Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 08, August-2024

Ergonomic Assessment of Musculoskeletal Disorder Risk Factors and Fatigue Experienced Among Pressers

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Abstract - In addition to the garment industry, Ironing is widely used in the domestic sector. Both men and women work in this field of ironing. Domestic ironing workers perform various tasks, such as ironing different types of clothes and folding them properly. Due to the nature of their work, they often adopt awkward postures, which can lead to discomfort and occupational health hazards. These postures include those of the neck, trunk, legs, upper arms, lower arms, and wrists, and the repetitive movements can result in a high prevalence of musculoskeletal complaints. These complaints are among the leading causes of low productivity in today's work environment. However, industrial ergonomics systems are designed to improve productivity for companies, but no similar system has been developed for domestic ironing workers. In this study, we conducted a Rapid Upper Body Assessment and Rapid Entire Body Assessment for a group of individuals to determine their discomfort levels, and we discuss suitable remedies to address these issues in this article.

Keywords: Musculoskeletal disorder, Health hazard, WMSD, Domestic ironing, RULA and REBA.

1.INTRODUCTION

In today's competitive world, the phrase 'survival of the fittest' aptly describes the current scenario. To remain competitive and stay in business, industries require higher production rates and advancements in technology. Consequently, modern jobs often involve tasks such as frequent lifting, carrying, and pushing or pulling of loads without assistance from other workers or devices; performing a single function or movement for extended periods; working more than eight hours daily; completing tasks at accelerated speeds, such as on assembly lines; and maintaining a firm grip when using tools. When coupled with poor machine, tool, and workplace design or the use of inappropriate tools, these factors can result in physical stress on workers' bodies, potentially leading to injury. Ergonomics (from the Greek Ergos, means "work", and Nomics, means "natural law") or human factors is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Any person indulging in an occupation, whether working for a big enterprise or self-employed, studying, earning, retired or a housewife, is exposed to occupational health hazards. Occupational health is a multidisciplinary field of healthcare concerned with enabling an individual to undertake their occupation, in the way that causes least harm to their health. The main focus in occupational health is on three different objectives: the maintenance and promotion of worker's health and working capacity, the improvement of working environment and work to become conducive to safety and health, development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings. Musculoskeletal disorders, commonly referred to as MSDs, are a prevalent type of work-related injury. These disorders affect the soft tissues, including muscles, tendons, ligaments, joints, and cartilage, as well as the nervous system. These disorders frequently impact the arms and back and often develop gradually over an extended period of time. Unlike injuries resulting from a single traumatic event, such as a fall or collision, MSDs typically result from prolonged exposure to multiple risk factors. These disorders can lead to a range of conditions, including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and in some cases, paralysis. MSDs can also result in lost time from work and in some cases, permanent disability. Some of the most common MSDs include carpal tunnel syndrome, tendinitis, sciatica, herniated discs, and low back pain. It is important to note that MSDs do not include injuries resulting from accidents such as slips, trips, or falls. Presently, there is no investigation carried out in the prevalence of work related musculoskeletal disorder among ironing workers in laundry shop. The ironing work is a fully manual operation. Ironing worker's shoulders, arms, and hands are in constant motion and are generally lacking in ergonomic design.Girish Joshi and Harvinder Lal et al., (2014) the common occupational problem of the workers is musculoskeletal disorders. Combined with a heavy physical workload, it results in a high frequency of work-related musculoskeletal disorders. The present study was aimed to evaluate the MSD of workers engaged in small scale casting industries. Study was conducted on 55 workers of a casting industry using the posture analysis tool REBA method. The Result of REBA that about 28% of the workers were under

