

# Analysis of Accidents in Nine Iranian Gas Refineries: 2007–2011

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## Abstract

**Background:** Occupational accidents are one of the major health hazards in industries and associated with high mortality, morbidity, spiritual damage and economic losses in the world.

**Objective:** To determine the incidence of occupational accidents in 9 Iranian gas refineries between March 2007 and February 2011.

**Methods:** Data on all occupational accidents occurred between March 2007 and February 2011, as well as other possible associated variables including time of accident, whether the accident was due to a personal or systemic fault, type of accident and its outcomes, age and gender of the victim, the injured parts of the body, job experience, and type of employment, were extracted from HSE reports and notes of health care services. Based on these data, we calculated the incidence rate of accidents and assessed the associated factors.

**Results:** During the 5 studied years, 1129 accidents have been recorded. The incidence of fatal accidents was 1.64 per 100 000 and of nonfatal accidents was 1857 per 100 000 workers per year. 99.4% of injured workers were male. The mean±SD age of injured people was 29.6±7.3 years. Almost 70% of injured workers aged under 30 years. The mean±SD job experience was 5.3±5.3 years. Accidents occurred more commonly around 10:00. More than 60% of accidents happened between 8:00 and 15:00. July had the highest incidence rate. The most common type of accident was being struck by an object (48%). More than 94% of accidents are caused by personal rather than systemic faults. Hands and wrists were the most common injured parts and involved in more than one-third of accidents. 70% of injured workers needed medical treatment and returned to work after primary treatment.

**Conclusion:** The pattern of occupational accidents in Iranian gas refineries is similar to other previous reports in many ways. The incidence did not change significantly over the study period. Establishment of an online network for precise registration, notification and meticulous data collection seems necessary.

**Keywords:** Accidents, occupational; Statistics; Oil and gas fields; Incidence; Iran

## Introduction

Occupational accidents exert direct and indirect (even hidden) health care and economic burden for societies. There are no standardized

statistics on occupational accidents, especially, in developing countries where for lack of the necessary infrastructures, and lack of proper recording and notification systems occupational accidents are under-reported. An accident would

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For more information on the effect of shoe sole tread groove depth on the gait parameters during walking on dry and slippery surface see [www.thejjoem.com/ijournal/index.php/ijournal/article/view/181](http://www.thejjoem.com/ijournal/index.php/ijournal/article/view/181)

lead to physical, mental, economic and financial damages.<sup>1</sup> Generally, accident is the third cause of human death regardless of age.<sup>2</sup> Among workers, it is the most common cause of occupational death.<sup>3</sup> According to an International Labor Organization (ILO) report, almost 720 000 occupational accidents happen every day worldwide that lead to over 1000 deaths a day.<sup>4</sup> The rate of fatal accidents was almost one-thousandth of that of non-fatal accidents.<sup>4</sup> Failure to precisely collect occupational accident statistics would result in under-report of statistics and underestimation of the incidence rates.<sup>4,6</sup> In 1999, based on data collected from selected ILO members states, the incidence of fatal occupational accidents was estimated at 14 per 100 000 workers per year.<sup>5</sup> Another study conducted based on the information from the World Economic Forum and Lausanne Institute of Management IMD revealed that the most competitive companies are also the safest.<sup>5</sup> Therefore, establishment of safety programs is of

paramount importance for development of a successful enterprise. Nonetheless, planning needs knowledge of the characteristics of occupational accidents.

We have little information on the characteristics of accidents in Iranian gas refineries. The refineries are among important active enterprises in Iran and knowledge about the trend of accidents there would help us in better planning of safety programs. We therefore, conducted this study to investigate the incidence of occupational accidents in nine Iranian gas refineries and associated risk factors over five years.

## Materials and Methods

The data of all occupational accidents occurred between March 2007 and February 2011, were extracted from HSE reports of 11 Iranian gas refineries in Ilam; Sarkhoongheshm; Fajrjam; Hasheminejad; Southern Pars 1, 2, 3, 4, and 5; Bidboland; and Parsian. We only used the data on accidents that occurred for workers at the time of their presence in refinery or while they were commuting there. The validity of the recorded data was ascertained by HSE supervisors. Having the data, we then calculated the incidence of occupational accidents for the refineries.

The study protocol was approved by Tehran University of Medical Sciences Institutional Review Board. The data were analyzed by SPSS® for Windows® ver 18. A p value <0.05 was considered statistically significant.

