Scoping Review on Measurement Tool for Work Fatigue

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Abstract. Measurement tools for assessing work fatigue are very diverse and developed according to research needs. The are several measurements that widely used to address or find out the work fatigue in industries. This research is a scoping review of "Swedish Occupational Fatigue Inventory", "The Multidimensional Work Fatigue Inventory", "Fatigue Severity Scale", "Fatigue Assessment Scale", "Short Form 36 Vitality Subscale", and "The Occupational Fatigue Exhaustion Recovery Scale (OFER). This was reported under the guidance of PRISMA extension for Scoping Review (PRISMA-ScR). This study shows an inconsistency in use of measurement tools, even though researchers argue for practicality. The large number of studies on work fatigue allows confusion of researchers to choose a measurement tool for work fatigue that is suitable for the research population. This research helps other to describe various measurement tools of work fatigue that are often used globally. Further research can determine the measurement tool of fatigue according to needs and some considerations of advantages to be more accurate.

1 Introduction

Work fatigue is a physical, mental, and emotional condition caused by excessive tasks or constant work pressure [1]. This is a frequent problem in different fields of work and can affect the well-being and productivity of individuals as well as the organization as a whole [2] [3]. The significance of addressing work fatigue in contemporary society cannot be overstated. In today's fast-paced and highly demanding work environments, the well-being of individuals is increasingly at risk. Work fatigue not only affects the physical and mental of employees but also has a profound impact on workplace productivity and safety [4]. Addressing this issue is crucial for promoting a greater work-life balance, reducing the risk of fatigue, and fostering a more sustainable and efficient workforce [5]. Moreover, a society becomes more aware of the importance of mental health and overall about well-being. Tackling work fatigue is fundamental step toward creating workplaces that prioritize the health and happiness of employees, ultimately leading to more resilient and thriving society as a whole [6].

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Discuss the potential consequences of work-related fatigue on individual and organizations. Work fatigue can have significant consequences on both individuals and organizations [7]. On an individual level, it can lead to a range of physical and mental health issues [8]. Physically, prolonged fatigue can result in increased susceptibility to illnesses, chronic conditions like cardiovascular disease, and musculoskeletal problems due to reduced physical capacity [9]. Mentally, it can lead to increased stress, anxiety, and depression, affecting an individual's overall quality of life. Moreover, fatigue can impair cognitive functions, leading to reduced concentration, memory problems, and poor decision-making skills. All these factors can contribute to a decreased job performance and job satisfaction, potentially causing personal and professional conflicts [10].

For organizations, the consequences of work-related fatigue can be equally detrimental. High levels of fatigue among employees are often associated with increased absenteeism, where employees are physically present but unable to perform at their best [11]. This can result in decreased productivity, lower-quality work, and missed deadlines [3]. Additionally, fatigue-related errors or accidents can pose significant safety risks, particularly in industries such as healthcare, transportation, and manufacturing. The costs associated with accidents, medical claims, and reduced productivity due to fatigue-related issues can be substantial (National Safety Council, 2017). Furthermore, organizations may face legal and regulatory challenges if they are found to be negligent in addressing work-related fatigue, potentially damaging their reputation and financial stability. Therefore, it is essential for organizations to proactively address work-related fatigue to safeguard the well-being of their employees and maintain a productive, safe, and compliant work environment [12].

The need for comprehensive examination of instruments used to measure work fatigue is paramount in the pursuit of accurate and effective fatigue management strategies. Work fatigue is a multifaceted phenomenon that encompasses physical, mental, and emotional aspects, making it a complex challenge to assess accurately [10]. Inaccurate or insufficient measurement tools can lead to misdiagnosis, overlooking critical fatigue factors, and ineffective interventions. Therefore, conducting a thorough evaluation of existing instruments is essential to ensure that they capture the nuances of work-related fatigue comprehensively. This examination should involve assessing the reliability, validity, and sensitivity of these instruments, considering factors such as the nature of the work, the specific population being assessed, and the cultural context. Only by refining and enhancing these measurement tools can we develop a deeper understanding of work fatigue and, subsequently, design more targeted and effective strategies to mitigate its adverse effects on individuals and organizations [13].

