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REVIEW ARTICLE

Unravelling the complexities in understanding Fatigue: An Interdisciplinary Approach

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Abstract: Fatigue is a multifaceted health issue with a significant physical component in its understanding. It is a complex issue with universal implications, making it difficult to define and manage practically. Terms such as fatigue, exhaustion, and burnout are often used interchangeably, but each has distinct nuances. Recognizing fatigue in different contexts is crucial, as it is often a secondary symptom of many illnesses. Its casual use in everyday language undermines its clinical significance, complicating accurate diagnosis and treatment for healthcare providers. The ambiguity in understanding and addressing fatigue can exacerbate its effects, contributing to poor personal health management. Secondary desktop research was conducted to understand the existing knowledge from sources such as PubMed, PsycINFO, Web of Science, and Google Scholar. It focuses on peer-reviewed articles about fatigue, mainly reviews and meta-analyses. The study provides a comprehensive understanding of fatigue by integrating activation theory with intersectionality. The conceptualization of fatigue varies greatly depending on the discipline and perspective of the specialists. The widespread occurrence of fatigue in modern society manifests as anxiety, insomnia, burnout, and indecisiveness, highlighting how these symptoms are deeply intertwined and often aggravate depression. The present-day demands of the work environment and lifestyle choices primarily contribute to the widespread proliferation of fatigue. Fatigue is multidisciplinary and ubiquitous and intersects with psychology, physiology, sociology, anthropology, gender, culture, and occupational health, and therefore requires a holistic approach for effective understanding and management. Identifying and addressing the factors contributing to fatigue can provide valuable insights for further exploration and effective management strategies.

Keywords: Activation theory, Anxiety, Burnout, Fatigue, Multidisciplinary

INTRODUCTION

Fatigue is a physical and psychological, significantly commonplace expression that has assumed epidemic proportions amid online work.[1] For instance, new occupational roles have imposed new technological competencies, and the shift to virtual work and lifestyle has impacted the community beyond just the clinical domain.[2] Clinically, fatigue is often associated with infections. When the body expends extra energy to combat disease and fight off invading agents. Scholars have attempted to understand the broader medical underpinnings of these issues, primarily through examining neuromuscular correlates and symptoms of underlying pathologies. Despite these efforts, the definition of fatigue and its classification continue to evolve. [3,4]

MATERIAL AND METHODS

While researching fatigue, secondary desktop research has been beneficial for understanding the breadth of existing knowledge, identifying trends, patterns, and gendered gaps in the research, and informing future primary research. The sources for conducting secondary desktop research on fatigue included- PubMed, PsycINFO, and Google Scholar for peer-reviewed articles on fatigue, focusing on reviews and meta-analyses for comprehensive overviews. Books and Book Chapters provided detailed discussions on fatigue, including theoretical frameworks, research findings, and practical implications. Government Health Agencies-CDC (Centres for Disease Control and Prevention); WHO (World Health Organization). Professional Associations- Organisations like the International Sociological Association or the Association for Applied and Clinical Sociology that offer resources, position papers, and research findings on fatigue.

Theoretical Perspectives on Fatigue

The Arousal/Activation theory, a seminal theory in Energetic theories, addresses the perception of fatigue as an emerging epidemic and delves into the physiological, psychological, and sociocultural factors contributing to increased reported fatigue levels. Activation theory is rooted in the broader psychological study of arousal and performance, which suggests an optimal level of arousal for peak performance, represented as a curvilinear relationship, often termed an *inverted U*. [5] In the context of fatigue, it explores

how deviations from the optimal arousal level require the body to expend additional energy to return to equilibrium, leading to fatigue. The theory also examines the role of chronic stress that can lead to a state of hyperarousal, where the body is constantly in a state of alertness and activation.

The theory acknowledges that fatigue is not purely physical. Cognitive and emotional states of activation, such as anxiety, excitement, mental exertion, and sleep deprivation, also contribute to the overall experience of fatigue. [6] Frequent physiological arousal can lead to fatigue, which decreases vitality and causes performance to vary from fast to slow. [7] The theory explains how women recover and adapt from high activation periods and repeated exposures, which impact their susceptibility to fatigue. [8] Gaillard suggests that arousal energizes individuals, encouraging them to put forth greater effort. This can result in temporary improvements in performance, but it may also lead to physiological and psychological stress that can influence each other. [9] Finally, Activation theory has implications for understanding various conditions and phenomena, including chronic fatigue syndrome, burnout, and shift effects.

