FATIGUE AT THE WORKPLACE

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ABSTRACT: Fatigue at work is a multidimensional phenomenon that influences the performance, health and safety of employees. It manifests itself as a reversible reduction in work capacity, being generated by physical or intellectual effort and classified into physical (muscular or static) and psychological (neuro-sensory or mental) fatigue. Its effects include reduced work efficiency, decreased attention and increased risk of occupational accidents, especially in demanding sectors such as mining, agriculture or construction. Studies highlight that preventing and compensating for fatigue are essential for maintaining productivity and protecting health, through measures such as workplace ergonomics, assigning tasks according to skills, regulating the work pace, adequate nutrition, adequate sleep and regular breaks. Implementing such strategies optimizes performance and minimizes the negative impact of fatigue on the body.

KEY WORDS: physical and mental fatigue, employee health and safety, risk reduction, ergonomics

1. INTRODUCTION

Fatigue at work is a major challenge for organizations and employees, being a determining factor in maintaining health, safety and professional performance. It occurs as a natural consequence of physical or intellectual effort and is characterized by a temporary decrease in work capacity. Fatigue can be classified into physical (muscular or static) and psychological (neuro-sensory or mental), affecting both individual efficiency and the quality of organizational activity (Purdea & Osoian, 1997). The prevalence of fatigue increases with age and is more pronounced in sectors with intense physical or mental demand (European Foundation, 2003). Preventing and compensating for fatigue involves ergonomically designing the workspace, adapting tasks to employees' skills, respecting the pace and duration of work, adequate nutrition, sufficient sleep and regular breaks (Holt & Andrews, 1993). The application of these measures contributes to increasing productivity and reducing occupational risks.

There has always been a tension between the employers' objective of increasing the productivity of the organization with the lowest possible costs and the need of workers to be protected from the dangers associated with the activity and the work environment. Fatigue represents, after stress or occupational illness, an increasingly frequent problem of workers in the workplace.

Regardless of the position or activity of the human body - rest, work, concentration - man constantly develops and consumes energy. Energy consumption occurs throughout life, and it is possible to distinguish between the energy necessary for basal metabolism and the energy necessary for professional work. Depending on the type of work performed (activity performed, body position, objects or equipment handled) energy consumption differs. For example, calorie consumption is 2 times lower for a job that does not require physical effort (office activities), compared to steelworker work which is very hard physical work. Also, the value of consumption is also influenced by the position of the body during work. Thus, if for a sedentary position, the consumption is 144 Kca, the consumption for a genuflexed position is double the consumption, approx. 288 Kca, and for a

forward leaning position it is 384 Kca (Purdea, Ososan, 1997, p.51).

2. FATIGUE. DEFINITION. CLASSIFICATION

During physical exertion, a series of changes and adaptation phenomena occur in the human body, as a result of the stress on various internal organs, tissues and muscular, skeletal and nervous systems. The most important changes are: increased breathing rate, accelerated cardiac activity, dilation of the heart vessels and stressed muscles, increased blood pressure, increased metabolism, increased body temperature. Quantifying these changes is used to establish the parameters of the body's adaptation to exertion, to assess the physical stress of the activities performed. The easiest to measure are respiratory rate, pulse, body temperature, visual capacity. Studies have shown that the pulse increases and returns to normal in relation to the intensity of the effort.

Although the specialized literature does not offer a commonly accepted definition of the concept of fatigue, we will understand *by fatigue a reversible reduction in the functional capacity of a certain organ or of the entire organism* (Purdea, Ososan, 1997, p.62). *Fatigue is a natural consequence of the physical or intellectual effort made by an individual to accomplish a task. This is materialized by the diminution or tendency to diminish the individual's work capacity.*

Fatigue is not a pathological condition, it only has temporary consequences on work capacity. Thus, the main characteristic feature of fatigue is reversibility. Fatigue is actually a phenomenon that precedes exhaustion, having an important role in preventing the limitation of work capacity and does not represent the actual depletion of the body's energy reserves. It is actually an alarm signal for the need to take measures to avoid reaching the state of exhaustion. If it is identified in time, fatigue can be avoided, but, since it can take various forms, identifying fatigue is not always easy. In general, fatigue can be physical or mental. Physical fatigue can be muscular (generated by effort) or static (generated by immobilization), and mental fatigue can be neuro-sensory (associated with a prolonged state of pressure) or mental (generated by prolonged concentration of attention).

Dynamic muscle fatigue: represents the weakening of muscle strength. Although it can be intense, if it does not cause damage to muscle mass, it is not extremely dangerous and can generally be recovered through rest. Medically, fatigue is measured by analyzing the breathing rate, pulse variation, heart rate, and blood vessel tension variation.

Static fatigue: represents a form of physical fatigue, generated by a state of immobility in a sufficiently uncomfortable position of the body or parts of it, when certain muscle groups are maintained in a state of contraction, consuming calories without any effective work being performed. Due to static fatigue, it is necessary to ensure at the workplace a position that allows free play of the muscles, their blood supply and the possibility of changing positions, in order to periodically relax the contracted muscles.