There are notable gaps in existing research and knowledge related to work fatigue measurement tools that warrant further investigation. First, many of the available instruments focus primarily on quantifying physical fatigue and fail to adequately capture the broader spectrum of fatigue, including mental and emotional aspects. This limitation overlooks the complexities of modern work environments where cognitive and emotional demands are often as significant as physical exertion. Second, there is a need for research that addresses the suitability and applicability of existing fatigue measurement tools across diverse industries and occupational settings [14]. The effectiveness of these instruments may vary widely depending on the nature of the work, the cultural context, and the specific populations being studied. Identifying which tools are most appropriate for different contexts can help the fatigue management strategies more effective [15].

The scoping review aims to address the gaps in research and knowledge related to work fatigue measurement tool [16]. The advancement of technology has opened new possibilities for continuous and real-time monitoring of fatigue, but research in this area remains relatively limited. Innovative approaches, such as wearable devices and smartphone applications, can provide valuable insights into the dynamic nature of fatigue and offer timely interventions to prevent its adverse consequences [17]. Strategies for fatigue mitigation are critical to reduce the prevalence of injuries, safety-critical events, and crashes in workplace. Further research on the incidence and characterization of fatigue among workers will guide the development of effective mitigation [18]. Evaluation of fatigue mitigation strategies can lead to the adoption of the most effective one for industry or workplace [19]. Addressing these gaps in research and knowledge related to work fatigue measurement tool is crucial to develope more holistic and context-specific understanding of fatigue, enabling the design of more effective strategies to combat its detrimental effects on individual and organizations.

1.1 Method

This study was a scoping review that was conducted using two electronic literature databases, PubMed (https://pubmed.ncbi.nlm.nih.gov) and ScienceDirect (https://www.sciencedirect.com). The following stages of the methodological framework created by Arksey and O'Malley (2005) were used to construct this scoping review. Then, in order to increase its usefulness for decision-making, particularly for readers who are interested in applying the work-fatigue instruments in their research, it was reported under the guidance of PRISMA extension for Scoping Review (PRISMA-ScR) [20].

1.2 Search Strategy

The article search focused on the measurement of work fatigue. Keywords that used to get the articles are “Swedish Occupational Fatigue Inventory”, “The Multidimensional Work Fatigue Inventory”, “Fatigue Severity Scale”, “Fatigue Assessment Scale”, “Short Form 36 Vitality Subscale”, and “The Occupational Fatigue Exhaustion Recovery Scale (OFER)”. All keywords generate 133 articles from PubMed and 2.593 articles from ScienceDirect. Screenings were used to get more accurate results and minimize extraneous articles because of the criteria including the period of article publication (5 years), only the original research, full-text, free accessible, published in English Language.

1.3 Selection of Sources and Data Charting

As referenced by the framework of Arksey and O’Malley (2005), the stages of scoping research were described into five steps. Step one was identification of research questions. Step two was to identify the relevant articles through two online databases. The third phase involved selecting the articles based on the title, keywords, and abstract that fit the requirements for being relevant to the study topics. The articles were then evaluated using a specific instrument that independently met the inclusion criteria after the complete text had been read. Next, using data-charting techniques, the suitable articles were extracted. The source (article title and year of publication), study location, study design, participants (number and type of profession), work fatigue measurement used and its description (name and dimensions), and the findings of the study (prevalence/distribution of work fatigue and information on the instrument in the research) are all included in the data-charting form. then, information regarding the work tiredness measurement and key conclusions. The fourth step entails mapping of work fatigue measurements narratively by categorizing studies that were taken from the findings and have similar features. The final step is gathering, analyzing, and reporting results. (The selection process by means of a flow chart was presented in Figure 1).