The History of Fatigue

Fatigue is depicted in Hesiod's didactic poems *Works and Days* around 700 BC, where the etiology of toil and pain is equated with weariness and divine punishment. [10] In the 1880s, during the Industrial Revolution, *Neurasthenia* was recognized as a condition of nervous exhaustion affecting intelligentsia that spread widely. Throughout history, exhaustion has been associated with energy expenditure. Marc Loriol introduced the concept of *Good and Bad Fatigue,* where *Good fatigue* results from healthy living and can be alleviated by rest. In contrast, *Bad fatigue* was associated with nervous exhaustion. [11] Pathological fatigue forms were discussed in theology [12] and medicine [13] during the eighteenth and nineteenth centuries, where physicians framed arguments regarding clinical, psychiatry, physiology, and psychology. However, social reforms converged, and fatigue became a severe industry threat (disorder). An estimated 100+ studies on fatigue in the American Index Catalogue of the Surgeon's General Office (1900) covered topics from muscular exhaustion to nervous and brain fatigue.

French medical textbooks described exhaustion as a *melancholic* state for workers overworked in factories. [14] Weber's analysis of the cultural roots of capitalism continues to be influential.[15] It argues that the *essential force* was work, imbued with a sense of moral duty. Fatigue emerged as a concern when workers performed their tasks without commitment or belief. Rabinbach explores the intersections of energy, fatigue, and modernity. The productivity unleashed by the second industrialization led to the argument, *working body as a motor* transformed the energy of nature into an industrial society. [16] Historically, fatigue was understood as the *biological governor of human motors* that limited productivity. A contemporary connection between fatigue, work, and gender emerged in the 1990s, effectively balancing productivity and fatigue. Socio-historical literature suggests that modern exhaustion is rooted in long-term fatigue resulting from self-inflicted physical conditions linked to the demands of modern life.

Defining Fatigue

While the term often refers to weariness, exhaustion, and burnout, it has a variety of meanings in different published works, contexts, and research settings. Several factors confound the understanding of fatigue, and thus, it has been assessed in various physiological and psychological terms. [17] Ehrenberg diagnoses the history of depression in the contemporary age, where fatigue is an insufficient motivational state. [18] In addition, Byung-Chul-Han reinforced fatigue from a philosophical position, arguing that it is a disease caused by negativity. [19] Weil (p. 181) discusses the mysticism of work, stating, "*Joys parallel fatigue: tangible joys, eating, resting, the pleasures of Sunday... but not money*." Work can awaken or destroy the spirit; fatigue is essential to moral, social, and religious philosophy. [20]

Fatigue has been broadly classified into two categories based on research areas. The first construct is theoretical/subjective, which conceptualizes fatigue as a result of observation or self-assessment. Hardy and colleagues examined fatigue in the workforce as a subjective, complex, and experimental phenomenon where complex emotions like motivation, drive, anger, fear, and previous memories all affect fatigue. [21] Thus, fatigue is experienced as a conscious sensation [22], subjective, and experience [23]. Hampson and colleagues describe fatigue as a dualistic view of mind and body, representing past experiences stored as memories, thoughts, and perceptions to anticipate future tolerance to challenges. [24] Using a socio-cognitive approach, Langer's work on mindfulness has been influential in managing fatigue by one's will. [25] In this sense, Camparo and colleagues describe fatigue as a psychological *illusion* of mindfulness. [26]

The second is using the term objectively/experimental in the form of occupational/environmental effects, somatic disorders, cognitive impairment, and deviance due to consummate behaviors, such as substance abuse. [27] Holding evaluated the effect of mental fatigue on the central nervous system objectively. [28] Recently, Michielsen and colleagues developed psychometric qualities of the fatigue assessment scale. [29] A fatigue state can range from mild exhaustion to mental and physical exhaustion, called *burnout.* [30] The World Health Organization's 11th Revision of the International Classification of Diseases, 2023, defines *burnout* as vital exhaustion associated with work, not as a medical

condition. [31] Conversely, Barofsky and Legro perceived mild fatigue as *boredom* or monotony caused by prolonged work hours. [17]

Therefore, it is possible to experience fatigue physiologically, clinically, and psychologically. Lewis and Haller provide clinical and physiologic measurements of fatigue and describe it as a loss of maximal force-generating capacity due to muscular activity, which affects cognitive abilities. [32,33] In psychological terms, it can be characterized as exhaustion caused by stress or intense emotional distress. [34] An overwhelming number of social and psychological factors have been linked to fatigue. Sociologists have not confined fatigue to one specific definition, but scientists and especially clinicians have institutionalized it, linking it with diseases and mental disorders.

