

Burden of Childhood Injuries in India and Possible Public Health Interventions: A Systematic Review

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Abstract

Childhood injuries are a major public health challenge in India and globally. This systematic review was conducted to understand the burden and spectrum of childhood injuries, with a focus on unintentional injuries, among children 5–14 years of age and to suggest approaches to prevention that can be adopted in the Indian context. This systematic review was conducted with the standard approach and use of keywords. A total of 33 studies which were found to be relevant were analyzed. Road traffic accidents (RTAs) contribute to nearly 85% of all unintentional injuries and related deaths and 90% of disability-adjusted life years (DALYs) lost in developing countries. Poor traffic regulation, heavy traffic load, and poor skill of identifying the dangerous road crossing sites make the children's age group vulnerable and prone to RTA. Children with poor skill of identification and response to dangerous road crossing sites, along with heavy unregulated traffic were found to be the major reasons for such accidents and make this age group more vulnerable. Public health-based prevention approaches need to be based upon legislation, regulation, and enforcement, as well as environmental modification, education and skill development, emergency medical care using levels of prevention, and principles of targeted prevention to effectively address child health challenges. Addressing child injuries should be a key component of all endeavors aimed at enhancing child mortality and morbidity rates, as well as the overall welfare of children, both at the national and global levels. It is imperative to prioritize policies focused on preventing unintentional injuries across all age groups, with particular attention to children.

Keywords: Children, Haddon's matrix, India, childhood injuries, primary healthcare

INTRODUCTION

Unintentional injuries rank as the second most significant cause of death in children, with an estimated 8.2 deaths per 100,000 population. Among these injuries, transport-related incidents account for 5.1 deaths per 100,000 population, making them the third leading cause of death worldwide.^[1,2] Also, numerous children suffer nonfatal injuries, leading to millions requiring hospitalization and leaving many with lifelong disabilities, underscoring the gravity of the issue.^[3,4] Unfortunately, over 95% of all child injury deaths occur in low- and middle-income countries (LMICs), resulting in a highly inequitable burden. In India alone, unintentional injuries contribute to 9.1 deaths per 100,000 population, while transport injuries account for 2.8 deaths per 100,000 population.^[5,6] After enteric infections, which are the leading cause of death in children aged 5–14 globally and in India, unintentional injuries stand as the second leading cause.

The lack of awareness surrounding this problem has hindered the implementation of proven preventive measures to the extent seen in high-income countries.^[7] The Organization for Economic Cooperation and Development (OECD) countries, for instance, have developed strategies that significantly reduced child injury deaths by half between 1970 and 1995.^[8] While current research has shed light on preventing child injuries and fatalities, there remains a gap between knowledge and action.^[9,10] Fortunately, the Sustainable Development Goals (SDGs) have targeted the reduction of global deaths and

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injuries from road traffic accidents (RTAs) by half in 2030. It is crucial to prioritize childhood injuries in all initiatives aimed at improving child mortality, morbidity, and well-being at both national and global levels.^[11] The aim of this systematic review is to present the epidemiology and spectrum of childhood injuries and place them in the context of injuries across all age groups. It also explores prevention approaches and suggests strategies tailored to the Indian context. This review specifically focuses on unintentional injuries, including traffic injuries, drowning, poisoning, burns, and falls, among children aged 5–14 years.

MATERIALS AND METHODS

A systematic review of literature was conducted on PubMed via Medline in August–September 2022 using keywords that included but were not limited to “Childhood injury,” “India,” and “prevention,” to identify the relevant articles. The search was restricted to English language articles. Two authors (MK, ST) independently screened the titles, abstracts, and full texts and extracted data using standard methods. Any disagreements were resolved by discussion or referring to a third author (VKP). The risk of bias (RoB) assessment was done using modified Newcastle–Ottawa scale.^[12]

Data collation was performed by one of the authors (MK) using Microsoft Excel. However, clarifications and quality checks (by randomly selecting studies and variables) were conducted by the other two authors (VKP, ST) at regular intervals. The outcomes of the study included spectrum of childhood (5–14 years of age) injuries, approaches to prevention, and strategies that can be adopted in the Indian context.

RESULTS

This initial search resulted in 344 articles and after reviewing the titles and abstracts, 176 articles were identified (articles of English language focusing on unintentional injuries among children 5–14 years of age reported from India or other countries, but with a scope for uptake were included). Finally, 33 studies that were relevant to the objective of this study were identified through full-text screening [Figure 1].

All the included studies focused on unintentional injuries (traffic injuries, drowning, poisonings, burns, and falls) among children 5–14 years of age ($n = 33$, 100%). The characteristics of the included studies are summarized in Table 1.

RoB assessment revealed that 33.3% of included studies were of high quality or low risk, 24.2% studies were of moderate quality, and 6.1% were of low quality. However, one-third of the studies was review articles and could not be assessed for RoB (36.4%). The findings of the included studies are summarized in Table 1.