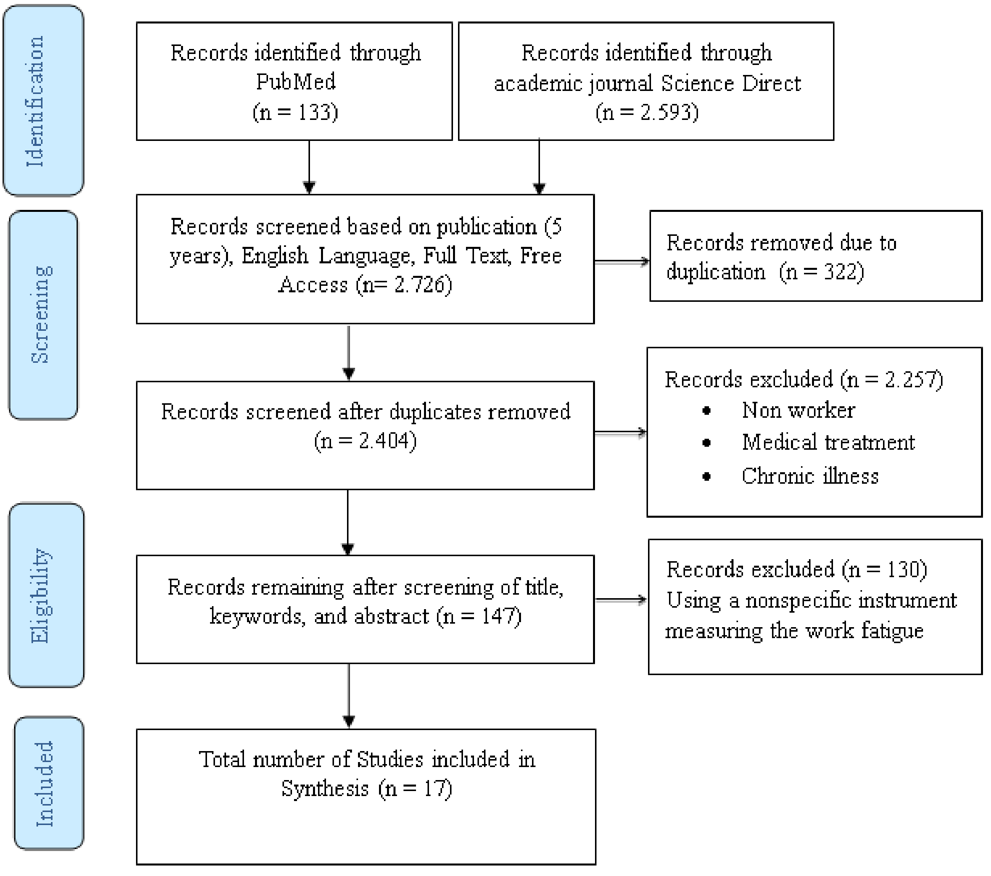

Fig. 1. Caption of the Figure 1. Below the figure.

2 Results and Discussion

From two databases (PubMed and Science Direct), 2.726 papers were selected by the same keywords. After selecting papers from duplicates, searches of electronic databases and review article references yielded a total of 2.404 papers. 2.257 papers were eliminated based on the title and abstract, leaving 147 full text articles to be obtained and evaluated for eligibility. 130 of these articles were eliminated for the following reasones: the participants of study were not worker, the study included medical treatment(s), the participants of study have chronical illness, and the study used non-specific fatigue instrument. The remaining 17 eligible articles were included in synthesis.

We reviewed 17 articles that came from 14 countries on 3 continents. Ten papers come from Asia (Iran, South Korea, Saudi Arabia, Hong Kong, China, Turkey and Japan); four papers come from Eurupe (Netherlands, United Kingdom, Finland, and Switzerland); one paper comes from Australia (the study covered Australia and New Zealand); and the last two papers come from America. The total number of participants of those studies were 9.973. As many as 47% of papers were cross-sectional survey research, 29% of papers were experimental study, 12% of papers were longitudinal study and the rest paper were mixed-method study. Data extraction of all eligible papers including the title, authors' name, year of publication, study location, study design, participants, fatigue instrument used and the key findings of the study are provided in **Table 1.**

Table 1. Overview of eligible studies measuring work fatigue.

