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FATIGUE: WORKING UNDER THE INFLUENCE

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Abstract: Fatigue is a significant cause of accidents, harm, and hazard in all industries such as transportation (road, aviation, and rail), mining, manufacturing, construction, and healthcare. Fatigue is a mental or physical description of how people feel in their daily life when they are tired or depressed. This can be notice by observing or actions, when experiencing fatigue; individuals usually have inability to continue functioning at the level of their normal abilities because of the lack of energy and motivation. Fatigue can cause forgetfulness, a lost of remembrance or the ability to not think of something that will happen in a short or long term. Furthermore, fatigue can cost poor communication and lack of alertness. For example, a worker and a boss working on a project and they are not in the same page or understanding each other; this can lead to confusion, contributing to larger disaster or loss to the company. Communication is very important and is a basic requirement for any daily activity and mostly universal and complex for all people in the world, but when people are feeling fatigue, it's hard to have a good communication. The examples of accidents due to fatigues are the Chernobyl nuclear reactor meltdown (lack of action by shift workers), the Exxon Valdez oil spill (workers' fatigue due to excessive workload), and the Waterfall train derailment in NSW (the train crew's inability to respond due to fatigue). This paper reviews 1) factors that cause fatigue, and 2) signs and symptoms of fatigue and, in discussion, the paper attempts to communicate the impacts of fatigue at work as fatigue mimic alcohol intoxication.

1. FACTORS THAT CAUSE FATIGUE

It is understood that fatigue is typically caused by physical, cognitive and emotional activities or by lack of sleep. Chemical causes such as poisoning can contribute to fatigue development, as well as can certain diseases ("Fatigue (medical)," 2006). Other causative factors of fatigue include inadequate recovery time from the expenditure of physical and mental effort, jetlag, stress, boredom, circadian disruption, mental challenge, monotony, etc. After reviewing numerous literatures, factors which can cause fatigue have been listed and described as below.

1.1 Sleep

Chronic Insomnia is the common cause of fatigue, and disturbed sleep is the most significant factor causing fatigue. Work load, female gender, and lack of exercise were the other significant factors (Akerstedt, et al., 2004). However, quantitative sleep characteristics such as sleep latency, nocturnal awakenings, and early morning arousals were not found to be significant causes of fatigue, while depression levels, somatization levels, and subjective sleep quality were more significant causes (Lavidor et al., 2003). In the contrast, fatigue can be the cause of sleep disorder as well (Lichstein et al., 1997).

1.2 Nutrition

Literatures suggest a number of marginal nutritional deficiencies may cause chronic fatigue syndrome. These include deficiencies of B vitamins, vitamin C, magnesium, sodium, zinc, L-tryptophan, L-carnitine, coenzyme Q10, and essential fatty acids (Werbach, 2000). In addition, human body needs enough liquids throughout the day, but should avoid high

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caffeine intake. Various drug intake can cause fatigue, especially the drugs effective on muscles (Landsberg, Vaughan, & Heffner, 1990).

1.3 Age

According to the study from the sample of ethnically diverse random community (Jason, et al., 1999), chronic fatigue syndrome was most prevalent among individuals in the age range of 40-49 years and least prevalent in 18- to 29-year olds and in those 60 years and older. However, it should be noted that older workers usually work fewer hours per week than the younger individuals.

1.4 Disrupted Biological Clock

The biological clock modulates hour-to-hour waking behavior, as reflected in fatigue and alertness, which generates circadian rhythmicity in neurobehavioral variables (Van Dongen & Dinges, 2000). Many factors can disrupt circadian rhythm. Those factors include motivational factors (Minors & Waterhouse, 1983), stress (Orr, Hoffman, & Hegge, 1976), food intake (Paz & Berry, 1997), posture (Kräuchi, Cajochen, & Wirz-Justice, 1997), ambient temperature and boredom (Mavjee & Horne, 1994), background noise (Landstrom, Lindblom-Häggqvist, & Lofstedt, 1988), and lighting conditions (Leproult, Van Reeth, Byrne, Sturis, & Van Cauter, 1997).

1.5 Physical Activity

It is known that overtime work may be associated with chronic fatigue and then decrease cardiovascular function (Spurgeon, Harrington, & Cooper, 1997). Park, Kim, Chung, & Hisanaga (2001) found positive relationship between long working hours and subjective fatigue complaints. Wu, Hsu, and Chen (2005) examined the effect of high intensity physical work on fatigue and recovery. The findings indicated that in high intensity work, physiological recovery time was significantly longer than subjective recovery time. Lack of physical activity also can cause fatigue. Inactivity induces muscular wasting and loss of cardiorespiratory function, which easily contributes to fatigue (Dimeo, 2001).

