



To study the prevalence of fatigue among chemical factory workers aged 25-45 years in Raigad District

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Abstract

Background: Fatigue is a multidimensional occupational health concern that reduces productivity, compromises safety, and affects physical and mental well-being. Chemical factory workers are at higher risk due to repetitive tasks, long working hours, and physically demanding environments

Aim & Objective: To study the prevalence of fatigue among chemical factory workers in Raigad district by using the Fatigue Assessment Scale (FAS).

Methods: An observational study was conducted among 92 male workers aged 25–45 years with at least one year of experience and working more than eight hours. Participants were selected through convenience sampling. Data collection included informed consent and administration of the FAS. Descriptive statistical analysis was performed using Microsoft Excel.

Results: Out of 92 workers, 66.3% experienced moderate fatigue. Most workers-maintained motivation, concentration, and daily energy, though early signs of physical and mental exhaustion were evident.

Conclusion: The study concluded that chemical factory workers commonly experience moderate fatigue, which, if unaddressed, may progress to burnout and reduced productivity. Workplace interventions such as ergonomic adjustments, rest breaks, and wellness programs are recommended to mitigate fatigue and support occupational health.

Keywords: Fatigue, occupational health, chemical factory workers, fatigue assessment scale, prevalence, Raigad District

Introduction

Fatigue is diagnostically nonspecific and associated with many health conditions. Broadly defined as a 'feeling of weariness, tiredness or lack of energy' Fatigue impairs work ability, workers with fatigue are significantly more likely to miss work and experience long- term work absence than workers without fatigue ^[1].

An organism's overall state, including that which results from overusing a particular organ or muscle, is known as fatigue. When assessing the values, it is important to consider the diurnal fluctuations of physiological functions. Specifically, the fatigued state should be evaluated as an undesired departure from the homeostasis that all functions tend towards. Fatigue is generally considered to have negative effects and is premonitory of maladaptation or impairment of the organism in the working environment. Mechanized work in industry today is often simple repetitive hand work which requires an unnatural working posture. Work like this results in neuromuscular fatigue in which the state is characterized as chronic fatigue of whole body. This means that work is now concentrated in peripheral muscles and nerves and in sensory organs such as eyes ^[2]. Fatigue is a key symptom of distress, often resulting from inadequate rest or sleep, intense physical or mental exertion, or a lack of motivation to engage in any activity ^[3]. Chemical industrial work often involves operating and maintaining chemical processing equipment's, handling and storing chemicals and raw materials, standing, walking, and lifting objects, working in fast-paced, dynamic environment. A cumulative lack of sleep makes the person exhausted and results in unstable, unpredictable sleep episodes that lessen the attention level, raise the mistake rate and may hinder employee efficiency at work ^[4].

In Fatigue is of interest to occupational health because it can lead to serious acute or chronic conditions as well as situations where workers are not given enough time to recover, which can result in poor performance, decreased service quality, and employee dropout. Effect of fatigue can be serious that the workers may experience disability leading to long term or even indefinite absenteeism from work ^[5].

Stress related disorders are labelled under quite a number of inter-related terms and definitions such as adjustment disorders, neurasthenia, nervous breakdown, overwork and burnout. Prolonged fatigue is one of the core symptoms, and stress related disorders are responsible for approximately 30% of permanent disability benefits in the Netherlands ^[5].

Fatigue is a serious symptom which is prevalent across a variety of occupations and industries. The U.S. centres of disease control and prevention estimates that one in three adults does not get enough sleep, labelling fatigue as a public health problem. Mental and physical fatigue as physical loads have changed to conflicts about how to operate new instruments, and each stress is accompanied by loads, restraints and difficulty of the work as added loads. Work related fatigue has become an issue resulting from prolonged work- related stress, absenteeism from work and ill mental and physical health have been described as consequences. Work related fatigue is a source of concern in most industrialized countries ^[6].

