Injuries as Global Health Risk Factor

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Causes, Burden, and Prevention

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Abstract

Injuries are most commonly categorized as unintentional or intentional, based on the perpetrator's intent or intentionality of the act. Unintentional injuries comprise both transport and nontransport injuries. This chapter examines in detail the risk factors for the leading causes of unintentional injuries, namely, road injuries, falls, drowning, burns, and poisoning. It places injuries in a global context, briefly presents the burden, and then goes on to discuss, in detail, the known risk factors for unintentional injuries in high-, low-, and middle-income countries (LMICs). A consistent theme for every category of cause-specific, unintentional injury is the dearth of reliable evidence from LMICs on risk factors, and thus the challenges informing development of evidence-based interventions, and cost-effective approaches to prevention.

Keywords

Unintentional injuries · Risk factors · Accidents · Road injuries · Drowning · Falls

Introduction

The World Health Organization (WHO) defines injuries as the physical damage caused by an acute transfer of energy – mechanical, thermal, electrical, chemical, or radiation energy – or by the sudden absence of heat or oxygen. It can result in a bodily lesion or impairment of functioning. Overall injuries account for 9% of global disease burden, of which 6% are unintentional and 3% intentional injuries (WHO 2018a). Among unintentional injuries road traffic injuries are the leading cause of death and disability. Globally, 1.35 million people died from road injuries in 2017. Age-standardized incidence rates of road traffic injuries increased between 1990 and 2017, while mortality rates decreased (James et al. 2020).

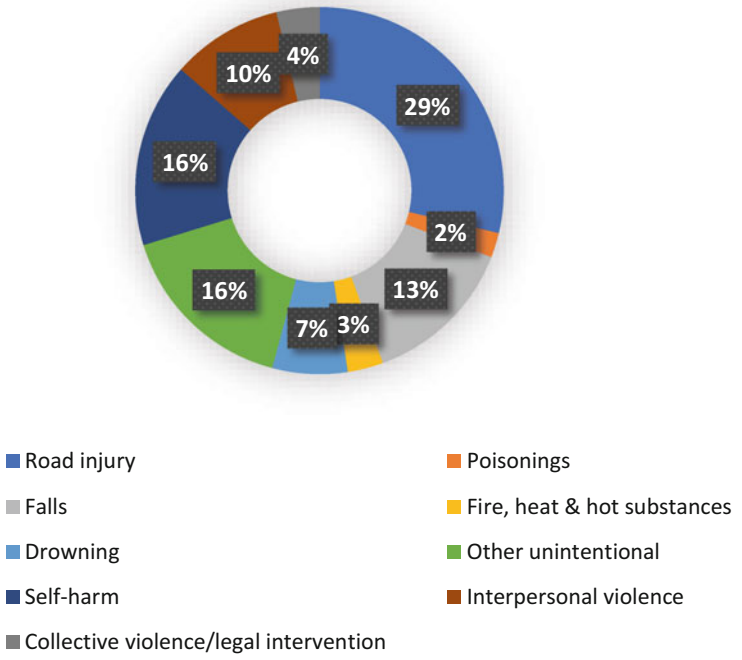

Fig. 1 Causes of injury deaths, world, 2016. (Source: Global Health Estimates 2016 (WHO 2018a))

Table 1 Classification of injuries: by intent/cause

Unintentional injuries	Intentional injuries	War and disasters
Transport Falls Drowning Burns Poisoning Other	Self-harm Interpersonal violence	Exposure to forces of nature Collective violence Legal intervention

Injuries are commonly classified based on "intentionality" (see Fig. 1 and Table 1). Most road traffic injuries, poisoning, falls, fire and burn injuries, and drowning are unintentional.

