
infections. The inability to exercise is considered a risk factor because it is a circumstance that takes away a crew member's ability to increase physical fitness, enhance sleep, think clearly and manage stress.

- .4 *Caffeine and other stimulants*: caffeine can be found in beverages such as coffee, tea and some soft drinks. Caffeine can improve alertness and concentration in moderate doses, but it is not a substitute for adequate sleep and rest. Too much caffeine can have harmful effects such as increased heart rate and blood pressure, and can cause fatigue in some people. It takes caffeine about 15 to 30 min to enter the body's system, and its physiological effects peak about an hour after the drug reaches the bloodstream. The effects of caffeine can vary greatly from individual to individual and depend on physical condition, age, level of sleep debt, frequency of use and time of day. Generally, caffeine levels drop by half every 5 or 6 hours. Its effects can last long after consumption and may interfere with needed sleep. Caffeine shortens total sleep time by preventing sleep. Caffeine consumption can also cause dehydration.
- .5 *Alcohol*: although alcohol is a central nervous system depressant, it can impair the quality of sleep. Alcohol can lead to increased sleepiness and reduced alertness, even after the alcohol is no longer detectable. There are also serious health consequences related to the long-term abuse of alcohol. Many shipping companies have "zero alcohol tolerance".
- .6 *Nicotine*: nicotine is highly addictive and the dangers to health are well documented. Nicotine users generally have more disturbed sleep, typically taking longer to fall asleep and experiencing more wake time during a sleep period.
- .7 *Drugs*: it is important for seafarers to be aware of how drugs and supplements may affect their health and their sleep/wake cycles. 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. In addition, there are other drugs prescribed for specific ailments that can have sedating side effects. Some prescription drugs can affect people's ability to operate machinery (induce sleepiness). They may also interact with existing fatigue levels and other drugs (including alcohol) and supplements, further affecting performance. Some over-the-counter drugs used for pain relief or colds and flu may increase drowsiness and fatigue-related symptoms.

- .8** *Supplements:* there are now a number of nutritional supplements, natural products and energy drinks that are available on the market that directly influence sleep/wake states. Just because they are sold over the counter does not mean they are safe or appropriate for everyone. These products may interact with prescription or over-the-counter drugs to further affect performance. Individuals should proactively seek advice and guidance from their healthcare providers before using these products to learn about their appropriate use.
- .9** *Sleep disorders:* other health-related aspects are the wide variety of sleep disorders, which are known to disrupt the quality of sleep and make restorative sleep impossible, even when individuals spend enough time trying to sleep. The most common sleep disorders are obstructive sleep apnoea, insomnia, restless legs syndrome, shift work sleep disorder and narcolepsy. Undiagnosed or untreated sleep disorders can cause sleepiness. Sleep disorders pose a particular risk for seafarers, especially as maritime operations already expose seafarers to restricted sleep. Large numbers of individuals suffering from sleep disorders are unaware of and have not been diagnosed or treated for their disorder.
- .1** Obstructive sleep apnoea (OSA) results in breathing being interrupted during sleep. Repetitive episodes of non-effective breathing, very shallow breaths or inadequate breaths lead to frequent partial arousals from sleep, resulting in ineffective sleep and sleep debt. OSA is a potentially serious sleep disorder resulting in excessive daytime sleepiness and can lead to cardiovascular problems. Sleep apnoea, which may be indicated by loud snoring with pauses of silence, often goes undiagnosed and untreated and has been known to be a contributing factor to incidents in all modes of transportation. Some risk factors include excessive weight, high body mass index (BMI), high blood pressure, smoking and diabetes.
- .2** Insomnia is the most prevalent sleep disorder and is characterized by an inability to fall asleep and/or by waking up during the night and having difficulty going back to sleep. Long-term insomnia is more common in women than men and tends to increase with age. Short-term insomnia may be caused by emotional or physical discomfort, stress, environmental noise, extreme temperatures or jet lag, or may be the side effect of medication. Secondary insomnia

may result from a combination of physical or mental disorders, undiagnosed or uncontrolled sleep disorders and effects of prescription or non-prescription medications.

