Fatigue Management for the Australian Aviation Industry

Fatigue Management Strategies for Aviation Workers: A Training & Development Workbook

May 2012
Contents

1. Introduction .......................................................... 8
   The aims of fatigue risk management training .................. 8
   The purpose of this workbook ................................... 8
   How to use this workbook ......................................... 9
   Assessment options ............................................... 9
   The Sleep Deprivation Quiz ..................................... 10
   Case study ........................................................ 11

2. Working Non-traditional Hours .................................... 12
   Intended learning outcomes ..................................... 12
   Shift work .................................................................. 12
   The body clock (circadian rhythms) ............................ 13
   Impacts on performance .......................................... 14
   Individual differences ............................................. 15
   Case study ........................................................ 16
   Knowledge Check ................................................. 17

3. Fatigue ................................................................. 18
   Intended learning outcomes ..................................... 18
   What is fatigue? ................................................... 18
   Causes of fatigue .................................................. 18
   Signs and symptoms of fatigue ................................ 20
   Figure 1. Signs of fatigue ....................................... 21
   Consequences of fatigue ........................................ 22
   How big a risk is fatigue? ....................................... 22
   High risk times for fatigue ...................................... 23
   Figure 2. Mean relative risk of error for hours on duty .... 23
   Case study ........................................................ 24
   Knowledge Check ................................................. 25

4. Sleep ................................................................. 26
   Intended learning outcomes ..................................... 26
   What is sleep? ...................................................... 26
   Normal sleep need ................................................. 26
   Sleep cycles and sleep structure ................................ 26
   Figure 3. The human sleep cycle ............................... 27
   Recovery sleep ..................................................... 28
Fatigue Management for the Australian Aviation Industry

Aging and sleep ................................................................. 29
Insomnia ........................................................................... 29
Setting up your bedroom .................................................. 29
Sleepwalking .................................................................... 31
Sleep apnoea ..................................................................... 31

Case study ......................................................................... 32

Knowledge Check .............................................................. 32

5. Napping ........................................................................ 33
Intended learning outcomes ................................................ 33
The benefits of napping ..................................................... 33
Key Points for a Napping Policy .......................................... 34
Sleep inertia ........................................................................ 35

Knowledge Check .............................................................. 35

Case study ......................................................................... 36

6. Food .............................................................................. 37
Intended learning outcomes ................................................ 37
Food and fatigue ................................................................ 37
Digestion and hunger .......................................................... 37
Controlling blood sugar with food ......................................... 37

Table 1. Grouping common foods by glycaemic index ............ 38

Low-fat protein strategies ................................................... 39
Evaluate your current diet ................................................... 39

Case study ......................................................................... 40

Knowledge Check .............................................................. 40

7. Hydration ....................................................................... 41
Intended learning outcomes ................................................ 41
Can hydration affect alertness? ............................................ 41
Contributors to dehydration ................................................ 41

Case study ......................................................................... 43

Knowledge Check .............................................................. 43

8. Caffeine and other Stimulants ......................................... 44
Intended learning outcomes ................................................ 44
What is caffeine? .............................................................. 44
The downside of caffeine .................................................... 45
The strategic use of caffeine ................................................ 45

Table 2. Caffeine content of common substances .................. 47

Knowledge Check .............................................................. 48

9. Alcohol ......................................................................... 49
Table 4. Benefits associated with different types of exercise

Establishing a routine
Exercise and fatigue

Knowledge Check

14. Social and Family Life

Intended learning outcomes
'Unsocial' hours
Coping strategies

Knowledge Check

15. Commuting

Intended learning outcomes
Commuting as a hazard
Making commuting safer
Case study

Knowledge Check

16. Work Schedule Design

Intended learning outcomes
Shiftwork on the rise
Work schedule design as a fatigue countermeasure
Different types of shifts
Dual responsibilities
Shift rotation
Shift intolerance
Guidelines for shift design
Case study

Knowledge Check

17. Jet Lag

Intended learning outcomes
What is it?
Jet lag and the body clock
Effects of jet lag
Easing the effects of jet lag
To sleep or not to sleep?
Getting used to jet lag?

Knowledge Check

18. Readings & Resources

Working non-traditional hours (sleep loss and disruption)
Fatigue and sleep
Sleep and sleep disorders ................................................................. 91
Napping and fatigue prevention ...................................................... 92
Food and nutrition........................................................................ 92
Water and heat stress .................................................................... 93
Caffeine ......................................................................................... 93
Alcohol ........................................................................................... 93
Nicotine .......................................................................................... 93
Medications .................................................................................... 93
General health and well-being ...................................................... 94
Exercise .......................................................................................... 94
Social and family life ..................................................................... 94
Commuting ...................................................................................... 94
Work schedules .............................................................................. 95
Jet lag and circadian dysrhythmia .................................................. 95
1. Introduction

The aims of fatigue risk management training

The challenges posed by fatigue in transport industries have been recognised for some time. A decade ago, the House of Representatives Standing Committee on Communication, Transport and the Arts conducted an inquiry into managing fatigue in transport in Australia. The resulting report, entitled ‘Beyond the Midnight Oil: Managing Fatigue In The Transport Industry’ noted that fatigue in transport is a problem that must be addressed by governments, by transport companies and by workers in the transport industry.

There was recognition in the report that it was unrealistic to wind back the advances and opportunities created by the 24 hour a day global economy, but that it was essential that responsibility be taken for the potential costs associated with these developments. It was concluded, “fatigue in transport probably cannot always be avoided, but it can be managed” (Foreword, p. vii).

The report included aviation industry-specific recommendations, including that fatigue management should be a basic requirement for air operators, including aircraft maintenance activities, and that the management of fatigue should be a component of safety audits.

The Civil Aviation Safety Authority is committed to improving aviation safety through the management of fatigue-related risks. To this end, a set of tools has been developed to support the Australian aviation industry. This support extends to elements of Fatigue Risk Management Systems (FRMS) or to assist operators and individuals understand their obligations in a prescriptive regime.

An important part of any system consists of training all employees about the safety hazards of fatigue and how effectively to manage them. Various training materials have been developed to achieve this goal. This fatigue risk management guidance was designed with the business needs of participating organisations in mind. In addition, the program attempts to move beyond simply raising awareness. The program is designed to promote the development of skills relevant to fatigue risk management.

Managing human resources has always been a demanding task. Now, as we become more aware of the implications of fatigue, industry must acknowledge the needs of employees who work in demanding roles; who work outside the Monday-to-Friday, 9-to-5 schedule; and/or have very active lives when they are not at work. Shift workers are not the only workers at risk of fatigue at work. There are many pressures and opportunities in today’s society to sacrifice sleep for other activities.

Nevertheless, the incidence and variety of non-traditional work schedules appear to be increasing. Shift work can have benefits for both employers and employees. However, scheduling decisions made without a thorough knowledge of the performance, safety and social impacts of such work schedules could result in unsafe shift arrangements that compromise any potential benefits.

The purpose of this workbook

This workbook aims to provide the knowledge and develop the skills to help you, an aviation industry worker, to make use of appropriate fatigue management strategies.
More specifically, you will learn how to:

- monitor potential causes of fatigue and devise action plans to minimise their effects in accordance with company procedures;
- identify personal warning signs of fatigue and appropriate counter-measures, in accordance with workplace procedures, to ensure effective alertness and work capability;
- make positive lifestyle choices to promote the effective, long-term management of fatigue;
- adopt and apply effective practices and countermeasures for combating fatigue; and

**How to use this workbook**

This workbook involves a combination of theory and practical strategies related to both work and non-work situations. This study guide will be your reference during your training.

Each section begins with a list of learning outcomes. These outcomes are provided to organise the training around clearly defined learning goals that students are expected to demonstrate on completion. The content includes background information on the featured topic and practical strategies to minimise the effects of fatigue at work.

Topics covered include sleep, nutrition, fitness, health, social life and work design and how relevant strategies can help to minimise the occurrence and severity of fatigue.

Exercises are provided throughout the workbook so that students can reconsider the content in a personal context. Checks of knowledge are also included at the end of each section to allow students to verify whether they need to review specific content.

**Assessment options**

Depending on the training format chosen by your organisation, you may be asked to complete a formal assessment to receive a certificate of completion for this course. Your trainer or supervisor will inform you whether an assessment process will be used and its format. Assessment can take various forms, including:

- For classroom delivery, group discussion of case study exercises to reinforce the course content.
- Written responses to the exercises in each section of the workbook, reviewed by the assessor or your supervisor.
- A written assessment exercise to demonstrate your understanding of the workbook material (items are likely to be similar to the knowledge checks provided at the end of each section).
- Demonstrating related skills (perhaps via classroom exercise or observation at work).
- Maintenance of a fatigue logbook that might include annotations about fatigue risks and challenges, and how you have applied the knowledge and skills learned during the course in your work situation and daily life.
The Sleep Deprivation Quiz

- Do you fall asleep in less than five minutes after going to bed?
- Do you often feel like you could do with a nap?
- Do you become drowsy after eating a large meal?
- Do you fall asleep when watching TV or sitting in meetings and presentations?
- Do boring activities make you sleepy?
- Do you sleep and hour or two longer than usual on days when off duty?
- Do you find that you can hardly make it through the working day without caffeine in some form?

The above scale was adapted from the book *Fatigue in aviation: A guide to staying awake at the stick*. According to the authors, John and Lynn Caldwell, if you answered ‘yes’ to one or more of these questions, you probably are not getting enough sleep to be at your best at work. You are sleep deprived.
A fatigue risk management tool as part of a Crew Management System


ENGLEWOOD, Colo., 5 Jan. 2011. Jeppesen has integrated fatigue risk management (FRM) functionality with its Crew Management System solution suite, as part of its work to prevent and reduce fatigue risk in crew planning and operation.

The FRM solution takes into consideration crew members' predicted levels of fatigue when generating and maintaining crew schedules. Predictions of crew alertness and fatigue risk are based on the Boeing Alertness Model (BAM), developed jointly by Boeing and Jeppesen. The modular design of the solution also allows airline operators to make use of alternative alertness models if desired.

Jeppesen recently released a related Apple iPhone mobile application, called CrewAlert, which gives the user an insight into how sleep science applies to crew schedules. CrewAlert is intended for use by crew schedulers, crew members, government regulators, and scientists to determine predicted levels of alertness. CrewAlert also allows for data, collected in actual operations, to be fed back into an airline’s Fatigue Risk Management System for purposes of correlation with other pilot data and further refinement of the FRM model.

"To help address a high-profile industry safety issue, Boeing and Jeppesen joined together to develop and successfully integrate FRM functionality into the Jeppesen Crew Management System," says Tim Huegel, director, Jeppesen Portfolio Management, Aviation. "For years, rules implemented at company, regulatory, and union levels limited duty times of crew with the intent of managing fatigue. Our fatigue management solutions -- with the integration of industry-recognized alertness models into our crew management software, plus the CrewAlert mobile application -- now allow airlines and their crew to enhance flight safety and maintain efficient operations."

Data generated by an FRM assessment, including alertness and risk information, is processed by Jeppesen crew planning optimization software when generating crew pairings and rosters for operators. This data is also available to crew planners to control and monitor fatigue risk during manual roster maintenance and day-of-operation changes.

The FRM solutions were developed in advance of new aviation industry regulations requiring operators to implement fatigue risk management systems as part of crew management operations, replacing existing regulations on flight time limitations (FTL). To research the issue and to develop FRM solutions that would meet operator requirements, Jeppesen and Boeing conducted a joint study of European, U.S., and Chinese FTL models, entitled "Flight Time Limits and Fatigue Risk Management: A Comparison of Three Regulatory Approaches." The study is available for viewing through the Jeppesen FRM solutions Website.
2. Working Non-traditional Hours

Intended learning outcomes

After reading through this section, you should be able to:

- Explain the positive and negative impacts that non-traditional hours of work can have.
- Identify individual differences that influence the capacity to adapt to non-traditional hours of work.

Shift work

We live in a 24-hour society where many different work patterns have developed beyond the traditional Monday-to-Friday, 9-to-5 routine. An increasing proportion of the workforce is engaged in shift work and non-traditional schedules.

According to the Australian Bureau of Statistics, as at November 2009, 16% of workers in Australia were employed in some form of shift work, amounting to 1.4 million workers. Of all employees who regularly worked shift work, 15% (or over 200,000) worked a regular night or evening shift.

The industries with the highest proportion of employees who usually worked shift work were mining, health care, accommodation and food services, and transportation.

Shift work serves multiple purposes within the Australian labour market. It allows employers to maximise production by making full use of 24 hours of each day. Shift work also ensures that many essential services (e.g. transportation, health care) are provided to the community around the clock.

For the purpose of this publication, the term ‘shift worker’ refers to a person who works rotating shifts, irregular shifts, evening shifts, afternoon shifts, morning shifts or split shifts. Another term for this work is ‘non-traditional work hours.’

Working regular or permanent shift work or non-traditional hours involves more than just a work schedule - it is a way of life. Shift work has a fundamental impact on not only work, but also sleep patterns and the management of health, family, and social life. Research indicates that shift work affects physical and mental health, as well as work performance.
What are some of the personal difficulties that you or some of your co-workers have experienced because of shift work or non-traditional working hours?

Can you think of positive and negative effects of shift work schedules on health, lifestyle, safety and well-being?

<table>
<thead>
<tr>
<th>Positive effects</th>
<th>Negative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Some shifts (such as night shifts) are more likely to be harmful to health than others (see Section 16 for different shifts and their impact on the worker). The effects of a particular shift depend on when it falls within a 24-hour period and the disruption it causes to your body clock.

The body clock (circadian rhythms)

One of the most predictable environmental variations to which the body must respond is the cycle of night and day. This cycle relates strongly to why we feel sleepy at night and awake during the day. Many physiological rhythms, such as sleepiness and wakefulness, the secretion of digestive enzymes, hormone production, and body temperature operate very close to a 24-hour cycle. These are called circadian (about a day) rhythms.

These biological rhythms do not adjust easily to a pattern imposed by work schedules unless the schedule is day work. On the whole, people find working at night more difficult than working during the day.

This is because night schedules disrupt sleep/wake patterns and other biological rhythms. People find themselves trying to be alert, to sleep and to eat when their body is not programmed to do so. This explains why long-term shift workers are more likely to experience fatigue due to sleep disruption and to suffer health complaints such as gastrointestinal disorders.

The circadian cycle has two periods of sleepiness, known as the circadian trough and the circadian dip. The circadian trough occurs typically between 0200 and 0500 hours (or dawn). During the circadian trough the body’s temperature is at its lowest level and mental performance, especially alertness, is at its poorest. The circadian lull is a lesser circadian trough that typically occurs between 1300 and 1600 hours (the post-lunch dip).
Impacts on performance

Due largely to fluctuations in level of alertness, work performance can be significantly influenced by time of day or night. Other factors play a role in work performance as well, such as the type of task to be performed, motivational effects, individual differences among workers, and how well workers adjust to changes in routine.

Unlike health effects, deterioration in performance can occur very soon after beginning to work certain hours. The negative effects on performance can be worse in jobs that require sustained attention (e.g., air traffic management) and extended hours (e.g., maintenance, ramp operations), or are characterised by high-reliability tasks (e.g., aircrew).

Some specific effects of fatigue on performance are:

- **Reduced attention.** People are slow to notice occurrences in their environment such as the approach of an aircraft.

- **Communication difficulties.** Increasingly, it is difficult to decide what needs to be said, how to say it or what someone else said; for example, tired aircrew or maintenance staff cannot formulate coherent messages and may omit important information in messages or briefs. Speech may become unintelligible.

- **Mood changes.** Significant changes in mood normally accompany performance degradation. These almost always include increased irritability and can entail depression and apathy.

- **Inability to concentrate.** Maintaining attention to the task at hand, for even a few seconds, is difficult. Soldiers cannot follow complex directions or perform numerical calculations and are easily confused.

- **Increasing omissions and carelessness.** Workers begin to skip tasks, miss events and make mistakes, for example, failure to perform routine checks or remember current aircraft status.

- **Decreased vigilance.** As people become less alert, they may fail to detect errors and potential hazards, especially during monotonous tasks or in tedious environments. The monitoring of instruments is especially effected. Tasks requiring sustained attention (typical in air traffic management) are the most adversely affected by sleep deprivation.

- **Slowed comprehension and learning.** It takes longer to understand any form of information; for example, it may take an excessive amount of time to comprehend a message or to find a location on a map or display.

- **Encoding/decoding difficulties.** It becomes more difficult to transform data or to process information; for example, navigation coordinates are decoded slowly, and mistakes are made while doing it.

- **Faulty short-term memory.** Recall of recent events is faulty. The content of a radio message may be immediately forgotten or recalled incorrectly. The ability to assimilate new information is badly degraded.

- **Muddled thinking.** Reasoning becomes slow and confused. Even simple operational procedures and situations may ‘stump’ the employee. This can deteriorate to irrational thoughts, poor logic, and false beliefs.

