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## 16 years of research on children's-unintentional injuries understanding the prevalence evidence at hand

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**Abstract**

Unintentional injuries has been very common and prevalent worldwide health problem in terms of high morbidity and mortality. Injuries can be fatal or nonfatal, and they can occur unintentionally and has been till today, an increasing cause of concern only, especially in the developing countries. Unintentional injuries within the home environment have not so far been recognized and urgent attention is needed to reduce child injuries and address risk factors according to local context. Preschoolers carry the greatest injury burden among children aged 0–14 years and these commonly occur at home and encouraging the collection of data on injuries and establishing a database on childhood injuries are some of the steps to be taken in initiating a national injury prevention initiative.

**Keywords:** unintentional injuries, children, research, prevalence evidence

**Introduction**

*“There is nothing more precious to a parent than a child, and nothing more important to our future than the safety of our children.”- Bill Clinton*

Childhood: the most vital stage, geared up to take on the world for development and cumulative life span education. Being the assets of future, ensuring their survival, growth and safety means investing in the upcoming of the nation as children hold nearly one third of the total population of nation. But child injury-portray the most urgent moral quandary of the new millennium. Children are courageous, inquisitive to escapade and living in surroundings designed merely for adults. Knowing the outcome of hazardous trials is a learnt behavior naturally lacking in them. Death is the main noteworthy measure of injury nevertheless it is neither the mere result nor the most frequent. Injury is graphically represented as a pyramid in which at the top with the smallest group is of death, in the mid is the group which is hospitalized and at the base forms the largest group which is unreported and non-hospitalized injury including consequences such as a hasty trip to hospital emergency department or to the general surgeon, the dentist or the medical store or a pharmacist or a slight injury- a cut, a discoloration, a bang or an abrasion which can be treated in the home or by a hug and assurance from mom or dad. It has been found that each day in New Mexico, an average of nearly 5 people die from an injury, approximately 40 other are hospitalized, 705 are seen in emergency departments, and another 2,035 visit other health care facilities for treatment of their injuries (The New Mexico Injury Prevention Strategic Plan: 2008-2012) [35].

Globally, injuries have turn out to be the universal and foremost cause of death among the children (Unicef, 2007 and WHO, 2012) [36, 38] and worldwide deaths from injury has increased by 10.7%, from 4.3 million deaths in 1990 to 4.8 million in 2013 (Naghavi, *et al.*, 2015) [20]. In low and middle income countries (LMICs), child injuries is an emergent civic wellbeing problem and is mainly missing from child survival initiatives because, is still thought to be a less severe problem than communicable disease and nutritional problems (Bartlett, 2002 and Hyder, *et al.*, 2009) [5, 14]. It is stated that each year, more than 875,000 children between 0 and 18 years of age die as an outcome of unintentional injuries (UIs), with a higher percentage taking place in low- and middle-income countries (LMICs): the World Report on Child Injury Prevention, 2008 confirms that a child UI death rate is 3.4 times greater in LMICs than in high income countries (HICs) (41.7 per million vs.

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12.2 per million, respectively), but a huge disparity occurs according to the category of injury death. For fire and flame deaths, the rate of injury death is nearly 11 times higher in low-income countries than in high-income countries, for drowning it is six times higher, for poisons four times and for falls around six times higher (Mathers, *et al.*, 2008) [18]. In concomitant with these studies it can be concluded that the distressing injury burden is inappropriately higher, research is the need of the hour to identify the magnitude and distribution of injury risks experienced by the children and requires to work out for effective injury surveillance systems, epidemiological review of all effects of injuries, promotion for prevention and treatment and assessment of existing effective interventions for injury prevention and trauma care.

This paper reviews and reflects on one and half decade of empirical studies (2000 to 2016) published in the medical and public health literature as regards the prevalence of five main childhood unintentional injuries (i.e., traffic, drowning, poisoning, burns, falls). It is becoming a cause of increasing concern, especially in the developing countries (Babu, *et al.*, 2016) [2]. Unintentional injuries within the home environment have not so far been recognized (Bansal and Dalal, 2013) [4] and urgent attention is needed to reduce child injuries and address risk factors according to local context (Kataoka, *et al.*, 2015) [16]. Preschoolers carry the greatest injury burden among children aged 0–14 years and these commonly occur at home (Simpson and Nicholls, 2012) [24] and encouraging the collection of data on injuries and establishing a database on childhood injuries are some of the steps to be taken in initiating a national injury prevention initiative (Mathew, 2000) [19].

