	No future	Loss/increase appetite	Weight gain/loss
Worried	Suicidal ideations	Restless	

Depression causes changes in sleep pattern, especially an increase in REM sleep. This is likely to cause more frequent awakenings. It is also widely accepted that sleep restriction or poor-quality sleep, can bring on depression or make the condition worse. If you feel you may have depression, seek help from a professional as soon as possible. If you, or anyone you know have suicidal thoughts or comments on death, take it seriously and seek emergency help immediately.

## Stress/anxiety

Stress affects different people in different ways. Some people thrive on stress and require a reasonable amount of stress to kick them into action. The other end of the spectrum is the person who finds it hard to cope with stress. There is a lot in between these two dimensions. Table 5 below shows some of the symptoms you might experience when stress becomes an issue. It is important to note that the table is not a diagnostic tool. If symptoms of stress affect your life, your sleep or carry on for a long time, consult with your mental health provider or GP.

**Table 5:** *Symptoms of stress*

<b>Emotional symptoms</b>	<b>Cognitive symptoms</b>	<b>Behavioural symptoms</b>	<b>Physical symptoms</b>
Moodiness	Pessimistic	Sleeping problems	Aches and pains
Irritability	Poor memory	Isolating oneself	Diarrhoea/constipation
Short temper	Poor focus	Procrastinating	Increased urination
Unable to relax	Anxious	Alcohol/coffee/smokes or drugs to relax	Indigestion
Overwhelmed	Constant worrying	Nervous habits (e.g., nail biting)	Nausea
Lonely and isolated	Poor judgment		Rapid heartbeat
Unhappy			Loss of sex drive

## COVID-19

The global COVID-19 pandemic started in late 2019 and by February 2020, had become a global pandemic. The virus caused fear and panic around the world, as millions of people contracted the virus and hundreds of thousands died as a result. One of the most important countermeasures applied by governments, was restrictions of people movements. This included forced social isolation in homes, causing fear, panic-buying and anxiety. Italian researchers<sup>31</sup> utilised an online survey to collect information on socio-demographic data and other COVID-19 information from people living in Italy. They collected information from 2,291 respondents on sleep quality, sleep disorders, generalized anxiety symptoms, psychological distress, and post-traumatic stress disorder (PTSD) symptomatology related to COVID-19. Results showed:

- 57.1% reported poor sleep quality
- 32.1% high anxiety levels

- 41.8% high distress
- 7.6% reported PTSD symptomatology linked to COVID-19

A significant relationship between sleep quality, generalized anxiety, and psychological distress with PTSD symptoms related to COVID-19 was established, especially among women, the youth, and those in fear of contact with COVID-19 sufferers.

Another interesting research article examined people who had been at home during COVID-19 for at least 60 days each. They found that a large portion went to bed later and rose later the following day, compared to when they were socially encouraged to wake earlier for work and other demands. This is quite common with people who have lost their jobs. It appears that without the need to wake early for work, many people revert back to what used to be a 'normal' bedtime routine of 10 pm or 11 pm in bed and 7 am to 8 am rise. This is usually only a problem when they return to work at some point and have to adjust backward. Or their partner still works and has totally different sleep onset and wake times.

At the time of writing this section (May 2021), Australia had worked swiftly to keep infection rates at a minimum. Australia's remote isolation from the rest of the world certainly helped the cause. More so when international flights were closed down. My own work drew quickly to a close, as most of my work involves standing in front of people in large groups discussing sleep. The world felt different, and you could sense that people had become anxious in many areas of life. It is quite likely that the sleep of Australians has been affected somewhat similarly to those in the Italian study. Research from other jurisdictions is showing similar results also. I am left to

ponder the mental and physical effects the pandemic has had globally. Time will tell.

Moving back to a more positive note, at this point I am hoping that readers now have a better understanding of what sleep is, how it works and all the benefits that can come from getting the appropriate amount. If I have been successful over these past years, it has been because I have helped people to better understand and appreciate all that sleep can be. Many people have known for most of their adult lives that seven to eight hours of sleep on average is what should be obtained each night. This knowledge alone has had little impact on people attempting to get that. What I now see due to making people aware of sleep's beauty is people both wanting more and trying to get more. If you now fit into this growing category, keep reading – you won't be disappointed!



## *Part Two*

# When Sleep Goes Pear-Shaped

“**B**ed is for sex and sleep only,” I said to Paul as I provided sleep coaching to aid his 15 years of sleep which was reduced to just three hours per night. “If you’re not lucky enough to be doing either, don’t be in bed.” In chapter three, we discussed the raft of issues that can affect your sleep. In this part of the book, we are going to focus on sleep disorders. The story of Paul’s issue with sleep maintenance insomnia is used to highlight how even the worst of sleepers can be helped.



## *Chapter Four*

# Solutions For Sleep Disorders

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**T**he International Classification of Sleep Disorders – Third Edition (ICSD-3) lists six main categories that cover more than 80 sleep disorders. The categories are:

- Insomnia
- Sleep Related Breathing Disorders
- Central Disorders of Hypersomnolence
- Circadian Rhythm Sleep-Wake Disorders
- Parasomnias
- Sleep Related Movement Disorders

This book isn't intended to be used to identify and treat sleep disorders. Merely to offer an understanding of some of the common disorders and some guidance to enable people to get the treatment/s they require.

### ***Insomnia***

Many sleep scientists state that insomnia is more a symptom of something, than it is a disorder in itself. For example, if

you have a lot on your mind and can't get to sleep, we call it insomnia, rather than simply being overwhelmed or having too many things on your plate. Nevertheless, I like to break insomnia into two categories depending on the length of time the person has the issue: 1. Acute insomnia – lasting a week or so, and 2. Chronic insomnia – lasting longer than months in many cases. We can further break insomnia into two common sub-types, which describe how the issues affect different components of sleep:

1. Sleep onset insomnia – this is where the sufferer has problems getting to sleep in the first place and is the most common form of insomnia affecting many people.
2. Sleep maintenance insomnia – the person gets to sleep but wakes up and has trouble getting back to sleep. I seem to be hearing more of this issue than sleep onset insomnia of late.

There are other forms of insomnia, and if you have a form of insomnia that doesn't fit into what is described in this book, I urge you to seek assistance from a general practitioner or sleep professional.

## **Sleep onset insomnia**

There are many different reasons that a person can't get to sleep. I'll focus on an issue that I see as commonplace within the large volumes of people that I teach.

## **The circadian timing of sleep onset**

The two basic questions that I ask when someone is asking me for sleep assistance are: 1) What time do you wake up each day?



and 2) What time do you go to bed each night? The tenets of good sleep are a mix of the following basic ingredients:

- A healthy diet
- Regular exercise
- Routine bedtimes and wake times

The time that you get out of bed in the morning sets the clock ticking regarding the build-up of waste products and adenosine in the brain. We learnt in part one that the homeostatic drive for sleep is generally governed by the influence of adenosine acting on parts of the brain to drive you to sleep. Time is key here. With this in mind, have a look at Table 6 to see an example of how different wake times can upset your rhythm by providing a different sleep onset time. Importantly, look at how sleeping-in on the weekend to catch up on sleep can start the next week poorly.

**Table 6:** *How your wake time sets your sleep onset time.*

Wake time and day	Hours of sleep	Notes
6 am Tuesday	7-8	Sleep onset time is 10 pm to 10.15 pm Tuesday night and it should be easy to get to sleep.
4.30 am Wednesday - early start for gym	6.5 Restricted sleep	Sleep onset time is now 8.30 pm to 8.45 pm Wednesday night. The person may resist going to bed that early even though they may feel sleepy.
6 am Thursday	7-8	Sleep onset time is 10 pm but may feel sleepy earlier due to a possible sleep debt carried over from Wednesday.

6 am Friday	7-8	Probably won't notice that you have not caught up on the sleep debt but may still underperform. Sleep onset time is 10 pm.
8 am Saturday	9-10	Nice sleep-in to catch up on any sleep debt. Will feel good. Sleep onset time is now midnight and it is unlikely you will sleep before this.
8 am Sunday	7-8	Sleep onset time is now midnight and it is unlikely you will sleep before this. However, you will go to bed early due to the 6 am Monday start. You will not likely sleep until midnight as it is not your sleep onset time till then. The anxiety about missing the alarm will also wake you through the night.
6 am Monday	5-6 Broken, restricted sleep	Sleep onset time will be 10 pm but your brain will cause a homeostatic sleep drive earlier in an attempt to pay back your sleep debt. It is likely you would have underperformed at work and been unsafe driving and working due to the poor sleep. We call this 'Mondayitis'.
6 am Tuesday	7-10	If you went to bed early to catch up, then you may have got up to 10 hours. Your sleep onset time is still 10 pm.

There is a little bit of variance with the sleep onset times shown above and it is often closer to 16 hours and 15 minutes after wake time. My best advice is to establish the best wake times for every day and try to keep the weekend the same where you can. Having a good circadian rhythm and getting your full amount of required sleep night after night sets you up so that if you have one short night of sleep, you tend to bounce back quicker. I have established a simple format for keeping a good circadian rhythm that is shown below.

### ***The Mabbott Method – asleep in ten minutes***

This method of getting to sleep, has literally assisted thousands of people get to sleep easy (within ten minutes) most nights and has assisted in their learnings of good sleep management. I developed the system around 2010 and had thousands of mining employees try it and report back on its success. Naturally, there were a few who the system did not work for, but that's life, isn't it? The system has some level of science behind it and a healthy dose of practicality. Here's how it came about.

I was delivering fatigue management training at a mine site in Australia, being accommodated in the site camp accommodation. The accommodation was the standard set of units, or 'dongas', which are generally around three metres by three metres, with a single king bed, a bar fridge and desk, and a separate small ensuite. Basic, but appropriate for a good sleep. I had to wake at 4.30 each morning to get ready for work, go to the mess for breakfast and to pack lunch, then get on the bus to work for a 6 am start. I knew that if I was waking at 4.30 am, then my bedtime should be around 8.30 pm. This is 16 hours awake which should make me sleepy around 8.30 pm.

One night I was lying in bed watching Bear Grylls on television, doing his normal thing, surviving the wilderness by eating all sorts of weird stuff. It was getting toward 8.30 pm and I didn't feel sleepy at the time. Getting to around 8.40 pm I was yawning and feeling like my eyes would close soon. I reached for the remote to turn the TV off. At that point, Bear Grylls caught a turtle and he was speaking of ways in which he might eat this turtle. Decision point – do I turn it off, or is it interesting enough to watch and put my sleep off for a few minutes? I chose the turtle! Around 8.55 pm, Bear had eaten the turtle and I had learnt a new skill. So,

I turned off the TV with the intention of going straight to sleep, as I had been nearly falling asleep earlier.

As I lay there minute after minute, after minute, I soon realized that I wasn't sleepy anymore. In fact, an hour later I was still thinking about that darn turtle! I eventually got to sleep around 10.30 pm that night, and had just six hours of sleep, prior to standing in front of a group of people to explain how seven to nine hours of sleep is a good thing for most people. This made me sit up and think about how it could be that you can be nearly asleep, get interested in something on TV, and get a 'second wind'. What the hell is this 'second wind' all about?

It was at this point that I remembered an old research article by Peretz Lavie<sup>32</sup> titled 'Nocturnal Gateways to Sleep' where he describes the sleep onset as an 'all or none phenomenon'. He also described 'forbidden zones' where it was not normal to sleep. Naturally, I found the article and had a good read. I was most interested in the 'gateways to sleep'.

I was at the mine site for a number of days, which gave me ample time to experiment with my sleep onset time in relation to the 4.30 am wake time. For the next several nights I was in bed at 8.30 pm and waiting for a sleepy feeling (a gateway to sleep). Without fail, it came around 8.40 pm to 8.45 pm each night. I then started suggesting to the miners that they try this and see how it goes for them, as most of them had the same wake time as I did (4.30 am).

With only a couple of exceptions, large numbers of miners either spoke to me or emailed me regarding how their heads barely hit the pillow before they fell asleep. Some said it was their best sleep in years, and most continued to apply this method to get around seven and a half to eight hours of sleep each night.

Some supervisors were telling me that their employees were much happier at the start, during, and at the end of their days. It seemed to lift their morale and camaraderie within the groups. I was onto something!

I called it the 'Mabbott Method', as it was hard to direct people to anything else that made them want to try a different way of getting to sleep. Over recent years, the Mabbott Method has had a huge impact on people's sleep onset. When I deliver fatigue management training to groups, I give them a simple formula:  $A + 16 \text{ hours and } 10 \text{ minutes} = \text{SW1}$ . This means your alarm time (A), plus 16 hours and 10 minutes, is the general homeostatic time that your body should be ready for sleep. The SW1 is what I believe to be the first sleep wave for that night. At this time, your adenosine level has risen to a point where your brain should be about to commence a sleep drive. In conjunction with this, your core body temperature will be falling, which assists with sleep onset. Also, at this point, the hormone melatonin will assist in sleep onset. Many people experience this while watching TV in their lounges, only to be woken and told to 'go to bed'. When they do, they can't sleep. This is the dreaded 'second wind'.

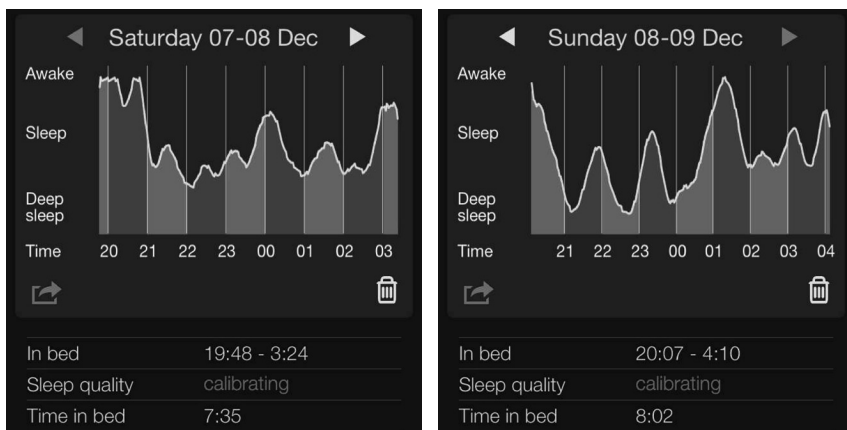
What I believe to be true, and hundreds of people describe this, is that if you miss the first sleep wave, it sometimes goes away for what seems like around 60 - 90 minutes. This could be Peretz Lavie's 'forbidden zone'. Interestingly, this equates to the same amount of time as a full cycle of sleep. Many people will call this insomnia, when it is actually going to bed at the wrong time for your circadian rhythm.

The Mabbott Method suggests that you know when SW1 is and you are ready for it, so that you don't have to wait for SW2 (sleep wave 2). I have no scientific reason for why this occurs in so many

people, but it seems to. In this case, the person sleeping on the second wave will get a maximum of six hours of sleep only. When I speak of this in training groups, many nod in agreement with normally catching the second sleep wave and getting six hours of sleep.

Figure 17 below shows the sleep data of a night of sleep before and after applying the Mabbott Method of sleep onset timing. The app was the 'Sleep cycle alarm' app for iPhones. It showed that by going to bed closer to the sleep onset time, the man fell asleep quicker and slept through to his alarm, as opposed to being in bed awake for a while. The three-hour sleep and fatigue management training session occurred during the morning of the Sunday.

A decade or so ago, many mining groups I spoke to had around half of the employees averaging 6 hours of sleep each night when on dayshift. If they worked 7 days straight, the average person who required 7.5 hours of sleep per night would go home with a sleep debt of 1.5 hours per night (seven x 1.5 = 10.5 hours). Many



**Figure 17:** Before and after learning about sleep onset time.

of the employees who had thought that their regular 6 hours per night was adequate, were happily surprised to find how much better they felt obtaining the new 7.5 hours on average.

Apart from sleep onset timing, stress and anxiety often cause issues with getting to sleep. Described as a ‘racing mind’ or ‘my brain won’t stop’, some people can’t allow the natural sleep drive to work, due to worries and concerns in their life. For some people, it’s their job to plan and manage things. Only sleep onset time is not the best time to do it. I say to these folk, “Do a brain dump half an hour before bedtime – write down what you need to do tomorrow or what it is that you can’t forget, then go to sleep.” By writing down thoughts and concerns, the brain is processing and putting into memory that which must not be forgotten. It not only allows you to get to sleep knowing you have thought about the issue, but the brain will have less work to do during REM sleep – that period of time where the brain organises you for tomorrow. This will often result in less awakening during the night.

### **Sleep Maintenance Insomnia**

There are many other reasons for sleep onset insomnia, such as pain, anxiety, depression, social influences, and all that was mentioned in chapter three. Most of these influences, and especially anxiety, often also cause sleep maintenance insomnia. At a recent conference I was in front of around 200 attendees. I asked how many people suffered sleep onset insomnia quite regularly. Around half of the group put their hands up. I then asked how many suffered with waking through their sleep and have trouble getting back to sleep. More hands went up! It appears that society is taking on more than it can deal with, and

the anxiety is waking people during their REM cycles, when the brain is attempting to process the myriad of current issues.

People who seem to suffer the worst are those who have to organise things the following day, those who have an exam the next day, or a performance (weddings included here). The cause of the awakening usually commences with a novel situation, such as those noted above. How people deal with the awakenings often determine whether or not the insomnia is acute (short-term) or chronic (long-term). Acute insomnia will cause some level of sleep disruption but can often be managed well. It is when the issue becomes long-term, or chronic, that people suffer in all sorts of ways. Let me explain, using a case study from a few years ago.

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### ***Case study – Paul the logistics supervisor***

I met Paul at a transport forum where I was presenting the ‘Science of Sleep’ presentation, which had become very popular in Australia. At the close of the forum, Paul introduced himself and asked for help with his sleep. He said that over a 35-year period, the shiftwork has ruined his circadian rhythm and he was all over the place with sleep. We commenced with a one-week sleep diary to get an overview with how he normally slept. The diary showed that a normal night of sleep would commence around 9 pm. He got to sleep straight away but woke up after his first full cycle of 90 minutes. He then lay there waiting to get back to sleep.

Paul didn’t use technology when awake, he just lay in bed waiting to sleep. He often got back to sleep and added one more 90-minute cycle before the alarm would wake him. For as long as Paul could remember, around 3 hours was all the



sleep he would normally get. He felt that his life was going downhill fast, including his health, wellness, and safety. He was worried about a premature death.

I provided a series of suggestions which he put in place immediately. They were to eat healthy every day, go for a 30-minute walk every morning and then work on his bed habits. Paul started with ordering 'Lite n easy' delivered to his door. This is a healthy meal plan that only needs to be prepared, taking out the need to buy healthy food and make meals. Paul also commenced walking immediately. Now for work on the bed routine.

What I explained to Paul was that if you lay in bed for too long without being asleep (I think 20 minutes is too long), the brain feels that it is OK to lay in bed and not sleep. He needed to re-train his brain to understand that his bed serves two purposes only. For a great introduction to how you can retrain your brain, read Dr Norman Doidge's books that I mentioned earlier. "*Neurons that fire together, wire together*" is the quote I use from Doidge's books to illustrate how the brain can learn to lay there awake if you let it. "Bed is for sex and sleep only". If you're not lucky enough to be doing either, get out of bed," I mused to Paul, as part of the coaching program.

The brain learns but can unlearn and re-learn. Paul's instructions were to get out of bed if still awake after 15 minutes and read a boring book in a not too bright area. No technology and no excitement. This getting out of bed to read a book serves one single purpose. It helps Paul to 'unlearn' the association of bed and being awake, that he has allowed his brain to develop over the past 15 years. Paul

was only to put the book down and go back to bed when he felt sleepy again and not before. It must be stated that for the first few nights Paul may not actually get back to bed, so safety on the road and at work could be highly compromised.

By only being asleep while in bed, Paul would eventually re-train the brain (using 'neurons that fire together - wire together to re-learn) that bed is for sleeping and not for when he was awake. After a while Paul's brain obviously reacted well, as he was spending less time out of bed as the nights went by. Paul was retraining his brain. About two weeks into the sleep coaching, Paul sent me this email:

*"I do appreciate the effort you are putting into me, and I am seeing results. I am sleeping soundly for the first four hours, waking up and reading for one to one and a half hrs and going back to bed and sleeping. A few nights the second half hasn't been that good but a lot better than the old me. I am generally waking up feeling fresher. I have not read a book in ten plus years, have now read three and enjoying it. Never read in the past because I could not keep awake whilst reading. I hope to one day be able to sleep eight hours without waking. Oh, it will be lovely."*

After three weeks of further work, this is the email I got from Paul:

*"Nick, I am really pleased with the progress, I do feel fresher in the morning and I am getting more sleep and quality sleep before waking up. I get up, put track pants on, a jumper on and slippers on and go out in the kitchen and sit at the table with the lounge room light on behind me. Read for about an hour and then back to bed. Sometimes takes a while to get back to sleep but I know I will."*

A further two weeks pass and another email:

*“Nick, progress is good, Last night for the first time I didn’t wake up, sleep from 10:15 pm to 5:40 am, Absolutely beautiful. Never thought the day would come that I would sleep a full night. Again, thanks for your help.”*

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Paul was a great example of how we try to do the right thing (get back to sleep) but don’t realise that if we lay there thinking, we teach the brain that this is what bed is for. I have coached many others since Paul and while writing this section, finalised a period of help for a man who slept around 90 minutes each night and had a nap of between 10 minutes and 2 hours each day. He is now averaging between 6 and 7 hours of uninterrupted sleep at the moment. His wife is very pleased about that, and he believes it has added years to his life. He has recommenced some of the work he hasn’t done for years and taken on a project making wooden toys for disabled children. He has his life back!

## ***Sleep Related Breathing Disorders***

There are a number of sleep related breathing disorders that affect infants, children and adults. For a full rundown on these, consult your general practitioner who will direct you to the most relevant specialist. We will discuss obstructive sleep apnoea, as this disorder affects thousands of people and can have terrible outcomes if left unchecked.

## **Obstructive Sleep Apnoea (OSA)**

Imagine this: You’re lying there snoring loud enough to be heard through the walls of the bedroom. Your partner is lying

awake, uncomfortable, annoyed, distressed about losing sleep and worried about your health. She rolls toward you and gently shakes your shoulder. "Wake up honey, you're not breathing". Nothing, not even a stir. A larger, more pronounced shake of the shoulder and a louder, "Honey!"

"What's wrong?" comes the reply.

"You stopped breathing again," she says.

Angrily you say, "No I didn't, let me sleep, will you?"

She replies with, "Sorry, I just get worried about you".

The final grumpy retort, "For goodness' sake, just go to sleep and leave me alone, will you?"

She rolls back and prepares for the cacophony of nasal sounds that indicate you are asleep again. There it is...snore, snore, gasp. She rolls back toward you and prods your ribs with two fingers, not in a nasty way, but enough to break the silence of the breathing cessation. This one has lasted more than 30 seconds. You gasp for air, stir a little and then it begins again... snore, snore, gasp.

The alarm sounds at 6 am. You struggle to wake, roll over and hit the snooze button. Five minutes of bliss until that dreaded sound again. You're ready to throw the mobile phone with its stupid alarm across the bedroom. Instead, you stumble out of bed, rub your bleary eyes and head for the bathroom. Go to the toilet, quick shower and shave and head back to the bedroom to get dressed for work. You glance at your wife who is fast asleep, snuggled up and looking peaceful right there where you would love to be. She woke you several times last night, your turn now. "Come on, honey. Time to get up and start the day."

Her eyes open quickly with a glare that could kill.

“What’s that look for?” you ask.

The reply, “You snored all night and only stopped when you held your breath. Surely that must be bad for you! I know it’s bad for me.”

Dismissively, you say, “I’m tired but I’ll get by. I always do”. Off to work you go.

Two months since the breathing cessations started and you haven’t done anything about it. It doesn’t seem to affect you. You get tired when driving and sometimes in the afternoon at work, but doesn’t everyone? You manage. You drink lots of coffee, close your eyes for a few minutes when no one’s looking and when you’re driving home, fix the sleepy spells by winding down the window, singing loudly and slapping your face. What could be wrong with that, you might ask?

Your relationship is taking a bit of a turn for the worse. Your wife now sleeps in a separate room, but this is good because she is not as grumpy as she was for a while there. You’re having a lot of trouble communicating with the kids. They do lots of things to annoy you: they make noises when they don’t need to, chase you for attention and want you to help them with homework and to fix their skateboards. They never used to annoy you but now they sure do. At work, everyone is annoying you. It seems that nearly every colleague and every boss is making you angry. Not sure what’s got into them, but you think of looking for a new job.

To top off all of what’s going on, the doctor has just informed you that your last fasting blood test indicated a high blood glucose level, and he wants you to do a glucose tolerance test to see how much of a problem it may be. He also mentioned that this could be one of the reasons you are constantly going to the toilet. And you were worried about your prostate!

Obstructive Sleep Apnoea (OSA) occurs when part of the throat collapses and causes a cessation of breathing. There are many components of your airway that can constrict your breathing: adenoids, tonsils, enlarged uvula or soft palate, tongue drawn down by a receding jaw or excess tissue surrounding the neck and pushing into your airway when you sleep. What generally occurs is that you breath out (exhale), usually in the form of a snore, then when you attempt to breath in (inhale), part of your throat collapses restricting the flow of air into your lungs.

To understand this, imagine trying to breathe through a soft plastic bag with the bottom cut out. You can breathe out through the bag, and it will make a flapping noise (similar to a snore). When you try to breath in, the soft plastic of the bag will collapse making it impossible to draw in air. Older people will remember a similar problem they had with the paper straws used to drink from. Halfway through the drink the straw would get moist and soft, and collapse. The harder you sucked, the less you got! This is similar to the airway of someone with obstructive sleep apnoea. And now the paper straws are back too!

