

A Cross-sectional Analysis of Patterns of Occupational Injuries among Patients Presenting at Lahore General Hospital Trauma Center

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ABSTRACT:

Background: Occupational injuries are a preventable cause of morbidity and disability, especially in developing countries with limited enforcement of workplace safety standards. This study aimed to describe occupational injury patterns and find independent risk factors for severe injury among patients attending Lahore General Hospital Trauma Center. **Methods:** This study collected demographic, occupational, injury, and clinical data through interviews, examinations, and hospital records of 240 adults with work-related injuries. Injuries were classified as mild/moderate or severe based on injury type, surgery, multiple injuries, intensive care unit admission, and prolonged hospitalization. Data were analyzed with SPSS version 26.0, and multivariable logistic regression identified factors associated with severe injury at $p < 0.05$. **Results:** The proportions of industrial and construction workers were 93 (38.8%) and 66 (27.5%), respectively. The most common injuries were machinery-related 71 (29.6%) and falls from height 58 (24.2%), with the upper limbs the most common site of injury 100 (41.7%). Fractures accounted for the highest frequency 87 (36.3%), with 96 (40.0%) requiring surgery and 118 (49.2%) being admitted. Severe injury was independently associated with lack of personal protective equipment (AOR=3.74, 95% CI: 1.95–7.16), working >8 hours/day (AOR=2.96, 95% CI: 1.54–5.69), experience <5 years (AOR=2.41, 95% CI: 1.23–4.71), no formal safety training (AOR=2.18, 95% CI: 1.08–4.39), and machinery-related accidents (AOR=1.96, 95% CI: 1.01–3.82). **Conclusion:** Most of the occupational injuries involve machinery, falls, upper limbs, and fractures suffered by males. Better compliance with PPE, more formal safety training, and supervision of inexperienced workers could reduce serious occupational trauma.

Keywords: Accidents, Occupational; Occupational Health; Occupational Injuries; Personal Protective Equipment; Risk Factors; Trauma Centers

INTRODUCTION

Occupational injuries are a significant public health problem and a contributor to preventable morbidity, disability, and economic losses among the working population worldwide ¹. The International Labour Organization estimates that millions of workers are injured on the job annually, causing significant loss of life, disability, productivity, and health-care costs ². This burden is disproportionately shared by workers in low- and middle-income countries (LMICs) as a result of the inadequacy of workplace safety measures, the lack of regulations, limited access to preventive measures, etc., due to rapid industrialization ³. Occupational injuries impact the health and well-being of workers as well as the socio-economic outcomes of their families and employers ⁴.

Occupational injury profile depends on the industry, workplace, and safety measures ⁵. The construction, manufacturing, mining, agricultural, and transportation industries have the highest rates of injuries every year, due to heavy machinery, hazardous equipment, falls from heights, electricity, and moving objects ⁶. Upper limbs are more prone to injury due to direct engagement in manual activities and thus are some of the most reported occupational injuries, such as fractures, lacerations, crush injuries, burns, and traumatic amputations ⁷. Occupational trauma is likely to affect young male workers and employees who have less work experience due to limited hazard awareness of their job, less supervision, and greater physically demanding work ⁸. A number of factors have been recognized as being significant in relation to the severity of injuries in the workplace. Lack of personal protective equipment (PPE), lack of formal safety training, excessive working hours, worker fatigue, poor machine maintenance, and lack of compliance with the occupational safety regulations increase the risk of serious injuries that may require hospitalization or surgery ⁹. In past research, it has been shown that structured safety program implementation, frequent training, engineering controls, and consistent use of PPE result in a significant reduction in accidents or injuries in the workplace and an improved safety for the workers ¹⁰.

The vast majority of existing studies have been conducted in specific industries or on specific types of injuries, and there are significant gaps in the knowledge. Despite the dynamic industrialization and growth of the construction industry, occupational injuries are an overlooked public health problem in Pakistan ¹¹. Evidence on the patterns, mechanisms, and risk factors of serious occupational injuries remains sparse, particularly in tertiary-care settings ¹². This study aimed to provide evidence on the pattern and characteristics of occupational injuries presenting to a tertiary trauma center in Lahore, helping inform targeted workplace safety measures and injury-prevention strategies in Pakistan.

This study was undertaken to assess the trend of occupational injuries presented at Lahore General Hospital (LGH) Trauma Center. It was also designed to identify targeted occupational safety interventions and reinforce injury prevention efforts in the workplace.