- **Slowness in perception.** People are slow to understand things seen or heard, especially patterns; for example, the significance of changes in display readings or aircraft movements may be missed.
• **Slow and uneven responsiveness.** People are generally slower to respond to events, but some reactions degrade more quickly.

• **Differential impacts due to task complexity.** Uninteresting and complex tasks, as opposed to those that are interesting and simple, are more seriously affected by sleep loss.

• **Hallucinations.** Sometimes when fatigue is very severe and stimulation is low, the tired brain starts to see and hear things that are not there. As these illusions can be very real, the person may respond inappropriately.

### Individual differences

The impact of a schedule varies from one person to another. Exercising, eating a balanced diet, having good sleeping habits, and using effective time management strategies are all behaviours that help to cope with shift work. More information is provided in the following sections on how these factors can reduce the adverse impacts of shift work and fatigue.

Coping with shift work and fatigue becomes increasingly difficult with age. This is in part because the body’s physiological systems become gradually less able to adapt. However, as we age, our past experiences and the strategies we have developed to manage and cope with the demands of non-traditional work hours may help to counter some of the physiological effects of aging.

The ability to cope with shift work also depends on an individual characteristic related to circadian rhythms. People can be categorised as morning or evening types (chronotypes) depending on the period of the day when they perform at their best.

Morning people will better adapt to early morning hours but will have more trouble coping with night work. Evening types cope more easily with evening and night shifts. They tend to cope better with shift work overall since they generally have less rigid sleep habits and find it easier to catch up by sleeping late in the morning. Individual differences may also go beyond this simple description.
Fatigue Management for the Australian Aviation Industry

Case study

Hard Work on Shift Work
By James Anthony

If you are in a 9.00am to 5.00pm job and think life is tough for you or your glide-time colleagues then spare a thought for the more than one million Australian workers who have to do shift work. They are the folk who tend to either be in mining, transport and service industries - running the late shifts at convenience stores and petrol stations - or nurses, police and ambulance people.

In order to keep many of these services running around the clock the workers are placed on what is known as rotating shifts where they will do a variety or morning, afternoon and overnight rosters. According to the Bureau of Statistics more than 500,000 Australians are on rotating shifts, which are regarded by researchers and worker bodies as not only the most stressful, but have serious health risks. Quick changes - doing a late-finishing afternoon shift followed by an early-morning one - are a regular occurrence, particularly in nursing, and there is growing evidence of health risks to shift-workers.

Figures show that most shift-workers are in safety-critical areas of work such as mining (43%), community services (33%) and the transport/storage industry (32%). While you may think mining workers are too far away to affect us, think about the dead-tired truck driver on the last few miles of his run near your travel route, or the nurse/doctor dispensing your medicine or helping you in Accident and Emergency and you may think again.

An interesting aspect of circadian rhythms is that some people have their biological clocks ahead of the normal daily cycle, while others are behind. People who prefer rising early, enjoy working in the morning, and cope best with demands early in the working day are commonly referred to as ‘larks’ or ‘early birds.’ In contrast, the ‘night owl’ can be very alert even late at night. What type, if either, do you think you are – and why?

These natural ‘offsets’ can result in differences of several hours between optimal alertness levels across individuals. Should work schedules be adapted to meet the natural tendencies of these people?
Knowledge Check

• Name three aspects of your life that can be affected by non-traditional hours of work.
• Name two types of biological rhythms that are regulated by the body clock.
• Name three personal characteristics that can influence how non-traditional hours of work will impact on performance.
3. Fatigue

Intended learning outcomes

After reading through this section, you should be able to:

- Define fatigue.
- Describe factors that contribute to fatigue.
- Identify signs of fatigue.
- Name the times of day when mental alertness is normally at its lowest levels.

What is fatigue?

According to the US Federal Aviation Authority, fatigue can be defined as a condition characterised by increased discomfort with and lessened capacity for work, reduced work efficiency, loss of energy or capacity to respond to stimulation, and is usually accompanied by a feeling of weariness and tiredness.

It is evident that fatigue can develop from a variety of sources. The important issue is not so much what causes fatigue but rather the negative impact fatigue has on a person’s ability to perform tasks. A long day of mental concentration such as studying for an exam or writing a detailed report can be as fatiguing as manual labour.

Several studies have demonstrated that fatigue can significantly impair a person’s ability to carry out tasks that require sustained concentration, complex thinking, and even manual dexterity.

Fatigue may occur in a relatively short time (hours or even minutes) after some significant physical or mental activity. Alternatively, it may occur gradually over several days or weeks. The latter situation typically occurs when someone does not get sufficient sleep over a prolonged period for reasons such as having an infant at home, frequent international travel, sleep disorders such as insomnia or sleep apnoea, and shift work. Work or personal demands can often involve ongoing physical and/or mental effort with insufficient rest.

The effects of fatigue can be made worse by inadequate fluids and food (hydration and nutrition), by exposure to harsh environments, prolonged or stressful mental work, or arduous physical work. This is especially so if we are not used to the type of work we are undertaking or are unwell or lacking fitness.

Causes of fatigue

The preceding section has highlighted that there are a range of factors that cause or contribute to fatigue. To summarise, fatigue is normally the product of one or more of the following:

- emotional strain;
Fatigue Management Strategies for Aviation Workers: A Training & Development Workbook

- mental workload;
- strenuous or sustained physical exertion;
- inadequate food and fluid intake;
- adverse environmental conditions, such as extremes of temperature, low light levels, vibration and confined spaces;
- periods of monotony or boring activities; and
- disrupted and lost sleep.

When trying to determine why fatigue has occurred, there is often a focus on the last factor in the list above: sleep. This is because both the quantity (how much) and the quality (how good) of sleep are especially important for recovery from fatigue and for maintaining normal alertness and performance.

Inadequate sleep (quality or quantity) over a series of nights causes a “sleep debt,” which results in increased fatigue that can sometimes be worse than a single night of inadequate sleep. A sleep debt can only be repaid with adequate recovery sleep.

Working non-traditional shifts, especially night shifts, can limit the opportunity for sleep and recovery in each 24-hour period. In fact, shift work can often reduce the amount of sleep a person normally gets by between one and three hours per day. This is because these hours of work tend to:

- limit the amount of time available for sleep; and
- disrupt the body clock, which is programmed for activity during the day and for sleep at night.

In addition to sleeping less, people who work non-traditional hours often obtain sleep of a lower quality.

There are many reasons why workers do not obtain the quality or quantity of sleep that they require to be adequately rested. Some of these reasons are work-related and some are non-work related.

Examples of work-related fatigue factors are:

- hours of work (especially night work, early morning starts, and high total number of hours);
- task demands or time pressures that do not allow long enough breaks between shifts for adequate sleep; and
- sleeping conditions that may compound fatigue (for example, noisy accommodation, lack of air conditioning in hot climates, uncomfortable in-flight sleeping facilities).

Examples of non-work-related fatigue factors include:

- disturbed sleep (noisy neighbourhood, noisy bed partner);
- disrupted sleep (a sick child, night feeds for a baby);
- undiagnosed or untreated sleep disorders; and
Fatigue Management for the Australian Aviation Industry

- social pursuits that take priority over sleep (parties, watching Wimbledon, playing computer games, interacting on other electronic devices).

The last point above appears to be increasing as a source of tiredness. Today’s ‘24/7’ (active 24 hours a day, 7 days a week) wired and global society provides numerous temptations to sacrifice sleep time.

Identify at least three causes of work-related fatigue that have affected you at work.

_____________________________

_____________________________

_____________________________

Signs and symptoms of fatigue

In general, we are not reliable judges of our own fatigue levels. It is difficult to tell when our fatigue has reached a point where it is no longer safe to work or drive. However, there are signs or symptoms that can be used as a gauge.

Fatigue-related signs and symptoms are often divided into three categories: physical, mental, and emotional. The diagram on the following page outlines some of the major signs in each category.

Depending on the type of work being conducted, there may be some task-specific indicators of fatigue that can be added to this list. For example, with respect to flight crew, the following symptoms could be indicative of fatigue:

- less comprehensive instrument scans;
- diminished crew coordination;
- increasing errors of omission (failing to detect and/or correct undesirable performance);
- increased sensitivity to noise;
- more passive flight control strategies;
- acceptance of increased risk;
- misinterpretation of instructions or instrument readings;
- occurrence of larger system deviations before corrections are made;
- disregard of peripheral cues and activities;
- acceptance of lower performance standards;
- increasing failures in prospective memory (forgetting intended actions);
- impaired visual perception;
- the occurrence of micro-sleeps; and
• falling asleep at the controls.

The more of the symptoms listed in Figure 1 that you experience, the more likely it is that your alertness is significantly reduced. Of course, fatigue is not the only cause of such symptoms, but when several occur together, it is likely to indicate fatigue-related impairment.

If you exhibit fatigue-related symptoms on a regular basis, you should consider seeing an appropriate medical specialist. Experience has shown that this is particularly important for individuals with a body mass index greater than 30 and a ‘large’ neck size (43 cm (17 inches) or greater in men; 40 cm (16 inches) or greater in women). These attributes are related to significantly higher risk of sleep disorders, particularly sleep apnoea.

**Figure 1. Signs of fatigue**

Circle any of the above signs and symptoms that have significantly affected you in the past. Reflect on these signs and symptoms and indicate how they have affected your work.
Consequences of fatigue

A fatigued individual is often impaired and cannot continue to perform tasks safely or efficiently. For example, fatigue can affect your ability to:

- react quickly in emergencies;
- communicate clearly with fellow employees; and
- work productively.

Fatigue and falling asleep have been identified as significant contributors to incidents and accidents in a wide cross-section of industry. This relationship has been well supported by investigations and industrial risk data. Fatigue-related incidents and accidents are often associated with employee injury, equipment damage, and, in some cases, fatalities. Police statistics indicate that 30% of fatal vehicle accidents in Australia have fatigue as a contributing factor. Fatigue is a significant factor in heavy vehicle accidents.

In relation to the impact of shiftwork on work-related injuries, Safe Work Australia reported the following:

- In 2005–06, 16% of Australian workers worked under shift arrangements yet they had 27% of the work-related injuries.
- Shiftworkers had almost twice the rate of work-related injury than non-shiftworkers: 114 shiftworker injuries versus 60 for non-shiftworkers per 1000 workers.
- High incidence rates of injury were not attributable to a lack of Occupational Health and Safety (OHS) training because a greater proportion of shiftworkers received OHS training than non-shiftworkers.

How big a risk is fatigue?

In recent years, researchers have compared the effects of alcohol and fatigue on performance. While most people understand that alcohol intoxication can be a significant risk on the roads, the effects of fatigue may not be as readily understood or acknowledged.

Studies using particular performance tests have indicated that:

- The performance of a person who wakes at 7 a.m. and stays awake for 17 hours until midnight is, by that stage, likely to be as impaired by fatigue as someone with a blood-alcohol concentration (BAC) of 0.05% -- the legal driving limit in many countries.
- A person who wakes at 7 a.m. and then stays awake for 23 hours until 6 a.m. the following day will have a level of general performance impairment similar to someone with a BAC of 0.10% - which is twice the legal limit for fully licenced drivers in Australia.

Although there are differences between being fatigued and being drunk, this research has provided employers and employees with a meaningful comparison that sends a strong message about the potential adverse effects of fatigue. For example, one night of sleep deprivation can leave you more impaired than would be acceptable for driving a vehicle.
High risk times for fatigue

There are particular times of the day when the risks associated with fatigue are increased, regardless of the relationship between fatigue and recovery sleep. It is important to understand these risks when making decisions about hours of work, hours of overtime, contingency planning, and emergency response.

Times when fatigue risk levels are particularly high are:

- Working midnight to dawn (especially between 2 a.m. and 5 a.m.). This is the low point in several of the body’s circadian rhythms (particularly body temperature) that are associated with alertness and performance.
- When regular breaks have not been taken
- When shifts are longer than eight hours (see the figure 2 on the mean relative risk of error for different shift durations).
- Early shift starts (before 6 a.m.). Early start times often shorten sleep obtained the night before because most people often find it difficult to go to bed earlier in compensation, find it hard to get to sleep quickly if they do go to bed early, or they “clock watch” due to anxiety about not waking up on time.
- When employees are new to the job or workplace. Learning a new job and getting to know the environment and the people is often challenging. Some individuals may find they do not sleep as well during the first week or so of a new job while they become accustomed to the new workplace, role, commute, and hours.

![Figure 2. Mean relative risk of error for hours on duty](image-url)
Case study

Ten major causes of fatigue

1. **Not Enough Sleep.** It may seem obvious but you could be getting too little sleep. Adults should get seven to eight hours every night. Fix: Make sleep a priority and keep a regular schedule.

2. **Sleep Apnoea.** Sleep apnoea briefly stops your breathing throughout the night. Each interruption wakes you for a moment, but you may not be aware of it. The result: you are sleep-deprived despite spending eight hours in bed. Fix: Lose weight if you’re overweight, quit smoking, sleep with a CPAP device to keep airway passages open.

3. **Not Enough Fuel.** Eating too little causes fatigue, and eating the wrong foods can also be a problem. A balanced diet helps keep your blood sugar in a normal range and prevents that sluggish feeling when blood sugar drops. Fix: Always eat breakfast, include protein and complex carbs in every meal, structure eating for sustained energy.

4. **Anaemia.** Anaemia is a leading cause of fatigue in women. Menstrual blood loss can cause an iron deficiency, putting women at risk. Fix: For anaemia caused by an iron deficiency, taking iron supplements and eating iron-rich foods, such as lean meat, liver, shellfish, beans, and enriched cereal, can help.

5. **Depression.** You may think of depression as an emotional disorder, but it also contributes to many physical symptoms, typically fatigue, headaches, and loss of appetite. If you feel tired and ‘down’ for more than a couple of weeks, seek medical advice. Fix: Depression responds well to psychotherapy and/or medication.

6. **Hypothyroidism.** The thyroid gland controls your metabolism - the speed at which your body converts fuel into energy. When the gland is underactive and metabolism functions slowly, you may feel sluggish and put on weight. Fix: If a blood test confirms your thyroid hormones are low, synthetic hormones can assist.

7. **Caffeine Overload.** Caffeine can improve alertness and concentration in moderate doses, but too much can increase heart rate, blood pressure, and jitteriness. Too much caffeine can cause fatigue in some people. Fix: Gradually cut back on coffee, tea, chocolate, soft drinks, and medications containing caffeine.

8. **Diabetes.** In diabetes, abnormally high levels of sugar remain in the bloodstream instead of entering the body’s cells where it is converted into energy. The result is a body that runs out of steam despite having enough to eat. Fix: Treatments for diabetes may include lifestyle changes, insulin therapy, and medications to help the body process sugar.

9. **Dehydration.** Fatigue can be a sign of dehydration. Whether you’re working outside or working a desk job, your body needs water to work well and keep cool. If you’re thirsty, you’re already dehydrated. Fix: Drink water throughout the day and have at least two cups of water an hour before a planned physical activity. Your urine should be lightly coloured.

10. **Heart Disease.** When fatigue strikes during everyday activities, such as cleaning the house or weeding the yard, it can be a sign that your heart is no longer up to the job. If you notice it’s becoming increasingly difficult to finish tasks that were once easy, talk to your doctor about heart disease. Fix: Lifestyle changes, medication, and therapeutic procedures can get heart disease under control and restore energy.
Describe one or more safety hazards you have witnessed in your work environment because of the fatigue-related issues discussed in this section.

Knowledge Check

- What are two major causes of fatigue?
- Name four signs and symptoms of fatigue.
- Compare performance in the following situations:
  - Being awake for 17 to 23 hours
  - Being under the influence of alcohol (say 0.10% BAC)
4. Sleep

Intended learning outcomes

After reading through this section, you should be able to:

- Describe the general functions of sleep.
- Explain the consequences of sleep deprivation.
- Explain ways of establishing a sleeping environment that can promote your sleep.

What is sleep?

Sleep is defined as a state of partial or full unconsciousness during which voluntary functions are suspended and the body rests and restores itself.

Despite the obvious importance of sleep, its specific function is not fully understood. In a broad sense, it is thought that during sleep the mind and the body “recover” from the stresses of the day and “prepare” or “recharge” for those to come the following day. Information about the function of sleep has mainly come from studies that have deprived animals and humans of sleep.

Normal sleep need

Sleep needs vary from person to person, and they change throughout the lifecycle. Newborns sleep between 16 and 18 hours a day. Children in preschool usually sleep between 10 and 12 hours a day. School-aged children and teens appear to need at least 9 hours of sleep a night.

Most adults need 7-8 hours of sleep each night to be at their best throughout the following working day.

Both the quality and quantity of sleep are determined largely by the timing of sleep in the 24-hour day. Humans have evolved to sleep during the night and to be active during the day.

Sleep cycles and sleep structure

Sleep varies through the night; that is, it cycles through different stages identifiable by distinctive brain wave patterns. The various sleep stages follow each other in a continuous cycle that lasts between 90 and 120 minutes. Each cycle is composed of five sleep stages.

