

Workplace Health and Safety Bulletin



Fatigue, Extended Work Hours, and Safety in the Workplace

Fatigue is a state of being tired. It can be caused by long hours of work, long hours of physical or mental activity, inadequate rest, excessive stress, and combinations of these factors. Although signs of fatigue vary from worker to worker, typical physical signs and symptoms are listed in Figure 1.

- Figure 1 Physical signs and symptoms of fatigue
- Tiredness
 - Sleepiness, including falling asleep against the individual's will (micro sleeps)
 - Irritability
 - Depression
 - Giddiness
 - Loss of appetite
 - Digestive problems
 - An increased susceptibility to illness

In addition to physical signs and symptoms, fatigued workers may have their ability to perform mental and physical tasks impaired. These impairments can take many forms and are listed in Figure 2.

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- Figure 2 Performance impairments
- Slowed reactions – physical reaction speed and speed of thought
 - Failure to respond to stimuli, changes in the surroundings, information provided
 - Incorrect actions either physical or mental
 - Flawed logic and judgment and an inability to concentrate
 - Increases in memory errors, including forgetfulness
 - Decrease in vigilance
 - Reduced motivation
 - Increased tendency for risk-taking

Incidents or injuries are the result of a number of factors acting in combination, fatigue being just one of them. Because fatigue cannot be measured, it is difficult to isolate the effect of extended work hours or lack of sleep on any changes in incident and injury rates. Although difficult to measure, fatigue *has* been identified as having played a significant role in a number of recent transportation and power utility disasters.

Sleep Loss and Sleep Disturbance

Most of us have personal experience with some degree of sleep loss and its effects on our ability to function. The degree and type of effects vary from person to person. Although there is considerable variation among individuals, research indicates that on average, workers require 7.5 to 8.5 hours of sleep per day. Workers obtaining less than their required amount of sleep develop a sleep debt that is cumulative. It is not possible to store sleep.

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A single night's shortened sleep period may not have a negative or noticeable effect upon performance the next day. This single night's lost sleep is quite easy to make up during the next sleep period. However, cutting sleep periods short for an extended period of time such as weeks or months leads to a condition of chronic sleep deprivation and its resulting performance effects. Studies of partial sleep deprivation show that workers can tolerate a certain degree of sleep loss without having their performance levels affected

significantly. Even under such conditions however there is a limit. It appears that a minimum of 4 to 5 hours of “core” sleep are required daily, permitting day time tiredness to be maintained at or near normal levels.

Even modest amounts of daily sleep loss - of as little as 1 hour per night - increase a worker’s tendency to fall asleep. Most workers can resist this tendency under normal circumstances. However, when physical activity is minimal and the body’s circadian rhythm (see Figure 3) is at its lowest point of alertness, the likelihood of an attention lapse, a micro sleep, or complete sleep is much more likely. Heavy meals, warm rooms, and long periods of driving reveal the presence of sleepiness (but do not cause it). In contrast, the behaviours associated with sleepiness - yawning, eye rubbing, and head nodding - can be reduced under conditions of high motivation, excitement, and exercise.

Figure 3 Circadian Rhythms

Virtually every function of the body – sleep, wakefulness, and alertness for example – is timed according to a day-night cycle. Such cycles, approximately 23-25 hours long, are known as circadian rhythms. Although circadian rhythms are influenced by external cues like sunrise and sunset, they are basically controlled by “biological clocks” located in the brain. Individuals function best when they follow their body’s natural pattern of sleep, wakefulness, and alertness.

Under conditions of severe sleep deprivation, workers lapse into micro sleeps. These very short periods of sleep are not as refreshing as regular sleep. The sleep-deprived worker continues to feel sleepy and performance continues to deteriorate even though a large number of micro sleeps may be taken. In cases of extended hours of work without sleep, poor performance has been noted within two broad groups of tasks: (1) tasks 30 minutes or more in length involving little novelty, interest, or incentive i.e. not particularly mentally challenging, and (2) tasks of high complexity i.e. requiring a higher degree of mental function.

Studies have shown that extensive sleep loss can be overcome if short-duration tasks are performed e.g. tasks usually less than 2 minutes in length and no more than 5 minutes in length. Workers are able to “hype” themselves up and perform the task. The ability to sustain such performance decreases significantly however as the physical or mental demands of the task increase.

