

Study on 100 Industrial Accident Cases in Nepal: Type and Severity of the Injuries and its Predisposing Factors

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Abstract

Introduction	Industrial health hazard, medical and surgical, is one of the major health problems among the workers. Cases of industrial accident become handicapped after the injury. Majorities of industrial accidents are preventable.
Objective	This study was to determine the type, the severity, outcome of industrial injury and its predisposing factor.
Method	A prospective study on 100 cases of industrial accidents was conducted in Tribhuvan University Teaching Hospital and Bir Hospital.
Results	Most victims were male of the 15–35 year's age group working in wood, furniture and carpet industries. In 81% of these cases, injury was in the upper limbs. Out of 100 cases 48% had open fracture. Majority of injured was untrained (96%) and unskilled. Average working hour was 8.7 hours a day. Some of the predisposing factors noted were as follows: continuous work without rest sometimes without meal, work despite illness, lack of knowledge about safety measures when handling the machinery and, unsatisfactory working condition such as congested working areas, poor lighting and ventilation. Child labor (9.5%), job insecurity (99.5%), lack of regular health check-up and insurance (92.5%), improper use or lack of first-aid treatment and lack of work schedule were noted as some of the major short comings of these industries. Per factory average 21.7 accidents used to occur per year and 61% of the workers had at least one work related accident (minor or major).
Conclusion	Findings of this study show that industrial accidents are one of the major health problems of the different industries in Nepal and that most of these accidents are preventable.
Key words	Industrial accidents, types of injury, predisposing factors

Introduction

Nepal is predominantly an agricultural country whose agricultural sector absorbs more than 80% of the total manpower of the country. However, only 18% of the total land area have been used for agricultural purposes. According to the tentative GDP estimate for 1997 the contribution from agricultural sector was only 41% (1) and it has been decreasing over the years. This has then prompted its people to look for alternate means of livelihood

for their daily survival. Many people from the rural areas thus migrate temporarily or permanently to the urban areas in search of Job opportunities. A number of industries have flourished in Nepal in recent years. Among the many types of industries present, the manufacturing of carpet is presently leading in Nepal occupying 54% of the total export commodity. Wood & furniture, garments, printing presses, rice & oil mills, shoe & slipper industries

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etc. are also rapidly increasing in number and are mostly concentrated within the Kathmandu valley. Untrained manpower, unhealthy and unscientific working condition, substandard machinery, lack of quality control, lack of health awareness among the workers, the managers, and the owners are some of the frequently raised issues regarding these industries.

The aforementioned problems in these industries have a direct impact on the health of the workers. Frequent respiratory tract infections, skin diseases, sexually transmitted diseases and industrial accidents are the some of the health problems noted among the industrial workers. Most of the health problems are preventable if proper training, use of standard machinery, proper working conditions, and health awareness programs are implemented.

Hospitals in Kathmandu often encounter surgical injuries due to industrial accidents. Usually, the injuries have a bad prognosis leading to severe disabilities. The number of such cases thus urged us to carry out an epidemiological study on industrial accidents. One hundred industrial accident cases seen in the Tribhuvan University Teaching Hospital (TUTH) and the Ministry of Health Bir Hospital were included in this prospective study. This study has highlighted some epidemiological important factors regarding the injuries such as severity of the injury, severity of the resulting disability and its predisposing factors.

Methodology

Test Instruments

1. Questionnaire design: Separate questionnaire forms were formulated to collect data from the patients and/or patient party, other factory workers and their managers.
2. Observation sheet: An observation sheet was also formulated to assess the existing physical facilities of these factories.

Data collection

One hundred industrial accident cases that attended TUTH and Bir Hospital were randomly included in the study. Pertinent data were collected from the patients and/or their parties using a specially designed questionnaire. The factories where the injuries occurred were traced. Twenty different factories were proportionately selected and included

in this study. Industries outside the Kathmandu valley were not visited due to their difficult accessibility. Information was also gathered from at least ten other workers and the managers of these factories. Trained field workers using an observation sheet assessed the working conditions and physical facilities in these factories. Information from the injured party, clinical findings etc. were collected by the attending doctor in the casualty department of the hospitals concerned.