No	Citation	Study Location	Study Design	Participants of Study	Instrument(s)	Key Findings
1	Mental Workload Profile and its Relationship with Presenteeism, Absenteeism and Job Performance among surgeons: the Mediating Role of Occupational Fatigue (Jalali et al, 2022)	Iran	Analytical Cross-Sectional Survey	165	- The SURG-TLX questionnaire - Swedish Job Fatigue Questionnaire (SOFI-20) - 5 dimensions of lack of energy, physical effort, physical discomfort, lack of motivation, and drowsiness	- Swedish Job Fatigue Questionnaire (SOFI-20) was used to determine the mental fatigue of the surgeons working - The direct effect of mental workload on job performance was not significant ($\beta = -0.21$; $p = 0.072$), but the effect of mental workload on work performance was mediated by occupational fatigue.
2	Acute Stress Effects of Impulsive Noise During Mental Work (Radun et al, 2022)	Finland	Laboratory Experiment	59	- Swedish Job Fatigue Questionnaire (SOFI-20) (tiredness, lack of energy, Lack of motivation) - Performance Measures: screening Audiometer, N-back task, Visual Serial Recall (VSR) task, Auditory Serial Recall (ASR) task - Phsycological measures: heart rate monitor, peripheral venous access catheter, and indirect blood pressure monitor.	The present results indicate that impulsive sound might generate stronger annoyance if a person is working during the sound exposure compared to just hearing the sound. Exposure to impulsive sound causes psychological and physiological load and decreases performance. Psychological stress was measured with subjective noise annoyance, workload, and fatigue. Fatigue measured by SOFI with three dimensions (tiredness, lack of energy, and lack of motivation)
3	Korean Version of the Swedish Occupational Fatigue Inventory among Construction Workers: Cultural Adaptation and Psychometric Evaluation (Lee et al, 2021)	South Korea	Cross-Sectional Survey	193	The Swedish Occupational Fatigue Inventory (SOFI)	This research showed a significant relationship of SOFI with other fatigue measures in terms of total and subscale scores. Occupational fatigue is one of the important risk factors associated with workers' health and safety at work. The new translated instrument is a reliable and valid tool for assessing fatigue among Korean construction workers. However, this instrument should be tested extensively in other working populations to devise specific interventions concerning fatigue reduction.
4	The Effects of Fatigue from Overnight Shifts on Radiology Search Patterns and Diagnostic Performance (Hanna et al, 2019)	Atlanta	Experimental Study	12	The Swedish Occupational Fatigue Inventory (SOFI)	Participants demonstrated worse diagnostic performance in the fatigued vs not fatigued state ($p<0.05$).
5	A Questionable Factor Structure of the Multidimensional Fatigue Inventory in the General Dutch Population(Kieffer et al, 2021)	Netherlands	Cross-sectional Survey	2512	Multidimensional Fatigue Inventory (MFI)	The results did not provide empirical support for a four or five (bi-)factor structure of the MFI, nor for an alternative model. The most reliable scale of the MFI seems to be the general fatigue scale that could be used as a general indicator of fatigue.

No	Citation	Study Location	Study Design	Participants of Study	Instrument(s)	Key Findings
6	Physical and Psychological Job Demands and Fatigue Experience among Offshore Workers (Bazazan et al, 2023)	Iran	Cross Sectional Survey	251	Multidimensional Fatigue Inventory (MFI–20), and Job Content Questionnaire (JCQ)	Fatigue levels were shown to be associated with exposure to both strenuous physical and psychological job demands.
7	The Physical and Mental Health of the Medical Staff in Wuhan Huoshen Shan Hospital during COVID-19 Epidemic: A Structural Equation Modeling Approach (Wang et al, 2021)	China	Observational Analytic	115	The Multidimensional Fatigue Inventory (MFI-20)	55 medical staff worked within Intensive Care and 60 worked in Non-intensive Care, the two groups were significantly different in reported general fatigue, physical fatigue and tenacity ($P<0.05$). Gender, duration working in Wuhan, current perceived stress level and health status were associated with significant differences in fatigue scores ($P<0.05$), the current perceived health status ($P<0.05$) and impacted on the resilience and anxiety of participants. The structural equation modelling analysis revealed resilience was negatively associated with fatigue
8	Heat Acclimation Attenuates the Increased Sensations of Fatigue Reported during Acute Exercise Heat Stress (Willmott et al, 2020)	United Kingdom	Experimental Study	20	Multidimensional fatigue symptom inventory-short form	Acute exercise-heat stress increases the sensations of fatigue
9	Zoom Exhaustion & Fatigue Scale (Fauville et al, 2021)	America	Mixed method	2724	The Multidimensional Fatigue Inventory; and Zoom Exhaustion & Fatigue Scale (ZEF Scale)	The Multidimensional Fatigue Inventory developed to be another instrument, which is Zoom Exhaustion & Fatigue Scale (ZEF Scale). This instrument is used to assess the fatigue of computer users. The five constructs are: Visual Fatigue, Social Vatigue, Motivational Fatigue, Emotional Fatigue, and General Fatigue.
10	The Use of Virtual Reality to Reduce Stress among Night-Shift Anesthesiologists: Study Protocol for a Crossover Trial (Chen et al, 2021)	China	Randomised Controlled Trial	30	NASA Task Load Index (NASA-TLX), Chinese Perceived Stress Scale (CPSS), perceived stress scores (visual analogue scale (VAS)), and Multidimensional Fatigue Inventory (MFI-20)	Although VR technology has been widely used in biomedical fields, it is still unknown whether the use of VR can reduce stress among night-shift anesthesiologists during working hours.
11	Prevalence of Obstructive Sleep Apnea among Saudi Pilots (Alhejaili et al, 2021)	Saudi Arabia	Cross Sectional Survey	39	Berlin questionnaire, Epworth sleepiness scale, Pittsburgh sleep quality index (PSQI), Fatigue severity scale (FSS), Visual analog fatigue scale (VAFS), and Patient health questionnaire (PHQ9)	Pilots had mild OSA (64%) and 5% had moderate and severe OSA (2.5% each). Different questionnaires showed one-third of the participants had insomnia, 33.3% of the participants had severe fatigue, excessive daytime sleepiness was found in 23.1% of the participants, and 10.3% had moderate depression, while 25.6% were classifed as having mild depression symptoms.
12	Predictors and Moderators of COVID-19 Pandemic Fatigue in Hong Kong (Lai et al, 2023)	Hong Kong	Longitudinal Survey	803	Fatigue Assessment Scale (FAS)	Daily hassles were found to be a core factor associated with anti pandemic fatigue.