Stage 1 is where we fall asleep. During this stage, you may occasionally experience muscle twitches or starts.
Stage 2 is a light sleep stage, when you are easily awakened.

Stages 3 and 4 are deep sleep stages. These stages are considered those where the body regenerates physically. People are usually difficult to waken during these stages.

The fifth and final stage is known as REM sleep, for rapid eye movement. If you were to observe a person in this stage of sleep, you would notice their eyes moving under their eyelids, and possibly some muscle twitches. This is the stage of sleep when we dream.

REM sleep is important for learning because memory consolidation occurs. REM sleep is also important for mental health. Recent evidence suggests that the REM sleep stage, along with the deep sleep stages, also contributes to physical restoration.

Early in the night, we spend more time in stages 3 and 4 of each sleep cycle. As the night progresses, we spend more relative time in REM sleep. Whenever we are sleep deprived, our body will try first to catch up on deep sleep (stages 3 and 4) and REM. A person who is sleep-deprived will quickly fall asleep, and move rapidly from light sleep (stages 1 and 2) to deep slumber (stages 3 and 4).

Figure 3. The human sleep cycle

Can you recall any situations where you have suffered from sleep deprivation? What factors lead to the lack of sleep? What was the impact of sleep loss? How long did it take for you to recover from this sleep deprivation?
**Recovery sleep**

Unwanted sleepiness and fatigue can be considered an annoyance - and a danger under certain circumstances. It can be fatal, for instance, while driving a vehicle or flying an aircraft.

Many strategies have been identified to reduce the likelihood or consequences of fatigue. Some are discussed later in this workbook, such as the use of caffeine or being more aware of what you eat.

More extreme examples include the use of amphetamines and other stimulants. However, such pharmacological strategies are only a temporary fix, no matter how effective they are. At some stage, sleep must be obtained for physical and mental recovery to occur.

The exact amount of sleep that each person needs every 24 hours to perform optimally differs, but in general, it is between 7 and 9 hours. As we get older, the need for sleep does not diminish, even though sleep may prove more difficult to obtain. Most people have a sleep clock that means a natural preference for sleeping between 10 p.m. and 8 a.m. Older people tend to sleep earlier than younger people do, although there will always be exceptions.

Sleep is most valuable if obtained in a single block. However, split sleep, or a number of short sleeps, is better than not getting any sleep at all. A short sleep or nap can provide a powerful boost to alertness. However, it is important to know that napping does not eliminate the need for sleep. There are other considerations relating to napping covered in Section 5.

---

**EXERCISE**

Approximately how many hours of sleep do you get (on average) per day? Do you have just one sleeping period – or do you nap? Is your sleep generally uninterrupted? (i.e., of good quality)

________________________________________________________________________

________________________________________________________________________

How much sleep do you need? That is, is the sleep you actually get enough? Do you think your effectiveness at work would improve if you got more sleep?

________________________________________________________________________

________________________________________________________________________

Does the amount of sleep that you normally get vary with the time of week (e.g. workdays versus weekends) or with the different shifts that you may work? If so, please explain.

________________________________________________________________________

________________________________________________________________________
Aging and sleep

As we get older, it generally becomes more difficult to get to sleep when we want to sleep and to stay asleep. This is particularly true during daytime sleep, but even night-time sleep may prove to be more challenging as we get older. Difficulty falling asleep and shorter sleep duration are not the only age-related changes that make non-traditional hours of work difficult.

Recent research suggests that an aging bladder can contribute to sleep disturbances because it causes you to wake up more often to visit the toilet. Along with other age-related physiological changes, this can cause awakenings that are more frequent across the sleep period. Frequent awakenings can lead to increased sleepiness when you are awake.

Have you noticed any significant changes in sleep patterns, in either yourself or a family member, which appeared to be related to age? If so, what were they?

Insomnia

Insomnia generally refers to a persistent difficulty in falling asleep or staying asleep. Sometimes insomnia can mean sleep is consistently unrefreshing. Insomnia is the most common type of sleep problem - it is thought to affect at least a third of adults at some point in life. Rates of insomnia are even higher in shift workers and people who work non-traditional hours.

Insomnia is usually defined as being transient (lasting up to a week), short-term (lasting up to three months), or chronic (more than three months). Insomnia is not defined by the number of hours of sleep or how long it takes to fall asleep.

Treatments tend to focus on chronic insomnia because most people experience transient or short-term insomnias several times a year. Such acute episodes of insomnia are considered quite normal.

There are many potential contributors to insomnia. These include work hours, life stressors, age, and sleep environment. Treatments may involve changes to schedules, habits, and lifestyle. The use of drug treatments is controversial. In general, drugs are considered appropriate for only transient or short-term insomnia.

Setting up your bedroom

Obtaining adequate sleep can sometimes be a challenge, even in ideal circumstances. From both a biological and social perspective, sleeping during the day can cause the greatest difficulty. This is related to the body’s biological programming to be awake during the day, as well as the fact that it is noisier and brighter during the day. In
addition, you may have more pressures on your time during the day. While some of these things are hard to change, you can set up your bedroom to maximise your chances of getting sleep when you have the opportunity.

Things you can do to your bedroom include:

- Block out as much light as possible. This might involve the use of blackout curtains, roller shutters, heavy blinds, or an inexpensive option such as black plastic.

- Use your bedroom only for sleep, relaxation, and sex. If possible, remove work desks, home offices, computers, and even televisions.

- Control the noise that enters your bedroom. For external sources of noise, this can be done using physical barriers such as roller shutters, double-glazed windows, and insulation. Internal noise might be managed by simply placing a sign on the door when you are sleeping. Unless you are on call, you should also turn down the telephone ring tone so that it does not disturb your sleep.

- Reduce the impact of noise that does enter your bedroom. In addition to the physical barriers listed above, noise can be dampened out in other ways. For example, many people have success using a ‘white noise’ source such as a fan, an air conditioner, a television set on an untuned station, or a relaxing music CD set on “repeat.”

- Ear plugs can be of use if you can sleep with them in. They are especially useful if you are sleeping away from home. Many aviation and industrial workplaces supply foam earplugs, and normally you can buy more solid silicone-based plugs at chemists or sporting goods stores.

- Minimise caffeine and alcohol intake in the hours before bedtime. Caffeine acts as a stimulant and makes you less sleepy. The stimulating effects of caffeine can last up to six hours. In addition, both caffeine and alcohol are diuretics - substances that flush water from your body. Therefore, they make you more likely to wake up to go to the toilet.

- Set up a “thermo-neutral” zone. The body sleeps best when the environmental temperature is between 18 and 24°C. If you are too cold or too hot, your body may wake you up to change its temperature in some way. A thermo-neutral zone is best set up using good placement of the bedroom in the house, good use of insulation, appropriate coverings, and using an air conditioner or heater with a thermostat.

- Try not to become overly anxious if you cannot get to sleep. Most people have days when they cannot sleep. Staying in bed and trying your hardest to get to sleep is unlikely to help, and may even make sleep more difficult. If you cannot sleep within 30 minutes or so, get out of bed and do something relaxing or restfully useful instead of staying in bed and being frustrated.

Establish a pre-bed routine, including quiet/relaxing activities. Each bedtime, do the same activities in the same order. For example, shower, clean your teeth, and lock the door. It does not matter how many things you do, so long as they are always the same and in the same order each time. Such a procedure can help to train your body to associate this sequence of activities with falling asleep.
Are there any improvements you could make to the way your bedroom is set up? What could be done to reduce noise? How could you reduce the chances of disturbance of any sort – at night? – and during the day?

---

Sleepwalking

Sleepwalking (somnambulism) is characterised by complex behavior (such as walking) occurring while asleep, often during the second or third hour of sleep. Sleepwalking activity may include simply sitting up and appearing awake (while actually being asleep) and getting up and walking around. The person is not aware of the activity and normally does not remember it upon waking.

Sleepwalking has been known to include other complex activities such as moving furniture; going to the bathroom; and dressing and undressing. There have been recorded episodes of people driving cars while actually asleep.

While moving about, the sleepwalker’s eyes are fully or partially open. They avoid obstacles, listen when spoken to and usually follow simple commands. If a sleepwalker is wakened by a gentle shake, he or she will normally be surprised to find themselves out of bed. An episode of sleepwalking is usually quite brief (lasting seconds or minutes) but can last for 30 minutes or longer. Sleepwalking occurs during REM sleep.

The causes of sleepwalking are not well understood and limited attention has been given to its treatment in adults.

Sleep apnoea

Sleep apnoea is a breathing-related sleep disorder that can reduce your capacity to stay awake when you are at work, driving, or engaged in other activities.

There are three types of sleep apnoea: central sleep apnoea; obstructive sleep apnoea, and mixed sleep apnoea. During sleep, the brain instructs the muscles of breathing to take a breath. Central sleep apnoea occurs when the brain does not send the signal to the muscles to take a breath, and consequently there is no muscular effort to take a breath.

Obstructive sleep apnoea occurs when the brain sends the signal to the muscles and the muscles make an effort to take a breath, but they are unsuccessful because the airway becomes obstructed and prevents an adequate flow of air. This is the most common form of sleep apnoea in Western society. Mixed sleep apnoea, occurs when there is both central sleep apnoea and obstructive sleep apnoea.

Consult with your doctor if you suspect - or have been told - that you have symptoms suggestive of sleep apnoea. Making choking sounds, stopping regular breathing during your sleep, and waking up with a start and gasping for breath are the ‘classic’ symptoms of sleep apnoea.
Case study

Damien is 51, married and has three grown children. He has spent 18 years working shifts as an aircraft maintenance engineer. He drives 45 minutes each way to work his 12-hour shifts.

Recently, Damien drove off the road on his way home from work at 5:45 a.m. Fortunately, he woke up before hitting any solid objects. Although it is normal for Damien to be tired after working a night shift, it was the fourth time in the past six months that he has dozed off while commuting home and this time it scared him. He stopped the vehicle, and walked around outside in the cool air before he continued home.

Although Damien had been avoiding talking to his doctor about a possible sleep disorder, the latest incident was the trigger for him to make an appointment. His wife, Tonia, has been telling him for nearly two years to do something because his stories about nearly falling asleep at work or on the way home from work concerned her. Damien thought he could avoid an accident, but now realises that he could hurt himself or others if he does not get help.

Knowledge Check

- On average how many hours of sleep should you ideally get each night?
- How can ‘white noise’ aid sleep?
- What room temperature range is most suitable for promoting sleep for most people?
- Explain the potential positive effects of a pre-bedtime routine.
- With respect to the case study above, how could Damien seek to improve his sleep?
- What options does Damien have for support with his sleep problem?
5. Napping

Intended learning outcomes

After reading through this section, you should be able to:

- Discuss the benefits of napping.
- Describe the short-term way that sleep inertia may compromise the benefits of a nap.

The benefits of napping

Short sleeps or naps can deliver many of the benefits of longer sleeps over a shorter period. These benefits can include improved short-term memory, increased performance, improved alertness, and improved reaction time. However, the benefits of naps do not generally last as long as the benefits gained from longer sleeps.

There is a lack of consensus in the literature as to how a nap is defined. A nap is defined here as any sleep of up to three hours in duration. A ‘short sleep’ is considered a sleeping period between three and five hours.

Naps as short as 10 to 15 minutes are known to deliver measurable benefits. In general, the longer the nap is, the more beneficial it will be in terms of recovery and improvements in performance. Naps shorter than 10 minutes are not thought to be beneficial.

Some research suggests that the time of day you take a nap also affects its recovery value. Other research suggests that this is not the case when fatigue is significant and that getting any sleep is much more important than the time the nap is taken. It is recommended that you take naps in the way that you believe best suits you. An understanding of research findings in this area (see following page) may nevertheless be useful. Keep in mind that a nap can negatively affect your chances of sleeping later that day or night.

One of the main impediments to napping in the workplace is the organisation’s attitude to such behaviour. Irrespective of the effectiveness of napping to reduce the adverse effects of fatigue, and the need to be alert in certain work roles in order to ensure safety, some organisations do not accept that napping is appropriate at work.

Is napping permitted in your workplace? If yes, under what circumstances? If not, how could you attempt to introduce it?
Key Points for a Napping Policy
Adapted from: L. R. Hartley et al., A Napping Policy to Prevent Commercial Truck Driver Fatigue, 2000

- A nap is a supplement to the main sleep when main sleep is insufficient or when extended operations are required.
- Naps which are aimed at preventing fatigue (preventative naps or ‘operational maintenance’ naps) generally are more effective at maintaining performance than are naps which occur when the operator is already fatigued (recovery naps).
- Fatigue is a foreseeable hazard - and naps are an effective way of helping to control fatigue.
- A napping policy should not be used to extend schedules beyond legitimate limits, but should promote safer operations.
- Napping should be encouraged to be a planned activity of fatigue prevention.
- A nap is of greatest benefit if taken before dangerous drowsiness occurs.
- Naps are helpful in maintaining performance if sufficient longer sleep is occasionally missed.
- Naps are helpful in maintaining performance if the normal work period has to be extended.
- At least fifteen minutes should be allowed after awakening from a nap to recover alertness before commencing duty.
- Where possible, naps should coincide with natural drowsiness in the afternoon (1 p.m. to 4 p.m.) or between 1 a.m. and pre-dawn if on night shift.
- An occasional nap of 45 minutes should be adequate to prevent fatigue developing (Note: this may not be effective for aviation operations where numerous fatigue factors co-exist).
- Napping policies should also promote information on diet, fitness, and alcohol and other drugs.
- Naps require special conditions to be of optimal benefit (if possible, provide dark, quiet conditions, in a comfortable temperature and with good ventilation).

Is napping a strategy that you could benefit from? If so, how could you apply it?
Sleep inertia

While both long sleep periods and napping are highly beneficial for a wide range of reasons, it is important to understand that your performance and alertness may be impaired for a while after you wake up. Most people experience a period of confusion when they wake or are awakened from sleep. This state is known as sleep inertia and generally lasts between 5 and 20 minutes. You should minimise activities that would be sensitive to sleep inertia (such as driving) for at least 20 minutes after waking up.

Exactly how long sleep inertia lasts depends on a number of factors. There is no effective way to eliminate or reduce the effects of sleep inertia.

Sleep inertia tends to last longer when you:

- are woken up - as opposed to waking naturally from sleep;
- wake up, or are woken up, from deep sleep compared to light sleep;
- wake up or are woken up at the low point of the circadian cycle (generally between midnight and dawn); and
- wake up or are woken up after a nap following a period of sleep deprivation.

Knowledge Check

- Name two benefits of napping.
- A napping policy should not be used to…?
- When is a nap of greatest benefit?
- Explain what sleep inertia is.
Case study

Businesses waking up to the benefits of napping
Tell your boss: A quick bit of sleep can actually make you more productive
Jascha Hoffman
Bloomberg Business Week, 9 June 2010
http://www.msnbc.msn.com/id/38907276/ns/business-bloomberg_businessweek/

From Thomas Edison and Winston Churchill to Bill Clinton and George Costanza, the nap has had many famous champions. And with good reason. Ever since sleep scientist David Dinges helped found the modern science of napping in the early ’80s at the University of Pennsylvania School of Medicine, short periods of sleep have been shown to improve alertness, memory, motor skills, decision-making, and mood. All while cutting down on stress, carelessness, and even heart disease.

With Americans averaging fewer than seven hours of sleep per night — and around 20 percent suffering from sleepiness during the day, according to a recent Stanford University study — many companies have turned to the humble nap in an attempt to stave off billions in lost productivity each year. Following the rise of workplace perks like lactation rooms, gyms, and child-care facilities, Nike workers now have access to nap-friendly “quiet rooms” that can also be used for meditation. Google, a forerunner in employee perks, has a number of futuristic napping pods scattered throughout its Mountain View campus.

Jawa, a small mobile technology company in Scottsdale, Ariz., has two resting rooms — one with a similar pod, the other with an old-fashioned couch—that are popular among programmers working long hours. Many airlines, including Continental and British Airways, allow pilots to sleep during long international flights while colleagues take over the controls. (The practice is prohibited for domestic flights by the Federal Aviation Administration.) Other companies, such as Ben & Jerry’s, have no official policy but provide unofficial space for the practice and don’t bat an eye when someone spends an extra half hour snoozing in the massage room. “If you have employees working 16-hour days, you want to give them an opportunity to take a power nap,” says Melissa Gierginger, a spokeswoman for Jawa.

"Over the last few years, there’s been a lot of focus on exercise and nutrition, but adequate sleep is arguably the most important element of productivity,” says Christopher Lindholst, co-founder of MetroNaps, which markets a napping chair called the EnergyPod to such companies as Google, Procter & Gamble, and Cisco Systems.