Musico questions the possibility of a fatigue test and abandons the attempts to measure it. [35] Other studies claim fatigue can only be measured subjectively, not objectively. [36]

Fatigue: Disciplinary Orientations

Fatigue in Anthropology

Numerous anthropological studies have examined fatigue as a concept intertwined with culture across different historical periods. Cultural patterns are often assessed psychologically through traits like fatigue within specific races or eras. As a theory of dramatic change, fatigue first appeared in anthropology when Kroeber tried to explain why Native Hawaiians abandoned their taboos before the arrival of missionaries. Many Hawaiians converted to Christianity after being exposed to a new culture. Although some reformers did so for personal advantage and convenience, the underlying motivation was social staleness and fatigue associated with religious norms and taboos. Kroeber calls it *cultural fatigue*. [37] A significant reason behind the French Revolution (1789-99) was staleness and social exhaustion due to rising socio-economic inequality. It is argued that the stress caused by racial microaggressions lead to '*racial battle fatigue*' in African Americans, resulting in various forms of mental, emotional, and physical strain. [38]

Fatigue in Culture Studies

Medically and culturally, exhaustion has existed since Hippocrates (460-379 BC). The writings of Hippocrates provide valuable insight into exhaustion, as he believed that an excess of bile leads to *melancholy and weariness* which are expressed and challenged in complex ways depending on the social background and individual interactions. [39] Karasz and Mckinnel examine cultural differences in conceptual models of fatigue. [40] Fatigue syndromes were more frequently medicalized among European American women, who considered them acute enough to necessitate treatment. Schaffner examines six influential case studies of exhaustion theories from the late 18th century, illustrating how medical concepts have evolved into cultural perceptions and critiques of exhaustion.[41] *Neurasthenia*, or nervous exhaustion, was used by physicians [42]; Freud theorized it as *libido* economy [43]; Ehrenberg explored it as *weariness of self* [18], and Crary conceptualized it as the socially corrosive effect of 24/7 consumerism. [44] Long-term values and norms have been used to explain cultural and historical exhaustion concerning humans and modernity. Rabinbach explores the intersection of energy, fatigue, and modernity in the 19th century and how *Taylorism and Fordism* ideals of the 20th century contributed to people's fatigue and exhaustion. [16] Various aspects of modern life contribute to individuals' growing sense of exhaustion, including *Toyotism*. Its history and characteristics are available in technological inventions, industrialization, women's emancipation, competitive capitalism, bureaucratization, neo-liberalization, and urbanization. [45]

Fatigue: A Psychological Entity

Radkau examines the age of nervousness in Germany post-World War II. [46] In response to this nervousness and weakness, *neurasthenia* developed, characterized by a feeling of exhaustion. Numerous writers have explored the underlying causes of this exhaustion. [18,47,44] By the early 20th century, neurasthenia disappeared from medical literature when Freud's analysis of sexual morality and nervous illness was discussed under the term *libido economy*, claiming that neuroses were caused by the suppression of sexual urges where contemporary individuals are subjected to a heightened level of internal and external stress, suppressing the sexual instinct and causing emotional and physical exhaustion with decreased productivity. [47] The brain was believed to function like a battery during the 1850s, and nerve fibers carried electrical currents throughout the body. This breakthrough that electricity was the actual agent of nerve action revolutionized the field of neurology. [42] Cheyne theorizes that weak nerves cause physical and mental fatigue. [48]

Fatigue is an illusion that hinders productivity, suggesting it can be modified, delayed, or eliminated through mental strategies. [24] Olson re-conceptualized the psychological effects of fatigue and exhaustion on behavior, using indicators such as sleep quality, stamina, cognition, and emotional responses. [49] Pirson and colleagues developed the larger mindfulness scale to state that individual perceptions influence fatigue, which is controllable or uncontrollable and can be managed according to personal preferences. [50] A crucial insight is that fatigue is related to the task at hand and varies from individual to individual.