Industrial accident cases with surgical injuries were conventionally grouped into two namely soft tissue and bone injuries. Bone injuries were further classified into three grades according to standard guidelines recommended by Gustilo and colleagues (2,3). Table 1 provides a quick reference to these guidelines and their reported incidence of complications among the different grades of open fractures. Sub-classification of grade III open fracture was not done to avoid confusion. Part of the body involved, time interval between the arrival of the injured and the initiation of proper treatment, and the type of treatment provided were noted.

All essential procedures were followed to avoid all possible bias. Proper attention was paid to minimize possible errors. In the study, the other questioned were randomly selected and all possible factors such as sex, age were well represented.

The collected data were processed and possible variables were cross-checked. Relative risk (Odd ratio) was calculated to assess the association between different risk factors and outcome using EPI Info. Program version 6.0.

Results

Age and sex wise distribution of the workers and the injured: Two third (63.5%) of the workers belonged to 16 to 35 years of age. Majorities (83%) of the injured workers were from this age group. Table 2 shows that 9.5% of the workers were of less than 15 years of age. Most of the injured (96%) were male. Male female ratio of the workers was 1.2:1. The odd ratio of 2.48 (1.24<OR<5.22) signifies that workers of younger than 35 years are in higher risk of accident. The odd ratio for sex wise accident risk was calculated to be 7.58 (2.64<OR<29.72) suggesting that male are more prone to accidents.

Table 1: Classification of the open fractures as recommended by Gustilo *et al.*

Grade	Wound	Level of contamination	Soft tissue injury	Bone injury
I	< 1 cm long	Clean	Minimal	Simple with minimal comminution
II	>1cm long	Moderate	Moderate, some muscle damage	Moderate comminution
III	usually >10 cms long	High	Severe with crushing	Usually comminuted with poor soft tissue coverage

Type of factory and number of accidents: Most of the injuries (66%) took place in carpet, and wood & furniture factories. Table 3 shows the factory wise distribution of the injury cases. The odd ration of 7.76 (4.37 <OR<13.82) signifies that working in wood & furniture, and carpet factories has higher risk of accident.

Training and accident: The workers of the factories were inquired whether they had any training related to their work; 82.5% them did not have proper training. Ninety-six percent of the injured workers did not have any formal training before being employed. The odds ratio of 0.20 (0.05<OR<0.58) signifies that training and industrial accidents are inversely related. Fifty eight percent of the injured were laborers, which includes non-professionals working without training. The control group workers and the injured were classified into unskilled, semi-skilled, and skilled on the basis of their working experience of less than 6 months, 6 months to 5 years, and more than 5 years respectively. Of the hundred injured workers, 24% were unskilled, 57% semi-skilled and 19% were skilled (Figure 1). Assuming that the risk of industrial injury for skilled workers is equivalent to 1 (OR=1), the OR for unskilled and semi-skilled workers was calculated to be 10.86 (4.12<OR<29.36) and 2.48 (1.33<OR<4.75) respectively.

Table 2: Age distribution of the workers and the injured

Age group	% of total workers	No. of injured
< 15 years	9.5	4
16 – 25 years	39.0	55
26 – 35 years	24.5	28
6 – 45 years	17.5	8
> 45 years	9.5	5

Time of accidents: Fifty six percent of the injuries occurred during daytime (9.00 am – 6.00 pm) and the remaining 44% had the injury during odd hours (before 9.00 am and after 6.00 pm). Of the 44, about 14% (6/44) sustained the injury at around 2.00 am.

Continuous work increases the risk accident: Of the 100 injured workers 18% were working continuously for more than 7 hours without rest. However, 19% of the injured were working for less than 1 hour, 25% for 1 – 2 hours, 26% for 3 – 4 hours and 12% for 5 – 6 hours. Excluding the workers who worked for less than two hours, 56% of the workers were continuously working without break on the day of the accident. The OR=28.5 (12.09<OR<66.90) shows that continuous work without leisure time between work significantly increases the risk for accident.

