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Identification and Risk Assessment of Potential Risk of Musculoskeletal Disorder and Fire and Safety Department in HPCL Visakh Refinery Visual Analogue Scale and NMQ

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Abstract

Objective: Identifying problem of MSDs among the workers working in Fire and safety department and estimate the losses due to the problem. Suggesting tools to reduce the risk of MSDs.

Material and Methods: The method used for investigation of potential causes related to MSDs the VAS is a common scale used to measure the intensity of pain (Huskisson, 1982). It is a 10 cm line with anchors of “no pain” and “worst pain possible” with a score of zero and ten respectively. The VAS is a simple, widely used self-report measure that has excellent reliability and validity.

Standardized questionnaires for the analysis of musculoskeletal symptoms in an occupational health context are presented. The questions are forced choice variants and may be either self-administered or used in interviews. It concentrates on symptoms most often encountered in an occupational environment. The reliabilities are mostly acceptable.

Result: When observing results we find the occupational activities in Fire and safety department as high to Moderate potential of MSDs in worker. Among the list of identified work groups (Table-1) having 3 work groups having Low potential of MSD, two work groups having more potential to get MSDs rather than the 2 work groups have moderate potential of MSDs.

Conclusion: The inadequate job environment and wrong posture were recognized as the most important risk factors in developing and increasing MSDs in different tasks. The improvement of the workshop environment, and education on the proper postures through training, and improvement of the workers' workstation can have a considerably improved safe work condition and reducing the problem of MSDs among the workers and employees.

Keywords: Musculoskeletal disorders, NMQ, oil and gas, visual analogue scale (VAS), fire and safety, ergonomics

1. Introduction

Musculoskeletal disorders (MSDs) are one of the common complaints among the industrial workers in India. MSD is one of the less studied and an under-observed factor of occupational health and safety in Indian industrial establishments as well as it is mostly neglected in oil and gas industries. Occupational stress is one of the great factors affecting the health of workers which is an unavoidable part of industrial life. This stress has bad effects on the wellbeing of workers in short and long term effects of their working capabilities and productivities. MSDs are the part of Ergonomics study in the occupational health and safety subject, to achieve goals for safe and healthy work environment the important ergonomics aspects must be considered as other important aspects. Canadian Centre for Occupational Health and Safety defines ergonomics as “Ergonomics is the science of matching the job to the worker and the product to the user. This section covers situations such as lifting, lighting, office/desk set up, etc. that may contribute to injury.”

HPCL-Visakh refinery is one of the major petroleum refineries in India, situated at the east coast of southern India and a major industrial unit in the region. Which is classified as a Major Accident Hazard industry as per factory act of the state. In operational process HPCL-Visakh refinery has a well-developed safety management system in compliance with safety regulations and standards evolved out of industrial practices. HPCL-VR has well described and clear SAFETY POLICY state that: “As an integral part of its business, HPCL believes that no work or service or activity is so important or urgent that safety be overlooked or compromised. Safety of the employees and public and protection of Corporation's as well as their assets shall be paramount. Corporation considers that safety is one of the important tools to enhance productivity and to reduce national losses; The Corporation will constantly endeavor to achieve and maintain high standards of Safety in its operations”. The overall aim of safety management is to make workplace safe as well as more comfortable and stress free, so

it's directly connected with productivity and financial interest of the company and the management has a clear view about that. Significantly risk likes fire, chemical spillage, explosion and the consequences related to Major hazard industries are considered most. Incidents like Near miss are low consequence, high frequency incidents while Major Fires are high consequence, low frequency incidents. Safety instrumentation system, Safe work practices, process safety management, Safety evaluation and auditing etc. are inherent safety and play important role in avoiding and controlling accidents and incidents. The goal to have safer environment, the involvement of every employee and the contract worker is very crucial and important in implementation of safe work practices in refinery. Apart from the major hazard related to oil and gas industries the work related hazard and stress are major cause for personal disability, occupational sickness and a large number of losses in working days. Musculoskeletal Disorder is one an important considerable potential diseases in Engineering and utility services in refinery. The aim of this study was to identify the risk related to MSDs in central maintenance workshop's employees and contract workers and also the psychological, physical and general health risk factors related to their day to day work. There is no any scientific study conducted for investigation and assessment of MSDs in Fire and safety department of the refinery till date. The data is scattered and mostly unavailable to identifying the risk related to MSDs.