## Results

After collecting the necessary data from all 11 refineries, we could not verify the accuracy of data collected from Bidboland and Parsian refineries. Therefore, we excluded them and the data from nine refineries were analyzed.

### TAKE-HOME MESSAGE

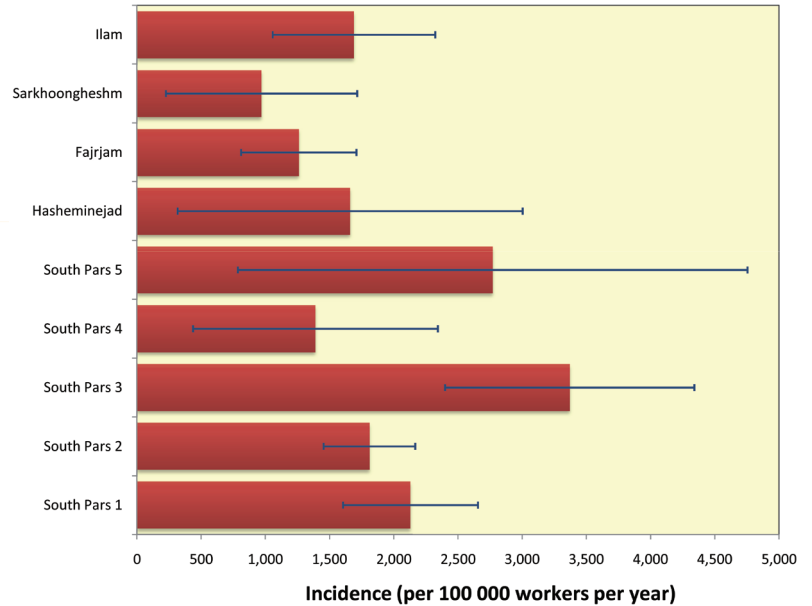
- Occupational accidents are one of the major health hazards in industries and associated with high mortality, morbidity, spiritual damage and economic losses in the world.
- Generally, accident is the third cause of human death regardless of age.
- We found that most of the injuries occurred in contract employees aged <45 years with <10 years of experience.
- In our study, the most common injured body parts were lower wrist, head, and lower ankle. The rate was almost similar to other reports; however, we showed that involvement of head and face was slightly more often than that reported earlier.
- The incidence of occupational accidents in Iranian gas refineries has not changed significantly since 2009.

The mean number of employees in the studied refineries was almost constant during the five years of the study. Almost 14 000 workers were working in the nine studied refineries. A total of 1129 occupational accidents was reported during the study period. One of the accidents led to death, hence, a mean occupation accidents-related mortality rate of 1.64 individuals per 100 000 per year. The incidence of non-fatal occupational accident was 1857 per 100 000 workers per year. The highest rate of accidents belonged to the Southern Pars 3 refinery (3370 per 100 000 workers per year); the lowest rate of 968 per 100 000 worker per year was recorded from Sarkhoongheshm (Fig 1). The rate did not change significantly over time, but it was maximum in 2009 and minimum in 2011 (Fig 2). Most (99.4%) of the injured workers were male.

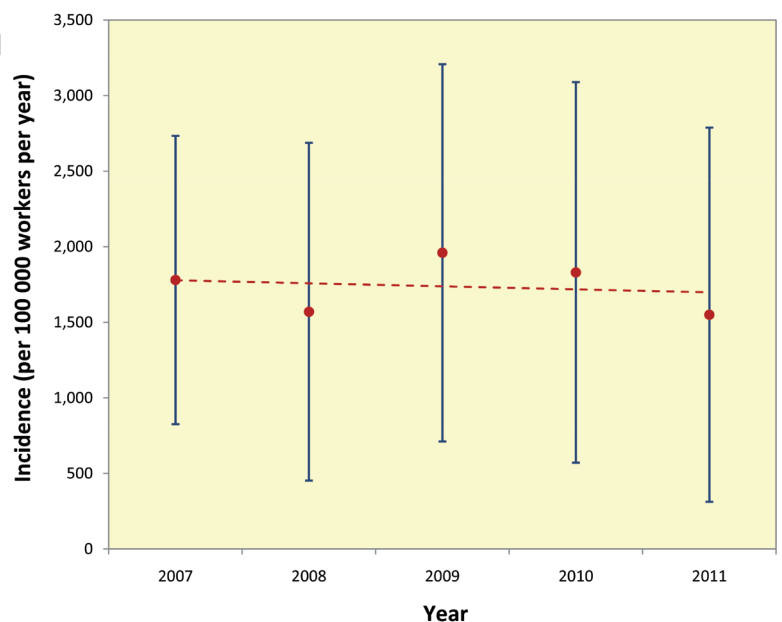
The mean±SD age of injured workers was 29.6±7.8 years. More than half of the injured workers aged between 26 and 35 years. More than 68% of injured individuals aged less than 30. The median (IQR) job experience of injured workers was 4 (4) years. More than 68% of injured workers had less than five years of experience. More than 80% of injured people were temporary workers.

