

Original Article

Firecracker injuries during Diwali festival: The epidemiology and impact of legislation in Delhi

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ABSTRACT

Setting and Design: A hospital-based retrospective study of firecracker-related injuries was carried out at a government sponsored hospital in Delhi. **Materials and Methods:** 1373 patients attended the emergency burn care out-patients clinic during 2002–2010 pre-Diwali, Diwali and post-Diwali days. Every year, a disaster management protocol is revoked during these 3 days under the direct supervision of the Ministry of Health and Family Welfare, Government of India. **Results:** There was an increase in the number of patients of firecracker-related injuries in Delhi national capital region from the year 2002 to 2010, based on the hospital statistics. During the study period, the hospital received approximately one patient with firecracker-related injury per 100,000 population of the city. 73.02% of the victims were 5–30 years old. Majority (90.87%) of them sustained <5% total body surface area burn. **Conclusions:** In spite of legislations and court orders, the number of patients is on the rise. The implementation agencies have to analyse the situation to find a way to control this preventable manmade accident. Websites, emails, SMS, social sites, etc. should be used for public education, apart from conventional methods of public awareness.

KEY WORDS

Disaster; Diwali; firecracker; legislation; noise pollution

INTRODUCTION

Firecrackers are extensively used in India during various festivals, ceremonies and social events, as is true the world over. They find a special place during Diwali, which is an annual festival marking an important Hindu mythological event. During this weeklong festival, the whole country lights lamps, and hence it is also

known as the “festival of lights.” In India, firecrackers are available for use by the common public. Each and every individual is free to light the crackers wherever he/she desires. It is a well-known fact that whenever firecrackers are used, there is always a risk of burn and injury.

Safdarjung Hospital has one of the largest burn care facilities in India. This facility receives the largest number of firecracker-related injury patients throughout the year. However, it almost takes the form of an epidemic during Diwali. This unit runs a special disaster management protocol around Diwali. This study has been carried out to assess the injuries during the period when the disaster protocol is in place. This is also aimed at assessing the effect of the government legislation on its occurrence.^[1]

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MATERIALS AND METHODS

This study has been approved by the department research committee and has been done in accordance with the Helsinki protocol. This is a retrospective hospital-based study involving data from 2002 to 2010. The Department of Burns, Plastic and Maxillofacial Surgery at VMMC and Safdarjung Hospital maintains the records of firecracker-related injuries of the patients during these 3 days of Diwali festival, i.e. pre-Diwali, Diwali and post-Diwali days, when the disaster protocol is in place. The disaster protocol is supported and monitored by the Ministry of Health and Family welfare, Government of India. The year-wise incidence is recorded in Table 1. A total of 1373 patients visited the emergency clinic around Diwali over these 9 years.

Considering the noise pollution caused by the firecrackers, the Supreme Court of India, which is the apex court, passed a legislation in the year 2005, to stop the noise pollution between 10 p.m. and 6 a.m. of the following day.^[1] The authors analysed the impact of the prohibitive orders of the apex court on the reporting of firecracker-related injuries in our hospital.

RESULTS

Exactly 1373 patients with firecracker-related injury attended the burn casualty over a period of 3 days around Diwali festival from, 2002 to 2010. There has been a continuous increase in the number of patients over the past 9 years, barring a small reduction in 2003 and 2007 [Figure 1]. There has been an obvious male preponderance (84.8%) in the occurrence of the injury [Figure 1]. The youngest patient was 14 months old and the oldest was 88 years of age. Majority (73.02%) of the

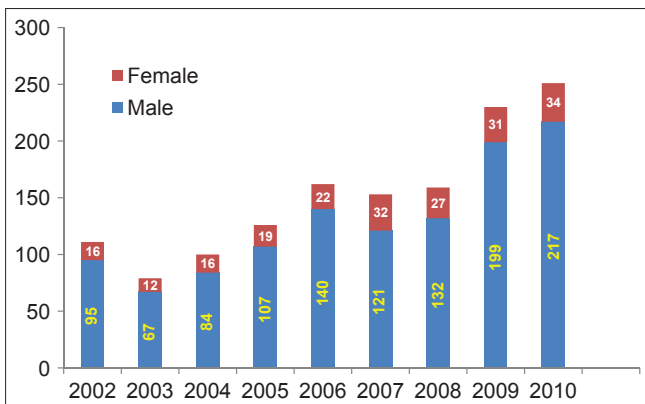


Figure 1: Year-wise distribution of patients with firecracker-related injuries around Diwali festival

patients were between >5 and 30 years of age, with 49.6% of them falling within >5–20 years of age. The age distribution of these patients is given in Table 1. Being a retrospective study, the details of the mode of injury were not available in the records of majority of them. The detail of the firecrackers causing the injury was available for 230 patients. The Anar (flower pot) was found to be the most common causative agent, closely followed by Bombs (sound-emitting fireworks) [Figure 2].