Breathing is performed at the subconscious level and organised in its rhythm through the brain stem, or medulla oblongata. The chest expands causing the lungs to expand and draw in air through the oesophagus. If the airway collapses closed, no air can be drawn into the lungs. Having little air left in the lungs means there is less air for the bloodstream. Receptor cells that reside in the cardiovascular system feeds back information to the brain stem on the level of carbon dioxide in the blood. Increased carbon dioxide will lead to an increase in both the depth and rate of breathing. However, if part of your throat has collapsed, no air will enter, and a different mechanism is required. Your brain will

have to move from the current sleep stage you are in, to arouse the structures of the throat to open and let air in. This is usually where you gasp for air.

Although you have usually moved out of the sleep stage you were in, it is unusual for you to wake. Most sufferers have no idea that they hold their breath during sleep until either someone informs them (normally a partner or perhaps a friend on a camping trip), or as a result of a good medical or mental health diagnosis. However, many health professionals have, in the past, overlooked obstructive sleep apnoea as a cause, or contributor to, issues such as depression, type 2 diabetes and a whole range of other illnesses. Later in this book, I will fully explain how the progressively restricted sleep affects weight gain to the point that the neck increases in size, making the problem worse.

As the apnoea disorder gets more severe, it becomes normal to have 10 or 20 cessations per hour. This will seriously affect sleep, as the cessations usually become longer, and the breath is held for a longer period. Tiredness during the day becomes normalised for most sufferers and starts to impact safety and attentiveness. I see this effect in the classroom, where people apologise profusely for falling asleep during training. It can get that serious that when stopping at a red-light intersection, a person can be asleep before the light turns green again. At this point, a sufferer may be having up to 60 cessations per hour and it is not unusual for the cessations to average over 20 seconds at a time. The daytime sleepiness is referred to as 'Excessive daytime sleepiness'.

There are a multitude of research articles on the extent to which living with untreated sleep apnoea affects almost every

aspect of a person's life. What I have personally seen and heard from literally hundreds of sufferers are the following issues:

- Onset or worsening of type 2 diabetes
- Increased weight gain
- Cardiovascular issues such as stroke, heart attacks, seizures, and related problems
- Mental health issues which can lead to poor workplace, family and social consequences
- Continuously tired and grumpy, causing family and social conflict
- Workplace incidents and serious (and sometimes fatal) vehicle crashes.

Research also indicates that ageing brain processes can be increased prematurely. My best advice, if you think that you or someone you love has the disorder, is to visit a GP as soon as possible. The GP will direct you to a specialist who treats the disorder.

The treatment for OSA is usually one of two forms. If the cause of the apnoeas are due to obstructions in the airway (adenoids, tonsils, uvula, etcetera), an ear, nose and throat surgeon may be able to remove the obstructions surgically. However, I have met a few people now who have had surgery on their throat, and it hasn't reduced the number or severity of the apnoeas. They have endured two weeks of pain for no gain. I always say in class, "If you're considering surgery for your throat, act like a carpenter – measure twice, cut once." In other words, get a second opinion before you commit to surgery.



The second, and more common treatment, is the use of a continuous positive airway pressure device, or CPAP as its commonly referred to. There is also an automatic positive airway pressure device, or APAP. One is set to a predetermined level and the other automatically adjusts the output pressure. These comprise a small machine which sits near to the sufferer while they sleep, and pushes air into the nose, or mouth, or both, through soft tubes and a face mask. The air pressure literally forces the collapsed airway to expand and allows air down into the lungs.

Many find them uncomfortable and hard to get used to. Once a person is used to wearing the device, it completely changes their life for the better. I have met people who appear to have a new lease on life, through improved sleep. They tend to have more energy, better moods and a significantly safer performance on almost every task they perform. Some reconnect with loved ones after months or years of poor moods have pushed them apart. They add years to a sufferer's life and are worth anything you might pay for one. People take them camping, on holidays or to workplace accommodation on fly-in, fly-out, or drive-in, drive-out operations. They soon know their value.

### **Central Disorders of Hypersomnolence**

Hypersomnolence is a term used to describe feeling very sleepy during the day, even when you've had sufficient sleep. There are various causes of hypersomnolence, including those related to medical disorders, medications or other substances, psychiatric disorders, or idiopathic (unknown cause). Restricted sleep may also cause hypersomnolence. Kleine-Levin syndrome is a disorder where people can sleep during the day for up to

20 hours at a time. This is quite a rare disorder. A not so rare disorder is narcolepsy. There is a great website which describes the five symptoms of narcolepsy very well<sup>33</sup>. They use the word 'Chess' as an acronym for the symptoms:

- **C - cataplexy.** Loss of muscle tone while still conscious. Can be brought on by stress, excitement, laughter, anger, etcetera
- **H - hallucinations.** Dreamlike experiences when falling asleep (hypnagogic hallucination) or when waking up (hypnopompic hallucinations)
- **E - Excessive daytime sleepiness.** This is the main symptom and is the inability to stay awake or alert through the day
- **S - Sleep paralysis.** Often accompanied with the hallucinations noted above. It is an inability to move muscles or to speak, usually through a frightening or threatening nightmare
- **S - Sleep restriction.** Sleep is restricted due to disruptions of sleep

A narcoleptic person requires a specialized treatment plan to enable them a normal life. They may not be able to drive a vehicle due to the sudden onset of sleep or cataplexy of the muscles. Treatment plans often include medications to assist and are not always effective.

## CIRCADIAN RHYTHM SLEEP-WAKE DISORDERS

### Delayed sleep-wake phase disorder

Have you ever entered your teenager's bedroom at 10 am in the morning only to find them still fast asleep? This is not

uncommon, and it is also not uncommon for teens to get scorned for 'being lazy'. A teenager may not actually have a disorder, as they naturally move to a delayed sleep-wake rhythm. This entails going to bed late and waking late. That said, a normal, healthy teenager should average around 8.5 to 9 hours of sleep. Therefore, if they go to bed at say, 11 pm, then wake prior to 8 am, its likely they will be sleep restricted. Adolescents, just like adults, suffer mental and physical health consequences of continuous sleep restriction.

It's interesting that some adults develop delayed sleep-wake phase disorder also. These are generally people who are not working at all or do not have to wake early. It seems the early morning starts keep a lot of people in check with their sleep. I remember a family member once being made redundant from her workplace. She went from a normal 10.30 pm sleep to 6.30 am wake each night, to one that got progressively later and later. She watched a lot of movies to keep occupied and found that she was eventually not getting to sleep until around 6 am. She would sleep till late afternoon, have dinner and then entertain herself during the evening. After a while, her friends were working and socialising as she slept. They slept when she was awake. She started to become quite downhearted at her newfound loneliness. She reached out to me for help.

Circadian rhythms can be adjusted forward or backward, but it takes time. Adjusting forward is easier because you only need to stay up later and later each night. Going backward is much harder, as most people realise when they have wound forward on the weekend and try winding it back on Sunday night. As the young lady was not working, it was easier to apply a 'rolling forward' strategy.

The plan was this: Instead of going to bed at 6 am, stay up until 8 am. Do this for 2 days. Then stay up until 10 am and continue for 2 days. Slowly it became 12 pm, then 2 pm, 4 pm, 6 pm, 8 pm and finally 10 pm. She was advised not to drive if feeling tired as the change can restrict sleep a little. It took around 16 days in total to move her circadian rhythm forward until she found the appropriate rhythm. Within 2 weeks she was with a new job, something she has enjoyed for the last 8 years.

## **Advanced sleep-wake phase disorder**

As its name suggests, this disorder is the opposite of the delayed phase. I had a colleague named Robb in Queensland who was super fit, clever as they come, and a lovely guy. He was married with one child and very happy with his life. However, he struggled to remain awake past 7.30 pm each night. When we discussed this issue, he mentioned that he woke at 3.30 am each morning but had nothing to do till after 6 am.

Robb did a lot of running at first light in the morning, and this gave me a clue to what had influenced his rhythm. “Early light – early night, late light – late night,” was what I suggested to Robb. “Change your morning run to late afternoon and see how you go.” Within one week his rhythm changed by one hour in the right direction. Some people use light therapy, with very technical glasses that emit special light frequencies to adjust your rhythm. They are expensive and clunky. Robb used natural sunlight and got his fix free of charge. It only took a few weeks to get back to a normal circadian rhythm. There are other circadian rhythm disorders, such as irregular sleep-wake rhythm, non-24-hour sleep-wake rhythm disorder, shift work disorder, and jet lag disorder. In most cases, all can be altered with help from a professional.

## Parasomnias

A parasomnia is a term used when someone moves a lot during their sleep. As you have learnt, there is non-REM sleep, which includes stage one, two and deep sleep. Then there is REM sleep, which is where the brain is very active. First, let's discuss what can happen on the way to sleep. One of the interesting parasomnias is known as 'exploding head syndrome'. No, it doesn't blow up and there haven't been any recorded cases that I know of where a person had a brain injury from exploding head syndrome. It usually occurs when a person's almost asleep and there is a popping (or other strange sound) deep within their brain. It doesn't affect most people and there is no fix as there is no known cause. Just one of those strange things that happens rarely.

Also, in attempting to sleep, people can have insomnia due to a feeling of having to move their legs. Known as restless legs syndrome (RLS), this hard to describe feeling can feel like itches, aches, like there are bugs moving under the skin, and a range of other creepy feelings. Many people can alleviate this with a supplement of magnesium. Literally hundreds of people in training rooms have stated that their RLS symptoms have been reduced with a magnesium supplement. Other have seen GPs or other specialists with issues such as too much iron in the blood and so on. Magnesium supplements come in tablet, powder, spray, and oil. One needs to ensure you follow instructions as a man in Queensland once found out.

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### ***Tales from the training room – "My partner gave me the shits!"***

While discussing magnesium in a training room, a man offered his story of RLS. He sourced magnesium oil and

his wife offered to rub it on his chest but didn't stop there. Seeing his enjoyment at the gentle massage, she moved around his upper body and gave a near-full body massage with the oil. Now fully relaxed, the man settled down to what he believed would be a wonderful sleep. However, within the hour the oil had penetrated enough to cause an overdose of magnesium (always read instructions!). The outcome, his stomach started to rumble and his bowels became very loose. His wife, literally, gave him the shits!

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Other parasomnias that are not necessarily related to any particular phase of sleep, include sleep-related hallucinations, bed wetting (enuresis), sleep talking and parasomnias due to medical disorders, medicine or other substances. I have always found sleep talking interesting, as some people can converse very well, and others seem to mumble and muffle their words. A likely reason for this is that talking requires two parts of the brain to work well for a string of words in sentence form to be spoken. The words themselves come from a part within the brain known as the Wernicke's area. This is involved in processing and understanding language. The other part is called the Broca's area, where you control speaking the words. The two parts and all their connections are required to be fully conversant. When you are asleep, there is no guarantee that all parts are connected. I have found that people who sleep walk, often become very good at sleep talking.

## **Deep sleep parasomnias**

I love discussing deep sleep parasomnias in training rooms, as so many people are happy to share their adventures and

misadventures regarding deep sleep parasomnias. Let's first have a look at some of the adventure stories.

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***Tales from the training room - Mechanical Dad***

A mechanic from a mine site went home one workday and spent the evening with his family. His daughter asked if she could borrow his car as the heater hose was broken in hers. He reluctantly said yes and no more was said until morning. When he woke for work, he found grease on his fingers and under his nails. When he asked his wife if she knew anything about this, her reaction was to ask "What? You don't remember fixing your daughter's car last night?" Apparently, some mechanics are even good when they're asleep!

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***Tales from the training room – Wandering in her PJs***

A mother once told me about her sleep walking daughter, who had let herself out of the front door one night, and nobody had heard her exit. It was unknown what time she left the house, but typically, sleep walking occurs in the early part of sleep during the deep sleep phase. Around 3 am there was a ring on the doorbell. The local police had found the girl walking the streets of Fremantle, Western Australia and returned her home. The girl was 14 years old and was only wearing light summer pyjamas. As a parent, merely the thought of this would make you highly anxious.

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Other people have woken only to find they have gone for a walk in the backyard, or down the street, packed a bag ready for travel, got ready for work or for school at 2 am or thereabouts, and a host of other adventures. Then there are the misadventures! Those stories that can make you infamous, like the man they call ‘Spoons’.

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### ***Tales from the training room - Spoons***

A man and his wife went on a camping trip with another couple of a similar age. There was a tent for each couple. During the night, there was a bit of a rustling in one of the tents. Our main man had gotten out of his tent, walked to the other couple’s tent, and let himself in. The couple woke up to find him ‘spooning’ the woman! The camping trip only lasted one night. He’s now referred to as ‘Spoons’.

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### **A different form of bed-wetting**

So many men and women have told me stories about urinating in strange places while they are asleep. Although unpleasant for most, many are quite funny when told as stories. It appears that the most common factor here is drinking a reasonable amount of alcohol before bed. Men have been known to get out of bed and pee in fridges, cupboards, corners and on one occasion, on a father-in-law. In his defense, they had recently moved to a new house, and the father-in-law was asleep in a room that was in a similar location to the toilet in the previous house. Not that that got him off the hook.

Unlike normal bed wetting that is done in the prone state, these people get out of bed. It simply appears that the combination of sleepiness and alcohol intoxication allowed



them to conjure up the most interesting of lavatories. Women also do this, but it doesn't appear to be as common as with men. I imagine that it's due to the different plumbing arrangements that women will occasionally pee in drawers, cupboards, or, in the case of two ladies I met, the swing-top tidy bin. Possibly the funniest urination story came from a young lady that I met at a mine site.

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### ***Tales from the training room - The final date***

A young woman told me and the training room attendees that she'd met a lovely guy, and they went out for a dinner date. They had a great meal and a nice time, so they decided they would do it again. On the second date, as the night progressed, they were feeling very strongly toward each other. They had their meal, walked around a bit, and got a hotel room for the night. The night finished well and they fell asleep in each other's arm. When they woke in the morning, they put their clothes on to leave the hotel. As the young lady was putting on her shoes, she noticed something poured out when she picked up the first shoe. It was urine! He had peed in her shoes for some unknown reason. This was the final date!

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Apart from the walking, talking, and urinating, some people tend to get out of bed and raid the fridge in the middle of the night. A young man told me that he stayed in a share-house while in a FIFO work situation. He was angry because his three other housemates were eating his food. That was till they videoed him raiding the fridge around midnight. Luckily, his housemates don't urinate in the fridge!

## REM-RELATED PARASOMNIAS

### Sleep paralysis

When you are in REM sleep, your cerebellum becomes inactive. The cerebellum is the part of your brain responsible for coordination and muscle movement. This inactivity is important as your brain is working very hard during REM sleep, organising thoughts and concepts on what you have added over the last few days and interlacing that with your years of collected memories. This can turn into dream states and if you were able to move when you were dreaming, things could go terribly wrong.

Have you ever dreamt you were flying? You definitely need to be paralysed at this point, otherwise you might launch yourself off a balcony or set of stairs. Sleep paralysis is a good thing. That is until you are having a nightmare, and someone or something is hunting you down. Some nightmares become so alarming that you are frightened out of sleep. You wake up with a real fright and because your brain has not yet adjusted out of REM sleep, the paralysis stays for a few seconds.

In those vital seconds, some people feel they will be attacked or be found by someone hunting them. They are paralysed and lay there in fright. Some keep their eyes closed in the hope it will go away. It usually passes in just a few seconds, but the memory of the moment lasts a while. The interesting part for me is that when people tell me about an episode they have had, they wait until I am by myself as they think that this behaviour is unusual or strange. I make it clear that it is much more common than they think. It is only when it becomes recurrent that you should seek medical help.

## REM Behaviour Disorder

The opposite of sleep paralysis is REM behaviour disorder, or REM BD. This occurs when there is no paralysis and a person in REM sleep is able to move freely. Unfortunately, this most often occurs during a vivid dream or nightmare and the actions can often be violent, vicious and in some cases brutal. People can kick, punch, bite, scratch, and run in their sleep, making it quite scary for a bed partner. Many men and women have stated to me that they have embarrassingly punched or kicked their partners.

I remember once dreaming about playing soccer on the big stage. As a kid I always thought it would be great to play in the world cup someday. This dream was just that. I was speeding towards goal and my team mate passed the ball to me and it landed right in my path. I could hear the roar of the excited crowd in the background. I unloaded with an almighty right foot, searching for the back of the net. At the point of releasing the kick, I woke up in just enough time to damp it down as I knew it was going straight into the back of my wife's leg. I didn't score! Instead, I spent the next five minutes profusely apologising for the rude awakening.

This has only occurred once for me. Knowing what I know, I explored the memories of the past evening's events. We had gone out for dinner to a Chinese restaurant and had a lovely meal with a couple of glasses of sauvignon blanc, but only a couple. I also remember waking with a bit of a headache, which was not due to a retaliation by my wife, or from too much alcohol. My wife also woke very dry and with a bit of a headache. I imagine it was the monosodium glutamates (MSG's) used in the cooking. I have avoided it since and have had no further episodes of REM BD.

I was once seated on a bus travelling to the Brockman Two mine site in the Pilbara in Western Australia. The woman next to me had the window seat and was fast asleep for most of the journey. In a flash, she swung both arms out, thumping both the wall of the bus and yours truly in the chest. She apologised and told me about the dream she had had of her falling off her motorbike.

There are some correlations between repetitive instances of REM BD and Parkinson's disease. Parkinson's disease is a progressive, degenerative neurological condition which can be brought on by demise of neurons that produce dopamine. It affects the control of body movements and can usually be very obvious in the walking gait of a sufferer. It causes trembles and shakes, making it hard to eat or drink. You can have Parkinson's without REM BD and you can also have REM BD without Parkinson's. Where there are signs of one of these disorders, it is wise to check for both, just in case. Catching Parkinson's onset as early as possible can really assist with more effective treatments.

As an aside, it is well known that most sufferers of Parkinson's can live for 10 or 20 years from first diagnoses. I have long had an interest in this as my father was wrongly diagnosed with Parkinson's around 1979. After several years, he was shakier, but he didn't really exhibit what I thought was Parkinson's symptoms. He went to a different practitioner, who laughed at the mere thought that what he had may have been Parkinson's. It was a mild motor-neuron disorder.

I was extremely fascinated by a story told by Dr Norman Doidge in his 2015 book *The Brain's Way of Healing*. In chapter two, 'A Man Walks Off His Parkinsonian Symptoms', he described how exercise helps fend off degenerative disorders and can defer dementia. He explains that when a person exercises (in the case

explained, fast walking eight kilometres a day), there can be a growing of new neurons in the brain (Neurogenesis). There is also a growing and formation of support structure for these neurons.

In short, the man walked enough to continuously supply new neurons that may have added more dopamine to his dopamine-depleted brain. As long as he walked, his symptoms were reduced to almost nothing. When he had a few medical episodes that stopped him from walking, the symptoms returned in full. Then when he recovered and recommenced walking, the symptoms disappeared again. There is hope!

### **Sexomnia**

The last parasomnia I will discuss has been labelled 'sexomnia'. As its name suggests, 'sexomnia' is when a person initiates sex while they are asleep. It is said to occur in the deep sleep stages. My personal thoughts are that this may not always be the case. My argument is that some people can be dreaming that they are making love to someone, and actually commence doing just that. Most dreams do occur in REM sleep, although dreams can occur in non-REM sleep also.

There are many issues with commencing a sexual act with a bed partner while they're asleep. None so important as not having permission to do so. The outcomes of sexomnia will vary dependent on the specific relationship the couple have, their levels of trust and honesty, and past experiences. Basically, the act of commencing lovemaking without permission can be viewed by some as fun, by some as 'You are pretending to be asleep', or as rape. I never open this topic up in training rooms for two reasons. First, some people will make a joke of it and the whole flavour of the training can be soured, and more importantly, some people

have felt (or have been) raped or tricked into believing their partner was asleep. This can open up bad memories and ignite post-traumatic stress in others. If this disorder causes issues for a couple, it should be investigated by a professional. There is a website specifically aimed at creating awareness of sexomnia, which can be found on the net. Look for the word itself in the web address. Counselling should also seriously be considered if sexomnia is an issue.



## *Chapter Five*

# Jet Lag

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Jet lag can cause serious disruptions to the circadian rhythm of a person. It is the changing of sleep timing due to the different time zone that upsets the rhythm. If managed well, the outcomes are short-lived and have little effect on health and wellness. If poorly managed, a range of issues can be expected.

### ***Jet lag and time zone changes***

A time zone is a defined region of the earth with a uniform local time that differs by one hour, or by part of one hour, from the uniform local time of an adjoining region of the earth<sup>34</sup>. Your circadian rhythm can be seriously affected by crossing different time zones. If you travel west across a couple of time zones, more hours will be added to your day, and this won't have much effect on your rhythm. It is often easy to get to sleep on the first night.

It may take a few days for your circadian rhythm to adjust to the new time zone and for the first few days, you can expect to wake at the same time you did at your departure point. For example, if you fly from Melbourne to Perth in Australia, and you normally woke at 6 am in Melbourne (non-Daylight Savings Time) your rhythm may wake you at 4 am in Perth. Going from

a 6 am wake up in New York to San Francisco in the US, you may wake at 3 am in San Francisco due to the three-hour time difference.

If you travel east across a couple of time zones, you will still be awake when most of the locals are asleep in your destination. Your rhythm (particularly sleep onset time) will be based at the time it was at your departure point. If you travel several time zones east, it may take several days to adjust to going to bed earlier. Going to sleep earlier is always hard to do.

For the first few days, you can expect to not get to sleep until you reach the same time you commenced sleep at your departure point. For example, if you fly from Perth to Sydney in Australia, and you went to sleep each night at 10 pm in Perth, your rhythm will likely keep you awake until midnight in Sydney (non-daylight savings time). Similarly, if your sleep onset time in San Francisco is 10 pm and you fly to New York in the US, you may have trouble getting to sleep until 1 am, due to the three-hour time difference.

Jet lag is the name of the condition of a person who has not yet acclimatised their circadian rhythm from the departure location time to the destination time. The signs and symptoms are the same as anyone who has had insufficient sleep over a few nights. Signs and symptoms would include:

- General lethargy/fatigue
- Poor coordination & cognitive skills
- Reduced fine and gross motor skills
- Issues with regularity in eating and bowel movements
- Poor mood (grumpy, irritable, low motivation)
- Lack of resilience to problems and stress



There are a range of issues caused by jet lag, including those shown below.

- Older people (over 50) are generally less resilient to changes in circadian rhythms, thus tend to suffer more
- Due to poor human physical and cognitive performance when suffering jet lag, there are issues concerning safety
- A person who has not fully acclimatised to the destination location should not operate machinery or undertake safety critical tasks until acclimatised, and any work undertaken prior to acclimatisation should be well supervised
- If you are travelling to compete in a sport, do not expect to perform at your best until you have acclimatised

Jet lag is similar to the effects of working shift work. However, unlike shift work, with jet lag you are encouraged to change your circadian rhythm to suit the local time, whereas with shift work you do not.

### Acclimatising

The Australian Civil Aviation Safety Authority (CASA)<sup>35</sup> uses the term 'acclimatised' for employees who are less than two time zones of travel or who have been at the new location for a set period of time (e.g., the time required to adapt your circadian rhythm). Table 7 below illustrates the time generally required for a person to acclimatise to the new location time zone.

**Table 7:** Time zone changes. Adapted from CAAP 48-1(1.1): Fatigue management for flight crew members.

Time zone change (measured in time zones)	Adaptation period to become acclimatised to new location	
	West	East
2	1 day	1.25 days
3	1.5 days	< 2 days
4	2 days	2.5 days
5	2 days	2.5 days
6	2 days	2.5 days
7 - 9	3 days	3.75 days
10 or more	4 days	5 days

## Planning to reduce the effects of jet lag.

Travelling two or fewer time zones usually doesn't affect a person for more than the following day, and there is little need to prepare for the time zone change. Three or more time zones will have an effect and should be included in trip preparation, and by using a table similar to that shown previously, you can estimate the time needed for best performance at work or for sport. If holidaying, you can use the table to estimate when to take tours, stop and rest (or just walk around) or drive. To see how many time zones you need to prepare for, simply google 'time zone maps' and you'll find many choices available to work out the time zone difference between your departure and arrival points.

You can make some adjustments to your circadian rhythm before you travel by changing your sleep patterns. Going backwards with sleep onset (e.g. bed at 8 pm instead of 10 pm) is always harder to adjust than going forward (e.g. bed at midnight instead of 10 pm). Therefore, if you are travelling to a destination (east or west) that is, say ten hours behind your current location (e.g., current location midday – destination 2 am), you could try a simple, forward-rolling bedtime routine change over a few nights. For example:

- Night one– stay up till 1 am and sleep till 9 am
- Night two – stay up till 3 am and sleep till 11 am
- Night three – stay up till 5 am and sleep till 1 pm

Note: this is only an example and should be managed carefully, remembering that the rest of the world might not allow you to adapt or you may not be able to due to commitments. Try and plan the flights that best suits when you wish to get to your destination so that you can sleep:

- On the plane
- A couple of hours (no more) in the morning if you land before lunch
- A twenty-minute nap (no more) in the afternoon if you land after lunch
- A full sleep if you land from 8 pm onwards

Other things you can implement are to:

- Take a pillow, eye-mask and loose clothes to be as comfortable as possible on the flight

- Pay extra to get a seat with more room if you can
- Have a walk and a stretch every hour to help avoid deep vein thrombosis (DVT)
- Avoid alcohol and ensure you hydrate throughout the flight

As a general rule, it usually takes around one day per two hours of time difference to acclimatise to the new location. You can help to acclimatise quicker by:

- Getting bright morning light as early in the morning as you can
- Eating small meals more frequently to ease your digestive system into the new time zone
- Avoiding alcohol, as drinking will increase the fatigue effect of jet lag and remove some of the benefits of sleep by reducing deep sleep and waking you more often
- Looking for sleep waves (feeling sleepy) early in the evening as this could be an opportunity to catch up on some early sleep
- Avoiding sleep medication unless you find it hard to get to sleep. In which case you should get advice from a pharmacist or general practitioner
- Having your alarm set early am and get bright light. This will force your rhythm to adapt quicker

## **The Argonne diet**

Charles Ehret from the Argonne National Laboratory proposed and developed a diet specifically designed to assist combat troops to adjust to different time zones rapidly. The diet utilises alternative days of feasting on high-protein morning and lunch meals and high-carbohydrate dinners and fasting on low calorie

small meals (800 calories). There is considerable research on the diet's success, and it is useful to search for the diet on the web to get more information, if you would like assistance with travelling to different time zones.

