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Morbidity and mortality from technological disasters in Iran: A narrative review

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Abstract:

Iran as a developing country is at risk of vulnerability to technological disasters. These types of disasters occur frequently in last years and affected thousands of lives. Technological disasters in Iran cause thousands of deaths, thousands of injuries, and millions of dollars' economic loss in recent years. We searched suitable keywords in national and international disaster databases for gathering epidemiological data in these disasters in Iran. In addition, we searched suitable keywords in scientific databases including Google Scholar, Scopus, PubMed, Web of Knowledge, Scientific Information Database, Magiran, and Irandoc. After screening, only 19 articles discussed challenges of technological disasters in the country. Road accidents, explosions and fires, mine accidents, and railway accidents are common events in the country. After 2015, these types of disaster cause 823 deaths and injuries. Experience of response to these disasters showed that technological disaster management in the country faces too many challenges including comprehensive and prospective programs, weakness of necessary infrastructure for urban management, weakness in group work and interorganizational coordination, lack of coherent involvement of people and nongovernmental organizations, lack of information coverage during the disaster, volunteers in police service presence at scene, and normalization of these events. Due to interorganizational nature of mitigation in technological disasters, it must be developed coordination between various organizations to mitigate these types of disasters.

Keywords:

Accidents, epidemiology, Iran, mortality, technological disasters

Introduction

Technological hazard defines as danger originating from technological or industrial accidents, dangerous procedures, infrastructure failures, or certain human activities, which may cause the loss of life or injury, property damage, social and economic disruption, or environmental degradation.^[1] According to the Center for Research on the Epidemiology of Disasters (CRED), a technological hazard must have at least one of the following criteria to known for technological disaster:

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10 or more people reported killed, 100 people reported affected, a call for international assistance, and declaration of a state of emergency.^[2,3]

Iran is a disaster-prone country and known for their high risk of disasters.^[4] Although Iran is being known for high frequency and catastrophe impacts of their natural disasters, limited information is available to risk perception of technological disasters.^[5] Iran is one of the developing countries and experienced rapid socioeconomic changes in last decades including rapid growing population, increase of urbanization, increase in the use of motor vehicles, and

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development of railway and aviation networks that are risk factors to occurrence of technological disasters.^[6] As a result, technological disasters are always happening in the country. Iran is faced with a variety of technological disasters, including numerous aircraft crashes, numerous road and rail traffic accidents with high losses, and terrorist incidents, as a result of its political geography, throughout history.^[3,7] These disasters can put families at risk of poverty and bring survivors and their families to the long-term complications of the incidents, including the cost of medical care and rehabilitation, as well as the costs of burial and the loss of family breadwinners.^[8,9]

These disasters are the negative consequences of human innovation that result in the harm or destruction of life, property, or the environment.^[6] They range from chemical spills to power failures and from computer programming bugs to mass transportation accidents. By their very nature, they are generally new hazards in terms of the full spectrum of threats humans have faced, so comparatively little is understood about their full likelihood or potential consequences, and in Iran, there is no comprehensive database about epidemiology of technological disasters.^[10] In addition, in the country, there is no preparedness and mitigation specific plan for technological disasters. In this article, we aimed to gather information about epidemiology and frequency of technological disasters and then extracted common triggers of technological disasters, and finally, we identify challenges of the most common technological disasters in Iran.

Methods

This study is a narrative review that aimed to gather information about epidemiology and challenges of technological disasters in Iran. For gathering all of the present information about technological disasters in Iran, we surfed all of the national and international disaster databases including the Iran Transport Incident and Accidents Comprehensive Information System, Iranian Emergency Medical Services Database, the CRED, and Disaster Statistics at the United Nations Office for Disaster Risk Reduction, and all of the literature in this topic in scientific databases included Google Scholar, Scopus, PubMed, Web of Knowledge, Scientific Information Database, Magiran, and Irandoc.