Though a large number of patients attended the clinic, the majority of burns were minor and most of them were <5% total body surface area (TBSA; 90.89%) and only 7.79% patients sustained >5% TBSA burn [Table 2].

To correlate the incidence with the growing population of the city, the number of patients has been correlated with the population of Delhi city as per an authentic website.^[2]

The proportion has been calculated per hundred thousand population [Table 3]. The number of patients reporting with firecracker injury has almost doubled over the study period of 9 years, from 0.81 to 1.51 per 100,000 population.

A legislation was passed in India to control the noise and environmental pollution in the year 2005. One can observe the effect of the legislation on the incidence of firecracker-related injuries in Figure 1.

DISCUSSION

Firecrackers are commonly used during celebrations because of their sound, sparkle and sudden burst of

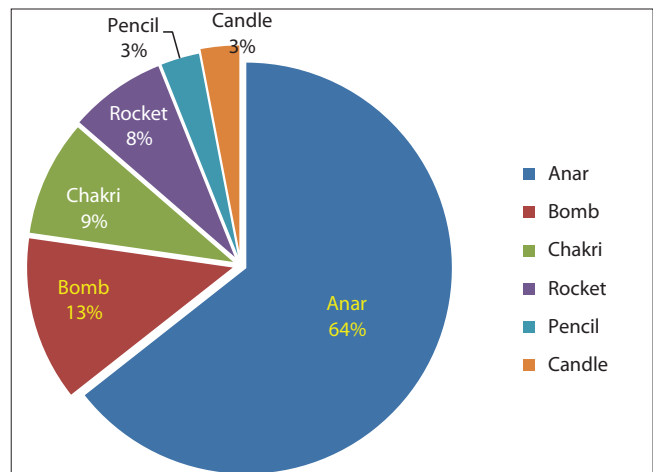


Figure 2: Types of fireworks causing injury around Diwali festival

Table 1: Number of firecracker-related injury patients around Diwali and their age distribution from 2002 to 2010

| Age | 1–5 years | >5–10 years | >10–15 years | >15–20 years | >20–25 years | >25–30 years | >30–35 years | >35–40 years | >40 years | Unknown | Total |
|-----------|-----------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|-----------|-------|
| 2002 | 17 | 17 | 19 | 13 | 13 | 14 | 7 | 2 | 8 | 1 | 111 |
| 2003 | 8 | 12 | 12 | 9 | 10 | 10 | 5 | 4 | 9 | 0 | 79 |
| 2004 | 4 | 17 | 24 | 13 | 16 | 12 | 6 | 6 | 1 | 1 | 100 |
| 2005 | 3 | 19 | 19 | 23 | 16 | 19 | 8 | 8 | 10 | 1 | 126 |
| 2006 | 5 | 24 | 41 | 25 | 23 | 14 | 11 | 7 | 9 | 3 | 162 |
| 2007 | 7 | 27 | 30 | 28 | 23 | 11 | 11 | 7 | 8 | 1 | 153 |
| 2008 | 9 | 22 | 26 | 29 | 22 | 15 | 12 | 7 | 15 | 2 | 159 |
| 2009 | 17 | 38 | 45 | 33 | 17 | 32 | 20 | 10 | 15 | 3 | 230 |
| 2010 | 6 | 36 | 43 | 37 | 30 | 26 | 25 | 16 | 30 | 4 | 253 |
| Total (%) | 76 (5.53) | 212 (15.44) | 259 (18.86) | 210 (15.29) | 170 (12.38) | 153 (11.14) | 105 (7.64) | 67 (4.87) | 105 (7.64) | 16 (1.16) | 1373 |