Furthermore, jobs that alternate shifts often have low control and high demand, which may amplify levels of stress and fatigue. However, due to individual fatigue tolerances and coping mechanisms, workers experience different levels of work-related fatigue, even when they have the same job and work schedule, making fatigue a difficult hazard to manage ^[7]. There is substantial evidence indicating that reduced

sleep duration and disruptions to the body's natural sleep-wake cycle are linked to significant increases in both morbidity and mortality [8].

Fatigue, as a sign of allostatic load, is consistently associated with work-related stressors such as excessive workload, even when controlling for depression [9]. Fatigue is caused by several factors ranging from those that are personal to the individual or those externally induced by the work environment and job design. Some of the factors are overtime work, sudden changes in the work environment due to high-technological innovations such as automation and introduction of ultramodern techniques, employment of middle-aged workers in the aging society, problems of working hours for part-timers, changes in work, personnel cuts, reconstruction of enterprises among others [10].

Within dynamic and complex construction environments, fatal and non-fatal occupational records are alarming all over the world. Fatigue among workers is one of the key causes which affects their ability to operate safely [11]. Mental disturbances which include stress, anxiety, depression and other psychological factors are also one of the leading causes of fatigue [12]. Fatigue is a major public health concern that requires research and the implementation of effective treatments. Physical therapists can help people manage their overall quality of life by providing education, exercise prescription, energy conservation techniques, postural correction, manual treatment, relaxation techniques, and self-management strategies [13].

The consequences of work-related fatigue are significant affecting personal productivity, occupational health and safety, healthcare costs and personal well-being. The most serious maladaptive effects of occupational fatigue arise when it becomes chronic. Such fatigue has been described as an enduring trait characterized by inefficient action patterns; declining interest, involvement and commitment; reduced Concentration and motivation; and negative emotions.

An exploratory factor analysis with all fatigue (sub) scales showed that the FAS (Fatigue assessment scale) had the highest factor loading. All fatigue questionnaires used in the fatigue at work programme measure fatigue unidimensional in a reliable and valid way. The FAS is the most promising questionnaire to measure fatigue in working population [14].

The FAS is a 10-item scale, varying from 1-never to 5-always. The developers Michielsen and colleagues analysed the scale's psychometric properties and found an internal consistency of 90 [14].

Need of The Study

Today's industrial work frequently entails repetitive tasks, substantial labour involvement, extended work hours, intensive physical effort, ergonomic challenges, and manual handling. Workers in the chemical industry perform diverse tasks, including operating and maintaining machinery, managing the handling and storage of chemicals and raw materials, preparing products for distribution, labeling and packaging. Their work also involves physical demands such as prolonged standing, walking, and lifting.

Fatigue is a state of physical and mental exhaustion that limits the ability to perform tasks effectively. It is often considered harmful as it indicates poor adaptation or decreased performance in the workplace. Typically resulting from extended effort, stress, or inadequate rest, fatigue can appear as physical weariness, mental decline, or emotional

strain. It impacts productivity and also poses risks to safety and decision-making.

Fatigue negatively impacts workers health and productivity due to such factors. Such conditions can lead to poor performance, decreased service quality, and higher absenteeism. Additionally, chronic fatigue syndrome and depressive disorders can adversely affect workers health and safety. This study helps us to determine the symptoms of worker fatigue and its potential impact on safety and health. Currently, there is a lack of evidence of database on fatigue and its attributes among chemical industrial workers in India.

