

Risk Assessment of Work-Related Musculoskeletal Disorders in Printing Workers by Rapid Upper Limb Assessment (Rula)

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Abstract

This study aims to assess the risk of Work-Related Musculoskeletal Disorders (WMSDs) in printing industry workers. The study included 100 workers working in different press and pre-press units of Printing presses situated in the Thane district. The study employed demographic details, job details, self-reported Nordic Body-Map Questionnaire (NBM) to collect data, along with the Rapid Upper Limb Assessment (RULA) to evaluate the working posture of the workers. The results showed that 37% of the participants experienced musculoskeletal complaints, with left knee pain being the most prevalent (13%), followed by right knee pain (11%) and Hips (11%). The RULA assessment revealed that a significant percentage of participants were at intermediate to high risk of developing WMSDs due to their working posture.

Keywords: Work Related Musculoskeletal Disorders, Nordic Body-Map Questionnaire, Rapid Upper Limb Assessment, Printing Industry Workers.

Introduction

Printing Industry is one of the fastest growing industrial sectors in India. The number of workers is also increasing. In printing industries there are various departments that can be categorized as prepress, press and post press departments. Prepress department include graphic designing department. Press departments include tasks like preparing and inspecting lithography plates, loading and unloading the printer, operating the printing machine, supervising the print process and quality control of the product along with the screen-printing process. Post press departments include cutting department, binding department, punching department, laminating department, pasting department, Packaging and delivery of the finished product. In a single press unit products like pamphlets, labels, cartons, books, invitation cards, blister packs, etc are manufactured.

Workers in a printing press often work long, irregular hours with heavy machinery performing tasks requiring repetitive movements.

Work-related Musculoskeletal-Disorders is one of the main causes of occupational illnesses worldwide. They are one of the most noticeable global problems ergonomists come across in a work place.[1]

Awkward postures, improper manual handling techniques, repetitive work, work involving high-exertion and/or exposure to force can contribute to the occurrence of Work-related Musculoskeletal-disorders.[1][4]

Neutral postures are where the joints are aligned minimizing the stress on the muscles, tendons, bones and nerves and allow for maximum-control and force-production. Awkward postures are postures that deviate from the neutral postures. Awkward postures place excessive strain on structures like muscles, tendons, bones and nerves, if held for long periods of time they pose a risk of injury thus becoming a hazard. [1]

A good working posture is a prerequisite in preventing work-related Musculoskeletal-disorders, However, workers might subconsciously start performing a required task in positions deviating from neutral positions and get used to awkward-postures. They may not realize that their body is under strain due to such posture until they feel actual pain. [1]

Measurement of musculoskeletal-disorders can be divided into: self-report approach, direct measurement and observational method.[5]

Nordic Body Map is a commonly used self-report method for measuring complaints felt by the workers. Nordic Body Map questionnaire is a type of ergonomics specification questionnaire frequently used for ascertaining the inconvenience of workforces.[5]

Observation method involves paying close attention to the working posture, Rapid Upper Limb Assessment (RULA) being one of the popular methods. [5]

Aim and Objective

Aim: To identify risk factors of work-related musculoskeletal disorders in printing workers

Objectives:

1. To find prevalence of musculoskeletal pain in printing workers by Nordic Body Map
2. To find risk factors of work-related posture using RULA
3. To find the relationship between musculoskeletal pain and individual risk factors.

Materials and Methods

- This cross-sectional study employed a convenience sampling method to examine the prevalence of WMSDs and assess the risk of MSDs due to working posture, among printing workers of press and post-press departments of Printing presses in Thane District. The sample size was 100. The study utilized the pen-paper method.
- Ethical approval for the research was taken from the Institutional Ethic Committee.
- Permissions were obtained from the Printing Press owners for conducting the study in their premises.
- The purpose of the study was clearly explained to the participants.
- Written consent was obtained from all the participants.
- The inclusion criteria was of male and female workers between 18-55 years of age, working for atleast one year as production operators from press and post-press units.
Exclusion criteria consisted of participant with the history previous musculoskeletal disorders, Non-occupational accidents affecting the musculoskeletal system and the participants who were not willing participate.
- The participants were interviewed and demographic data was collected, this data included Age, Gender, Height, Weight, BMI, Duration of Employment, Daily Working hours, Job Title, Job description.