2. Objective

Musculoskeletal symptoms seem to be most frequent occupational health problems and a major contributor in disability and losses of working days in present time of industrial environment. The main objective of this study to identifying the risk related to MSDs in Fire and safety department of the refinery as well to estimate the potential losses related to the risk. Identify the risk reduction process and method and advice to adoption of safety standard procedure to avoid potential risk of MSDs. Estimate overall job environment and work culture enhance safety of individual in Fire and safety department of the refinery.

3. Materials and Methods

The study involves different types of jobs and work procedures of a Fire and safety department of the HPCL Visakh Refinery. The fire and safety department consisting different section as per functional requirement. Fire section divided in to who section 1. Fire and emergency preparedness and 2. Fire and emergency response, further function stretched toward safety norms obligations and implementation of safety aspects in day to day activities of the refinery i.e. 3. Occupational health and safety 4. Process safety. Another additional section attached functioning separately with Safety section i.e. 5. Project Safety. The major physical activities involved in Fire section mostly in Emergency preparedness part of the services. Emergency preparedness is a one of the core activity and involved physical, mental and strenuous labour for achieving successful emergency response in oil refinery. The jobs are not directly associated with main occupational job are also considered in the assumptive study. Over all 07 jobs are selected for MSD risk assessment among

other jobs of the main and allied occupations which have potential risk of MSD among the workers of Fire and safety department. Further, conduct formal interview of the workers involved in specific job to assess the history of complains related to occupational stress, MSDs and work related injuries and illness.

A comprehensive study of data from past research papers available on internet on MSDs related to similar occupations. There is no direct involvement of individual workers and employees in this study, but considered the work related conditions and relied on past research on identical subjects.

a) Visual Analogue Scale (VAS)

The VAS is a common scale used to measure the depth of ache (Huskisson, 1982). It's far a 10 cm line with anchors of "no pain" and "worst pain viable" with a rating of zero and ten respectively. The VAS is a simple, extensively used self-file degree that has incredible reliability and validity. Visual analogue scale scores \leq three.5 indicated slight pain; the cut-off points between moderate and excessive pain were five.8, 6.5, and 7.5, depending on the statistical strategies used. The take a look at shows VAS ratings \leq three.4 have been high-quality defined for patients with continual musculoskeletal ache as mild pain, 3.5 to 7.4 as moderate ache, and \geq 7.5 as excessive pain. Latent magnificence evaluation observed that a 3-elegance answer fitted best, ensuing within the instructions zero.1 to 3.eight, three.9 to five.7, and 5.eight to ten cm. there may be outcomes and finding on cut-off factor schemes on MSDs of differs from have a look at to study but a few point its seems to be universally widely wide-spread cut off points and in view of the low-to-mild institutions between VAS rankings and functioning and among VAS and verbal score scale rankings, the suitable classification of VAS ratings as moderate, moderate or severe in the clinical practice seems no longer reliable.

b) Use Nordic Musculoskeletal Questionnaires (NMQ) for the analysis of potential MSDs symptoms.

The Nordic Musculoskeletal Questionnaires became developed with the aid of the Nordic institution-challenge funded by using the Nordic Council of Ministers. The intention changed into to increase and test a standardized questionnaires technique permitting comparison of low returned, neck, shoulders and standard complaints to be used in epidemiological research. The tool was no longer developed for scientific diagnosis, but the comply with the tradition of identical earlier clinical questionnaires-e.g. Cardiovascular, Pulmonary survey, and studies council's persistent bronchitis. The 2 essential motive of the questionnaires are function gadgets for

- i). The screening of musculoskeletal problems in ergonomic context, and
- ii). For the profession health care services. The research may additionally offer mean to measures final results of epidemiological research of MSDs.

The evaluation examine may function device for work environment designing, laptop designing and tool designing.

Identification of jobs having potential risk of MSDs.