Searching in the databases was carried out in August to September 2018 using keywords of "Iran" and "technological disasters" or "technological hazards" or "manmade disasters" and "road traffic accidents" or "road injuries" or "fire accidents" or "railway accidents" or "mine accidents" or "mine disasters."

The inclusion criteria were as follows: (a) documents that study epidemiology or challenges of response to technological disasters in Iran, (b) documents in English or Persian language, (c) studies that published, and (d) studies that published in the context of Iran.

Exclusion criteria were as follows: (a) articles without full text and (b) studies in other languages than Persian and English.

At the initial step, 114 articles identified. After screening by two members of research team and reading full texts, only 19 articles were selected to review.

Epidemiology of Technological Disasters in Iran

Historical data

Hazard data and literature across the world have shown increasing trends of more technological disasters and larger disastrous impacts over the past century, especially in the past 50 years. These trends are likely to stay as the global population becomes more concentrated, urbanization keeps growing, and industrialization deepens. Technological hazards are interwoven with the elements of complexity, surprise, and interdependence. Therefore, technological hazards should be understood in terms of political, economic, social, and historical contexts within which they occur^[11,12] [Tables 1 and 2].

According to the CRED, most of the technological disasters in Iran are related to road accidents, especially fire, and left the buses. Fire and collapse of Plasco building in Tehran resulted in most injuries. It also inactivated several thousand people and caused millions of dollars in economic losses.^[13]

Common Triggers of Technological Disasters

Technological disasters usually occur as a result of an external spark. A variety of natural and unnatural factors can initiate a technological hazard. In Iran, the Plasco collapse building occurred due to the fire on old electric cables. The Fukushima nuclear disaster was formed in Japan in 2011 due to a natural trigger (earthquake and tsunami).^[14] Many of the road, railway, and airway transport accidents occur due to technical defects in technology as well as human mistakes. The Indian Bhopal catastrophe occurred due to defects in safety systems and humanitarian abilities. These examples illustrate the diversity of factors that trigger such disasters. All identified factors for these events are showed in Table 3.^[15,16]

Most Common Technological Disasters in Iran

Road accidents

In Iran, road traffic injuries (RTIs) are the leading cause of the injuries and the second cause of mortality, and their prevalence is four times higher than those of the high-income countries.^[17] It is estimated that RTIs in Iran each year cause the loss of 2271 years of life and also damage amounting to 6 billion dollars.^[18] Studies showed that >70% of mass-casualty incidents (event that results in at least three deaths or at least five injuries) in the country are related to RTIs.^[19] Iran with an area of 1 million 648 thousand square kilometers and nearly 82 million people is one of the largest and most populous countries in the Middle East. There are about 27 million active vehicles in the country.^[20] Although the government reported that 17,994 people died due to road traffic crashes in roads of the country in 2014,

Table 1: Epidemiological data of technological disasters in Iran 1895-2011 (according to UNISDR)

Event	Deaths	Injured	Losses (US \$)
Accident	8228	9907	483,900,000
Explosion	365	991	11,610,000
Fire	621	1309	16,000,000
Structure collapse	82	45	4,780,000

Table 2: Statistics of technological disasters in Iran from 2015 according to the Center for Research on the Epidemiology of Disasters

Type of disasters	Frequency	Deaths	Injuries
Road accidents	7	99	117
Aviation accidents	2	77	-
Mine accidents	1	42	75
Fire	1	26	235
Train accidents	1	49	103
Total	12	293	530

Table 3: Triggers of technological disasters

Main factors	Sub factors
Human triggers	Operator and managerial errors
	Lack of education
	Physical and psychological situation
	Managers' experiences
	Morale and satisfaction of people
Organizational triggers	Lack of communication
	Policy failures
	Inadequate resource allocation
	Business pressure
	Lack of emergency plan
Technological triggers	Expenditure pressure
	Technical integrity
	Defective equipment and faulty design
	Contaminated materials and supplies
	Faulty technical procedures

the world health organization estimated that this rate is about 25,000 fatalities.^[21]