The Child Safety Network conducted the first study in the United States during the early 1980s to examine the sizes of different groups affected by child injuries. Its findings revealed

that for every child under the age of 19 who died due to injuries, 45 children required hospitalization and an additional 1300 children visited the emergency departments and were discharged.^[44] Subsequent research conducted in various regions and countries have confirmed this pattern, although the specific ratios may vary depending on the availability of local services and access to hospital care.^[45]

This systematic review highlighted that RTAs resulting in injuries and deaths pose a significant public health issue in developing countries. Developing countries account for over 85% of all RTA-related deaths and 90% of disability-adjusted life years (DALYs) lost due to road traffic injuries. In low-income countries, the proportion of vulnerable road users is much higher, necessitating the design of vehicles, roads, and environments that prioritize their safety. The study also revealed that children demonstrate poor skills in identifying hazardous road-crossing locations. Their judgment primarily relies on the visible presence of cars nearby, neglecting blind spots, obscured obstacles, and complex intersections as potential threats. [Table 2].

Moreover, the literature indicated several policy-related findings. Safety belt laws, especially when combined with rigorous enforcement, are effective in all settings. Primary safety belt laws are particularly more effective than secondary laws. Also, aside from vehicle crashworthiness, transportation planning, exposure control, intelligent separation of nonmotorized traffic on major roads, and traffic calming measures are likely to play a significantly important role in promoting road safety.

DISCUSSION

Injuries among children are one of the leading causes of morbidity and mortality, which are showing an uptrend with the unregulated urbanization, weak policy in place, and poor awareness of preventive strategies for the same. The current systematic review clearly demonstrates that traffic in low-income nations consists of a substantially higher proportion of vulnerable road users, necessitating the design of cars, roads, and the surroundings for their safety. These issues do not have many easy solutions. To create new policies and designs, creative effort must be taken all around the world. Transportation planning, intelligent separation of nonmotorized traffic on key routes, exposure control, and traffic calming are expected to play a considerably more significant role than the crashworthiness of automobiles.

The Ministry of Road Transport and Highways (MoRTH) and the Ministry of Health and Family Welfare (MoHFW) jointly brought several steps and actions to prevent RTAs. Education measures such as publicity and awareness campaigns to the public and engineering measures such as identification and rectification of accident blackspots were taken. There were steps for speed control in vehicles that included speed limit signs, speed breakers, and associated signages. Legislative measures such as the Motor Vehicles Act and strengthening

