



The Relationship between Fatigue Levels and Work Performance: Bibliometric Analysis

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Abstract. Working continuously can lead to fatigue, both physically and mentally. The objective of this study is to provide a macroscopic overview of the relationship between fatigue levels and work performance based on existing publications. There is a relationship among the three dominant clusters, namely human aspects, health survey, and work performance. The research results indicate that there are still many researchers exploring the relationship between mental fatigue and physical activity that influences work performance.

Keywords: Human performance, Fatigue, Scopus, Bibliometric, Work performance.

1 INTRODUCTION

Working continuously can lead to fatigue, both physically and mentally. Physical fatigue may manifest as deteriorating health, especially for the eyes consistently exposed to monitor lighting. Eye fatigue is defined as strain on the eyes caused by visual sensory organs that require the ability to see for extended periods and under uncomfortable viewing conditions [1].

Some early symptoms of eye fatigue include headaches, dry eyes, blurred vision, burning sensations in the eyes, double vision, and pain in the neck, shoulders, and back muscles. In addition to the physical fatigue experienced by employees, mental fatigue may also occur. Mental fatigue is defined as a psychobiological state caused by prolonged cognitive activity and characterized by subjective feelings of "fatigue" and "lack of energy" [2]. Workers experiencing fatigue generally exhibit a decrease in their ability to perform tasks. Employees are expected to maintain a constant state of focus and make swift decisions. High performance is derived from physical, mental, and cognitive aspects. Factors influencing job performance include working hours and shift schedules. Fatigue is a factor with significant potential to impact individual job performance, particularly in the context of a 24-hour operational command center. Especially when the work environment frequently demands intensive monitoring, quick decision-making, and a high level of concentration, fatigue levels become a primary concern. Changes in work schedules, demanding job requirements, and continuous exposure to computer screens can have a negative impact on performance quality and productivity. Figure 1 is a picture that shows the relationship between fatigue and work performance. This figure is taken from [3].

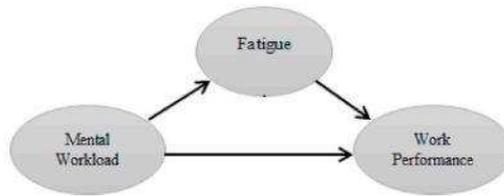


Fig. 1. Relation of Fatigue and Work Performance

For researchers and practitioners, it is crucial to observe trends and obtain a structured overview of factors relevant to the conducted research. One analysis that can assist in this regard is bibliometric analysis. The objective of this study is to provide a macroscopic overview of the relationship between fatigue levels and work performance based on existing publications. Trends in research development, gaps, and information regarding opportunities for further research are presented in this study.

2 METHOD

In this research, the researcher employed a bibliometric analysis approach to explore trends and the impact of scholarly literature related to the relationship between fatigue levels and work performance. Through statistical analysis, the researcher evaluated empirical data found in the literature to identify patterns, correlations, and statistical significance related to fatigue levels and their connection to worker performance. The results of this analysis provide in-depth insights into critical aspects associated with the relationship between fatigue and work performance, laying a strong knowledge foundation for further understanding and the development of effective management strategies in the workplace. The database utilized was Scopus, consisting of research information system (.ris) and comma-separated values (.csv) formats. Scopus, established in 2004, serves as a comprehensive database for scholarly research [4]. This database is a product of Elsevier, often regarded as one of the largest curated databases covering scholarly journals, books, and conference proceedings [5]. According [6], the VOSviewer software offers various types of analyses, including:

1. Co-authorship analysis to examine collaborations with other authors.
2. Co-occurrence analysis to study networks based on existing keywords.
3. Citation analysis to demonstrate citations between documents.
4. Bibliographic Coupling to reveal connections between documents that share references.
5. Co-citation analysis to visualize references used by the analyzed documents.