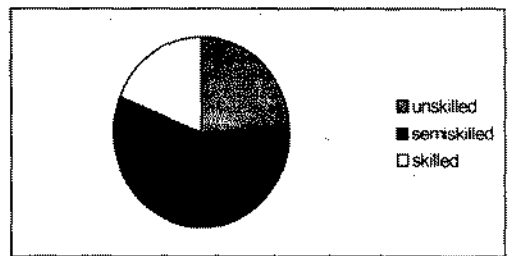
Table 3: Industry-wise distribution of injured workers and types of injury

Industry	Soft-tissue fracture	Close fracture	Open fracture			Total
			I	II	III	
Carpet	11	2	2	9	4	28
Wood & furn.	17	3	5	7	6	18
Rice & Oil	0	0	1	0	2	3
Printing press	1	1	0	3	2	7
Motor workshop	3	0	1	1	0	5
Garment	3	0	0	1	0	4
Grill & iron	4	0	0	0	0	4
Shoes & slip.	1	0	0	1	0	2
Others	5	1	0	3	0	9
Total	45	7	9	25	14	100

Known disease, medication, alcohol consumption and addiction to illicit drugs did not cause the accidents: All injured workers except one did not have any known disease before and at the time of the accident. Also, all workers except one were not under the influence of alcohol at the time of the accident. None of the workers were illicit drug users.

Traveling time of the injured to the hospital: On an average, the traveling time of the injured person to the hospital was 1.46 hours. Seventy percent of the injured were taken to the hospital within an hour. Still, 28% of the injured were taken to the hospital late but within 6 hours even though they were from the Kathmandu valley. Two cases arrived at the hospital in Kathmandu after 24 hours of the accident and they were from outside the valley.

Figure 1: Pie chart showing percentage of unskilled, semi-skilled and skilled workers



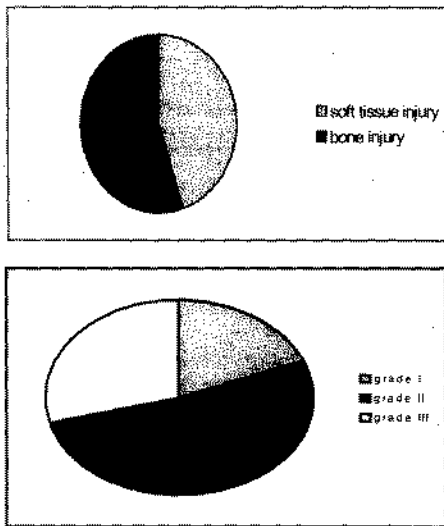
24% were unskilled, 57% semi-skilled and 19% were skilled.

Part involved: Upper limb involvement comprised 81% (41% right and 40% left) of the total number of injury cases. Thirty eight percent of the cases involved the fingers only while 41% had hand injury with or without finger involvement. The entire limb was injured in two cases where big skin lacerations, open fracture of the bones, and

traumatic-amputation from the mid forearm were involved. Five out of seven lower limb injury cases had soft tissue injury including tendon injuries around the ankle. Two cases had open fractures of the tarsal, metatarsal, and phalange bones. Six percent of the cases sustained head injuries, 4% had scalp injuries and 2% had skull fractures with neurological deficits. Six percent had multiple skin lacerations all over the body including the perineal area. One of them presented with ribs fracture. (Table 4)

Types of injury: Of the 100 cases included, 45% had soft tissue injuries and 55% had bone injuries. Seven of the bone injury cases had simple fracture and 48 had compound fractures of different grades; grade I = 9, grade II = 25 and grade III = 14 (Figure 2a & 2b).

Figure 2a & 2b: Pie charts showing type of injury (a) & grades of open fracture (b)



Of the 100 cases included, 45% had soft tissue injuries and 55% had bone injuries. Seven of the bone injury cases had simple fracture and 48 had compound fractures of different grades; grade I = 9, grade II = 25 and grade III = 14.