Overview: Risk Is a Function of Four Elements (Peden et al. 2004)
1.Exposure, for example, to traffic such as travel modes, mixture of motorized and nonmotorized vehicles, land use planning, bodies of water, availability of poisons

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2.The probability of an injury occurring, such as the speed of travel, the toxicity of a substance, the height of a fall, the depth of water
3.The probability of sustaining an injury given an event, for example, the age of the victims, the use of safety equipment, presence of vehicle safety features
4.The outcome following injury – how rapidly a victim is transferred to hospital, whether appropriate prehospital care, hospital, and rehabilitation facilities are available

These risk elements can be furthered to Haddon's matrix of four columns and three rows combines public health concepts of host-agent-environment as targets of change with the concepts of primary, secondary, and tertiary prevention (Runyan 1998).

This chapter focuses on risk factors for unintentional injuries, specifically road injuries, fire, heat and hot substances burns, falls, drowning, and poisoning.

Road Traffic Collisions

Background

Around 1.36 million people lose their lives in road traffic crashes every year and more than 50 million are nonfatally injured (WHO 2018b). Around 93% of fatal collisions occur in low- and middle-income countries (LMICs) despite the fact that these countries only account for 60% of the registered vehicles worldwide (WHO 2018b). Furthermore, more than half of all deaths worldwide are among so-called "vulnerable road users" – those who are not protected by a vehicle, such as pedestrians, cyclists, and motorcyclists.

Road Safety Risk Frameworks

The world report on road traffic injury prevention published by WHO and the World Bank in 2004 promoted a new way of looking at risk factors for collisions and thus interventions – moving away from the paradigm of blaming the road user solely to a more systematic way of understanding risk factors and therefore interventions (Peden et al. 2004). Three approaches are particularly useful – the Haddon Matrix, the Safe Systems Approach, and the Decade of Action for Road Safety "pillars" – all help understand road traffic collision and injury risk factors.

The Haddon Matrix

The Haddon Matrix, developed in the 1960s by Dr William Haddon Jr, a physician who was also director of the National Highway Traffic Safety Administration in the USA (Haddon 1968). Haddon developed a comprehensive framework – combining the traditional epidemiological triad with the timing of the injury – thereby enabling

Table 2 The Haddon Matrix

		Risk factors		
		Human	Vehicle	Environment
Phases	Precrash	Information Attitudes Impairment Police enforcement	Roadworthiness Lighting Braking Speed management	Road design & layout Speed limits Pedestrian facilities
	Crash	Use of restraints Impairment	Occupant restraints Other safety devices Crash-protection design	Crash-protective roadside objects
	Postcrash	First-aid skills Access to medics	Ease of access Fire risk	Rescue facilities Congestion

Source: World report on road traffic injury prevention (Peden et al. 2004)

researchers and practitioners to consider the multitude of risk factors which play a causal role in road traffic injury prevention as outlined in Table 2.

The Safe System Approach

Building on the insights of the Haddon Matrix, the safe systems approach to road safety was developed in Sweden where it is locally known as "Vision Zero." This approach recognizes that humans are fallible and thus promotes a shared responsibility between road users, vehicles, and infrastructure in order to ensure a high level of safety (Kristianssen et al. 2018). The long-term vision of this approach is that there should be no fatal or serious injuries within the transport system.

The Decade of Action for Road Safety Pillars

In 2010, the United Nations General Assembly announced a Decade of Action for Road Safety (2011–2020) through Resolution A/RES/64/255. Launched on 11 May 2011, the Decade encouraged countries around the world to put in place known good practices for road safety based on a Global Plan for the Decade of Action. The Global Plan introduced five "pillars" which combined previous risk frameworks with road safety management, policies, and principals. The resulting five pillars, viz. road safety management, safer roads, safer vehicles, safer road users, and postcrash response were accompanied by a set of indicators. These were refined and negotiated resulting in a set of 12 global performance targets (and their related indicators) which were endorsed by United Nations Member States in 2018.

Risk Factors

A risk factor is any attribute, characteristic, or exposure that increases the likelihood of developing a disease or injury. In terms of road safety, according to the World

report on road traffic injury prevention (Peden et al. 2004), risk is a function of four interacting elements as outlined in the introduction. Risk is influenced by human error, the kinetic energy transferred, tolerance of the human body, and the quality and availability of emergency services, and follow-up care and rehabilitation. Risk factors may be nonmodifiable (sometimes also referred to as intrinsic) or modifiable (sometimes referred to as extrinsic). Examples of intrinsic risk factors include age and sex, while socioeconomic status, behavior, infrastructure, or vehicle factors are extrinsic risk factors.