Unfortunately, these mass casualties sometimes come into national disasters. Every year, several disasters occurred in roads of Iran and cause death of tens of people. These disasters also provoked public emotions. For example, from 2015, seven technological disasters occurred due to road accidents.^[2]

Road traffic accidents in Iran come into a national disaster, and many organizations are responsible for decreasing these incidents. Policy concentration is on legislation limits to unsafe driving. Despite national efforts to overcome this crisis, there are still a lot of problems.^[22] At the organizational level, the trustee has yet to determine the response to these incidents, and there is no coordination among the stakeholders. Although relatively comprehensive laws have been laid down in this regard, the application of the rules is not well implemented. The most important problem that many studies have acknowledged is the safety of cars, but over the years, the identification of these problems still does not have the safety of cars.^[23,24] Other obstacles include the wrong driving culture in the country. The perception of people's risk is very low and needs to be sensitized at the community level in order to increase the perception of danger. In addition, most roads in the country are unsafe and need to be restored.

Despite recent advances in equipment, human resources, and relief capacity, the response process to road traffic accidents suffers from serious shortcomings.

Aviation accidents

Since Iran opened its first aviation facility, transient accidents have been unexpectedly affecting this industry, and today, the industry in Iran has one of the highest incident rates in the world. The reasons given for analyzing the very high number of air accidents in Iran include the West's economic sanctions against Iran, the standard of pilots and their quality control, the weakness in practice of aircraft safety standards, and the mismanagement.^[25]

According to the Iran's Aviation Safety Network, 1500 air crashes occurred among Iran with fatalities between fifty and seventy in recent decades. Forty air accidents occurred from 1944 to 1979. After the 1979 revolution, >1400 people died in Iranian air traffic accidents and the crash of the Airbus A300 aircraft on Iran's 655 flight. Air, by the US Navy warship in the Gulf, is the eighth airplane accident in the world in terms of the number of passengers killed, and all 290 people were killed. The fall of the military plane in Kerman with 276 dead was the largest air crash between 1998 and 2004.^[25]

The first air strike occurred after the revolution on June 21, 1980, followed by 233 civilian casualties, including 67 deadly accidents, resulting in 998 deaths and 97 injuries. According to other statistics, the number of people killed in the air crash of Iran on April 13, 2005, reached 1345.^[31] If we add 128 deaths of the incident on December 15, 2005, and add 11 dead Falcon-20 Corps, this figure will reach 1484 by the beginning of September 2006. Furthermore, at noon, on the following day, a Caspian Tupolev passenger plane, which was heading for Armenia, collapsed minutes after landing at Tehran's Imam Airport near Qazvin, killing all 169 passengers.

According to aviation safety network data, 1720 people died before 2009 due to air crashes in Iran.

Fire accidents

According to the World Health Organization reports, about 300,000 people killed due to burn accidents every year around the whole of the world. Ninety-five percent of them lived in developing countries. The burn rate in Iran as a developing country is eight times the global average. About 30,000 people suffered from severe burns annually in the country. Of these, 3000 are dead. Fire is a severe global health hazard that causes great losses in disability-adjusted life years and damage.^[26,27]

In January 19, 2017, the 16-story Plasco building in the dense commercial precinct of Tehran experienced a fire event resulting in the building's collapse. The fire caused 26 people (including 16 firefighters) to die, a further 200 people to be injured, and millions of dollars to be lost.^[28,29] The first challenges that show after this disaster were poor coordination between rescue agencies and problems in scene management such as people gather on the roads around the scene and resulted in traffic problems; thus, rescue vehicles do not access to the collapsed building. These problems showed public education related to public response and behavior had not enough efficiency. The collapse of the Plasco building is not the only incident of recent years in Iran. There are thousands of insecure buildings in Iran's metropolis that have not met international fire safety standards.^[30] The incident showed how the destruction of a building could engulf the entire country's relief capacity.