Review of Literature

1. Vimala Rani Swaminathan *et al.* (2024) [4] conducted a study on "A Cross-Sectional Study to Analyze the Physical and Cognitive Fatigue Due to Sleep Disruption Among Shift Workers in Tamilnadu." A Cross-sectional Analysis was done among airport workers. 200 participants were randomly selected for the study aged 35-45 years and conducted for a duration of 6 months in the Airport, Tamilnadu. Sleep quality and cognition were assessed using a validated questionnaire. The study demonstrates that, in comparison to day workers, night shift workers will experience physical and cognitive exhaustion due to disrupted sleep patterns. The effects of working night shifts on one's health and well-being are complicated. The objective is to maintain shift workers overall health, so we must consider health promotion in addition to health protection.
2. Thomas R. Cunningham *et al.* (2022) [7] conducted a study on "Work-related fatigue: A hazard for workers experiencing disproportionate occupational risks". Articles in the Occupational safety and health literature that addressed fatigue in higher-risk workers were identified by the authors or recommended by subject matter experts in workplace fatigue as part of a Working Hours, Sleep and Fatigue Forum. Additional articles were identified by searching for a combination of specific at-risk worker group titles (e.g., female workers, temporary workers) with fatigue or working hours. The literature reviewed in this paper suggests that several of these populations are at increased risk of fatigue due to multiple factors, such as irregular shifts, lack of access to fatigue management resources, and socioeconomic barriers.
3. Ahmad Bazazan *et al.* (2019) [3] conducted a study on "Occupational fatigue and mental health complaints among 8-hour shift workers of petrochemical industries in Iran" This cross-sectional study evaluated occupational fatigue and mental health complaints and their relationship in rotating 8-hour shift workers. In this study, 287 shift workers participated. The Multidimensional Fatigue Inventory (MFI-20) and General Health Questionnaire (GHQ-28) were used to evaluate the level of fatigue and mental health, respectively. A relatively high prevalence of mental health complaints (particularly social dysfunction) and fatigue (especially general fatigue) were found among the study population. In general, 43.4% of participants reported a mental health problem. A moderate correlation was found between fatigue and mental health ($r=0.58$). The stepwise regression model revealed that fatigue was significantly related only to "anxiety and insomnia" and "severe depression". This study

revealed that the 8h shift workers in studied areas are exposed to a considerable risk of mental health and fatigue. So, improving the ergonomics and health aspects of the workplace is recommended to reduce related risk factors.

4. A.M. Lock *et al.* (2018) [8] conducted a study on “The psychological and physiological health effects of fatigue”. Literature searches were conducted using PubMed and Google Scholar scientific databases. Filters included reviews, systematic reviews and randomized trials. The following terms were used such as “sleep deprivation, sleep restriction, sleep loss, fatigue, acute or chronic, occupational, shift work, health effect”. The quality of this in-depth review meets the recommendation of grade A using the Scottish intercollegiate Guidelines Network (SIGN) grading system. Meta-analytical data show that workers with sleep problems are 62 more likely to have workplace accidents and that 13% of all injuries at work are associated with disordered sleep. Long term occupational fatigue leads to slower career progression, with higher rates of early resignation and retirement. In fact, 24 hours of prolonged wakefulness has been shown to have the adverse effect on cognitive performance.
5. D. M. Rose *et al.* (2017) [9] conducted a study on “Associations of fatigue to workrelated stress, mental and physical health in an employed community sample”. authors used cross-sectional data of N =7,930 working participants enrolled in the Gutenberg Health Study (GHS) from 2007 to 2012 filled out the Personal Burnout Scale (PBS) of the Copenhagen Psychosocial Questionnaire (COPSOQ), the PHQ-9, and a list of work-related stressors. Fatigue as one of the crucial indicators of burn-out is consistently associated with work-related stressors in the context of an increased allostatic load. Associations remain after controlling for depression. The Personal Burn-out Scale is a brief scale suitable for assessing work-related fatigue in the general population.

Aim and Objective of the Study

Aim of Study

To study the prevalence of fatigue among chemical factory workers in Raigad district.

Objective of Study

To find out the prevalence of fatigue using a measure, Fatigue assessment scale in chemical industrial workers.

Methods

Type of Study: Observational study

Study Setting: Chemical Industrial companies in Raigad district.