"Tiny naps are much more refreshing than people tend to realize," said Jim Horne, director of the Sleep Research Centre at Loughborough University in England. "A short nap in the afternoon will get rid of sleepiness without interfering with nighttime sleep." That said, it’s best not to depend on napping as a permanent replacement for lost sleep. "On occasion it will get you over the hump, but whether it gets you back to peak is an open question,” says Dr. Roger Rosa, a senior scientist at the National Institute for Occupational Safety and Health.
6. Food

Intended learning outcomes

After reading through this section, you should be able to:

- Describe what the glycaemic index means.
- Distinguish high, intermediate, and low glycaemic-index foods.
- Explain the impact of these foods on alertness.
- Explain how digestion and hunger are affected by non-traditional hours of work.

Food and fatigue

As discussed elsewhere in this workbook, the ability to stay awake is related largely to whether you have had adequate rest and recovery. However, other factors may contribute to feeling weary, sluggish, and more tired in general. One of these is low blood sugar. Many people underestimate or are unaware of the effect of low blood sugar on their ability to stay alert and safe.

Digestion and hunger

As humans, we are programmed to be awake during the day and asleep at night. Many other processes also follow this pattern, including digestion. Digestion is programmed to be most efficient during the day and much less so at night. This is because digestive juices (stomach acids and enzymes) are mainly secreted during the day.

Food eaten at night is digested at a slower rate. This can often lead to feeling bloated or constipated and can cause heartburn and indigestion. Gastrointestinal upsets are very common in people who eat outside of traditional meal times. These upsets can be made worse by drinking tea, coffee, or alcohol. Research has found that night workers are five times more likely to get peptic ulcers than day workers are.

Many people working outside traditional daytime hours also notice that their hunger patterns change and that they get hungry at unexpected times of the day.

Controlling blood sugar with food

Given that non-traditional hours of work affect digestion and hunger, it is not surprising that it is difficult to keep your blood sugar stable under such circumstances. A stable blood sugar level is an important ally in minimising changes in energy levels that are common for shift workers.

The belief that snacks loaded with sugar cause a fast rise and fall in blood sugar has been disproved recently. The way blood sugar levels react to different foods is known as the glycaemic index (GI) of foods.
High GI foods make your blood sugar levels rise and fall quickly, whereas low GI foods make your blood sugar level change more slowly. High GI foods are ideal when you have been doing physical work or exercise and need energy quickly to recover.

Low GI foods are ideal to keep an already stable blood sugar level from becoming too high or low. Low GI foods are also ideal for raising blood sugar slowly and avoiding the fast drop in blood sugar (and energy) that can occur after eating high GI foods. Low GI foods are ideal as regular snacks across a shift to help avoid big changes in your energy levels.

Research into GI foods also holds important implications for people with diabetes. In general, medical practitioners recommend that diabetics avoid high GI foods to help regulate blood sugar levels. However, high GI foods can be useful as a pick-me-up for non-diabetics, particularly after physical work or exercise. More often than not, however, low GI foods will be more useful in your day-to-day life.

Examples of low, intermediate and high GI foods are provided in the following table. There is surprising variation across different published GI tables, so don’t be surprised if one source states that a particular food is high GI, while another suggests it is intermediate.

<table>
<thead>
<tr>
<th>Examples of high GI foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>White or whole grain bread</td>
</tr>
<tr>
<td>Cornflakes or Coco Pops</td>
</tr>
<tr>
<td>Doughnuts</td>
</tr>
<tr>
<td>Muffins</td>
</tr>
<tr>
<td>White or quick brown rice</td>
</tr>
<tr>
<td>French fries</td>
</tr>
<tr>
<td>Rice crackers</td>
</tr>
<tr>
<td>Puffed corn or rice cakes</td>
</tr>
<tr>
<td>Baked or mashed potato</td>
</tr>
<tr>
<td>Cakes</td>
</tr>
<tr>
<td>Breakfast bars</td>
</tr>
<tr>
<td>Pancakes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of intermediate GI foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
</tr>
<tr>
<td>Basmati rice</td>
</tr>
<tr>
<td>Rye or high-fibre bread</td>
</tr>
<tr>
<td>Full-fat ice cream</td>
</tr>
<tr>
<td>Sugar</td>
</tr>
<tr>
<td>Pineapple</td>
</tr>
<tr>
<td>Weetabix</td>
</tr>
<tr>
<td>Flavoured milk drinks</td>
</tr>
<tr>
<td>Sweet corn</td>
</tr>
<tr>
<td>Soft drinks</td>
</tr>
<tr>
<td>Cookies</td>
</tr>
<tr>
<td>Cranberry juice</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of low GI foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oranges or orange juice</td>
</tr>
<tr>
<td>Baked beans</td>
</tr>
<tr>
<td>Fruit bread</td>
</tr>
<tr>
<td>All bran, porridge, muesli</td>
</tr>
<tr>
<td>Low-fat yogurt</td>
</tr>
<tr>
<td>Lentils</td>
</tr>
<tr>
<td>Chocolate</td>
</tr>
<tr>
<td>Peanuts or cashews</td>
</tr>
<tr>
<td>Noodles or pasta</td>
</tr>
<tr>
<td>Apples or apple juice</td>
</tr>
<tr>
<td>Grapes</td>
</tr>
<tr>
<td>Oat bran or grain bread</td>
</tr>
</tbody>
</table>

**Table 1. Grouping common foods by glycaemic index**
Low-fat protein strategies

Research also suggests another diet strategy for shift workers: consuming low-fat protein foods can help you stay awake. This is due to a process involving the amino acid tyrosine and leads to increases in the levels of stimulating chemicals in your body.

Low-fat, high protein food selections can be found quite easily in supermarkets these days via nutrition labelling. High-protein foods are also good for health, as they offer essential nutrients for strength and growth. Choosing both low-fat and high-protein foods is wise for a healthy diet.

Fish, poultry and leaner cuts of red meats are examples of low-fat protein sources. Vegetable sources of protein include beans, lentils and greens like broccoli and peas.

What type of GI foods do you normally consume at work or before work: high, intermediate, or low? Give examples.

Are there any food changes you should consider, based on what you now know about the GI of foods? If so, what are they?

Evaluate your current diet

It is likely that at least some of the information in this section is new to you. You may have picked up some fresh strategies. Try things for a while and see how they work for you. Keep in mind that you are more likely to notice a difference using these strategies if you apply them when you are tired.

It is also important to maintain a balanced diet. In general, the evidence suggests that a low-fat diet comprised mainly of low and intermediate GI foods along with some good quality protein is most beneficial. Eat in moderation.

In addition, it is important to consider the level of fibre in your diet (from fresh fruit and vegetables) as well as the levels of minerals and salt.

The recommended daily salt intake is 3.8 grams per day (about half a teaspoon) to replace the amount lost daily through perspiration and to ensure your diet provides sufficient amounts of other essential nutrients. Extra salt above the recommended daily requirement can result in high blood pressure, which can lead to stroke, heart disease, or kidney disease.
Case study

Jeff is a 58-year-old maintenance engineer who has been working in the aviation industry since he was 16 years old. His three children are grown up and have their own homes and families. Jeff and his girlfriend Lisa have been together for seven years.

Lisa prepares Jeff’s meals. When he has a night shift, afternoon shift or an early morning shift, she packs whatever they would have eaten had they been together. Jeff cooks his meals in the kitchen at work and often prepares steak and eggs, reheats meatloaf, or roasts pork chops. This is the way things were before Lisa was around, and this is the way they have stayed.

The problem is that in the last few years, Jeff has been getting bad stomach pains whenever he eats a heavy meal on the night shift. Jeff has only a few more years until he plans to retire and he does not want to change the way he does things now. Jeff’s doctor has been saying that the pains are associated with the type of food that he eats on nights, but Jeff thinks he will be okay.

Jeff actually had a serious case of peptic ulcer. It is unfortunate that Jeff does not listen to his doctor because ulcers can be treated quite easily with diet changes and short-term daily medication.

Knowledge Check

- Why might Jeff experience stomach problems after eating a heavy meal on the night shift?
- What changes might Jeff make to his diet to help reduce his stomach problems?
- Why are low GI foods generally appropriate when working night shifts?
- What effect does a stable blood sugar have on energy levels?
7. Hydration

Intended learning outcomes

After reading through this section, you should be able to:

- Describe the general functions of sleep.
- Explain why being hydrated is important for alertness.
- Name four factors that contribute to dehydration.
- Determine whether you are drinking enough water each day to stay hydrated.

Can hydration affect alertness?

As mentioned earlier in this workbook, it is not just sleep that affects your alertness. Examples have been provided related to digestion and food. Similarly, hydration has an effect on your ability to feel alert and therefore to be safe.

When your body is low on water, it tries to conserve what you have left. It does this by reducing your activity and making you relax and slow down. When you are relaxed, you have a higher chance of falling asleep. Being dehydrated can also make you feel light-headed and cause headaches.

Most people do not drink enough water to be fully hydrated. In extreme cases, this can result in medical problems, including kidney problems. In most cases, however, the effects of dehydration are short-term and are easily resolved by drinking more water.

Contributors to dehydration

The recommended daily intake of water is two litres or eight glasses (although the science supporting this advice remains obscure). Drinking less than this is likely to contribute to dehydration. Other factors can cause dehydration, even if your daily intake of water is adequate. Some of these factors include:

- Performing physically demanding tasks.
- Working in hot environments.
- Drinking many caffeinated drinks - caffeine is a diuretic - a substance that actively flushes water from your body.
- Drinking alcohol, which is also a diuretic.
- Drinking soft drinks, which may not provide the same degree of hydration as plain water.
- Eating foods that are high in salt, which require additional water to be processed through the body.
Another problem can be the availability of water in the workplace. For example, many employees who drive vehicles for a living do not have access to water – especially cold water – unless they bring it with them.

To be as alert and awake as possible, you need to monitor your fluid intake. For some people, optimising their alertness by being fully hydrated might mean doubling their normal fluid intake - or more. Surprisingly, many people find that when they drink more water they feel more alert but do not necessarily go to the toilet any more often - their urine output is simply higher each time.

What sort of fluids do you drink at work?

________________________________________

________________________________________

________________________________________

Approximately how much water do you drink at work? How much other fluids?

________________________________________

________________________________________

________________________________________

Based on what you have just read, do you think you need to make any changes in your fluid-intake habits? Provide details.

________________________________________

________________________________________

________________________________________
Case study

Terry is a 52-year-old pilot who has been flying for 24 years. He flies 90 to 100 hours per month at all hours of the day. He has recently noticed that he gets more tired than he used to when doing longer-duration flights.

A while ago, a friend suggested that drinking water might help him feel more alert while flying. She also recommended that he think more about when he drinks coffee and alcohol – and how much of these fluids he consumes.

Terry heeded this advice. He now only drinks coffee when he is really tired. This way he reduces his dehydration from caffeine but still gets its stimulating benefits. Terry also drinks more water and thankfully doesn’t seem to need to go to the toilet any more frequently. Although he was initially sceptical that such simple changes would have any real effect, Terry reports that he does feel more alert.

Knowledge Check

- Why might Terry have to go to the toilet more frequently when he drinks caffeinated drinks?
- What effects do alcohol and caffeine have on water in the body?
- How does water affect alertness?
- On average, what is the recommended minimum amount of water you should drink every day?
8. Caffeine and other Stimulants

Intended learning outcomes

After reading through this section, you should be able to:

- Explain the effect of caffeine on bodily functions.
- Understand the effect of caffeine on alertness.
- Discuss the effect of caffeine on sleep.
- Name symptoms of caffeine withdrawal.

What is caffeine?

Caffeine is an addictive drug. You may be addicted to caffeine if you feel you cannot function without it and need to consume it every day. Caffeine occurs naturally in many plants including coffee beans, tea leaves, and cocoa nuts. It is also found in an array of food products and beverages such as chocolate and cola drinks.

If you drink caffeinated beverages, you are probably aware that caffeine perks you up. If you are low on sleep and need to remain active, caffeine can make you feel alert by blocking adenosine reception. Adenosine causes blood vessels to dilate and nerve cell activity to slow down, causing drowsiness. After drinking coffee, you may notice that your hands get colder, your muscles tense, you feel excited, and your heart beats faster.

It takes caffeine about 15 – 30 minutes to enter your system, and its physiological effects peak after about an hour after the drug reaches the bloodstream. The intake of caffeine can be speeded up with more direct forms of ingestion, such as caffeine-impregnated chewing gum.

The effects of caffeine usually last for approximately five hours. This is why you should avoid having your last caffeinated drink too close to bedtime. The stimulant effect may reduce your chance of falling asleep.

The advantages of caffeine include:

- nearly everyone has personal experience with using caffeine;
- it is not a restricted substance;
- it does not interfere with recovery sleep following sleep deprivation; and
- it has low abuse potential.
The downside of caffeine

Many people consciously use caffeine as a alertness tool – a mental and physical ‘pick me up.’ The often-reported instant surge of alertness and energy from the ingestion of caffeine is probably largely placebo (an expectation effect). Any perceived change immediately after ingesting caffeine is likely to be psychological.

We noted above that caffeine takes some time (15-30 minutes) to enter the bloodstream and even longer (about an hour) after that for its effects to peak. Nevertheless, some people are adamant that they can feel the effects of a coffee instantaneously.

One reason for reported elevations in mood and energy levels may be related to the social and psychological aspects of preparing a cup of coffee or tea. Making or getting a coffee necessitates a break in work, and movement to the preparation/purchasing area and perhaps another area for ingestion. These activities often will be associated with social interaction. It may be that these coincidental characteristics of making and drinking a beverage are responsible for the reported immediate effects of caffeine ingestion.

Another theory gaining research support is that the caffeine surge effect is actually related to substance dependence. When addiction to any drug occurs, the body will manifest all sorts of discomforting reactions unless the drug is regularly ingested. Caffeine is such. The reported surge effect actually may be the body responding to caffeine whilst in a state of substance withdrawal.

A disconcerting message from recent research is that if you are a regular user of caffeine, you may actually require it for your brain to function normally. Such drug dependence clearly is not desirable in personnel who are in safety-sensitive or safety-critical occupations, particularly aircrew and other aviation industry personnel.

This lowered performance from the effects of addiction may also explain why some researchers believe that caffeine is not an effective alertness management tool in people who normally ingest three or more cups of coffee each day. These people need coffee just to get back to baseline mental performance levels. On the other hand, a light or non-caffeine user may benefit from as little as 20 mg of caffeine if alertness management is the goal.

Health authorities have suggested that more than six cups of coffee (or an equivalent caffeine source) can puts one’s health at risk. These risks include increased likelihood of osteoporosis (abnormal loss of bony tissue resulting in fragile porous bones) and anaemia (lack of red blood cells and haemoglobin) - because caffeine actively works against the absorption of calcium and iron.

There have been suggestions that high levels of caffeine consumption can impair memory. Not surprisingly, caffeine is also linked to insomnia. High intake of coffee during pregnancy is thought to increase the risk of miscarriage by as much as one third.

The strategic use of caffeine

Most people do not use caffeine as effectively as they could. They tend to drink coffee and tea when they are not really tired, which means the stimulating effect doesn’t have much impact. Regular caffeine consumption leads to increased tolerance, which means that over time we get less effect from the same quantity. When you have a high tolerance to caffeine, drinking one or two cups when you are tired may make little difference to your alertness.
People who are addicted to caffeine often experience withdrawal effects when they stop drinking it. These include a dull headache that lasts from one to five days, irritability, nervousness, restlessness, and sleepiness. In extreme cases, nausea and vomiting have been reported.

