



Original Article

Epidemiological Study and Estimating of Accidents Distribution in Construction Industry Workers in Yazd City by Applying Time Series until 2011.

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Abstract:

Millions of construction industry accidents occur in the world cause troubles and injuries to workers and consequently economical losing every year. The aim of this paper is an epidemiological study and determination of an estimator model for accidents of instructor industry until 2011, for the first time, in Yazd city.

This study is a descriptive, analytical and modeling. The questionnaire contains the variables such as age, occupation, type of accident, injured part and the results of accident.

Fatal rate of workers who hadn't insurance was more than those who had which was statistically significant ($p < 0.001$). The most rate of accident was falling (48.58%) and the less was chocking (29%). The highest level of injured was related to hands and feet and then head injury (22.27%). The relationships of accident results with kind of occupation and also part of body were statistically significant in construction industry ($p < 0.001$). After testing many models, time series model of quadratic form was the closest model to the trend of data. This model estimation shows that if the situation be the same as now in 1390 the cases will be more than 300 per year. So this model recommended making change in the trend for preventing the accidents in future.

Key Words: Accident, time series analysis, construction workers, Yazd city

Introduction

As human beings gain more comfort and conveniences, they encounter more and more dangers and hazards. Millions of occupational accidents occurring annually impose damages and economical losses and detriment [1]. Accidents have been rendered as one of the most important crippling factors contributing to disabilities and life-threatening situations in the developed and developing countries [2]. An accident is defined as an inadvertent happening occasionally being damaging and detrimental that prevents the normal continuation, progress or performance of a task or activity. It is most often induced by unsafe acts or conditions or a combination of the two.

The occurrence of numerous catastrophic events in recent decades demonstrated that the consequences resulting from ignorance of safety principles and reaching of unwanted energies to damageable or fragile elements and materials can lead to a threat towards the human, economical, social, and political elements and question his being [3]. Also, occupational accidents exert a considerable effect on the public health.

In our own country, high amounts of money are annually devoted to compensating for payments of illness bouts of employees when they are off work or for work place disability payments. This imposes many damages to the active manpower of our society [4]. The building industry is one of the most hazardous fields around the world [5]. Building activities is considered as one of the most dangerous jobs in Hong Kong. The occurrence of various building accidents is one of the leading causes of mortality and morbidity in this country.

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In addition to work accidents, the building workers are faced with pathogens as asbestos, sillies, fumes, noise pollution, and other endangering factors in their work milieu. Yet, most of these workers enjoy poor hygienic conditions and inappropriate conveniences [6, 7]. The age range curve shows that the age group of 20-29 years suffered from most damage.

Another study carried out in Rafsanjan in south east of Iran on construction workers showed that most of the hurt workers were busy in the welding section. They had a work experience less than five years. The causes of accidents were mostly carelessness and lack of the use of safety appliances [8]. A study by Halvani reported the accidents to be the most among the workers with less than one year of experience and the least among the workers with more than 20 years of experience [9].

In the study by Colak, carelessness and lack of use of a suitable protection accounted for the first and second cause of occurrence of accidents, respectively [13].

Many research projects have been carried out on the occupational accidents in which factors contributing to the accidents have been determined. Among these factors are: type of accident [10-15], cause of damage [10, 14-17], source of accident [10, 15], month of accident [14], worker's experience [10, 14] and worker's age [10, 11, 14, 15, 18]. The present study applied all these factors as well as Time Series Model to estimate the related variables.

Due to the fact that %9-12 of the workers in our country are busy in this section and few epidemiological studies have been carried out in this regard, the present study made an attempt to manage the building accidents process efficiently via studying the population factors and parameters as time of accident, cause of accident, and consequences of accidents. Since estimating the distribution of accidents and determining their model of occurrence are effective factors for planning and prevention of accidents in future, this study used the Time Series Model for the first time to study accidents.

Methods

This was a descriptive cross-sectional modelling study in which all the construction workers sustaining occupational accidents during 2002-2006 participated. The documented report of the accidents was recorded in the Office for Work and Social Affairs in Yazd, Iran. The population under study included 247 subjects. The required data were collected on the basis of

research purposes using a questionnaire. The questionnaire included variables as date of accident, time of accident, work shift, age, occupation, working experience, education level, insurance status, marital status, the consequence of the accident, the hurt organ, type of accident, and cause of accident. The data were given to the statistical software "Minitab" and analysed via descriptive statistics, Chi-square, Time Series, Trend analysis. The Time Series Model was used to estimate accidents.

The method of data fitting and curving, especially for annual data, was to fit a simple function as the polynomial curve (linear, degree one, degree two, ...) in the form of Gompers curve or logistic curve as the following:

$$\text{Gompers curve: } \ln x_t = a - br^t$$

$$\text{Logistic curve: } x_t = a / [1 + b \exp(-ct)]$$

Obviously, when the time variable is large enough, these curves tend to an asymptotic quantity. For both these curves, the fitted curve provides a measurement of the trend and the remainders offer the difference between observations and corresponding values of the fitted curve, providing an estimation of local fluctuations.