Study Population: Chemical Industrial workers

Sampling Method: Convenience sampling

Sample Size: 92

Criteria for selection

Inclusion criteria

1. Working in chemical industries
2. Workers with minimum 1 year of experience
3. Participants working for more than 8 hours
4. Only Males are included in the study
5. Age criteria – subjects between 25-45 years of age

Exclusion criteria

1. Workers not having minimum 1 year of experience
2. Working less than 8 hours
3. Workers with pre-existing neurological condition, recent fracture, trauma, recent MI, cardiac episode

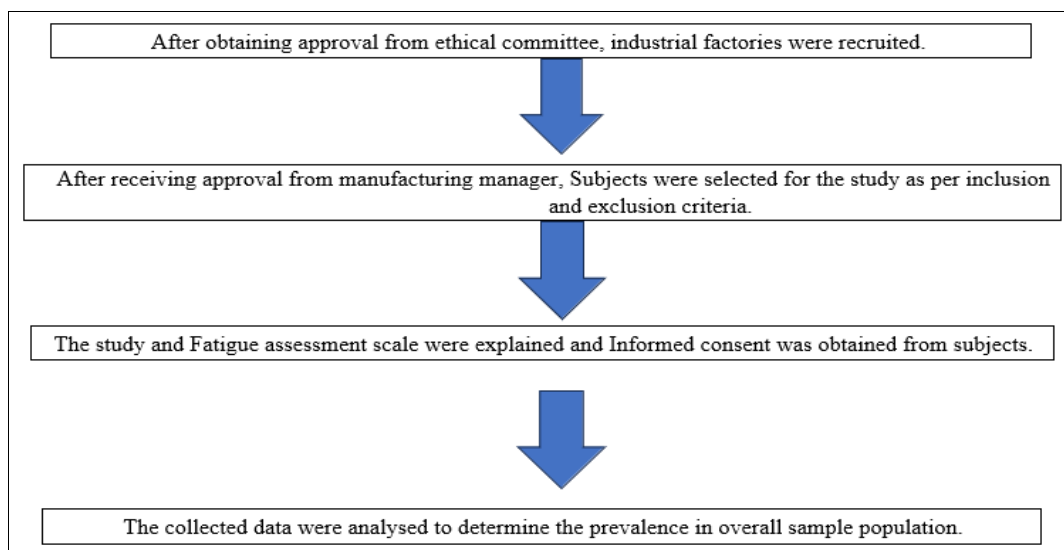
Outcome measure

1. **Fatigue Assessment Scale (FAS):** The fatigue assessment scale is a standardized tool used to evaluate the severity of fatigue in individuals. It consists of 10 statements that cover both physical and mental aspects of tiredness, such as feeling exhausted, lacking energy, or having difficulty concentrating. Each item is rated on a five-point scale ranging from 1 (never) to 5 (always), and the total score ranges from 10 to 50. Scores between 10–21 indicate no fatigue, 22–34 suggest moderate fatigue, and 35–50 reflect severe fatigue. The FAS is widely used in research and clinical settings to assess how frequently and intensely fatigue is experienced.

Materials used

1. Fatigue assessment scale
1. Pen
2. Paper

Methodology



Results

Statistical Analysis

1. Microsoft Excel was used for data entry, descriptive statistics, and graphical representation.
2. All the data were subjected to descriptive statistics for mean and standard deviation.

Demographic Data

Out of 92 participants, mean age: 35.75 years Standard deviation: ±5.29 years All participants were male.