Neuro-sensory fatigue: occurs in the case of intensive use of a sense organ (eyes, ears) or sustained nervous tension. This type of fatigue is less obvious than muscle fatigue but is much more dangerous, and can cause irreparable disabilities. Because neuro-sensory fatigue strongly alters the normal development of movements, statistics show that approximately 85% of work accidents are due to this type of fatigue (Purdea, Ososan, 1997).

Mental fatigue: occurs when an individual is continuously required to perform an activity for a long time that requires intellectual concentration,

complex cognitive processing, and prolonged attention to ensure the smooth running of the work. Studies show that even production workers can be exposed to this type of fatigue, since all work involves a certain degree of mental participation. In most situations, mental fatigue occurs in conditions of concentrated attention: distributive attention, required simultaneously for different problems: management responsibilities; fast pace of work; unpleasant work environment or atmosphere. The appearance of this fatigue is manifested by a state of drowsiness that can be corrected by rest.

Regarding the effects of fatigue, it is associated with:

- General weakening of the body against harmful agents of any nature, including the new coronavirus (SARS CoV-2);
- Reduction in the work efficiency of workers, both quantitatively and qualitatively, a situation with which employers do not agree;
- Because the ability to concentrate and pay attention decreases, workers are subject to an increased risk of accidents.

Statistical data provided by the European Foundation for the Improvement of Living and Working Conditions (2003) show that the general state of fatigue increases with age, starting with 40 years and particularly affects workers in agriculture, mining, construction, hotels and restaurants. In order to minimize the negative effects that fatigue can have in the workplace, a series of ways have been identified to prevent and combat fatigue.

3. WAYS TO PREVENT FATIGUE

Prevention (avoidance or postponement) of fatigue can be achieved by:

- *Ergonomic arrangement of the work area*: a scientifically designed and functionally organized workplace (by ensuring a comfortable position, by using the most common signaling systems, their correct placement), contributes to avoiding the occurrence of increased fatigue;

- *Ensuring the concordance between the worker's qualification and the work activity*: through the selection and organization of human resources, workers are assigned to perform tasks that correspond to their training, skills and work capacities;

- *Rhythm and cadence of work*: the rhythm of work activities represents an important source of fatigue reduction. By repeating the same set of movements at certain intervals, their execution acquires an automatic character. Thus, nervous tension is reduced and the negative influences of unsystematic changes and too great diversity of movements are eliminated. Under these conditions, although the pace of execution increases, the worker's fatigue does not increase proportionally.

- *Proper nutrition*: through the necessary intake of calories, the individual's working capacity is maintained. Rational nutrition must take into account both the nature of the work and the particularities of the worker.

Fatigue compensation methods have the effect of reducing fatigue after it has set in, as a result of physical or mental demands during the execution of a work task. These methods involve ensuring a rational work and rest regime and are used either outside or within the work shift.

Sleep

On average, a person can go a month without eating, but they can't sleep for a month. Sleep deprivation doesn't necessarily cause psychosis, as is sometimes claimed, but at some point we get so tired that we literally fall asleep standing up, and we can't stay awake. It's the same with breathing: we can't commit suicide by stopping breathing. In the worst case, we lose consciousness, after which the body automatically starts breathing again. It's the same when we

don't sleep anymore: the body starts to recover after we faint.

It's known that people need sleep; but until recently it was quite unclear *why*. "Well, for rest," many would think. But this is not an answer to the question that may sound different: why does the body need rest, and especially in this way?

Sleep research has freed this field from many misconceptions and replaced the wrong questions with the right ones. When it was discovered that sleep is a brain-*induced* state, which does not imply a decrease in brain activity, the theory of sleep as "fatigue-rest" was also eliminated. Our brain does not rest, especially during sleep. And gradually one thing became clear: our body can withstand without sleep, but not the brain!

Every person has various experiences during the day; they meet new people and live new situations. In order for these experiences to remain in long-term memory, they must be sedimented, and this happens during sleep. As we have known for more than half a century, sleep is not a uniform and equal state. Brain activity goes through different changes: every night there are four to five cycles, from superficial to deep sleep, which turns into superficial sleep again. After that the brain remains active, as shown by the electroencephalogram, but the sleeping person is much more relaxed and harder to wake than in deep sleep. Therefore, this state has been called *paradoxical sleep* because the brain is awake as in the waking state, but isolated from the outside world: it does not receive impulses (higher threshold of wakefulness) and does not send impulses (maximum muscle relaxation). Because in this phase the eyes perform rapid movements (rapid eye movement, REM) and dreams are frequent and intense, it is also called REM sleep or the dream phase.

After spending 10 to 15 minutes in this state, the process starts all over again: light sleep, deep sleep, light sleep and the second phase of REM sleep. The cycle repeats itself about five times until morning, and the percentage of deep sleep decreases, while that of REM sleep increases.

Ways to compensate for fatigue:

a) Ways to compensate for fatigue outside the work shift involve establishing an appropriate (rational) duration of the working day, establishing the duration and structure of the working week and the duration of annual rest leaves.