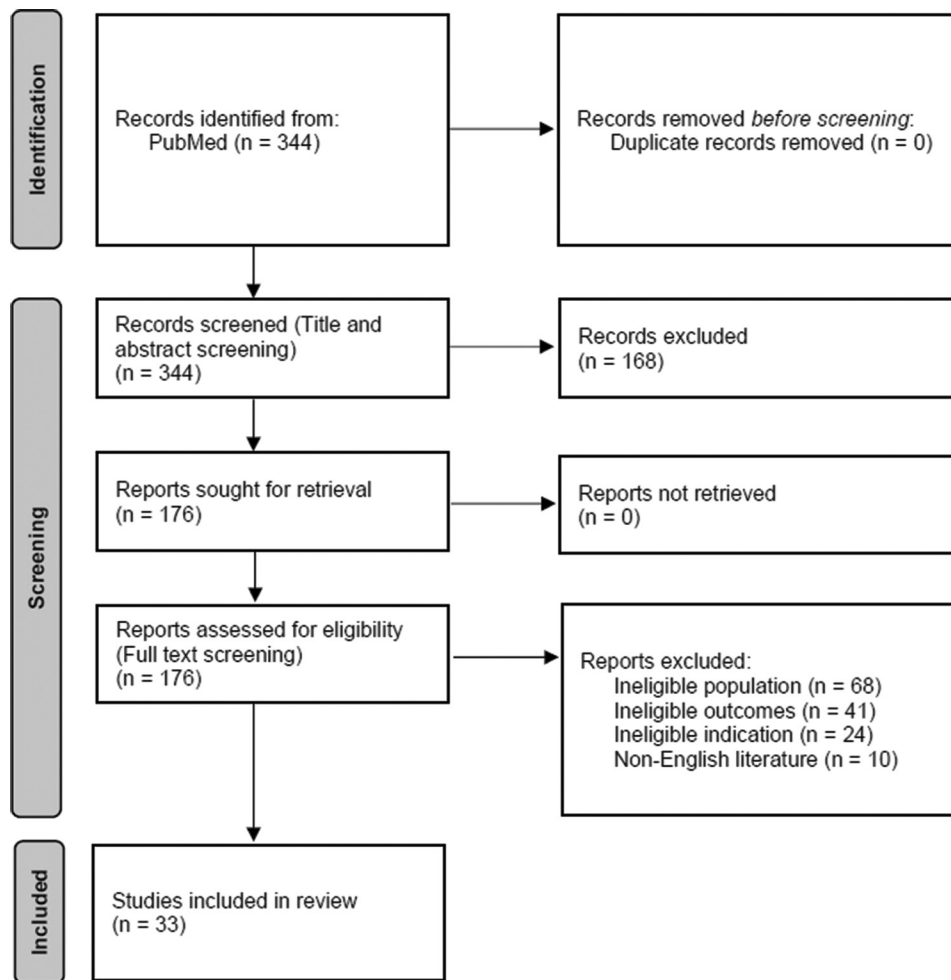


Figure 1: Study flow diagram

enforcement and road safety contribute to road safety in India. MoRTH has issued the “Helmet for riders of Two Wheelers Motor Vehicles (Quality Control) Order, 2020.” The inclusion of Protective Helmets for Two-Wheeler Riders in the compulsory Bureau of Indian Standards (BIS) certification and the issuance of the Quality Control Order have been implemented.^[46] Enhanced compensation of INR 2 lacs in case of death and INR 50,000 for grievous hurt for victims of hit and run accidents is provided.^[47] RTA is a major public health crisis, which has higher rates of deaths, disabilities, and hospitalizations in India. The Government of India (GoI) initiated trauma care in public hospitals near highways. MoHFW has also issued an official memorandum that “No patient in emergency should be denied first-aid and other medical examination and treatment irrespective of the patient being a medico-legal case or otherwise, and also treatment should not be with-held pending legal formalities.” A dedicated emergency helpline (112) for road accident victims provides early response for action.

The distribution of injuries is commonly depicted as a pyramid, illustrating different groups based on their size and severity. At the top of the pyramid is the smallest

group representing fatalities, followed by the middle group consisting of hospitalized injuries. The largest group, located at the base of the pyramid, represents nonhospitalized injuries. This visual representation, as shown in Figure 2, helps understand the incidence and severity of injuries by establishing a general relationship between injury-related deaths, hospital admissions, and visits to the emergency department.^[13,48]

With increasing evidence, prevention is the most important and urgent strategy. In recent years, two important changes have occurred: firstly, shift in emphasis from individual to the environmental context in which an injury can occur and secondly, having models that involve a range of causes instead of single-cause explanations of injury. The public health model approaches this issue in a systematic and coordinated way, following four logical steps [Figure 3].^[49]

Injuries can be prevented or controlled, and a wide range of prevention approaches is called for. Of the various health promotion and disease prevention models (e.g. ecological model, health belief model, and transtheoretical model) the classic model includes the following:^[50-52] 1) primary

Table 1: Characteristics of studies included in the review

Name of the first author	Year of the study	Place of the study (country)	Study methods	Sample size, sampling technique	Findings
James <i>et al.</i> ^[8]	2018	Global	Secondary data from literature studies, survey data, surveillance data, inpatient admission records, outpatient visit records, and health insurance claims Also, results from cause of death models were used	68,781 data sources	Global prevalence, incidence, and years of life lost due to disability have been documented for amputations, burns, fractures, head injuries, spinal injuries, minor injuries, and other injuries. These were the Global Burden of Disease estimated for the year 2017
Mock ^[11]	2001	–	Review article	–	Throughout the developing world, injuries are a major public health problem. However, there has been a disproportionately low policy response to the problem. Many low-cost solutions could help to lower the burden of suffering from injury
Lee <i>et al.</i> ^[49]	2010	USA	Data from 2004 for Massachusetts was used. Unintentional and intentional injuries accounted for 197 deaths, 7120 hospitalizations, and 199,814 emergency department visits, giving a ratio of 1:36:1014	Secondary data	The injury pyramids constructed for 2004 differed by mechanism and intent from those for 1980 Also, there were lower rates of overall injury and of most major injury mechanisms in Massachusetts in 2004
Mohan ^[20]	2002	–	Review article	–	Traffic in low-income countries comprises a much higher share of vulnerable road users, and so vehicles, roads, and the environment have to be designed for their safety Solutions for such problems are not readily available Innovative work needs to be done around the world to arrive at new policies and designs. In addition to crashworthiness of vehicles, transportation planning, exposure control, intelligent separation of nonmotorized traffic on major roads, and traffic calming are likely to play a much more important role
Mock <i>et al.</i> ^[58]	2004	–	Review article	–	There is a need to strengthen the capacity of national institutions to do research on injury control, to design and implement countermeasures that address injury risk factors and deficiencies in injury treatment, and to assess the effectiveness of such countermeasures Injury control activities should be undertaken in the context of attention to human rights and other broad social issues
Zeedyk <i>et al.</i> ^[21]	2002	Dundee, Scotland	Cross-sectional study	56 children, aged 5–6 years	60% of the children failed to stop before proceeding from the kerb onto the road. Looking for oncoming traffic was exhibited by no more than 41% of the sample, dropping to as low as 7% in some instances Consideration of individual performance revealed the existence of individual differences; such differences were relatively stable across the two road crossings
Ampofo-Boateng <i>et al.</i> ^[24]	1991	Scotland	Experimental design	64 children between 5 and 11 years of age	Children 5 and 7 years old exhibited very poor skill in identifying dangerous road crossing sites. Their judgments relied exclusively on the visible presence of cars in the vicinity Blind summits, obscuring obstacles, or complex junctions were never recognized as threatening situations. Children were not willing to make detours when planning their own routes, even where the direct route was manifestly dangerous The study concluded that young children up to about 9 years must often be at considerable risk