Swami, *et al.*, (2006) [25] carried out a descriptive hospital based study to find out the common types of unintentional injuries among children admitted for management of unintentional injuries in Pediatric Surgery department and Intensive Care Unit of a tertiary care hospital of North Kerala and to find out the contributing risk factors. A total of 400 children admitted during the study period of 6 months of 2009 constituted the study population. Mechanical injuries comprising of Road traffic accidents and accidental fall were the major cause of unintentional injuries (36%), followed by Poisoning (22.3%). The study highlights the need to identify the different types of unintentional injuries and the risk factors of childhood injuries which require hospitalization. Identification of risk factors will help to formulate strategies aimed at risk reduction and prevention of childhood injuries.

Fatmi, *et al.*, (2007) [7] concluded that in Pakistan, the health survey at National level estimated the annual incidence, patterns and severity of unintentional injuries among persons over five years of age. For this, over the preceding one year, interviews of 18,315 persons in urban and rural areas over 5 years of age were conducted using a two stage stratified design technique. The overall annual incidences of unintentional injuries were found to be 45.9 per 1000 annually. It was revealed in the survey that annually the expected unintentional injuries that occurred in Pakistan were 6.16 million among persons over five years of age. The annual incidence of injuries due to falls were 22.2, poisoning 3.3 and burn was 1.5 per 1000 per year. The majority of injuries occurred at home 19.2 or on the roads 17.0. Road traffic/street, school and urban injuries were more likely to result in handicap.

RoSPA, (2007) [37] discovered that every year in the UK more than 5,000 people die in accidents in the home and 2.7 million turn up at accident and emergency departments seeking treatment. But, because the accidents happen behind closed doors in isolated incidents they rarely attract public and media attention. Among the very few national voices RoSPA is one who speaks on this subject. The common unintentional injuries and their causes among children are:

- a) Falls: Falls are by far the most common causes of accidents in the home; they account for 44 per cent of all children's accidents.
- b) Fires: Domestic fires pose one of the greatest risks to children and the frequent cause to house fire is playing with matches and lighters.
- c) Scalds and burns: Many of the children who go to accident and emergency with a burn or a scald are referred on for further hospital treatment and also the recovery is long, painful and many result in with permanent scare.
- d) Poisoning: Most poisoning accidents involve medicines, household products and cosmetics. More than 28,000 children receive treatment for poisoning, or suspected poisoning accidents every year.

Van Niekerk, *et al.*, (2008) [27] in an analysis of the Injury Mortality Surveillance System at National level in 2004 statistics showed that while the proportional representation of children among all injury-related death is only 7%, twice as many of all burn and pedestrian injuries are located among children (15% each). Globally, burns are a serious public health problem. It has been estimated that each year deaths from fire alone is 195000 and global data are not available for many deaths caused by electrical burns, scalds and other forms of burns. Among the 15 leading causes of death fire-related deaths is one among children and young adults of 5-29 years of age. Over 95% of fatal fire-related burns occur in low- and middle-income countries. South-East Asia alone accounts for just over one-half of the total number of fire-related deaths worldwide. Death is not only the major outcome; apart from this millions suffer from disfigurements and, result in frequent shame and rejection. Drowning is the 3rd leading cause of unintentional injury death worldwide, accounting for 7% of all injury related deaths. There are an estimated 388000 annual drowning deaths worldwide. Global estimates may significantly underestimate the actual public health problem related to drowning.

Borse and Hyder, (2009) [8] in the study to document injury literature, a bibliometric analysis was carried out on published literature on low- and middle- income countries. Using MeSH terms on PubMed a systematic search was done. Papers by publication date on road traffic injuries were reviewed by country/cluster for two periods i.e. from March 2001 to March 2004 and April 2004 to April 2007. The rate of articles published per million population was calculated. Finally, a comparison was made between disease burden in disability adjusted life years (DALYs) and quantum of papers published. Results revealed that PubMed had 8.26 million articles listed; of which, only 2 per cent were on unintentional injuries. 41 per cent papers on road traffic injuries were from US, 36 per cent from Europe (other than Eastern Europe). Two most populous countries, China and India contributed only 0.9 and 0.7 per cent papers on road traffic injuries, respectively. India and China had less than one article on road traffic injuries per 1,000 road

traffic related deaths. Unintentional injuries overall represented 18 per cent of the burden in terms of DALYs and represented only 2 per cent of all published articles.