To use caffeine more effectively, start by being strategic about when you drink it. Here are a number of tips on how to use caffeine to its best advantage:

- Avoid drinking caffeinated drinks when you are not tired. The caffeine will have little effect and will contribute to increasing your caffeine tolerance. Your body will get used to having it and, over time, you will need to drink more to get the same effect.
- Avoid drinking caffeinated drinks in the morning. The early part of the day is a time when your body is waking up naturally and you normally will feel more awake as the morning progresses without any need to ingest caffeine.
- Ingesting large amounts of coffee first thing in the morning can exacerbate the effects of the early afternoon circadian dip when most people feel a period of tiredness. This is because caffeine has a half-life of about six to seven hours. Therefore drinking a large amount of caffeine at six or seven o'clock in the morning means that the alerting effects will decline from about midday.
- Using caffeine to speed up the natural morning waking process may simply increase your tolerance to the drug. One exception may be if you have to get up unusually early in the morning – well before dawn – when the body is still in the circadian trough (the lowest ebb of alertness).
- Avoid caffeinated products for a few hours before bedtime (normally at least two hours, but for some people the optimum abstinence period might be as much as six hours). As previously noted, caffeine acts as a stimulant, and therefore can make falling asleep and staying asleep more difficult.
- Be aware that caffeine ingested as a fluid usually takes at least 15 to 30 minutes to enter the system and to take effect; noticeable effects normally last approximately 5 hours for most people.
- Be mindful of how much caffeine is in different foods and drinks (see following table).
- If you do drink caffeinated drinks, it has been recommended that you increase your water intake to counter caffeine’s diuretic effect (i.e., an elevated fluid loss due to increased urination). You may have noticed that you need to urinate more frequently when you drink caffeinated drinks.
- Most importantly, be strategic: the less caffeine you drink, the more effective it will be when you need to use it to help you stay awake.
<table>
<thead>
<tr>
<th>Item</th>
<th>Average (mg)</th>
<th>Range (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Espresso coffee (standard cup)</td>
<td>240</td>
<td>180-300</td>
</tr>
<tr>
<td>Brewed coffee</td>
<td>120</td>
<td>90-150</td>
</tr>
<tr>
<td>Percolated coffee</td>
<td>90</td>
<td>64-124</td>
</tr>
<tr>
<td>Instant coffee</td>
<td>75</td>
<td>30-120</td>
</tr>
<tr>
<td>Decaffeinated coffee</td>
<td>3</td>
<td>1-5</td>
</tr>
<tr>
<td>Black tea – brewed 1 minute</td>
<td>21</td>
<td>9-33</td>
</tr>
<tr>
<td>Black tea - brewed 3 minutes</td>
<td>33</td>
<td>20-46</td>
</tr>
<tr>
<td>Green tea</td>
<td>12</td>
<td>5-18</td>
</tr>
<tr>
<td>Cola-type soft drink (250 ml can)</td>
<td>40</td>
<td>32-50</td>
</tr>
<tr>
<td>Energy drinks (e.g., 250 ml red bull)</td>
<td>90</td>
<td>80-100</td>
</tr>
<tr>
<td>Milk chocolate (50g)</td>
<td>11</td>
<td>2-28</td>
</tr>
<tr>
<td>Dark chocolate (50g)</td>
<td>38</td>
<td>10-65</td>
</tr>
<tr>
<td>Chocolate-covered coffee beans (50g)</td>
<td>550</td>
<td>n/a</td>
</tr>
<tr>
<td>Chocolate milk (carton)</td>
<td>5</td>
<td>2-7</td>
</tr>
<tr>
<td>Medication forms (e.g., NoDoz) – per regular strength tablet</td>
<td>100</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Table 2. Caffeine content of common substances

Note: Figures on caffeine content vary considerably across different sources. The figures given in the table reflect some averaging across these sources.

Any deliberate use of caffeine as an alertness management tool for aviation industry personnel should be properly planned to avoid misuse and/or health risks.

If caffeine is being relied upon to prevent the decline of alertness in a normal working day, it is likely that there is something wrong with your health or your sleep. Sleep and naps should take priority over pharmacological approaches to alertness management, even if the pharmacological approach is the humble cup of coffee.

For those who prefer ingesting caffeine in solid form you should note that dark chocolate holds three times the amount of caffeine as milk chocolate. However, you would have to eat more than 250 grams of dark chocolate to get the equivalent caffeine that is in one large cup of coffee.
Review your caffeine intake. Are there any changes you could make to the way you use caffeine on the job?

Knowledge Check

- Why does caffeine lose its ability to improve your alertness if you drink caffeinated drinks regularly?
- Provide three tips you can apply to get the maximum benefit from caffeine as a stimulant.
9. Alcohol

Intended learning outcomes

After reading through this section, you should be able to:

- Discuss the effects alcohol has on alertness.
- Discuss the effects alcohol has on sleep.
- Explain how alcohol consumption affects performance.

What is alcohol?

In order to be well rested and fit for work, you need to understand how alcohol works and how it influences sleep and alertness. At moderate and high levels of intoxication, alcohol significantly impairs performance. Alcohol intoxication greatly affects the way you respond and interact with your environment and increases your risk of having an accident.

In many industrialised countries, workplaces require a zero blood alcohol concentration (BAC) for their employees. Although in most working environments employers cannot tell employees how much alcohol they are allowed to consume away from work, one exception occurs in the Australian Civil Aviation Regulations, which demand that aircrew not drink alcoholic beverages within eight hours of flying.

Alcohol is the second most widely consumed drug after caffeine. Alcohol is legal in most countries and is so common that it is easy to forget that it is a drug and that it can be dangerous if not used sensibly.

The effects of alcohol

Alcohol is a central nervous system depressant. In small doses, it can make you feel more relaxed and less inhibited. In larger doses, it makes you drunk and impaired.

Alcohol reduces:

- environmental awareness;
- responses to sensory stimulation;
- mental functioning; and
- physical activity.

In high doses, alcohol can produce:

- increased drowsiness;
- lethargy (lack of energy);
• amnesia (memory loss);
• anaesthesia (loss of sensations); and
• semi-consciousness that may lead to loss of consciousness.

Alcohol intoxication is one of the major causes of road accidents. Most countries have laws restricting people with a BAC above a certain level from driving, working, or operating dangerous equipment. In Australia, a BAC of 0.05% or higher means that driving is prohibited. Many activities in the aviation field have ‘zero alcohol tolerance’ and may specify mandatory periods of pre-shift abstinence.

There are also serious health consequences related to the long-term abuse of alcohol. These problems include alcoholism, cardiovascular disease, abnormalities in the absorption of food nutrients, chronic pancreatitis, liver disease, brain damage, and cancer. Sustained alcohol abuse is also associated with interpersonal, financial and employment problems.

Alcohol and accident risk

Table 3 provides details of the effects of different ranges of blood alcohol concentration. Alcohol progressively impairs your ability to perform and dramatically increases the risk of accidents. For example, with respect to driving:

- At a BAC of 0.05 to 0.08%, there is a four-fold increase in the risk of a motor vehicle accident.
- At a BAC of 0.10 to 0.14%, there is a six- to-seven-fold increase in accident risk.
- At a BAC of 0.15% and higher, there is a 25-fold increase in accident risk.

In Australia, alcohol is the most significant contributing factor in:

- about a third of road accidents;
- nearly half of fire injuries;
- over a third of falls and drownings; and
- one in ten industrial accidents.

A standard drink

Alcohol concentration is usually expressed as alcohol “proof.” Proof means twice the percentage of alcohol. So, if a drink is referred to as 80 proof this means it contains 40% alcohol.

The labels on alcoholic drink bottles and cans show the number of standard drinks they contain. A standard drink contains about 10 grams of pure alcohol. See the figure Standard Drink Equivalents for examples of how alcohol volumes for different drinks are standardised.
Hotels and restaurants usually serve alcohol in standard drink size glasses, although there are differences across states in Australia. In addition, wine may be sold in 140 mL or 200 mL glasses. A 200 mL glass of wine contains approximately two standard drinks. It is worth noting that glasses used at home are unlikely to be standard drink size – they are often larger.

**Figure 4. Standard drink equivalents**

### Metabolising alcohol

On average, a person can metabolise 7 to 10 grams of alcohol per hour. This is about the same as clearing two-thirds of the alcohol in a standard drink from the body through the liver, sweat, breath, and urine.

If you consume more alcohol in an hour than you are able to metabolise, your blood alcohol concentration will increase.

### Australian guidelines

The Australian guidelines for low-risk drinking have changed recently. There are now just four guidelines:

- Reduce the risk of alcohol-related harm over a lifetime by drinking no more than two standard drinks on any day (for both men and women).
- Reduce the risk of injury on a single occasion of drinking by drinking no more than four standard drinks on a single occasion.
• For children and young people under 18 years of age, no drinking alcohol is the safest option.

• For women who are pregnant, planning a pregnancy, or breastfeeding, not drinking alcohol is the safest option.

**Alcohol and performance**

Drinking alcohol can lead to increased sleepiness and reduced alertness, even after the alcohol is no longer detectable. This effect is commonly known as a hangover. Alcohol intoxication significantly impairs performance, as previously mentioned.

Intoxication tends to lead to overly optimistic assessments of ability, which in turn, can lead to error and performance failures. The costs associated with alcohol abuse in the workplace include:

• increased number of accidents causing injury;
• increased absenteeism or lateness;
• reduced productivity;
• frequent stoppages;
• lower quality work; and
• equipment damage.

**The persistent effects of alcohol**

An emphasis on blood alcohol level in determining fitness for work has masked a vital issue about alcohol use: its lingering impact on performance, even after BAC has returned to zero. The persistent effects of alcohol can result in marked impairment of performance for reasons including dehydration, hypoglycaemia, gastrointestinal upset and disturbances in the vestibular system.

The alcohol-related reduction in performance after BAC returns to zero is known as ‘post-alcohol impairment.’ Many people, including members of the aviation community, are not aware of the enduring effects that alcohol can have on performance.

Recent studies have indicated that pilot performance can be measurably impaired for at least 8 to 14 hours after last alcohol ingestion. These performance deficits are apparent across a range of psychomotor and mental abilities, and include slowed reaction time, lowered vigilance, difficulties processing radio communications, disruptions to the formation of new memories, and impaired judgement in activities such as determining angle of bank and rate of turn. Of particular relevance to aircrew is that vestibular illusions (for instance, the ‘G-excess’ illusion) are known to be more pronounced if alcohol has been consumed.

Several of the deficits listed above have implications for performance across the aviation capability, including maintenance tasks and air traffic management.
### Table 3. Blood alcohol concentrations, stages, and relative effects

<table>
<thead>
<tr>
<th>Blood Alcohol Concentration</th>
<th>Stages</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 0.05%</td>
<td>Feeling of well being</td>
<td>Talkative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relaxed</td>
</tr>
<tr>
<td>Above 0.05% to 0.08%</td>
<td>Risk state</td>
<td>Judgment affected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mood affected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intense high or low moods</td>
</tr>
<tr>
<td>Above 0.08% to 0.15%</td>
<td>Dangerous state</td>
<td>Slow speech</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unstable balance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blurred vision</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vomiting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sleepiness</td>
</tr>
<tr>
<td>0.20% to 0.40%</td>
<td>Drunken stupor</td>
<td>Heavy sedation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No bladder control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coma</td>
</tr>
<tr>
<td>0.45% to 0.60%</td>
<td>Shock/Death</td>
<td>Shock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Death</td>
</tr>
</tbody>
</table>

**Knowledge Check**

- Describe three ways sleep can be affected when you have more than four standard drinks before going to bed.
- Name four effects alcohol has on the body.
- How does alcohol affect the risk of accidents?
- What is ‘post-alcohol impairment’? How long can it persist after consuming alcohol?
10. Nicotine

Intended learning outcomes

After reading through this section, you should be able to:

- Discuss the effects of nicotine on alertness.
- Discuss the effects of nicotine on sleep.
- Name symptoms of nicotine withdrawal.

What is nicotine?

Nicotine is a stimulant found in the leaves of the tobacco plant. Tobacco has been smoked or chewed for centuries. Nicotine stimulates respiration and heart rate and depresses appetite by activating nicotine-sensitive nerve receptors. In small doses, it wakes you up and gives you a high by exciting the central nervous system.

Nicotine is highly addictive and the dangers to health have been well documented. Smoking cigarettes increases the chances of heart and lung disease, gum disease, numerous cancers, poor circulation and literally dozens of other health problems. Smoking complicates a range of medical conditions, including asthma, tuberculosis and pneumonia. Most smokers are less fit than non-smokers are.

Cigarettes contain 1 to 20 mg of nicotine (depending on the brand and strength). The effect of nicotine mostly dissipates after 60 minutes. Nicotine readily diffuses through skin (patches), lungs (smoke), and mucous membranes such as the gums and the lining of the nose.

The most common and quickest way for nicotine to enter the body is through the lungs. Nicotine moves to the small blood vessels, then to the brain, and finally to the rest of the body. Once it has reached the brain, it is responsible for the “good” feelings that smokers experience.

People usually keep smoking to maintain a constant level of nicotine in their bodies. The number of cigarettes it takes to do this varies from person to person because different people metabolise nicotine at different rates. People also have varying degrees of tolerance to and dependence on nicotine.

Nicotine withdrawal

Nicotine withdrawal can begin to occur during a single night, making it difficult to fall asleep and stay asleep. Nicotine withdrawal may also contribute to distressing dreams and problems waking up in the morning. This is especially true for heavy smokers.

If you smoke, avoiding nicotine in the evening and at bedtime may help to improve your sleep – if cravings are not too severe. If you quit smoking, you are likely to start sleeping better after 10 days without a cigarette. In heavy smokers, withdrawal symptoms can kick in 20-30 minutes after the last cigarette.
Physical and mental withdrawal symptoms from nicotine may include:

- headaches;
- muscular aches;
- sore gums and tongue;
- impaired concentration;
- low blood pressure;
- lowered heart rate;
- feelings of stress or anxiety; and
- depression and irritability.

Physiological symptoms of withdrawal peak three to four days after quitting but can last up to 10 days. Sleep improves dramatically after withdrawal symptoms have passed.

---

**Knowledge Check**

- Why might heavy smokers wake during the night?
- Name five negative health effects caused by smoking.
11. Medications

Intended learning outcomes

After reading through this section, you should be able to:

- Name problems associated with sleeping pills.
- Explain the difference between prescription and over-the-counter medications.

How drugs work

Drugs are taken into the body through the mouth (ingestion), blood (injection), or nose (inhalation). After they enter the bloodstream, they act on the brain. Drugs are eliminated from the body through the liver and kidneys into the urine.

Drug effects vary not only from person to person; they can also vary for the same person depending on time of day, mood, tiredness, and the amount of food eaten. A person might get drunk on just a few beers one night but be hardly affected by the same amount on another night. Age, gender, and the size of a person also influence the overall impact of drugs and the rate of recovery.

Prescription medications

Some prescription drugs can affect your ability to drive or operate heavy machinery. They may also interact with existing fatigue levels and other drugs (including alcohol), further affecting your performance.

If you take prescription medication, and work in safety-sensitive roles, you should:

- ask your doctor about possible interactions with other drugs;
- ask your doctor about the drug’s effects on performance, such as your ability to drive, fly, and operate machinery and technical equipment;
- tell your supervisor what you are taking so they are aware of your situation (depending on the policies and regulations in your workplace); and
- remember that anaesthetics are prescription drugs that can show a positive result on a screening test - inform your supervisor if you have had an anaesthetic recently.

Prescribed medications that come with a warning not to drive or operate heavy machinery include those for the treatment of:

- blood pressure (angiotensin);
- allergies (antihistamines);
- sleep and anxiety problems (both barbiturates and benzodiazepines);
- depression (monoamine oxidase inhibitors); and
• other mental disorders (notably phenothiazines).

It is wise to always check the advice labels on the packaging of your medication and ask your doctor or pharmacist if you are unsure.

Over-the-counter drugs

Some over-the-counter drugs used for pain relief or colds and flu may increase drowsiness and fatigue-related symptoms. Again, always carefully check the advice labels/directions for use. If you are unsure about the side effects of the drug, talk to your pharmacist.

Some shift workers employees who have difficulty sleeping purchase over-the-counter sleeping pills, herbal remedies or other drugs that are known to induce sleep. For example, some people have used the drowsiness-inducing effects of antihistamines to help the onset of sleep. It is, of course, never sensible to use drugs for purposes for which they were not designed. However, when faced with the frustration of insomnia, people can do some irrational things.

Any substance used to induce sleep, might also cause increased sleepiness the following day. Such drugs should be used prudently and their use limited to no more than two consecutive nights.

There are also over-the-counter drugs that are designed to increase alertness (broadly called stimulants). These medications include caffeine-based tablets or capsules (such as No-Doz) and pseudoephedrine, a decongestant (such as Sudafed). While both can be effective in increasing alertness and decreasing fatigue-related symptoms, they can also have serious side effects. For example, pseudoephedrine can cause increased anxiety levels, heart palpitations, and insomnia. Clearly, such symptoms have the potential to affect safety and work performance. It is recommended that stimulants be used sparingly and always under medical supervision.

Sleeping pills and sedatives

Benzodiazepines are a group of synthetic drugs prescribed by a medical practitioner mostly for the treatment of insomnia and anxiety. Because of their link to sleeping problems, the remainder of this section has a focus on benzodiazepines.

There are many different types of benzodiazepines available. They are taken orally or, more rarely, by injection. Some of the more common drugs in this group are Diazepam (e.g., Valium), Temazepam, Nitrazepam (e.g., Mogadon), Oxazepam (e.g., Serepax), Alprazolam (e.g., Xanax), Clonazepam, and Lorazepam.
Health effects

Benzodiazepines may be legally prescribed by doctors but it is illegal to obtain them under false pretences or to give/sell them to anyone else.

The effects of some benzodiazepines last as little as four to six hours, while others last as long as two to three days. The short-term effects of using benzodiazepines include:

- relaxation, drowsiness, lethargy, fatigue;
- memory impairment (especially short-term memory);
- impairment of motor coordination, thinking and memory (decreased reaction time and increased accident risk);
- staggering, blurred vision, vertigo;
- slurred speech;
- disturbing dreams;
- altered mood (particularly depression or euphoria);
- confusion; and
- sensitivity reactions such as skin rashes.

High doses of benzodiazepines may lead to paradoxical effects such as rage, uncharacteristic behaviour, and peculiar thoughts such as feeling invisible, invulnerable and invincible.