More than 62% of accidents occurred between 7:00 and 15:00. Accidents happened more frequently (13.6%) around 10:00 followed by 17:00. The least frequent time of accident was around 3:00. Among the months, July (12.5%) and among seasons, summer (31.9%) had the highest rate of accidents. In March (4.6%) and winter (18.6%), the rate was lowest.

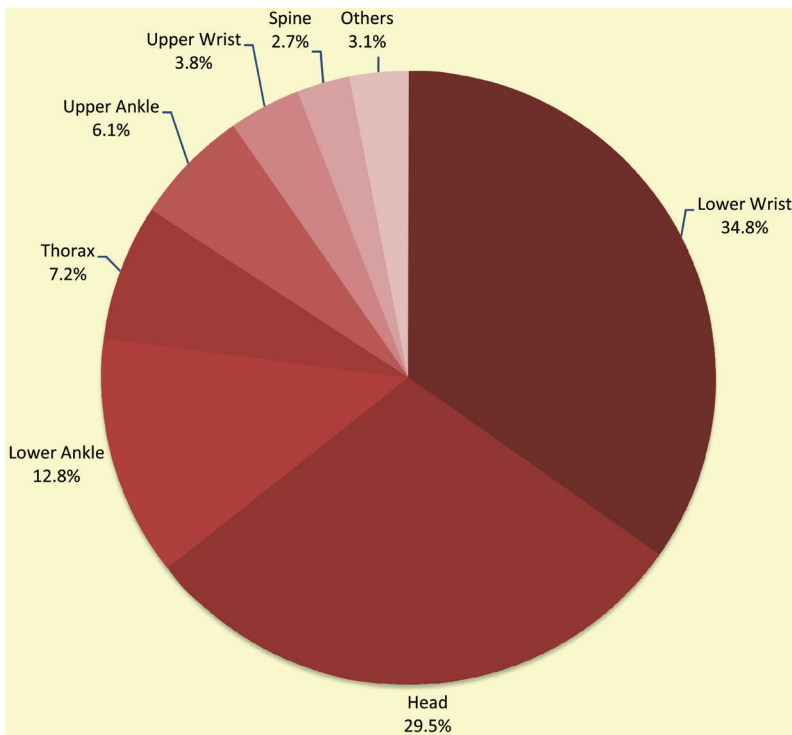
Almost 95% of accidents were due to personal faults such as being careless at work, being in a hurry, having drug abuse, having dangerous fun, and malpractice. Personal faults were maximum in South Pars 4 and Ilam refineries where the rate was 100%; it was minimum in Sarkhoon-



**Figure 1:** The mean incidence of occupational accidents in nine studied Iranian gas refineries. Data were pooled for years 2007 to 2011. Error bars represent SD.



**Figure 2:** The mean incidence of occupational accidents in workers from 2007 to 2011. Data were pooled for nine studied Iranian gas refineries. Dashed red line is the regression line.



**Figure 3:** Relative frequency of body parts of the workers injured in occupational accidents from 2007 to 2011. Data were pooled for nine studied Iranian gas refineries.

gheshm refinery where the rate was 83.7% and systemic faults like use of poorly designed insecure equipment, inadequate training of personnel and poor administration were responsible for 16.3% of accidents.

More than 75% of injuries involved lower wrist, head, and lower ankle (Fig 3). The frequency of injury sites did not change over the study period. Being struck by object (48%), having chemical exposure (eg, inhalation and dermal exposure and burns) and radiation (17%), and falling down (15%) were responsible for more than 80% of the injuries. Electrical injury was the least common mechanism of injury (0.4%).