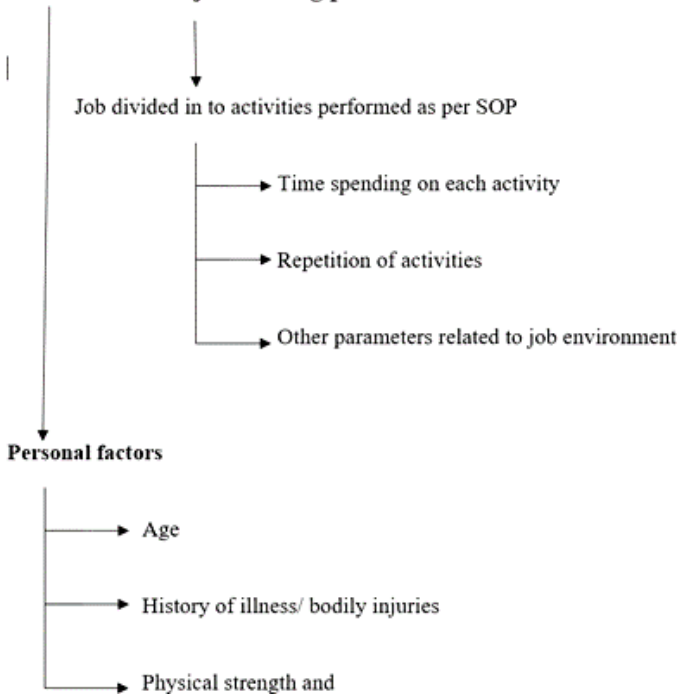


Fig 1: Factors considered to assess the potential risk of MSDs.

Discussion

Work-related musculoskeletal disorders (MSDs) are a group of painful disorders of muscles, tendons, and nerves. Carpal tunnel syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome are examples.

For the purpose of developing injury prevention strategies, many health and safety agencies include only disorders that develop gradually and are caused by the overuse of the above constituents of the musculoskeletal system. The traumatic injuries of the muscles, tendons and nerves due to accidents are not considered to be MSDs or are considered separately. However, there are organizations, such as the European Agency for Safety and Health at Work, that include acute traumas and fractures within in the MSDs group.

This document will discuss those injuries resulting from overuse and those that develop over time. Work activities which are frequent and repetitive, or activities with awkward postures cause these disorders which may be painful during work or at rest.

Almost all work requires the use of the arms and hands. Therefore, most MSDs affect the hands, wrists, elbows, neck, and shoulders. Work using the legs can lead to MSDs of the legs, hips, ankles, and feet. Some back problems also result from repetitive activities.

The table below outlines occupational risk factors and symptoms of the most common disorders of the upper body associated with MSDs.

Table 1: Identified disorders, occupational risk factors and symptoms

Disorders	Occupational Risk Factors	Symptoms
Tendonitis/tenosynovitis	<ul style="list-style-type: none"> • Repetitive wrist motions • Repetitive shoulder motions • Sustained hyper extension of arms • Prolonged load on shoulders 	Pain, weakness, swelling, burning sensation or dull ache over affected area
Epicondylitis (elbow tendonitis)	Repeated or forceful rotation of the forearm and bending of the wrist at the same time	Same symptoms as tendonitis
Carpal tunnel syndrome	Repetitive wrist motions	Pain, numbness, tingling, burning sensations, wasting of muscles at base of thumb, dry palm
DeQuervain's disease	Repetitive hand twisting and forceful gripping	Pain at the base of thumb
Thoracic outlet syndrome	<ul style="list-style-type: none"> • Prolonged shoulder flexion • Extending arms above shoulder height • Carrying loads on the shoulder 	Pain, numbness, swelling of the hands
Tension neck syndrome	Prolonged restricted posture	Pain

Observation

This study aimed to conduct a job risk assessment using a macro-ergonomic viewpoint and NMQ in an oil refinery Fire and safety department. The other study on same subject have been shown that several factors, such as unsuitable working environment conditions and workstations, high workload, and the values of harmful factors in the working environment can have different effects on workers' health that leads to MSDs. On the other hand, regarding gathering data on the macro-ergonomic status of the department, one can be informed about the general situation and harms of each job and use this information to allocate budget and time for further analysis to decrease the MSDs, thereby increasing the department's productivity. Based on the results, it was found that among 5 domains related to the by NMQ, undesirable posture, manual material handling, and environment are the most important dimensions. W-1 and W-4 reported that undesirable posture was one of the most important risk factors for the development of MSDs, which was consistent with the findings of the present. It is impossible that the workers

maintain the proper posture for the entire duration of the work. Moreover, due to the lack of a suitable workstation, all jobs in this field have some weaknesses. A good number of studies have not been performed so far to investigate the association of NMQ parameters with MSDs in the industries. Therefore the fundamental of the result may be unmatched with other studies conducted in past and other environment. Furthermore, posture and manual material handling found wide range of pain NMQ. Another reason may be the high effectiveness of environmental risk factors reported by the workers in the NMQ study, including noise, humidity, work at high altitude and vibration, and heat in the working environment of the oil refinery Fire house. However, in a study is mostly based on personal factors and the working setup. In general, mobile vehicles, such as fire vehicles, are used for transferring and moving the fire and response equipment; however, in this Fire house, the small objects and loads were transferred on trolley and manually. Moreover, the manual handling of loads is prevalent during a work shift in the fire house. In addition, it concluded that employees