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 08, August-2024

very high risk levels and required immediate change. About 51.5% of the workers were at high risk levels which required changes soon and 20.5% of the workers were at medium risk levels. Nicolas Vignais et al., (2014) studied a biomechanical analysis of the upper extremity during a cylinder grasping task is conducted by using a parameterized musculoskeletal model of the hand and forearm. The proposed model is composed of 21 segments, 28 musculotendon units, and 20 joints providing 24 degrees of freedom. Boundary conditions of the model are defined by the three-dimensional coordinates of 43 external markers fixed to bony landmarks of the hand and forearm and tracked with an optoelectronic motion capture system. A task consisting of closing and opening fingers around a cylinder 25 mm in diameter was investigated. Results are consistent with literature and they improve the understanding of musculo tendon forces and joint loads of the hand during movement. Catarina Nordander et al., (2013) compared the relationship between exposure and response in occupational risk factors and musculoskeletal elbow and hand disorders. Prevalence of complaints (Nordic Questionnaire) and diagnoses (physical examination) were recorded in 19 groups of female workers (1891 individuals), and 8 groups of male workers (761 individuals), with highly similar work tasks within each group are collected. Relationships were also demonstrated for low job control, job strain and isostrain. Women exhibited a higher prevalence of complaints than men. McNee et al., (2014) presented to access the activity levels of the sternocleidomastoid muscle and upper trapezius muscle during static postures under controlled and standardized conditions, and to determine whether the muscle activity differed between sexes. Electromyographic (EMG) activity was recorded unilaterally from the sternocleidomastoid and upper trapezius muscle in 17 participants whilst they were performing various postural tasks. Head leaning and shoulder shrugging postures yielded substantial muscle activity in both muscles. Muscle activity did not differ significantly between male and female participants ($p = 0.078$). According to this study, to compare investigate personnel working in the garment industry using three distinct approaches in order to assess working postures, identify musculoskeletal system stress factors, and determine exposures based on working postures as to study the physiological stress among ironing workers and to iidentify the associated risk factors of WMSD problems and to suggest an ergonomics improvement needed in order to reduce the WMSD risks.

2. METHODOLOGY

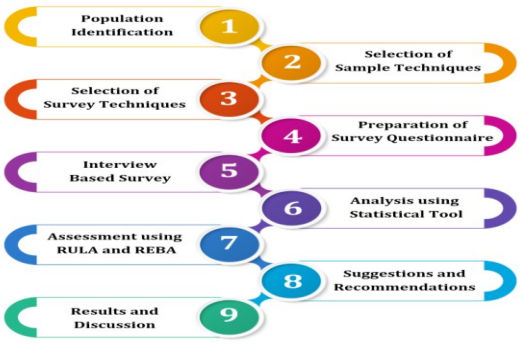

Fig-1: Methodology

The above flow chart shown in the figure 2.1 explains the methodology followed for the study of work related musculoskeletal disorders among ironing workers.

2.1.Statistical Packages for Social Sciences (SPSS)

SPSS Statistics is a software package used for statistical analysis. SPSS is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners and others.

Statistics included in the base software:
Descriptive statistics: Cross tabulation, Frequencies, Descriptives , Explore, Descriptive Ratio Statistics.
Bivariate statistics: Means, t-test, ANOVA , Correlation (bivariate, partial, distances), Non-parametric tests.
Prediction for numerical outcomes: Linear regression.
Prediction for identifying groups: Factor analysis, cluster analysis (two-step, K-means, hierarchical), Discriminant.

2.2.RULA Assessment Tool

The RULA Assessment Tool was developed to evaluate the exposure of individual workers to ergonomic risk factors associated with upper extremity MSD. The RULA ergonomic assessment tool considers biomechanical and postural load requirements of job tasks/demands on the neck, trunk and upper extremities. A single page worksheet is used to evaluate required body posture, force, and repetition. Based on the evaluations, scores are entered for each body region in section A for the arm and wrist, and section B for the neck and trunk. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk.

2.3.REBA Assessment Tool

This ergonomic assessment tool uses a systematic process to evaluate whole body postural MSD and risks associated with job tasks. A single page worksheet is used to evaluate required or selected body posture, forceful exertions, type of movement or action, repetition, and coupling.

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3.RESULTS AND CALCULATIONS

3.1.Statistical Analysis Using SPSS

Data were collected from 300 ironing workers using interview based survey technique. The table 3.1 shows the Demographic characteristics of the ironing workers taken into consideration for the study. It gives the percentage of workers in each category such as height, weight etc.