- *Working day* - by establishing the schedule and the duration of the working day, two goals are pursued: avoiding the fatigue accumulated by the worker, as well as obtaining an optimal yield. Studies have concluded that, both in terms of fatigue and work efficiency (per day and per hour), under usual conditions, the 8-hour working day is the most appropriate. Through a normal duration of the working day of 8 hours, each worker is ensured the necessary time for rest and relaxation. In certain branches of the economy where working conditions differ from the usual ones, where although adequate occupational safety and health measures have been taken, workers are exposed to the action of harmful factors, a reduced work schedule of 6 or 4 hours can be applied, without the work implying a reduction in salary.

-*Reduction of working time* - this can take place in different forms: increasing the number of days of annual rest leave; reducing the length of the working day; reducing the working week by turning a working day into a day off (the latter implies savings in overhead costs, lower costs by reducing leave, sick leave, better possibilities for carrying out maintenance and repair work on equipment, physically and mentally rested workers).

- *Annual rest leave* - the use of a longer rest period is necessary due to the

fact that other forms of rest (daily rest, weekly rest, legal holidays) do not offer the possibility of complete recovery of the body's fatigue.

b) *Ways to compensate for fatigue during the work shift*: in order to maintain a work pace at an appropriate level, it is necessary to provide rest breaks along the way, to recover from fatigue, which inevitably occurs as a result of the work done. The problems that need to be solved regarding the efficient distribution of hours within the work schedule concern the number and duration of rest breaks, their timing, and their content.

-*The number and duration of breaks* depend on the time available for rest during the shift. Starting from the energy consumption during the shift, the stress factors, the intensity and difficulty of the work done, the time required for rest can be determined. If for certain activities two rest breaks are sufficient, before and after the lunch break, for more demanding activities, the number of breaks can reach four or five. Generally, more breaks are required during the night shift.

At the end of the 19th century, the Italian scientist Mosso formulated two laws regarding fatigue:

a) light weights lifted frequently cause less fatigue than heavier weights lifted infrequently;

b) rest breaks can ensure recovery from fatigue.

To illustrate the first law, moving a quantity of water from one basin to another in 50 movements with a large container will be more tiring than 100 movements with a small container. The second law was verified by observations of the gradual increase in the labor productivity of workers at the beginning of uninterrupted work, then stagnation, followed by a decrease in productivity. Although the time periods associated with these stages differ depending on the type of work and the characteristics of the workers, the pattern of productivity evolution is preserved. Therefore, if a break is introduced before the stage of decline in productivity, the period of stable production will continue after the break, and the decline stage will be shorter. The more demanding the physical activity, the more breaks are needed (Holt and Andrews, 1993, p.128).

The subjective perception of fatigue is associated with both a reduction in productivity and physiological changes in the body. Breaks allow body fluids to return to their normal state, which occurs more quickly if the break is taken before physiological changes occur.

Thus, another important aspect of rest breaks is determining *the precise moment to take the break*. As mentioned above, studies show that breaks are mandatory and must be taken before the worker feels tired. Breaks are not indicated after fatigue has already set in because a longer period of rest is necessary for recovery and to maintain the level of productivity.

In addition to compensating for physical and mental fatigue, breaks during the shift also have other useful effects: increasing the volume of work that is performed per day without being associated with a directly proportional increase in fatigue; reducing the oscillation of work performance during a day. Studies have shown that introducing short breaks during the shift does not lead to a decrease in the volume of production, but due to the work performed uniformly, its productivity can increase (Purdea, Osoian, 1997, page 74). For example, by introducing a 5 min. break every 55 minutes of work, a 10% higher production was obtained, although the actual working time was reduced.

Given all these dangers that are associated, to a greater or lesser extent, with any workplace, both the employer and the workers must implement all necessary measures to ensure the safest possible performance of the work activity.

4. CONCLUSIONS

Fatigue at work is a complex phenomenon that simultaneously affects employee health, occupational safety and organizational productivity. It manifests itself through a temporary decrease in work capacity, affecting both physical and mental performance, and can be classified into physical (muscular or static) and psychological (neuro-sensory or mental) fatigue. Understanding the mechanisms of fatigue and the factors that trigger it is essential to prevent negative effects on employees.

Studies highlight that the risk of fatigue increases with the intensity and duration of work, as well as with the age of employees, being more pronounced in industries with high physical or intellectual demands, such as mining, construction or agriculture. Early identification of signs of fatigue and the implementation of preventive and compensatory measures allow reducing risks, protecting workers' health and maintaining an optimal level of professional performance.

Prevention and compensation measures include ergonomic workplace design, skill-based task allocation, work pace and duration adjustment, proper nutrition, adequate sleep, and regular breaks. Strategic breaks and adequate rest not only reduce fatigue, but also contribute to increased productivity and reduced performance fluctuations throughout the workday. In conclusion, an integrated approach to fatigue in the workplace is an essential tool for maintaining employee health and safety, increasing organizational efficiency, and preventing occupational accidents. Investing in preventive measures and fatigue compensation strategies not only protects employees, but also optimizes the economic performance of organizations.

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