METHODOLOGY

The study was a hospital-based descriptive cross-sectional observational study (July 2022-December 2022) carried out in the Orthopedic Surgery and Trauma Department at Lahore General Hospital (ref#006/01/22). This study aimed to observe the pattern of occupational injuries presenting to the Trauma center and the factors contributing to the severity of the injuries (frequency, pattern, mechanisms, and characteristics of occupational injuries) in patients seen at the Trauma center. A total of 240 consecutive patients with WRI were recruited. The sample size was calculated using the formula $n = Z^2P(1-P)/d^2$, where n represents the required sample size, Z is the standard normal deviate corresponding to the confidence level, P is the estimated prevalence, and d is the absolute precision. OpenEpi Version 3.0 (Emory University, Atlanta, GA, USA; RRID:SCR_021913) was used based on an expected proportion of 50%, a 95% confidence level, and a 6.3% margin of error, resulting in a required sample size of approximately 240 participants. A total of 240 eligible patients were subsequently recruited using consecutive sampling

Patients 18 years or older who had suffered an injury while working and had been transported to the trauma center during the study period were included. An injury was seemed to be an occupational injury if it was physical and happened while at work or in connection to work, and was a requirement to seek medical assessment or treatment and hospitalization of more than 5 days. Patients with off work injuries, reinjuries (defined as a new injury involving the same anatomical site of a previous occupational injury that had not completely recovered), poor follow-up attendance, incomplete records, or refusal to participate were excluded.

Data were collected by direct patient interviews using a structured data collection form, physical examination and review of patient's hospital medical records. The demographic variables were age, gender, occupation and years of work experience. Employment sector, PPE equipment, hours per day in the workplace, shift time, and occupational safety training history was included in workplace information. Mechanism of injury, anatomical site of injury, injury type, surgery required, hospital admission, intensive care unit (ICU) admission, and length of hospital stay (LOS) were recorded and included as injury-related variables. Injury severity was classified as mild/moderate or severe, based on injury type, requiring operative surgery, multiple injuries, admission to ICU or LOS. Clinical data was collected through hospital discharge records. Routine hospital trauma management was used to assess and treat the patient.

The Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA) was used to analyze the data. Means and Standard deviations (SDs) were used for continuous variables and frequencies and percentages for categorical variables. The incidence of injuries and the relation between workplace characteristics and severity of injuries were analysed using the Chi-square test or Fisher's exact test as appropriate. Univariate analysis variables that were statistically significant were used to create a multivariable logistic regression model to determine independent predictors of severe occupational injuries. Odds ratios (OR) were computed with 95% confidence intervals (CIs) and a 2-tailed p-value of <0.05 was considered statistically significant. All participants gave informed consent, and the confidentiality of patients' information was maintained throughout the project. The ethical principles mentioned in the Declaration of Helsinki were followed in all the research.

RESULTS

A total of 240 patients with work-related injuries admitted to the Lahore General Hospital Trauma Center were included. The mean age was 34.6 ± 10.8 years, and 209 (87.1%) were male. The top two occupations were industrial workers, 93 (38.8%), and construction workers, 66 (27.5%). The most prevalent injury patterns were those of the upper limbs, 100 (41.7%), and fractures, 87 (36.3%). The lack of personal protective equipment (PPE) and work experience of less than 5 years and extended working hours (>8 hours/day) were significantly associated with severe occupational injuries (p<0.05). The top occupation category was industrial worker 93 (38.8%), followed by construction worker 66 (27.5%), suggesting that most trauma presentations were related to manual labour occupations **Table I**.

Table I: Occupational and Demographic Profile of Injured Workers (N=240)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
18–29	82	34.2
30–44	109	45.4
≥45	49	20.4
Gender		
Male	209	87.1
Female	31	12.9
Occupation		
Industrial worker	93	38.8
Construction worker	66	27.5
Agriculture worker	39	16.3
Healthcare worker	18	7.5
Others	24	10.0
Mean Age (years)	34.6 ± 10.8	

As shown in **Table II**, the most common occupational injuries were machinery accidents 71 (29.6%), injuries from falls from height 58 (24.2%), and sharp object injuries 47 (19.6%) were most common. Injuries to upper limbs 100 (41.7%) had the highest proportion of affected body region, followed by injuries to lower limbs 67 (27.9%). The predominance of extremity injuries was consistent with the high representation of industrial and construction workers in the study population.