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Table 1: Contd...

Name of the first author	Year of the study	Place of the study (country)	Study methods	Sample size, sampling technique	Findings
Salter <i>et al.</i> ^[23]	2004	Bath, United Kingdom	Secondary analysis of data (qualitative analysis)	158 children	The need to provide adequately for the younger accident and emergency patients by supplying information, communicating appropriately, and offering an environment that is more appropriate for young people has been highlighted
McAnally <i>et al.</i> ^[33]	2004	Dunedin, New Zealand	Cross-sectional study	1480 tertiary students	Male gender and drinking status were independently associated with speeding, drink-driving, and drink-riding, but not with seatbelt use
Fatimah <i>et al.</i> ^[34]	1997	Kuala Terengganu	Case-control study	140 cases and 140 controls	The significant predictors of RTAs were pupils' knowledge regarding road crossing, parental supervision, and parents having driving licenses
Nantulya <i>et al.</i> ^[35]	2002	–	Review article	–	RTAs resulting in injuries and deaths are a major public health problem in developing countries. More than 85% of all deaths and 90% of DALYs lost from road traffic injuries occur in developing countries The burden of injuries and fatalities is disproportionately distributed among poor people in developing countries, such as pedestrians, passengers of buses and minibuses, and cyclists
Runyan ^[22]	1998	–	Review article	–	The study adds a third dimension to Haddon's matrix to facilitate its use for making decisions about which countermeasures to apply (phases, factors, and decision criteria)
Dinh-Zarr <i>et al.</i> ^[25]	2001	USA	Systematic review of motor vehicle occupant-related intervention	46 studies were included	Provides a logical framework for seatbelt interventions The study highlights the effectiveness of safety belt laws (along with enhanced enforcement) in general and the incremental effectiveness of primary safety belt laws relative to secondary laws Information is provided about the applicability, other effects, and barriers to implementation of these interventions
Heydari <i>et al.</i> ^[36]	2019	Global	Review article	Four studies	The review has summarized 10 focus areas (including global best practices, equitable distribution, paucity of data) and seven major research directions
Macpherson <i>et al.</i> ^[28]	2008	Global	Cochrane review	29 studies	Bicycle helmet legislation appears to be effective in increasing helmet use and decreasing head injury rates in the populations for which it is implemented
Macarthur ^[30]	2003	Canada	Random digit dial telephone survey	220 per group	Safe Kids Week 2001 was a multipronged national public awareness campaign on scald and burn prevention Parents exposed to Safe Kids Week 2001 were 2–3 times more likely to test and lower the water heater temperature
Thompson <i>et al.</i> ^[62]	1998	Global	Cochrane review	Three studies	Pool fences should have a dynamic and secure gate and should isolate the pool from the house (i.e., four-sided fencing) Legislation should require isolation fencing with secure, self-latching gates for all pools – public, semi-public, and private Legislation should require fencing of both newly constructed and existing pools and include enforcement provisions in order to be effective
Bilukha <i>et al.</i> ^[32]	2005	USA	Systematic review	Four studies	Provides an analytic framework for early childhood home visitation Home visitation has substantial positive effects on the prevention of child maltreatment – a median relative reduction of 39%

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Table 1: Contd...