No	Citation	Study Location	Study Design	Participants of Study	Instrument(s)	Key Findings
13	The Independent Association of Source Specifc Transportation Noise Exposure, Noise Annoyance and Noise Sensitivity with Health-Related Quality of Life (Cerletti et al, 2020)	Switzerland	Cohort study	2035	Short-Form Health Survey (SF-36)	The study found associations between road traffic noise exposure and various health outcomes, including obesity, diabetes, and mental health issues. Noise sensitivity and annoyance were also found to be related to HRQoL. Short-Form Health Survey (SF-36) assess physical component scores (PCS) and mental component scores (MCS)
14	The Efectiveness of an Online Interdisciplinary Intervention for Mental Health Promotion: a Randomized Controlled Trial (Przybylko et al, 2021)	Australia and New Zealand	Randomized Controlled Trial (RCT)	425	The instruments used in this study include the Depression, Anxiety, and Stress Scale-21 (DASS-21), the 7 Dimensions of Wellness Index, and the 36-item Short Form Health Survey (SF-36).	The online interdisciplinary intervention led to significant improvements in mental health and emotional wellness. 36-item Short Form Health Survey used to know the mental health conditions in the general population.
15	Psychometric Properties of the Japanese Version of The Occupational Fatigue Exhaustion Recovery Scale among Shift Work Nurses (Yamaguchi et al, 2022)	Japan	Cross-sectional survey	351	Occupational Fatigue Exhaustion Recovery scale (OFER), Multidimensional Fatigue Inventory, Pittsburgh Sleep Quality Index, and Short-form Health Survey 36	The validity and reliability of the OFER-J were verified as acceptable for shift-work nurses. The OFER-J is useful regarding surveillance and monitoring of fatigue and recovery levels and assessing the effect of shift scheduling design.
16	The Impact of Fatigue on Shipyard Welding Workers' Occupational Health and Safety and Performance (Okumus et al, 2023)	Turkey	Observational Analysis & Cross Sectional Survey	12	the Occupational Fatigue Recovery Exhaustion (OFER)	The result shows that two different welding positions affect different body parts. The OFER scale results show that age and years of experience influenced the chronic fatigue level and inter-shift recovery difficulties.
17	Comparison of Fatigue, Quality of Life, Turnover Intention, and Safety Incident Frequency between 2-Shift and 3-Shift Korean Nurses (Hong et al, 2021)	Korea	Cross-sectional survey	227	The Occupational Fatigue Exhaustion Recovery Scale (OFER) and Quality of Life Scale were used	Results showed that 2-shift nurses had lower chronic fatigue ($t= -2.38$, $p= 0.018$) and higher recovery between shifts ($t=3.90$, $p<0.001$) and quality of life scores than 3-shift nurses ($t=3.69$, $p<0.001$). There were no significant differences for turn-over intention ($t= -1.48$, $p=0.140$), frequency of needlestick accidents ($t=0.30$, $p=0.763$), medication errors ($t=-1.46$, $p=0.146$), or near-miss medication errors ($t=0.78$, $p=0.437$).

