Human stampedes at mass gatherings: An overview

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Abstract **-** The main aim of this study is to present an overview of human stampedes and to identify the major triggering factors with respect to the type of events leading to number of fatalities and injuries. Considering major crowd incidents, the stampedes were categorized based on location, triggering factor, type of event and year of occurrence. This paper lists a total of 137 stampedes occurred all over the world between the years 1883 and 2017. The details include the name and type of event, location of the event, number of injuries and fatalities, probable reason for the stampede and type of reliable source. Stampedes are classified based on type of events as religious, sports, entertainment, festival, political and others. Among all types of events, religious gatherings cause 64% of total fatalities and 51% injuries. The triggering factors are identified as rumours, fire, structural failure, narrow passage, overcrowding and others. Out of all the triggering factors mentioned above, narrow passage causes about 27% fatalities followed by overcrowding and rumours with 23 and 21% respectively. The majority of injuries caused by overcrowding turn out to be 35%. It is also observed that the frequency of stampede occurrences increasing since 1980. This study can be considered as an initial step in giving an overview of human stampedes, which would help to prepare a framework based on the past experiences. Further, it can give better insights for large-scale crowd management and to minimize the loss of human lives in future.

Keywords**:** Human stampedes, Triggering Factors, Fatalities, Injuries

1. Background

Human stampedes can occur at mass gatherings due to several reasons such as high crowd densities, physical and psychological problems of humans and crowd management issues etc. which leads to injuries and fatalities. Few researchers have addressed the need of studying human stampedes. Based on the number of deaths and injuries, Ngai et al., [1] proposed a logarithmic scale ranging from Class I to V to classify the human stampedes. This unique categorization may help the researchers and scientists to understand the characteristics of stampedes for systematic investigation and further analysis. Illiyas et al., [2] identified that majority of human stampedes occurred in India are in religious gatherings. Ngai et al., [3] tried to estimate the degree of underreporting of human stampedes in India by using two different methods. For a systematic investigation of epidemiological characteristics of stampedes, they have emphasized the need of an international standardized database that can record the human stampedes occurring all over the world. Alaska et al., [4] highlighted that the crowd control measures such as use of crowd simulation models, video monitoring, modification of transport system etc. were adopted during Hajj played a crucial role in improving the safety. The current study made an attempt to present an overview of human stampedes and to identify the major triggering factors with respect to the type of events leading to number of fatalities and injuries.

2. Analysis

Data related to human stampedes were collected from various sources such as reports, journal publications, different search engines etc. After a thorough review of literature, the stampedes were categorized based on location, triggering factor, type of event and year of occurrence. A total of 137 stampedes occurred all over the world between the years 1883 and 2017 were considered in this paper. The details include the name and type of event, location of the event, number of injuries and fatalities, probable reason for the stampede, and type of reliable source. Stampedes are classified based on type of

events as religious, sports, entertainment, festival, political and others. Among all types of events, religious gatherings cause 64% of total fatalities and 51% injuries. Further, it is observed that most of the peak values in Fig.1 representing the fatalities and injuries occurred in different years are related to various religious events. This observation is in concurrence with the findings of [5] reporting that majority of the stampedes occurred in India and Saudi Arabia. Some of the major stampedes were described in table 1. The triggering factors are identified as rumours, fire, structural failure, narrow passage, overcrowding and others. Out of all the triggering factors mentioned above, narrow passage causes about 27% fatalities followed by overcrowding and rumours with 23 and 21% respectively. The majority of injuries caused by overcrowding turn out to be 35%. Proportion of fatalities with respect to type of event and impact of triggering factors on number of injuries, fatalities are shown in Fig.2.