- .3 Restless legs syndrome (RLS) is a movement disorder that is often associated with a sleep complaint. People with RLS have unpleasant leg sensations and an almost irresistible urge to move their legs. Symptoms are worse during inactivity and often interfere with sleep. Sitting still for long periods becomes difficult; symptoms are usually worse in the evening and night and less severe in the morning.
- .4 Shift work sleep disorder is characterized by insomnia and excessive sleepiness affecting people whose work hours overlap with the typical sleep period. There are numerous shift work schedules (permanent, intermittent or rotating); consequently, the manifestations of this disorder are quite variable. Those with shift work disorder complain more of mood problems such as impatience and depression, as well as more self-reported health complaints such as ulcers and substance use.
- .5 Narcolepsy is a chronic sleep disorder that usually becomes evident during adolescence or young adulthood. The main characteristic of narcolepsy is excessive and overwhelming daytime sleepiness (even after adequate night-time sleep). A person with narcolepsy is likely to become drowsy or to fall asleep at inappropriate times and places, and, in extreme cases, during periods of activity. Daytime sleep attacks may occur without warning and may be irresistible. In addition, night-time sleep may also be fragmented.

Individual differences

41 Individuals respond to fatigue differently and may become fatigued at different times, and to different degrees of severity, under the same circumstances. There are also individual characteristics related to circadian rhythms. People can be characterized as morning or evening types depending on the period of the day when they perform at their best.

Effects of fatigue

42 When a person is affected by fatigue, performance on the job can be significantly impaired. Impairment will occur in every aspect of human performance (physically, emotionally and mentally), such as in

decision-making, response time, judgement, hand-eye coordination and countless other skills. When impairment due to fatigue, such as impaired memory or poor communication, coincides with other risks in the environment, incidents can result. This is evidenced in the number of maritime casualties in which fatigue was a contributory factor. Maritime studies have also confirmed the association between fatigue and poor performance.

43 People are poor judges of their own level of fatigue, performance and decision-making. The following is a sample of fatigue's known effect on performance:

- .1 Fatigued individuals become more susceptible to errors of attention and memory (for example, it is not uncommon for fatigued individuals to omit steps in a sequence).
- .2 Fatigued individuals will often select strategies that have a high degree of risk on the basis that they require less effort to execute.
- .3 Fatigue can negatively affect an individual's ability to identify and respond to stimuli.
- .4 Fatigue can also negatively affect problem-solving, which is an integral part of handling new or challenging tasks.

44 Particularly dangerous situations at sea arising from sleep debt are brief, uncontrolled and spontaneous sleep episodes while working, termed microsleeps. During a microsleep, the brain disengages from the environment (it stops processing visual information and sounds). Sleep deprivation, which is caused by cumulative sleep debt, can make people more susceptible to microsleeps. The likelihood of microsleeps is even greater if the individual is on duty during a circadian low.

45 The range of effects and signs of fatigue can typically be grouped into three categories: cognitive (e.g. loss of vigilance), physical (e.g. yawning, micro-sleeps) and behavioural (e.g. irritability, mood). The following table outlines some of the major symptoms under each category; however, it is not exhaustive. Additionally, many of these symptoms may be subtle.

Table 1: Effects of fatigue

Cognitive	
Performance impairment	Signs/symptoms
Inability to concentrate	<ul style="list-style-type: none"> – Unable to organize a series of activities – Preoccupied with a single task – Focuses on a trivial problem, neglecting more important ones – Reverts to old but ineffective habits – Less vigilant than usual – Decline in ability to solve complex problems – Lapses of attention – Difficulty in multitasking
Diminished decision-making ability	<ul style="list-style-type: none"> – Misjudges distance, speed, time, etc. – Fails to appreciate the gravity of a situation – Overlooks items that should be included – Chooses risky options – Greater indecisiveness
Poor memory	<ul style="list-style-type: none"> – Fails to remember the sequence of a task or task elements – Difficulty remembering events or procedures – Forgets to complete a task or part of a task – Memory lapses
Slowing of cognitive processes	<ul style="list-style-type: none"> – Responds slowly (if at all) to normal, abnormal or emergency situations

Physical	
Performance impairment	Signs/symptoms
Involuntary need to sleep	<ul style="list-style-type: none"> – Slow eyelid closures – Droopy eyelids – Itchy eye – Nodding off – Inability to stay awake
Loss of control of bodily movements	<ul style="list-style-type: none"> – Affected speech, e.g. it may be slurred, slowed or garbled, or difficulty finding the right words – Feeling heaviness in the arms and legs – Clumsiness, such as increased frequency of dropping objects like tools or parts – Difficulty with hand-eye coordination skills (such as switch selection) – Tremors
Health issues	<ul style="list-style-type: none"> – Headaches – Giddiness – Rapid breathing – Digestion problems – Leg pains or cramps – Insomnia – Sudden sweating fits – Heart palpitations/irregular heart beat – Loss of appetite (and sometimes an increase in unhealthy eating habits)