

Cancer-related fatigue: Why it occurs and how physical activity can reduce levels of fatigue.

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What is Fatigue?

Fatigue is one of the most common symptoms experienced by cancer survivors (Dimeo et al., 1997). *Note: The term "cancer survivor" is used throughout this article.* A person is considered to be a cancer survivor on the first day of diagnosis (Survivorship: During and after treatment, n.d.). Studies show that 70% of cancer survivors report fatigue as a symptom during radiation and chemotherapy, however, fatigue frequently persists for years beyond treatment (Devlen et al., 1987; Irvine et al., 1991; Smets et al., 1993). Fatigue is a necessary self-regulating, physiologic instrument for healing and protection. Fatigue is typically defined as feelings of tiredness, lack of energy, or weariness (Dimeo, 2001). This fatigue impacts many facets of cancer survivor's lives. Fatigue can be divided into three categories: mental, physical, and volitional fatigue. Survivors who have a loss of memory or decreased ability to concentrate are experiencing mental fatigue. Survivors who have tiredness or exhaustion from physical activities are experiencing physical fatigue. Lastly, survivors who are unable to initiate tasks or avoid of social activities are experiencing volitional fatigue (Dimeo, 2001). Mental and volitional fatigue may be indicative of mental distress or psychological disturbance, but physical fatigue is typically a result of muscular, skeletal, and vascular system alterations caused by cancer treatments.

Why Does Cancer Cause Fatigue?

Several mechanisms have been postulated in an attempt to explain general fatigue in cancer survivors. Some of the best explanations of why cancer causes fatigue include pain, anemia, electrolyte and fluid disturbances, weight loss, nutritional changes, drug interactions from chemotherapy and radiotherapy, sleep disturbances, and concentration changes of the metabolically active molecules that result from the interaction between a tumor and defense system of the body. Psychologic factors related to cancer and cancer treatments such as emotional distress and depression, may also contribute to cancer-related fatigue (Dimeo, 2001).

What is happening in our body to make us feel fatigued?

Physical fatigue in cancer survivors can be understood as a consequence of changes in the body's energy systems due to cancer treatments. Normally, our muscle cells rely on two main pathways to generate energy for movement and other functions. One pathway, known as aerobic metabolism, uses oxygen to convert carbohydrates and fats into a molecule called adenosine triphosphate (ATP), which stores energy. This process takes place in the mitochondria, the cell's energy factories.

However, when oxygen levels are reduced, such as during intense physical activity or when there are impairments in oxygen delivery to cells, another pathway called anaerobic glycolysis kicks in. In this process, glucose is metabolized incompletely, leading to the production of ATP along with lactic acid.

Cancer treatments can disrupt the body's ability to supply oxygen to cells through various mechanisms. For example, chemotherapy may damage the bone marrow, leading to decreased production of red blood cells and resulting in anemia, which reduces the blood's oxygen-carrying capacity. Some chemotherapy drugs can

also harm the heart, leading to decreased cardiac output and less blood reaching the muscles. Lung function may also be compromised, further impairing oxygenation of the blood.

These factors collectively limit the amount of oxygen available for ATP synthesis, forcing the body to rely more on anaerobic metabolism. While this pathway can provide energy, it is less efficient and leads to the accumulation of lactic acid, causing additional metabolic stress.

As a result, cancer survivors often experience increased heart and respiratory rates as their bodies work harder to meet oxygen demands. However, the energy produced is less effective, leading to reduced stamina and feelings of tiredness even during normal daily activities. This fatigue can significantly impact the individual's ability to carry out everyday tasks and occupations (Dimeo, 2001).

Why is fatigue a problem?

Fatigue may become pathogenic and turn into a long-lasting problem when it persists for years after completion of treatment and prevents a patient from participating in normal daily activities, known as occupations (Dimeo, 2001). Survivors, family members, and clinicians are recognizing the significant consequences of cancer-related fatigue on recovery and engagement in occupations. "In occupational therapy, *occupations* refer to the everyday activities that people do as individuals, in families, and with communities to occupy time and bring meaning and purpose to life. Occupations include things people need to, want to, and are expected to do" (World Federation of Occupational Therapists, 2012, About Occupational Therapy section).

