ORIGINAL RESEARCH ARTICLE

Health Status and Risk Assessment of Workers in Offset Printing Presses in a City of Western India

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ABSTRACT

Introduction: Printing press workers are exposed to occupational hazards due to the nature of their work. Awareness of these hazards is essential for prevention. This study aimed to assess health status and perceived occupational hazards among printing press workers.

Methods: A cross-sectional study was conducted in thirty-five printing presses. Workers directly involved in hands-on offset printing operations with at least six months of experience were included. Health examinations were performed and work-related hazards were documented. A Risk Assessment Matrix was used to estimate risk based on likelihood and severity.

Results: Among one hundred eighty-six workers examined, most were males. Common complaints included skin problems, nasal irritation, eye discomfort, burning sensation in the stomach, and calf pain. Normal body mass index and normal blood pressure were observed in a minority of workers as per JNC seven criteria. Awareness regarding chronic diseases and the harmful effects of printing dyes was low. Risk assessment indicated severe risk for finger-cut injuries and moderate risk for hand-cut injuries and electrocution.

Conclusion: The study highlights health problems and perceived occupational hazards among printing press workers, though causality cannot be established. Targeted occupational health awareness and preventive programs are required to improve risk perception and promote protective practices.

Keywords: Occupational Health, Printing Industry, Risk Assessment, Cross-sectional Study, Workplace Hazards

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INTRODUCTION

The printing industry in India is a rapidly expanding sector comprising a large number of micro, small, and medium enterprises that engage in activities including pre-press preparation, press operations, and post-press finishing. These smaller printing units often function with limited formal occupational-health oversight and fragmented safety practices. Workers in this sector routinely handle inks, dyes, cleaning solvents, photochemical, mineral oils, resins, and paper dust, all of which are known to pose dermatological, respiratory, neurological, and systemic health hazards through both inhalational and dermal routes.[1-4]

Studies from various regions have demonstrated higher prevalence of acute and subacute symptoms such as eye irritation, airway discomfort, headaches, neurological symptoms, and skin problems among printing-industry workers compared with non-exposed groups.[2-5] Additionally, chemical-safety information in many printing establishments is often incomplete or inconsistently communicated, leading to inadequate awareness and underestimation of occupational hazards among workers.[1] These challenges are accentuated in smaller privately operated presses where occupational health surveillance mechanisms are typically absent.

In recent years, structured occupational hazard-assessment tools such as the Occupational Health Risk Assessment (OHRA) framework and the Risk Assessment Matrix (RAM) have been increasingly recommended for small and medium enterprises. These methods allow semi-quantitative ranking of workplace hazards based on likelihood and severity when direct environmental measurements or industrial hygiene monitoring are not feasible.[6-8] Application of RAM in printing and related industries has shown that such approaches can effectively identify priority risks, guide preventive measures, and enhance workers' understanding of occupational hazards.[6,7]

Despite the growth of the printing sector in India, there is limited research on the combined assessment of workers' health status and their perceived occupational hazards using a structured risk-assessment tool. Most available Indian studies focus on dyeing or textile-printing units, with very few examining offset printing presses specifically. Moreover, occupational-health surveillance in India's micro and small enterprises continues to face gaps in implementation, worker awareness, and hazard monitoring.[9]

Given these evidence gaps, the present study was undertaken to assess the health profile of workers directly involved in operational activities of offset printing presses in a city of Western India and to evaluate their perceived occupational hazards using a Risk Assessment Matrix (RAM). This dual approach aims to generate context-specific insights for targeted risk-reduction strategies in small-scale printing industries.

METHODOLOGY

This cross-sectional study was carried out in the offset printing presses within the geographical limits of the Rajkot city. Rajkot is the biggest city in the Saurashtra peninsula of Gujarat state of India and has large number of micro, small and medium enterprises. This study was planned and conducted during the ongoing COVID-19 pandemic. Issues pertaining to lockdowns, limited production, varying layoffs, absenteeism, and general apprehension among the owners and workers of the printing press to admit a health care person for medical check-up in the premises of the printing press had to be kept in mind. The printing presses which were located within the geographical boundary of the Rajkot Municipal Corporation and whose management agreed for their workers to participate in the study for assessing their health and occupational hazards in their work place, were thus actually selected.