Six instruments were employed to measure fatigue on the research, according to the 17 publications that were selected. There were The Swedish Occupational Fatigue Inventory (SOFI), Multidimensional Fatigue Inventory (MFI), Fatigue Severity Scale (FSS), Fatigue Assessment Scale (FAS), 36-item Short Form Health Survey (SF-36), and The Occupational Fatigue Exhaustion Recovery Scale (OFER). Out of these instruments, we had identified several instruments but those had been excluded in the evaluating process because those didn’t specifically measure fatigue, or fatigue is only one dimension in another construct. The most frequently used instrument is MFI (6 articles), followed by SOFI (4 articles), SF-36 and OFER (each 3 articles), while FSS and FAS (each 1 article) are less prevalent. Table 2 contains a description of each instrument's properties and range of use based on an examination of the 17 studies.

Table 2. Description of work fatigue measurement tools.

Instument	First Author	Year of Publicat-ion	Population	Subscale(s) & number of item	Psychometric properties	Adopted by	Variation
The Swedish Occupational Fatigue Inventory (SOFI)	Ahsberg et al.	1997	bus drivers. teachers, hard outdoor life, fire fighters, caretakers, stud. examination, op. nuclear plant, op. emergency ass, op. of machinery, medical personnel, workers in factory, physiotherapists, goods drivers, dustmen, max. physical test, cloakroom att	25 items in five factors: - Lack of energy - Physical exertion - Physical discomfort - Lack of motication - Sleepiness (5 items each factor)	Cronbach's alpha of each factor varied between 0.77 and 0.91	1) Jalali et al, 2022 2) Radun et al, 2022 3) Lee et al, 2021 4) Hanna et al, 2019	1) 5 dimensions/ factors: lack of energy, physical effort, physical discomfort, lack of motivation, and drowsiness. (each of dimensions consists of 4 questions, 20 questions in total, score each question from 0 to 10, and 200 for the sum of the scores) 2) 3 dimensions: Tiredness, Lack of energy, and Lack of motivation (20 items in total questions). Each item's score: 1 Not at all, 2 Slightly, 3 To some extent, 4 Quite a lot, 5 Very much (100 scores in total). 3) 5 dimensions: aspects lack of energy, physical exertion, physical discomfort, lack of motivation, and sleepiness. Each item is measured based on a 7-point Likert scale (0 - 6), with total scores ranged from 0 to 120. 4) Consists of 25 expressions which are divided into 5 dimensions: lack of energy, physical exertion, physical discomfort, lack of motivation, and sleepiness. There is no explanation about the score of each item.
Multidimensional Fatigue Inventory (MFI)	Smets et al.	1995	Radiotherapy patients (RT), Chronic fatigued patients (CF), psychology students (PS), medical students (MD), and army recruits (AR)	20 items, with dimensions: - General Fatigue, - Physical Fatigue, - Mental Fatigue, - Reduced Motivation, and - Reduced Activity (likert scale 1-7)	The MFI-scales show good internal consistency of each dimension (>0.80)	1) Kieffer et al, 2021 2) Bazazan et al, 2023 3) Wang et al, 2021 4) Willmott et al, 2020 5) Fauville et al, 2021 6) Chen et al, 2021 7) Yamaguchi et al, 2022	1) Consists of 5 dimensions: - General Fatigue, - Physical Fatigue, - Mental Fatigue, - Reduced Motivation, and - Reduced Activity Items are scored on a 5-point scale (1 for "no, that is not true" to 5 for "yes, that is true"), 4-20 score each item (higher score indicates higher fatigue). 2) 5 dimensions: - General Fatigue, - Physical Fatigue, - Mental Fatigue, - Reduced Motivation, and -Reduced Activity