In both Europe and the U.S., surveys have shown that night workers get about 5 to 7 hours less sleep per week than do their day-working counterparts. This sleep is sometimes regained on days off but does represent a chronic state of partial sleep deprivation that affects the worker’s mood and ability to perform their work. Workers unable to maintain sleep regularity will also become sleep deprived because of changing, non-regular sleep periods.

Quality of sleep is as important as quantity. Sleep may be disrupted by the use of prescription drugs, stimulants such as caffeine, and sleep-related illnesses such as sleep apnea. Alcohol may help a person fall asleep quickly but sleep will be light and disturbed, not deep and steady. Sleep can also be disrupted by conditions such as noise, light, temperature, or uncomfortable sleep surfaces. Research further shows that individuals tend to sleep poorly in surroundings that differ from their normal place of rest.

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Extended Hours of Work

Typical hours of work and the number of overtime hours have increased in many industries to match the demands of increased production or fluctuations in product or service demand. The result has been workers working more hours per day and fewer days per week, squeezing the traditional 36 to 44 hour work week into three or four days. This approach does offer some advantages over traditional work schedules. These advantages include more time for family and other activities, fewer consecutive night shifts, longer blocks of time off, and workers commute to and from work less often.

There is little agreement however as to what is meant by extended hours of work. For some industries it refers to 12-hour working days while other industries consider it as work periods exceeding 12 hours, with periods of up to 16 hours being the norm in some sectors. According to Alberta’s Employment Standards Code, the workday is

limited to 12 consecutive working hours in any one work day unless (1) an accident occurs, urgent work is necessary to a plant or machinery, or other unforeseeable or unpreventable circumstances arise or, (2) special permission is granted to extend the hours of work.

Of the studies examining extended 12 hour work shifts, none have conclusively shown that such extended work hours compromise safety from the point of view of increased incident rates, reductions in job performance, or increases in error rates. These results have several possible explanations. First, fatigue research is very complex and not yet fully understood. Second, workers are in favour of their extended work hours and may make efforts to accommodate them. And finally, employers and workers are so concerned over a possible deterioration in safety that there is an increased emphasis on preventive safety measures. If true, sustaining this increased emphasis becomes extremely important to maintaining a safe workplace. Providing that adequate measures are taken, it seems that 12 hour work periods do not automatically create an unsafe workplace. No studies examining the safety effects of 16-hour workdays have been published.

One criticism of extended work hours is that they can interfere with a worker's family and social needs. Very often there is little time for activities beyond eating, working, and sleeping. And in some cases, eating and sleeping habits suffer because of pressures and commitments outside of work, including time required for travel and family responsibilities. Employers and workers need to be aware of how extended work hours can affect a worker's health, safety, and family and social life.

Time of Day and Incidents

In those workplaces where sustained attention is necessary for safety, research has shown that the probability of an incident occurring rises and falls with the tendency to fall asleep (see "Circadian Rhythms"). The poorest job performance consistently occurs on the night shift and the highest rate of industrial incidents is usually found among shift workers. Catastrophic incidents do not happen at random throughout the day - they are more likely at times when workers are most prone to sleep, between midnight and 6 a.m. and between 1 and 3 p.m.

Incident rates among long-haul truckers for example, have been found to peak during the early morning hours. An analysis of incidents involving commercial trucks found that drivers in fatigue-related incidents had slept an average of 5.5 hours during their last sleep period, as compared with 8.0 hours of sleep for drivers in non-fatigue-related accidents. The highest rate of automobile accidents occurs in the early morning hours, a time at which the fewest number of automobiles are on the road but when most people experience the greatest degree of sleepiness.

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Health and Safety Issues

Employers must recognize that work outside of the “normal” workday and extended hours of work can lead to fatigue. It is a problem which cannot be dismissed on the basis that it is a “personal problem” - one that the worker will simply learn to deal with. A worker completing a 16-hour work shift may have only 4 to 5 hours for sleep once travel, eating, and social time is taken into account before they return to the work site. Employers must be aware of the factors influencing worker performance, work site productivity, and methods of preventing or reducing the likelihood of problems. These methods may include work site accommodation to eliminate travel time, prepared meals to eliminate meal preparation time, and quiet accommodation.