1.6 Work Schedules and Fatigue

It has been shown that there are significant differences in fatigue between day and shift workers, so that shift workers prefer to transfer to day work (Jansen, van Amelsvoort, Kristensen, van den Brandt, & Kant, 2003). The nature of the shift work may disrupt sleeping pattern and schedule that contribute to the perceived fatigue level (Ahsberg, Kecklund, Akerstedt, & Francesco, 2000).

1.7 Monotony

Monotony can be a causal factor of fatigue due to low arousal, boredom, and possibly due to stress. Monotony and fatigue are usually mentioned together for driving behavior studies. Often times fatigue and monotony are used as synonyms, because they both reduce driver's attention (Brandt, Stemmer, & Rakotonirainy, 2004), although they are different terms from psychological and medical point of view. Thiffault and Bergeron (2003) showed that disruption of monotony have positive effect on alleviating fatigue during tasks requiring driving.

2. SIGNS AND SYMPTOMS OF FATIGUE

"About 20% of Americans claim to have fatigue intense enough to interfere with their having a normal life." Physical causes are estimated at 20-60%, and emotional causes are the other 40-80% (http://www.emedicinehealth.com/fatigue/article_em.htm/). The most common signs of fatigue are forgetfulness, poor communication, yawning, always tired, nodding off, lack of alertness, drowsiness, micro sleep, feeling withdrawn, feeling

moody, feeling quick to anger, feeling irritable, no sense of humor, slow reaction time, boredom, depressed, lack of interest, restlessness, tired or sore eyes, and impaired decision making skills.

2.1 Forgetfulness

Forgetfulness is the lost of remembrance or the ability to not think of something that happens in a short or long term. It's a sign of fatigue, because forgetting can be from stress, lack of rest or even sleep.

2.2 Poor Communication

Fatigue can cause poor communication. A research has shown that children who passively exposed to TV (22,000 hours between the ages of 3 & 18 today) exhibit a greater % of slower brain wave activity which is also related to such factors as fatigue, drugs, & poor communication (Gambion and Richard, 1972).

2.3 Yawning

According to healthcentral.com, yawning is a normal response to fatigue and drowsiness, but excessive yawning can be caused by a vasovagal reaction. This reaction is cause by the action of a nerve, called the vagus nerve, on the blood vessels (Shikdar et al, 2003). A review of the literature reveals that yawning is a sign of fatigue that brain stem arousal reflex with both peripheral and central loops subserving reversal of brain hypoxia or hypoxemia (Shikdar et al., 2003).

2.4 Always Tired

Being always tired is a sign of fatigue that mean exhaustion or lack of strength; laziness and unwilling to complete any task. In a review of literature Chronic pain is usually accompanied by chronic fatigue many patients report that they do not get a good night's sleep, and that they always feel fatigue and doze off during the day. As a result, they lack energy, feel weak, and experience tiredness, even after mild exertion (Turk, 2006). So, it is not only the pain that causes you to limit your activities, it may also be an enduring sense of fatigue and weakness.

2.5 Nodding Off

Nodding off is moving your head up and down. Nodding off happens when an individual is tired or sleepy with countless of yawning and lost of energy. Not getting enough sleep and eating probably may lead to feeling tired, sleepy and nodding off (Sheppard, 2004).

2.6 Lack of Alertness

Lack of alertness is a sign of fatigue in which people tend to lose focus or interest. Not paying attention or mind wondering in a different world.

2.7 Drowsiness

Drowsiness is feeling the need to sleep, while fatigue is lack of energy and motivation. As instated in chronicfatigue.health-rewards.com, drowsiness and apathy (a feeling of indifference or not caring about what happens) can be symptoms of fatigue. A study has shown that drowsiness and hypo vigilance frequently occur during highway driving and that they may have serious implications in terms of accident causation (Thiffault, 2003).

2.8 Micro Sleep

Micro sleep are brief, unintended episodes of loss of attention associated with events such as blank star, head snapping, prolonged eye closure, etc. which may occur when a person is fatigued but trying to stay awake to perform a monotonous task like driving a car or watching a computer screen. Micro sleep episodes last from a few seconds to several minutes, and often the person is not aware that a micro sleep has occurred (Corfitsen, 1999).

2.9 Withdrawn

Withdrawn is a sign of a fatigue where individuals feel socially detached or not belonging (Steka, 2004).

2.10 Moody

Moody is the feeling a change of mood or expressive of mood (Gorman, 2005).

2.11 Quick to Anger

Quick to anger stress is a mentally or emotionally disruptive or upsetting condition occurring in response to adverse external influences and capable of affecting physical and psychological health (Lee, 2005).