### **Safety**

When you reach your destination, ensure you are aware of any issues that may affect your safety and welfare. For example, I remember hosting some guests from the United States and Canada at a fatigue conference in Fremantle, Western Australia. Crossing a busy street, I had to remind my guests that before stepping onto the road, we (Australians) look to the right last for oncoming vehicles (as the vehicles drive on the left side of the road, compared to on the right side in the US). Our friends were looking left just as they were about to step out onto the road.

If you are suffering from jet lag, you will be less able to estimate risk and remove yourself from harm as well as you normally can. Try and allow for this in your planning. Road rules and direction of vehicle travel can surprise you if you do not learn them quickly and vehicles may have operational controls fitted opposite to what you are used to (e.g., wipers & indicators). Learn them prior to driving and don't expect that car hire companies will alert you to this. Obtain advice on personal safety at the destination and surrounds. When you are tired, you are much more vulnerable to the locals than when well rested.



## Chapter Six

# Help For Sleep Issues

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**G**etting five hours of sleep may feel so short but stay awake that length of time and it seems an eternity. So many people have so many sleep issues. Most are reluctant to discuss them until either something happens regarding their health or safety, or someone like me stands before them and offers advice to anyone who wants it. It can take a mighty effort to ask for help, due to the perception that good sleep should be easy to get. However, it's easy to lose sight of what constitutes good sleep hygiene and circadian rhythms. I am often known to say to groups (regarding sleep knowledge), "You don't know what you don't know."

### **Employee Assistance Program (EAP)**

The Employee Assistance Program (EAP) is a program designed to assist employees of a company to deal with any psychological or emotional issues that they, or their immediate family, may have. Stress, anxiety and depression are often reasons to contact the EAP, however, their help is beneficial with family issues, drug and alcohol problems, gambling and other addictions, loss of loved ones or the stress involved with marriage, divorce, moving to a new house, bullying or issues with kids and teenagers. The list

is endless. The service usually provides up to six counselling sessions per problem per year. However, this may vary with different providers. Nearly every employer has an EAP, and you should try to find out what their contact details are. Some EAPs have sleep management programs that could assist you to sleep better.

### **General practitioners**

Sleep is the second highest reason a person will visit a GP, only after pain. Most GPs know something about good sleep hygiene, but most are limited in being able to assist any further than referral to a specialist or prescribing sleep medicines. For this reason, if you visit a GP with a sleep issue, I suggest that you do not expect a long-term fix without seeing someone else. I remember a GP once saying to me, “Nick, people don’t want to talk about sleep, they want a pill.” While this used to be the case, in my travels I have seen a slight shift toward seeing specialists for sleep issues. However, sleeping pills are still big business.

My take on sleeping pills is quite different to most of my colleagues. Many sleep and fatigue practitioners are quick to point out the numerous issues with long-term use of sleep medication, and I won’t challenge that line of thought. Most over-the-counter pills are quite harmless; however, prescription medications have a reputation for causing long-term issues with health and mortality.

I disagree with using prescribed sleep medication long-term but have no issue if it is used to get people sleeping better for a few nights. This can sometimes be the panacea to get back on top of whatever the issue is. Similarly, use of over-the-counter sleep medication often carries a wonderful ‘placebo effect’ with

it, leading to increased sleep on the first night in a strange bed, or the first sleep between nightshifts. That can't be a bad thing.

## **Sleep specialists**

There are many and varied specialists in the sleep field and one can start the search by simply putting the issue into a search engine and hitting the go button. Asking your GP or EAP for a referral can be useful, as can asking people who may have had similar sleep issues. Best to decide where the sleep issue is anchored first. Is it due to pain or disease, a medical condition (e.g., gastroesophageal reflux), a current stressor, long-term stressor, post-traumatic stress disorder (PTSD) or an issue with mental health? Perhaps your partner has told you that you hold your breath while you sleep. Or you suffer from extreme sleepiness during the day and fall asleep at the red traffic light. Have a good think about what might be causing poor sleep prior to going to a GP. I find it beneficial, if you could make up a sleep diary for a week before the visit. Similarly, use an app on your phone that can measure your sleep for a few days. This will assist the GP to refer you to the right specialist.



# *Part Three*

## Sleep For Health

I never had a health super power until I learned how to use sleep to improve my life. I now use sleep to improve sporting performances, present as a nice partner and parent, and to be one of the healthiest versions of myself that I have been as an adult. My doctor has known me for more than 15 years. When we first met, Dr Choong assessed my percent risk of having a heart attack or stroke in the next five years – a measure used to assess the absolute risk of such, dependent on several factors. This measure can be used for health or life insurance purposes, but more so to gauge and manage the heart health of a person. The factors include: Age and gender; Body mass index; Blood sugar and Cholesterol levels; Liver and kidney functions; Whether or not you smoke, and any other factors the GP feels is appropriate

A score over 15% is associated with high risk and a one in seven chance of a heart attack or stroke in the next five years if nothing changes. Scores between 10% and 15% are known as moderate, with at least a one in 10 chance of the attack or stroke. Below 10% is a less than one in 10 chance. It is normal to have the percent risk rise as you age.

My first assessment by Dr Choong came in at around 13%, something I wasn't proud of. I really started managing my sleep

well around 10 years ago, and in that time, lost weight, exercised more and have had a generally healthier lifestyle. My most recent assessment really made Dr Choong smile. I came in just under 9% and he went to lengths to advise that the normal progression of heart risk as you age is up, not down. I think I even look better than I used to!



## *Chapter Seven*

# Sleep To Improve Health

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### ***Type 2 diabetes and obesity***

Since the early 2000s scientists have studied the relationship between sleep and type 2 diabetes. In 2004, Dr Eve van Cauter and her associates from the University of California, experimented with healthy young individuals and found that sleep restriction can have an almost immediate impact on type 2 diabetes. Using subjects in the twenty-two-year-old range with healthy dispositions and no indications of diabetes, the experiment showed that a lack of sleep can promote high levels of the stress hormone cortisol, reduce the ability of cells to take in glucose and increase insulin resistance. Basically, after a four-hour sleep for six nights in a row, subjects went from a healthy blood glucose range to pre-diabetic levels. Importantly, the subjects spent the following week catching up on sleep and their blood glucose levels returned to the baseline range.

In 2007, Dr Eve van Cauter and her colleagues conducted an experiment similar to the 2004 experiment in subject age and health range. The emphasis on this occasion was to determine if slow-wave sleep cycles reduce the body's capacity to enable

adequate glucose distribution and intake into the cells. For three consecutive nights, the experimenters had subjects sleep for eight hours, but each time the subjects moved into deep sleep stages, they were nudged or moved just enough to move the subject out of deep sleep and back into lighter sleep. Overall, each subject had three nights of sleep of eight hours duration, but without deep sleep. Similar to the 2004 experiment, all subjects progressed to a pre-diabetic state. In both of these experiments, all subjects returned to healthy blood glucose levels after a period of catch-up sleep.

That the subjects in the above experiments returned to normal blood glucose levels post-experiment, provides hope for those who have been suffering sleep issues together with a decline in health. I have met many people who have had sleep issues and have progressed into type 2 diabetes, albeit at the lower end of the scale. With assistance for their sleep disorders, some have reduced their type 2 diabetes levels and managed the condition better.

In a study of 169 pregnant women in their second trimester of pregnancy, researchers investigated the effects of poor sleep quality on gestational diabetes<sup>36</sup>. They found the following results:

- For every hour of reduced sleep, there was a 4% increase in glucose levels
- Increased likelihood of gestational diabetes in women with sleep disordered breathing and frequent snoring
- Pre-term delivery occurred more for the women with increased Epworth Sleepiness Scale scores (a measure of daytime sleepiness) and poor sleep quality

- Neonatal intensive care admissions for women with increased Epworth Sleepiness Scale scores and sleep disordered breathing

The authors concluded that pregnant women with sleep disorders and short sleep duration have increased risk of developing gestational diabetes.

Many other research projects have determined that sleep restriction not only increases type 2 diabetes risk but is associated with the world's high levels of obesity. Notwithstanding other factors, such as diet and exercise, there are a number of reasons that sleep restriction will increase obesity levels:

- Inadequate sleep increases inflammation markers, leading to joint pains and a reduction in movement
- Lethargy reduces motivation to move and exercise
- A tired person usually craves simple carbohydrates, often including high levels of sugars
- Sleep restriction increases the level of the hormone ghrelin, which makes a person hungrier than normal
- It decreases the level of the hormone leptin, which indicates to the brain to stop eating when the dietary need has been met. This leads to overeating.

Good sleep, in conjunction with a healthy diet and well-managed level of exercise, can help to keep metabolic disorders in check.

### **Cardiometabolic disease**

Cardiometabolic disease describes a cluster of conditions, usually beginning with insulin resistance. Being significantly

overweight, an inactive lifestyle, and a high carbohydrate diet can promote insulin resistance. It can also occur when a reduction of deep sleep reduces the correct amount of human growth hormone which gets human cells in top condition to allow insulin to penetrate cells and allow glucose to be converted into energy. Insulin resistance can progress to metabolic syndrome, pre-diabetes, and finally to more severe conditions including cardiovascular disease (CVD) and type 2 diabetes.

It is said that type 2 diabetes is one of the fastest growing chronic condition around the world, while cardiovascular disease is still the leading killer. Lack of physical activity, prolonged sitting, short sleep and poor diet, are common behaviours in general populations. They are all risk factors in the development of cardiometabolic disease. You may have heard the term ‘Sitting is the new smoking’.

An Australia study reported in-press in December 2020<sup>37</sup>, illustrated the importance of sleep, moderate exercise and sedentary time, in the role of cardiometabolic health. Using data from 1073 Australian children aged 11-12 years, and 1337 adults, they found strong associations between the 24-hour use of time and all cardiometabolic health outcomes. Basically, longer time asleep was associated with more favourable cardiovascular health. The authors concluded, *“Reallocating time from sleep to moderate-vigorous physical activity (MVPA) had favourable associations with cardiometabolic health but reallocating from sleep to sedentary time was associated with less favourable cardiometabolic health.”* We should exercise caution here, as cutting sleep time drastically to exercise, can have adverse outcomes.

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***Tales from the training room – Exercise to get fat!***

A woman in her early thirties approached me following a sleep and fatigue training session, regarding how her exercise wasn't showing any benefits. First, I asked what her targets for the exercise were. "I want to tone up and lose weight," was the reply. She worked at a FIFO mine, started work at 6 am and had to be on the bus to work at 5.45 am. She woke at 3 am to get to the gym for an hour before preparing for work. When I told her that a bedtime for a 3 am start would be around 7.15 pm, she said that she doesn't get into bed until around 10 pm. This gave her five hours of sleep before waking for the gym.

When I asked how it was working out for her, her reply was, "I'm getting fat!" I assisted her understanding by telling her about how short sleep increases the hormone ghrelin, which makes you hungry. I added that short sleep also decreases the hormone leptin, which sends messages to the brain that there are sufficient energy stores in the fat cells, so you can stop eating. So, less leptin equals less signals to stop eating. Coupled together, a person who has short sleep is hungry, and they often overeat. Add the fact that a tired, hungry person will usually reach for high-sugar, high-fat foods, and the recipe is for weight gain. I recommended seven to eight hours of sleep first, then try to fit in exercise that will help with muscle tone and weight reduction.

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## **Cardiovascular illness**

Cardiovascular illness has been a killer in Australia and other countries for years. Several studies have linked high blood

pressure (hypertension) to either reduced sleep episodes or disorders such as obstructive sleep apnoea (OSA).

The authors of a study of teens argued that hypertension in children is a risk factor for adult hypertension and that early recognition and intervention are important aspects of health care<sup>38</sup>. Their findings suggested that an association was found for increased hypertension and poor sleep quality for 26% of their community sample. The three-and-a-half-fold increase in hypertension was independent of gender, obesity, socioeconomic status and sleep apnoea. Once again, sleep isn't the only cause of hypertension, but it certainly can influence its onset or worsening of the condition.

### ***Immunocompetence***

Immunocompetence is the ability of the body to produce a normal immune response following exposure to an antigen. An antigen could be bacteria that an adult picks up from any source. The usefulness of immunisation programs is shown in the worldwide eradication of smallpox and the reduction and control of polio and other debilitating diseases. However, it has been suggested that sleep restriction may lead to reduced immune responses to vaccination.

It is well established that the immune system is maintained and supported with good sleep. Studies have been conducted on how sleep restriction may affect the human response to an introduced pathogen in the form of a vaccine. Numerous studies have been conducted on vaccinations for influenza and a few other illnesses in both adults and children.

A study in 2003<sup>39</sup> investigated the human antibody response to hepatitis A vaccinations. Using two groups of subjects, all were



vaccinated at 9 am. One group went to bed around their normal sleep time and the second group stayed awake all night, until the following night at 9 pm. Although only a small study, the results clearly demonstrated that regular sleep enhances the ability to develop antibodies to an antigen. The group that slept normally were found to have improved the formation of antigen-specific immune defence to the hepatitis A vaccination, some four weeks post-vaccination. The authors go on to say that: *“The results underscore the importance of sleep for immunocompetence.”* (p.834)

Another study with adults being administered the standard 3-dose Hepatitis B vaccination, again showed similar effects<sup>40</sup>. Their analyses revealed that shorter sleep duration was associated with a lower secondary antibody response independent of age, sex, body mass index, and response to the initial immunization. Shorter sleep also predicted a decreased likelihood of being clinically protected from hepatitis B at the end of the vaccinations.

Research administering the influenza vaccine<sup>41</sup> has shown that when subjects were restricted to four hours of sleep for four nights and administered the vaccine after night three, they had less than half of the immune response that a similar (control) group had when sleeping normally.

A study reported in November 2020<sup>42</sup> investigated the effect that working nightshift might have on immune response to the meningococcal conjugate vaccine in healthy workers. 34 healthy workers were divided into dayshift and nightshift and received the meningococcal C meningitis vaccine. Nightshift workers showed decreased deep sleep and REM sleep duration and total sleep time. They had increased inflammatory mediators and a weak response to the vaccination, compared to the daytime workers.

I often mention to people that if they are unwell or generally not sleeping well, put off the vaccination until you are better. This is especially important with your children.

## Cancer

In discussing how sleep restriction may impact the onset, or worsening of cancer in a person, care is needed so that people are not stressed if they have had poor sleep over the years. There have been numerous studies performed over the decades with a myriad of results, often conflicting and with inconsistent results. What has become clear is that short and long sleep times are associated with a number of negative health outcomes. These may be what influences or increases the risk of developing cancers. However, much more work is needed to get a better idea of how sleep affects the onset of cancer development.

A recent meta-analysis<sup>43</sup> (combining multiple research studies) of total sleep times and associated all cancer mortalities, investigated the results of 14 cohort studies, enrolling 866,877 participants with 43,021 cancer deaths in total. The authors found that total sleep time of less than seven hours was not significantly associated with increased all cancer mortality. However, sleep restricted to four to five hours was significantly associated with an increase in all cancer mortality. The increase was by 8% above people who sleep between seven and eight hours a night. Further, where sleep was longer than eight hours on average, there was also mild increase in all cancer mortality, which became stronger with sleep of more than nine hours. Compared to seven to eight hours of sleep, the increased risk of all cancer mortality was increased with eight to nine hours of sleep, and nine to ten hours

of sleep, and more than ten hours of sleep, by 3%, 4% and 17% respectively.

Once again, caution should be added here, as sleep is one of a multitude of factors that may bring about cancer development. As mentioned, sleep's main effect on cancers may be how short or long sleep affects metabolic and other physiological health issues. For further information, the author's supply a good list of health issues linked to short or long sleep. They also mention that further research is needed to better establish the aetiology pathways underlying the associations of cancer deaths with short or long sleep.



## *Chapter Eight*

# Maintain That Brain

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A young gentleman approached me after a training program on sleep and fatigue management. He was a miner in his thirties and was a picture of health. He held himself well, appeared to be very bright and looked quite athletic. He looked extremely worried, and his concern was simple. “I’m worried about getting Alzheimer’s Disease and only having a short life.” I asked him why he thought this, and he explained that his grandfather had the disease, and his father was getting it. I asked questions about their occupations and sleep over the years. His father and grandfather were both farmers who did the traditional late to bed and early to rise. He estimated that his grandfather averaged five hours of sleep per night for most of his life. His father got between five and six on average.

I didn’t need to ask, to know that the man himself was getting good sleep and plenty of it. He looked bright, with good facial tone and no bags under his eyes. He held himself well and looked the picture of health. He said he averaged around eight hours per night and that he even slept well when on nightshift. He was a miner with a FIFO routine of having a week of rest and recuperation at home, alternating with lifestyle in a camp-based accommodation setting. In the latter, he had almost 12 hours to

shower, exercise, eat and sleep eight hours each 24-hour period. If only more people used their time this well.

I confidently said to him that he is doing everything possible to reduce the risk of Alzheimer's Disease developing and that he would most likely 'break the family mould' in life expectancy and dementia. In his case it wasn't just the good length and quality of sleep that would reduce the risk. His diet was healthy, and he exercised often. All of the pillars of health required. Suffice to say that he had a huge weight lifted from his shoulders to the point that he swanned out of the room with a pleasant grin on his face.

### ***Cognitive Loss***

A study of 2,012 cognitively unimpaired individuals over 65 years old showed that having a nap during the day reduced their risk of cognitive decline 10 years later by 52% (compared to those who did not nap). They also found that those who obtained less than 6.5 hours of sleep each night on average, were 105% more likely to develop cognitive impairment over the following 10 years. Those who reported excessive daytime sleepiness were 121% more likely to suffer cognitive decline.

This tends to make a lot of sense to me. As you age, your sleep tends to be more fragmented, with more awakenings due to aches and pains, stress and worry. An older person may spend nine hours in bed, with the equivalent of only six hours of sleep. Having a nap during the day would simply add to total sleep for the 24-hour period and provide a greater opportunity for the brain to remove the proteins that can promote different forms of cognitive impairment and dementia. I say if you feel like a nap during the day, take it!

## ***Alzheimer's Disease***

People are now living for much longer than they used to. Awareness and treatment of cardiovascular illness has been the main reason for this increase in life expectancy. While this is a very positive outcome, it has bought about a huge increase in the number of people reaching older ages. With increasing numbers of years, comes increases in the risk level of developing age-related brain diseases such as Alzheimer's disease. The burden on society is huge, as is the burden on families.

As we age, sleep patterns change in their structure and length, with an overall lighter sleep (i.e., reduced slow-wave sleep), which is more fragmented. A number of recent studies have been investigating sleep's influence on Alzheimer's Disease, in the hope that better treatment plans can be made available, compared to current medicinal treatments which are very limited in positive outcomes.

Chapter one of this book discussed how proteins such as tau and  $\beta$ -amyloid ( $A\beta$ ) are removed from the brain while we sleep. It is these proteins that are present in large volumes in people who are suffering from Alzheimer's Disease. It has been suggested that the reduced sleep of older people could be the reason for the increased risk of Alzheimer's Disease. Interestingly, the mild cognitive impairment (MCI) stage that precedes Alzheimer's Disease, often shows signs of sleep impairment, which tends to worsen the aetiology of the disease.

There has in the past, been studies linking Alzheimer's Disease to sleep disorders such as obstructive sleep apnoea and various forms of insomnia. Care should be taken to remember that there are other influences involved, such as diet and exercise, and general health. Nonetheless, people need to understand that

there is much you can do to either reduce the risk of Alzheimer's Disease onset, and/or to slow the progression of the disease.

Notwithstanding the use of medication, applying assistance with sleep disorders, providing a healthy diet and programs of cardiovascular exercise, we should not give up. It is interesting to see on TV from time to time, a current affairs program or similar that has shown how people living with dementia have had moments of memory recall and the associated joy that goes with it, from exercising, including singing and dancing.

Earlier I mentioned Dr Norman Doidge's book on *The Brain's Way of Healing*. In one chapter he speaks of how a man with Parkinson's disease reduced his Parkinsonian symptoms to almost nothing, by jogging around eight kilometres per day. It was a slow start which required an enormous effort by the man. It was explained that the brain is capable during exercise, of growing and maturing up to 500 neurons per day. It may be that these new neurons could be programmed to grow into the type of neuron required. For example, dopamine-producing cells would help to reduce the symptoms of Parkinson's for the man who jogged his symptoms away.

It stands to reason that someone suffering Alzheimer's Disease may grow new neurons in the hippocampal structures responsible for short-term memory storage when they exercise. In Alzheimer's Disease, the hippocampus is often quite blocked by plaques arising from  $\beta$ -amyloid, so growing new neurons in the hippocampus may assist with short-term memory storage and recall. Both singing and dancing are mild forms of exercise, so I am never surprised when these current affairs programs showcase the results. It's a pity that more people are not made aware of this.



## *Chapter Nine*

# Let Sleeping Black Dogs Lie

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**E**ven for mental health professionals, shit still happens! I have always taken pride in how well I manage my mental fitness, and just like everyone else, it was hard to admit that I had become depressed. But I had, so it was time to admit it and move forward.

### ***Depression/Anxiety***

It's May 2020 and we are in the grip of the pandemic COVID-19. My face-to-face sleep and fatigue management training for the last two years has been full-on to the point that having face-to-face training cancelled or postponed, was initially a bit of a relief. I kept busy for a month assisting groups to remodel their rosters, especially concerning fly-in, fly-out rosters. The new requirement was for FIFO workers to fly less and stay for longer. This meant longer rosters and assessments for fatigue and other issues relating to longer rosters.

I also had a bit of work conducting desktop fatigue assessments and developing fatigue management plans. The Western Australian Police Major Crash Division had me investigating whether or not fatigue was a causal factor in several fatal crashes. This work took me from mid-March through to the end of May. Then it dried up.



I spaced out this work with a considerable amount of work around the house, including garden maintenance and painting the whole exterior of the house, including the roof. Towards the end of May, the Perth weather turned cold, wet and windy. Something unusual happened. I was out of paid work and out of opportunities to work outside. I found I was sitting much more than I was previously. I was missing seeing my family and the opportunity to be close to them. I lost a friend to suicide and could not attend his funeral due to social distancing requirements.

My sleep was becoming fractured, and I awoke a few times every now and then, wondering how the business would move forward. I watched more television (mainly Netflix), and my bedtime routine became a little later and my sleep length reduced on occasions. I have always been proud of my 7 hours and 28 minutes of sleep and the ability to get to sleep at the right time and within 10 minutes or less. Now I was sleeping like a teen but felt like an old man!

My diet was not quite as good as it was, and I was struggling to start any projects. I drank wine on most nights. Not much, but on most nights. I felt a darkness starting to invade my thoughts. Things were appearing to be harder to achieve and I felt like I may never get on a plane again to do the work I love. It didn't take much introspection to understand that I was getting depressed.

That dark, hairy hound had me by one leg and it was time to choose which way to go. Do I try and see the positive in life and move forward, or do I simply go down the horrible dark spiral of negativity, where anyone close trying to help you is met with negativity? Don't think for a second that such a choice is an easy one to make. It seems easier to eat poorly, drink unwisely and

sleep irregularly when you should be working towards something more meaningful.

I think I'm lucky to know what I know. The first thing I did when I made the realisation was to talk to my wife. I am also lucky to have one of the most caring people I have ever met, as a wife, friend and partner. She was very concerned and immediately started trying to help. This doesn't always work, and it took a lot of effort to allow her to offer suggestions. Not because I didn't want to hear her. This is just what depression does to you. I understood that to kick the black dog quickly, several things had to change - and I had to make those changes!

Here is a list of what can help to send the black dog off with its tails between its legs:

- Exercise
- Diet (Mediterranean is always good)
- Sleep
- Processing depression

I always tell my training groups that when you exercise, you not only grow new brain cells, but you also receive that wonderful hormone serotonin and other endorphins. Further, exercise enables a deeper sleep at night, allowing for more delivery of serotonin. I noticed that the average number of steps I then took per day on my pedometer app, was around 3,000. My normal average would be around 6,000 plus, with a daily target of 7,000, or around five kilometres. This needed to improve and because I couldn't get out in the horrible weather, it looked like the exercise bike it was. This made an immediate impact, as I knew it would.

I started to ensure my meals were healthy choices and colourful, which are much healthier and good for the gut. Meals like Atlantic salmon steaks with a range of colourful vegies are a good example of where I was going with diet. We had also established three alcohol-free days each week. On alcohol inclusive days, there is a limit of around two to three standard drinks. This is not a diet, just getting back to a healthy way of living. It makes a difference to how you feel inside, and a recent journal article showed that having good gut microbiomes improved sleep quality. Microbiomes in the gut assist with digestion, metabolism, mental health, the immune system, and sleep. So far, so good.

I reverted to my normal sleep of a 6 am wake time and a 10:10 pm bedtime. The effects on sleep onset were immediate and I was soon back to a 5 to 10-minute sleep latency (time it takes to get to sleep). The waking through the night and thinking, was reduced the longer I stuck to the routine. I got better sleep and felt a little better each day. The exercise, healthy diet and wonderful sleep did the trick. All supported with the love of a wonderful family.