Name of the first author	Year of the study	Place of the study (country)	Study methods	Sample size, sampling technique	Findings
Peek-Asa ^[14]	2003	USA	Review article	–	The study provides causal model of injuries, environmental strategies to reduce injuries in the preventive phase specific to roadways, workplace, pedestrian children, and for elderly at homes, reduce injuries in the event phase specific to fire, and reduce injuries in the post-event phase specific to delivery of emergency and trauma care, disaster response
Bergman <i>et al.</i> ^[16]	1991	Sweden and USA	Review article	–	Highlights the 35-year-old campaign that focuses on trauma surveillance systems and injury prevention research, ensuring safer environments and products through legislation and regulation, and a broad-based safety education campaign using coalitions of existing groups
Forjuoh <i>et al.</i> ^[18]	1996	Global	Review article	–	Framework for injury prevention, transport-related injury interventions, and home injury interventions are summarized in this article
Vecino-Ortiz <i>et al.</i> ^[19]	2018	Global	Systematic review	47 studies	Interventions potentially most effective in preventing deaths from drowning are formal swimming lessons for children younger than 14 years and the use of crèches to supervise younger children
Ker <i>et al.</i> ^[37]	2005	Global	Systematic review	87 studies	The results provided no evidence that post-license driver education is effective in preventing road injuries or crashes
Pless ^[38]	1997	Global	Editorial	–	Benefits of teaching swimming skills early, various life-saving techniques, the design of small boats, and the safety equipment should be explored quantitatively
Logan <i>et al.</i> ^[39]	1998	USA	Randomly dialed national telephone survey	5238	Adequate pool fencing prevents a child from having access to a swimming pool if a responsible adult is not present and has been promoted as a method to prevent drowning
Turner <i>et al.</i> ^[36]	2012	Global	Cochrane review	Four studies	There are a very limited number of research studies allowing conclusions to be drawn about the effectiveness of community-based injury prevention programs to prevent burns and scalds in children
McLoughlin <i>et al.</i> ^[41]	1990	USA	Secondary data analysis	–	A “cost of burn injury” model suggests a dollar value of societal losses from childhood burn deaths and injuries at approximately \$3.5 billion Preventing fire deaths through residential sprinklers, smoke detectors, fire-safe cigarettes, and child-resistant lighters would prevent more than three-quarters of all childhood fire/burn deaths
Cummins <i>et al.</i> ^[38]	2001	USA	Review article	–	The article highlights the research needs in the area of injury prevention and ways to sustain healthy communities
McClure <i>et al.</i> ^[39]	2005	Global	Systematic review	Six studies	There is a paucity of research studies from which evidence regarding the effectiveness of community-based intervention programs for the prevention of fall-related injury in children could be based
Kendrick <i>et al.</i> ^[66]	2013	Global	Cochrane reviews	98 studies	Interventions providing free, low-cost or discounted safety equipment appeared to be more effective in improving some safety practices than those interventions not doing so. There was no consistent evidence that interventions were less effective in families whose children were at greater risk of injury
Makalinao <i>et al.</i> ^[67]	2005	Asia	Review article	–	The paper highlights the experiences and resources available to the Philippine and Malaysian poison centers and the strengths generated by networking and collaboration

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Table 1: Contd...

Name of the first author	Year of the study	Place of the study (country)	Study methods	Sample size, sampling technique	Findings
Nixon <i>et al.</i> ^[68]	2004	Global	Systematic review	Four studies	There is a paucity of research studies in the literature from which evidence regarding the effectiveness of community-based childhood poisoning prevention programs can be obtained
Lindqvist <i>et al.</i> ^[63]	2002	Sweden	Population-based quasi-experimental design	Motala municipality and Mjölby municipality areas in Östergötland county	The relative risk for child injury in the intervention community decreased significantly more than in a control community exposed only to national injury prevention programs

DALY=disability-adjusted life year, RTA=road traffic accident



Figure 2: Childhood injuries- the possibility for prevention

prevention refers to any methods used to prevent injury events from occurring, and is thus concerned with the period of time before the occurrence of injuries (pre-event phase) and 2) secondary prevention refers to the implementation of measures to reduce the negative consequences during an injury event, such as a car crash or specific event phase. Tertiary prevention, on the other hand, involves efforts focused on treating and rehabilitating injured individuals or, in some cases, those responsible for violence or injury resulting from RTAs. Tertiary prevention primarily deals with the period following an injury event.

Another approach to defining prevention activities is by considering the target group. This approach categorizes interventions into three levels: universal, selective, and indicated.^[53] Universal interventions are designed for the general population or groups without considering individual risk factors.^[49-51] Examples include violence prevention programs delivered to all students in a school or children of a specific age, community-wide media campaigns, and seatbelt laws. Selective interventions target individuals at higher risk of injury or violence due to one or more risk factors. Examples include driver education for young or elderly drivers and parenting training for low-income, single parents.^[15,54,55] Indicated interventions are aimed at individuals who have already demonstrated risky behaviors, such as interventions

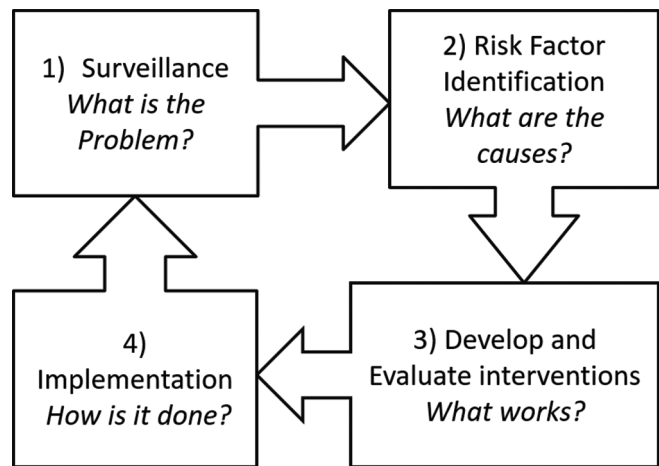


Figure 3: Public Health approaches to injury prevention

to reduce alcohol consumption among alcohol abusers and programs for domestic violence perpetrators.