Drug interactions are also a potential hazard. Benzodiazepines exaggerate central nervous system inhibition and have been known to react badly with other depressant drugs (e.g. alcohol, opioids). When doses are large, deaths from respiratory suppression have occurred with these drug combinations.

Due to the tolerance and dependency effects of benzodiazepines, people are generally advised to take them for only short periods. Long-term usage can produce symptoms of:

- lethargy, sleepiness and lack of motivation;
- emotional blunting, depression;
- irritability;
- memory impairment;
- muscle weakness;
- headaches, nausea, weight gain;
- menstrual irregularities, breast engorgement, reduced libido;
- dependence;
- loss of muscle and speech coordination;
- increased appetite; and
- paradoxically.
A dependency on benzodiazepines can be developed after little more than one week of use. A benzodiazepine-dependent person will require higher doses to achieve the same effect. Further, pharmacological dependence means that symptoms of physical withdrawal will occur when use of the drug is stopped. Withdrawal effects can be delayed, with people taking up to a week before they begin to experience them.

Benzodiazepine withdrawal symptoms may last up to a few weeks. The symptoms include:

- headaches;
- nervousness;
- poor appetite;
- disturbed sleep;
- sweating;
- anxiety;
- vomiting;
- muscle spasms;
- depression; and
- flu-like symptoms.

**Performance effects**

In relation to functioning, benzodiazepines can adversely affect the following performance enablers:

- fine motor skills;
- cognitive functioning (particularly memory);
- mood;
- realistic self-appraisal;
- alertness; and
- learning behaviour.

Based on the preceding information, it should be evident why benzodiazepines should not be taken when driving, flying or operating machinery - or in any safety critical situation. This class of drugs impairs the ability to judge whether one is affected physically or mentally.

Benzodiazepine use also has been associated with hangover-type symptoms on waking. Users often report grogginess and drowsiness after wakening. These effects could have implications for work safety.
Chronic use of benzodiazepines can lead to impairment that persists long after you stop taking the drug. However, most users show improvements once they are no longer taking the drug.

**Clearance times**

In general, the time the body takes to clear this type of drug varies between one and seven days depending on the specific drug and dosage. With increasing age, clearance times for long acting benzodiazepines (like Valium) can greatly increase from a few days to a month. For people who abuse benzodiazepines, it may take up to six weeks for their systems to clear.

---

**Knowledge Check**

1. Name three problems associated with sleeping pills.
2. How does age affect the body’s response to drugs?
3. What is the difference between a prescription drug and a non-prescription drug?
4. Name five negative health effects caused by smoking.
12. General Health & Well-being

Intended learning outcomes

After reading through this section, you should be able to:

- List the body systems affected by non-traditional hours of work.
- Explain why shift workers have a higher incidence of certain health problems than day workers.
- Discuss the different facets of well-being and how to foster them.

Many studies have found health-related problems associated with non-traditional hours of work. In general, shift workers report a higher number of health complaints than day workers. Shift workers, especially those on rotating shifts, have a higher incidence of sick leave, a higher rate of visits to workplace clinics, and poorer scores on a variety of health scales.

Some of the most common complaints associated with non-traditional hours of work are sleeping problems, fatigue, and irritability. Physical systems affected include gastrointestinal, cardiovascular, and reproductive systems. Apart from specific disorders, the adverse effects of such hours on workers’ health also influence their general sense of well-being.

Shiftworkers regularly report increased levels of stress, increased use of alcohol and other drugs, and a general feeling of weariness. This may be made worse by mental stress related to being less satisfied in the domestic and social areas of their lives.

Gastrointestinal problems

Research has shown that shift workers are four to five times more likely to develop a gastrointestinal disorder, such as peptic ulcers, indigestion, heartburn, flatulence, and constipation. As discussed in the section on food, the digestive system is less likely to tolerate some foods at night when it slows down.

In the short term, irregularities in food intake resulting from non-traditional or changing work patterns may lead to digestive problems and gastrointestinal complaints. While the more severe disorders generally develop over time, you can reduce your chances of being affected by them by changing any unhealthy eating habits.

A basic strategy to reduce long-term gastrointestinal problems is to eat at normal meal times as much as possible. As discussed in the food section, you should examine your diet critically. Consider what and when you eat and drink, and how your eating makes you feel physically.

It is important to be aware of early warning signs of gastrointestinal disorders, particularly peptic ulcers, which are one of the most serious. Fortunately, they can be treated quite effectively. If you are having digestive problems, do not delay in seeking professional advice.
Cardiovascular disease

Compared to day workers, shift workers have a higher risk of developing cardiovascular diseases such as high blood pressure and heart attack. There is also a strong link between cardiovascular disease and genetics. If any of your biological family members have been diagnosed with cardiovascular disease in the past, you should pay more attention to your own lifestyle, especially factors such as exercise, diet, and smoking.

A startling finding in a study reported in 2011 is that there is a 48 per cent increase in risk of a fatal heart attack in people who sleep less than six hours per night. The same study reported that risk of stroke rises 15 per cent in people with similar levels of sleep.

Practically speaking:

- It is important to know whether your family history includes cardiovascular disease.
- Regular check-ups of blood pressure and cholesterol can help detect problems early.
- Be aware that smoking is a major additional risk factor for cardiovascular disease.
- Always try to maintain a healthy balanced diet, low in animal (and other saturated) fat.
- Undertake regular exercise, even if it is a daily walk.

Pregnancy and reproductive health

There are specific female health problems associated with shift work. Studies have shown that women who work shifts - night shifts in particular - more frequently experience irregular menstrual cycles and more severe menstrual pain. Studies have determined a range of factors that women who work non-traditional hours should be aware of, including:

- an association between rotating shift work and how long it takes to become pregnant;
- a relationship between an increased risk of spontaneous abortion and some forms of shift work;
- a link between pre-term birth and night work; and
- an association between rotating shift schedules and lower foetal growth and birth weight.

For some of these effects, the differences observed between shiftworkers and non-shiftworkers are statistically small so that some may question their importance. The body of evidence on reproductive health is also relatively small compared to other areas of research, such as the effects of shift work on sleep. Nevertheless, it is wise to consider work hours as a potential factor in reproductive health.
General health complaints tend to be higher among shift workers than day workers. Have you experienced any of the following?

- Sleeping problems
- Irritability
- Fatigue
- Frequent colds and flu
- Headaches
- Gastrointestinal disorders (stomach and digestive upsets)
- Cardiovascular disease
- Pregnancy or reproductive health issues

Yes Yes Yes Yes Yes Yes Yes Yes
No No No No No No No No

Well-being

Well-being refers to the personal, physical, material, mental and spiritual state of the person that contributes to their contentedness, health and sense of accomplishment in their work, social relationships, and leisure pursuits. Along with loss, depression, anxiety and stress, fatigue is one of the major threats to well-being in our modern age.

Organisations and well-being

Many organisations have adopted or developed programs that have the goal of improving employee well-being. These efforts might include: equity and diversity policies, Occupational Health and Safety requirements, performance appraisal systems, flexible working arrangements, generous leave entitlements, work-sponsored fitness facilities and programs, and access to support staff such as chaplains, social workers and psychologists.

These policies and support programs reflect the belief of many senior managers that an employer has certain obligation to promote the well-being of those they are responsible for. This obligation includes genuinely supporting well-being initiatives, fostering communication with all staff about well-being issues and initiatives, providing guidance for supervisors in promoting well-being at work, and identifying areas where work-related well-being could be improved.

The individual and well-being

The individual, irrespective of their role and level in the organisation, also has a responsibility for their own well-being. Like fatigue management, staff well-being is a dual responsibility between supervisors and the individual. Nevertheless, individuals have significant control over emotional and physical well-being.

Emotional well-being

People with good emotional well-being generally have high self-esteem, and positive relationships with family, friends and work colleagues. When emotional well-being is strong, people are likely to keep issues and problems in perspective. A realistic outlook normally leads to a fulfilling and enjoyable life, both at work and at home. Good
emotional well-being is also associated with well-developed coping strategies, a range of support resources, and a willingness to access these resources.

Coping techniques that are helpful in combating the challenges to well-being include:

- thought stopping – preventing the tendency to think the worst and to ‘catastrophise’ the situation;
- reinterpreting an event in a more positive light;
- relaxation techniques such as reducing muscular tension and meditation;
- exercise – to help use up the chemicals in the body produced by the stress response;
- suppress less important activities - put other projects aside, try to avoid becoming distracted by other events, let other things ‘slide’ in order to deal with the main stressor;
- restraint - waiting for an appropriate opportunity to act;
- seeking moral support, sympathy, or understanding; and
- acceptance - accepting the reality of a situation.

Physical well-being

This is also largely under individual control. Physical well-being has a number of key components: notably exercise, diet, hydration, and sleep. On the other hand, physical well-being can be undermined by substance abuse – notably alcohol and nicotine. These issues are covered in some detail in other sections of this workbook.

Proper physical self-care results a range of positive outcomes including reserves of energy during the working day, consistent and restful sleep patterns, proper concentration spans and a satisfying sense of feeling healthy.

Material well-being

For many people, material well-being is important to their overall well-being. Material well-being will have an impact on your family as well. Of course, one of the major stressors in modern life is finance.

A fascinating research finding is that people generally expect a fair remuneration for their work, and paying them too much is actually detrimental to their work satisfaction. It seems that, once our basic material needs are met (a place to live, security, clothing and food), most people seek other, nonmaterial goals and rewards from their work. These goals and rewards might be some form of recognition, such as promotion and awards, increased responsibility, and more satisfying work roles.

Spiritual well-being

For some people, the fundamental foundation of well-being is found in spirituality. Spirituality refers to the intangible, non-physical matters that provide a sense of meaning or purpose in our lives. Spirituality is often associated with religious belief and/or organised religion. For others, spirituality may be intensely personal, independent of any association with religion. What is common to spirituality / belief systems / moral perspectives / personal philosophies is the person’s understanding about how they should live and the purpose and meaning of their life.
A number of studies have shown that people with a well-developed personal philosophy or who practise their spiritual beliefs tend to adapt well with challenges such as grief, loss, health issues, and work problems.

**Seek balance**

Being fit to perform at work is linked to one’s level of well-being – one’s overall contentedness, health and sense of accomplishment. Most fundamentally, a balanced approach to one’s life goals and activities appears to be the key to a strong sense of well-being. Models of ‘life balance’ typically emphasise work, friendship / family, and leisure as the core ‘triad’ of facets underpinning well-being.

**EXERCISE**

Consider three forms of well-being and describe their contribution to your own overall level of well-being.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
The health benefits of sleep

Sleep makes you feel better, but its importance goes way beyond just boosting your mood or banishing under-eye circles. Adequate sleep is a key part of a healthy lifestyle, and can benefit your heart, weight, mind, and more. Here are some health benefits researchers have discovered about a good night’s sleep.

**Improved memory.** Your mind is surprisingly busy while you snooze. During sleep, you can strengthen memories and ‘practice’ skills learned while you were awake (a process called consolidation).

**Longer lifespan.** Too much or too little sleep is associated with a shorter lifespan -- although it is not clear if this is a cause or effect (illnesses may affect sleep patterns too). A related factor is that sleep also affects quality of life.

**Enhanced creativity.** In addition to consolidating memories, your brain appears to reorganise and restructure these memories, which can result in increased creativity.

**Better performance.** If you have a physically demanding job, sleep may be a simple way to improve your performance. One study found that football players who tried to sleep at least 10 hours a night for seven to eight weeks improved their average sprint time and had less daytime fatigue and more stamina.

**Effective study.** Several researchers have found that students who get less sleep achieve poorer grades. Many students sacrifice sleep in order to cram for exams but they are probably better off getting a good sleep the night before a test.

**Sharpened attention.** A lack of sleep can result in poor attention span, particularly in children.

**Weight control.** If you are thinking about going on a diet, plan on an earlier bedtime as well. One study found that dieters who were well rested lost more fat while those who were sleep deprived lost more muscle mass (the two groups shed similar amounts of total weight). Dieters also felt more hungry when they got less sleep.

**Lower stress.** Sleep and stress are inextricably linked. One of the first signs of severe stress is trouble sleeping. On the other hand, good sleep promotes physical and mental recovery – key resources in combating the daily stressors we all face.

**Fewer accidents.** In many countries, fatigue accounts for the highest number of fatal single-car run-off-the-road crashes - even more than alcohol.

**Less depression.** Sleeping well means more to our overall well-being than simply avoiding irritability. According to medical authorities, a lack of sleep can contribute to depression. Good sleep habits help to decrease anxiety and foster emotional stability.

Adapted from: [http://www.huffingtonpost.com/2011/02/02/sleep-health-benefits_n_817803.html#s234464&title=Improve_Memory](http://www.huffingtonpost.com/2011/02/02/sleep-health-benefits_n_817803.html#s234464&title=Improve_Memory)
Knowledge Check

- Name four types of health complaints often reported by shift workers.
- What is the most serious gastrointestinal disorder reported by shift workers?
- Name three factors that may contribute to cardiovascular disease.
- What are some of the health problems for women that appear to be associated with shift work?
- How can organisations contribute to the well-being of their employees?
13. Physical Exercise

Intended learning outcomes

After reading through this section, you should be able to:

- Name the effects of physical exercise on sleep.
- Discuss the effects of physical exercise on general health.
- Name the benefits of physical exercise.

Benefits of exercise

The health benefits of regular exercise include increased protection from heart disease, stroke, high blood pressure, noninsulin-dependent diabetes, obesity, back pain, and osteoporosis. (Remember that there is a higher incidence of cardiovascular disease – and other health complaints - in the shift working population.)

Exercise traditionally has been associated with physical health, but now understand that exercise has a more holistic effect on the human body and includes the promotion of psychological health. The psychological benefits of regular exercise include improved mood, better stress coping, and enhanced self-esteem and well-being. Most people simply feel better for exercising.

Exercise can also improve sleep. Research has shown that exercise taken 30 to 180 minutes prior to bed can increase the amount of deep (restorative) sleep that you obtain. One study found that night exercise increased the feeling the next morning of a good night’s sleep and reduced the amount of daytime sleepiness that day. Furthermore, being fit helps to increase your stamina and thereby increase the potential enjoyment of your leisure time.

More specifically, other potential benefits of physical exercise include:

- increased energy levels;
- reduced muscle tension;
- reduced stress;
- improved muscle tone and strength;
- increased aerobic fitness (heart and lungs);
- improved flexibility;
- strengthened immune function;
- reduced body fat;
- improved bone density;
- improved circulation;
- better digestion; and
The benefits associated with particular fitness activities are summarised in the following table:

```
<table>
<thead>
<tr>
<th></th>
<th>Walking</th>
<th>Running</th>
<th>Tennis</th>
<th>Dancing</th>
<th>Cycling</th>
<th>Golf</th>
<th>Swimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endurance</td>
<td>****</td>
<td>****</td>
<td>***</td>
<td>*****</td>
<td>*****</td>
<td>**</td>
<td>*****</td>
</tr>
<tr>
<td>Flexibility</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>*****</td>
<td>**</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Strength</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>***</td>
<td>****</td>
<td>*</td>
<td>**</td>
</tr>
</tbody>
</table>
```

Source: Sydney Hospital, OH&S Unit, 1996

Table 4. Benefits associated with different types of exercise

Establishing a routine

Many people who work non-traditional hours find it difficult to establish regular exercise routines. On average, female shift workers are 5 to 10 kg heavier than their non-shift working colleagues, while male shift workers are 10 to 12 kg heavier.

For the greatest overall health benefits, experts recommend that you do 20 to 30 minutes of aerobic activity three or more times a week and some type of muscle strengthening activity and stretching at least twice a week.

However, if you are unable to do this level of activity, you can gain substantial health benefits by accumulating 30 minutes or more of moderate-intensity physical activity a day, three to four times a week. Moderate-intensity physical activity includes everyday activities like vacuuming, mowing, and walking. Walking costs nothing, can be done without special clothing or footwear, and can be done at any time - even when workload is high and working hours are irregular. Former Prime Minister John Howard was an excellent role model for taking a daily walk irrespective of the pressures of his work.

Before you commence an exercise program, talk it over with your doctor, especially if you are overweight, over 30 years of age, or have not exercised before.

If you have been inactive, you should start with less strenuous activities such as walking, gentle cycling, or swimming at a comfortable pace. Take time to build up the pace and intensity of your fitness activity so that you avoid injury.

Exercise and fatigue

Recent research has found that sedentary people who regularly complain of fatigue can increase their energy levels by up to 20 per cent and decrease their reported fatigue by up to 65 per cent by engaging in regular, low intensity exercise.
The participants in this study were volunteers who had fatigue that was persistent yet didn’t meet the criteria for a medical condition such as chronic fatigue syndrome. It is estimated that about 25 per cent of the general population experiences such fatigue.

One conclusion from the study was that the commonly held belief that an exercise quick workout will leave us worn out – especially when we are already feeling fatigued – is incorrect. Regular exercise was shown to increase feelings of energy in most of the participants.