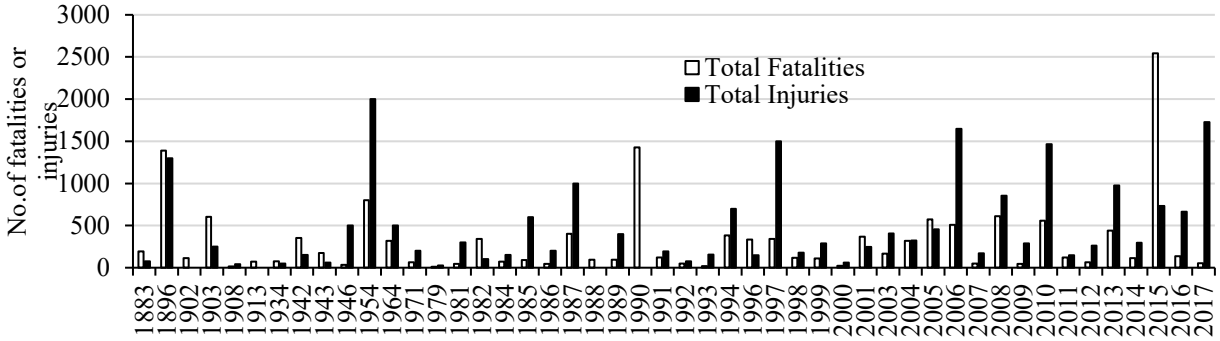

Fig. 1: Total number of fatalities and injuries with respect to year of all the events

Table 1: Description of some major stampedes

S. No	Name of the Event	Year	Country	Location	Fatalities	Injuries	Type of Event	Triggering factor
1	Nicholas Coronation	1896	Russia	Moscow	1389	1300+	Festival	Rumour
2	Iroquois Theatre Fire	1903	United States	Chicago	602	250	Entertainment	Fire
3	Peru Stampede	1964	Peru	Lima	318	500	Sporting ingress	Tear Gas
4	Hajj	1987	Saudi Arabia	Mina, Mecca	402	1000	Religious	Conflict b/w people
5	Hajj	1990	Saudi Arabia	Mina, Mecca	1426	-	Religious	Narrow Passage
6	Hajj	1994	Saudi Arabia	Mina, Mecca	270	200	Religious	Overcrowding
7	Wai Stampede	2005	India	Wai, Maharashtra	267	200	Religious	Wet Floor
8	Mandhar Devi temple	2005	India	Satara, Maharashtra	258	200	Religious	Fire
9	Hajj	2006	Saudi Arabia	Mina, Mecca	380	1000	Religious	Overcrowding
10	Naina Devi Temple	2008	India	Himachal Pradesh	163	48	Religious	Rumour
11	Phnom Penh	2010	Cambodia	Phnom Penh	347	395	Entertainment	Rumour
12	Sabarimala	2011	India	Pullumedu, Kerala	102	100+	Religious	Narrow Passage
13	Hajj	2015	Saudi Arabia	Mina, Mecca	2431	427	Religious	Narrow Passage
14	Puttingal Devi temple	2016	India	Kerala	106	383	Religious	fire

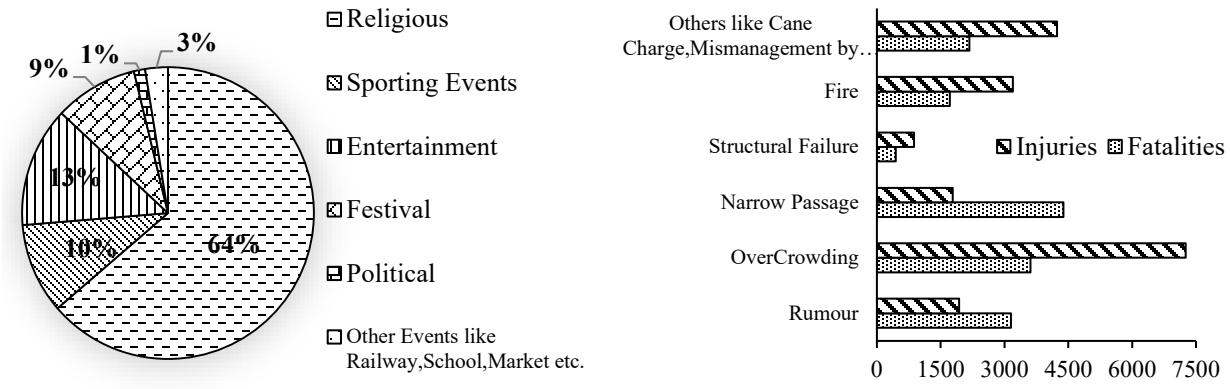

Fig. 2: (a) Distribution of fatalities with respect to type of event (b) Influence of triggering factors on injuries and fatalities.

3. Conclusion

The study presents an overview of human stampedes occurred all over the world. It is observed that the frequency of stampede occurrences increasing since 1980 and most of the stampedes are happened in religious gatherings. The major triggering factors in various stampedes were identified as narrow passage, overcrowding and rumours. This study can be considered as an initial step in giving an overview of human stampedes, which would help to prepare a framework based on the past experiences. Further, it can give better insights for large-scale crowd management and to minimize the loss of human lives in future.

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