The processing of the depression was simple - I was wondering most about the business that we had built over the past decade. It had gone from a very slow start to a period of hit-and-miss, and finally, full-on work for more than two years straight. All of the moments in front of conferences and forums, the advertising, newsletters and the website, finally had a huge impact. My training knowledge and delivery of sleep and fatigue management information was highly regarded in a number of large organisations around Australia, and some parts of other countries.

Then to have it all stop dead in its tracks just floored me. Seven months after the state borders closed and work started trickling back in, slowly but surely. People still needed help with sleep and organisations needed help with employee sleep, rosters analysis and fatigue management assessments and plans. It just had to go on hold while COVID-19 took centre stage. Writing this book has helped me to keep focussed and centred on work, while a wonderful wife, 9 fantastic children and 12 awesome grandchildren have kept me feeling like I'm living the dream. I sincerely wish that everyone's journeys with depression were as short and as well supported.

## **Anxiety**

Anxiety is yet another mental health issue that can seriously affect sleep. Poor sleep on the other hand, can also cause anxiety. Let's start the anxiety discussion with 'sleep anxiety'. People can get sleep anxiety for one of two general reasons:

1. The person is worried about going to sleep, and
2. The person is worried about not being able to get to sleep or get enough sleep.

People who worry about going to sleep may fear what could happen when they are asleep. This might include a whole range of illegal and immoral occurrences, such as:

- A domestic situation with family members
- An issue within the neighbourhood, such as break-ins and other illegal activity
- A regional situation, such as living in or near a conflict zone.

I remember clearly in the early 2000s, meeting many people who emigrated from South Africa to live in Australia. They spoke of the threat of their lives on a nightly basis, and even living in Australia for a decade or so, hadn't removed the disrupted sleep due to security concerns. Similarly, a returned Australian soldier who spent most of his active duty as a sniper, told me of the nightly habit he formed due to his service. He mentioned that he would get out of bed and 'check the perimeter' every hour or so. He said he never remembered doing it, but his wife said she could set the clock by his walks.

Even with good security, some people still have trouble sleeping due to worries about break-ins and other community wrong doings. They worry due to seeing and hearing crime in the media or from others they communicate with. Even the content on television crime shows can evoke the feeling of fragility while in the dark and alone. Or perhaps something has occurred in the past whereby thoughts are triggered at night time. In most cases, counselling can help people develop the skills to avoid the triggers, or ways of countering the dark thoughts with positive thoughts.

People who suffer serious sleep apnoea may also have sleep anxiety due to worrying about having heart attacks or suffocating while they sleep. It is usually a bed partner who advises them of the breathing cessations, or 'apnoeas' that occur while they sleep. The concern over the lack of breathing is what normally causes the sleep anxiety for apnoea sufferers.

The second sleep anxiety is where a person is so worried about not getting enough sleep, that they actually struggle to get to sleep. This form of sleep anxiety can largely be caused by sleep and fatigue practitioners catastrophising sleep and

fatigue issues. Take, for example, the earlier discussion of how fatigue is said to be a causal factor in the grounding of the Exxon Valdez, the space shuttle disaster and Chernobyl. Worse than this catastrophising is the way that some practitioners deliver information regarding how so many physical ailments can be attributed to sleep restriction.

“Poor sleep causes cancers, metabolic disorders, cardiovascular issues and issues with ageing and mental health,” goes the chant of many practitioners attempting to be heard. There is some truth to all of these claims, but there is a much more positive way of delivering the results of past research. As practitioners and educators, we have a responsibility to not make sleep worse for those who have issues sleeping. For example, I might say the following to a group in a training session, or a conference: “Did you know that short-term sleep loss has an effect of raising blood glucose levels in healthy adults? Importantly, by catching up on that sleep loss, you can also see a reduction in blood glucose levels to normal levels again if the sleep loss was the cause? This was shown in the 2004 research by Eve van Cauter discussed earlier.”

Just by changing the way this is explained, not only do we educate people on the importance of sleep in metabolic disorders, but we also offer hope that good sleep can not only return blood sugar levels to normal but provide hope to type 2 diabetics to better control their disease if they can obtain good sleep. Then we provide the information to assist with the better sleep.

Similarly, when I discuss sleep and ageing, I often use the saying, “Using the three pillars of health, such as a good diet, regular exercise and healthy sleep patterns, you have the combination

that offers you the very best protection against ageing and declining cognitive ability and getting the best out of your genetic material regarding mortality.”

I have mentioned to a few of the people who I have provided sleep coaching to, that one of the reasons they struggle to sleep is that they worry too much about it (sleep anxiety). In some cases, they have added one extra hour of sleep the following night from just realising that they need not worry so much. If you ever worry about not getting enough sleep, think of why you are worried and focus on what you can do to actually make the sleep better or longer. Hopefully, this book provides enough information for you to make it happen.

### ***Mental Fitness***

I have never been so mentally fit since I worked out how to regularly get my 7 hours and 28 minutes of sleep on most nights. In an everchanging world with highs and lows, with good days and bad, being around the right people versus the wrong people, my moods are adjusted by the level of sleep over previous nights. I can tell the difference just by driving on multi-lane roads, where some days you are tolerant of other’s mistakes, and sometimes you are clearly not. We may not all be the same, but the reports back from sites where I have delivered sleep and fatigue management training to, usually have a common theme – that the mental health and general camaraderie of the workforce has improved post-training.

I challenge anyone to discover just how good ‘the best version of themselves’ could be by stringing together three consecutive nights of adequate sleep. For the masses, that would be around 7.5 hours per night, remembering that some naturally need a little

more or a little less. I often recall the words of the supervisor on an oil platform who was floored when his colleagues told him that now that he is sleeping better, he is not nearly as grumpy as he used to be. He never once thought himself to be grumpy prior to this statement. Good regular sleep can provide your best level of 'mental fitness', resilience and tolerance.





## *Chapter Ten*

# Infant To Adolescent

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**E**asily the most commonly asked question in class is “How much sleep does my child need and how do I make sure they get enough?” Any parent will tell you there is nothing more valuable than the health and safety of a child – especially their child. However, children don’t come with a ‘user manual’ and parents learn many parenting skills by trial and error or the sharing of knowledge from family and friends. While most parents want their children to thrive and learn, many are unaware of the problems that can be caused by poor sleep or sleep restriction. This chapter aims to assist parents better understand the need for appropriate sleep and how to recognise and correct it when sleep goes awry.

### **Different sleep needs**

Sleep is very important for children for many reasons. For the infant born with something like 200 billion neurons and very few neuronal networks, sleep plays a vital role in growing neuronal connections and establishing new pathways for learning. It has become commonplace for parents to want their infants to sleep through the night and some may attempt to make it happen through different methods. This can lead to

considerable angst for the parent who can't understand why their child won't sleep through the night without waking. Infants do need to wake and feed during the night. This is a part of life and growth.

Table 11 below is interpreted from Dement & Vaughan's chapter entitled 'The Circadian Rhythm of Life: Growth and Aging'. It sets out important and useful information for better understanding your child's sleep needs, noting that individual differences apply here. The 'red flags' comments are included to illustrate where it is likely a child/adolescent will have negative effects of sleep restriction.

**Table 8:** *Adapted from Dement & Vaughan's (2000) ages and sleep needs.*

Age	Hours of sleep per day	Notes	Red Flags
<b>Newborn Infants</b>	16 – 18	A set pattern of sleep and waking is absent or very weak and parents must adapt to the sleep of the infant by catching naps whenever possible.	Less than 14 hours. Don't force overnight consolidated sleep.
<b>Around 7 to 8 weeks</b>	16 – 18	Start to sleep around the same time each day but about 10 minute later each day and an hour later each week. Baby will start to sleep for longer periods (caused by the consolidation of sleep periods) and be awake for longer periods.	Less than 14 hours. Don't force overnight consolidated sleep.

## The Wonder of Sleep: Beyond Midnight

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<b>Around 15 weeks</b>	16 – 18	More day and night rhythms become evident although there will be awakenings during the night to feed. Baby should not be expected to sleep continuous through the night yet.	Less than 14 hours. Don't force overnight consolidated sleep.
<b>Around 40 weeks</b>	14 – 16	Baby starts to wake and sleep at the same times each day and night, forming a pattern. At this point baby may start sleeping for five or more hours without waking. Many parents consider this 'sleeping through the night'.	Less than 12 hours.
<b>One year</b>	14 – 15	Baby should sleep through the night and be awake during the day except for a few naps.	Less than 12 hours.
<b>18 months</b>	14 – 15	About one to two naps per day.	Less than 12 hours.
<b>2 years</b>	12	About one nap per day.	Less than 10 hours.
<b>2 – 5 years</b>	10 -12	Daytime napping usually stops.	Less than 8 hours.
<b>5 years - puberty</b>	10	Usually very consistent.	Less than 8 hours per day.
<b>Adolescents</b>	9 – 10	May become very inconsistent due to technology and social media.	Less than 8 hours per day.

## ***Infants***

They say it takes a village to raise a child and truer words could not be spoken. Irrespective of whether your child is a 'good sleeper' or a 'bad sleeper', a parent who cares for the child usually suffers from a build-up of sleep debt. This sleep debt can have many negative outcomes if not paid back when and where it can be. The outcomes of having a continuous sleep debt may have many different effects as shown below.

- Mental health - post-natal depression, anxiety, and feelings of being inadequate
- Physical health - Type 2 diabetes, immune system depletion, lack of resilience to pain and normally mild ailments
- Safety - Increased road safety risk, slips, trips and errors around the home, safety risks with baby (e.g. boiling water, etcetera)
- Parenting - Easily distracted, intolerant & grumpy, and becoming angry easily
- Being a partner - Taking tiredness out on partner, blaming partner or others for negative outcomes, and relationship issues that would normally seem irrelevant
- Productivity - Can't keep up with household chores, finding it hard to start any tasks, and the cessation of hobbies and sports

## **Parental recovery**

It's wise to ask for assistance when you are short of sleep or have built up a sleep debt. The sooner you can do this, the better. Rather than wait for an accident to happen or for someone to point out that you are becoming intolerant with your child, try

and catch up on sleep where you can. Below are some tips that you might find useful:

- Practice short naps of 20 minutes whenever your baby has a sleep. You may want to tidy up or get other things done, but without catching up on sleep, all these things will appear harder than they really are.
- If there is another parent available, try and get longer sleeps in blocks of 90 minutes. For example, 3 hours, 4.5 hours, or 6 hours. This will allow you to go from light sleep, into deep sleep and then back out to rapid eye movement sleep before waking up. The more sleep, the better.
- Ask a trusted friend or family member if they would mind staying over for a night and looking after your child while you get a whole night of sleep. If you can catch up with nine hours of sleep, you will greatly benefit.
- If you can't find someone to do an overnight stay, consider asking someone to do a day-long stay where you try to get as much day sleep as possible. Your room may need additional blackout material for the window and aluminum foil can be a good short-term blackout if you place it on your glass. Do not leave the foil there long-term as it is said to ruin the glass after several weeks. A warm shower and a cool room can also assist.
- If you can't find anyone to assist when you get some recovery sleep, ask for help from a hospital, general practitioner, or clinic in your area. It is not a sign of weakness if you ask for help. It's stating that you want the best for baby. A parent with sleep debt may not be the best version of the parent that they normally could be.

## **Preteens**

Older children (2 to 12 years) often sleep well. But be aware of how much computer and other technologies can affect some kids' bedtimes. For example, 'Facebook', 'Twitter' and other social media increases alertness and the added light from screens may delay their normal sleep phases. This may delay sleep onset, cause awakenings, and reduce morning alertness. Sleep issues of children need to be taken seriously as it will affect their physical, emotional and mental development. If your child is continuously not sleeping well, seek the help of a professional.

## **Physical health**

A study of 915 children aged between 6 months old and 2 years old in Massachusetts<sup>46</sup>, found that when the children slept for less than 12 hours per day on average, it became a risk factor for childhood obesity. The authors state, *"being overweight in young children is associated with later obesity, conditions such as hyperlipidaemia, hypertension, asthma, and type II diabetes, and higher morbidity and mortality in adulthood."*

More recently, researchers<sup>47</sup> investigated the effect that sleep and media had on obese children in Turkey. They used insulin resistance, blood lipid profile and liver enzymes to determine if media time and sleep duration influenced their metabolic profile. There were 108 children from 10 to 15 years of age within the study. Insulin resistance and lipoprotein were elevated in conjunction with short sleep and extended media use. This led the authors to suggest that improving sleep duration and limiting media time could help reduce metabolic risk in obese children and teens.

## Immunocompetence

*Immunocompetence* is the ability of the body to produce a normal immune response following exposure to an antigen. In an earlier chapter we introduced research findings regarding adult immunocompetence and how sleep can affect it. There are few pediatric studies published in this area, but anecdotal evidence suggests that when a child is immunised, the conversion of an introduced vaccine into immunisation antibodies (sero-conversion) is affected by poor or restricted sleep. A study comparing 50 children with obstructive sleep apnoea against 52 children without the sleep disorder<sup>48</sup> suggested that the poorer sleep caused by obstructed sleep apnoea contributes to poor immune function for those children.

## Children's sleep, mood, and behaviour

Parents are quick to point out that the mood of children can be directly influenced by how much sleep they obtain. Researchers<sup>49</sup> have supported this with studies that have found direct relationships between short sleep duration and:

- Positive affective response
- Emotion regulation
- Short-term memory
- Working memory
- Aspects of attention

In the study of 32 children aged 8-12 years old, short sleep was only 1 hour shorter than the child's normal sleep. It took only 4 nights of short sleep for children to have the reactions shown above.

## **Attention deficit hyperactivity disorder (ADHD)**

For many years, parents have noted that children who suffer from ADHD often have sleep problems. Sleep is not always investigated by practitioners when making assessments on ADHD behaviours. However, recent studies suggest that they should. A team investigating children between 6 and 11 years old (147 children)<sup>50</sup> who were diagnosed with ADHD, had the children's parents measure their sleep habits. 14 percent of the children had less sleep than is recommended for their ages and 31% had a sleep latency (time to get to sleep) of more than 20 minutes. The few children in the study who were taking medication for ADHD had even longer sleep onset latency than those who did not take medication. Further, 41% of the parents stated that their child needed to catch up on sleep on the weekends.

When 28 drug-free ADHD children were studied to investigate cognitive functions and sleep parameters, the researchers<sup>51</sup> found that the average sleep duration was less than 9 hours. Results showed correlations between slow wave sleep, stage 2 sleep and rapid eye movement sleep were predictive of cognitive function, particularly for verbal Intelligence Quotient (IQ). The authors suggested this has been previously recognised in studies.

This is also a problem for parents, as the sleep and actions of ADHD children can seriously affect their sleep. 62 children aged 7 to 17 years, who were diagnosed with ADHD, had their ADHD symptoms, anxiety, arousal prior to bedtime and sleep measured, in conjunction with their parent's sleep onset and sleep abnormalities<sup>52</sup>. Children with a clinical sleep score (indicating sleep less than recommended) were more impaired in behavioural, cognitive, and emotional domains. The children's



pre-sleep arousal significantly predicted a longer sleep onset for the parents, which can further exacerbate parenting problems when trying to get children with ADHD back to sleep when awoken.

The authors recommend comprehensive evaluations of sleep be included in routine ADHD evaluations, supporting a similar stance taken by researchers in 2010<sup>53</sup>, where it was suggested that sleep become a focus as part of a global approach to evaluating ADHD children. An Australian study in 2015<sup>54</sup> of 244, 5 to 12-year-old children with ADHD, examined the use of a short behavioural intervention program to improve sleep. The children were divided into a control group with no intervention, and an intervention group. A trained psychologist, or a trainee consultant paediatrician with six hours of training, delivered the training program and a follow-up phone call to the children in the intervention group. Consultations assessed the sleep of the children in the intervention group and provided advice to parents on how to set limits and promote better sleeping patterns.

At three- and six-month follow-ups post-intervention, the intervention group had a greater decrease in ADHD symptoms than the control group. They also had fewer sleep problems and teachers reported improved behaviour at both three and six months post-intervention. Working memory of the intervention group children improved at six months. The families also reported greater improvements in their children's ADHD symptoms, behaviour, quality of life, sleep, and daily functioning. The experiment was a great example that stimulant medication is not always necessary and that non-pharmacological solutions should not be neglected.

## ***Adolescents***

Teenagers tend to go to bed later and sleep later if they can. This 'phase shift delay' is quite common and wouldn't be as much of a problem if they didn't have to get up reasonably early to go to school or get ready for work. A teenager should typically get around eight to nine hours of sleep. Research is showing that children and teenagers are becoming more obese and have higher incidences of type 2 diabetes due in part to a reduction of sleep. Use of social media often delays sleep onset until around midnight and sometimes later.

In 2008 the team of van Cauter and Knutson<sup>55</sup> investigated the link between childhood sleep, obesity, and type 2 diabetes. They noted that recent times have seen shorter sleep for adults, teenagers and children that has developed over the same time as increases in obesity and type 2 diabetes. They reviewed research which illustrates the link between reduced sleep and childhood/teenage obesity and found that when young adults restricted their sleep there was:

- Decreased glucose tolerance (inability to draw glucose into cells to create energy)
- Decreased insulin sensitivity (cells fail to respond normally to insulin)
- Increased evening cortisol (the hormone which helps you stay awake and fight stress)
- Increased ghrelin (hormone that makes you hungry)
- Decreased levels of leptin (hormone that tells your brain when to stop eating)
- Increased hunger and appetite

## Sleep and behaviour

Technology plays a perceived vital role in the life of teens. In a recent study of 50 teens aged 14 to 17, researchers<sup>56</sup> had the teens sleep a normal baseline for 1 week, followed by sleep restriction to 6.5 hours per night for 5 nights (reflecting late night usage of technology), then 10-hour sleep opportunities for 5 nights. Over the study period, teens obtained an average of 2.5 hours less in the restricted condition than in the 10-hour sleep opportunity condition. Throughout the restricted sleep over 5 nights, teens rated themselves as significantly more:

- Tense and anxious
- Angry and hostile
- Confused
- Fatigued and less vigorous

Parents and teens noted greater oppositionality/irritability and poorer emotion regulation through the period of sleep restriction. The authors concluded that only after a few days of short sleep (common for millions of teens on school nights), teens have worsened moods and are less able to regulate negative emotions. If you are the parent of a teen, you almost certainly would have noticed this.

High-achieving teens at school may also restrict their sleep opportunities to excel and meet the requirements of entry into university. For high-achieving school teens sleeping seven nights of five hours per night compared to a control group sleeping nine hours per night, researchers<sup>57</sup> in 2016 found performances of:

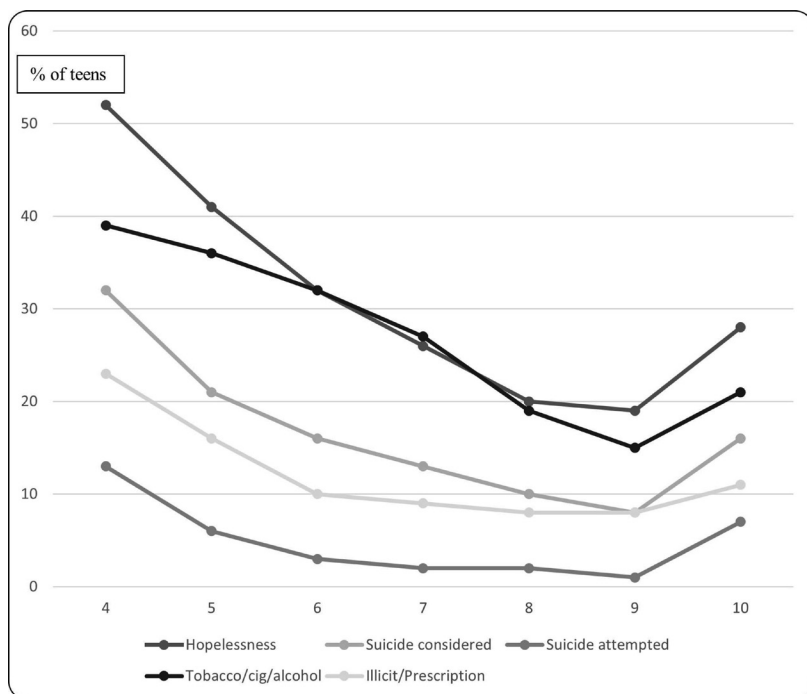
- Incremental deterioration in sustained attention, working memory and executive function
- Increases in subjective sleepiness
- Decrease in positive mood

The performances continued to deteriorate even after two nights of catch-up sleep. This is a concern for teens who may stay up late during the school week trying to fit in school work/homework, socialising, gaming and social media. It could be true that catch up sleep on the weekends may not bring their performances back to a healthy and scholastic level.

In August 2014, a large study on teens and sleep was reported in the *Journal of Youth Adolescence*. The study investigated the sleep of 27,939 teenagers from the Fairfax County 2009 Youth Survey<sup>58</sup>. The study sample was 51% female and was ethnically diverse. The self-report survey was taken by 8th, 10th and 12th grade students at the time. The average length of sleep for the students was 6.5 hours and 20% had 5 or less hours of sleep on average.

It is well known that teens generally require around 9 hours of sleep. Only 3% reported getting around 9 hours. The findings were that 1 hour less of sleep was associated with increases in the following:

- Feeling hopeless
- Seriously considering suicide
- Suicide attempts
- Substance use



**Figure 18:** Adapted from Winsler et al. (2014) *Sleepless in Fairfax: The Difference One More Hour of Sleep Can Make for Teen Hopelessness, Suicidal Ideation, and Substance Use*.

If you have teens and are concerned, check the amount of sleep they are getting. Even if you can get them one more hour of sleep, the difference can be substantial. Don't be afraid to ask for help if you need to get more sleep for your teen. Figure 18 shows the differences that an extra hour of sleep can make to a teens' state of mental health, according to the Fairfax study.

## **COMMON CAUSES OF POOR SLEEP & COUNTERMEASURES**

### **Sleep onset**

Research of preschool children in 2007<sup>59</sup> showed that 90% of parents used TV as a babysitter due to perceived positive effects of TV programs. Blue screen technology has been researched considerably of late and found to influence reducing melatonin output at bedtimes. Melatonin assists in both sleep onset and keeping a person asleep. The results of some of these studies has been questioned regarding how accurate the results are. My personal take on this is that anyone using a screen when it gets to their first sleep wave (as suggested by the 'Mabbott Method') can easily miss that sleep wave due to being so entrenched in the activity of the screen contents. Children and teens are using more and more technologies that have blue screens and are using them later into the night. Social media has become a serious issue for teenagers as they spend many nights going to bed considerably later than they should.

### **Awakenings**

Awakening for children can be more prominent in children who may have issues with anxiety. The anxiety can come from many causes, such as family issues (violence, abuse, etc.), bullying at school or elsewhere and in some cases, from the content of television programs or games played on the internet. Parents whose children suffer many awakenings could ask the children if they are dreaming or having nightmares and if this is waking them up. They could also be questioned about what they are thinking when they wake up as that could provide insight into what might

be triggering the awakenings. It may be worth speaking with a child counselor or psychologist to get a better understanding of how these issues might affect the anxiety and stress levels of children.

## Sleep duration

Several studies have shown bedroom TV practices to be associated with:

- Bedtime resistance
- Sleep onset delay
- Sleep duration

The results affected both children and teenagers. Research<sup>60</sup> using the Sleep Disturbance Scale Children Questionnaire showed that children with an abnormal score (high score) were likely to have a TV in the bedroom and were more likely to experience nightmares, sleep terrors, sleep talking and tiredness upon awakening. The research clearly shows the effects that a television in a child's room can make on their sleep onset and sleep disturbances. Efforts should be made by parents to limit televisions to family areas only and limit viewing time for children.

Other reasons a child may restrict their time asleep may include:

- Staying awake on social media
- Fear of missing out (FOMO - i.e., on what friends are doing, especially on social media)
- Out late with friends

- Inconsistent parental control
- Timing of early school start times for teens

### ***Tips for getting better sleep for children and teens***

Here is a list of actions for assisting your preteens to get better sleep.

1. Limits on screen time. Work out how much sleep your child needs and ensure the screen time stops at least an hour prior to bedtime. You can purchase devices that can stop wifi signals at predetermined times.
2. Regularity. All humans benefit from regular bedtimes and wake times. Consistency is key.
3. Have a room that is comfortable and conducive to sleep. Make it cool and dark. If a child insists on sleeping with a light on, make it a dim light close to the ground. Bright light may wake the child, or at least cause disturbances when the child moves into REM sleep. This is due to the increased activity in the brain and recognition of light along the optic nerve.
4. A relaxing warm bath prior to bedtime. The bath will relax muscles and slightly increase core body temperature, which will then drop once removed from the bath. This helps to increase the sleepy feeling for the child.
5. Providing a comforting story or song to the child can feel like a reward for being in bed. Make the stories positive and meaningful and avoid scary stories that may result in negative dreams or nightmares. For example, it may be less frightening for a child who is listening to a story about being eaten



up by a monster, to hear the story: “*There’s a Monster Under my Bed Who Farts*”.

6. Don’t bring the child into your bed to co-sleep. There is considerable research to indicate that this results in poor quality sleep for both the child and the parent/s. Try to persevere with teaching a child to self-soothe and return to bed for sleep. Give rewards for staying in bed, rather than negative outcomes for not.

When it comes to teenagers, it’s best to simply point out how sleep can be a benefit to their life. Help them to understand that appropriate sleep will assist with weight control, good skin, and facial tone (they all want good looks), greater strength and sporting performance, better moods, and a much more attractive personality.