Time of starting proper treatment at the hospital: Proper treatment was started within 30 minutes in 12 cases, within an hour in 26, within 2 hours in 32, within 3 - 5 hours in 16, within 6 hours in 5 and in 8 cases, it was initiated more than 6 hours after their hospital arrival. In one case, the treatment was started only after 24 hours of his hospital arrival. The findings further show that the treatment was more prompt in soft tissue injuries, close fractures and grade I open fractures. All grade II and grade III open fracture cases underwent intermediate to major operations under general or regional anesthesia and were hospitalized. Excluding the cases with big skin lacerations, all soft tissue injury

cases, simple and grade I open fracture cases were treated in the casualty and outpatient departments. The results revealed that treatment provided in the hospitals was proper and conventional.

Residual defects: The final outcome of the treatment or the presence of possible residual deformities could not be assessed in most of the cases treated due to lack of adequate follow-up. Applying to the prognosis prediction of different grades of injuries recommended by Ramon B Gustilo *et al* (Table 1) 2 - 7% of grade II and 10 - 25% of grade III open fracture cases are predicted to have to have poor prognosis due to sepsis and higher rates of amputation. Two cases who had traumatic amputation at the mid-forearm level had permanent disability. Two head injury cases had neurological deficits at the time of hospital discharge.

Health care, First-aid services, and Health Insurance: Only 7.5% of the factory workers were getting health check-up service and it was regular only in 25% of the factories. First-aid kits were found only in 55% of the factories and none of them had sufficient necessary contents. Majority (62%) of the workers had never even seen it. Health insurance was not provided for 92.5% of the factory workers in 75% of the factories. None of the injured in our series had health insurance.

Frequency of industrial accidents: Sixty one percent of the workers had experienced at least one accident while working. On an average, there were 21.7% accidents per factory per year, ranging from 1 to 201 major and minor accidents.

Working condition of the factory: In contrast to the opinion of the factory authorities, 73% of the workers concluded that they had poor working condition. Only 20% of the factories had good ventilation, lighting and working condition in terms of cleanliness around the factory (figure 4).

Work without meal and during illness increases the risk of accident: Thirty-seven percents of the workers often used to work without meal and 16% used to work even during illness. They considered illness only when they were bed ridden and could not do their work.

Preventive measures: None of the factories had regular servicing and maintenance of the machinery and none of them provided protective wearing to the workers. Only about half (52%) of the workers were taught about the safety measures. Only 63.5% of the workers used to check the machines before use.

Work basis and weekly income: Most of the workers (86%) joined the factories for a better life. The rest of them (14%) wanted to change their previous profession like prostitution in the case of females and get-rid-of their father's atrocities in the case of males. Ninety-nine percent of the workers

were working on daily wage basis or a contract basis. Average income per worker per week was 425.75 Rs (approximately 6 USD) and it ranged from 200 to 2000 Rs. (approximately 3 to 30 USD).

Discussion

Establishment of industries in Nepal has helped the national economy and has provided better job opportunities for many people living in poverty. Our study shows that more than 86% of the workers was working in different industries in the hope of a better life. Besides other industrial hazards, industrial accidents are one of the major health problems among industrial workers. We performed a prospective study on 100 cases of industrial accidents that were occurred in the different industries of Nepal.

Majority of the injured workers in our study was from wood and furniture and the carpet industries (66%). The risk factor for accidents in these industries is statistically significant (OR=7.76). Males of the 16 to 35-year age group were in the top of the list of injured (83%). Factors like carelessness, over-activeness and more exposure to machinery at this and sex group may be responsible for the accidents (<35 years and >35 years age group OR=2.48; male: female OR = 7.58). Though the minimum recruitment age in 70% of the industries was pegged at 15 years, child labor, which is forbidden by law, was an open secret. The numbers of workers below 15 years old were 9.5%.

One of the major contributing factors for the injuries was lack of proper training for the workers. Percentage of untrained workers in the factories and injured among them was recorded at 82.5 and 96 respectively. Statistically, training and accidents occurrence are inversely related (OR = 0.02). The risk factor for accident is significantly higher in unskilled (OR = 10.86) and semi-skilled workers (OR = 2.48). Majority of the injured workers belonged to laborer group. These findings Jinadu MK (4) who found decreased incidence of accidents with increasing age and length of experience in a Nigerian wood industry. In a Swedish study (5) a significant over-representation of work related accidents existed for men, those in the 16 - 34 age group, and those in the manufacturing or farming industries. However, Mathur *et al.* found fewer injuries in the 18 to 25 year age groups than in those over the age of 36 (6).