- Nordic Body Map questionnaire was used to determine self-reported musculoskeletal symptoms. Nordic Body Map questionnaire uses images of human body which is divided into nine main segments: shoulders, neck, elbows, upper back, lower back, hips/buttocks, wrists/hands, knees, and ankles/feet.[3][5]. The term musculoskeletal symptom can be defined as ache, pain or discomfort in atleast one of the anatomical sites during last 12 months[2]. Pain level is classified as No Pain, Moderate Pain, Pain, Very Painful [5].
- Rapid Upper Limb Assessment (RULA) scale has Group A (upper arm, lower arm, wrist and wrist twist) and Group B (neck, trunk and legs), Muscle use (static or repetitive), Force/Load.[1][6]. Risk depends on Final score : 1 or 2 = acceptable; 3 or 5 = investigate further; 5 or 6 = investigate further and change soon; 7 = investigate and change immediately.[6].

Workers were observed while performing their routine tasks. The following postures were evaluated: the most difficult postures and work tasks, the posture sustained for the longest periods and the posture where the highest force loads occur. Group A and Group B postures were recorded on RULA assessment sheet and Final score was calculated.

Data Analysis and Results

Table 1 – Descriptive Data

Age (n=100)	Mean	36.76 ±9.56
BMI (n=100) (According to Asia-Pacific Classification)	Underweight	20%
	Normal	42%
	Overweight	15%
	Obese	23%
	Mean	21.833 ± 3.94
Gender (n=100)	Males	89%
	Females	11%
Duration of employment (in years) (n=100)	1 to 10	56%
	11 to 20	29%
	21 to 30	12%
	Above 30	3%
	Mean	11.617 ± 9.01
Daily working hours (n=100)	Below 8 hours	1%
	8 hours	36%
	10 hours	40%
	12 hours	23%
	Mean	9.69 ± 1.59

Table 1 shows the descriptive statistics of data including age, BMI, gender distribution, duration of employment and daily working hours of the participants.

Table 2 – Job Titles Of The Participants

Job Title	Number of workers (n=100)
Binder	8
cutting machine operator	11

Delivery and packaging	4
Folding Machine Operator	3
Helper	18
Lamination machine operator	8
Pasting operator	1
Printer Assistant	10
Printing machine operator	26
punching machine operator	9
Screen printer	1
screen printing assistant	1

Table 2 shows the distribution of the participants based on their job titles

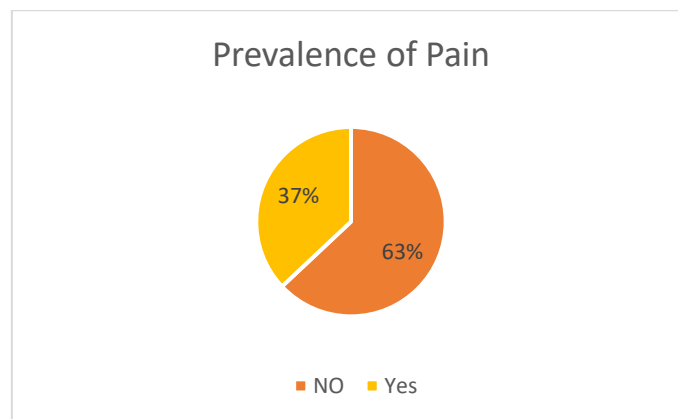


Figure 1 – Pain Prevalence

Figure 1 shows that 37% of the participants suffer from pain in atleast one of joint of their body