Instument	First Author	Year of Publicat-ion	Population	Subscale(s) & number of item	Psychometric properties	Adopted by	Variation
							Items were rated on a 5-point Likert scale (from 1 = yes, that's correct to 5 = no, that's incorrect). The total possible score for each dimension ranged from 4 to 20, higher scores indicating a higher level of fatigue. 3) 20-items of 5 dimensions: - General Fatigue, - Physical Fatigue, - Mental Fatigue, - Reduced Motivation, and - Reduced Activity Every item is rated on a 5-point Likert scale, every subscale's single total scores is summed up ranging from 4 to 20 scores. Higher total scores indicates higher level of fatigue. 4) The are 30 items of five dimensions: -General, -Physical, -Emotional, -Mental, and -Vigor additional: Total Fatigue scale. Each item scored by Likert scale from 0 (Not at all) to 4 (Extremely). 5) MFI modified to be Zoom Exhaustion & Fatigue Scale (ZEF Scale) with 15 items validated, from dimensions: -General Fatigue, -Visual Fatigue, -Social Fatigue, -Motivational Fatigue, and -Emotional Fatigue All items are measured on a 5-point Likert-scale ranging from 1 = "Not at all", 2 ="Slightly", 3 = "Moderately", 4 = "Very" to 5 = "Extremely" except for the two frequency questions (marked with asterisks) from 1="Never", 2= "Rarely", 3= "Sometimes", 4= "Often", 5= "Always".

Instument	First Author	Year of Publicat-ion	Population	Subscale(s) & number of item	Psychometric properties	Adopted by	Variation
							6) 20 items of five dimension: -general fatigue, -mental fatigue, -physical fatigue, -reduced activity, and -reduced motivation. with unspecified scoring scale/likert-scale. 7) MFI-Japanese consists of 20 items with five subscales. Total scores (range 20–100), higher values indicate more severe fatigue. Cronbach's alpha coefficient of this study was 0.88.
Fatigue Severity Scale (FSS)	Krupp LB	1989	Patients with multiple sclerosis (MS); patients with systemic lupus erythematosus (SLE); and normal healthy adults (NHA)	9 items (unspecific scoring item)	Cronbach's alpha of MS (0.81), Cronbach's alpha of SLE (0.89); Cronbach's alpha of NHA (0.88)	Alhejaili et al, 2021	9 items of the FSS with 36 minimum score
Fatigue Assesment Scale (FAS)	Michielsen HJ, et al.	2003	Workers	10 items (likert scale 1-5)	Cronbach's alpha coefficient of FAS was 0.90.	1) Lai et al, 2023	Anti Pandemic Fatigue was consist 8 questions adapted by FAS (diverse emotions: worries, concentration, and energy)
36-item Short Form Health Survey (SF-36)	RAND Corporation	1992	General population	Three dimensions: -Physical health (scale: physical functioning, role limitations due to physical health, and pain), -Mental health, (scale: role limitations due to emotional problems, and emotional well-being), and	Cronbach's alpha: -Physical function (0.93), -Role functioning-physical (0.84), -Pain (0.78), -Role functioning-emotional (0.83),	1) Cerletti et al, 2020 2) Przybylko et al, 2021 3) Yamaguchi et al, 2022	1) (No variation) 2) Two subscales used in this study: mental health (5 items) and vitality (4 items) with unspecified scoring scale/likert. 3) SF-36-J consists of 36 items, devided to five domains: -Role physical, -Vitality, -Social Functioning, -Role Emotional, and -Mental health Eeach domain were expressed on a scale from 0 – 100 points.

Instument	First Author	Year of Publicat-ion	Population	Subscale(s) & number of item	Psychometric properties	Adopted by	Variation
				-General health (scale: general health, energy/fatigue, and social functioning). 36 total items with various likert scale: -5 items with 5 scale, -10 items with 3 scale, -7 items with yes-no answer, 10 item with 6 scale, and -4 items with true-false answer (5 scale) each scale scored 0 - 100 points.	-emotional well being (0.90), -General health (0.78), -Energy/fatigue (0.86), and -Social functioning (0.85).		
The Occupational Fatigue Exhaustion Recovery Scale (OFER) and Quality of Life Scale	Winwood, et al.	2005	Full time nurses Worker	15 items (three subscales: -Chronic Fatigue or Exhaustion (OFER-CF) item 1-5, -Acute fatigue (item 6-10), and -Intershift recovery (item 11-15). with a 7 likert scale. The standardized score (range 0–100)	Cronbach's alpha with a cut point for acceptability 0.80 - chronic fatigue: 0.93 - acute fatigue : 0.82 - intershift recovery: 0.75	1) Yamaguchi et al, 2022 2) Okumus et al, 2023 3) Hong et al, 2021	1) The scale consists of 15 items, with 5 items each for CF, AF, and IR. All items are based on a 7-point-likert scale (0 = strongly disagree to 6 = strongly agree), and items 9, 10, 11, 13, and 15 were reverse-coded. For AF and CF, a higher standardized score indicated a higher degree of chronic or acute fatigue, while a higher standardized score for IR indicated a better degree of recovery. The standardized score range 0–100 for each subscale. 2) The OFER scale originally contained 15-item questionnaire, five for each section: chronic fatigue, acute fatigue, and intershift recovery fatigue. Unspecified scoring likert scale and points.