Results

A total of 247 construction workers suffering from accidents in Yazd, Iran participated in this study. They belonged to the age group of 12-71 years with the mean age of 32. The accident rate was highest in the second half of the month specially the last 10 days of the month so that 45 %of the accidents occurred in the last third (the last 10 days) of the month. The accidents mostly occurred in summer than other seasons (31.58%).

The rate of accidents increased progressively during 2002-2006 with 28.34% of the whole accidents occurring in 2005. There was a little decrease in the rate in 2006. The amount of accidents occurring in the morning shift (72.87%) was higher compared to the evening shift. Most of the hurt workers (38.1%) belonged to the ager group of 20-29 and the least (21.5%) belonged to the age group of 30-39.

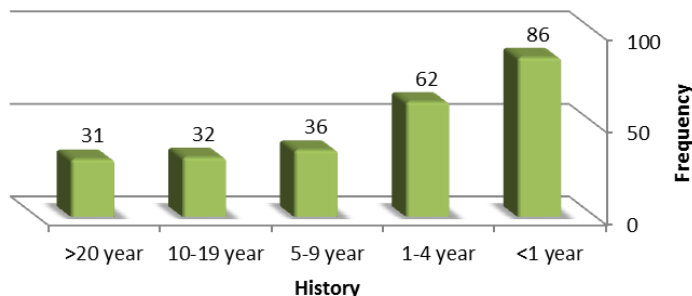
Most of the hurt workers (33.20%) had primary school education. Also, most of the hurt workers (63.97%) were married. Further, most of the accidents (46.56%) occurred among the simple workers due to their nonstandard work, unsafe act, and laborious task.

Table I Settings of the Quest-300 Dosimeter

job	accident					total
	head	Hand and leg	Back and neck	Heart and lung	Other	
Simple worker	23 (20)	30 (26.1)	21 (18.3)	10 (8.7)	31 (26.9)	115 100
Mason	10 (21.3)	11 (23.4)	12 (25.5)	10 (21.3)	4 (8.5)	47 100
Well digger	1 (8.3)	0 (0)	4 (33.3)	1 (8.3)	6 (50)	12 100
Driver and administrative	3 (30)	5 (50)	1 (10)	0 (0)	1 (10)	10 100
Scaffolding Installers	3 (21.4)	4 (28.6)	5 (35.7)	0 (0)	2 (14.2)	14 100
Welder and serviceman	1 (12.5)	2 (25)	2 (25)	1 (12.5)	2 (25)	8 100
Other	4 (9.8)	16 (39)	10 (24.4)	4 (9.7)	7 (17.1)	41 100
Total	45	68	55	26	53	247

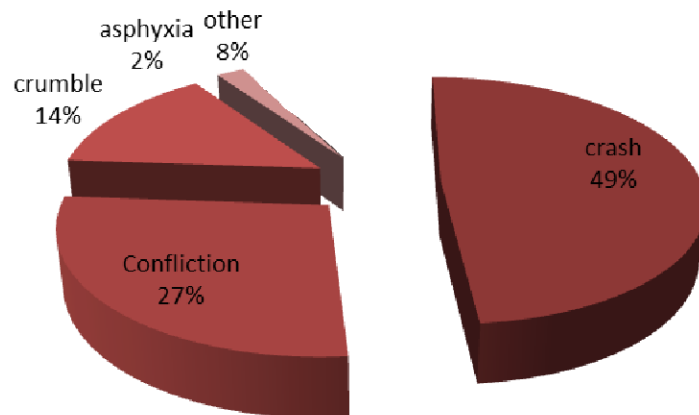
Work experience showed no statistically significant correlation with accident consequence (P=0.272). Most of the accidents leading to death, injury and fracture, and amputation occurred among the workers with a work experience less than one year.

Figure 1. Frequency distribution of injured persons based on history (n=247)



Additionally, the correlation between literacy level and accident consequence was statistically significant (P<0.001). Most of deaths (38.71%) happened among the illiterate workers. Injury and fracture (36.96%) mostly occurred among the workers with only primary education. Invalidism and amputation (36.17%) mostly occurred among the workers with secondary education.

Figure 2. Frequency distribution of injured persons based on type of accident (n=247)



There is no correlation between workers' marital status (single and married) and the consequences of accidents (P=0.41). Most cases of death, fracture, and amputation occurred among the married workers. There was a statistically significant correlation between workers' insurance status and accident consequence (P<0.001). In other words, death occurred mostly among the workers without any insurance (61.29%). However, the rate of fractures and amputation was higher among the insured workers (62.32%, 72.34%).