Chowdhury, *et al.*, (2009)<sup>[9]</sup> in a cross sectional survey in 12 randomly selected districts of Dhaka Metropolitan City used stratified, multistage, and also the cluster sampling design. Simple random sampling was used to distribute sampling unit children over one year old. During the study period 5577 cases of unintentional injuries were identified in children aged 17 years or less including 154 fatal cases. Common causes of injuries among these children were falls (n = 1663; 29.8%), burns (n = 1013; 18.2%); injury by sharp cutting object or cut injury (n = 743; 13.3%); road traffic injury (RTI) (n = 675; 12.1%); drowning/near drowning (n = 495; 8.9%); animal bite (n = 361; 6.5%), and electrocution (n = 277; 5.0%). The rate of fatal and nonfatal injury among children of under 18 years was 43.8 per 100 000 children years and 1542.2 per 100 000 children years, respectively. Children below 1 year old were less vulnerable to injuries where as 1–4 years old children were the most vulnerable group. Drowning was the leading killer of children over 1 year of age and falls were identified as the leading cause of injury morbidity. However, in the study falls, burn, cut injury and road traffic injury were found as the 4th, 5th, 7th, and 8th leading cause of burden of diseases in regard to morbidity.

Verma, *et al.*, (2009)<sup>[28]</sup> conducted a prospective study from March 2006-February 2007, at the emergency services of a tertiary care hospital with approximately 3,000 pediatric injury visits annually. Two hundred and twenty five children with a mean age of 6.14 years (range 2 months to 12 years) were enrolled. School children (6-12 years) were most commonly injured 50.6%, followed by preschoolers [(3-5 years) 26.6%], toddlers [(1-2 years) 18.6%] and infants [(0-1 years) 4%], respectively. Home was the most common place of injury [137 (60.8%)]. Other sites included street/highways [38 (16.8%)], Park/playground [37 (16.4%)], school [8 (3.5%)] and miscellaneous (workplace, neighborhood etc.) [5 (2.2%)].

De Sousa Petersburgo, *et al.*, (2010)<sup>[10]</sup> discovered that childhood injury accounts for a substantial burden of disease in Maputo, Mozambique between the ages of 5–9 years (34.9%). An observational, prospective convenience study was conducted in 2007. During the study period the data was collected from 335 children who were presented to three hospitals having age of 0–14 years in Maputo. The prevalence of trauma-related complaints was 12%, and between the ages of 5–9 years it was 34.9%. Falls were the most common mechanism of injury having 40.6%, followed by this was burns with 19.1% and road traffic injuries with 14.3%. The majority 61.8% of falls occurred in the home and 94.1% were unintentional. Burns were predominantly due to hot liquids having 82.8% and less frequently i.e. 17.2% due to fire. The majority of burns (62.5%) involved the patient alone. The majority of RTIs were pedestrians who were struck by vehicles (81.2%). Falls were the most commonly reported mechanism of injury occurring in 40.6% patients, with 68% of these were 5–14 year olds. Most falls (36.0%) were reported as ground level falls and (25.8%) involved a fall from height. Most falls (61.8%) occurred in the home environment, and the vast majority (94%) was classified as unintentional.

Lasi, *et al.*, (2010)<sup>[17]</sup> carried out a study which aimed at determining the incidence, nature, and extent of childhood

injuries in two suburban and rural communities of Pakistan. The findings of the study were based on cross-sectional survey of 2,292 children aged 1-8 years. Retrospectively the information was sought from the primary caregiver on the occurrence of injury during the past three months. The most common non-fatal injuries were falls (10.5), followed by this was burns and scalds (3.5 burn injuries per 100 person), and road traffic injuries (RTIs) (2 RTIs per 100 person). During the study period one drowning casualty was also stated. The data also revealed that 61% of the injuries took place inside the home.