Table – 3.1: Demographic characteristics of the ironing workers

Factors	Category	No. of Respondents (300)
Gender	Male	300
Age of the person	20-30	75
	31-40	66
	41-50	108
	>50	51
Height of the person	4'0"-4'5"	5
	4'6"-4'11"	38
	5'0"-5'5"	88
	5'6"-5'11"	148
	>5'11"	21
Weight of the person	<=50	44
	51-70	201
	71-90	53
	>100	2
Working hours of the day	1-3	5
	4-6	30
	7-8	216
	>8	49

Table – 3.2: Frequency of pain among ironing workers in Ironing shops

Frequency of pain (%)		
Pain location	**Population (n=300)**	**Percentage**
Shoulder pain	268	89.33
Neck pain	219	73.00
Hand/wrist pain	244	81.33

The above table 3.2 gives the frequency of pain among the ironing workers. The total number of participants is 300, around 85 % - 90 % of participants were suffering from any one of the musculoskeletal disorder problem. 89.33 % of participants have shoulder pain, which is the most frequent pain symptom among the respondents. The shoulder pain is then followed by the Hand/Wrist pain (81.33%), Neck pain (73%).

3.2.Consolidated Results from RULA

Score	Level of MSD Risk
1-2	negligible risk, no action required
3-4	low risk, change may be needed
5-6	medium risk, further investigation, change soon
6+	very high risk, implement change now

Fig-2:Levels of MSD risks in RULA

The working postures of the sample workers considered for the work are analyzed using RULA tool and a consolidated ergonomic factors table was prepared. The table 3.3 gives the consolidated pain scale readings. The numbers in the table gives the pain scale reading.

Table – 3.3: Consolidated Pain Scale Readings from RULA

Workers	Upper arm	Lower arm	Wrist	Neck	Trunk	Legs
1	2	2	2	2	2	2
2	2	2	3	3	3	2
3	2	3	3	3	3	2
4	4	2	2	4	3	2
5	4	3	3	4	4	1
6	4	2	2	4	3	1
7	3	2	2	3	3	1
8	2	2	2	2	3	2
9	2	2	2	3	2	2
10	2	2	3	3	3	2

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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It can be seen from the above table that the most frequent pain observed is Shoulder pain, Neck Pain and back pain, which is in accordance with the analysis from SPSS.

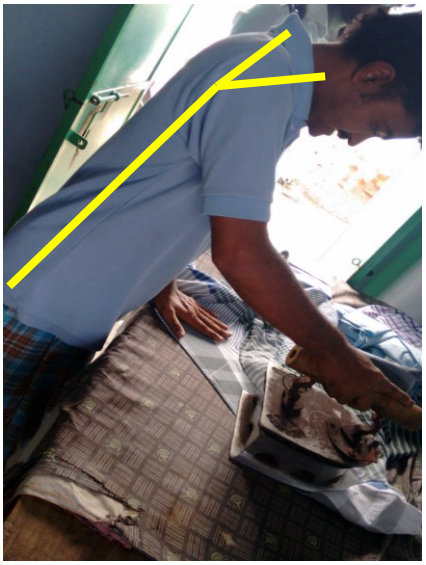

Fig-3:Improper posture of neck during ironing work

3.3.Consolidated Results from REBA

The working postures of the sample workers considered for the work are analyzed using REBA tool and a consolidated ergonomic factors table was prepared. The table 3.4 gives the consolidated pain scale readings. The numbers in the table gives the pain scale reading.