2.12 Depressed

Depressed is a common term for a sad or low mood or emotional state, or the loss of pleasure (Banthia, 2004)

2.13 Tired or Sore Eyes

Tired or sore eyes Meares-Irlen Syndrome is characterised by visual stress and visual perceptual distortions that can be alleviated by individually prescribed coloured filters (Evans, 2002).

2.14 Impaired Decision Making Skills

Impaired decision making skills Shift work, particularly at night, contributes to the pressures of air traffic controllers and carries substantial safety implications. The most immediate effect of shift work is the direct-hit impact on the body clock, as it attempts and fails to adapt to the altered activity and rest schedule, which can have serious adverse effects on sleep.

3. WORKING UNDER THE INFLUENCE (WUI)

Would you allow a worker on your worksite who is too drunk to drive? Obviously you would not begin to condone such activity. When a worker becomes fatigued, his cognitive and motor skills degrade as if his blood alcohol levels are above the legal limit of impairment.

A person, who is fully intoxicated with alcohol, has a similar condition as the person who is affected with fatigue. When Blood Alcohol Concentration (BAC) reaches 0.10% (Drew Dawson and Kathryn Reid, 1997), it is very dangerous to the person who is driving, working or operating dangerous equipments (Nicole Lamond and Drew Dawson, 1999). Because he/she experiences symptoms such as the lack of alertness and hand-eye coordination, there is every chance for the person to get involved in an accident (Drew Dawson and Kathryn Reid, 1997).

Various experiments (Dawson and Ried, 1997; Fletcher et al. 2003) indicated that both sleep-induced-fatigue and alcohol intoxication demonstrated very similar effects. These studies compared the effects of fatigue after and before known number of hours spent without sleep to known percentage of (BAC) Blood Alcohol Concentration before and after

alcohol intoxication. An experiment by Fletcher et al. (2003) was conducted to compare the performance levels under fatigue and alcohol intoxication. Two different counter balance experiments were conducted. One of these groups were kept awake for 28 hours and the other was asked to drink 15g of alcohol with 30 minute frequent intervals of time until there BAC (Blood Alcohol Concentration) reached 0.1%. When a psychomotor test was performed, the results for both the conditions decrease significantly. For every hour increase after midnight, the performance of a person on the task decreased by 0.004% rise in BAC (Dawson and Reid, 1997). In addition, the study by Fletcher et al. (2003) found the results which include sleep deprivation, alcohol intoxication. For this group of subjects are considered, where they participated in all the different experiments based on laboratory conditions. (BAC is generally calculated by Emergency Medical system at the site of crash or at the hospital before any liquid infusions is given to the patients. BAC is measured in milligrams of alcohol in milliliters of blood. A BAC of 80mg of alcohol in 100ml of blood is the level above which it is an offence to drive. And based on these conditions the tests are conducted.)

They subjects were asked to be awake for around 18-22 hours for sleep deprivation and the other group were asked to consume alcohol till there BAC was 0.10%. Various tests were performed to know the relation between sleep deprivation and alcohol such as GRT response latency, GRT error rate, TRK score, VIG response latency, VIG % correct, and SSC % correct. For the alcohol condition, it was observed that the performance levels decreased as the increase in BAC for almost all the test and for the sleep deprivation, as known the results were very high as the performance of the person decreases (Fletcher et al., 2003).

A study by Williamson and Feyer (2000), the percentages between alcohol intoxication and low sleep were measured. Subjects were divided into 2 different groups so that one of them got ready for alcohol test and the other for the sleep depression test. Both were given enough sleep before the test begun. The alcohol was given to the group in 4 consecutive doses such that they BAC were 0.025, 0.05, 0.075, 0.1%. They were decided based on the body fat and weight. Then, the other group was asked to be awake for number of hours and tested. The result indicated that performance after 17-19 hours without sleep on some test was equivalent or worse than that at a BAC of 0.05%. In agreement, a study (Lamond and Dawson, 1999) found that 18.5 and 21 hours of wakefulness produced performance impairment the same magnitude as 0.05% and 0.08% BAC, and approximately after 20-25 hours of wakefulness the produced performance decremented equivalent to BAC of 0.1%.

Many studies suggested that the effects of fatigue were very similar to the effects of alcohol. It was also found that fatigue had a greater effect than alcohol on the speed responses while alcohol had the greater effect on accuracy responses when memory task was considered (Fallet et al., 2003) and they were completely not decidable when driving and working with dangerous equipments (Lamond and Dawson, 1999).

In conclusion, workers under the influence should not be driving equipment or be making important decisions. Therefore, it is imperative to identify if a worker is fatigued or not at his/her worksites.

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