The finding that exercise can reduce fatigue adds an additional technique to the battery of fatigue management techniques. Exercise is certainly a healthier option than consuming caffeine and energy drinks in order to reduce fatigue, raise alertness and increase energy levels.

What improvements could you make to your current level of physical fitness?
Describe the first step you would take to achieve this.

What benefits would you expect from increased fitness?

Knowledge Check

• Explain why you should engage in some form of physical exercise. Name at least six benefits of exercise.
• What should you do before you engage in any exercise program, particularly if you are overweight, over 30 years of age, or have never really exercised?
• What effect can physical exercise have on sleep?
• What effect can physical exercise have on fatigue?
14. Social and Family Life

Intended learning outcomes

After reading through this section, you should be able to:

- Explain the impacts that working non-traditional hours may have on family and social life.
- Identify strategies that may help to balance your work and family/social life.
- Name the benefits of a good balance between work, family, and social time.

‘Unsocial’ hours

A healthy social and domestic life is an important foundation for good physical and mental well-being. Much of the research into non-traditional work hours shows that working these typically ‘unsocial’ hours creates unique family and social stresses.

In general, social time is arranged around the standard working week (9 a.m. to 5 p.m., Monday to Friday). This is why evenings and weekends are highly valued as time for social interaction and participation in leisure pursuits (e.g., hobbies, fitness, gardening).

Shift workers are regarded as being relatively ‘time poor’ in terms of social opportunities compared to those working traditional hours. If the hours you work are constantly changing or are unpredictable, the opportunities for social interaction are reduced. This lack of socialising is obviously the case, too, if you regularly work evenings and/or weekends.

It may also be difficult for permanent shift workers and those working non-traditional hours to see themselves as part of the community. Shift workers are less likely to be members of clubs, attend meetings, join political organisations, and undertake group activities such as sports.

Balancing family and work can be a source of conflict, regardless of whether you work traditional or non-traditional hours. Such conflict may make it hard for you to meet your family’s needs or expectations. This tension can increase as the demands of work or family increase.

The conflicts associated with shift work or non-traditional working hours hold particular resonance for women. Australian census statistics confirm that women generally assume greater responsibility for managing the house and parenting. There is a trend for men to be taking on increased responsibilities in the household and therefore they will increasingly experience similar pressures. In such situations, it is not uncommon for people to place family and social responsibilities before their personal needs.

Pressure or imbalance between family, social and work commitments can cause significant stress for the worker. When people are not able to meet family and social obligations, they often feel a sense of isolation. This, in turn, can lead to despondency and depression, which can significantly affect the health and well-being of the worker.
People may try to overcome loneliness by sacrificing sleep time for social or family time. This creates a potential safety hazard - for both employees and employers. If you find yourself in this situation, be aware of your elevated fatigue levels, and the associated risk of either a work- or non-work related accident.

The potential conflicts in trying to balance non-traditional hours of work with social and family life are readily apparent. However, there can be a positive side to shiftwork. If you can effectively balance your various goals and obligations, working non-traditional hours can be beneficial. Some of the benefits include:

- **Discretionary time during the day.** This can be particularly useful for paying bills, running errands, and having face-to-face access to services that are only available during the traditional 9-to-5 work day.

- **Child care.** Many parents choose to work non-traditional hours, so that one parent can usually be at home to look after young children.

- **Increased income.** Many jobs that require non-traditional work hours have higher remuneration; partly to compensate for the social and family sacrifices that are made.

Some working arrangements have potential advantages for families and activities outside of the workplace. One example is the 12-hour shift system. Assuming over-time is not worked, 12-hour shifts generally involve long uninterrupted blocks of time away from the workplace (e.g., five days on, seven days off). These blocks of free time are often highly valued by employees because they provide the opportunity for a more flexible lifestyle. This may include being able to spend more quality time with family, extended time to relax and engage in social activities and short holiday trips, or time to undertake sizeable hobby or household projects.

However, 12-hour shifts have a considerable downside. On working days, employees have little time for anything other than work and adequate sleep (7-9 hours), which will constrain involvement in daily family or social activities.

Provide some examples of changes in family and social life that are brought about by non-traditional hours of work.

Coping strategies

There are a number of strategies that workers can use to balance work, social, and family time, and thus avoid feelings of isolation. One of the main strategies is talking about your work schedule with your partner and children. This can be effective in planning ahead to spend time together as a family.

Regular discussion with your family about work schedules will ensure they are aware of when you are likely to be sleeping after work. As a result, they can arrange to be out of the house when you are sleeping, or be more considerate of the need for quiet. This in
turn can provide you with undisturbed sleep, allowing more energy for social and family interaction during non-work and non-sleep time.

Another strategy is to be active in organizing family and social events. Make a point of spending time with those close to you, including your family, friends, and colleagues. This may be organized on a routine basis around your work schedule to ensure regular contact.

Joining a recreational organization can also be a useful strategy to minimize feelings of isolation. This can be particularly effective for meeting friends who work a similar schedule to yours. It provides an opportunity to socialize and relax when most other people are working.

Knowledge Check

- Why are some working arrangements referred to as being “unsocial”?
- Describe two strategies that can help in balancing work and family.
15. Commuting

Intended learning outcomes

After reading through this section, you should be able to:

- Discuss why commuting can be a hazard for workers.
- Name strategies that may help reduce the risks associated with commuting.

Commuting as a hazard

So far, we have focused on fatigue as a workplace hazard. Driving to and from work when fatigued should be considered a hazard. This hazard is increasing in significance as cities expand, people settle in ‘ruburbia’ (rural-suburbia), and public transport options diminish. As a consequence of these and other factors, many people are undertaking longer and longer commute times to their workplaces.

You will always be at risk of falling asleep behind the wheel if you are driving while tired or sleep deprived. There are certain high-risk times when you are more at risk of having a fatigue-related accident. These include:

- long drives without a break;
- driving home after a long shift;
- driving between midnight and dawn (a biological low point);
- driving in heavy traffic;
- long stretches of road with low traffic; and
- roads with little variation in bearing or outlook.

In many capital cities in Australia, it is not unusual for people to commute an hour or even two hours between home and work. This situation arises where urban development has expanded, traffic density is high, or the nature of a particular job means it is confined to a particular location (e.g., aviation jobs are normally near an airport).

While it is difficult to eliminate all the risks associated with commuting, it is possible to take some measures to improve safety on the road. While the following suggestions may not be relevant to everyone, you should be able to devise a road safety strategy that suits your circumstances.

Making commuting safer

- **Take public transport if it is available.** This option is not only safer but is usually much less expensive than running your own vehicle. For many people, the downsides of public transport are the lack of flexibility that one’s own car provides, and longer commute times to and from work. However, the travelling time can often be productively spent reading, working on the laptop and messaging. Alternatively, the
time can be exploited for its potential relaxation – listening to music, chatting, or just watching the world go by.

- **Move closer to work.** On first consideration, this may not be a realistic option for many. It is perhaps most feasible for those renting. Nevertheless, for homeowners who believe their job is secure and long-term, the option of moving to a new home closer to work might be worth consideration. A saving of 90 minutes commute time each day amounts to about 350 hours a year – a full 14 days.

- **If you live close enough to work, consider riding, running, or walking to work.** This is a particularly good strategy if you have been trying to get some regular exercise into your week. Another advantage is that, apart from the cost of shoes or a bike, it is free!

- **Car pool.** This may be a viable option if you live close to people who work with you. Car-pooling allows costs to be shared and gives the driver company during the ride, reducing the monotony of the drive.

- **Don’t be in a hurry.** Many accidents occur when people rush, so plan for delays and keep your perspective if delays do occur. Getting frustrated and taking risks is less than prudent. Conversation, music, talkback radio, and talking books can help to pass the time and keep you focussed on less stressful aspects of the journey.

- **Do not use a mobile phone while driving.** Recent research clearly shows that dividing your attention between driving and talking on a cell phone is dangerous. This is true even of mobile phones with a hands-free attachment. If a call is that important, find a safe place to pull over until the call is finished.

- **Take a nap.** As detailed in the sleep and napping section, naps can be a powerful and efficient strategy for gaining temporary improvements in alertness and performance. Naps are rarely convenient unless they are pre-planned. Nevertheless, you should get off the road if you observe any warning signs of fatigue. Keep your nap short, say 10 to 15 minutes, and be sure to give yourself at least 10 to 15 minutes to shake off your sleep inertia before you drive off. This wake-up time can generally be shortened if the nap is during the day.

- **Have some caffeine.** As covered in the caffeine section, caffeine can provide a boost to alertness, making commuting safer. The downside: caffeine can reduce your ability to get to sleep once you get home.
Fatigue-related road deaths

Cait Bester, Daily Mercury, 3rd April 2010


Fatigue was a contributing factor in one-third of the fatal accidents on the Mackay district roads last year (2009). And nearly half the deaths on our roads in that period were as a result of fatigue related crashes. The number of crashes and deaths on our roads has been linked to miners returning home from shift work within the Bowen basin. The majority of deaths occurred in black spots on the Bruce Highway, Peak Downs Highway, the Fitzroy Development Road and the Suttor Development Road.

While fatigue is one of the fatal four killers across the nation, with the mining industry, Mackay Traffic Branch Sergeant Gerry Doyle said the Mackay district was at a greater risk. “Those working in the mining industry with their long shifts and distances that they choose to travel before and after their shifts certainly makes them in a high risk group,” he said. “And they need to be aware of the issues of fatigue and take the appropriate action if they are driving and start to feel tired. If they don’t make the correct decision within a split second they could be dead on the side of the road. They are also threatening the lives of other innocent road users.”

Sgt Doyle said it was not just heavy vehicles involved in fatigue related crashes but also light cars with several resulting in multiple deaths. “Last year we had 23 crashes on Mackay district roads and eight of those crashes were fatigue related,” he said. “The eight accidents resulted in 12 deaths.”

Road Accident Action Group (RAAG) road safety coordinator Graeme Ransley said drivers needed to learn to manage their fatigue better and families needed to learn and understand fatigue. “At the moment RAAG is focusing on families – a lot of pressure is put on a family member who works away in the mines from family back home to get home quickly,” he said.

Mr Ransley said an increased number of crashes were not only happening on the way home from work but also on the way to work. “They are then packing as much as they can into their time off or they are playing ‘hardball’ such as partying all weekend and not getting the rest they need. If wives, partners or girlfriends, even the children understand the factors then they could have an influence and help reduce deaths on our roads.”

The CFMEU Mining and Energy district secretary Jim Valery blamed mining companies for fatigue related deaths on our roads with the increase of shift hours. “A prime example of dangerous shift lengths is … adoption of a fatigue management policy that could see shift lengths extended from 12 to 14 hours and in some cases 16 hours – for 14 consecutive days.”

Sgt Doyle said some of the typical signs of fatigue were drowsiness; eyes may suddenly get sore or drivers could find themselves drifting off. “People don’t realise the benefits of a power nap – just by pulling over taking a nap, a walk around the car followed by a drink of water and fresh air could save their life,” he said. “You are better off having a 10 to 20 minute break on the side of the road than not getting home at all.”
EXERCISE

Why is commuting a fatigue risk?


Are there any changes you could make to the way you commute that would reduce fatigue-related risks?


Knowledge Check

- With respect to the preceding case study, propose three strategies that mining shiftworkers could use to get home safely from work.
- Name at least two reasons why some workers are spending more time in their cars travelling to and from work?
16. Work Schedule Design

Intended learning outcomes

After reading through this section, you should be able to:

- Discuss respective responsibilities of employee and employer in the context of a fatigue risk management system.
- List considerations when designing working time arrangements.
- Explain the pros and cons of different types of shifts.

Shiftwork on the rise

It is estimated that fatigue is responsible for at least as many crashes on the road as alcohol. Despite this, fatigue has only recently begun to receive attention from regulatory bodies.

Globalisation, competition and demand are pressuring organisations to adopt new flexible working time arrangements that include 24-hour operations. As the workforce increasingly moves towards alternative working arrangements, the potential for fatigue-related risk is likely to increase. This problem is further compounded by the growing use of high-powered machinery where the margin for error is small and the potential for serious injury is high.

There is little doubt that flexible working time arrangements have productivity benefits. Flexible, non-standard working hours are also attractive to employees whose home responsibilities and personal preferences are at odds with traditional work schedules.

Work schedule design as a fatigue countermeasure

The scheduling of work and sleep/rest periods is a key aspect of fatigue prevention. Of course, the best countermeasure to fatigue is sleep. Yet sleep opportunity is determined to a great extent by the hours you are not at work.

When designing working arrangements, the following should be considered:

- length of shifts;
- number of consecutive shifts;
- direction of rotation in alternating shifts (i.e., forward or backward);
- type of shifts to be worked (nights, afternoons, early mornings, days);
- staffing levels, experience, expertise, and opportunities for job rotation;
- rest breaks between and within work periods; and
- the types of tasks being undertaken (repetitive, boring, stimulating).
Consulting with all stakeholders about the development of new work schedules should be customary. By encouraging participative decision-making, there is likely to be greater feelings of ownership of the resulting system and therefore fewer compliance problems.

Any changes to existing work schedules should be evaluated to determine the impacts on the health, safety, and productivity of employees and the company.

**Different types of shifts**

There are numerous types of shifts operating in industry. For example, extended shifts are a common occurrence for employees who work a regular 9-to-5 workday when asked to work for an extra hour or so. Workers can also find themselves assigned to shifts starting early morning, in the afternoon, or at night. Individual employees and work teams can be assigned to these shifts at short notice or according to well-established rosters. They may be expected to stay on a particular shift for periods from as short as a day or two to permanent status.

Many shift structures have developed from tradition over decades, even centuries (the watch rotation system on board ships has been used for hundreds of years). Other shifts are the result of industrial relations negotiations. What many of these systems share, however, is that they have been designed without an appreciation of human factors such as sleep need, the circadian cycle, and the detrimental impact of fatigue on performance. The detrimental aspects of some shifts often go unnoticed, are ignored, or are accepted as unavoidable by-products of core operations.

A detailed examination of the strengths and limitations of some common shift schedules follows.

**Extended shifts**

Extended shifts involve either starting a shift earlier or finishing later than the standard 9-to-5 workday. There are many reasons an organisation may choose to use extended shifts. In some cases, extended shifts allow for longer hours of production, without the need for night work.

Extended shifts are also popular among employees because of the extra money they can earn working longer hours. Alternatively, the standard 38-hour work week can be compressed into three or four days, allowing bigger blocks of time off between shift sequences.

Working the occasional extended shift of one or two hours is unlikely to affect fatigue-related risk significantly. This is especially so if the shift does not affect sleep opportunity (i.e., starting before sunrise, or finishing after ‘normal’ bedtimes). Over longer periods, shifts longer than 10 or 12 hours should be avoided. Even if these shifts do not specifically affect your sleep periods, they will reduce the amount of social time available. Research has shown that the mean relative risk of error at work increases substantially for every hour after eight hours that a shift extends (recall the diagram in the *High Risk Times for Fatigue* segment in Section 3 on Fatigue).

Research has shown that employees often sacrifice sleep in exchange for a healthy social life if they do not have sufficient time for both, producing higher fatigue levels. If longer shifts are required, make sure you have adequate recovery time after your shift has ended.
Fatigue Management for the Australian Aviation Industry

Night shifts

Humans are diurnal, which means we are naturally active during the day and sleep at night. Because of this, it is particularly difficult to adjust completely to night shifts. Night work requires you to be awake when your natural tendency is to be asleep, which disrupts body rhythms and affects the quality and quantity of sleep. Night workers generally get less sleep, and the sleep they do get is of poorer quality than that of day workers.

Unlike most other animals, we are influenced and motivated by what we choose to do and how we choose to do it. Motivation plays a role in how you manage your work hours. Money has generally been used to compensate employees who work at non-traditional times. Those who work at night, in the evening, and on weekends are traditionally paid at a higher rate than those who work days, Monday to Friday.

Morning shifts and afternoon shifts

Although they may be less problematic than night shifts, morning and afternoon shifts are not without problems. Morning shifts that start before 7 a.m. often result in workers cutting sleep periods short, which can cause higher levels of fatigue at work.

This ‘sleep sacrifice’ has been supported by studies that show a higher frequency of accidents at the start of early morning shifts. As with the night shift, the risk of a fatigue-related incident becomes significant when sleep is cut short over several days.

From a sleep perspective, afternoon shifts can appear ideal. Workers get home between 9 p.m. and midnight, which means they can go straight to bed and still get up reasonably early and have a productive morning before the next shift. However, some afternoon shift workers find that it takes them a while to ‘unwind’ after getting home – they are simply not ready to sleep.

Furthermore, the afternoon shift lifestyle has drawbacks from a social perspective. For example, the evening meal with family or friends, often regarded as the most important socialising period of each day, is missed. Also missed is the traditional Friday evening ‘end-of-week’ social activities with work colleagues or friends.