Bhargava, *et al.*, (2011)<sup>[6]</sup> carried out a study on 200 consecutive children aged 12 or less reporting to the Neurosurgical emergency unit. Amongst the 200 patients aged 12 years or less; 105 children were in the age group of 1–5 years and 82 children between 5 and 12 years. The most common mode of injury was fall from height (unprotected rooftops while playing) seen in 56.5% of patients, followed by road traffic accident (being hit by a moving vehicle), accounting for 21% of injuries. Other modes were simple falls from chair or bed (17.5 %) and falling of heavy objects on the head. Slight carelessness on the part of parents can help avoid disastrous consequences for the children.

Sharma, *et al.*, (2011)<sup>[22]</sup> conducted a prospective study at a tertiary care hospital over a 12-month period. Out of the total 6102 pediatric patients admitted, the cause of admission for 791 patients was trauma. The mean age of presentation was 6.3 years. School-going children (6-12 years) were the most commonly injured (52.33%). Fall from height (39.44%), RTAs (27.83%) and burns (15.18%) were the most common mode of injury leading to pediatric trauma. Most of the cases (98.36%) were injured unintentionally. RTA was the second most common mode of injury. Of 220 children involved in RTA, 64.54% were pedestrians, 20.45% were two-wheeler passengers and 15% were four-wheeler passengers. Preschool age group formed the largest group of poisoning victims (71.73%). Most of these victims had ingested kerosene (67.39%) followed by insecticide (13%), castor seed (10.86%) and drugs (8.69%). The study also revealed RTA as one of the major causes of injury, causing the highest mortality (35.29%), followed by burns (27.45%) and fall from height (15.68%). The prevalence of trauma in childhood patients was approximately 19.23%. This was probably due to delayed presentation to our tertiary institute, or probably due to lack of knowledge. Home was the most common place of injury. By study findings it can be concluded that majority of pediatric injuries are preventable and pediatric epidemiological trends differ from those in adults.

Banerji & Inuit and Métis Health Committee, (2012)<sup>[3]</sup> reported that according to Statistics Canada, mechanisms of injury focus on the major causes of injury-associated morbidity and mortality. These are -

- Motor vehicle collisions: MVCs cause the most injuries and deaths in First Nations children and youth.
- Drowning: Drowning remains a common cause of death, especially for males. Although Indigenous peoples comprise about 5% of the Canadian population, they account for approximately 26% of drowning which involve a snowmobile, 16% of drowning after a fall, 10% of drowning during recreational aquatic activities, and 9% of drowning related to boating activities.
- Fires: In a survey, fire deaths were found to be about 31% in children of 1-14 year age in Indigenous

populations, as compared it was found to be 16% in the general Canadian population.

Centers for Disease Control and Prevention, (2012) <sup>[31]</sup> revealed that in United States between 2000–2009, unintentional injuries among children aged 1–19 years accounted for 42 percent of all Years of Potential Life Lost (YPLL). The YPLL rate due to unintentional injuries among children was 5 times higher than the rate for cancer, 13 times higher than the rate for heart disease, and 31 times higher than the rate for influenza and pneumonia. What is the Burden of Child Injury, by Cause of Injury?

- **Motor Vehicle-related Injuries:** Motor vehicle-related injuries are the leading cause of death for U.S. children aged 5–19 years. These injuries account for 24 percent of deaths from all causes in this age group and for most (63%) unintentional injury-related deaths. In addition, 514,604 children were treated in hospital EDs in 2009 for non fatal injuries from motor vehicle crashes.
- **Suffocation:** Unintentional suffocation is a leading cause of fatal and nonfatal injury among infants and young children. More than three-quarters of injury deaths among those younger than 1 year old are due to suffocation.
- **Drowning:** The location of drowning varies based on the age of the child. Infants tend to drown in bathtubs; children aged 1–4 years in swimming pools, and older children in natural bodies of water (e.g., lakes, ponds, and rivers).
- **Poisonings:** It was found that in U.S. 824 children in 2009, died and more over the greater ones i.e. 116,000 were treated due to poisoning in hospital emergency departments. For unintentional exposure to prescription and over-the-counter medications young children are especially at risk.
- **Fire and burn injury:** In 2009, almost 119,000 U.S. children were injured severely enough due to unintentional fires and burns that they had to visit an ED.
- **Falls:** Falls are the leading cause of child injury-related ED visits, accounting for more than 2.8 million emergency department visits in 2009 and about 150 child deaths per year. Most fall-related injuries occur at home.