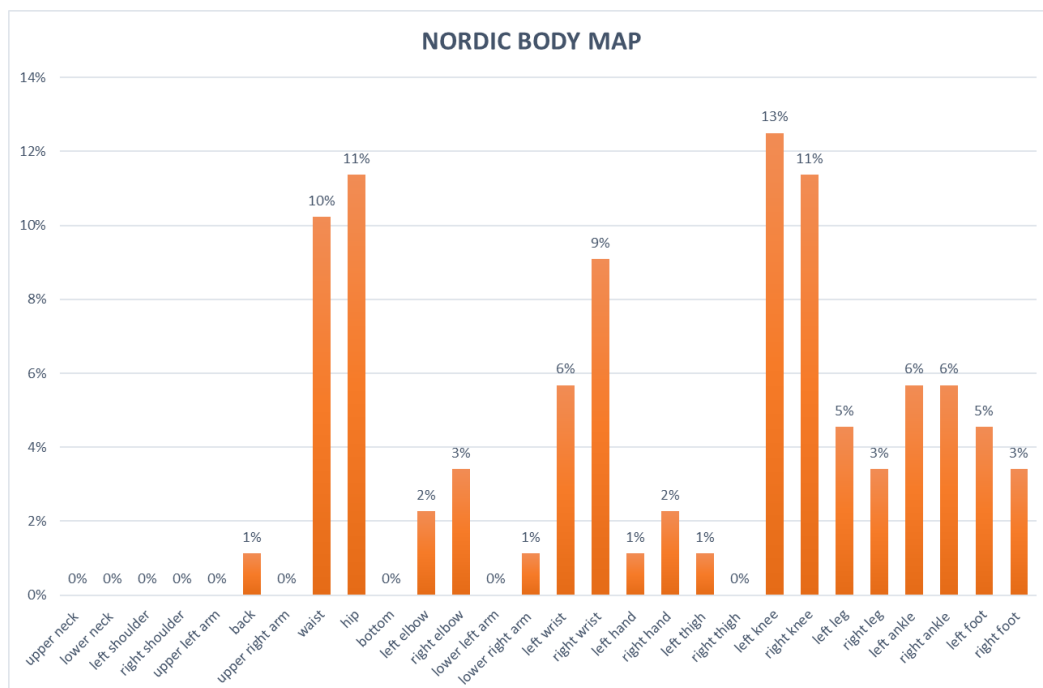


Figure 2 - Nordic Body Map – Musculoskeletal Complaints

Figure 2 shows that, 37 participants who reported presence of pain, reported total of 88 musculoskeletal complaints. The majority of the reported complaints are in the left knee (13%), followed by complaints in right knee (11%), Hip (11%) and waist (10%).

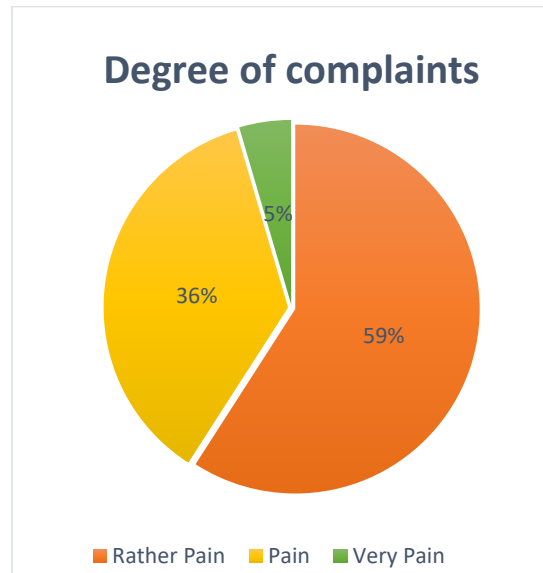


Figure 3 – Nordic Body Map – Degree Of Complaints

Figure 3 shows that Majority of the musculoskeletal complaints, i.e. 59% of the musculoskeletal complaints, were of the rather pain/moderate pain degree.