A framework commonly used to address the issue of road traffic safety and prevent various types of injuries is Haddon’s matrix. This matrix applies principles of public health and consists of a table with four columns representing the host, agent/vehicle, physical environment, and social environment. These columns represent factors that contribute to the injury process. The matrix also has three rows corresponding to the periods before, during, and after the injury, which align with primary, secondary, and tertiary prevention.^[22,56,57] The matrix helps identify strategies and priorities for injury prevention, taking into account cost, effectiveness, research gaps, and resource allocation in the past and future.^[58] Based on guiding principles, the key approaches to address childhood injury are as follows [Table 3]:

- a. **Legislation, regulation, and enforcement:** Legislation plays a significant role in preventing injuries, specifically in the road environment (such as child passenger restraints, seatbelts, bicycle helmets, and motorcycle helmets),^[23,25,59] home environment (including smoke alarms, regulations on hot water temperature, and child-resistant containers),^[26,60]

Table 2: Description of Haddon's matrix using playground injuries among children

	Host (children on playground)	Agent/vehicle (playground equipment, surface under equipment)	Physical environment (playground)	Social environment (community norms, policies, rules)
Pre-event	Educate children about safety behavior rules Children to wear clothes without strings Adult supervision	Equipment design appropriate to child's age Equipment stability, guard rails, protective barriers, safe openings Surface free of objects	Enough space between play structures Equipment with moving parts in separate area Playground free of rocks, tree roots, and broken glass	Educate adults about safe behavior, counter measures Standards, policies, rules, financing Maintenance, inspection of equipment
Event	Disproportionate body parts (exposure to head injuries)	Proper height of equipment Soft, thick protective surface (wood chips, sand, rubber mats) Swing seat made of soft materials	Proper use of cones for protective surfacing around equipment Surface under equipment free of objects (bikes, backpacks) Children not to stand under equipment	Educate adults about safe behavior, counter measures Standards, policies, rules, financing Technological development
Post-event	Adult supervision Assisting child and giving first aid	Surface under equipment free of standing water (risk of drowning)	Avoiding exposure to cold environment (risk of frostbite) Efficient communication system, emergency transport Emergency and hospital treatment	Educate and train adults in first aid, emergency guidelines for schools Medical science development Rehabilitation programs accessibility

Table 3: Key approaches in the context of traffic injuries, drowning, burns, falls, and poisoning

Key approaches	Traffic	Drowning	Burns	Falls	Poisoning
Legislation, regulations, and enforcement	Speed limits, comprehensive drink driving laws, child restraints	Four-sided pool fencing	Hot water tap temperature legislation, smoke alarms	Playground equipment standards	Manufacture, storage, and distribution of harmful substances requiring safe packaging
Product modification	Vehicle front modification, child restraint systems	Personal flotation devices	Non-tip lanterns and candle holders	Baby walker modification, safety glass	Medication packaging, child restraint closures
Environmental modification	Child-friendly infrastructure, safer routes to school, safer play spaces	Barriers such as well coverings and fencing	Separation of cooking area from the living area	Window guards on tall buildings, roof railings, non-climbable banisters	Safe storage of potentially harmful substances
Education and skills development	Helmet wearing, using child restraints	Swimming training and supervision	First aid – “cool the burn”	Supportive home visitation to identify fall hazards	Immediate first aid
Emergency medical care	Child-sized equipment, child-friendly environment	Immediate resuscitation	Burns centers	Appropriate pediatric acute care	Poison control centers

and leisure environment (such as isolation fencing around swimming pools).^[27] Since standards may not always be in place for various products and establishing standards for individual products can be a time-consuming process, a practical approach is to identify specific hazards associated with a product and implement measures and mechanisms to reduce risks. This approach, known as “vertical standards,” has proven to be effective. It is worth noting that the effectiveness of laws is not solely dependent on their introduction, but also on their consistent application and rigorous enforcement.^[61]

- b. **Product modification:** Modifying the design and production of goods with the aim of decreasing the likelihood of injury, limiting exposure to hazards, and minimizing the seriousness of injuries^[49]
- c. **Environmental modification:** To make it more user-friendly, having supportive home visits, promotion of safety devices^[28,29]

- d. **Education and skill development:** Engaging all stakeholders and actively investing in their capacity building through education and skill development with periodic reinforcements will aid effectively underpinning other strategies.
- e. **Emergency medical care:** Providing emergency medical care involves proper situation handling, such as ensuring the victim lies on their back on a flat surface while carefully checking for any obstructions in their neck or windpipe. Scene safety (i.e. patients should be removed from the scene if dangerous like fire, smoke, oil spillage on ground, etc.) is equally important to minimize the injury.