Children in India, (2012) <sup>[32]</sup> reported that while an absolute increase of 181 million in the country's population has been recorded during the decade 2001–2011, there is a reduction of 5.05 millions in the population of children aged 0–6 years during this period. Death rates for children age 5–14 is generally a period of lower mortality than at ages 0–4 years. The main leading causes of death at ages 5–14 are: Certain infectious and Parasitic Diseases (22.9%), Injury, Poisoning and Certain Other consequences of External causes (12.5%), Diseases of the Nervous System (11.5%), Diseases of the Circulatory System (10.5%), Diseases of the Respiratory System (8.5%), and Other Major groups (34.2%). In 2010, it was anticipated that, out of the total reported deaths, by the Sample Registration System, 14.5% were infants below 1 year, 3.9% were deaths of 1–4 year children while 18.4% were deaths reported of children of 0–4 years and simultaneously the 2.7% deaths were of children in the age group 5–14 years respectively.

Ray, *et al.*, (2012) <sup>[21]</sup> carried out a cross sectional epidemiological study to find the profile of injuries among municipal primary school children in Siliguri, from

February - May 2009 in, West Bengal. 20% of total primary schools under Municipal Corporation of Siliguri were randomly selected. To assess the profile of injury and associated factors a pre-designed as well as a, pre-tested schedule was used. Total number of children participated in this study were 956 out of total 1165. The age of children was between 5–12 years and the response rate was 82%.  $7.18 \pm 1.48$  years was the mean age of all the children. Among all the injuries, open wound was the commonest type of injury which accounted for 59.6%. The most common site to be injured was the extremities (55.3%). It was found that injuries experienced was more than 41% at home, followed by this was 31.6% which was on road. When considering the causes of injury, fall was found at the top level with the percentage of 39.5 for most of the cases, followed by this was collision; both of these occurred mostly during sports and other playing activities. 44.5% of the injuries were managed by the first-aid care. The commonest place of first-aid was either at home or at traditional practitioners 36.9% and 7.6% were managed in the school. The medical practitioners as well as the hospitals managed for 55.5% of the cases.

Bansal and Dalal, (2013) <sup>[4]</sup> with the aim to determine the profile of unintentional injuries in Fanda block of district Bhopal, carried out a study. All the inhabitants (13,587) of randomly selected 11 villages of Fanda block formed the study population. 487 persons had a total of 543 new injuries during three months prior to the interview. Only 292/543 (53.7%) of the recorded injuries received medical care at health facilities. Home and road traffic injuries constituted the most common injuries with incidence rates of 27 and 24, respectively. Home injuries were most common among young children. Maximum injuries recognized were due to cutting and crushing. Falls were the leading cause among the young.

Report on Strategic Plan for the Prevention of Unintentional Injury, (2013) <sup>[34]</sup> unveiled that unintentional injuries are the second leading cause of death for Massachusetts children ages 1–14. In fiscal year 2011, Massachusetts infants and children ages 0 to 14 years required more than 117,000 emergency department visits and over 2,000 inpatient hospitalizations for treatment of non-fatal unintentional injuries. As a result of unintentional injuries, 18 Massachusetts children in 2010 died whose age was 1–14 years.

Zaidi, *et al.*, (2013) <sup>[29]</sup> to describe the patterns of injuries among children of rural and urban registered areas under department of community medicine, carried out a community based cross-sectional study at JNMC, Aligarh. A 282 household's survey was conducted. A standard questionnaire was administered to guardians of 91 of these children to elicit information on the etiology of the injury, demographic and socioeconomic details. Study results revealed that children aged 6–15 years (19%) suffered more injury than children under 5 years age group (14%). Under five year old children were found to be more prone to fall (32.4%) and struck/hit by person or object (32.4%) as compared to children aged 6–15 years. Injuries due to fire/flames or heat (8.8%) were found to be more in children in under 5 years age group as compared to other group.

Alonge and Hyder, (2014) <sup>[1]</sup> stated that deaths from injuries in Western sub-Saharan Africa and South Asia accounted for more than 50% of all deaths. Rates in these regions are 68.0 and 36.4 per 100 000 population, respectively,

compared to 6.4 in Western Europe. Road traffic injuries (RTI) are the commonest cause of death, followed by deaths from drowning, burns and falls.