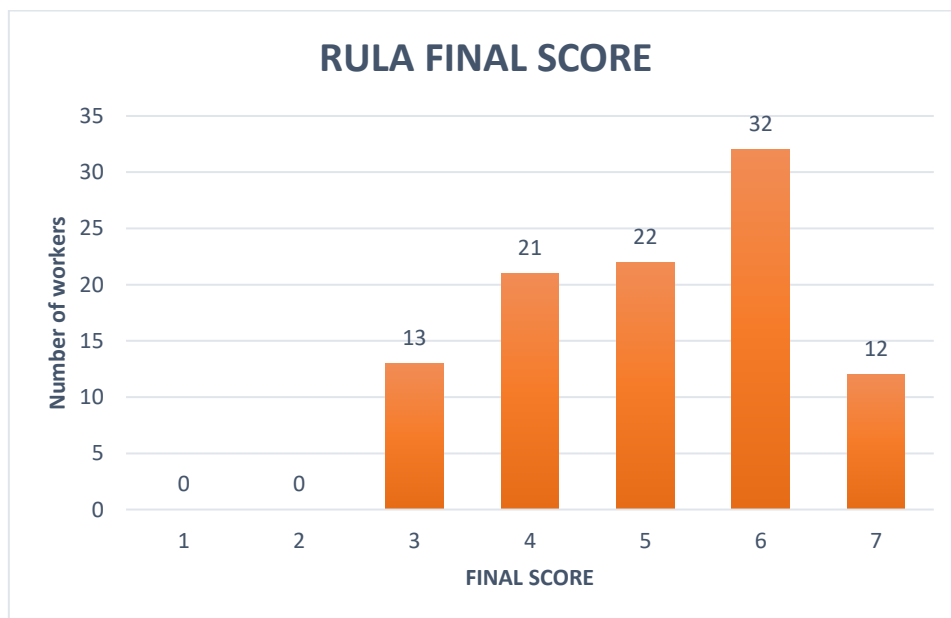


Figure 4 – RULA Final Score

Figure 4 graph shows that maximum participants (32%) have a final score of 6, followed by 22% having score of 6 and 21% having score of 4.

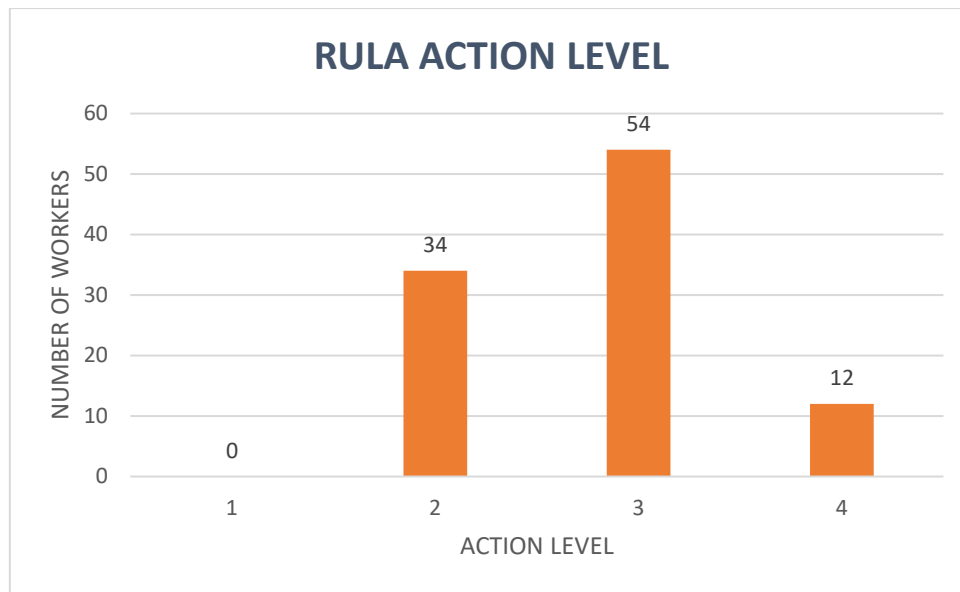


Figure 5 – RULA Analysis (Level Of MSD Risk)

FINAL SCORE	ACTION LEVEL	RISK LEVEL
1 – 2	1 - Acceptable	Posture Accepted
3 – 4	2 - Investigate further	Low risk
5 – 6	3 - Investigate further and change soon	Intermediate risk
7	4 – Investigate further and change immediately	High risk

Figure 5 graph shows that maximum participants, i.e. 54%, fall under Action level 3 category indicating a medium risk of MSDs, followed by low-risk category (34%) and high-risk category (12%).