## Learning and Memory

This section is a longer version of the earlier one on how memories are laid down long-term in stage two of sleep. It is too big for the flow of that section and fits nicely here with children and adolescents. However, most of the following information also applies to adults.

Any learning, including learning what your parents might look like as a newborn baby, involves chemical reactions of neurotransmitters and the growth of neuronal axons and terminal branches. Vision of an occurrence, for example, commences with a message being sent through the eyes and along the optic nerve to the occipital lobe, where a map will be developed within the network of neurons in that area. The map will develop due to the neurons actually growing their axons to connect with dendrites of

other neurons. Where the axon reaches an end, it terminates in a pre-synaptic termination. A 'synapse' is the term given to the gap between the pre-synaptic end of the neuron's axon and the post-synaptic start of the dendritic branches of the following neuron.

Within the synapse, chemicals are released (neurotransmitters) from the pre-synaptic axon into the space which then binds to receptors of the post-synaptic dendrite. Different neurotransmitters have either a stimulating effect on the following neuron or an inhibiting effect on the following neuron. If there is enough of the stimulating neurotransmitter, then the following neuron will fire once a certain amount of stimulation has been received (called potentiation). Other neurotransmitters may inhibit the effect on the following neuron and cause it to not fire, even with the stimulating neurotransmitter present in the synapse.

The forming of new synapses (synaptogenesis) occurs when the brain is learning something new or laying down memories. This creates an increasing network of information, including storage and transmission of information. In the example of the infant looking up at the parent, the information gathered in the occipital lobe then passes into the cortical regions of the brain where determinations of what you see come to bear. What you determine from what you see will also be highly dependent upon other aspects of life at that very moment. For example, if the child repeatedly experiences a warm, soothing voice while being gently hugged, the child will learn that the image of the face is associated with safety and comfort. This is known by scientists as the principle that "neurons that fire together, wire together."

Short-term memory is formed in an area of the brain called the Hippocampus. It is a convoluted structure deep within the brain

and above the brain stem. In this location, the short-term memory serves to provide humans with a working memory of what has recently occurred, so that we do not spend our days repeating everything. This wonderful and efficient memory system will allow us to plan our day, work through it, remember the names of people we meet (although not always on the first occasion of hearing the name), and whether or not, when standing in front of the toilet door, we have been or are yet to go!

Basic driving, for example, requires that we plan the drive by utilizing the knowledge of places and roads (declarative memory) and choosing a route (procedural memory) to either get to our destination quicker, safer, easier or a combination of these. Without procedural memory, we would have to stop at each intersection and work out which way we have to turn. Whenever I have to travel to a place where I have to use a new route, I will study a map of the route the afternoon prior to sleep. I'll let rapid eye movement sleep run through that a few times so that when I'm ready to go, I'll get there easy.

Working memory helps us recall information on a test, or how to achieve a productive work day without injuring ourselves through undertaking dangerous tasks in a way that exposes us to injury. For example, imagine working in a situation whereby we are cutting timber on a bench saw. We know the safety aspects of the work (procedural memory) and how very dangerous circular saws can be when something goes wrong (declarative memory). Keeping your footing when working with your hands near the machine is crucial to your safety. A piece of wood falls off the bench and onto the floor while you are half way through cutting the timber. The remainder of the safe operation of the cut is dependent upon remembering that there is wood on the floor,

and you could easily step on it and slip. Short-term memory helps to protect you from harm.

Learning requires the formation of memories. The process of laying down a short-term memory is said to take approximately five to ten minutes, dependent on how complex the information is to process and understand. To enable the short-term memory to become a long-term memory, other processes have to occur. Otherwise, the short-term memory remains just that, short-term.

Through the processes of sleep, short-term memories are distributed throughout the cortex (the exterior of the brain, mostly made up of neuronal cell bodies). There they are laid down as long-term memories, stored for future use when we require them. If you can reflect back on a time where you may have stayed up all night studying, it may help you understand the requirement of sleep in aiding long-term memory retention. Spending the hours that you should have been asleep, studying, you put a considerable amount of information into short-term memory. You arrive at school, college or university ready for the exam and find you have just about enough short-term memory left to make it through the exam (not usually with flying colours). Your responses within the exam will be a mix of long-term memories from the cortex of the brain and short-term from the hippocampus. Consider the hippocampus like a dash cam of a vehicle. The device will continually record (short-term) and will eventually write over itself unless you hit the 'save' button (go to sleep). If you don't sleep, you save very little memory for long-term.

The following day, you attempt to reflect on your learnings from 'the night before'. Alas, there is not much to recall. Much of what was placed into short-term memory has now seemingly

vanished into thin air. Very little of what was learnt that night will stay with you. I remember developing a saying at university when undertaking my undergraduate degree in Psychology, “What you don’t know the day before the exam, you don’t know! Have a feed of fish and get eight hours of sleep.” When you consider that passing exams are important, it is also highly beneficial to retain information acquired from the course of study into your future. Good sleep will assist this to occur.

During the phase of rapid eye movement (REM) sleep, we consolidate the long-term memories by playing a neuronal version of ‘connect the dots.’ The pons area of the brain is located virtually wrapped around the top of the brain stem. The pons has many functions including moving information from one hemisphere of the brain to the other side of the body through a cross-over process. This is why damage to one side of the brain nearly always affects the appropriate location on the opposite side of the body. For example, damage to the right motor region of the cortex will often cause lack of, or reduced movements to some of the left side of the body.

During REM sleep, the pons sends a barrage of neuronal signals from itself to the cortex of the brain. You could liken it to the phenomenon observed during the science experiments, where you place your hands on a glass dome with electricity running through the middle of it and tiny lightning-like strikes will move to the places where your hands lie. Through this phenomenon, the long-term memory that has been established throughout the cortex will be consolidated so that the person can recall the memory if and when required. This ‘dot to dot’ connective phenomenon is an integral component of memory formation and recall.

A few notes worthy of consideration here. First, the brain is an amazing organ, in the capacity to gather and store an incredible amount of information. Imagine for a moment, if I asked you to write down every memory you could ever possibly recall. From that first time you can remember losing a car toy in the sand patch (one of my earliest memories) to the significant events of your life up to now. Don't forget all the other non-significant memories, such as passing your lower school exams and perhaps whether or not your driving examiner was a male or female. Furthermore, all the colours, people, animals, insects, and places you have seen or visited. Will you ever live long enough to write all this down?

Second note, this memory consolidation process also somehow allows us to work through problems that often arise. One brief example was that of a gentleman who lost his wallet four days prior to me meeting him at a training session. He reported finding it the night before in his jeans pocket right where he left it four nights previous. At around 3 am in the morning he awoke from a dream with the vision in his head and he got out of bed to find it exactly as visioned in his dream. Is this a miracle perhaps? Or maybe a run-down of events that day could help explain it. He was annoyed that he lost his wallet to start with and spent a lot of time that day running through memories of his previous days of activity. Thoughts of who might have it and possibly the credit available on his cards, was of major concern. He cancelled all of the cards that he could recall that he had. There were a lot of new neuronal processes going on in his brain which he then took to bed as short-term information. He then laid it down as long-term and in the consolidation phase, ran through some of the processes. At this point, his dream awakened him with information leading to the discovery of his wallet, full of cancelled cards!

## *Part Four*

# Sleep Restriction Effects on Safety And Productivity

John and Tammy were looking forward to the two weeks at the coastal resort, which boasted daytime tours and good fishing. Due to restricted travel from COVID-19, the holiday was set within their own state, but was a place they had not yet been to. They had planned to relax in the afternoons and spend fun evenings with their ten- and twelve-year-old boys. They weren't expecting to be rushed to hospital, with Tammy's broken arm and John's chest and stomach injuries from the seat belt. Tammy's lipstick left a distinct set of lips markings on the now deflated airbag. The one they call the 'kiss of life'. The ambulance officer suspected that John may have internal injuries, so there was an urgency to get him to hospital quick. No one knew what happened that day, as everyone was asleep, including Tammy, who was driving at the time.



## *Chapter Eleven*

# Road Safety, Commuting and Holiday Driving

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Road safety has been at the forefront of government planning for many decades. Since 1970, the introduction of seat belt legislation, and the later legislation on drink-driving, had major impacts on reducing both the number of road crashes and the trauma severity. Safer vehicles and roads, policing and traffic management has also contributed to a lowering of road deaths per 100,000 population, as has campaigns and programs aimed at advising and educating the public on better driving behaviours. However, the number of vehicular crashes and the road trauma that goes with it, sadly remains too high. A report of Australian National crash statistics for the ten years to March 2020<sup>61</sup>, showed decreases in the number of deaths but an increase in hospitalisation rates. Safer vehicles are protecting their occupants from death more, but far too many crashes still occur.

The Australian National Road Safety Action Plan 2018-2020 included fatigue as a target component. I am confident that this occurs in many countries and locations around the world. There is nearly always a mention that the best way to avoid fatigue is with



adequate sleep. However, sleep is one of the components that most road safety initiatives speak little of. This is understandable, as sleep is a hard topic to approach when there is no way of demanding, regulating or enforcing what people do when they are away from the roads. Perhaps a sleep and fatigue training program could become part of the curriculum in the lead up to driving exams for new drivers and those who are needing to re-obtain a full license to drive. It is often included for operators of heavy vehicles, so why not the general public?

Fatigue can be caused by long drives, a lack of breaks during driving, pressure to arrive at certain pre-determined times, driving through late-night periods, or through sickness or use of drugs/medications. Underpinning all of these causes is the amount of sleep that drivers obtain. Both sleep restriction or poor-quality sleep can cause fatigued driving coupled with the points above, or on their own.

### **Tired, sleepy or fatigued?**

I tend to not use the term 'fatigue' very often as it is a very broad term that could include any noticeable signs of tiredness. Thus, it will always be hard to target strategies to avoid driving fatigued. Definitions from the Oxford Languages show the term 'fatigue' as: extreme tiredness resulting from mental or physical exertion or illness. The term 'extreme tiredness' offers little in determining exactly what countermeasures are put in place to avoid it. Nor does it explain the level of control over a vehicle a person who is driving 'extremely tired' would have.

Interestingly, whenever I ask a group of trainees how they would be feeling if they were 'Fatigued' enough to stop their vehicle and take a break, the most common responses are: When my eyes

are closing; when my head is nodding; I'm drifting all over the road; when I can't remember where I've been. This is too late, as they have been driving impaired at that point. The focus seems to be on only stopping 'when I'm about to crash'. For this reason I would love to get rid of the term 'Fatigue'. Other terms used in road safety for the driving behaviours observed due to fatigue are much more useful:

- **Tired** - in need of sleep or rest, weary
- **Drowsy** - a feeling of being sleepy and lethargic
- **Sleepy** - needing or ready for sleep

My thoughts on the use of the word 'tired' is that a person could be tired from physically exhausting work or a number of other reasons. A break in the right conditions can often bring about a respite from this condition due to the reduction of lactic acid build-up and increases of energy from food and fluids. Driving is not physically demanding - it is mentally demanding. Therefore, a break in driving can both help to reduce the effects of becoming tired, or when used correctly, can generally put off becoming tired in the first place. Most road safety campaigns target this portion of fatigue quite well, with the exception of not discussing the benefits of taking breaks before becoming tired. They normally recommend stopping every two hours or when you feel tired or 'Fatigued'.

The term 'drowsy' relates to feeling sleepy and being ready to sleep. It defines the actual feeling of impairment. The term 'sleepy' should be used to describe drivers who are actually falling asleep at the wheel. This is the endpoint of drowsiness. Road safety campaigns should always ensure that the difference

between the terms (e.g., tired, drowsy and sleepy) are well understood and treated differently. I believe that by clearly pointing out the differences, we may see a change in people's driving behaviours.

A population-based case-control study in North Carolina<sup>62</sup> examined driver risk factors for sleep-related and fatigue-related motor vehicle crashes. Cases included 312 drivers identified by police as asleep at the time of a recent crash, and 155 drivers identified as fatigued at the time of a recent crash. Controls were 529 drivers not identified as asleep or fatigued in recent crashes, and 407 drivers not involved in recent crashes. In the analysis of driver risk factors, they found the following to be at higher risk of a sleep-related crash (I have added my own notes in parenthesis to illustrate the affects from restricted sleep):

- Working multiple jobs (some won't have time for adequate sleep)
- Nightshift (driving after being awake all night causes sleep pressure)
- Averaging less than 6 hours of sleep a night (inadequate sleep length)
- Poorer overall sleep quality (sleep quality is important)
- Frequent driving between midnight and 6 am (driving when you would normally sleep)
- Excessive daytime sleepiness (nearly always due to inadequate sleep)
- Driving after less than 5 hours of sleep the night before (inadequate sleep length)
- Driving after being awake more than 15 hours (getting towards the normal sleep promoting drive in the brain)

- Use of soporific medications (mainly sleep medication doing its job)

Many of the subjects self-admitted driving while drowsy in the past, which was one of the strongest risk factors overall. It led the authors to conclude, *“The results demonstrated a strong dose-response relationship and suggest that, like drinking drivers, drowsy drivers may accumulate considerable experience driving while impaired prior to crashing.”* (p. 330)

This leads me to consider how this motivation to continue driving while drowsy occurs. Professor Jim Horne and Louise Reyner from the University of Loughborough, UK, have cited research indicating drivers know they are drowsy well before they have a sleep-related crash. This would be true for most people with the exception of people with narcolepsy, who tend to not spend time in a transitional stage between wakefulness and sleep onset. They basically have a ‘broken on-off switch’ for sleep.

The statement, *“Drowsy drivers may accumulate considerable experience driving while impaired,”* relates to how habitual it can become, to the point that it is not surprising to feel drowsy at the wheel. I always ask my groups of people in training, “Have you fallen asleep at the wheel in the past?” The resounding answer of yes, followed up with stories of near-misses and tragedies, highlights that drowsy driving is a very common theme within the population. People will readily admit driving drowsy on many occasions, and I believe the reasons they feel this is not exceptional is due to:

- Being uneducated on how sleep affects driving behaviour and performance

- Not yet having had a fatigue-related crash
- Feeling drowsy on many driving occasions and continuously getting away with it
- Being unable to determine how drowsy they have become due to being too impaired to judge their own impairment levels
- Risk homeostasis (a common feeling that you can take more risks as the roads and vehicles are now safer and you are less likely to be killed or sustain an injury)
- Misperception of how long a micro-sleep may last, and how far they can travel with no control over the vehicle

I remember when I delivered a training session on sleep and fatigue to the Western Australian Police Major Crash Division, one of the officers said, “All drivers should do this training before sitting the driving exam.” I believe this could be a game-changer for road safety, as many people that I meet want more sleep than they currently get. After my training sessions, many people report getting more sleep with the new found knowledge of sleep and how to improve it. This will assist with better driving behaviours for most of them.

I like to use my own driving experiences as examples, and just recently I drove a 6-hour journey in Queensland, taking breaks for the sake of keeping a rapid reaction time and not getting bored. I did not feel tired, or drowsy for the whole trip. When I arrived at my destination, I was still energised enough for a 30-minute walk. The basis of being able to do this (and this is not an isolated event) is my wonderful sleep, which last time it was measured, averaged 7 hours and 28 minutes per night over a 2-week period. I believe that if the bulk of drivers made more effort to sleep better, we

would see a major decline in the number of crashes on roads. It is likely that the number of fatalities and hospital admissions would decline also, as sleepy drivers tend to hit obstructions at full speed, as they often have no avoidance manoeuvres due to sleepiness.

### ***Different levels of driving impairment***

Most road safety strategies and programs are aimed at having a driver stop to take breaks regularly and to think about ‘not trusting your tired self’ when driving. This is good advice indeed. But I think we can do better. I often discuss when delivering training, how driving impairment generally falls into three levels as mentioned earlier:

1. Tired – Feeling a little lethargic, depleted of motivation, getting a bit stiff in the major muscle groups, bit of an itch or tight around the neck and shoulders, or bored
2. Drowsy – Eyes feel heavy, slumped in the seat, missing signs by the road, forgetting parts of the drive, struggling to stay awake
3. Sleepy - Microsleep episodes, such as eyes closed for lingering moments in time, no, or very little vehicular control

Countermeasures need to be appropriate for each level. I will expand each of these levels of driving impairment, offering the appropriate countermeasure for each level.

### **Level one driving impairment – Tired driving.**

Most people don’t recognise the first level of impairment. Being in a sedentary position for a while takes a toll on the

human body. Circulation slows, reducing blood flow to major muscle groups, muscles relax and cause a compression through structures such as joints and the spine. A forward-tilted head and slumped lumbar region can create muscle tension in your neck. Arousal diminishes and reaction times increase. There can often be a gradual decline in attention to detail of driving tasks, such as lane tracking, overtaking manoeuvres and judging the oncoming speed of vehicles at intersections. Generally speaking, your driving is affected to the point of making mistakes which you often get away with.

This level of impairment can be recognised, but unless you take note of these small errors, nothing changes. Alex Jerrim from the group 'Incident Free Driver' is a friend of mine who educates on road safety. He encourages people to 'look in the mirror' at their own driving behaviours. The general premise of this model is that for every driving incident you have, there is a very good chance that something you did either contributed to the event happening or being unable to avoid the errant driving behaviours of others. Either way, you are encouraged to find faults that you can rectify to reduce incident occurrences in the future. If you follow this model, it can have a profound effect on your driving performance. The positive thing about being at level one impairment is that you should not be too impaired to notice your own errors.

The main countermeasure at level one impairment is to take a break. Road safety education often refers to having a break every two hours. This is not bad advice, but here is my version of the advice. ***Have a break before you get tired!*** Think about this strategy for a moment. It is the strategy I use for my travel, especially on long drives of 4 to 12 hours (I haven't driven longer than 12 hours).

What I do is I plan my drive to find things of interest along the way. I might drive an hour and stop to look at a shop I have driven by previously. I might see something worthy of a photograph just 90 minutes after resuming the drive. This will continue for the whole drive. At each stop, I will walk and move, stretch and get a good lung full of fresh air. I tend to snack, rather than have bigger meals and I hydrate often. The movement, fresh air and the break of monotony refreshes my driving skills and abilities. It keeps my reaction times sharp and my level of looking out for others' driving behaviours in check. I have avoided many incidents by correctly anticipating the movements of others coming toward me and at me.

I also ensure that I regularly move while I'm driving. When safe to do so, I'll roll my ankles, stretch my legs, stretch and arch my back, move the hips forward and backward, and do a few shoulder rotations. These movements, along with winding down the window to refresh the air every now and then, helps immensely.

***Act like a smoker, but don't smoke!*** In training sessions, I refer to taking breaks before getting tired as 'acting like a smoker, without smoking'. Most training participants quickly get what I mean, especially for company truck drivers who are not allowed to smoke in the truck. It means, stop the vehicle, park it safely, move around for a couple of minutes, and get on your way. The reference to a smoker is that a smoker does not generally want to be seen to be slowing down production. But the drive to have a cigarette is strong enough to take that break just for a couple of minutes to feed the habit. Therefore, they will do it safely and without conspicuity. While I would never condone smoking, I fully support taking a break regularly enough to not get tired, ensuring



production principles are met. It's the movement that will keep you performing better for longer. It is interesting to note that people who do this, recognise that productivity can actually be increased by taking more breaks.

In open cut mines, if a haul truck driver starts to get 'tired' he or she might forget to drop the load off at the waste dump and reverse under the shovel for a load. Embarrassingly, they get a call up on the two-way radio that asks, "How much more do you want on that load?" Production has just slowed because they drove tired, and they have to complete the whole drive over again to make sure they remember to drop off the load. Other silly mistakes occur at this point of driving, such as missing turn-offs or taking loads to the wrong place. It gets expensive when a load of ore is dropped onto the waste dump. A mine in Kalgoorlie had two loads of high-grade gold ore crushed and laid out as road base on a nightshift. That was an expensive for the operator, as it cost him two cartons of beer to his crew for his mistake. Employees had to walk the road to recover as much of the gold as possible.

### **Level two driving impairment – drowsy driving.**

When you don't take the necessary breaks to reduce the onset of driving impairment, you slowly move to the next level past tired. This can also be caused by not having had adequate sleep over the last night or two. Believe me, you don't have to drive for long to reach this level of impairment if you have a sleep debt. Your brain will look at trying to pay back the sleep debt as long as you are sitting down. This is what I would refer to as drowsy driving.

A team of scientists from Bern, Switzerland<sup>63</sup> was seeking to develop the Bern continuous and high-resolution wake-sleep scoring criteria. Historically, sleep was measured by

electroencephalograms (EEG) on paper with epochs of 30 seconds. They felt that the American Academy of Sleep Medicine measures did not capture **microsleep episodes (MSEs)** between a subject being awake and going into true sleep. This period of drowsiness for the subjects is described by the authors as the 'wake-sleep transition zone'.

The study used data from 76 patients admitted to the Bern University Hospital for testing of excessive daytime sleepiness. This disorder can have several causes and the determination of the level of daytime sleepiness is through the use of the Maintenance of wakefulness test (MWT). In this test, subjects undergo 4 trials in a day - 2 before and 2 after lunch. There is a minimum of 2 hours between trials. Patients sit on a chair in a semi-darkened room for 40 minutes and are instructed to stay awake. The level of motivation to stay awake is likely to be influenced by the level of sleep restriction. This is similar to driving a vehicle, where the knowledge of falling asleep at the wheel would drive a motivation to remain awake. However, experience with automobile crashes has clearly shown that this motivation is simply not enough to escape sleep onset when drowsy.

MSEs and full sleep were measured using occipital EEG, face videography of eye position, and slow eye movements. The patients were scored during the 3 pm scheduled trial of the MWT, as this coincides with the post-lunch dip of the circadian rhythm, where many people feel drowsy, especially if they are sleep restricted. 39 patients reached full sleep in the trials and only 4 did so without a MSE prior to sleep. A further 7 patients recorded MSEs but did not reach full sleep.

For 50% of the patients, sleep occurred within four minutes of the first MSE. For 80% of the patients, sleep occurred with

10 minutes of the first MSE. Sleep was preceded by at least one, but often by two or more MSEs in all patients except for three. Two-thirds of the MSEs recorded lasted between one and five seconds.

As the patients were all admitted to Bern Hospital for assessment of excessive daytime sleepiness, the outcomes cannot directly translate to all groups of people. However, people who undertake excessively long drives over an extended period of time, or those who have been sleep restricted for more than a few days would likely show signs of excessive daytime sleepiness.

Driving a vehicle requires a 'duty of care' to other road users, including those within the vehicle being driven. It is an expectation that a driver will be in full control of a vehicle at all times. However, the motivation to remain awake at the wheel is seriously compromised when a driver is in a wake-sleep transition zone.

My observation of drowsy drivers, both in vehicles and in driving simulators, is that after a period of driving, drivers start staring with semi-glazed eyes - not cognizant of hazards, but largely focused on the task of following the road contours. I call this, 'The lights are on, but nobody's home.' Driving without awareness is a condition where the eyes focus within a restricted field of view, having little to focus on except the road edge line, known as the 'fog line'. Importantly, the driver may gaze at the white line but completely fail to see a pedestrian or an animal wandering onto the road. Driving without awareness is common when people are fighting stage one sleep. Reactions to objects that appear in the visual field tend to be very slow, if there are any reactions at all.

Speed and headway distance (distance between vehicle being driven and vehicle being followed) tend to vary, simple tasks such as indicating and correct timing of dipping lights, become forgotten tasks and lane tracking becomes unstable with large steering manoeuvres instead of micro-corrections to steering. Reaction times tend to slow down to around two to three seconds, whereby the normal reactions tend to be around one second. At this point, you do not have the capabilities to log landmarks into your memory, because you need to be fully awake to lay down short-term memories. You may have arrived at your destination without memory of the last few kilometres as you have been in and out of stage one sleep. This is common with drowsy driving.

Your driving impairment level has increased to the point that you are likely incapable of assessing how impaired you are. This is akin to drinking large volumes of alcohol. For example, after a couple of standard drinks you will notice a warm glow and an increase in confidence. You overcome shyness and get what we sometimes refer to as 'Dutch courage', taking a few higher-level risks than you otherwise might. However, you do notice the changes and can react accordingly (by ceasing or continuing to drink alcohol). I rate this equivalent to 'driving tired'.

After consuming a few more drinks, the intoxication levels rise, as does the impairment. Now your singing has improved, you are the best dancer in the room, and you have never looked so awesome. Or so you think! Your impairment is now high enough to also impair your judgement of your behaviours. I rate this level of intoxication the equivalent of 'drowsy driving'. This level of impairment will mean you are less likely to stop and take a necessary break from driving. You are too drowsy to notice that you are drowsy!

I believe that once you get past ‘driving tired’ without applying a countermeasure, it is unlikely you will react at all to ‘driving drowsy’. What this means in reality is that the chance to put a countermeasure in place to avoid a fatigue crash may have slipped by some time ago. I don’t believe that most drivers are stupid enough to risk closing their eyes for more than a second or two while driving. Yet we do it when we have microsleeps! And for most people, it’s not just the one occasion. As previously mentioned, it appears the more we get away with it, the more we tend to do it. This is risk homeostasis at its worst.

So how do we address level two impairment (drowsy) if we, or someone else, recognises it? Obviously, the first decision needs to be to stop driving immediately when safe to do so. This means you do not simply stop on the side of a freeway, with vehicles passing by at 100 kilometres per hour, where an errant vehicle could lead to your demise. Look for the first opportunity to stop in a safe place. This is a good start, but what you do from here could mean the difference between a safe drive to your destination or risking the chance of a fatigue-related crash. We’ll discuss the outcomes of a fatigue-crash shortly. If you are with another person who is capable of driving, discuss what the choices are.