It is crucial to note that public health approaches possess fundamental characteristics such as being focused on populations, employing multidisciplinary strategies, relying on evidence-based practices, promoting collective action, and emphasizing prevention. Public health emphasizes the importance of acquiring

knowledge about effective methods. Sweden recognized the significance of child injury prevention and implemented policies based on the recommendations provided by the World Health Organization (WHO).^[30] This involved establishing safety policies, organizing a national multisectoral safety promotion program, and involving academic institutions in public health policymaking, which was a pioneering effort. Sweden's commitment included factors like reliable surveillance data, research, actions to create safer environments, comprehensive safety education campaigns in collaboration with various agencies, dedicated leadership in addressing safety concerns, and a sense of corporate responsibility.

Also, it is crucial to assess the effectiveness of different approaches. Traditionally, interventions aimed at preventing unintentional injuries have been examined through the lens of the “three E’s,” that is, Education, Enforcement, and Engineering. These interventions are evaluated within the framework of the previously discussed Haddon’s matrix.^[62]

The way forward

A study conducted in LMICs examined effective interventions for the prevention of transportation and home-related injuries. The study determined that various interventions, which included the use of seatbelts in vehicles, bicycle helmets, and motorcycle helmets, implementation of speed limits, installation of pedestrian crossing signs, ensuring proper road lighting, creating physical separation between pedestrians and vehicles, employing measures to enhance visibility (such as using reflective products), promoting the use of basic safety equipment, and implementing packaging measures to prevent poisoning, could be adopted by LMICs.^[31,32]

This set of interventions should be considered to initiate and take the “Campaign against Childhood injuries” forward. This should be a “mass movement.” Scaling it in mass movement helps in community participation and also attracts involvement of nongovernmental organizations (NGOs) along with funding (Viability Gap Funding). Also, in this narrative review, we have tabulated 10 simple and affordable strategies with examples related to prevention of child injuries suitable to Indian community settings [Table 4]. Steps from parents would also help in reducing the childhood injuries as listed in Box 1.

However, there are a few bottlenecks such as insufficient data availability for decision-making, lack of political commitment and understanding, limited capacity at various levels to implement the interventions, and lack of funding.^[49]

Utilizing the Health and Wellness Center model, which emphasizes comprehensive care at the primary healthcare level in India, there’s an opportunity to enhance primary services by integrating key insights from this evidence. This integration can be applied to training guidelines and program components, ultimately contributing to the reduction of unintentional childhood injuries in the country.^[63-65] This paper clearly depicts the importance of strategies to prevent child injury at all levels of health care and also at the level of community. Training of health-care workers to sensitize the community to adopt such preventive measures is equally important as the skill-based training to handle such emergencies.^[66] Such models can be developed, pretested, and adopted for all beneficiaries (child, adult, and elderly) at our primary health center. Emergency and Trauma Care module release by GoI can be considered as a stepping stone to give due weightage to the topic. Numerous trainings of health-care staffs placed at Primary health centre (PHC) have been already rolled out in the last 2 years.^[67-70] All countries have committed to SDGs, and there is attention on noncommunicable diseases. However, unless RTAs and injuries are given attention, this will be an incomplete task.^[66-70]

It is crucial to enhance the capacity of national institutions to conduct research related to injury prevention, develop and implement effective measures that target risk factors and address deficiencies in injury treatment, and evaluate the effectiveness of such interventions. Furthermore, injury control initiatives should be carried out within a framework that acknowledges human rights and considers broader social concerns. Haddon’s matrix can be utilized as a tool to aid decision-making regarding the selection of appropriate countermeasures, considering the various phases, factors, and decision criteria involved.

At the national level, there is need for a multipronged national public awareness campaign similar to Safe Kids Weeks. The most promising interventions for reducing drowning-related fatalities include providing structured swimming lessons for children under the age of 14 and implementing childcare facilities, such as crèches,

Table 4: Description of 10 simple and affordable strategies with examples related to prevention of child injuries

Strategy accessibility	Example related to child injury prevention
Prevent creation of the hazard in the first place	Banning the manufacture and sale of inherently unsafe products
Reduce the amount of energy contained in the hazard	Speed reduction
Prevent release of the hazard	Child-resistant medicine containers
Modify the rate or spatial distribution of the hazard from its source	Use of seat belts and child restraints
Separate people in time or space from the hazard and its release	Bicycle and pedestrian pathways
Separate people from the hazard by interposing a material barrier	Window bars, pools fencing, covering wells
Modify the relevant basic qualities of the hazard	Softer playground surfaces
Make the person more resistant to damage	Good nutrition for children
Counter the damage already done by the hazard	First aid treatment for scalds – “cool the burn”
Stabilize, repair, and rehabilitate the injured person	Burn grafting, reconstructive surgery, and physical therapy