1. Total Score - Fatigue Assessment Scale (FAS)

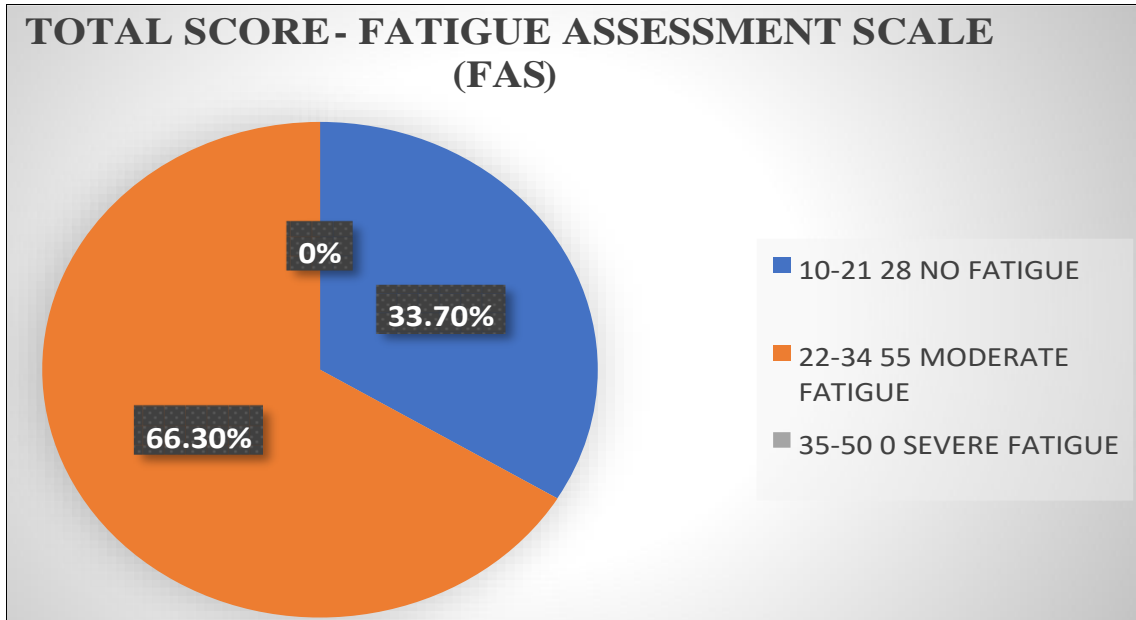


Fig 1: presents the interpretation of Fatigue Assessment Scale (FAS) total scores for the chemical factory workers. Out of 92 workers, 66.3% (n=55) scored in the moderate fatigue range, while the rest did not show any symptoms of fatigue