Table 1. The parameters used for data scanning

No	Parameter	Description
1	Research theme	Literature review on the relationship between levels of fatigue and work performance
2	Database	Scopus
3	Keyword	(TITLE-ABS-KEY ("body fatigue" OR "physical fatigue" OR "human fatigue" OR "mental fatigue" OR "eye fatigue" AND "work performance" OR "workload") AND TITLE-ABS-KEY ("relation"OR "relationship"))

Data processing is carried out using the VOSviewer application for bibliometric analysis and Microsoft Excel for statistical analysis. The utility of VOSviewer are in conducting, illustrating, and examining the interconnected relationships within the citation network of articles [7]. In the VOSviewer application, there are three visualization modes utilized in bibliometric analysis: network, overlay, and density visualization [8]. Network visualization is employed to display the interconnections between the analyzed terms. If paths or connections in bibliometric analysis appear thick, it indicates substantial and strong relationships between the terms. Conversely, if the connections between terms are depicted as thin with small circles, it signifies weak relationships among the observed terms. The overlay mode is used to showcase the research history. The darker the visualization in bibliometric analysis, the longer the research has been conducted. The last visualization mode is density, which plays a role in presenting the level of density or emphasis on research groups. This bibliometric analysis visualization aids in identifying research areas that are still underexplored or extensively studied. For researchers, this information can be highly beneficial in planning future research. The research flowchart is shown in Figure 2 below.

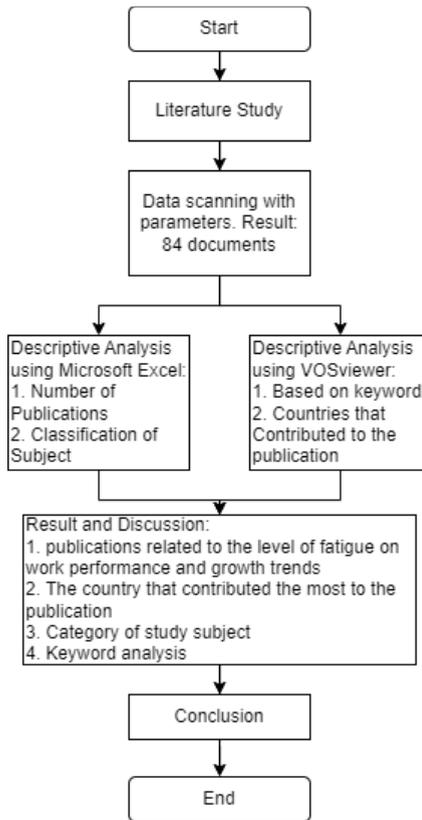


Fig. 2. Research Flowchart

3 RESULT AND DISCUSSION

The publications resulting from scanning data in the Scopus database amount to 84 documents, which were retrieved on October 14, 2023. These 84 documents comprise 68 articles, 8 conference papers, 3 reviews, 3 book chapters, 1 letter, and 1 conference review.

3.1 Trend In The Growth Of Publications On Fatigue Levels And Work Performance

Cumulatively, publications on the relationship between fatigue levels and work performance have experienced an increase. From 1988 to 2015, there were only about 1 to 2 publications per year. The increase per year began in 2016, with 7 publications. In the subsequent years, there were between 5 and 8 publications annually, as indicated in Figure 3.

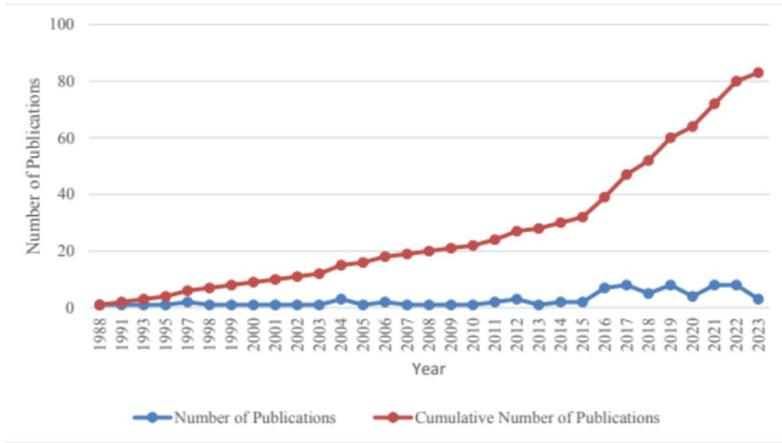


Fig. 3. Number of Publications on The Relationship between Fatigue and Work Performance.