Here are a few:

- Consider swapping drivers
- See if you can recover with food and fluids
- There may be an opportunity for a 20-minute nap (timed and in a safe situation)
- Try stretches and movement to remind your brain that you are moving, and it is not conducive to sleep
- Perhaps a walk around a place of interest

Most importantly, if you feel sluggish or drowsy prior to recommencing the drive, don't drive. We sit to drive. Therefore, your condition will deteriorate. At this point your brain wants you to sleep for a reason. Whatever that reason is, as long as you sit, a sleep drive within the brain will be attempted. If none of the above countermeasures have returned you to a better condition, then not driving may save your life. Your next level of driving impairment is your highest level of driving risk.

### **Level three driving impairment – sleepy driving.**

Level three driving impairment is the serious stuff. There is no guarantee that you will make it to your destination. Luck plays a major role, and some people are just not lucky. I see this pointy end through my work with the Western Australian Police Major Crash Division, when they get me involved in fatal vehicle crashes thought to be caused by a driver no longer in control of the vehicle (i.e., asleep at the wheel). Let's start with hypnogogic hallucinations.

### **Long-distance truck drivers - hallucinations and stories from the road.**

There are two basic forms of hallucinations. One is based upon a human being having impairing, or hallucinating drugs in their blood stream, which may alter the workings of the human brain. Another form of hallucination appears when a human has a build-up of sleep debt. Often termed a 'hypnogogic hallucination', it is a form of hallucination that occurs on the way toward sleep, in the brains attempt to force the person to sleep to pay back a sleep debt.

It appears that with serious levels of sleep debt, the brain does not go through the normal stages of stage one through to deep

sleep, then REM sleep. Rather, the brain attempts to catch up on REM sleep first. This is due to a sleep restricted person missing more REM sleep stages while being sleep restricted. In sleep terms, we call this 'REM rebound'. However, if you get into REM components of sleep while you are in a wake-sleep transition, you may hallucinate, instead of dreaming.

Grain farmers often have a very small window of opportunity to harvest their crops before either the seeds drop, or bad weather ruins the harvest. As such, many such farmers will work almost around the clock for several days to 'bring in the harvest'. Usually, by the second night with very little sleep and around 30 to 40 hours of work, drivers of harvesters and the like will start to imagine they see shadows and sometimes weird shapes within the crops. Crop circles are not uncommon, but in this case the cause is drowsiness and not aliens. Perhaps we've uncovered a long-held mystery here?

People who work for the armed forces sometimes undergo exercises whereby they live out scenarios of two to three days of walking, exercising, combats and other forms of military deployment. They do this without sleep for the duration of the exercise. Some have reported seeing enemy approaching, figures appearing from behind obstacles, walls of ravines closing in on them and trees and bushes taking on different shapes. Some will discharge a firearm at seemingly nothing. Others have been known to go into a state of high anxiety and they are quickly withdrawn from the scenario.

This form of sleep deprived training has many benefits, including: 1) It introduces personnel to the harshness of sleep deprivation often encountered in military operations; 2) It affords an opportunity to withdraw some personnel from scenarios that

may lead to their demise if they were otherwise deployed into combat; 3) It ensures that personnel fully appreciate the feelings associate with severe sleep deprivation, often leading them to grab any and all opportunities for sleep when and wherever they can get them.

Long-distance truck drivers have provided me with many interesting and fascinating stories of hallucinations as they drive across many thousands of kilometres of Australian outback. Australia is unlike most other countries in that the distance between major destinations can be up to hundreds of kilometres, and long drives with only a few major towns are not unusual. Here are a few of their stories that have entertained me over the years:

A couple of north-south drivers in Western Australia have commented that on several occasions, they have had to stop for a train that was crossing the road at the time. Once they pulled the rig up and put the vehicle into 'park', they notice that there is no train, and looking down the track, there probably never was.

A 12-foot-tall cow! Now that would startle anyone. Funny though, Australia has since recorded its tallest steer, coming in at 178 cm. Quite short of 12-foot though. There has also been a range of pink elephants and numerous other animal sightings (which the drivers later believed were never there).

The Nullarbor Plain of Australia takes its name from the Latin: '*nullus arbour*', meaning no trees, even though there is scrub and bushes. Being around four times the size of Belgium, it can take days to drive across. Some drivers refer to the trip as 'crossing the paddock'. As such, some drivers have hallucinated that they have to stop and open the gate to the paddock, even though there are no gates.



One driver mentioned reading a comic prior to driving and then seeing cartoon figures on the road. Two drivers have told me stories of having to stop for large ships crossing the road. One reported that the passengers were waving to him. He admitted using the medication 'Duramine' at the time to go further without sleep. Duramine is an appetite suppressant which is mainly amphetamine based. On seeing the ship with waving passengers, he threw out the pills and has never used them again. It should be mentioned that you don't have to be a long-distance driver to have hypnagogic hallucinations. A large sleep debt is all that is required.

One final comment on how moving toward REM sleep as you are driving may affect you physically. In REM sleep both men and women have their genitalia somewhat prepared for sex. For this reason, if you ever drive drowsy, you may find yourself becoming aroused while you drive. This is not something to be proud of guys, it's a tumescent warning of pending sleep!

### **The sleep – wake transition, or microsleep episodes.**

Earlier, I discussed the research from Switzerland in 2020, where they measured the sleep onset of people being tested for excessive daytime sleepiness. They called the article 'Microsleep episodes in the borderland between wakefulness and sleep'. The research was undertaken to find a more precise way of measuring sleep onset, but it is what the authors call 'the wake-sleep transition zone', that piqued my interest.

A driver generally doesn't drive and simply fall asleep. He or she will go through feeling tired and then progressing to drowsy, prior to falling asleep. Road safety specialists often

speak of microsleeps, which are typically 1 to 5 seconds of duration. At 100 kilometres per hour, 1 second of driving will cover 27.8 metres. 5 seconds will result in 139 metres being driven without any control of the vehicle. The Swiss authors found that 2/3 of the people in the study had microsleeps of up to 5 seconds.

The authors discuss the instability of fluctuations between wakefulness and sleepiness, leading to microsleep episodes (MSEs) and periods of wakefulness. I noticed this phenomenon in my own PhD research in 2008, where I studied people driving in a driving simulator and having multiple microsleeps, with periods of wakefulness between microsleeps. It was also clearly noticeable in the research, that some microsleeps were not micro at all. On some occasions, drivers were falling asleep with no sign of waking, up until a warning buzzer sounded and woke them. This most likely would have been the transition to full sleep had they not been woken up with alarms. In real driving scenarios, they may have resulted in fatalities.

My investigations of data from seeing-eye technology in haul trucks has shown similar outcomes. In some cases, warning buzzers and vibrating seats have saved haul truck drivers from having serious crashes due to falling asleep. One gentleman in a New South Wales mine, quit working when he viewed the footage of his truck about to leave the road and go over the high wall. The fall would have certainly killed him. The vibrating seat and buzzer saved his life, and he didn't even know he fell asleep until his supervisor called him up to stop work.

The Swiss research noted earlier found that some of the participants had MSEs with their eyes open. This finding supports what us fatigue specialists have known for years but had little

data on. With the exception of three of the Swiss patients, actual sleep was preceded by at least one MSE, but more often two or more MSEs. If this occurs in a moving vehicle, it provides several opportunities to crash. The Swiss authors were surprised to find how early and frequently, MSEs occurred prior to sleep onset later on.

Similar to driving drowsy, a sleepy driver needs to stop immediately when safe to do so. The best chance of avoiding further MSEs at the wheel is to cease driving altogether. If this is not possible, the least action to take is a 15-20-minute nap in a safe place. My preference would be to nap in the back seat and not in the driver's seat. This almost sends a signal to the brain that it's OK to sleep in the driver's seat when it is clearly not. If a sleepy driver can access strong coffee or a power drink, then consuming this prior to the nap has the added benefit of entering the bloodstream as the driver is waking from the nap. Researchers Professor Jim Horne and Louise Reyner from the University of Loughborough have shown this to reduce driver fatigue for up to a couple of hours. In some cases, having a healthy meal can also add some energy to the drive.

To sum up this part of the chapter on 'tired', 'drowsy' and 'sleepy' driving, it may save your life and the lives of others, if you follow the guidelines below. They are over and above what is recommended by road safety authorities, and they work a treat for me.

They are:

- Take breaks before getting **tired**
- If you feel **tired**, stop and stretch, and eat/drink. Don't resume driving unless you feel good again

- If you notice signs of **drowsiness**, such as yawning, forgetting parts of the drive, have a wandering mind, missed turns that should have been taken, noticed you are driving slower than the rest of the traffic, or are having driving errors, stop as soon as it is safe to do so. Just taking a break may not stop you falling asleep when you resume driving. Consider eating and drinking and having a nap. A few stretches and seriously consider whether or not you should continue to drive any further.
- If you notice or have been told you are driving **sleepy**, stop as soon as it's safe to do so. Get someone else to drive if you can. Definitely have a strong coffee followed by a 15-20-minute timed nap. When you wake, seriously assess whether it is worth driving further. Call someone to come get you, rather than risk yours and other's lives.

### ***Holiday driving***

Australia is a beautiful country, and the road network allows access to some of the most scenic and interesting destinations in the world. With over 913,000 kilometres of road, and over 353,000 kilometres of them paved<sup>64</sup>, the holiday opportunities are endless. One of the main issues is that due to the vast distances between locations, driver fatigue often factors high on the list of road safety risks. Let's look at how some of the risks arise.

What appears to be common for families going on holiday is to be up late packing the night before travel and stressing over items that may have been forgotten to be packed. This often leads to getting to bed late and not being able to get to sleep straight away due to the stress involved. If the alarm is set for

an early start as it usually is, many people will wake through the night to check the clock. This will lead to broken sleep and add to the sleep restriction noted above.

Finally, the family wakes up, has breakfast and gets on the road as early as possible, either to beat the traffic or simply get to the destination as early as possible. The scene is now set for disaster. Driving before 6 am is always high risk and the peak of fatigue-related crashes occur prior to 6 am. This is mainly due to the accompanying sleep restriction of not going to bed to compensate for the early wake time. As the whole family has usually had sleep restriction at this point, an hour into the trip all passengers are fast asleep in the car.

When the family are asleep, the driver will often attempt to stay awake while not doing anything to disturb the sleeping family. This means not applying mild fatigue countermeasures such as winding down the window, singing or interacting with others through conversation. These are the things to do when the driver gets tired. As the driver is most likely to be sleep restricted, he or she may eventually be fighting sleep while driving. It is also unlikely the driver will stop for a break as this will also wake the sleeping family.

The outcomes of the continued driving commence with early signs of drowsy driving, such as lane wandering, headway maintenance (distance between vehicles), speed variation, forgetting parts of the journey, fixed gazes without taking in peripheral information, slow reflexes, intolerance of other road users and poor judgement. If the driver progresses through this stage of fatigue it may proceed to microsleeps and loss of control of the vehicle.

A fatigue crash often occurs immediately following a bend or on a straight, whereby the car wanders off the road and strikes an object or the vehicle rolls when the driver overcorrects back onto the bitumen surface sideways. Striking objects at speed or rolling the vehicle often leads to serious disabling injuries or fatalities. There are also some instances where a crashed vehicle is not seen for a while in remote areas.

## **Preparation**

Here are the top ten tips to ensure that your holiday driving is a pleasure and is less likely to be ruined by driver fatigue, family grumpiness and impatience. It will also help you get to your destination more safely.

### **1. Have a journey management plan**

A journey management plan can make your trip so much more pleasant. If it's a short trip (a few hours), plan to have the kids play games, etc., so they don't get too bored. If the trip is a long one, perhaps plan stops at interesting places and do things (e.g. local second-hand shop at a small town, or interesting sights). A playground for the kids to burn off some energy can be helpful.

Consider breaking the trip in two with an overnight stay in a place you haven't been to before along the way. Detail stops at regular intervals and ensure you take the breaks (e.g. every hour for brief stop and stretch, and every second hour for a walk around an interesting location). If you make enough of the planned stops you won't have to worry about where to stop to go to the toilet. If you have teens going with you on the trip, ask for their input into the journey management plan so that they feel they have a say in where you might take breaks.

## **2. Vehicle safety check**

Do a safety check of the vehicle at least a week before the trip in case any work needs to be done (e.g. wheel alignment, tune up). Ensure the spare wheel is in good condition, inflated to the correct pressure and you have everything you need to change it. Locate or purchase a first aid kit and anything else you need to make your holiday easier, safer, and more enjoyable. Check all fluids and have extra coolant, oil and at least ten litres of spare water (getting stuck on the side of the road in forty-five-degree heat will ruin any trip, especially without water). Clean the inside of the car to make the journey more pleasant. Have a rubbish bag!

## **3. Have a packing plan**

Make up lists of what you will need for the holiday (fishing, kayaking, cooking, etc.) and have a spot to start getting it all together. Have the kids help make up their list and they can cross each item off as they go. Aim to have all items ready the day before you pack the vehicle. Don't let packing make you stressed! Try and organise time off work to get the vehicle packed early in the evening if possible and have a slow-cooked meal or take away to reduce cooking and cleaning time prior to packing the vehicle.

Have a plan to pack your vehicle in a way that ensures you can get to the spare tyre and tools if you need to. Packing the vehicle should be increasing your excitement about going on holiday. Do a final vehicle check of the vehicle, including fluids, lights, etc. in the early evening. Have a relaxing hour or two to wind down and go to bed at your normal sleep onset time. Regularity is important.

#### **4. Good preparatory sleep**

Research shows that if you can get seven to eight hours of sleep each day for most of the week, you are in a great position to be resilient to stress and the odd short sleep. Being all caught up on sleep before you travel will make you feel more comfortable, drive safely and according to road conditions and be in much happier moods. Remember, if you don't get enough sleep in bed, you might find your brain driving you to sleep at the wheel.

#### **5. Don't drive early**

Most people like to do this, however, there is so much evidence suggesting that driving prior to 6 am makes you get up too early and the result is driving tired. Many fatal fatigue crashes have occurred due to this. Try and sleep at least seven to eight hours and wake up fresh. Rather than beat the traffic, let the traffic go early so that your drive is more pleasant. If you are not in a rush, you may make better driving decisions regarding overtaking and tailgating. Remember, when you are not in a hurry, you are less likely to speed.

#### **6. Plan to swap drivers**

Fatigue crash research has shown that when drivers drive fatigued, they have often had the opportunity to swap drivers but didn't do so. If you plan to swap drivers during the drive, you are more likely to do this. Most drivers are not professionals (like truck drivers) and are not good at estimating how far they can go before needing a rest. Most importantly, sleepiness portends sleep. If you feel sleepy, it is likely you will fall asleep at the wheel. Be smart and change drivers or stop.



## **7. Be mindful of others asleep in the vehicle**

Many of the fatigue crashes I have investigated, have had passengers who were asleep at the time of the crash. If your passengers are asleep, you do not apply alerting strategies, such as stopping often, winding down the window for fresh air, getting music playing to decrease boredom, etc. Have your passengers sleep a good sleep in their bed at home prior to leaving on the trip. Ensure they converse with you on the trip. Play games that are fun but do not distract the driver!

If passengers sleep in the back seat, please ensure they sleep sitting upright with their seat belt worn correctly (lap and sash). If a crash occurs and a rear passenger is in a lying position with only the lap component of the belt on, the injuries sustained are often horrific. Because they are almost sideways in the lap belt, they almost 'snap' in the middle due to the forces of the vehicle striking an object at speed. The weight of the torso and legs unrestrained are thrust forward and the waist bears the full force, by being restrained. The injuries are often disabling or fatal.

## **8. Mobile phones are for passengers only**

Get passengers to do your texting and making calls. There is absolutely no excuse for texting/calling while driving. A driver talking with a hand-held phone is at 4 times the risk of a crash, while a driver texting is around 16 times the risk of a crash. Get the family interested in the drive and places you might visit when you stop for a break. If your passengers are on electronic devices the whole trip, it won't be as interesting, and the driver may get drowsy due to boredom.

## **9. Make up a driving meal and snacks.**

Most people on long drives will pull into a roadhouse or café to eat. It is normal to order the fast food so that you get on the road quicker. The problem is, it will be mostly deep fried and/or high in carbohydrates that may make you feel drowsy or, at the very least, feeling horrible. Organise to take healthy snacks of cut up fruit and tasty proteins (nuts, boiled eggs, chicken, jerky, etc.). Have a picnic at one of the designated stops on your journey management plan.

Take plenty of fresh water! Dehydration leads to fatigue and drinking fresh water keeps you feeling much better than carbonated or caffeine-based drinks will. Plan to take healthy snacks such as bite-sized salads or sandwiches. Chocolates, lollies, and salty snacks may seem nice, but they can make you feel horrible later due to high sugar levels and/or dehydration due to salt intake. Avoid milky drinks such as iced coffee as dairy helps you sleep. Drink plenty of water along the way. Keeping hydrated will assist with fatigue management.

## **10. Observe your driving and react to it (look in the mirror!)**

If your passenger observes that you're looking tired or displaying fatigue behaviours (e.g. long stares, slow blinks or becoming quiet and withdrawn), they should mention it to you. This is part of the passengers' 'duty of care' on the road. As it is yours to stop if these symptoms occur. Observe your driving behaviours such as getting angry at other drivers or being impatient. If you make mistakes or driving errors, think about how your actions contributed to the error ('look in the mirror').

Use your breaks wisely and not only will you reduce fatigue, but you will arrive feeling better. When you stop for breaks, get some fresh air, some light and have a few stretches before you walk around. As your major muscles tighten when seated for long periods, the stretches will help to loosen them and avoid minor sprains and other injuries from walking on uneven ground. If stopped on the side of the road, always be aware of your environment and the safety of your family. Watch for snakes and biting insects, wandering stock and the possibility of errant vehicles.

The most important thing a driver can do for themselves and their family is to react to impaired driving before an accident occurs. All impaired drivers notice that they are feeling tired, but most will not stop. There is a false perception that fatigue can be easily overcome by simply 'focusing more', and an even worse misperception that microsleeps are very short in duration. They are often the start of a catch-up sleep and if you survive the microsleep, you have just been lucky!!



## *Chapter Twelve*

# Workplace Safety

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“**A**re you drunk, stupid or both?” Professor Drew Dawson once wrote a paper called ‘Tired or drunk, what’s the difference?’ He described the fatigue due to extended hours awake, likened to that of a driver with alcohol impairment. What is extremely notable in industry is the willingness to re-train employees on tasks they had been previously trained on and already know well. What they often don’t factor in is that a person working with the effects of fatigue can be impaired to levels of that which they would be if they were drunk. Rarely does a normal incident investigation collect enough sleep and wakefulness information to determine if fatigue played a role, and that the employee is not simply ‘stupid’.

### ***Recognising Impairment***

Before discussing ways to recognise fatigue impairment, let’s get a better understanding of risk and how easy it is to underestimate risk. Fatigue risk is often underestimated. The bolt shown below has eight nuts on it labelled from ‘A’ to ‘H’. If your task were to remove all the nuts and put them all back on in the correct order you would probably think it’s ridiculously easy. And it is! However, mistakes can be made and especially if you are suffering with a

sleep debt and your brain is looking for opportunities to 'dumb you down' and put you to sleep. At this point you may be slightly impaired and not performing as good as you could. The number of different ways to get it wrong is a massive 40,320 ways (eight-factorial). Easy to get this wrong if you are fatigued!



### **Fatigue behaviours**

When employees work in skilled labour positions such as the medical profession, motor trades, building and construction, carpentry, machining, processing and production, etc, the following fatigue behaviours and errors may be seen or experienced.

### **Grumpy and intolerant**

People who are sleep restricted in any way tend to be generally grumpy and intolerant of issues that would normally seem quite tolerable. It is this type of intolerance that can lead to workplace confrontations with colleagues when something has gone wrong (e.g., errors, miscalculations, differences of opinions, etc).

### **Continuing a procedure even if told it is incorrect**

Fatigued employees might start a procedure and quickly be told it is incorrect by a colleague or supervisor. Being tired tends to reduce the person's ability to see the correct way of doing things, rather than the way it was started by themselves.

Even when it has been clearly pointed out by a colleague. This often leads to conflict due to the intolerance of the tired employee.

## **Blaming colleagues for taking misplaced objects**

Fatigued employees might put a tool or part down somewhere and completely forget where they put it. The confusion, backed with feeling grumpy, can lead to accusations that colleagues may have taken the item or moved it to another location. This is often mentioned within training groups of workshop employees, but I'm sure it's not restricted to just this profession. Once again, this can lead to workplace hostility.

## **Taking short cuts**

Many industries have attempted to control incidents through the development of processes and procedures for each workplace task. As mentioned earlier, these are often referred to as safe work instructions (SWIs) or safe work procedures (SWPs). They contain a list of appropriate tools for the job, steps and procedures set out in the correct sequence and the use of mitigating controls regarding safety of the task involved (such as barriers, personal protective equipment [PPE] and so on).

The use of SWIs or SWPs is usually well known and reinforced throughout the workforce. However, tired employees tend to take short cuts by omitting a step in the tasks, not utilising PPE appropriately, or simply attempting to finish the job as quick as possible. Often the result of this can be incidents and injuries, leading to downtime and reviews of processes. Many of the incident investigations will lead to outcomes of 'human error' or 'lack of training', etc.

It is quite rare that the sleep of the employee has been investigated enough to identify fatigue as a causal or contributing factor. This then leads to incorrect controls being put in place, allowing similar incidents to occur in the future.

### **Slower movements and reduced coordination**

Fatigued employees are known to have slower movements and to have reduced coordination. Both conditions arise from slower brain processing and a reduced ability for parts of the brain to interact well. This may reduce coordinated movements in relation to sensory information obtained from the working environment. When working in an environment that requires certain human movements in relation to machinery movements, employees can easily become entangled or trapped in moving parts. Of lesser significance is the fact that the fatigued employee may damage or cause harm to the product being produced.

### **Reduced fine and gross motor skills**

Once again, a fatigued brain will reduce the motor skills of an individual. Consider a brain surgeon performing surgery on your brain after the surgeon has been awake for 20 hours already. It is likely that unless there was no choice, you would prefer the surgeon wait until after having recuperative sleep. Think of the fine motor skills required in your profession:

- A roof carpenter walking on thin beams
- Using a micrometer to measure exact sizes for metalwork or woodwork
- Perfecting the icing on a three-tier wedding cake
- Your skills in artwork or sign-making

Being tired can be like working with the opposite (non-dominant) hand when it comes to fine motor skills. Go on, try that now. Write your name with your non-dominant hand and see how you go. It won't perfectly reflect your performance when fatigued, but you'll get the picture.

## **Problems with vision**

It appears that one of the first parts of the brain to be affected by sleep restriction or fatigue is the occipital lobe. This lobe located at the back of your brain is directly connected to your eyes by way of the optic nerve. The lobe receives visual information from the eyes and works with other parts of the brain to determine what you are seeing and how you should react. The problem with the occipital lobe, when affected by fatigue, is that the eyes will also be affected. This will make it harder to focus the eyes on what you are looking at. This can lead to a condition known as 'driving without awareness, which was mentioned earlier within the context of driving. This can amount to blurred vision or missing seeing important components of your work.

## **Long blinks and hypnagogic jerks.**

When an employee has a sleep debt, the brain will look for opportunities to go to sleep to pay back the debt. This can be felt by the eyes continually wanting to close and the employee struggling to keep them open. If an employee is moving around a lot, it is less likely to occur. However, the employee may find that if he/she stops for a break and sits down, the brain will attempt to get the person to sleep - starting with the eyes closing. Many



people who work on their feet will say that when they sit and stop for a break and get ready to resume work, they then feel tired.

A hypnogogic jerk is a term referring to when a sleepy person's head falls, then lifts quickly in relation to a startle reflex. Hypnogogic means 'going to sleep' and the head is most likely to fall when the brain enters stage two sleep and the lobe known as the cerebellum is reduced in function. The cerebellum controls muscle tone and allows coordination of muscles. The neck requires this level of functioning to hold the head in position. When this is reduced, the head falls under its own weight. On the way down, the semi-circular canals of the middle ear detect that the head is falling and will awaken the employee with a 'panic' reflex, whereby the head will automatically jerk upwards. This can be quite noticeable in meetings and training sessions.

### **Micro-sleeps**

It is unusual for someone who is moving major muscles (i.e. walking or continuously changing their body position) to have a micro-sleep. The author believes that the brain of a person with a sleep debt will continuously monitor the position and movements of the person to determine if it is opportunistic to fall asleep and catch up on sleep. If the employee is seated or in a relaxed position, the brain may commence a micro-sleep. If the person is moving, it is not appropriate to sleep, and the person will simply perform impaired.

### **Fatigue errors**

Along with the fatigue behaviours, there are different types of workplace errors that can be influenced by fatigue.

## **Errors of judgment**

Errors of judgment that can be caused by an employee suffering fatigue may include miscalculating distances, sizes, shape, quality, or placement of things. Errors of judgment could also include incorrect grading of foods or components, sizes and dimensions of buildings, rooms, fittings and construction or the quality, color, taste of foods. These are merely examples of the numerous errors of judgment that could be made by fatigued employees. It takes a good amount of judgment for a digger operator, for example, to scoop up material and turn a machine to locate the precise point at which to drop material into a truck without spilling the material, hitting the truck, or walking the machine off the mound on which it sits.

## **Incorrect procedure implemented**

Fatigued employees may implement incorrect procedures. This may prove very problematic in cases of, for example, tag-out procedures, where a piece of machinery is required to be 'inoperable' due to safety reasons. Tag out procedures can include danger tags that warn of injury or harm to a person if the machinery is operated, 'do not operate' tags if starting the machinery may cause damage to the machine, or a host of other important reasons not to start or operate machinery or systems. Incorrect use of danger tags or an inability to correctly isolate components of plant can lead to serious incidents.