Debnath, *et al.*, (2014) <sup>[12]</sup> assessed the knowledge of mothers regarding domestic childhood injuries and safety measures adopted in a cross-sectional study among 230 rural mothers of west Tripura district during May to June 2012. A semi structured interview schedule which was pretested was used to collect the information and the sampling technique used was a systematic random sampling. Only 3.9% met minor domestic injuries. Out of which 6 (66.7%) of respondents' children 3 were treated at home, remaining at hospital and all of them recovered. The reported incidence of domestic injury was low that might have been due to under reporting.

Kamel, *et al.*, (2014) <sup>[15]</sup> carried out a study in Egypt, in Damares village, El-Minia, with objectives to measure the types and incidence of home injuries in rural areas affecting the children aged up to 12 years. This cross-sectional and a descriptive study included 283 mothers as sample and structured interview was conducted to elicit the response. The results revealed that at the previous 8 weeks, 39.8% of the children suffered from home injuries. About 30% of the injured children were aged  $\leq 3$  years and 48% stated cut/wound as the highest percentage of home injury, followed by this was fracture/fall representing 36% and burn were 11.9%.

Shriyan, *et al.*, (2014) <sup>[23]</sup> conducted a cross-sectional study on the profile of unintentional injury among under five children in coastal Karnataka, India from October to November, 2014 attending the anganwadis in Udupi Taluk. Time frame located convenient sampling method was adopted and a total of 95 mothers of children under-five were interviewed by using interviewer administered semi-structured questionnaire. The results revealed that the prevalence of unintentional injury among under-five children was 46.3% and the commonest causes of the injuries were due to falls followed by burns and animal bites. From the study it can be concluded that the prevalence of unintentional injuries among under-five children was high.

Georgia Child Fatality Review, (2015) <sup>[33]</sup> in a report stated that in United States of America, the unintentional injuries among children of 1 to 19 years are the leading cause of death, which almost represents about 40 percent of all the death in this age group. Each year, an estimated 8.7 million children and teens from birth to age 19 are treated in emergency departments for unintentional injuries and more than 9,000 die as a result of their injuries—one every hour. Fires or burns, falls, drowning, poisoning, suffocation, and transportation-related injuries are among the most common causes of unintentional injuries in childhood. Injuries claim the lives of 25 children every day. While tragic, many of these injuries are predictable and preventable.

Kataoka, *et al.*, (2015) <sup>[16]</sup> examined the occurrence and risk factors of serious non-fatal injuries in children aged 7–9 years (n=1820) from Andhra Pradesh, India. Logistic regression models were used to explore potential risk factors for these injuries. Based on a 3-year recall period, 336 (18.5%) children reported serious non-fatal injuries. Of the most serious non-fatal injuries reported, falls (n=186, 55.4%) were the major cause of injuries, followed by road traffic injuries (50, 14.9%), and assaults/blows/hits (26, 7.7%). Twenty children (6.0%) did not fully recover from

their injuries, and 14 (4.2%) had long-term health problems as a result of their injuries.

Babu, *et al.*, (2016) <sup>[2]</sup> to find out the leading cause of pediatric admissions in Trauma Surgery in New Delhi, India conducted a study. For the study inpatient data was searched retrospectively in Jai Prakash Narayan Apex Trauma Centre Trauma Registry. All patients aged 18 years or less was included. Results revealed that 300 patients over a 33 month period were the part of the study. Overall the predominant cause was RTAs in 132 (43%) patients. On subgroup analysis of up to 12 years age group (n = 147), the most common cause was found to be RTAs again. However, falls showed an incremental upward trend (36.05% in up to 12 age group versus 27% overall), catching up with RTAs (44.89%). Overall, 12 patients expired in the cohort.

Overall from the above studies it can be summarized that injuries can be fatal or nonfatal, and they can occur unintentionally as revealed in a study by Deal, *et al.*, (2000) <sup>[11]</sup>. Mathew, (2000) <sup>[19]</sup> revealed that more than 90% pediatricians reported that they attend to children with injuries and Tiagi, *et al.*, (2000) <sup>[26]</sup> uncovered in their study that injuries are a worldwide health problem in terms of high morbidity and mortality and maximum took place at home. But still, has been till today an increasing cause of concern only, especially in the developing countries (Babu, *et al.*, 2016) <sup>[2]</sup>.

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