Fatigue: A Sociological Concept

Rather than a medical perspective, Ehrenberg examines fatigue illness as a sociological manifestation of contemporary depression. [18] Cowles examines the

mental symptoms of fatigue associated with chronic disease and treatment. [51] Crary argues that technology, particularly the internet, has eroded the natural rhythm of life and reduced the boundaries between work and rest. [44] Crary uses the term *24/7* as an evil of consumer culture in which people are worn out by sameness. Many studies have identified burnout as a *social malaise* rather than an individual pathology. [43,18,43,52] Schaufeli and colleagues' review contends that modern work culture is strongly related to the transformation from industrial to service industries. Therefore, fatigue could be perceived subjectively as a result of these impacts. [53] Neckel, Schaffner, and Wagner discuss burnout in a competitive society. [54] Van de and colleagues explore the association of fatigue with daily activities with chronic stroke. [22] Yu and colleagues review fatigue among older people and find fatigue as a feeling/conscious perception based on previously stored memories, beliefs, and motivation. [23] As a multidimensional and complex phenomenon, fatigue affects physiology, cognition, emotion, and social function. Fatigue is thus a ubiquitous phenomenon, explained by different scholars from their perspectives.

Fatigue in Gender Studies

The mid-nineteenth century was a time of medicalization and lifestyle changes. Nursing care was provided to middle-class patients in their own homes by nurses. Consequently, the literature of those times described the sick rooms and the exhaustion of women living in dark, isolated places. [55] With changes in women's roles and participation in economic spheres, society transformed. Fatigue has also been noted to be described in fictional literature like *Madame Bovary-1857* [56]; *The Yellow Wallpaper* [57], and *The Woman Who Went to Bed for a Year* [58] where the human experience of medicalization has been characterized as long-term exhaustion and by gendered sociocultural norms, fatigue, and exhaustion remained the central themes of all these literary works. A common theme in *Madame Bovary and The Yellow Wallpaper* was that being a woman meant being ill in the 19th century.

Lian and colleagues compared fictional literature on women's long-term exhaustion, portrayed in fictional novels throughout the 19th century, to what women experience today. [59] Despite juggling their chores and considerable work pressure, they still need to meet the sociocultural expectations of society, connecting realities to theories of the past. Global commerce, time zone differences, and job complexity increase stress levels while reducing rest and recovery time. Additionally, cultural expectations from women as primary caregivers create significant psychological strain, adding to stress and fatigue. A woman's stress and fatigue cannot be solved by one probable solution as she faces challenges in all spheres, such as societal, cultural, financial, medical, work, and psychological. Research from Future Forum shows that 46% of women under 30 are at the most significant risk of burnout and fatigue. [60] Even though there is no definite reason for this, the financial uncertainty and childcare crisis during SARS-COV-2 have significantly increased women's stress and frustration. Saad and colleagues analyze the gender gap in worker burnout during the pandemic, stating that working women have experienced double the burnout rate of men since 2019. [61] This widening gap could be attributed to gender inequities in the workplace than physiological differences.

Fatigue in the Workforce

Early research focused on industries emphasizing workers' fatigue due to prolonged work hours to increase production output. Weil's prominent activist roles in advocating for factory workers were based on their intense physical work and its resultant fatigue and frustration. [20] Marey's work describes how science evolved from the energy economy and fatigue interplay. He proposed chronophotography based on principles that analyze motion in discrete units and measure body fatigue. [62] Cameron conceptualized fatigue as a general response to prolonged stress. [8] It has been noted that exhaustion disorder and fatigue have persistent physical symptoms leading to disability and absenteeism from work. [63] Loengaard and colleagues; Broddadottir and colleagues recommended developing tools and resources to accurately differentiate fatigue conditions and measure persistent physical problems to provide adequate care. [64,65] As stated in the Office of Technology Assessment of the United States of America[66], medical professionals have a significantly higher level of continuous duty and longer working hours than industrial workers. Medical catastrophes occur when healthcare workers, including clinicians, are sleep-deprived, resulting in impaired performance. [67] A study by Mollica and Fricchione addresses the mental and physical exhaustion of healthcare workers after 18 months of fighting SARS-COV-2. [68] The Physician Foundation of America surveys the impact of fatigue on doctors. At the same time, a study by the International Council of Nurses reviews the impact of nursing staff burnout, which rose to 80% globally. [69] In addition to maximizing business productivity, Zoom meetings increased dramatically after the SARS-COV-2 pandemic forced lockdowns, contributing to *Zoom Fatigue* in both work and personal life. [70,71]