Sampling technique and sample size estimation: There were a total of 108 printing presses within the limits of the Rajkot city. For feasibility issues (considering constraints of ongoing pandemic, and availability of time; selection bias potential) one third of the printing presses were selected using simple random sampling using lottery method. In case of refusal (12 refused) from the administration of printing press the next in list was selected. These refusals from the printing press administrators were predominantly due to their apprehension of allowing a person from the health care setup (the principal investigator was in a tertiary care government health care setup involved in COVID-19 related health care) to enter their printing press premises. In this way, out of 108 presses, 35 offset printing presses were selected. By and large it was found that there were about five to seven workers who were directly involved in the printing process in each printing press. Considering an average of five workers in each printing press the total sample size was estimated as 175 workers.

Ethical consideration: The study protocol, questionnaire and consent forms were approved by the Institutional Ethical Committee (Human) of the Pandit Deendayal Upadhyay Medical College, Rajkot (IEC No: PDUMCR/IEC/89/2021, Dated 26/6/2021) before enrolment of any subject into the study. Written informed consent was obtained from all the participants.

Inclusion Criteria: All the persons who were directly involved in the various activities involving *hands on operational functioning* of the printing press were interviewed and examined. A duration of hands-on working experience in the printing press for a *minimum period of six months* was considered. This was to give a reasonable time period for the development

and manifestation of any acute health hazard due to the work exposure.

Exclusion criteria: Owners/entrepreneurs, Human Resource Managers and other persons who were not directly involved in activities involving hands-on-operational functioning of the printing press were excluded. Workers in the printing press having a duration of hands-on working experience *less than a period of six months* were excluded from the study. Persons who did not give written informed consent or refused to take part in the study were excluded from the study.

Data Collection Tools: Data was collected using a pretested semi-structured questionnaire in a local language, followed by the clinical examination of the printers. The questionnaire consisted of the following broad headings: individual details and personal examination; general and systemic medical examination, and assessment of the occupational hazards (physical complaints, work and environmental hazards, mechanical hazards, psychological hazards). Revised BMI guidelines for calculation of obesity in Indian population were used to classify obesity.[10] Waist-Hip ratio above 0.90 for males and above 0.85 for females was considered as high risk for the workers.[11] Blood pressure assessment was carried out using a mercury sphygmomanometer. Checks were carried out daily to ensure that the instrument was functionating properly without any leaks and the mercury was at zero mark with the cuff completely deflated. Each participant was seated comfortably, with the arm supported at heart level, and allowed a minimum rest period of five minutes before the measurement. Two readings were taken one minute apart, and their average was used for further categorisation. The blood pressure levels were classified according to the **Seventh Joint National Committee (JNC 7)** guideline.[12]

In Occupational Safety and Health (OSH), the process of assessing risks of identified hazards considers both (a) the foreseeable events and exposures that can cause harm (b) the likelihood or probability of occurrence.[7] The workers were asked to identify the hazards connected with the type of work at the printing press. The risk assessment of the hazard was done using a semi-quantitative method (Table 1) based on two key factors - 'likelihood' and 'severity' of the occurrence of the hazards.[8] From the hazards identified, the 'Risk Score (RAM score) of the hazards' were assessed using the following equation: Risk Score (RAM score) = Likelihood x Severity. To account for both, a tabular format known as a Risk Assessment Matrix (RAM) is used. The cells within the RAM indicate the 'Risk'. The Risk Scores are classified into *'sustainable', 'moderate', 'severe' and 'critical'* (Table 2).[7,13]

Data Management and Analysis: The collected data was checked for missing entries (before leaving the site of collection), coded and introduced into a personal computer then analysed using MS Office Excel, Epi-Info software (Version 7.1.5) from CDC, Atlanta, USA. Qualitative data was presented as frequencies and percentages, while quantitative variables were presented as mean, standard deviation (SD), median, interquartile range etc. The data was analyzed using median, Inter Quartile Range (IQR), percentage, Chi Square test and Fisher's exact test. A p value of <0.05 was considered as statistically significant.