2) Components Of FAS

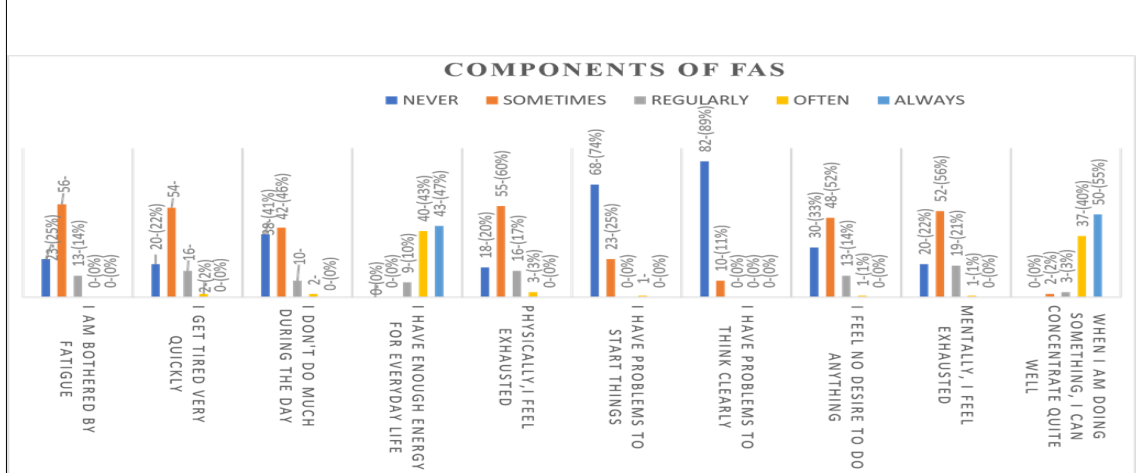


Fig. 2 shows the distribution of responses of chemical factory workers on the Fatigue Assessment Scale (FAS). The highest reported concern was being bothered by fatigue reported by 61% (n=56). This was followed by physical exhaustion reported by 60% (n=55) and tiring very quickly reported by 59% (n=54). A considerable proportion also indicated mental exhaustion with 56% (n=52). Regarding concentration 55% (n=50) gave the highest response, followed by 40% (n=37) for the same. About 52% (n=48) felt no desire to do anything. Around 47% (n=43) had enough energy for everyday life, followed by 43% (n=40) who reported the same. About 46% (n=42) indicated that they did not do much during the day. while 25% (n=23) reported difficulty in starting tasks. The lowest response was for difficulties in thinking clearly reported by only 11% (n=10).

3. FAS Components Mean and Standard Deviation

Table 1: shows the highest mean score was observed for the statement ‘When I am doing something, I can concentrate quite well’ (4.46 ± 0.67), followed by ‘I have enough energy for everyday life’ (4.36 ± 0.65). This suggests that despite fatigue symptoms, workers perceived themselves as capable of maintaining concentration and sufficient energy for daily activities

Fas components	Mean	Standard deviation
I am bothered by fatigue	1.89	± 0.61
I get tired very quickly	2	± 0.69
I don't do much during the day	1.80	± 0.71
I have enough energy for everyday life	4.36	± 0.65
Physically, I feel exhausted	2.04	± 0.70
I have problems to start things	1.28	± 0.52
I have problems to think clearly	1.10	± 0.31
I feel no desire to do anything	1.83	± 0.69
Mentally, I feel exhausted	2.01	± 0.68
When I am doing something, I can concentrate quite well	4.46	± 0.67

Discussion

A total of 92 participants were included for the study on finding the prevalence of fatigue among chemical factory workers in Raigad district-an observational study using fatigue assessment scale. The present study aimed to determine level of mental and physical well-being of chemical factory workers through self-reported responses to various statements. In this study, 66.3% of participants were in the moderate fatigue category.

The highest number of participants (33%) were in the middle-aged group of 35–39 years.

Our study found that a considerable proportion of chemical factory workers aged between 25–45 years experiences varying levels of fatigue, with many reporting moderate tiredness. The results indicate that a significant number of chemical factory workers experience early signs of physical exhaustion. This is mainly due to long shifts, repetitive physically demanding tasks, prolonged standing, heavy manual handling, insufficient rest breaks. also, long working hours, shift patterns and workplace demands are primary drivers of persistent fatigue among industrial workers [7]. This aligns closely with the findings of Sharma *et al.* (2023) [13], who reported a prevalence of fatigue of among middle-aged individuals in the general community, with 57% experiencing moderate fatigue. The similarity in prevalence suggests that work demands, environmental exposures, and lifestyle factors play a key role in fatigue, whether in community or industrial settings. In chemical factories, where tasks are physically demanding and shifts expose workers to stressors, the fatigue observed in this study may represent an intensified form of the broader public health issue reported by Sharma *et al.* (2023) [13].

Workers reported getting tired quickly, likely because of long shifts, limited rest between tasks, and heavy workloads. These results closely align with the study by Bazazan *et al.* (2019) [3], who reported that petrochemical workers in Iran also exhibited high general fatigue and moderate physical fatigue, particularly among shift workers. Therefore, although motivation and energy may currently remain stable among workers, the presence of sustained fatigue could indicate a potential risk for future burnout or reduced productivity, emphasizing the need for regular fatigue monitoring and supportive interventions in factory environments [3].