Contemporary Perspectives on Fatigue

Fatigue and related terms like wear and stress have been used with overlapping meanings since the 1880s. Han explores the effects of fatigue on modern society, highlighting that these consequences are more harmful than helpful. He calls this condition a *doping society*, where the relentless pursuit of success results in exhaustion and fatigue. [19] As a result, life is left with the bare minimum to remain healthy and functional. Stress and exhaustion are not just personal experiences; they need a broader approach linked to factors outside the body, such as work and personal life. Ehrenberg diagnoses the history of fatigue, anxiety, indecision, and

insomnia as inherent in contemporary society and symptomatic of depression. [18] Han delves into the societal impact of burnout, emphasizing the role of a culture of multitasking, user-friendly technology, and convenience, which creates a range of personality disorders. Modern individuals feel under pressure to be successful in both personal and professional life, especially women who are not *wonder women* capable of handling all situations. In addition, employers expect their workers to be punctual, persuasive, creative, independent, and capable of working with others in the team, pushing them to adapt to complex environments and continuously improve. Such prolonged tension and stress result in fatigue at the workplace. [72] Joinson discusses coping with *compassion fatigue* as a specific form of exhaustion experienced in caregiving professions due to continuous exposure to individuals who have faced trauma stemming from role conflict and role ambiguity. [73] Research has explored compassion fatigue among various groups, including healthcare workers, [74] mental health professionals, [75] social workers, [76] and novice teachers. [77]

Pandemic Fatigue

A significant public health crisis of *pandemic fatigue* resulted from severe losses in the economy, education, and employment opportunities associated with the SARS-COV-2 pandemic. [78] The WHO identifies pandemic fatigue as the gradual loss of motivation to follow recommended protective behaviors. [79] The global pandemic had adverse mental health consequences for patients, their families, and healthcare workers. [80,81,82,83] Lack of sleep and exhaustion resulting from people's engagement with stressful news, such as pandemic-related news, primarily via smartphones, combined with a fear of missing out on important information, was termed *infodemic* [84]. It is consistent with the situation among primary healthcare providers who claim to be self-limiting and uncertain about the cause and severity of their medical complaints regarding the differential diagnosis of exhaustion. [85]

The symptoms of pain and fatigue are also commonly reported by individuals with chronic conditions. [86] Clinical descriptions of fatigue for patients suffering from rheumatic diseases, multiple sclerosis, and rheumatic diseases [87] affect the quality of life with economic and health consequences. [84] Apart from disease-related fatigue, there are new sources of fatigue in recent times. Overusing the internet among university students is a dominant cause of fatigue. [88] Gen Z and younger millennials entering the workforce during a global pandemic surrounded by intense geopolitical conflict are bound to experience stress and fatigue as they feel less control over their careers and financial stability. [89] High achievement pressure has led to younger generations placing high demands on themselves to work hard no matter what. The Bureau of Labour Statistics notes that women's academic participation escalated amid and after SARS-COV-2. [90]

CONCLUSION

Fatigue is a widespread cultural, socioeconomic, and health issue with a significant physical component in its understanding. This universal concept can clarify the similar meanings of fatigue, exhaustion, and burnout. In common vernacular, a casual element also acts as a limitation for defining it as a definitive diagnostic criterion. However, there is a general agreement about its presence as a symptom of many chronic conditions. [86] Recognizing fatigue in different contexts is crucial, as it is often a secondary symptom of many illnesses. This important aspect is frequently neglected in treatment and care. The ambiguity surrounding its identification contributes to worsening fatigue and burnout, leading to poor management of this widespread issue in today's work culture. Therefore, examining the phenomenon from an epidemiological approach documents the distribution and diverse patterns, suggesting strategies for managing fatigue by regulating activation levels through stress management techniques, optimizing environments for arousal levels conducive to the task, and improving recovery practices.

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