## **Slips and trips**

As opposed to employees who are seated and subject to micro-sleeps, a fatigued employee who constantly moves is more subject to slips and trips due to poor judgment and poor

gross motor skills. This creates more opportunities for slips and trips where the non-fatigued employee may step around or over objects or spills. Similarly, a fatigued employee may apply the wrong process to hazardous materials or chemicals causing inappropriate outcomes.

Incorrect application of procedures has led to serious consequences in nuclear power plants in the past. An example is the Chernobyl disaster in 1986, whereby the operators prepared a core for a test contrary to the checklist for the test. The outcome was catastrophic and is regarded as the worst nuclear catastrophe in history. Fatigue may have, in part, contributed to this error, but I still don't believe it caused the meltdown. There were too many other contributing factors.

## ***COUNTERMEASURES***

### **Proactive quality sleep**

The best proactive measure is to sleep well every night, obtaining around 7.5 hours of sleep per 24 hours, or whatever your personal sleep requirements are. While you cannot bank sleep, it has been found that having a regular 7.5 hours per night increases your resilience to the odd short sleep or a bad night in bed. You also tend to bounce back quicker when you catch up on sleep. Good quality and quantity of sleep will also provide better outcomes in safety, mood, alertness, attention to detail and willingness to get more done.

### **Reactive countermeasures**

At the early stages of fatigue, a break, with fresh, cool water, good light (sunlight is best) stretches and body movement may return you to full working capacity. However, you may

also need to notify your supervisor and have a longer break or possibly even a 20-minute nap. If you have a nap, it is important to let your supervisor know where you are. Ensure you have no longer than a 20-minute nap or you may progress to deep sleep. If you enter deep sleep and get woken, you may suffer sleep inertia, where you will feel groggy and sleepy for up to 30 minutes or so.

Finally, if you find yourself falling asleep, having hypnagogic jerks (where the head falls suddenly) then serious countermeasures need to be implemented. Your supervisor should be advised immediately, and an assessment of your condition should be made. If it has arisen from sleep restriction, then napping or being taken home may be the best options. If you don't think that sleep restriction has caused your condition, you should consider a medical assessment to find the underlying cause. In any case, your safety should be paramount, and you should not drive a vehicle or operate machinery if feeling sleepy.

Working in an office, studying, researching or anything to do with reading, writing, data manipulation and complex thought, requires considerable mental capacity. When becoming fatigued to the point of a wake-sleep transition zone (drowsy), we often find that words on documents are hard to focus on. Lines of text tend to run into one-another, and paragraphs don't deliver the meaning they are written to deliver.

We often re-read paragraphs and still don't get the intended message. We sometimes misconstrue words and take the wrong meaning from them. Data entry becomes problematic, sums do not add up, three runs of a simple mathematics problem can yield three different outcomes. Data is missed or re-entered into a database,

You experience problems with the photocopier, get frustrated when the computer is running slow, growl at a colleague for disagreeing with your ideas and have a run-in with the boss over work issues not normally thought of as a major concern to you. To top it off, the coffee machine has run out of beans, and nobody took the time to top them up. It is left to you, but you can't be bothered - you'll go without today.

Basically, your stage one sleepy brain has reduced your mental capacity to attend to different tasks. Multi-tasking seems impossible, and your level of work production has hit rock bottom. Things that normally take 5 minutes are taking 20 minutes to complete. Some tasks remain incomplete. Your work colleagues and your boss are now getting impatient. Time to crawl under the desk for a power nap!



## *Chapter Thirteen*

# Decision Makers

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**M**anagers, superintendents and supervisors all have a clear role to play in the safe workplace, as do employees. Most countries are clearly legislated to ensure a 'duty of care' is provided to all employees at workplaces. Most legislative documents do not go into detail regarding how a business will protect an employee from the harms associated with fatigue. This is mainly because of the highly complex issues surrounding sleep and fatigue, and the fact that it is hard to direct employees to sleep well when they are not at work. The useful documents are the 'codes of practice' and 'guidance notes' on managing fatigue in the workplace. Generally, they take a risk-managed approach, rather than a prescriptive set of hours or scheduled work days/nights.

Underpinning the management of fatigue in a workplace is having a well-constructed fatigue management plan. The plan will outline how rosters and schedules are set up and implemented. It will ensure broad discussion and consultation within the workforce on fatigue management issues, set maximum limits on numbers of hours in a shift and number of successive dayshifts or nightshifts. The plan will set minimum limits on breaks to be taken and a plethora of other components of a fatigue management system.

This is designed to meet legislated duty of care requirements, regarding 'safe systems of work'.

Where I see management teams get things wrong is when they entrust lower-level safety advisors or similar personnel, to develop and establish fatigue management plans. Fully understanding the relationships between sleep, mental health, physical health, environmental factors, physiological factors, timing of work, rosters and schedules, for example, are very complex. It takes a subject-content expert to at least assist in the conducting of fatigue-risk audits, roster assessments and development of fatigue management plans for an organisation or business.

There is often a misperception that fatigue risk is only an issue for people who work shiftwork, and this could not be further from the truth. Although the risk of a fatigue crash is exacerbated during the hours between midnight and 6 am, fatigue risk can also creep in at any time of the day or night. I have explored incident databases which clearly show how we have made great efforts to protect shift workers from harm overnight but failed to protect them during the daytime. This was evident at a site at which I provided fatigue management advice for a construction group, who were about to commence 14 consecutive, 11-hour nightshifts, followed by a week of rest and recuperation. This was permanent nightshift for this crew of 100 personnel for a year.

At the outset, I was advised that the roster was set in stone according to an enterprise bargaining agreement. The agreement was made without the input of the regional safety manager, who contacted me in desperation for assistance when he found out. The risk assessment that I conducted for the organisation laid out a total of 36 controls required to ensure employee safety. This included a special section of camp accommodation, with

protection from external noises from other employees and vehicles. Hours were reduced to 11 per shift, with extra breaks as required and risk assessments for each high-risk task performed. All employees were bused to their locations and were not allowed to travel from interstate. Interstate employees took on the dayshift roles only. All employees and their supervisors undertook my three-hour training sessions for employees, and additional training for supervisors, to better understand their roles and responsibilities with this exceptional roster.

At the end of one year, the construction was finished ahead of schedule and under budget. For nightshift workers, there was one finger injury on the job, which was caused when an employee dropped a tool, and in the quick effort to catch it before it hit the ground, struck his finger on a sharp object. This required minor first aid on site, and he went straight back to work. There were no other incidents reported on nightshift.

But wait! What about the dayshift crew? At the end of the same reporting period, there had been numerous incidents that had occurred on dayshift. These were from minor first aid to hospital admissions. When I had mentioned that all dayshift employees should also undertake the fatigue management training, it was rejected due to having a perceived lower risk. This issue was made worse as the high-risk tasks had been moved from nightshift to dayshift operations.

Management had thought, like so many others do, that dayshift employees don't require fatigue management training. This unfortunate misperception is due to the simple notion that the largest contributing factor to fatigue in the workplace is quality and quantity of employee sleep. Certainly, other factors play a role, such as shiftwork, length of shifts, start times, breaks and



conditions. However, if you attend work with a sleep debt, you take the fatigue risk into work with you.

‘Duty of care’ works both ways but is rarely mentioned in training as an employee responsibility. If an employee is tired due to poor sleep, they should either stay at home and call in sick or mention it to the supervisor as soon as they enter the workplace. That way, a supervisor who has been trained in how to manage a fatigued employee, can ensure the employee’s and others’ safety.

I have also noticed that a lot of organisations won’t implement fatigue training for supervisors. When they do, I am amazed at how lacking in confidence most supervisors are in dealing with fatigued employees. Even when they have specific tools to use to assess employee fatigue, they lack the confidence to use them as they are rarely trained in administration of the tools. They are often very grateful for any advice in this area.

On the other hand, I have had the pleasure of working with a few organisations that go above and beyond regarding fatigue management. What has made this work the best is when high-level members of management teams set an example by attending one of the first sleep and fatigue training sessions on the site. They then speak to their superintendents, managers and supervisors about the benefits of the education on fatigue, and what they and their employees could get out of the education. This is followed up with ensuring all crews have the opportunity to attend the training sessions with the full support of their supervisors.

It doesn’t take long to know if you are in one of these wonderful workplaces. Employees turn up ready for the training sessions saying things like, “Looking forward to this training,” or “I’m hoping you can help me sleep better,” for example. Within a couple of days, employees are stopping you to ask for more information, or

to tell you about how they applied their new knowledge and the results they got from it. The icing on the cake is when employees meet you and brag about how good their sleep has been, or a manager stating that his crew have much better camaraderie and an increase in mental fitness. This is what keeps me passionate in what I do. Generally, good leaders help their teams get good results. This includes sleep!

### ***Zooming around the world – meetings online***

The impact that COVID-19 has had on face-to-face meetings has seen an unprecedented movement to online meetings within organisations around the world. One of the major issues here is the different time zones. For example, someone in your organisation in Brazil may need to speak to you at 1 pm their time. If you are in Brisbane, that would be 2 am. This will severely interrupt your sleep pattern and if it's a regular thing, your circadian rhythm may be affected and/or you will start to underperform. Here's what I recommend for companies who are needing to communicate by 'Zoom', 'Teams' or 'Webex' online.

Have a person examine the time zones of each location that would be involved in any of the meetings. In most cases, and with good organizing, there will be opportunities to meet at reasonable times that don't affect sleep. For example, <https://www.worldtimezone.com/> or <https://www.timeanddate.com/worldclock/> provide an ability to see what time it is in your zone and see what time it is in every other zone at the same time. Below is an example:

A Sao Paulo (Brazil) meeting commencing at 6 pm is a meeting time of 7 am in Brisbane (Australia). Similarly, a morning meeting in Sao Paulo at 6 am, is a meeting time in Brisbane of 9 pm. These

time slots will not affect sleep if they don't go for long. Then it's just up to good scheduling.

If you can't make that work, then I suggest the following:

- Everyone tries to keep good circadian rhythms and sleep patterns where possible
- Maintain around seven to eight hours of sleep each night so that an interrupted night is easier to recover from. Good sleep and fatigue management training would assist here
- Ensure where possible, that someone who has disturbed sleep due to a meeting be 'not invited' to exceptional timed meetings for at least 2 days to recover. This is similar to call-outs for local employees who must not return to work for 10 hours after a call-out
- Waiting for an expected meeting at a particular time will cause anxiety when attempting to sleep. I suggest that you plan your sleep in 90-minute cycles to wake 15 minutes prior to the meeting. For a meeting at 2.15 am, try to be asleep by 9.30 pm (3 x 90-minute cycles) or 11 pm (2 x 90-minute cycles) to suit normal sleep timing of the person, plus 15 minutes to prepare for the meeting and look sharp
- If sleep has been interrupted, try relaxing with a warm shower, followed by bed. If you can't sleep, either write down what you might be thinking regarding the meeting or read a book to relax. Don't be tempted to work!
- Short 15 to 20-minute naps taken during the day will help manage fatigue due to interrupted sleep

# *Part Five*

## Pulling It All Together

I'm wandering through a dream which slowly reaches a point where the person speaking to me has a slow change of voice. She gets higher pitched and drags out her words. Soon, the words are no longer words, but more of a shrill. This turns into the call of a bird outside in the bushes. I open my eyes to the glimmer of light shining through the gap in the curtain. I know it's not yet time to get up, as the alarm hasn't gone off. But I feel wide awake. I stretch and get up to go to the toilet. On the way back to bed, the alarm sounds, and I turn it off. I head to the kitchen to make me, and the love of my life, a coffee.

I feel great and I'm looking forward to work today. Yes, you heard that right. I am not only blessed with being my own boss, but the work I do has meaning for others. Not to mention the benefits I get from knowing when to go to bed, getting to sleep within minutes, and not waking until a moment or two before the alarm is due to sound. The volume and quality of my sleep has improved nearly every avenue of my life. Want some?



## *Chapter Fourteen*

# Simple Life Hacks for the Best Sleep

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### Applied Circadian Rhythms

To fully understand what a circadian cycle means, it is useful to go camping. First, we need to set the rules for the camping trip. There will be no artificial light but a camp fire is allowed. Alcohol is kept to a minimum. Finally, no electronic gizmos allowed. This is what I refer to as ‘being back in nature’. The way humans developed as they came down from the trees and started wandering the earth in search of food and shelter. The basic driving principles were food, protection, procreation and sleep. Procreation aside, when we go camping, we seek shelter from the elements, protection from harm, and sleep is guided by the old-fashioned time-keepers of light and dark (sun and moon). We are very aware that when we spend a good few days in the camping environment, we return feeling ultra-refreshed, alive and generally free of our anxieties and everyday issues.

What have we just done that makes us so much more refreshed than any other week at home? Let the light guide the way. Depending on where you are camping and the season at hand, the sun will light the sky at some point in the morning and

take leave in the early evening. Let's take the summer season to begin with. It is not unusual for the sun to set around 7 pm to 8 pm. By 8 pm it will be getting dark. The camper is losing light and only has the brightness of the camp fire to see their way. Without alcohol, TV, artificial light and electronic gizmos, the camper will be getting tired not long after nightfall. With little light and little distraction, the camper soon retires and finds they are asleep within 10-15 minutes. You hear very little about camping insomnia!

After several nights of 'going to bed when it's dark', your circadian rhythms will be synchronizing and aligning nicely. Your core body temperature will be dropping from 37 degrees Celsius to its low point of around 36 degrees. The drop in temperature is a cue to sleep. This natural circadian rhythm is very healthy, but often changed due to waking early for work. Over the years, the artificial light and use of technology has gradually pushed our sleep onset times later. This wouldn't be as big an issue if we didn't have to wake early. I recommend trying to keep a steady circadian rhythm as often as possible. Now that you know how the 'Mabbott Method' works, apply this as much as you can and see the benefits from regularly getting your required amount of sleep.

## Exercise

We have all noticed that when we have exerted a lot of energy during the day (for example, digging over a garden bed, working in the heat, playing vigorous sports, etc), we tend to 'sleep like babies' that night. Much research is finding that exercise can have a positive effect on sleep. For example, sleep onset latency (the time taken to get to sleep) can be reduced by as much as 50%, improvements in total sleep time up around 20%, with up to 13%

improved sleep efficiency (percentage of time spent asleep as opposed to time spent awake in bed)<sup>65</sup>. One of the theories is that exercise increases core body temperature and as the core body temperature slowly decreases, the brain is triggered to sleep<sup>66</sup>.

The researcher Youngstedt claims, *“Historically, perhaps no daytime behaviour has been more closely associated with better sleep than exercise. The assumption that exercise promotes sleep has also been central to various hypotheses about the functions of sleep. Hypotheses that sleep serves an energy conservation function, a body tissue restitution function, or a temperature down-regulation function all have predicted a uniquely potent effect of exercise on sleep because no other stimulus elicits greater depletion of energy stores, tissue breakdown, or elevation of body temperature, respectively.”*<sup>67</sup>

Regular exercise will help you to:

- Have a stronger cardiovascular system
- Have more flexibility & strength
- Reduce type 2 diabetes onset
- Have a better immune system
- Cope with daily problems
- Fight depression
- Have better moods
- Be more confident
- Perform better
- Sleep better!

Add to this Dr Norman Doidge's claim that a human can grow and mature as many as 500 new neurons per day with regular exercise, and you really have a heap of benefits.

## Diet

Diet is an important component of life and can contribute to either sleep onset, assisting to keep one awake or supplying a short burst of energy. Table 9 below sets out the three groups of food in relation to sleep that are examples but are not exhaustive. When working or driving, you might want to consider eating food in the first column to help keep you awake a little. Food from the second column may assist with sleep.

This is only a guide, and my personal opinion is that the effect that food has on staying awake or going to sleep is quite minimal. I believe it is most important that you maintain a healthy diet more for your good health and gut health to assist with sleep. If you add exercise and good sleep to the healthy diet, you probably have the best chance ever at being as healthy as you possibly can.

**Table 9:** *Foods that help you stay awake or get sleepy.*

Help to keep awake	Help to sleep	Short burst of energy
<p>Fruits of all kinds, especially green apples.</p> <p>Protein rich foods such as eggs, chicken, beans, fish, lean red meats, lentils.</p> <p>Veggies, except potatoes, sweet potato, pumpkin, squash &amp; corn, which are high in carbohydrates.</p> <p>Fresh cool water.</p>	<p>Carbohydrates, such as pasta, rice dishes and noodles.</p> <p>Low GI carbs such as porridge or Weet-Bix (with milk), crackers and bread.</p> <p>Potato, sweet potato, pumpkin, squash and corn.</p> <p>Dairy products.</p>	<p>Sugary drinks, such as cordial, cool drink.</p> <p>Caffeinated drinks including coffee, tea, and energy drinks such as 'Red Bull', 'V', etc.</p> <p>Fast foods high in sugars and saturated fats. Hamburgers, fries, sausage rolls, hot dogs, pies, pasties, etc.</p> <p>NOT RECOMMENDED!</p>



## **Family and social activities**

There are many ways that a family can contribute to your sleep, and it is worthwhile to get your family involved in your sleep needs. The following points are worth discussing with your family to ensure sleep is an important priority.

## **Partner's bed habits**

Many people say that they go to bed at different times to their bed partners. While it is important to have the freedom to do what one likes, partners coming into bed at different times can wake or disturb sleep. Workers who need to get up early for work (say around 5 am) will generally get tired around 9.30 pm to 10 pm. If they go to sleep at this point, they can usually be asleep within 10–15 minutes. If the partner comes to bed later and reads or watches TV, this will often disturb the worker's sleep. If awoken, it is often hard to get back to sleep.

I recommend you both go to sleep around the same time if possible. If both partners go to bed at the same time and sleep at the same time, then sleep is rarely disturbed. The couple will awaken in the morning happier. The intimate time spent together before sleep onset is often very good for the relationship. If your partner has a sleep disorder (such as heavy snoring, sleep apnoea or restless legs), it will have a profound effect on you while you are asleep. The earlier chapter on sleep disorders may help you there.

## **Sleep hygiene**

Sleep hygiene refers to getting all aspects of your sleeping environment right for good sleep. Most people require:

- Darkness (although some like a dim light on). Not good if one of a couple likes light and the other needs dark to sleep. It may be worth investing in 'blackout' materials for windows that are lit by street lights, and perhaps a salt lamp for the person who requires a dim light
- Quiet. If there are street noises, the white noise from a fan or low volume music can help
- Cool. There is no perfect temperature for everyone but around 22 Celsius to 24 Celsius tends to be quite good. People with higher body mass indexes (BMI) tend to prefer cooler temperatures, while thinner people like it a little warmer. Generally, women prefer a warmer temperature and men slightly cooler. But this is not a hard and fast rule
- A good bed is like magic to sleep on. Make the investment to get the bed that is right for you. It doesn't have to cost the earth, but it must suit you
- A good pillow that suits your sleeping style. I recently had a side sleeper who was having all sorts of issues with both her neck and her sleep. After coaching her to obtain a pillow that feels good to put her head on, and that supports her head and keeps her spine in alignment, the feedback was incredible. She mentioned that she had no idea a pillow could have made the difference to her life that it has. Including her mental health!

## De-stress

Stress has always been an issue that affects the sleep of many people. Some blame their work stressors for the affect it has on their sleep, but there are ways around most of these problems.

Here is a simple list of tips to avoid lying awake thinking of all the stressful events in your life.

- Remember the timing of sleep onset involved in the ‘Mabbott Method’ of sleep, as even stressed people find they can get to sleep when stressed if they apply the correct timing
- If you can’t turn off the thoughts, then before going to bed, make a list of what you need to do tomorrow. Make an ‘A’ list of the important items. Sometimes doing this can help you process the information enough that you don’t have to keep thinking about it, or worry about forgetting that you need to do it
- If you sometimes wake with thoughts, you know that if you fall straight back to sleep you will likely forget it, so you stay awake. Keep a pen and paper next to the bed so you can jot it down and then get back to sleep. This is similar to when Keith Richards from the Rolling Stones managed to lay down a few minutes of *I Can’t Get No Satisfaction* on his tape recorder. The rest, as they say, is history
- Remember that there are some things that you can change, and there are some things you cannot. Make the effort to change that which you can and be comfortable in accepting that which you cannot change
- If life and stress is getting too much, seek the help of a professional. A general practitioner can usually refer you to the right person. Don’t forget that in many places, you can access mental health plans to enable cheaper help from psychologists. A quiet mind sleeps better!

If you don't work shiftwork, or work in an industry that requires you to fly or drive to a distant location and stay for the duration of a roster, then read no further unless you have an interest in the special needs of such a worker. I sincerely hope you have enjoyed this book and have gained a better appreciation and desire for sleep. If you are a shift worker, please read on. It may help you perform better, live better, and maybe even save your life.

Dr Mabbott has joined with the band **'Forest'** to produce some beautiful meditation music to assist with sleep. A QR code is provided on the back cover of the book to take you to the music.

## *Part Six*

# The Shiftworker

**S**tart nightshift and put on ten kilos! Nightshift takes ten years off your life! I often hear this at conferences, and it annoys the hell out of me. How about we help shift workers get better sleep? Now that's a thought! Nightshift workers don't have to be limited to only 4.5 hours of sleep on average. With the help of education and awareness, there's a large group of Australian nightshift workers who have recently increased their daytime sleep by a very satisfying amount. This includes increasing the 7+ hours of sleep per day group by over 61%. The hardest part was making porridge look awesome!



## *Chapter Fifteen*

# **Shift Work and Fifo/Dido Personnel**

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**S**hiftwork accounted for around 1.7 million Australians in 2015, 3.1 million British in 2018 and 15 million Americans in 2020. If you work regular or irregular shiftwork or have to relocate to a workplace for a roster period and stay in accommodation, you have special sleep needs. Most accident databases will show an increase in accident rates during evening or nightshifts, and many of the fatigue fatal crashes that I investigate, occur in the evening periods.

Shift work is usually classified as working outside of the standard 6 am to 6 pm time slot. Many different industries and occupations work shiftwork, and the number of hours usually range from a couple of hours to 10 or more. In many mining and other resource operations, shifts are 12 to 12.5 hours duration, sometime longer. Although the length of the shift can be an issue, especially with driving home at shift end, it is working when you normally sleep, and trying to sleep when you normally work, that creates the greatest problems.

## Transitioning into nightshift

Nightshift nearly always follows a period of time where a person has a circadian rhythm set to day mode. I believe that a couple of the problems with nightshift involve commencing nightshift with a sleep debt from inadequate sleep on dayshift, and a poor transition into nightshift. It is extremely important to obtain sufficient sleep on dayshift prior to entering nightshift, as you can never repay a sleep debt on nightshift sleep.

There are two basic strategies used to transition into nightshift. Here is the least effective, but most commonly used, strategy. The night before the first nightshift, you deliberately stay up late in an attempt to get used to working through the night. You might go to bed at say, midnight or 1 am and sleep as late as possible, waking around 11 am. That would be a good 10-hour sleep. So far, so good.

If you wake at 11 am, there is almost no chance that you will be able to get any sleep in the afternoon prior to the first shift. Therefore, if you are working a 12-hour nightshift, starting at 6 pm, then you have been awake for seven hours before starting the shift. Add 12 hours of the shift and you have been awake for 19 hours at the end of the shift. Allow at least an hour to get home (or to camp) and get cleaned up and fed, and you have now been awake around 20-plus hours. Based on the homeostatic need to clear waste from the brain and metabolise adenosine, there is a need for around nine or more hours to restore the brain to a healthy level. This would be almost impossible to do during the day and the sleep debt accrued usually results in a poor performance on night two. Night two is typically the worse night of performance according to shift workers.



The other way of transitioning into nightshift is the preferred method by those who have tried it. It commences with a regular daytime circadian rhythm, whereby you have got into a steady rhythm of say, 8.30 pm sleep onset with a 4.30 am wake up. The night prior to shift one, simply go to bed at the same time (8.30 pm). Wake at the same time or extend your sleep to around 5 am. Make sure you get your normal, healthy number of hours of sleep. Go for a walk or undertake exercise to start the day as this sets up an opportunity for a nap in the afternoon.

If you wake at 4.30 am, then 8.5 hours will elapse before 1 pm. I recommend having lunch around midday, followed by a nice, warm shower around 12.45 pm. The shower may increase your core body temperature just a little. When you step out of the shower, your core body temperature will drop back down, and you may feel a little sleepy. Use this slight sleepiness, together with the refreshment of the shower to go to sleep. Set the alarm for 4 pm to ensure you don't oversleep and miss work.

If you can obtain 3 hours of sleep, this will make a huge difference to being able to stay awake through nightshift 1. Also, you have only been awake for 2 hours before starting the shift. Add 12 hours and 1 hour to get home and cleaned up, and you have only been awake a total of 15 hours. This compares favourably to the 20 hours using the previous method and you may need a whole lot less sleep to return your brain to a healthy level. Night 2 is usually easier to get through using this second strategy.