Table 1: Likelihood and Severity Rating for the hazards exposed by the workers

Likelihood of occurrence	
Likelihood	**Implications**
Very high	The hazard has a very high chance of occurring
High	The hazard has a large chance of occurring and it is not unusual
Medium	The hazard might occur sometime in future
Low	The hazard has a low probability of occurring
Very low	The hazard has not been known to occur since many years / has not occurred
Severity of occurrence	
Severity	**Implications**
Very high	Irrecoverable damage and loss of productivity in case if the hazard occurs
High	Major damage to the person if hazard occurs
Medium	Disabling but not permanent injury in case if the hazard occurs
Low	Non disabling and non-permanent injury in case if the hazard occurs
Very low	Minor abrasions, bruises, cuts etc. injury in case if the hazard occurs

Table 2: The Risk Assessment Matrix (RAM)

Likelihood of Hazard	**Severity of Hazard**				
	Very Low	**Low**	**Medium**	**High**	**Very High**
Very High	Moderate	Severe	Severe	Critical	Critical
High	Moderate	Moderate	Severe	Severe	Critical
Medium	Sustainable	Moderate	Moderate	Severe	Severe
Low	Sustainable	Moderate	Moderate	Moderate	Severe
Very Low	Sustainable	Sustainable	Sustainable	Moderate	Moderate

RESULTS

A total of 186 workers could be interviewed in the 35 printing presses visited. Of them 170 (91.4%) were males and 16 (8.6%) were females. The maximum age of the male workers was 70 years, while that of female workers was 55 years. Out of 186 workers, 75 (40%) belonged to the age group of 18-27 years, followed by 64 (34%) in the age group of 28-37 years, followed by 30 (16%) in the age group of 38-47 years and 13 (7%) workers belonged to age group 48-57 years. The median age of the workers was 30 years with an Inter Quartile Range (IQR) of 24 to 38 years. The median age of male workers was 30 years with an IQR of 24-38 years. The median age of female workers was 33.5 years with an IQR of 27-38.7 years. The mean age of workers was 31.9 years with a standard deviation (SD) of 10.5 years. The mean age of male workers being 32 years with a SD of 10.8 years, while the mean age of female workers was 32.9 years with a SD of 8.8 years (Table 3). The median duration of work experience was 5.5 years.

Only 36% of the workers were having normal BMI (Table 3). There were 26.3% workers who were overweight and 14% were obese. The prevalence of underweight was 23.7% among the workers. Among the male workers, 40 (23.5%) were 'underweight', 60 (35.3%) were 'normal', 46 (27.1%) were 'overweight' and 24 (14.1%) were 'obese'. Among the female workers, 4 (25%) were 'underweight', 7 (43.8%) were 'normal', 3 (18.8%) were 'overweight' and 2 (12.5%) were 'obese'. There was no statistically significant difference between 'normal' and 'other categories' ('underweight', 'overweight', and 'obese') of BMI in the study groups ($P = 0.50$).

Table 3: General Characteristics of the Printing Press Workers (N=186)

Characteristic	Workers		
	Male (n=170)(%)	Female (N=16) (%)	Total(n=186) (%)
Age Group (Years)			
18-27	71 (41.7)	4 (25)	75 (40.3)
28-37	56 (32.94)	8 (50)	64 (34.4)
38-47	27 (15.8)	3 (18.7)	30 (16.1)
48-57	12 (7.1)	1 (6.3)	13 (7)
58-67	3 (1.76)	0 (0)	3 (1.6)
68-77	1 (0.6)	0 (0)	1 (0.5)
Total	170 (91.4)	16 (8.6)	186 (100)
Body Mass Index (BMI) Category*			
Underweight (UW) (<18.5)	40 (23.5)	4 (25)	44 (23.7)
Normal (N) (18.5 -22.9)	60 (35.3)	7 (43.8)	67 (36)
Overweight (OW) (23 - 24.9)	46 (27.1)	3 (18.8)	49 (26.3)
Obese (OB) (≥25)	24 (14.1)	2 (12.5)	26 (14)
Waist Hip Ratio (WHR)†			
Normal	158 (92.9)	10 (62.5)	168 (90.3)
High Risk	12 (7.1)	6 (37.5)	18 (9.7)
Blood Pressure (BP)‡			
Normal	40 (23.5)	7 (43.8)	47 (25.3)
Pre-hypertensive (PH)	77 (45.3)	4 (25)	81 (43.5)
Stage - I Hypertension (ST-1)	46 (27.1)	4 (25)	50 (26.9)
Stage - II Hypertension (ST-2)	7 (4.1)	1 (6.3)	8 (4.3)

*Chi Square BMI, (Normal v/s Rest - UW, OW, OB) $\chi^2 = 0.453$, df = 1, $P = 0.50$
†Fisher's Exact Test WHR, (Normal vs. High Risk) $P = 0.002$, OR = 1.41 (95% CI: 1.02 - 1.96)
‡Chi Square BP (With Yates' Correction), (Normal v/s Rest - PH, ST-1, ST-2) $\chi^2 = 2.186$, df = 1, $P = 0.139$