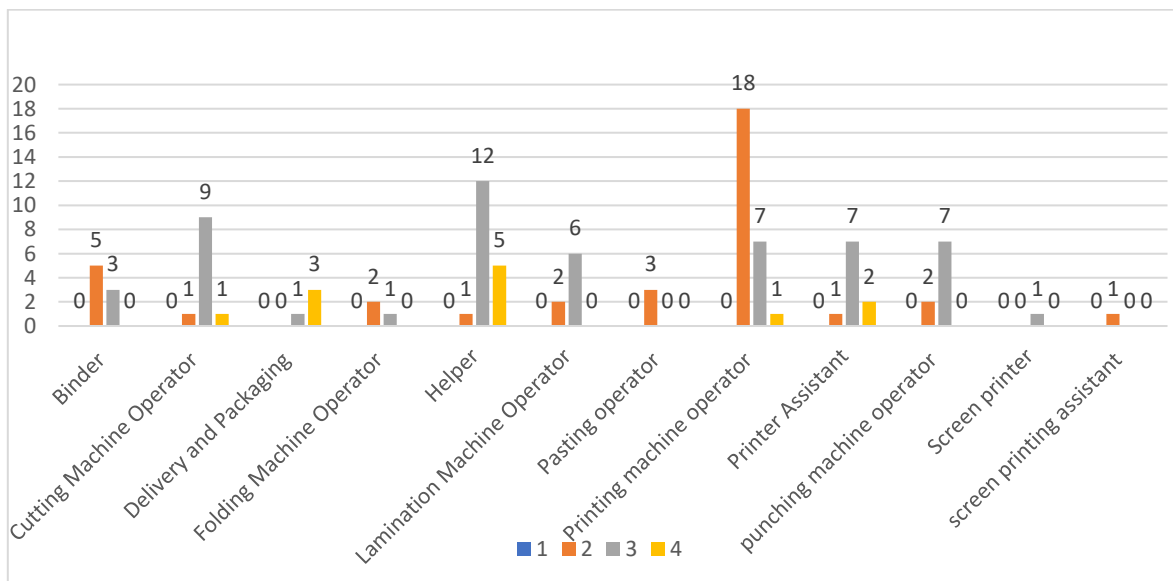


Figure 6 – RULA Action Level According To Job Title

Figure 6 graph depicts that in printing machine operators, majority operators i.e. 18 operators have low risk of MSDs (Action level 2); in helpers, majority workers i.e. 12 workers had intermediate risk of MSDs (Action level 3); in cutting machine operators, majority operators i.e. 13 operators had intermediate risk

of MSDs (Action level 3)

	MSK Complaints	Pain	RULA Score
Age	0.1702	-0.4264	0.0104
BMI	0.0733	-0.1179	-0.0273
Work Experience	-0.0919	-0.1885	0.1012
Working Hours	0.3889	-0.1237	0.0705

Table 3 – Correlation Between Individual Factors (Age, Bmi, Work Experience and Working Hours) And Musculoskeletal Complaints, Presence Of Pain And RULA Score.

(Pearson’s Correlation Coefficient i.e. “r” value)

Pearson’s correlation test was used to find the correlation between individual factors and Musculoskeletal complaints, Presence of Pain and RULA Score

The Pearson’s correlation coefficient indicates very weak positive correlation between age and BMI of the participant with the musculoskeletal complaint, weak positive correlation between daily working hours of the participant with musculoskeletal complaint and very xweak negative correlation between work experience of the participant and musculoskeletal complaint.

The Pearson’s correlation coefficient indicates moderate negative correlation between age of the participant presence of musculoskeletal pain, very weak negative correlation between BMI, work experience and daily working hours of the participant and presence of pain.

The Pearson’s correlation coefficient indicates very weak positive correlation between age, work experience and daily working hours of the participant with the final RULA score, and very weak negative correlation between BMI of the participant with the final RULA score.

Discussion

The present study aimed to investigate the prevalence of work-related musculoskeletal disorders (WRMSDs) and associated risk factors among printing industry workers. The study included 100 participants between the ages 18 – 55 years, mean age being 36.76 (±9.56) years. The participants were surveyed and assessed using Nordic Body Map (NBM) questionnaire and Rapid Upper Limb Assessment (RULA). Workers work for average of 9.69 hours per day, with average work experience of 11.617 (± 9.01) years.