The workers also presented mental fatigue, which could be linked to heavy mental load, poor sleep, and stress. Shift work, long hours, and job stress are known to reduce focus

and make workers feel mentally tired, even when the physical demands are not high. Some also experienced difficulty in starting tasks, likely due to cognitive fatigue, low motivation, or exposure to harmful chemicals, as studies suggest these factors can affect focus and task initiation. At the same time, several workers maintained good concentration, possibly because they were familiar with their tasks, made extra effort to stay attentive despite fatigue, or because such jobs often retain only those who can sustain focus. This aligns with the findings of Vlasak *et al.* (2022) [15], who reported that certain mental functions may remain intact even under fatigue [15]. However, some workers reported having no desire to do anything, suggesting the presence of mild emotional or motivational fatigue. This loss of motivation may result from fatigue, stress-related depression, or repetitive work. Occupational studies confirm that stress and fatigue can lower motivation [16].

Many workers reported having enough energy for daily life, suggesting that despite feelings of exhaustion, they still perceived their functional energy levels as adequate. In terms of activity, some mentioned not doing much during the day, but the majority still considered themselves active, which contrasts with typical signs of burnout. Only a few workers reported difficulty in thinking clearly, indicating that clarity of thought was generally preserved. However, studies show that ongoing exposure to solvents and toxic chemicals can reduce attention and memory, and even low exposure may affect brain function. In addition, irregular and long working hours may affect the sleep cycle, lowering focus and memory [16].

Overall, the present study highlights that chemical factory workers aged 25–45 years commonly experience moderate levels of fatigue, particularly in the form of physical tiredness and reduced energy. While severe fatigue was uncommon, the presence of early symptoms indicates a risk of progression if left unaddressed indicating the need for early screening and intervention in occupational health practice. The presence of sustained fatigue could indicate a potential risk for future burnout or reduced productivity, emphasizing the need for regular fatigue monitoring and supportive interventions in factory environments.

Physical therapists can help workers to reduce fatigue and enhance their overall quality of life by providing education, exercise prescription, energy conservation techniques, postural correction, manual treatment, relaxation techniques, and self-management strategies. Taking regular breaks,

improving workplace ergonomics, rotating tasks to avoid task repetition, and encouraging healthy habits like good diet, sleep, and exercise are key strategies to manage fatigue^[13]. In addition, periodic health check-ups and fatigue awareness programs may help workers recognize symptoms early and adopt coping strategies. Implementation of these preventive measures not only enhances worker well-being but also sustains productivity and safety in industrial environments.

Conclusion

Chemical factory workers aged 25–45 years experienced moderate fatigue, with physical fatigue being more common than mental. Despite this, most were still able to maintain concentration and manage their daily energy.

Limitations of The Study

1. The sample size was relatively small, which may reduce the statistical power and limit the generalizability of the findings to the wider population of chemical factory workers.
2. The study did not test practical interventions like ergonomic adjustments, shift scheduling, or wellness programs to see their impact on fatigue and productivity.

Recommendations For Future Study

1. Longitudinal studies could track fatigue levels over time to assess changes and identify potential causal factors such as work hours, environmental exposures, and lifestyle habits.
2. Intervention-based research, testing strategies such as ergonomic improvements, shift scheduling adjustments, and wellness programs, would further guide practical solutions for reducing fatigue and enhancing worker health and productivity.

Clinical Implications

1. The use of standardized tools such as the Fatigue Assessment Scale can help detect moderate fatigue among workers before it progresses to severe exhaustion. Regular screening should be integrated into occupational health check-ups.
2. Physical therapists can support workers by prescribing exercises to improve endurance, teaching posture correction, and providing energy conservation techniques that reduce strain during long shifts.
3. Ergonomic modifications, proper task rotation, and scheduled rest breaks can help minimize physical tiredness caused by heavy and repetitive tasks.
4. Education on sleep hygiene, balanced diet, and stress management strategies should be included in workplace health programs to address lifestyle contributors to fatigue.

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