Table 2: Distribution of TBSA burn in firecracker injury patients

| Year | Number of patients with TBSA burn | | | | | | | | Unknown | Total |
|-----------|-----------------------------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-------|
| | 1% | 2% | 3% | 4% | 5% | >5–10% | >10% | | | |
| 2002 | 74 | 16 | 3 | 0 | 7 | 7 | 4 | 0 | 111 | |
| 2003 | 32 | 11 | 13 | 2 | 7 | 7 | 6 | 1 | 79 | |
| 2004 | 30 | 24 | 18 | 8 | 5 | 9 | 1 | 5 | 100 | |
| 2005 | 60 | 38 | 13 | 4 | 5 | 4 | 1 | 1 | 126 | |
| 2006 | 55 | 42 | 20 | 7 | 20 | 10 | 6 | 2 | 162 | |
| 2007 | 91 | 26 | 12 | 2 | 7 | 9 | 6 | 0 | 153 | |
| 2008 | 100 | 23 | 10 | 7 | 9 | 4 | 5 | 1 | 159 | |
| 2009 | 160 | 23 | 5 | 10 | 10 | 9 | 6 | 7 | 230 | |
| 2010 | 120 | 100 | 5 | 3 | 11 | 9 | 4 | 1 | 253 | |
| Total (%) | 722 (52.58) | 303 (22.06) | 99 (7.21) | 43 (3.13) | 81 (5.89) | 68 (4.95) | 39 (2.84) | 18 (1.31) | 1373 | |

Table 3: No. of patients reporting to our centre in relation to the population of the city

| Year | Population of Delhi city | No. of firecracker-related burn patients visiting our centre | Ratio of patients reporting per 100,000 population |
|------|--------------------------|--|--|
| 2001 | 13,782,976 | 111 (in 2002) | 0.81 |
| 2011 | 16,753,265 | 253 (in 2010) | 1.51 |

colours, expressing the festive mood. They are used during Tihar in Nepal, Hari Raya in Malaysia, Day of Ashura in Morocco, Guy Fawkes Night or bonfire night in the United Kingdom, Independence Day and Halloween in the USA, Bastille Day in France, Spanish Fallas and New Year's Day in Guatemala, Chinese New Year by the Chinese and many other festivals all over the world.

India is a large country with 1.21 billion population, with a huge diversity in culture and social events. The epidemiology and pattern of firecracker injuries also differs from place to place. Another major hospital in India reported 154 patients of firecracker injuries in 10 years.^[3] Puri *et al.* in 2009 have mentioned that there had been a decrease in the prevalence of firecracker injuries over 10 years of their study period.^[3] Firecracker injuries in the USA affected approximately 10,000 persons

annually from 1980 to 1989 as per the National Electronic Surveillance System,^[4] while during 1990–2003, 85,800 paediatric firework-related injuries were treated.^[5] In the UK, the number of firework-related injuries peaks during Halloween and Guy Fawkes Night.^[6] In Denmark, over a 12-year period from 1995–1996 to 2006–2007, there were 4447 patients of firecracker-related injuries during 2 days of New Year.^[7] Injuries caused by fireworks are a national problem in Greece too. The reported incidence is 7 per 100,000 children annually, out of which 70% are in the age group of 10–14 years.^[8] Hence, firework-related injuries are encountered the world over. Both the developed and developing countries are facing the problem of firecracker-related injuries in large numbers. These are the national statistics of different countries. Our hospital, only one of the many, though the largest in the Delhi national capital region catering to most of the firecracker-related injuries, has encountered 1373 patients over a 9-year period.

Our centre received 0.81 patients per 100,000 population of Delhi national capital region in the year 2002 and in the year 2010 this ratio rose to 1.51 per 100,000 population. This is in spite of the efforts taken

by many government and non-government agencies in the form of legislations, amendments, prohibitive orders, educational programmes, etc. to prevent firecracker-related injuries. This is partly because of poor implementation of the regulation. This may also partly be due to the increasing popularity of our hospital in the field of burn care, especially during these 3 days around Diwali festival. Many patients travelled long distances to report to this hospital for their primary care. There are many other facilities in Delhi for treating firecracker-related injuries. However, many of the patients preferred to take treatment at our institute because of the prompt attention and good quality treatment that they receive.