Score	Level of MSD Risk
1	negligible risk, no action required
2-3	low risk, change may be needed
4-7	medium risk, further investigation, change soon
8-10	high risk, investigate and implement change
11+	very high risk, implement change

Fig-4: Levels of MSD risks in REBA

Table – 3.4: Consolidated Pain Scale Readings from REBA

Workers	Neck	Trunk	Leg	Upper Arm	Lower Arm	Wrist
1	2	2	4	2	1	1
2	2	3	4	2	1	1
3	2	2	2	2	1	1
4	2	3	2	3	1	1
5	3	4	2	4	1	1
6	3	4	2	4	1	1
7	3	4	3	2	1	1
8	3	3	2	3	1	1
9	2	3	3	2	1	1
10	2	2	4	2	1	1

It can be seen from the above table that the most frequent pain observed is Shoulder pain, Neck Pain and Leg pain. The consolidated results from REBA are comparable with RULA.

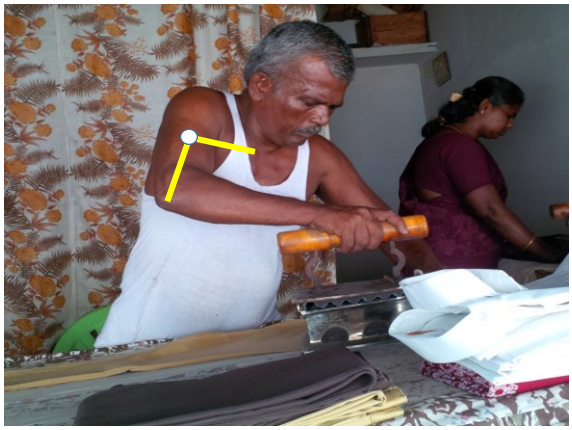

Fig-5:Improper posture of shoulder during ironing work

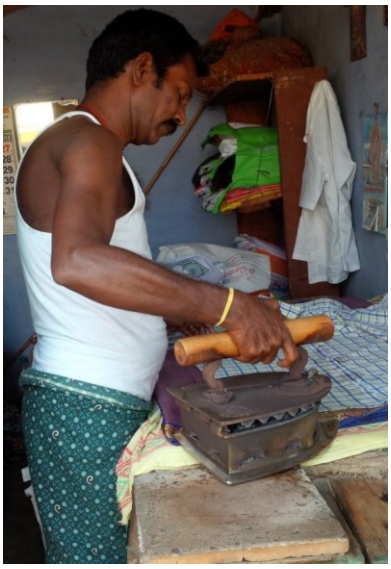

Fig-6:Improper posture of wrist during ironing work

Based on the observation of the working style, routine, work environment and other factors of the ironing workers, the following suggestions are made to reduce the impact of musculoskeletal disorders and also for their overall wellbeing.

- Take frequent breaks
- Take in healthy food
- Regular intake of fluids to replenish the level of fluids in the body
- Make the working environment spacious and well facilitated
- Do regular physical exercises, stretch-outs etc.,
- Reduce the weight of the iron box
- Can reduce the number of working hours in a day.
- Avoid bad habits like smoking and drinking

International Journal of Engineering Research & Technology (IJERT)
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The main reason for improper postures which is in turn responsible for the musculoskeletal disorders is the table height. The table height has to be comfortable to the worker. There is no exact relation between the height of the person and height of the table. The National Institute of Occupational Health and Safety (NIOSH) has made some recommendations on the table height based on the type of work and is shown in figure 7.4. Ironing can be considered to be under the category of heavy work as it includes frequent lifting of heavy iron box. So as per NIOSH guidelines the recommended table height is 28''-35'' (70-88 cm).

4. CONCLUSIONS

Based on a comprehensive review and analysis of the evidence, as described above, the following conclusions are made: Musculoskeletal disorders of the low back and upper extremities are an important national health problem, resulting in approximately 1 million people losing time from work each year. These disorders impose a substantial economic burden in compensation costs, lost wages, and productivity because workplace disorders and individual risk and outcomes are inextricably bound, musculoskeletal disorders should be approached in the context of the whole person rather than focusing on body regions in isolation. A number of characteristics of the individual appear to affect vulnerability to work-related musculoskeletal disorders, including increasing age, gender, body mass index, and a number of individual psycho-social factors. These factors are important as contributing to and modifying influences in the development of pain and disability and in the transition from acute to chronic pain.

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