Box 1: Parents' and schools' role in reducing childhood injuries and improving road safety

- Teach road safety to all children. This should be done at multiple opportunities and at the levels of parents, families, communities, and schools
- Always encourage a child to hold hands of parents or caregiver while near vehicles or crossing a road. The importance of such process need to be explained to the child by parents and teachers
- Be a good role model for all aspects related to road safety for the child. These include all situations including wearing a seatbelt, crossing roads safely, and obeying the local traffic regulations
- Schools should teach children how to read traffic signals and road signs. There should be regular classes/sessions on this topic. The importance of footpaths and zebra crossings should be explained, and their use should be actively promoted
- Teach children how to cross roads using the traffic signals
- Observe road safety day/week in schools, colleges, and other settings to raise awareness of road safety issues among children.
- Promote children's engagement in interactive road safety programs facilitated by the traffic police department
- Include school and college students in various road safety activities
- Public health community and health-care professionals should use every opportunity to raise awareness about road safety
- School health programs should give due attention to road safety components

to closely monitor younger children. In many settings such as India, where driving license process is not always authorized, the post-license driver education and retraining can help in reducing the accidents. The targeted approach aimed at high-risk groups such as male gender, and parental supervision and parents having driving licenses should be used as policy interventions.

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Conflicts of interest

MK and CL conceptualised the paper. MK and VKP conducted initial Literature review which was adjudicated by CL. MK, ST and AU wrote the first draft. VVS, VKP and CL revised and edited the draft and contributed to the analysis and discussions. All authors approved the final version.

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SUPPLEMENTARY FILE

Supplementary Table 1: Risk of bias assessment using modified Newcastle-Ottawa scale

Authors of included studies	Selection (Maximum 5 stars)	Comparability (Maximum 2 stars)	Outcome (Maximum 3 stars)	Quality of study
James SL <i>et al.</i> ^[8]	****	*	**	High
Mock C ^[11]	NA	NA	NA	NA
Lee LK <i>et al.</i> ^[49]	***	*	*	Moderate
Mohan D ^[20]	NA	NA	NA	NA
Mock C <i>et al.</i> ^[58]	NA	NA	NA	NA
Zeedyk MS <i>et al.</i> ^[21]	***	*	**	Moderate
Ampofo-Boateng K <i>et al.</i> ^[24]	***	*	*	Moderate
Salter E <i>et al.</i> ^[23]	**	-	*	Low
McAnally HM <i>et al.</i> ^[33]	***	*	**	Moderate
Fatimah M <i>et al.</i> ^[34]	**	-	*	Low
Nantulya WM <i>et al.</i> ^[35]	NA	NA	NA	NA
Runyan CW ^[25]	NA	NA	NA	NA
Dinh-Zarr TB <i>et al.</i> ^[27]	****	*	**	High
Heydari S <i>et al.</i> ^[36]	NA	NA	NA	NA
Macpherson A <i>et al.</i> ^[28]	****	**	***	High
Macarthur C ^[30]	**	*	*	Moderate
Thompson DC <i>et al.</i> ^[62]	****	**	***	High
Bilukha O <i>et al.</i> ^[32]	**	*	***	Moderate
Peek-Asa C ^[14]	NA	NA	NA	NA
Bergman AB <i>et al.</i> ^[16]	NA	NA	NA	NA
Forjuoh SN <i>et al.</i> ^[18]	NA	NA	NA	NA
Vecino-Ortiz AI <i>et al.</i> ^[19]	****	**	***	High
Ker K <i>et al.</i> ^[37]	****	**	***	High
Pless IB ^[54]	NA	NA	NA	NA
Logan P <i>et al.</i> ^[55]	**	-	*	Moderate
Turner C <i>et al.</i> ^[56]	****	**	***	High
McLoughlin E <i>et al.</i> ^[57]	***	*	*	Moderate
Cummins SK <i>et al.</i> ^[42]	NA	NA	NA	NA
McClure R <i>et al.</i> ^[59]	****	**	**	High
Kendrick D <i>et al.</i> ^[65]	****	**	***	High
Makalinao I <i>et al.</i> ^[67]	NA	NA	NA	NA
Nixon J <i>et al.</i> ^[68]	****	**	**	High
Lindqvist K <i>et al.</i> ^[63]	***	**	**	High

Quality of study, Final assessment approach, High quality or low risk, studies with 7 to 10 stars; medium quality or moderate risk, 4 to 6 stars; low quality or high to very high risk, three and less