Alcohol consumption, use of drugs, systemic diseases and medications are safety hazards (7,8). All but one of the injured (n=99) does not have any systemic disease, were not drunk nor were taking any medications. None of them were addicted to illicit drugs. Dunn-EV also found, in his series, no relation between medication and the accidents (9).

Our series confirms the findings reported by Lees RE *et al* (ref 10), Onis O (11) and Salminen S *et al*

(12), that skill and knowledge bases human errors accounted for most of the accidents.

Though injuries also happened to workers who worked for less than two hours, 31% of the injuries were continuously working for more than 5 hours on the day of the accident. Continuous work increases the risk of accident (OR = 28.5). This may be due to lethargy or to extreme fatigue thus leading to less concentration. Forty-one percent of the accidents occurred at odd hours (before 9 am and after 6 pm). Leigh JP (13) also found that job characteristics like frequent overtime, operative and laborer occupation categories, length of time with the job and hazardous working conditions are better predictors of industrial accidents than are personal characteristics like age, marital status and schooling.

Ninety-nine percent of the workers were on a daily wage contact. Because of a constant fear of being jobless, there was a strong desire to work long hours on an average 8.73 hours daily in spite of hunger (37%) and illness (16%). The average income per worker per week was 425.75 Rs. (approximately 6 US\$) that was not enough to support their families.

Inadequate safety precautions, ignorance, and human errors have been reported to significantly contribute to injuries (11). All industries included in this study had no work schedule. The machinery was not checked and was not properly maintained. Only 52% of the workers were taught safety measures. None of the factories undertook proper preventive measures to prevent work related accidents. Only 20% of the factories were noted to have good working conditions.

The health status of the workers was never considered at the time recruitment in most factories (14,15). Law establishes provisions of regular health services, health insurance and compensation for the victims in developed countries. In our study, regular health services and health insurance were not provided in 92.5% of the workers.

Sixty one percent of the workers had at least one work related accident. The average rate of accidents, both minor and major, was 21.7 per year. Though the incidence is less than it was reported in a wood processing industry in Nigeria (4) this figure is medically alarming. The immediate transport of the injured and the appropriate deployment of prompt treatment of industrial traumas have been suggested to obtain better prognosis (16,17,18). In our series, only 55% of the factories had first-aid kit and none of them were properly used suggesting that first-aid management of the injured cases was negligible in Nepalese industries. Although 70% of the injured, in this series, were taken to the hospitals within an hour of the injury, in 62% of the cases, the treatment was started 2 hours after their arrival at the hospital. The time lag was even more in grade II and III crush

injury cases. Shortage of trained manpower, patient overload, delay in arranging the admission and /or surgery may be some causes for the delay. The cases were otherwise treated properly in the hospitals concerned.

The upper limbs were involved in 81% of the cases (right 41% and left 40%). Of the 48% compound fracture cases, 25% had grade II injuries while 14% had grade III injuries, which had relatively poor prognosis. Of the seven cases from printing press industries, 72% had grade II & III open fractures.

Supporting the previous study (19), this study has highlighted some of the epidemiological important variables and socio-economic factors associated with industrial accidents. Based on the aforementioned findings we, the authors, have formulated a number of recommendations that may help for scientific management in the industries, may reduce the rates of industrial accident, and more importantly, prevent work related handicaps. Recommendations: 1. Proper training and refresher training programs should be conducted to educate the workers as well as their supervisors particularly on safety measures. 2. The machinery should be regularly checked and maintained. 3. Regular health check-ups and health awareness programs should be conducted for the workers. 4. Appropriate work schedules should be developed and the workers should be assured of their job. 5. Health insurance for the workers should be provided. 6. Provision of first aid must be compulsory in all factories. 7. Treatment in the hospitals must be efficient. 8. The working condition in the factories should be made more scientific and concerned government authorities should regularly check the standard. 9. There should be a provision of occupational and vocational rehabilitation for the injured workers. 10. More extensive studies on the different aspects of industrial hazards should be conducted in Nepal.

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