Table II: Characteristics of Occupational Injuries(N=240)

Variable	Frequency (n)	Percentage (%)
Mechanism of Injury		
Machinery-related	71	29.6

Fall from height	58	24.2
Sharp object injury	47	19.6
Slip/trip/fall	34	14.2
Burn/electrical injury	30	12.5
Body Region Injured		
Upper limb	100	41.7
Lower limb	67	27.9
Head/neck	29	12.1
Chest/abdomen	18	7.5
Multiple body regions	26	10.8

Table III shows that fractures 87 (36.3%) were the most common type of injury, followed by lacerations 66 (27.5%) and soft tissue injuries 51 (21.3%). Nearly half 118 (49.2%) of the patients had to be admitted to hospital, and 16 (6.7%) of them to intensive care, with surgical intervention being needed in 96 (40.0%) of cases. The average LOS was 5.8 ± 3.7 days.

Table III: Injury Severity and Clinical Outcomes(N=240)

Outcome Variable	n (%)
Fracture	87 (36.3)
Laceration	66 (27.5)
Soft tissue injury	51 (21.3)
Crush injury	24 (10.0)
Amputation	12 (5.0)
Surgical intervention required	96 (40.0)
Hospital admission	118 (49.2)
ICU admission	16 (6.7)
Mean hospital stay	5.8 ± 3.7 days

Table IV shows that severe occupational injuries were significantly associated with the absence of personal protective equipment (42 (60.9%) vs. 54 (31.6%), $p<0.001$), working more than eight hours per day (44 (63.8%) vs. 66 (38.6%), $p<0.001$), limited work experience of less than five years (56.5% vs. 35.7%, $p=0.004$), lack of formal safety training (41 (59.4%) vs. 70 (40.9%), $p=0.011$), and night-shift work (27 (39.1%) vs. 45 (26.3%), $p=0.049$).

Table IV: Workplace-Related Factors According to Injury Severity(N=240)

Variable	Mild/Moderate Injury (n=171)	Severe Injury (n=69)	p-value
No PPE use	54 (31.6%)	42 (60.9%)	<0.001
Work experience <5 years	61 (35.7%)	39 (56.5%)	0.004
Working >8 hours/day	66 (38.6%)	44 (63.8%)	<0.001
No formal safety training	70 (40.9%)	41 (59.4%)	0.011
Night shift work	45 (26.3%)	27 (39.1%)	0.049

Not wearing PPE showed the strongest association with severe occupational injury (AOR=3.74, 95% CI: 1.95–7.16, $p<0.001$). Other significant predictors were work hours of >8 hours/day (AOR=2.96, $p=0.001$), work experience of <5 years (AOR=2.41, $p=0.010$), lack of formal safety training (AOR=2.18, $p=0.029$), and machinery-related accidents (AOR=1.96, $p=0.047$), showed in **Table V**.

Table V: Multivariable Logistic Regression Analysis of Factors Associated with Severe Occupational Injuries

Predictor	Adjusted OR	95% CI	p-value
Lack of PPE	3.74	1.95–7.16	<0.001
Working >8 hours/day	2.96	1.54–5.69	0.001
Work experience <5 years	2.41	1.23–4.71	0.010
No formal safety training	2.18	1.08–4.39	0.029
Machinery-related accidents	1.96	1.01–3.82	0.047

Lack of PPE was the strongest independent predictor of severe occupational injury (AOR=3.74, 95% CI: 1.95–7.16, $p<0.001$). Prolonged working hours, limited work experience, absence of formal safety training, and machinery-related accidents also significantly increased the odds of severe injury, as shown in **Figure 1**.

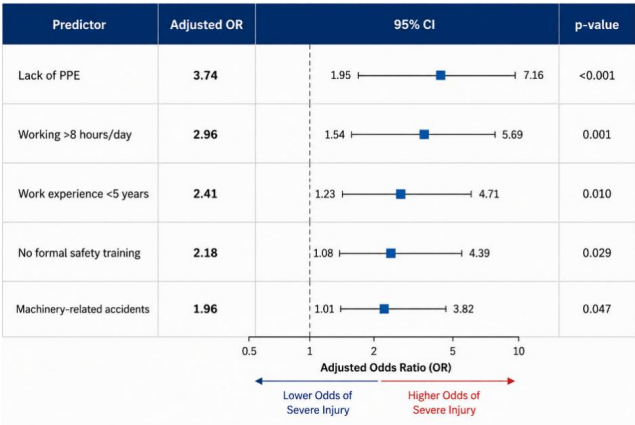


Figure 1: Forest plot showing independent predictors of severe occupational injuries based on multivariable logistic regression analysis.

The type and intensity of the work-related injuries varied in various workplaces. Fractures from machinery were the most common cause of injury, with 46 (49.5%) of the cases requiring surgery and an average LOS of 6.4 ± 3.8 days. Fractures were the most common injury among construction workers, and lacerations were common among agricultural workers, while sharp object injuries were common among healthcare workers, who tended to have a shorter LOS, as presented in **Table VI**.