Treatment Options

The specific cause of general fatigue in cancer survivors is unknown, making the treatment approaches for this symptom eclectic. Many therapies have been proposed for treatment of cancer-related fatigue including biofeedback, support groups, rest and relaxation, or use of pharmacologic treatments (Forester et al., 1985). These treatment options often led to increased fatigue and slower recovery (Forester et al., 1985). Recently, scientific evidence changed the ideas surrounding the relationship between physical activity, rest, and cancer-related fatigue, with a new report that physical activity can prevent the intensity of cancer-related fatigue for cancer survivors during and after treatment (Dimeo, 2001).

Physical activity for cancer-related fatigue

The WHO defines physical activity as "any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity refers to all movement including during leisure time, for transport to get to and from places, or as part of a person's work. Both moderate- and vigorous-intensity physical activity improve health." (WHO, 2020).

How does exercise reduce cancer-related fatigue?

Physical activity brings about important changes in both the cardiovascular system and muscles, which play a crucial role in combating fatigue and improving overall well-being. When we engage in physical activity, our bodies adapt in several ways (Bower, 2014; Dimeo, 2001; Horber et al., 1987; MacVicar et al., 1989):

- **Increased Muscle Mass:** Regular physical activity leads to an increase in muscle size and strength, which enhances our ability to perform tasks and activities without feeling tired too quickly.
- **Increased Plasma Volume:** Physical activity also boosts the volume of fluid in our blood (plasma), which improves circulation and the delivery of oxygen and nutrients to our muscles and organs.

- **Increased Cardiac Reserve:** The heart becomes stronger and more efficient with physical activity, allowing it to pump more blood with each beat. This increased cardiac reserve means our heart can handle greater demands during physical exertion.
- **Improved Lung Function:** Physical activity enhances lung ventilation and perfusion, meaning we can breathe more deeply and efficiently. This improves the exchange of oxygen and carbon dioxide in the lungs, supporting better oxygenation of the blood.
- **Increased Concentration of Oxidative Muscle Enzymes:** Physical activity leads to an increase in enzymes within our muscles that help in the aerobic metabolism of energy. This means our muscles can produce more energy efficiently, reducing reliance on anaerobic glycolysis.

Benefits of physical activity beyond physiological changes

1. **Reduction in Fear and Anxiety:** Engaging in regular physical activity can help alleviate feelings of fear and anxiety, promoting a sense of calmness and well-being.
2. **Improved Social Interaction and Confidence:** Participating in physical activity often involves group activities or classes, which can foster social connections and boost confidence in one's abilities.
3. **Increased Feelings of Independence, Control, and Self-esteem:** By taking charge of one's physical health through physical activity, individuals may feel more in control of their bodies and their lives, leading to increased self-esteem and feelings of independence.

(Bower, 2014; Dimeo, 2001; Horber et al., 1987; MacVicar et al., 1989)

Conclusion

Fatigue is a significant challenge faced by cancer survivors, often persisting long after treatment completion and affecting various aspects of their lives. Understanding the underlying mechanisms behind cancer-related fatigue, particularly the impact of cancer treatments on the body's energy systems, is crucial for developing effective interventions.

Physical activity emerges as a promising approach for managing cancer-related fatigue. By promoting cardiovascular and muscular adaptations, physical activity helps the body become more efficient in utilizing oxygen and generating energy. Additionally, engaging in physical activity offers secondary benefits beyond physiological changes, including reduced anxiety, improved social interaction, and increased feelings of independence and self-esteem.

Recognizing the importance of physical activity in combating fatigue, healthcare professionals are increasingly incorporating physical activity interventions into cancer care plans. This shift in approach highlights the potential of physical activity as a complementary strategy for improving the well-being and quality of life of cancer survivors.

Moving forward, further research and advocacy efforts are needed to promote the integration of physical activity into cancer care protocols and to support individuals in adopting and maintaining active lifestyles. By harnessing the power of physical activity, we can empower cancer survivors to better manage fatigue and enhance their overall health and recovery journey.

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