As discussed previously, when individuals are deprived of social time by extended shifts, they will often sacrifice sleep to catch up on lost social time on other days. Again, this can cause a vicious cycle associated with increased fatigue-related risk.

Dual responsibilities

Managing fatigue and associated risks are the dual responsibility of employers and employees. As will be seen in the next two sections, various types of shifts have various effects on workers and their lives, and entail some fatigue-related risks. Both employers and employees must be aware of the risks involved with various types of shifts. Examples of the respective responsibilities of employers and employees with regard to fatigue are listed below.

Employer responsibilities

- Develop work schedules that prevent high levels of fatigue from developing during a work shift.
- Develop work schedules that allow for adequate rest and recovery periods during between shifts (that allows for an anchor sleep period of seven to eight hours).
- Ensure safe work practices, such as limiting overtime to sensible levels.
- Implement appropriate and safe shift duration.
- Continuously assess, control, and monitor fatigue-related hazards.
- Develop policies, procedures, and practices to manage risks related to fatigue. For example, where napping is allowed, there should be clear instructions on how to deal with sleep inertia.
- Provide information on workplace hazards, such as fatigue.

**Employee responsibilities**

- Arrive at work in a fit state to work the expected shift length.
- Report all safety incidents and accidents.
- Maintain appropriate communication about safety with work colleagues, management, and relevant unions.
- Be aware of fatigue and how to counter its effects in the workplace.

**Shift rotation**

Where night work is required, rotating shifts are often employed to share the night shifts among employees, rather than restricting them to one group of employees. Employees working nights typically get less sleep, which can accumulate to cause high fatigue levels, particularly over several days in a row. Using a rotating shift schedule can reduce fatigue-related risk by giving employees fewer night shifts in a row.

Research suggests two options with respect to shift rotation. One is rapid rotation of shifts (i.e., changing after just one or two shifts - before significant circadian readjustment occurs). The other is extended rotation (maintained for weeks and even months) so that circadian adjustment can occur and be maintained.

There is consensus that if shifts are to rotate, rotating them in a forwards direction (i.e., morning to afternoon, afternoon to night) is preferable to rotating backward (i.e., night to afternoon to morning).

Many people prefer to be on permanent night duty. For some, this preference is based on remuneration, for some it suits their ‘night owl’ chronotype, some enjoy the nature of night time work, while for others it suits their family and social needs.

**Shift intolerance**

In contrast to those who prefer night shift, about 10 - 20 per cent of people are ‘shift intolerant’. This means that, even with well-designed shift systems, and with the best intentions, some individuals do not adapt to shift work. Rather than gradually adjusting to a new phase of shift work, their circadian rhythm remains in a state of permanent flux and disruption. Night shift is particularly problematic for these people. The result is
Fatigue Management for the Australian Aviation Industry

chronic sleep deprivation and its associated adverse effects on health, mood, and work efficiency.

Guidelines for shift design

There is no ‘optimal’ shift schedule. There is also a great deal of disagreement in the relevant scientific literature, based mainly on civilian sector research, about the timing and duration of shifts, speed and direction of shift rotation, and flexibility of shift systems. The following guidelines for developing a shift schedule for continuous operations are given:

- Avoid any schedule that is not tied to the 24 hour circadian cycle.
- Allow a major rest/sleep period every 24 hours (for example, a 24-hour-on/24-hour-off schedule effectively means that personnel will sleep only once every 48 hours).
- Schedule the main rest period for the same time each 24-hour period.
- Attempt to allow at least a week on each shift before a rotation (though individuals who appear ‘night shift intolerant’ are best given only one or two consecutive night shifts). Longer rotation periods are best if optimum performance is the primary priority.
- During periods of critical work demands, attempt to provide a ten-hour rest/non-work period each 24 hour period (this generally allows for a six to eight hour period for sleeping – depending on commute times). An eight-hour rest period will only allow up to six hours of sleep – which is below the recommended amount.
- Avoid daily or continuously rotating schedules (those who advocate rapidly rotating shifts tend to do so mainly for social considerations).
- Forward or clockwise shift rotation (morning - afternoon - night) is favoured as it allows longer rest intervals and parallels the body's natural tendency to extend past a 24-hour cycle.
- Do not commence morning shift before 0700 hours to avoid beginning work during the circadian trough and to maximise REM sleep.
- Shift length should be determined by the physical and mental characteristics of likely duties. Hours should be reduced for highly complex and demanding tasks (such as flying using night vision devices).
- When possible, program short nap periods into night shifts.
EXERCISE

Have you noticed any differences between your sleep patterns when you are on night shift and when you are on other shifts?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Do you have any suggestions about how current working hour arrangements could be improved? If yes, what are they?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Fatigue Management for the Australian Aviation Industry

Case study

Innovative Watch Rotation Focuses on Safety, Training
Lieutenant Benjamin Mattes, United States Navy
Source: www1.netc.navy.mil

With the increased operational tempo that Navy ships encounter on deployment and the many duties that our officers, chiefs, and enlisted carry these days due to reduce manning, there have been many moments in which fatigue has been a major problem for those on watch during deployments. Most ships operate on a watch schedule of “5 and dimes” (5 hours on and 10 hours off) or “4 section 5 hours” (5 hours on and 15 off). Both watch rotations possess greater risk due to long periods requiring alertness and continual rotating around the clock watch. At best, maybe half the crew is fully alert. In this day and environment, ships need to have maximum crew alertness.

The aviation community has long embraced the concept of “crew rest” and “human factors” to encourage maximum performance in a demanding environment. During a recent deployment, USS San Jacinto adopted many of the ideas in creating a new kind of watch rotation … that was recommended during a recent Bridge Resource Management course. … It entails a 4-section watch with each section standing two 3-hour watches with a 9-hour break between them. The rotation looks like this (offsets intentional):

Section 1: 00-03 12-15
Section 2: 03-06 15-18
Section 3: 06-09 18-21
Section 4: 09-12 21-00

The primary effect is the ability to establish a circadian rhythm by standing the same watch and working the same hours every day – I have observed that the watch-standees are much more alert since making the change. The watch rotates every two weeks on a Sunday to minimise acclimatization time and to prevent stagnation of the same routine every day. Changes to the daily routine include late sleepers / early taps for those on the early morning watches (00-03, 03-06) and focusing major evolutions, meetings and drills between 0900-1500.

Secondary effects have included:
- Increased time for PT (Physical Training)
- Better predictability of an individual’s daily routine
- (Ability) to average 6 hours of sleep vice the 3-4 hours of sleep from other watch rotations
- Watch teams are consistent, allowing true “Combat Teams” to form and train together
- Depth on the 4-section watch bill also allows flexibility to rotate staff … or to support special evolutions
- The engineers in the hot main spaces have benefited from the 3-hour watches and long recovery times which minimize the risk of heat stress

In today’s environment, our sailors are working harder than ever before. Our job as leaders is to look out for them and ensure safety is paramount. Ensuring our sailors are getting adequate sleep, and are able to execute a consistent workday and circadian rhythm, will only benefit the Navy more. Instead of long hours barely awake and struggling to make it through a day, our sailors are more alert and ready for to call to action at any time.
Knowledge Check

- Name three factors you could consider when designing work schedules.
- Name three employee responsibilities and four employer responsibilities with respect to managing fatigue-related risk.
- Name one negative and one positive aspect for each of the following shifts: morning, afternoon, and night.
17. Jet Lag

Intended learning outcomes

After reading through this section, you should be able to:

- Explain why long-distance travel causes jet lag.
- Explain why travelling east can produce more jet lag than travelling west.
- Provide practical strategies to ease the effects of jet lag.

What is it?

Jet lag is a condition caused when we travel across time zones, and our normal circadian rhythms are disrupted. It is experienced in the form of physical and psychological discomfort. Jet lag is also more formally known as desynchronosis.

The symptoms of jetlag may include excessive sleepiness, feeling ‘flat’ or lacking energy, an increase in simple mistakes and forgetfulness, premature awakening or difficulty getting to sleep when desired (insomnia), anxiety, constipation, diarrhoea, confusion, dehydration, headache, irritability, nausea, sweating, and coordination problems.

Some people also experience some of these symptoms for the first day or two after the change to daylight saving time, even though this is just a one-hour time shift. Interestingly, traffic accident rates and a host of other risk indicators increase measurably for up to a week after a daylight saving change, indicating how sensitive some people are to disruptions to their circadian cycle.

The main determining factor in the impact and experience of jet lag is how many time zones are crossed. The world has 24 time zones, one for each hour of the day. Each zone runs from north to south in bands that are about 1,600 kilometres wide (the actual width varies to reflect political, geographical and practical boundaries). Since time zones change only when travelling in east or west directions, north-south flights produce far less jet lag.

For example, flying from Perth to Sydney (normally three hours difference) can produce substantial jet lag. However, a traveller on a north-south flight of the same or longer duration – Melbourne to Darwin, for example - will normally not be affected by jet lag.

Some travellers, however, find air travel to be fatiguing irrespective of the direction of travel. Reasons for such fatigue include less sleep than normal the preceding night due to travel preparations, an unusually early start to catch the plane, or factors such as noise, vibration, motion, cabin conditions, and glare.

Jet lag and the body clock

The cause of jet lag is the inability of the body of a traveller to instantly adjust their body clock to the time in a different zone. The body clock has already been discussed in Section 2 in terms of the effects of shiftwork and trying to sleep during the day. While
Fatigue Management Strategies for Aviation Workers: A Training & Development Workbook

circadian irregularities are fundamentally the same for international travel, there are two main differences between shift work and jet lag:

- the time zone change associated with jet lag is preceded by the fatiguing activity of travel; and
- the day/night environment surrounding sleep will have changed (i.e., become earlier or later), which confuses the body clock.

The hypothalamus in our brain is the biological alarm clock that activates various body functions such as hunger, thirst, and sleep. The hypothalamus also regulates body temperature, blood pressure, and the level of hormones and glucose in the bloodstream. It takes time for the hypothalamus to readjust to a new time zone. First, it needs to realise that a change has occurred. The body picks up various clues that the time zone has changed - from differences in eating times, to changes in the environment. For example, fibres in the optic nerve transmit perceptions of light levels to the timekeeping centre within the hypothalamus.

Despite these various alerts, the hypothalamus takes time to re-regulate the body’s many systems. One rule of thumb is that for each time zone difference between the time zone you were acclimatised to and the new zone, the body may take about a day to adjust. Therefore, nine time zones equals approximately nine days until your body is functioning ‘in sync’ with your new surroundings. Most of the symptoms of jet lag, however, subside within three or four days.

**Effects of jet lag**

It is easier to delay our sleep and waking time, i.e. move it backward rather than bringing it forward, making the day longer rather than shorter. Eastbound travel shortens the day or night, so travelling west produces less jet lag.

You are more likely to be affected by jet lag when flying east because:

- depending on the distance travelled, you lose several hours of sleep time
- your body clock will only partially reset when changing time zones.

The impact and experience of jet lag varies considerably between individuals. How you are affected depends on many factors, including:

- the direction of travel (travelling west is easier);
- physical fitness (it is thought that better fitness improves the speed of circadian adjustment); and
- age (the effects of jet lag increase with age).

One of the most common symptoms of jet lag is sleep disruption. This is likely to include:

- difficulty getting to sleep at the regular bedtime;
- waking up during the night and not being able to get back to sleep; and
- fighting sleep during the day.
This level of sleep disruption is likely to lead to insufficient sleep quality and quantity, and subsequent fatigue.

**Easing the effects of jet lag**

The following tips help to minimise the effects of jet lag.

**Keep fit.** Regular exercise also has a large impact on the severity of jet lag. Unfit people tend to experience longer periods of jet lag.

**Change your schedule ahead of travel.** Resetting the body clock is more easily accomplished gradually than all at once. Depending on the direction you are travelling, and how long you plan to stay at the destination, one option is to start adjusting sleep and eating times before you leave. There is some agreement that shifting your bed and meal times by an hour or two can jumpstart the change in your body clock in the right direction.

**Start your travels without a sleep debt.** Ensure you are well rested before your journey begins. Too often before international travel, people attempt to finish off too many tasks at work or around the house at the last opportunity. Some people put off packing until the last minute (possibly because of competing work demands) and therefore sleep has to be sacrificed in order to prepare for the trip. Some people deliberately stay up in order to get limited sleep before a flight. The belief is that they will be able to sleep better upon arrival at their location. In reality, however, people who are already in sleep debt before a flight will experience more symptoms of jet lag than those who are well rested.

**Avoid alcohol.** It is recommended that you do not drink alcoholic beverages the day before, during, or the day after your flight. As we saw in section 9, alcohol causes dehydration, disrupts sleeping schedules, and can trigger nausea and general discomfort. If you cannot resist having a drink, certainly do not drink excessive amounts.

**Avoid caffeine.** Similarly, try not to drink caffeinated drinks before, during, or just after flight. Caffeine also causes dehydration, can disrupt sleeping schedules, and tends to amplify any anxieties associated with travel. Revisit section 8 to refresh your understanding of the effects of caffeine.

**Stay hydrated.** Drink plenty of water, especially during the flight, to counteract the effects of the dry atmosphere inside the plane. Dehydration and dry air can cause headaches and nasal irritation, which can exacerbate the symptoms associated with jet lag.

**Exercise and move about on the plane.** Most airlines now recommend in-seat exercises and some walking (perhaps every hour or two) during long flights in order to avoid circulatory problems such as deep vein thrombosis. The same advice applies to aircrew.

**Wear comfortable clothing.** Comfortable clothes and shoes aid relaxation during flight. (Nevertheless, be safety aware with respect to clothing on aircraft.)

**Restful accommodation.** Research your accommodation options with comfort in mind. Do their rooms have double glazing, heavy window shades, and air conditioning? Numerous independent hotel rating websites exist that allow you to pick up issues such as noisy rooms, uncomfortable beds, and unserviceable cooling and heating devices. Upon arrival, check that provisions for noise abatement, environmental control, and light
suppression are adequate – and functional. For example, do not accept a room next to the elevator shaft.

**Enhance your quality of sleep.** A fundamental technique for minimising the effects of jet lag is maximising sleep quality and quantity. Such methods were examined in section 4.

**Adapt to the local schedule.** It is generally agreed that the sooner you adapt to the local time zone, the quicker your body will adjust. Therefore, if you arrive at noon local time (but, say, 5 a.m. your acclimatised time), eat lunch, not breakfast. During the day, expose your body (and your eyes – so go without sunglasses for a while) to sunlight by taking walks or sitting outdoors. The sunlight will cue your hypothalamus to reduce the production of sleep-inducing melatonin during the day, thereby initiating the process of resetting your internal clock.

**Use sleep medications wisely.** It is best to try to establish sleeping patterns without resorting to medication. However, if you have difficulty sleeping on the first two or three nights, you might try a mild sedative (see section 11). A reminder: do not use sedatives for more than a few days without medical advice.

**To sleep or not to sleep?**

Some people believe that they should never sleep on long-haul flights because it will interfere with adjustment to the destination time zone. However, for Australians going overseas, this approach is simply unreasonable. International travel schedules out of Australia can routinely surpass 24 hours (especially if travelling to anywhere in Europe). Trying to stay awake for such a period will only exacerbate fatigue and the effects of jet lag upon arrival at your destination.

Most travellers find it difficult to sleep on aircraft and certainly sleeping at will is not a common ability. Nevertheless, one approach to easing jet lag is to attempt to link sleep during the flight to normal sleep time at the destination, even if only for four or five hours. For example, many flights from Australia reach Heathrow around dawn. Therefore, delaying sleep until the last five or six hours of the flight might help to ‘jumpstart’ your adaptation to the new time zone.

**Getting used to jet lag?**

In 1994, a survey was conducted of international flight attendants in New Zealand. Almost all flight attendants surveyed said that despite being accustomed to international travel, they regularly suffered from jet lag.

One of the symptoms commonly reported by the flight attendants following a long flight was a sensation of confusion or “fuzziness.” For example, some flight crew members reported checking to make sure their hotel rooms were locked two or three times. It would seem that jet lag is not something most people get used to irrespective of how much they encounter it.
**EXERCISE**

Have you ever experienced jet lag? Describe your experience.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What techniques do you use (or have used) to cope with jet lag?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Based on what you have just read about jet lag, are there any changes you should think about making? If so, what?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

---

**Knowledge Check**

- Explain what causes jet lag.
- Identify two factors that can affect the experience of jet lag.
- Explain five ways to ease the negative effects of jet lag.
18. Readings & Resources

Working non-traditional hours (sleep loss and disruption)

Fatigue and sleep

Sleep and sleep disorders
Australasian Sleep Association: [http://www.sleepaus.on.net](http://www.sleepaus.on.net)
Sleep Disorders Australia: [http://www.sleepoz.org.au](http://www.sleepoz.org.au)
Napping and fatigue prevention

Food and nutrition
Water and heat stress


Caffeine


Alcohol


Nicotine


Medications


**General health and well-being**


**Exercise**


**Social and family life**


**Commuting**


Work schedules


Jet lag and circadian dysrhythmia