Table 4: The Risk Assessment Matrix for the hazards identified

Likelihood of occurrence of the hazard	Severity of Hazard				
	Very low	Low	Medium	High	Very high
Very high	Moderate	Severe	Severe	Critical	Critical
High	Moderate	Moderate	Severe	Severe	Critical
Medium	Sustainable	Moderate	Moderate	Severe	Severe
Low	Sustainable	Moderate	Moderate	Moderate **H**	Severe **F**
Very low	Sustainable	Sustainable	Sustainable	Moderate **E**	Moderate

F = Finger Cut Injury; H = Hand Injury; E = Electrocution Injury

Table 5: Risk assessment of the hazards identified by the Workers

Hazards Identified	Severity of the hazard	Likelihood of occurrence of the hazard	Risk Score
Finger cut Injury (F)	Very High	Low	Severe
Hand Injury (H)	High	Low	Moderate
Electrocution (E)	High	Very low	Moderate

The waist hip ratio was normal in 168 (90.3%) of the workers. A normal waist hip ratio was seen in 92.9% of the male workers as compared to 62.5% of the female workers. The difference was statistically significant (P=0.002).

Blood pressure values varied considerably among workers. Based on the JNC 7 classification, only 47 (25.3%) workers were found to have normal blood pressure. Pre-hypertension was observed in 81 (43.5%) workers, while Stage I hypertension and Stage II hypertension were recorded in 50 (26.9%) and 8 (4.3%) workers respectively. There was no statistically significant difference between 'normal' and 'other stages' ('*Pre-hypertensive'*, '*Stage - I hypertension*', and '*Stage - II hypertension*') of blood pressure in the male and females (P = 0.139).

The workers were asked to elicit all the physical complaints they had suffered from in the past six months. The commonest complaints related to skin related issues like rash, blisters itching, allergy, dryness in 11.8% workers. Nasal complaints (9.7%), backache (7%), burning sensation in the stomach (6.5%), eye related complaints (4.3%), calf pain (3.8%), were a few other complaints reported by the workers in the last six months. By and large all these complaints were of a short duration less than seven days.

General examination of the workers in the printing press revealed the following: 4.3% had 'pallor'; 2.2% had 'clubbing' and 2.2% had 'icterus'. None of the workers had edema or cyanosis.

Very few workers were knowing if they were suffering from any chronic non-communicable disease like hypertension (1.6%), hypothyroidism (1.1%), and diabetes mellitus (0.5%).

Occupational Hazards: Out of 186 workers interviewed, 167 (89.8%) had never suffered any sort of injury at their work place. Of the 19 workers (10.2%) who suffered injuries, most of them (11, 57.9%) were involved in the printing process per se, and 8 (42.1%) workers were involved in the post-press (finishing process). When inquired about the use of PPE (personal protective equipment) by the workers during their regular work, none of them reported to be using it.

When the workers were asked about their perception regarding the presence of occupational hazards associated with their work, 157 (84.4%) of the workers reported that there was no occupational hazard associated with their work and 29 (15.6%) workers reported that there were occupational hazards present in their work.

The workers were asked to identify specific occupational hazards to the task they were involved in the printing press. Most of the workers 151(81.2%), thought there was negligible/no hazard in the job which they were doing. There were 23(12.4%) workers who believed they could suffer from finger cut injury while working in the press. There were 11(5.9%) of the workers who thought that they could get their hand injured while performing the task. One worker (0.5%) identified electrocution as a potential hazard. The workers did not have an idea of the harmful effects of dyes on heart, liver, and kidneys.

The risk assessment, based on the workers' perception for 'Finger cut injury', 'Injury to hand' and 'Electrocution injury' have been shown in the Risk Assessment Matrix (Table 4). The *likelihood* of finger cut injury was found to be 'low' and its *severity* was 'very high'. The *likelihood* of hand injury was found to be 'low' and its *severity* was 'high'. The *likelihood* of electrocution injury was found to be 'very low' and its *severity* was 'high'.

The Risk score as from the RAM is shown in Table 5. The risk score of finger cut injury is 'severe'. The risk score of hand cut injury is 'moderate'. The risk score of electrocution is 'moderate'.