The workers that participated in the study had 12 different job titles in Press and Post-Press departments. There tasks require repetitive movements, awkward static postures, pulling or pushing heavy loads and fine motor movements like pushing buttons, twisting knobs, etc.

As depicted in Figure 1 Out of 100 participants, 37 participants suffered from musculoskeletal disorders in atleast one of the joints of their body. Results of NBM questionnaire indicated that the prevalence of pain was higher in left knee followed by right knee and hips. A similar study conducted in 2021, among 121 physical workers in graphic and publishing activities in Croatia, in which higher prevalence of symptoms in lower back, neck, shoulders and knees was found[4]. These findings are consistent with present study offering evidence that there is high prevalence of MSDs among printing industry workers.

As depicted in Figure 4 and Figure 5 RULA analysis of all the participants indicates that 54 participants had an Intermediate risk of MSDs, as 54 participants had a RULA final score of 5 – 6 indicating Action level 3. This shows that further ergonomic investigation should be done and ergonomic changes in the working posture to be done to prevent the incidence of WRMSDs. A study conducted in 2017 among

rotary screen-printing machine operators identified two high risk postures of awkward back posture and awkward neck posture had action level 2 and action level 3 respectively [1]. These findings are consistent with the present study offering evidence that this population has a low to intermediate risk of MSDs due to the awkward working posture.

As shown in Figure 6, among the 12 job titles, the majority workers were printing machine operators followed by helpers and cutting machine operators. In printing machine operators, majority of the operators had RULA action level 2. In the helpers, majority helpers had RULA action level 3 and among cutting machine operators, majority had a RULA action level 3. This indicates that Printing Machine operators have a low risk for MSDs while helpers and cutting machine operators have an intermediate risk of MSDs.

Weak correlation was found between factors like age, BMI, work experience, daily work hours and musculoskeletal complaint, RULA score. A study suggests that the relationship between BMI and Musculoskeletal disorders in lower back and knees is statistically significant [2]. This is not reflected in present study. It might be due to the wide age range of the participants and variable job description of the participants.

Majority of the workers perform their tasks in a standing posture as they need to handle heavy machinery and also due to the lack of proper sitting arrangement. The workers participating in the study had working hours of 8 to 12 hours. A work task can be classified as prolonged work in upright position when the workers have to spend more than 50% of their total working hours in a standing position without leaving the work area [7], therefore the workers are exposed to effects of prolonged standing. Muscle fatigue after 90 minutes of prolonged standing occurs in muscles of lower back and legs leading to pain and discomfort [7][8]. Workers have a tendency to alter their posture, while working extended hours to reduce the pain and discomfort due to muscle fatigue[7] [8].

A study conducted in 2005, among newly employed workers in diverse occupational settings, concluded that carrying loads and posture of bending forward influenced the risk of knee pain[9]. Exposure to occupational activities of kneeling and squatting leads to risk of osteoarthritis of knee[10].

Conclusion

- Majority of participants reported musculoskeletal symptoms in left knee joint.
- Majority of participants had a RULA score of 5 – 6 (Action Level: 3) indicating Intermediate risk of Musculoskeletal Disorder due to the awkward working posture.
- Weak correlation was found between individual risk factors and pain.

Clinical Importance

- The findings of this study can serve as a basis for designing and implementing appropriate ergonomic interventions, such as job rotation, training in proper posture, the use of ergonomic equipment, and scheduling of rest breaks to reduce the risk of Work-Related Musculoskeletal Disorders (WMSDs) among Printing workers.
- This can be done through Training Programs/Workshops and Education Manuals.
- Further studies with larger sample size can be undertaken to identify the factors responsible for increased prevalence of Work-Related Musculoskeletal Disorders (WMSDs).

Limitations of the study

- The study's cross-sectional design only included a specific portion of the population, which may limit the generalizability of the study findings to a broader population.

- This study didn't include equal samples from various departments, which reduces the specificity of the study.

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