In the present series of patients, the age ranged from 1 to 88 years. Majority of the patients fell in the age group of 5–30 years. This is unlike most of the earlier studies in which the commonest group affected was formed by children below 16 years of age.^[3,5,9-11] Our patients were equally distributed below and above 20 years of age. In the USA, high incidence of firework-related injuries among children has been reported. In different reports, children below 15 years formed 40–50% of the victims.^[12-14] It was observed that the states in USA which are liberal in allowing fireworks for personal use have 7 times greater incidence than the states where more restrictions are imposed.^[12] It has been suggested that public fireworks should be encouraged and fireworks for individual use should be banned.^[13] In a recent publication from Bangalore, India, while presenting 51 patients of firework-related ocular injuries, it was concluded that firework-related injuries result in significant morbidity and the authors emphasised upon public education to reduce them.^[15]

Firework-related injuries are considered as preventable, and to reduce their menace, many countries have formulated legislations during the past two decades. The efforts of the government and the legislative bodies have given mixed results. National Electronic Injury Surveillance System data in 1994 suggested banning the rocket, restrictions in access to young ones and educational programmes to reduce firework-related injuries.^[4] Fogarty and Gordon (1998)^[10] and Puri *et al.* (2009)^[3] have recommended restriction in the use of firecrackers by children under 5 years of age. Public education in schools, strict standardisation of firecrackers, supervision by adults, restriction in personal use of firecrackers and promotion of public display of firecrackers are the other means suggested.^[3]

In the UK, Banger firework was banned in November 1996. The Firework Act 2003 and The Firework Regulation 2004 banned purchase and possession of firecrackers around bonfire night by children under 18 years of age. Edwin *et al.* (2008) noticed that there was a positive impact of this ban and, in 2004, the injuries reduced to 83% of previous years.^[16] Prophylactic actions in the form of change of legislation, implementation of legislation and dissemination of information were effective in reducing the incidence significantly in Denmark.^[17]

In New Zealand, a bill was introduced in the parliament for tighter restriction on the sale of fireworks in March 1992. However, after the analysis it was concluded that a complete ban on the public sale of fireworks is not required.^[18] On the contrary, Northern Ireland relaxed the legislation regarding sale and use of firecrackers during Halloween period in 1996 to bring it at par with UK. The 2-year prospective analysis of injuries showed that liberalisation of the law on firecrackers did not result in a significant increase in injuries requiring hospital admissions in their country.^[10]

Indian scenario is quite different. In 2005, the apex court of India said the right to live in an atmosphere free from noise pollution has been upheld as guaranteed by the constitution. There shall be a complete ban on bursting sound-emitting firecrackers between 10 p.m. and 6 a.m. Simultaneously the court also said that it was not necessary to impose restriction on bursting of colourful/light emitting fireworks. Pollution control board was directed to take a decision and implement the order, considering all aspects of the matter. However, many of the enforcement agencies, non-governmental organisations and the media publicised a complete ban on bursting of all types of firecrackers in the year 2005–2006. It was publicised as “No to firecrackers after 10 p.m.” It is observed from Table 1 that there is no impact of the legislation on the incidence of firecracker-related burn injuries received in our hospital. This is progressively increasing in spite of multiple amendments of the legislation since 2005 and repeated advice from the High court in 2009.

This analysis of epidemiology and the effect of Indian legislations points towards failure of administrative efforts in bringing down the incidence of firecracker-related injuries at least in India. The government has to make an effort to implement the legislation with an iron hand. This will be possible only if the public is taken into

confidence and they are involved in its implementation. Or else, the government has to think beyond the court and legislation(s).

Posters, banners and publishing media have been used in the past. However, we do not see any positive impact on the occurrence of these avoidable injuries. In the 21st century, one needs to be innovative too. Information technology has taken a big leap in its popularity. This technology should be used judiciously. Websites with information on firecrackers and their risks should be appropriately designed. Popularity of the social network sites should be used for dissemination of knowledge. Chains of emails should be started and sent to all the users.

Mobile phones are the most popular communication method at present. One can make use of its power and penetration in rural as well as urban areas in the country. Through mobile phones, the public may be advised about the dos and don'ts in the form of messages and ring tones, on firecrackers while enjoying the festivity.

We also need to exploit the power of electronic media. Television serials and reality shows are very popular among the masses. Almost all such programmes incorporate episodes on Diwali festival. The producers of these programmes should be motivated to incorporate educational programme on prevention of accidents while playing with firecrackers.

To conclude, the hospital is receiving increasing number of firecracker-related injuries from the Delhi national capital region over the past 9 years. Unlike most of the studies, children and adults are equally affected. The number of patients is on the rise, disproportionate to the increase in population of the city. It has almost doubled during the 9-year period. The passing of legislations and amendments did not have any impact on the number of patients visiting our hospital. This requires sincere thought. If the suggested innovative methods fail to bring down the incidence of such injuries, then the only way to prevent this will be by making firecrackers unavailable to the general public for individual use.

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