### **Issues with shift work**

There are many and varied issues with working shiftwork. Second to the issue of taking a sleep debt into nightshift and not

transitioning well, probably the biggest problem is the amount and quality of sleep obtained during the day. It stands to reason that sleeping is hard to do during the day, due to the following:

- The circadian rhythm makes it hard to sleep due to a rising core body temperature and the presence of the wakeful hormone cortisol in the system
- If at home, there are neighbourhood noises (dogs barking, lawnmowers, traffic noise) and noises within the home (doorbells, children, family members)
- Sunlight and heat in some cases
- Needing to urinate (you will be woken from REM sleep when the brain checks the body needs, usually after 4.5 hours of sleep)
- Some will see the time off during the day as a time to do chores, or undertake social activities (such as watching the children at a sport carnival at school)
- Getting hungry around lunchtime

To sleep during the day requires absolute sleep hygiene principles. These include a dark room (using block-out curtains, shades or shutters), an eye mask, cool room, a well-made bed, and quiet. Some people find that a fan or audio of rain or other relaxing sounds can provide a 'white-noise' or such to drown out other noises such as traffic or people talking. Eye masks suit some people, while others don't like having masks on while they sleep. In this case, window treatments provide the best opportunity for black-out. Many night shifters have established that a roll of aluminium foil is a cheap but effective window treatment short-term. I have even used this to effectively get

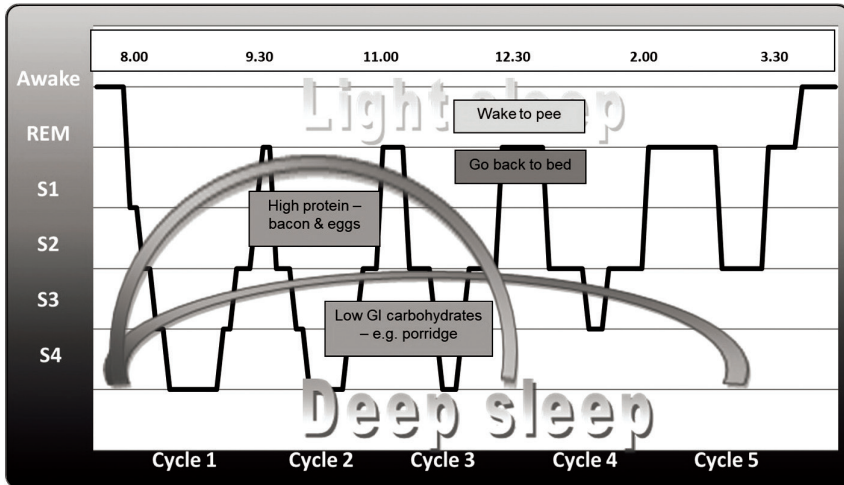
my grandchildren sleeping later in the morning when they have sleep-overs.

I remember when I was a young adult and my father worked as an officer in the Department of Corrections. As a prison officer, he worked many night shifts. I remember on a few occasions visiting my parents and if Dad was on nights, he would stay awake during the day when we visited. We didn't give it another thought at the time. In retrospect, we were setting him up to be in poor condition in the workplace. This included not only his normal safety at work, but many criminals use any opportunity to take advantage of an officer if they perceived them to be the least bit fragile. He was OK and only had one criminal threaten his life in his many years of service. Luckily, his strong resolve and gift of empathy had him convincing the man that there were better options.

### **Diet while on nightshift**

I recently trained 1,200 people at a site called GEMCO over a total of six weeks. Being a remote island (Groote Eylandt), it is a fly-in, fly-out (FIFO) site with a large camp and a few smaller camps. Groote Eylandt is the fourth largest island in Australia, located in the Gulf of Carpentaria. It's the homeland of, and is owned by the Warnindhilyagwa, who speak the Anindilyakwa language. Only a small number of people from the mine and two communities of indigenous people live permanently on the island. Mostly, the employees eat at the camp mess.

A number of people worked night shift, and like most shift workers, averaged around four and a half hours of sleep per day between the shifts. My discussion with the shift workers centred around good sleep hygiene, making sure that during their R & R



**Figure 19:** Sleep graph of 5 90-minute cycles overlaid with a daytime sleep timeline and diet information.

they didn't build a sleep debt to bring to work, transitioning into nightshift well, plus eating to extend sleep.

Many shiftworkers who eat at a camp mess go straight to the bacon and eggs. The smell tends to get them interested as soon as they walk in! While there are some good proteins in eggs, there is not much in the way of carbohydrates to extend sleep with longer releases of glucose. I believe that the large amount of bacon and eggs sets them up for the common four-and-a-half-hour sleep. See Figure 19 above to understand how this occurs.

If a person goes to bed around 8 am and gets to sleep quickly, then by 12.30 pm they are likely to wake to urinate. Urination is more common during the day, and near the end of the REM cycle is where the brain will recognise a full bladder. Normally, if you wake to urinate you can get back to sleep quite quickly. Especially

if you are able to keep your eyes closed and feel your way to the toilet. However, if you wake to urinate and you are hungry (such as at 12.30 pm), it is unlikely you will get back to sleep due to the process of eating. The combination of light and having already had most of your deep sleep means that getting back to sleep is uncommon.

The grey arc that rises the highest in the diagram illustrates the likely length of energy you will have after eating bacon and eggs. The body will use most of the goodness from the food in the first four to five hours. Alternatively, the flatter arc represents the likely timeline of low glucose index (low GI) carbohydrates, such as porridge. A good feed of porridge is likely to keep you from being hungry for up to six or seven hours if all you are doing is sleeping.

The immediate response from many employees was that the porridge wasn't that attractive in the morning, compared to the range of higher protein and simple carbohydrates on display in the kitchen. I was lucky enough to have most of the chefs in another training session and we discussed options for flavouring up the porridge without simple carbohydrates, such as sugar and syrups. Berries and diced fruit could be more beneficial in this case. It was an easy sell as making large batches of porridge is easier than hundreds of eggs and hills of bacon.

Armed with this information, the employees did try a change in diet to get more sleep during the day. There were some immediate reports coming in from supervisors regarding a lift in the mental health of the employees. Contacts at the mine suggested that the employees were doing better through nightshifts on average.

Four months after the training, a ‘monkey survey’ was conducted by the training department to get a feel for how the employees had used their new-found knowledge of sleep to obtain more sleep, both for dayshift and for nightshift. The questions were developed by myself and were peer-reviewed by an organisational psychologist from ARRB Transport Research. The questions focussed on the amount of sleep obtained on average for each night when on dayshift, and for each day when on nightshift. Other questions asked how much sleep they obtained prior to the training, which had been delivered four months earlier.

Out of 1,200 employees, only 190 responded to the survey. There were other surveys being conducted around the same time and management had spoken of ‘survey fatigue’ as the likely reason responses were low. There is no way of determining whether or not the employees who responded were ‘representative’ of the collective group. Nonetheless, the responses were surprising to me, even though I had hoped for a good outcome. The responses came in two batches. Firstly, sleep for dayshift work, and secondly, for nightshift.

The employees had been taught the ‘Mabbott Method’ of sleep which was discussed earlier in this book. They enjoyed having a focus on the time that they should be in bed ready for sleep each night when on dayshift. Armed with a time for the ‘first sleep wave’, many were ready for bed at the right time. For nightshift, the main changes to their normal routines were consistent timing, a good breakfast of low GI carbohydrates, and a warm shower prior to bed. The survey results are in Table 10 below.

**Table 10:** Survey results for changes to dayshift & nightshift sleep.

Sleep for dayshift	Hours of sleep	Pre- and post-training	Difference
	4 to 5 hours of sleep	Was 17, reduced to 5	Reduced by 70%
	5 to 7 hours of sleep	Was 134, reduced to 124	Reduced by 7.4%
	More than 7 hours of sleep	Was 40, increased to 61	Increased by 52.5%
Sleep for nightshift	Hours of sleep	Pre- and post-training	Difference
	Less than 4 hours of sleep	Was 4, reduced to 1	Reduced by 75%
	4 to 5 hours of sleep	Was 28, reduced to 20	Reduced by 28%
	5 to 7 hours of sleep	Was 68, increased to 71	Increased by 4.4%
	More than 7 hours of sleep	Was 13, increased to 21	Increased by 61.5%

While the sleep for dayshift ‘seven plus hours’ category increased by 52.5%, I found the change to the ‘seven plus hours’ category for nightshift outstanding. I was very pleased with the result and proud that people used this knowledge to improve their sleep. If the group was a representative sample, then there would be more than 120 people now averaging more than seven hours of sleep on nightshift. I only hope that this is the case.

I was so pleased with the outcome, that when I next visited the island for work, I spent some time with the chefs and camp management, to find out what changes they had made to the foods. Their reply was:

- Porridge: added blueberries, mixed frozen berries (thawed), mangoes, chopped nuts, brown sugar and maple syrup. Consumption increased to two big pots per day where they only used half a pot a day before
- Increased vegetable rice and vegetable pasta dishes in crib, increased more nutritious brown bread and wraps
- Replaced meat pies with chicken and vegetable, with a much lower GI pie sourced
- Decreased the use of ready-made containers, to people making their own choices
- A much larger choice of milks and decreased sugary cereals to four more nutritious ones

This was a great example of how a ‘community’ (in this case, mining community) could work together to increase the sleep of shift workers. Increasing their amount of sleep had a serious flow-on effect with their mental fitness, according to several supervisors and others in management roles. Two years later and I have recently been back to the site. I was very humbled by many of the employees who told me they used this knowledge of sleep to improve not only their lives, but the lives of their loved ones at home. I love what I do!



## Sleep stress

A 2020 study<sup>68</sup> identified another issue less thought of regarding shiftwork sleep length – stress. While the general focus is on attempting to sleep during a circadian phase that is naturally alerting, this study aimed to determine if stress factors also had an influence on the sleep onset latency (SOL), the latency to persistent sleep (LPS), waking after sleep onset (WASO) and sleep duration (SD) of shiftworkers. A total of 48 shiftworkers completed an eight-hour polysomnography (PSG) during their daytime sleep, after a night of shiftwork. Their naturally occurring circadian phase was measured using saliva samples to determine melatonin levels over a 24-hour period. This Dim Light Melatonin Onset (DLMO) illustrates the circadian phase of the shift worker.

The Ford Insomnia Response to Stress Test (FIRST) is a nine-item self-report measure of trait vulnerability to sleep reactivity and was used to measure components of sleep for the shiftworkers. They found that after controlling for the circadian phase, higher scores on the FIRST was associated with problems staying asleep (WASO) and a shorter sleep duration. It did not predict difficulty falling asleep. However, higher FIRST scores did predict a longer time to get into persistent sleep. The authors suggested that sleep reactivity to stress and circadian misalignment are independent processes and can both disrupt daytime sleep. This may not often be considered when rostering shiftwork to employees but clearly should be included in any risk analysis conducted for shiftwork. The following tables attempt to capture the stress involved in short and long periods of successive nightshifts.

**Table 11:** *Stressors for two to four consecutive nightshifts.*

<b>Local</b> Drive to and from work each shift. Go home to their family.	<b>Two to four nights - stressors</b>
	Driving in and out in local traffic
	What partner is doing while away (e.g., spending, fidelity, making decisions without input)
	Missing sports or events on some occasions
	Length of sleep and effect on workplace safety
	Worry about being woken by neighbourhood noises and house visitors
	Worry about security while not at home
	Stress due to work commitments & pressure

**Table 12:** *Stressors for five to seven nightshifts.*

<b>FIFO/DIDO</b> Stay at a camp or other accommodation while in the roster cycle. Away from family for the duration of the roster.	<b>Five to seven nights - stressors</b>
	Dangers with driving home at the end of a long roster of nights
	What partner is doing while away (e.g., spending, fidelity, making decisions without input)
	Missing sports or events on many occasions
	Unable to participate in team sports
	Length of sleep and effect on workplace safety
	Stress due to work commitments & pressure
	Worry about security while not at home
	Isolation from family and lack of closeness

The two tables focus on ‘local’ and FIFO/DIDO (fly-in, fly-out & drive-in, drive-out) to cover different scenarios. The ‘local’ table (Table 11) does not include nightshifts of more than four, as the dangers of driving any distance post four nights is far too high (compared to what it might be for shorter rosters). The FIFO/DIDO table (Table 12) does not include rosters shorter than

five nights as they are generally longer numbers of successive nightshifts.

Good use of counsellors and/or chaplains, can help to alleviate some of the worries and stress that employees have around nightshift operations. Organisations will benefit from advertising the use of these valuable people and having them well utilised.

### **Diet through nightshift work**

There are three basic issues to consider when working on nightshifts: 1) Postprandial somnolence; 2) Gastrointestinal disorders and 3) Weight gain. Postprandial somnolence occurs when a large meal enters the stomach and causes the parasympathetic nervous system to kick in. This is the opposite of the sympathetic nervous system, which allows humans to fight, freeze or flee in the face of danger. The parasympathetic system slows and relaxes the body, allowing the functions of the stomach and intestines to operate to digest the meal. This causes a sleepy state. If the shift worker is operating machinery, the sleep effects can be dangerous.

Many studies show that nightshift workers have higher than normal levels of gastrointestinal disorders. The circadian rhythms that you learnt about in chapter one of this workbook discussed several daily changes in the body. One such change is eating. The stomach is generally at rest during the normal night but shift workers often treat the stomach as if it is daytime. It is important to eat smaller meals during the night. Even better, snack on small portions of very healthy foods through the night.

“Start nightshift and put on ten kilos” is a popular saying in shift work. Apart from a lucky few, most shift workers suffer poor sleep during the day. Studies indicate that when you do

not sleep properly, you produce too much of a chemical called ghrelin and too little of the chemical leptin<sup>69</sup>. Put simply, ghrelin increases appetite and leptin tells the brain to stop eating when the fat cells have enough energy. Therefore, if you don't sleep well, you may be very hungry and tend to overeat. Poor sleep also reduces motivation to exercise and choose the correct foods (when extremely hungry or tired, many people choose high sugar foods).

### ***Fly-in, fly-out and drive-in, drive-out personnel***

FIFO and DIDO workers are people who travel a long way to work and generally stay at a camp for the duration of the roster cycle. They face many unique challenges with travel safety, separation anxiety, and transitioning into and out of shiftwork. The mental health of these people is often challenged due to the isolation and loneliness. They generally live in 'dongers' which are small, self-contained rooms and gather at the mess to eat breakfast and dinner and prepare lunches to take to work. Other issues include sleeping in a strange bed and getting used to having others sleep within half a metre away (separated by a thin wall). The most important risks for these employees are cumulative fatigue and the drive home at the end of a series of days or nights (or both).

Some employees choose to drive to the airport or the workplace, for a few hours in one direction, and then commence a 12-hour shift. If it's a dayshift, then the drive will be in the very early hours of the day encompassing high risk driving. The risk is caused by a coupling of not enough sleep and driving through a high-risk period. The drive home from the workplace, or an airport, can add a significant number of hours to an already

long day. As previously mentioned, staying awake for 17 hours creates a driver performance similar to 0.05% blood alcohol concentration (BAC). Worse still, being awake for 20 hours gives driving performances equivalent to 0.08% BAC.

Think about the following scenario: Jimmy works in the Pilbara on a seven-day, seven-night, seven-off roster. The work periods are 12 hours. On the day of his last nightshift he wakes up in the afternoon at 2 pm and can't get back to sleep. Therefore, he is awake 4 hours before he starts work. At the end of his 12-hour shift, he has been awake for 16 hours. He goes back to the camp, packs his gear, has breakfast and goes off to the bus to take him to the airport. The drive is a short one. He waits a while, boards and flies back to Perth. When he arrives, he has been awake for 19.5 hours apart from a 20-min nap on board. He climbs into his vehicle and commences his drive to Albany (4.5 hours). It takes 2 days of Jimmy's recreation time to pay back the sleep debt. If Jimmy gets to Albany safely, he has been awake a total of 24 hours. His performance will have been equivalent to someone with a 0.10% BAC level.

Let's investigate an opportunity to get Jimmy home safer and in better condition. Jimmy still only sleeps till 2 pm before his last shift. His employer has ended his shift at 3 am instead of 6 am and Jimmy went back to camp and slept for nearly three hours. This has paid back some of his sleep debt. After flying back to Perth, he has had three hours of sleep plus a brief power nap on the plane. He then drives back to Albany much safer and after having a long overnight sleep, takes only the first day to recover. There are many similar scenarios at FIFO sites and some of the countermeasures might include an overnight stay before travelling further. A journey management plan is often required

by mines prior to long distance commuters commencing work. It is very sensible to have one.

My own research conducted in New South Wales in 2005<sup>70</sup> found that a large portion of coal miners had journeys of between one and six hours after finishing their last 12-hour shift in a series. Others were adding up to three hours of driving per work day. The research found that for every two years, one driver is killed, and 60 drivers will be injured either going to, or going home from work in an NSW coal mine. In 2023 this hasn't changed much and there is discussion of employees working 12.5 hour shifts and driving at least an hour, to an hour and a half, each way to and from work. Add to this a start time of 6 am and the risk of crashing becomes inflated.

Research in Queensland has similarly troubling results and much has been done since 2000 in the Bowen Basin (e.g., the Road Accident Advisory Group [RAAG] committee and good work by the Qld police service). That said, lives are still being claimed on the roads and more work is required to reduce such carnage.

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### ***Tales from the training room – Wrong side of the road!***

Here's a real occurrence from a Queensland mine: Glenn works at a coal mine in the Bowen Basin. He drives in to the site, leaving at 2 am from home to ensure he gets there on time to start the day shift. He works two days and two nights, staying at a camp nearby the mine, then after the last shift drives 3.5 hours to his home. One morning after his last nightshift, while driving home he didn't realise he had fallen asleep, until he woke up on the wrong side of

the road travelling at nearly 160 kph. He believed that only luck kept him alive. His foot had slowly pressed down on the accelerator pedal and, driving with only his right-hand on the steering wheel, slowly drifted across to the wrong side of the road. He now has a three-hour sleep in a 'fatigue room' at the camp prior to driving home. His family understands that he is going to be home later and that he will drive much safer and is less tired when he gets home.

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### **Planning to be away from home**

A couple of days before going back to work, start a list of what you need to do before going back and another list for what you need to take to work. Check items off the list as you do them and if it is too stressful or unrealistic timewise, add it to the list for your next break at home. Ensure you have had some time for yourself as some people become resentful if they feel that it's all work and no play. Perhaps it could be a fishing trip or taking the kids to a sporting event. Whatever it is, make the time to do it.

Remember that separation anxiety affects many FIFO/DIDO workers and their families. Common signs to look for are silly arguments with spouses, or kids becoming naughty as you get close to time to leave. It is useful to understand that this anxiety is simply because you do not like being away from your family and they have a hard time without you there. This shows in behaviours that often do not make sense and leads to arguments and confused moods. Discuss separation anxiety with your family so that everyone understands what causes it, how to best manage it and what to do when it arises. If your family is constantly affected, seek the assistance of the company's employee assistance provider (EAP) which is confidential and available to all members

of your family at home. They can assist with setting up routines to better deal with the anxiety before it gets out of hand.

## **Communication**

Work out a communication strategy with the family (e.g. Skype, face-times, video calls, etc.) and ensure that you are equipped with what you need to communicate. Also remember that at some residential camps, the use of electronic data becomes quite limited at times when large numbers of employees finish work, and all want to communicate with their families at the same time. Make a point of remembering important family dates, such as birthdays, children's sport or academic activities and try to either get someone to video the event or have a live feed for presentations if possible (e.g. record the event to messenger or another application). By simply communicating your awareness of the upcoming event, the family has a better feeling of inclusion in your life.

If you are a FIFO or DIDO worker who is away from the family, let the family know that issues discussed before bedtime can have a big effect on you getting to sleep, which in turn can have a big effect on your level of safety at work. It can be worthwhile setting boundaries for what should be 'home discussion' and what should be 'away discussion'. Also, set a time beyond which no more phone calls should be made, unless it is something serious. My family only ever call me early in the day when I'm away. This is important when I'm in a different time zone.

## ***Driving to the workplace to start a series of day shifts.***

If you are commencing dayshift with an early start time (e.g. 6 am), consider driving the afternoon prior and staying overnight



in accommodation prior to the first shift. While most employees would rather have the night at home, there are many reasons not to:

- You need to get a good amount of sleep before the early morning drive, and most people won't, due to the anxiety of waking early
- The poor or short sleep will cause serious road safety issues driving early and for a long distance
- You will inevitably start your first day of your roster with a sleep debt. This may affect every working shift if you do not get the chance to pay back the debt
- The separation anxiety usually causes issues at home, then it's very hard to sleep well

### **Transitioning back to days when travelling from work after nightshift**

If you finish your last shift on nights and you are flying out in the morning straight after work, have a nap on the plane if you can and ensure you have a ride home from the airport when you land (family, taxi, or ride-share). This is very important as the sleep debt accumulated on nightshift will make it very dangerous for you to drive. If you must drive from the airport, ensure you plan adequate stops for breaks. Try and carpool, but make sure any passengers stay awake to help you stay awake while driving.

Once home safely, do what you need to do but try and get some sleep in the morning. Try not to nap in the afternoon as this will keep your rhythm running on nightshift mode. Do not operate machinery or undertake any safety critical tasks as you

will still have a high level of sleep debt. Go to bed early, say around 8 pm and have a big sleep overnight. Around 10 hours of sleep would be very beneficial to pay back some of the sleep debt from successive nightshifts. On the following days, if you feel drowsy in the afternoon, see if a 20-minute nap brings you back to arousal. Longer sleeps can take you back into a nightshift pattern.

### ***Travel home after a series of shifts.***

If you finish your last shift on days and are flying out in the evening, apply the same driving rules as above. If staying overnight in a camp or hotel/motel before you fly, you will be better rested and will have a much safer drive home from the airport if you have to drive. You will also arrive home as a much nicer version of yourself! If you finish on nightshifts and you are driving, make sure you have a good sleep before driving (three to 4.5 hours would be a minimum, but more is safer). Have a journey management plan in place, with stops and communication points along the way.

### **Carpooling**

Carpooling is an effective way of allowing two or more employees to share the costs of travel to and from site. It also allows for either person to drive if one is not feeling too energetic. It provides the opportunity to have good discussions and to share thoughts, feelings, and current issues. It can be good for mental health to have a good friend to talk to. One of the down sides to this is that passengers often take the opportunity to sleep if they are not driving. While this is good for the person to reduce their sleep debt, drivers will often not apply fatigue controls if

feeling fatigued. This is due to noises and cool air waking the passenger. This practice should be avoided as it increases the risk of a fatigue crash.

Carpooling is useful only if the front passenger continuously communicates to keep the driver awake. Planned driver swapping is highly recommended to keep the drive safer. I say 'planned' because if you ask a tired, drowsy or sleepy driver if they are ok, they will invariably say 'yes'. Swapping drivers can save lives. Where I have investigated sleep-related crashes for the Police, I have found that nearly all of the crashes have had the front passenger asleep at the time of the crash. Often, the front passenger is killed in the crash. Interestingly, had the passenger been awake on these trips, they may have noticed that the driver was going through the wake - sleep transition zone. Suffice to say, this period is a combination of being awake, getting sleepy, being awake and so on.

### **Sleeping in a strange bed**

There are often times where you need to travel for work, play or to relax. Your next sleep might be in a hotel, motel or a work camp, such as those used in the oil, gas and minerals industries. Your first night of sleep is usually quite poor and this can be due to many factors. First, you have to get used to noises that can be quite different to those at your normal residence. Hotels and motels, for example, often have a mix of tourists, travellers and workers. While many of the workers are quite likely to go to bed at a reasonable time, most of the tourists and travellers don't have similar needs. The end result if you get unlucky, you'll have a tourist keeping you up late with their noises on one side and a worker getting up early to start work on the other.

I have been in situations where the noisy tourists are asleep around midnight and the worker on the other side, up at 4.30 am and reversing out with a reverse beeper on their work vehicle. It pays to ask for a room away from others or at least tourists if possible. If you know that a worker has a reverse beeper, ask if they can reverse into the parking spot when they come home from work, rather than reversing in the morning. The other issue with sleeping in a strange or unfamiliar location is the natural reaction of the brain as mentioned earlier. Research has indicated that the left hemisphere of the brain does not get into deep sleep for at least the first session of deep sleep (which is often the longest period of deep sleep)<sup>71</sup>. Termed the 'first night effect', it starts many people on their first day in a new location, with a sleep debt.

My own experience is that if you travel a lot, as I do, you tend to suffer less with this problem. It can be very useful to take your own pillow with you as I believe that if your head is on your own pillow, the feel and smell of this may alleviate the stress response of being in a strange bed.



# Epilogue

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One of the main reasons for writing this book has been that I have learnt so much over the years and there are rarely any avenues to tell all I know. I find this a shame as what I have learnt has made a spectacular difference in my life and some that I have helped have said the same. We all deserve to live good, healthy lives, but clearly many people just don't know how to. Sleep is one of the pillars of health, along with a healthy diet and appropriate exercise. Yes, I've said this repeatedly throughout this book and I don't apologise for it.

I sincerely hope that you have got some benefit from this book. I invite you to implement some of the ideas if your sleep is not what it should be. In opposition to the last statement, if your sleep is good, then just enjoy it. Don't change what isn't broken! If you find that some of the information has changed your sleep for the better, help your family benefit too. Feel free to visit the website [www.beyondmidnight.org](http://www.beyondmidnight.org) for free information and the opportunity to join the newsletter list. Or scan the QR Code to go directly to my YouTube Channel. Please subscribe.

At the end of the day, health is one of the most important components of your life. Live well!



**THE END**



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# THE WONDER OF SLEEP: BEYOND MIDNIGHT



YOUTUBE WONDER OF SLEEP CHANNEL

*Want more sleep?  
Noticed a few driving errors lately or getting  
to your destination and wondering how?  
Motivation at work or at home dropping off?*

Sometimes we just don't get the sleep we need.

There appears to be a war against sleep. Yet sleep underpins so much in relation to health and wellness, safety, and productivity. Most people don't really know how much better their lives could be, until they get three nights of adequate sleep in a row.

This book is a compilation of knowledge gained from years of research, presenting in front of more than 29,000 people, and using tales from the training room to discuss the nuances, disappointments, and joys of sleep.

Dr Mabbott presents a mix of scientific evidence and practical strategies to help people get to sleep in five minutes on most nights. He also shows how his knowledge has helped some nightshift workers go from an average of 4.5 hours of sleep per day, to over 7 hours.

Using the information from within the book, we can become safer drivers and workers, better parents, and partners, and feel much better in ourselves.

The reader is challenged with the question:  
"Are you currently the best version of yourself?" and is provided with the means to find out how to be just that.