There was a statistically significant correlation between the injured organ and accident consequence (P<0.0001). Damage to

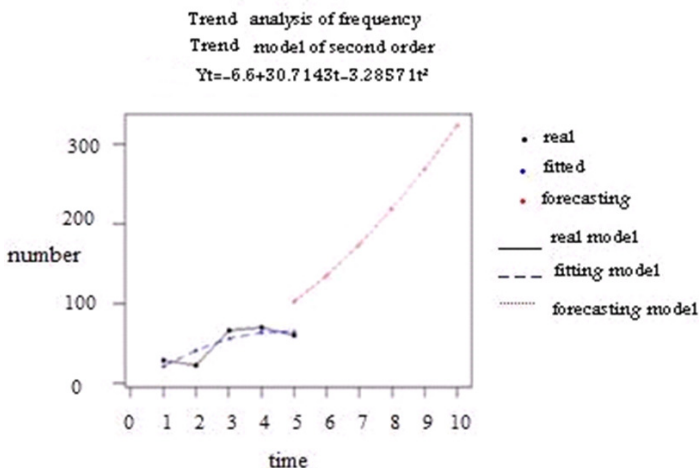
Further, most of the accidents (46.56%) occurred among the simple workers due to their nonstandard work, unsafe act, and laborious task. Most of the hurt workers (34.8%) had less than one year work experience and 13.4% of the hurt workers enjoyed a work experience greater than 20 years.

Falling from a height (48.58%) formed the greatest cause of damage, while damage due to suffocation accounted for only %2 of the causes of accidents. In this study, 55.87% of the accidents led to injury and fracture, 25.1% led to death, and 19.03% led to crippling and invalidism.

The correlation between the accident consequence and workers' age was not statistically significant (P= 0.188). Most of the accidents leading to death (32.26%), invalidism and disability (53.19%), injury and fracture (35.51%) belonged to the age group of 20-29. Although this correlation at the confidence level of P= 0.05 is not statistically significant, the P-value shows that this finding may be generalized to 81% of the population. The correlation between accident consequence and workers' occupation was statistically significant (P<0.001) showing that most of the accidents leading to death occurred among simple workers (51.61%). Also, injury, fracture, and invalidism occurred mostly among simple workers than other tasks (49.28% and 31.91%).

the head led to death in 61.51% of the cases. Damage to the back and neck led to fracture and injury in 34.78% of cases. Also, damage to the arms and legs led to amputation of these organs and disability (57.45%). No correlation was found between accident type and accident consequence in this study.

Figure 3. Estimation model of accidents during 1385-1390 using the amount of accidents during 1380-1384.



Having tested different models with accidents data, as it can be seen, the degree two model with the equation:

$$Y_t = -6.6 + 30.7143t - 3.28571t^2$$

Corresponds to accidents where the dashes indicate the model and continuous line indicates data. They are very close together and there is approximation. Based on the said model and using the fitting function, this estimation can be used for predicting the rate of accidents during 2006-2011, and it can be hypothesized that in the case of the continuation of the current trend, the rate of accidents occurring in 2011 exceeds 300 cases per year

Discussion

The trivial or unimportant accidents were excluded from the recorded events. That is, only the significant accidents adversely and detrimentally affecting workers and active manpower were studied. The findings of the study indicate that about 30% of the damaged subjects aged between 20 and 29, being consistent with findings by Jeong [15]. The results of the study also showed that mostly simple workers (46.6%) following them were the expert builders (19.03%) constituted the damaged subjects. The high rate of accidents among the building workers was due to their lack of enough working experience, lack of training, and the like.

The results of the study showed that the highest rate of accidents

was among workers (34.8%) with less than one year of working experience. Also, the lowest rate of accidents (12.55%) belonged to workers with more than 20 years of working experience. This is consistent with Halvani et al's findings [12].

Furthermore, the highest rate of accident consequences (87.55%) belonged to injuries and fractures. Then followed the accidents leading to death (25.1%). This shows the severity and intensity of the damage induced by building accidents and is consistent with the findings by Colak reporting the highest consequence rate of accidents as belonging to injuries and fractures (94.5%) [13].

As it can be inferred from the findings of the study, the highest frequency of occurrence (48.58%) belongs to carelessness and the lack of proper protective appliances or tools (28.74%) is rendered as the second leading cause of accidents, being consistent with the findings by Colak and Larsson [13,16].

Conclusions

Regarding the results of the present study and other studies, the role of training construction workers in work safety principles and guidelines is accentuated. In other words, more than 50% of occupational accidents may be avoided via executing correct and efficient programs and emphasizing the observation of protective guidelines.

It should also be mentioned that lack of suitable protection or deficient protective instruments have caused a considerable portion (28.74%) of accidents. In a study by Colak et al in Turkey, 14.4% of deaths was reported to be caused by lack of or deficiency of safety measures [13]. Unlike Chia-Wen's study that reported the highest rate of damage in the age group beyond 55 years [24], this study reported the highest rate of damage among the age group of 20-29. On the whole, based on the results of this study and the estimation done on 300 accidents, it can be inferred that factors as teaching the safety principles to workers and obliging them to use some protective instruments, supervising the performance of young inexperienced workers, and emphasizing the observation of law, hygienic and protective principles, can greatly reduce the occurrence of accidents.

Regarding the model which was corresponded to the accidents, compiling and composing the protective and hygienic guidelines and instructions and its follow-up by the legal authorities are rendered as mandatory for reducing the undesirable accidents.

Compiling and provision of educational programs by communicative channels and mass media including radio, TV, local newspapers, and national journals and papers can encourage the use of safety tools and protective measures in the work environment especially the building construction activities.

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