Table VI: Distribution of Occupational Injury Patterns by Workplace(N=240)

Workplace	Most Common Injury	Surgical Management n (%)	Mean Hospital Stay (days)
Industrial sector	Machinery-related fracture	46 (49.5)	6.4 ± 3.8
Construction sites	Fall-related fracture	30 (45.5)	6.1 ± 3.5
Agriculture	Laceration	11 (28.2)	4.2 ± 2.6
Healthcare facilities	Sharp object injury	3 (16.7)	2.3 ± 1.2
Other occupations	Soft tissue injury	6 (25.0)	3.9 ± 2.1

Overall, the findings demonstrate a substantial burden of occupational trauma, with machinery-related injuries, falls, upper-limb injuries, and fractures representing the predominant patterns. Severe injuries were particularly associated with absence of PPE, longer working hours, limited work experience, and inadequate safety training. These findings provide a basis for interpreting the occupational and workplace factors associated with injury severity.

DISCUSSION

The present study indicated that industrial and construction workers, mostly young and middle-aged males, were predominant among the victims of occupational trauma at Lahore General Hospital. The most common mechanisms of injury were machinery-related incidents and falls from height, and the most common clinical groups were upper limb injuries and fractures. Many patients needed to be admitted to hospital or operated on, and lack of PPE, prolonged working hours, limited experience, no formal safety training, and machinery exposure were independently associated with severe injury. The profile confirms the findings of Pakistani analyses, which indicate that more occupational injuries among males and workers involved in manufacturing, construction, agriculture, and elementary occupations ^{14,15}. A recent study in Karachi also reported frequent cases of construction injuries and increased risk of injuries for those working more than 8 hours a day ¹⁶.

The construction and metal industries are strongly associated with workplace injuries due to poor fit of PPE and unsafe work schedules ¹⁷. The disproportionate age of injuries among males aged 30-44 years may be due to the higher number of males in physically challenging jobs, machine-related work, and jobs that involve heights ¹⁸. Nearly two in three were industrial and construction workers, suggesting that intensity of exposure and lack of enforcement of safety measures may influence the caseload to the trauma center ¹⁹. Hands and arms were directly engaged in operating, feeding, cleaning, and fixing equipment that has moving parts, making machinery accidents a significant problem with industrial workers ²⁰.

Forty percent (40.0%) needed surgery, and 49.2% required hospital admission, indicating a high level of demand for orthopedic, operative, inpatient, and rehabilitation services. The lowest level of PPE was highly associated with serious injury, with nearly 4 times higher odds of injury. This finding is consistent with systematic reviews and meta-analyses reporting substantially higher occupational-injury risks among workers who did not use PPE and demonstrating that appropriate PPE use is an important protective factor against occupational injuries ²¹. However, the effectiveness of PPE relies on availability, proper selection, fit, compliance, supervision and task-specific instruction ^{22,23}. Severity was also independently associated with working beyond 8 hours, which lends further support to the incidence of fatigue, delayed reactions, diminished attention and lack of recovery during prolonged working hours, which is consistent with previous studies ²⁴. Insufficient experience can be a cause of poor hazard recognition and potentially poor knowledge of emergency response procedures. This association is supported by the reviews, which reveal the benefits of structured training to increase safety knowledge, behavior, and safety indicators ²⁵.

Fractures caused by falls are among the most frequent injuries among construction workers, and suggest the need for protected scaffolding, guardrails, safe ladders, harnesses, and pre-task hazard assessment. There were more lacerations and sharp-object injuries in agriculture and healthcare, indicating that prevention needs to be specific to workplace hazards. Inspection, management commitment, engineering controls, and monitoring are needed in addition to regulation or training to achieve the desired effects for interventions ^{26,27}.

The current study has some limitations, such as it has a single-center, observational design and a sample of the trauma centers; it may overrepresent severe injuries and underrepresent minor and unreported injuries; residual confounding, selection bias and recall bias due to self-reporting. Intervention studies should evaluate the effectiveness of combined provision of PPE, fatigue management, training, machine guarding, and regulatory inspection in reducing incidence of injury and severity of injury.

CONCLUSION

This study identified that being young and middle-aged, male, and an industrial and construction worker is associated with occupational injury, with the most common being from machinery accidents, falls, injuries to the upper limb, and fractures. The absence of PPE, long working hours, insufficient experience, absence of safety training, and machinery-related incidents were associated with severe injuries. Findings indicate that workplace hazards can be prevented and provide evidence for the direction of workplace safety policies. Standardized prevention programs, long-term disability, return-to-work outcomes, and legal enforcement of workplace safety policies should be assessed in future studies conducted at multiple sites.

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