Regarding the severity of injury, 17.5% of injured employees did not develop important medical problems; they returned to work immediately after taking first aid

at the site; 70% of injured workers were referred to the clinic in the refinery. They injured workers were visited by a physician and received appropriate medical care and returned to work within one hour. About 12.5% of injured workers were referred to hospital or exempted from work for a median (IQR) of 4.5 (16) days.

### Discussion

We found a mean occupation accidents-related mortality rate of 1.64 individuals per 100 000 per year. The rate was lower than many reports. For example, International Association of Oil and Gas Producers (OGP) reported an incidence of 3.8 per 100 000 individuals per year in 2012,<sup>7</sup> and NIOSH reported a rate of 4 per 100 000 per year in 2008.<sup>8</sup> In a study on occupational accidents in 175 countries, the estimated rate for the Middle Eastern countries was 20 per 100 000 per year.<sup>5</sup> The rate was highest for Morocco was more than double the figures of other countries in the region. Egypt and Tunisia also had high rates.<sup>5</sup> Another study on fatal occupational accident in 2008 in Iran reported a rate of 1 per 100 000 per year<sup>9</sup>

We found that the incidence of non-fatal accidents was 1857 per 100 000 workers per year, which was nearly 1000 times of our fatality rate. Many studies revealed that the ratio between fatal and non-fatal accident is almost constant for different countries.<sup>4,5</sup> The incidence of occupational accidents did not change significantly over the study period, while other studies showed a decreasing trend.<sup>7,10</sup>

Most of the injuries occurred in contract employees aged <45 years with <10 years of experience, which was similar to previous studies.<sup>8,10</sup> Obviously, contract workers are often young and do not have adequate experience, and are usually assigned to work in difficult harmful condi-

tions. This finding is in keeping with several studies.<sup>7,11,12</sup>

We noted that the frequency of accidents was higher during official time when more workers are at work and more repair activities are done. The accidents peaked at 10:00 and 17:00, which was similar to the report of National Iranian Oil Product Distribution Company (NIOPDC) in 2008.<sup>13</sup> Most of accidents occurred in summer, especially in July; the minimum rate belonged to winter in March. This observation was in contrast to the report of NIOPDC<sup>13</sup> where most accidents were reported in autumn. The difference would probably arise from the location of the refineries. The studied gas refineries are mainly in southern part of Iran where the climate is warm. Many of accidents reported during this period were attributed to warmth of the summer sun. Oil refineries, on the other hand, are located all over the country, regardless of the climate; therefore, the frequency of accidents related to warmth could not outweigh the incidence of accidents over different months.

We demonstrated that personal faults were more common (nearly nine times) than systemic faults which was in accord to classic texts.<sup>3</sup>

The most common injured body parts were lower wrist, head, and lower ankle (Fig 3). The rate was almost similar to other reports; however, we showed that involvement of head and face was slightly more often than that reported earlier.<sup>10,14</sup> This difference may attribute to inappropriate use of personal protective devices including safety helmet and face shields among our workers. Being struck by an object was the most frequent cause of injury (48%) in our series; this was slightly more than the previous studies that reported a ratio of 20%–40%.<sup>7,8,10</sup>

More than 87% of our injured workers were treated in local clinics in refin-

eries; they returned back to work; 12.5% of injured workers needed work exemption. This ratio is better than other previously figures; the statistics presented by NIOPDC (2008–2010) reported a ratio of 25%.<sup>13</sup>

Our study had some limitations. First, we could not collect information on the body mass index of the injured employees, which could be important.<sup>15</sup> Second, we did not collect information about those employees who did not have any accidents during the study period, so that we could not compare them with injured workers. Third, we had to exclude data collected from two refineries for data quality control, which could have changed our results.

For better results, establishment of an online network for precise registration, notification and meticulous data collection seems necessary. For analyzing the main causes of occupational accidents and providing appropriate preventive measures, diagnosis of personal faults—as the most important etiology of the occupational accidents—is of paramount importance. It seems that engineering and administrative interventions are required to decrease the rate of head injuries in occupational environment. Special attention should be paid to the collisions of vehicles and hitting objects—the most frequent mechanism of accidents in our study.

There is no evidence indicating that any company would benefit from a low level of safety and health in longterm. Our knowledge of the epidemiology of occupational accidents is scarce and further longitudinal studies are needed to better understand this issue.

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**Conflicts of Interest:** None declared.

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