3.2 Contributing Countries Of Publications

Publications on the relationship between fatigue levels and work performance, according to the Scopus database, originate from 35 countries. The country that dominates publications on this topic is the United States with 20 publications, followed by the Netherlands, Japan, and the United Kingdom. Figure 4 displays the top 5 countries contributing the most to publications on the relationship between fatigue levels and work performance.

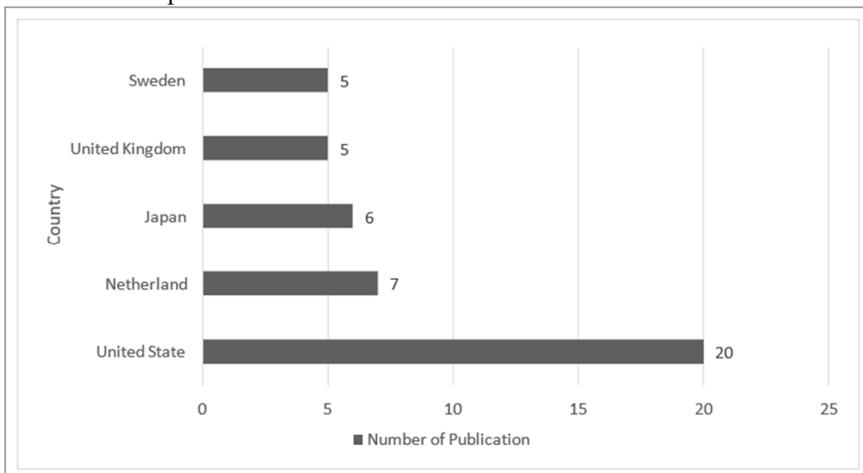


Fig. 4. 5 Countries with the Most Publications.

Countries such as the United States, Japan, the Netherlands, Sweden, and the United Kingdom are considered advanced nations with high levels of economic and academic activity. This is reflected in the development of economic infrastructure, literacy rates,

and research and innovation capacities. The United States, as one of the world's largest economies, has a strong academic sector with numerous outstanding educational institutions and research centers. Japan, with its rich technological heritage, is also a hub for high-level innovation and research. The Netherlands, Sweden, and the United Kingdom are likewise renowned for their high-quality education systems and research. Many institutions, such as fire departments, police stations, and oil drilling industries, operate 24 hours a day, requiring the presence of workers in multiple shifts [9]. For example, in the United States, OPEC's report on oil production over the past ten years has documented a significant increase.

The United States is one of the countries with the strongest military. This was evident in a study conducted by [10] in the *Military Health Journal*. Beyond the physical demands of military activities, it is well understood that mental fatigue can significantly impact human performance. The findings of this research led to several actionable insights articulated by the Chief of Training, Transformation, and Education at the Task Force Forward (TFF). These insights are poised to enhance the development and dissemination of health education based on the Task Force Forward and Health Performance Optimization (TFF/HPO) principles across various Department of Defense initiatives and programs. Adopting a broader approach to military health education that leverages the TFF/HPO framework will have a direct and positive impact on the health and performance of military personnel. Incorporating TFF/HPO principles into the structure of military health education signifies a shift towards a more holistic, proactive, preventative, and performance-based health education culture. This approach not only acknowledges the importance of physical readiness but also underscores the significance of mental well-being in achieving optimal performance. It is a proactive and comprehensive cultural shift towards promoting health and enhancing performance, aligning with the evolving needs and challenges faced by the military.

The results of the analysis in VOSviewer regarding the countries contributing to publications are shown in Figure 5, indicating that the United States contributes the most. The distinguishing factor in colors is that the brighter shades signify more recent publications.