When considering extended work hours, worker exposure to chemical and physical hazards must be minimized. Exposure to hazards such as noise, vibration, chemicals, and extreme temperatures must be taken into consideration when extending hours of work. Various models and approaches for adjusting occupational exposure limits (OELs) for conditions of extended work hour exposure are available. Determining these safe exposure levels may require consultation with occupational hygiene specialists.

Personal protective equipment (PPE) such as respirators or specialized heavy or bulky clothing may test the limits of endurance of some workers. The criteria used in selecting PPE must take into account the equipment’s extended hours of use and the effects on workers wearing such equipment.

In some industries and workplaces, peer pressure or workplace culture can contribute to a situation in which great value is placed on work endurance i.e. an employee gains standing among his or her peers by being willing to work very long hours regardless of fatigue. While a strong work ethic should be highly valued, the consequences of working through extreme fatigue and a workplace culture which supports such behaviour should be carefully examined. And although imposing mandatory off-duty hours does not guarantee that a worker will rest or sleep during that period of time, it does increase its likelihood.


Coping at Work

Workers experiencing fatigue over extended periods of time tend to develop and adopt coping strategies in an attempt to minimize the effects of fatigue on their performance. Employers should expect to see some of the following workplace habits:

- (1) working more slowly;
- (2) checking work more thoroughly;
- (3) using more memory cues or reminders;
- (4) relying on fellow workers; and
- (5) choosing to carry out less critical tasks.

In effect, workers slow down the pace of their activities and decision-making to accommodate their reduced level of function. This avoids making errors that may carry the risk of physical injury to themselves and their co-workers. It is also done to avoid costly errors affecting an industrial process or interfering with production. The effectiveness of these strategies can, however, be compromised by factors such as time pressures and having to work alone.

For more information

 canadiansleep.healthology.com/focus_index.asp?b=canadiansleep&f=sleep_disorders

Canadian Sleep Society – Sleep-related video clips and articles


 www.csleep.com/contents.htm


Canadian Sleep Institute

 www.sleepfoundation.org


National Sleep Foundation

References


 American Institute of Chemical Engineers. *Guidelines for Preventing Human Error in Process Safety*. American Institute of Chemical Engineers, New York; 1994.

 Bonnet MH. Sleep Deprivation - Chapter 5. In Kryger MH, Roth TR, Dement WC (editors): *Principles and Practice of Sleep Medicine, 2nd Edition*; W.B. Saunders Company: Philadelphia, 1994.

 Canadian Centre for Occupational Health and Safety (CCOHS). *Extended Workday: Health and Safety Issues*. April 27, 1998.

 Coleman RM. *Wide Awake at 3:00 AM*. Stanford California: Stanford Alumni Association, 1986.

 Commission of Inquiry - Hinton Train Collision; December 1986.

 Folkard S. Shiftwork and Performance. In Johnson LC, Tepas DI, Colquhoun WJ, Colligan MJ (editors): *The Twenty-Four Hour Workday: Proceedings of a Symposium on Variations in Work-Sleep Schedules*. Washington, DC: U.S. Government Printing Office, DHHS Publication Number (NIOSH) 81-127, 1981, p 347-373.

- 📖 Mitler MM, Dinges DF, Dement WC. Sleep Medicine, Public Policy, and Public Health - Chapter 41. *In* Kryger MH, Roth TR, Dement WC (editors): *Principles and Practice of Sleep Medicine, 2nd Edition*; W.B. Saunders Company: Philadelphia, 1994.
- 📖 Mitler MM, et al. The Sleep of Long-haul Drivers. *New England Journal of Medicine*, 1997; 337: p 755-61.
- 📖 Monk T. Shift Work - Chapter 43. *In* Kryger MH, Roth TR, Dement WC (editors): *Principles and Practice of Sleep Medicine, 2nd Edition*; W.B. Saunders Company: Philadelphia, 1994.
- 📖 Roth T, Roehrs TA, Carskadon MA, Dement WC. Daytime Sleepiness and Alertness - Chapter 4. *In* Kryger MH, Roth TR, Dement WC (editors): *Principles and Practice of Sleep Medicine, 2nd Edition*; W.B. Saunders Company: Philadelphia, 1994.
- 📖 Smith L, et al. Work shift duration: a review comparing eight hour and 12 hour shift systems. *Occup Environ Med* 1998; 55: p 217-229.

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