working in the oil refinery fire service are exposed to harmful factors, such as gases and chemical vapors, fumes and smokes from fire, noise, shift work, and undesirable workstations, which can be cited as another reason for obtaining the highest score from the environment domain, compared to other domains. However the Fire and safety department located away from the operational zone and properly ventilated and illuminated. For instance, the exhaust gas produced during the vehicle test run (i.e. running of IC engine) process or the noise generated during process can also influence other people, such as technician, housekeeping staff working and visitors in other sections. In the study found the workers involved in machine jobs are most effected due to improper work station setup and age related factors. The Fire inspectors are working with undesirable posture and the bending and twisting of the low back due to the lack of a suitable workstation. In this study, macro-ergonomics was used to obtain a proper understanding of job requirements in the department; additionally, 07 job groups and dangerous risk factors were identified in an oil refinery Fire and safety department, it is found at somewhere that the negligence of the workplace and equipment standard created and exacerbated the MSDs. The body dimensions of the working people were studied from the viewpoint of the macro-ergonomics, and it was found that the workstation inadequacy caused an unfavorable posture in workers with a high level of

risk. The results from this study and past identical studies where to factors are mostly co related with the working conditions and the hazards related to MSDs in workshop environment. The study can be considered as tool to eliminate or minimize the effects of exposure to risk factors studies, which may reduce the likelihood of Musculoskeletal complains among the workers and employees. I can be also useful to reduce accidents, injuries and absenteeism, as well as indirect cost to company. Due to different environmental conditions, limited number of cases studied, as well the abstracts from past studies can be helpful in some extend, but need to conduct specific studies on the same subject in various locations and departments are advisable always.

Table 2: The categories of work having potential of Level of MSDs.

Sr. No	Job	Level of Potential risk of MSDs
1.	Manual Handling	High
2.	Hand work	High
3.	Posture	Moderate
4.	Sensory	Moderate
5.	Environment	Moderate
6.	PPE	Moderate

Results

Table 3: Identified the type of JOB having different potential level of MSDs Fire and safety department.

Sr. No.	Type of JOB	Level of potential risk of MSDs
1.	Driving	Low
2.	Inspection of Portable fire equipment	Low
3.	Changing of Fire landing Valve gasket on Fire Water Line	High
4.	Operation of Isolation valve	High
5.	General Mechanics	Moderate
6.	Testing of fire hoses and allied equipment	Moderate
7.	Control room Monitoring	Moderate

When observing results we find the occupational activities in Fire and safety department has high to Moderate potential of MSDs in worker. Among the list of identified work group (Table-3) having different work group having different potential of MSD, high aged work groups having more potential to get MSDs rather the lower aged work groups have moderate potential of MSDs.

Table 4: Other factors (Demographical) of workers group Potential Risk of MSDs

Variables	Groups	Level of Potential Risk of MSDs
Age	25-35	Low to Moderate
	35-45	Moderate to High
	45-60	High
Work experience	5-15	Moderate
	15-30	High to Moderate
	30-40	Moderate-Low
Educational status	Primary	High
	Inter/Diploma	High
	Degree	Moderate
	Master Degree	Low

Conclusion

Manual material handling, work environment, and undesired posture were identified as the most important risk factors associated with the development of MSDs in different job groups in HPCL Vishkha Refinery Fire and safety department. Therefore, some measures, such as the improvement of the work station design, training and education on how to maintain proper posture while working, elimination or reduction of work activities, a short break while need to work continuously, allow to change in work profile within occupation, using proper lifting and carrying tackles and methods can be recommended to reduce the probability of the risk of developing MSDs among workers.

Abbreviations

- MSD:** Musculoskeletal disorder
- VAS:** Visual Analog scale
- NMQ:** Nordic Musculoskeletal questionnaires
- HPCL:** Hindustan Petroleum Corporation Limited
- ENMG:** electroneuromyography
- EMG:** Electromyography
- NCV:** Nerve conduction velocity
- MRI:** Magnetic Resonance Imaging
- PPE:** Personal protective Equipment

10. HSE: Health Safety Environment

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