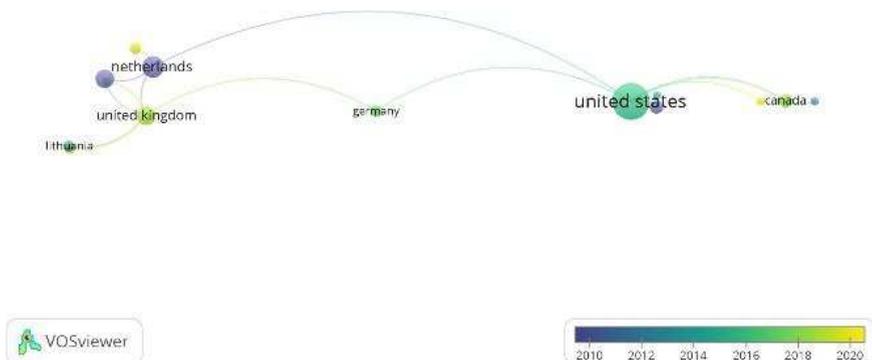


Fig. 5. Overlay Visualization of Contributing Countries.

3.3 Classification Of Study Subject

The Scopus classification comprises 334 subject areas (SAs) grouped into 27 macro-categories. Scopus allocates a varying number of subject areas to the medium of publication (e.g., journal, conference proceedings, book) rather than to the individual document [11]. Measurement of fatigue levels and work performance is not only conducted in the field of engineering but also in other fields such as health, medicine, nursing, psychology, social sciences, and computer science. Figure 6 displays the top 10 subject areas that extensively discuss the relationship between fatigue levels and work performance.

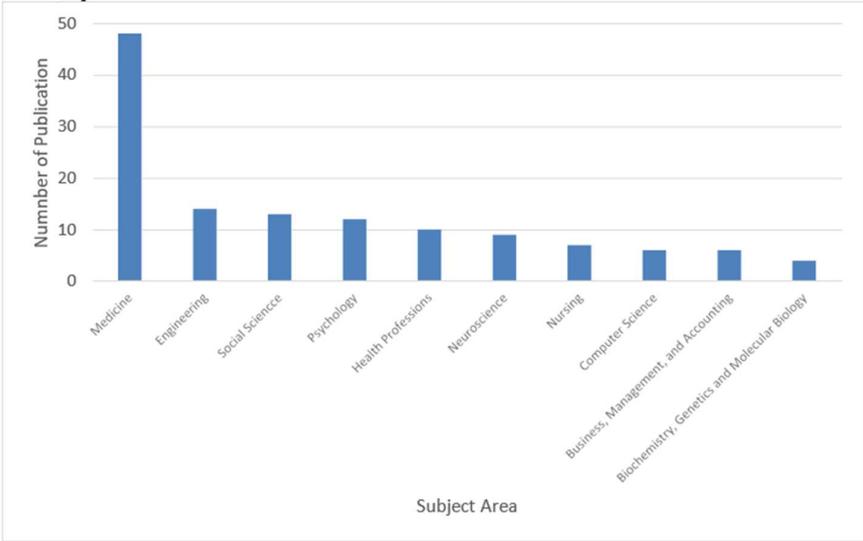


Fig. 6. Number of Publication based on Subject Area.

3.4 Keyword Analysis

The keyword analysis was conducted to examine bibliometric data using VOSViewer with the steps of "creating a map based on bibliographic data." All keywords present in the 84 publication documents were analyzed, and the minimum limit for the occurrence of keywords was set at 5 times, resulting in a visualization of 65 keywords. Based on the keyword analysis results using VOSViewer, 4 clusters were identified. Figure 7 represents the outcome of network visualization, and Table 2 contains the clusters from the keyword analysis results.

professionals seeking to enhance their performance by addressing physical and mental fatigue more effectively.

However, the gap in addressing specific types of fatigue, such as eye fatigue, is a notable point of impact. The absence of attention to this issue in the keyword results from VOSviewer underscores a potential research avenue. This gap is particularly relevant in today's digitally driven work environments, where continuous eye concentration is demanded, often due to prolonged computer screen usage. Recognizing the relevance of eye fatigue as a potential performance-influencing factor is a significant contribution that could steer future research efforts.

Furthermore, the call for future studies to explore more extensive exclusion criteria for keyword results from publications has a considerable impact. This suggestion opens doors to broader and more comprehensive analyses, allowing researchers to delve into a wider spectrum of factors that influence fatigue and, in turn, work performance. It encourages a more thorough understanding of this multifaceted relationship, ultimately benefitting the fields of human performance and fatigue management.

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