Discussion

The present study was conducted in 35 offset printing presses of Rajkot City, and 186 workers were interviewed over a period of one year between August 2021 to July 2022. The study documents important health and occupational risk patterns among workers employed in small-scale offset printing presses in Western India. The workforce was predominantly young and male, a profile that mirrors observations from printing units in other parts of India and South Asia and likely reflects the physically demanding nature of printing work, limited job security, and high workforce turnover in this sector.[14,15]

A substantial proportion of workers were found to have blood pressure values above the normal range. Although causal inferences cannot be drawn from this cross-sectional study, the coexistence of occupational and behavioural risk factors may plausibly contribute to the elevated blood pressure observed. Evidence from metabolic health assessments among printing workers further supports the presence of adverse cardiometabolic profiles in comparable settings.[15]

The nutritional status of workers reflected a dual burden of malnutrition, with both undernutrition and overweight observed. This pattern has been documented among workers in small manufacturing industries and may be attributed to irregular meal timings, physically strenuous work, prolonged shifts, and suboptimal dietary practices.[16] Such nutritional imbalances may aggravate fatigue, musculoskeletal complaints, and vulnerability to non-communicable diseases.

Skin complaints, nasal irritation, eye discomfort, and gastrointestinal symptoms were commonly reported by workers. These findings are consistent with national and international studies linking such symptoms to exposure to inks, solvents, volatile organic

compounds (VOCs), and paper dust in printing environments.[14,17,18] Experimental and field studies have demonstrated that VOC emissions during printing and cleaning processes can cause mucocutaneous and respiratory irritation even at relatively low exposure levels, which may explain the symptom profile observed in this study.[17,18]

Despite the presence of these health complaints, awareness regarding chemical and noise-related hazards was limited, and none of the workers reported using personal protective equipment. Similar deficiencies in hazard awareness and safety practices have been reported among printing press workers in India and other low- and middle-income countries, highlighting gaps in occupational health training, safety communication, and regulatory oversight in small-scale enterprises.[19,20]

Mechanical hazards, particularly finger-cut injuries, were perceived as the most severe risks, while hand injuries and electrocution were rated as moderate risks. In a study done by Badoozadeh et al in printing presses at Iran to assess the job safety, the predominant hazards identified were of mechanical (60.9%), electrical, ergonomical and chemical nature.[21] This pattern is consistent with previous studies indicating that workers are more likely to recognize immediate and visible hazards than chronic or less perceptible chemical exposures.[14,20] As the Risk Assessment Matrix used in this study captured workers' perceptions rather than objectively measured exposures, the findings represent perceived risk levels and should be interpreted accordingly.

Overall, the findings underscore the need for periodic health surveillance, improved occupational health education, and basic safety interventions such as machine guarding, PPE use, and hazard awareness training in small-scale printing presses. Evidence suggests that even low-cost preventive measures and regular health screening can substantially reduce occupational morbidity in similar industrial settings[20,22]

Strengths and Limitations

This study examined 186 workers who were working directly in processes involved in printing. Hence the results are purely of the printers themselves and no information of others who are not associated with the printing work have been taken. There have been very few studies on workers connected with the printing process per-se in India and abroad. The workers had subjected to their examination and declaration of hazards related with the printing press without any sort of fear and favour. The interference of the owners or administrator of the printing press was not seen at any stage during the interaction with the workers. The Risk Assessment Matrix has been used to find out the risk score of the hazards as identified by the printers themselves. However, no biochemical and laboratory investigations of the workers or the environmental sampling could be undertaken due limitations of financial resources as well as the general apprehension of the workers due to the ongoing Covid-19 pandemic.

Conclusion

The study examined the workers who were involved in the printing operations in the printing press. The majority of the workers had blood pressure levels elevated from the normal recommendation. However, very few were aware of that fact and were on antihypertensives. Most of the workers had their BMI levels which was either less than or more than the recommended standards. Skin and nasal related complaints were the predominant health related complaints. The worker should be made to undergo regular health check-up. A complete timeframe and schedule of such health checkup along with biochemical markers is the need of the hour to enable early detection of any health issue and prompt treatment. A complete lack of awareness related to the harmful effects of dyes was seen. Finger cut injury, hand injury and electrocution were the main hazards which the workers enumerated. As per their perception of the likelihood and severity associated with these hazards, the risk score from the RAM was calculated. The risk score for finger cut injury is 'severe', for hand cut injury is 'moderate' and for electrocution is 'moderate'. The workers need to be given health education related to their occupational hazards.

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Availability of Data: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Non-use of Generative AI Tools: This article was prepared without the use of generative AI tools for content creation, analysis, or data generation. All findings and interpretations are based solely on the authors' independent work and expertise.

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