On the other hand, relief efforts by relief organizations are not safe enough and cost-effective. If the firefighters used safe procedures, the evacuation of the building took place at a suitable time and prevented the firefighters from killing. In Iran, there is no codified instruction for evacuation in such circumstances.

Mining accidents

Iran is rich in oil and natural gas, and most of its economies are based on the production and export of

these materials. Coal mines, copper and other metallic mines, and sand and gravel are most active mines in Iran. Iran has 7% of the world's mines. It ranked among 15 countries that produce mineral products, holding some 68 types of minerals, 37 billion tonnes of proven reserves, and >57 billion tonnes of potential reserves worth \$770 billion in 2014.^[31,32] Lack of sufficient infrastructure, legal barriers, exploration difficulties, and government ownership of most mines are the most important challenges of the mines. Although the petroleum industry provides the majority of economic revenues, just about 25% of all mining sector employees work in mines producing oil and natural gas. About 75% of them work on coal, iron ore, copper, lead, zinc, chromium, and other mines. About 30% of investments are taking place in the mining sector.^[33]

Accidents are the second leading cause of death in Iran. One report from the National Social Insurance Organization included 14,114 occupational accidents with 268 fatalities among insured people in 2001. Of these, 641 were in the mining sector. On average, 4% of the annual work-related injuries happened in the mining sector. Mine workers represent 0.4% of the Iranian labor force. Based on a study, the number of workers who died each year ranged from 22 to 28, and the overall annual rate of death was 24 per 100,000 miner population.^[33,34] The most common cause of death between miners was machine crashing, falling down, explosion, destruction of the mine, fallen thing crashing, trapped between two hard things, thermal shock, and electrical shock, respectively. A study in Kerman Province showed that with the current situation, it is 95% probable that an accident will happen every 24 days.

Every year, several accidents in Iranian mines occurred that some of them come into disaster. For example, eight workers lost their lives after the explosion occurred at Tabas mine in 2007. In December 2010, an incident occurred in one of the mines in the province of Kerman, which resulted in the loss of four miners. It should be noted that on April 19, 2011, the body of three workers was discovered and did not publish the fourth person's fate. A gas explosion in one of the Kuhbanan coal mines killed three people and wounded six other miners. The incident occurred when dozens of workers were mining coal at the bottom of the mine. In this incident, a number of workers were subjected to rubbish, which, with the vigilance of other miners and their aid workers, quickly departed from the rubble and took off from the accident. However, six of these miners were injured, who were quickly transferred to nearby hospitals and were treated, but among them, three of the miners were not lucky and lost their lives due to explosions. On May 3, 2017, an explosion occurred at a depth of 1200 meters in a tunnel of the Zemestan-Yurt coal mine, when miners

were trying to power a locomotive using an external battery. Forty-two people were killed in the accident and at least 75 injured, primarily from burns and inhalation of toxic gas.^[35]

Conclusion

Various types of technological disasters occurred in Iran. Transport accidents (road, aviation, and train) are the most serious technological hazards in Iran that occurred frequently and resulted in many deaths and injuries. In addition to their consequences on human health, they resulted in major economic losses. Fires and mine accidents also had major consequences. The cause of these disasters differs from disaster to disaster and consists of human, organizational, and technological causes. Many of the technological accidents in the country occurred due to technical defects in technology as well as human mistakes. Therefore, training people on working with new technologies to reduce human errors, continuously reviewing and continuously controlling technologies and devices, having an emergency response plan in each organization, providing the necessary requirements for response to technological events, and gathering comprehensive and integrated data about these disasters and root cause analysis of these incidents in the country is necessary. In addition, for measuring real burden of these events, identifying the secondary effects of these disasters on victims, organizations, and societies is necessary.

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Conflicts of interest

There are no conflicts of interest.

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