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Instument	First Author	Year of Publicat-ion	Population	Subscale(s) & number of item	Psychometric properties	Adopted by	Variation
							3) Fatigue scale consist 15 questions (5 for chronic fatigue, 5 for acute fatigue, and 5 for recovery between shifts) with a 7 point Likert scale (0-6)

MFI is the instrument most widely used in the studies captured in this scoping review. Although the author did not write explicitly the reasons for choosing this instrument, but psychometric properties are generally primary considerations [21]. The MFI has a valid factor structure and psychometric properties. MFI have good internal consistency in several populations [22-25], with an average Cronbach's alpha coefficient of 0.84 [26-27].

Several characteristics can be used to categorize the six fatigue instruments. First, was divided into two groups based on the target demographic of the fatigue instruments. Instruments created specifically for workers: SOFI [28], FAS [29], and OFER [30], make up the first group. Whereas instruments created for the general public are MFI [31], FSS [32], and SF-36 [33]. As a preference, the target population's specificity should also be taken into account because an instrument will produce valid measurements for a specific target group and not valid for other groups [21].

The instrument's dimensions or subscales serve as the foundation for the second feature. The first group includes the SOFI, MFI, SF-36 and OFER, a multidimensional instrument with two or more subscales, while the second group includes the FSS and FAS, a unidimensional instrument. Instruments that have more dimensions or subscales show item complexity so they are better able to capture many components of fatigue than unidimensional instruments [21]. Most of the authors have chosen more complex instruments [22-27, 34, 35], whereas only two papers used the simple unidimensional instruments [36-37].

The variation of uses is the third category. The articles were divided into two type: those who fully accept the instruments and those who modify them. The FSS and FAS were used by researchers in this review in full. While there are many applications for SOFI, MFI, SF-36 and OFER based on the number of the items and the dimensions. There were several variations of SOFI, the original one of measurement tool consists of five factors or dimensions and 25 items, then in the recent research, SOFI developed to be three dimensions and consists of 20 items/questions. Total score in this developed measurement tool ranged from 0 to 10, so that the sum of score will be 200 [34]. In the other research, SOFI developed to be 100 in total score [35]. Another developed measurement tool of fatigue had the range of 7-likert scale with score ranged 0 – 6, and the sum score ranged 0 to 120 [38]. This condition could be different because of the score range or likert-scale.

MFI is one of the most frequently used measurement tools of fatigue in describing work fatigue in various types of work. The original measurement tool consists of 20 items with five dimension and seven likert-scale (1-7). There is no explanation either for counting the score in each item or sum score. Then, in general, the development of work fatigue measuring instruments varies greatly. There is no difference in the dimensions, but there are various ways of setting the likert scale and total items [22-27, 39]. In the other hand, original SF-36 and OFER not developed much in last half-decade. SF-36 with five dimension or subscale consists of 36 items then developed to two subscales and nine items [40]. The other study consistent with 36 items and score ranged from 0 – 100 points. OFER still consists of 15 items with seven the likert scale [39,41,42]. This disscussion shows an inconsistency in use, even though researchers argue for practicality. Generally, respondents prefer shorter questionnaires because they are more time efficient [21].

This article shows that the large number of studies on work fatigue allows confusion of researchers to choose a measurement tool for work fatigue that is suitable for the research population. This research helps other to describe various measurement tools of work fatigue that are often used globally. Further research can determine the measurement tool of fatigue according to needs and some considerations of advantages to be more accurate.

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