Age and Gender

Currently road traffic injuries are the leading cause of death for children and young adults aged 5–29 years (see Box 1). Adolescents in particular appear to be a particularly vulnerable group who have very high rates of road traffic injuries and deaths across the world (Sheehan et al. 2017). However, over the next two to three decades, as countries demographic profiles change, there are likely to be greater numbers of people over the age of 65 years exposed to traffic risks, especially in high-income countries. Elderly road traffic collision victims have an increased risk of severe and fatal injuries because of their increased frailty and comorbidities. Furthermore, they can also put their passengers and other drivers at risk (Lee et al. 2006). Road traffic mortality rates are higher in men than in women in all regions of the world regardless of income level, and also across all age groups. This may reflect the fact that males are more likely to be on the roads, often because of sociocultural reasons, as well as a greater propensity to take risks, compared to females.

Box 1 Getting To and From School: A Significant Risk Factor for Children Across the World

Road traffic crashes are one of the leading causes of death for children aged 5–14 years in most low- and middle-income countries. A number of

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Box 1 (continued)
developmental factors place children at greater risk of road traffic crashes than adults. These limitations include:

- Size: child pedestrians and cyclists may be hard to see by drivers and other road users because of their small stature.
- Vision: a child's depth perception is not as acute as an adult's and thus they have difficulty judging distance.
- Hearing: a child has difficulty discerning the direction of sound as well as judging the size of a vehicle and speed it is travelling at from the sound it emanates.
- Attention: a child has a short attention span and can be easily distracted which may lead, for example, to them running out into a road.
- Judgment: a child's ability to judge left from right only develops at around age 7 years. In addition, they have difficulty judging speed and distance and thus crossing a road alone is particularly risky.

Getting to and from school is a significant danger for children both those travelling inside a vehicle and those walking or cycling. A study in Tanzania, for example, showed that 73% of child road injuries and deaths in Dar es Salaam occurred while children were either on their way to or from school (Museru et al. 2002). A study in Vietnam recently identified the following risks for children on their way to and from school (Sidik et al. 2019).

Road user	Potential risks
As a passenger	Lack of use of appropriate child restraint or seat-belt Not getting out the vehicle at the curb-side Vehicle stopping far away from school requiring child to cross a busy road Distracting the driver
As a pedestrian	Lack of supervision when walking Lack of safe crossings (zebra crossings, traffic lights) Poor infrastructure (no or inadequate sidewalks, lack of street lighting, no traffic calming) Speeding vehicles
As a cyclist	Not wearing a helmet or wearing it incorrectly Not understanding the rules of the road (lack of training)

Socio-economic Status

More than 90% of road traffic deaths occur in low- and middle-income countries (WHO 2018b). Road traffic injury death rates are highest in the African region (Table 3). Even within high-income countries, people from lower socioeconomic backgrounds are more likely to be involved in road traffic crashes.

Table 3 Road traffic deaths worldwide in 2017

Global population (billions)	7.3
Global total registered vehicle fleet (billion)	2.0
Deaths	
Estimated number of road traffic deaths (millions)	1.35
Death rates per 100,000 population	
Globally	18.2
African region	26.6
Region of the Americas	15.6
Eastern Mediterranean region	18.0
European region	9.3
South-east Asia region	20.7
Western Pacific region	16.9
Proportion of deaths among vulnerable road users (%)	54

Source: Global status report on road safety (WHO 2018b)

Risk-Taking Behavior

Behaviors such as speeding and alcohol consumption significantly influence the risk of a crash, while the nonuse of protective equipment such as seat-belts, child restraints, and helmets influences the probability of sustaining a severe injury given a crash. Evidence from around the world shows the following:

- **Speed** is a leading causal factor in road traffic crashes, injuries, and deaths. An increase in average speed is directly related both to the likelihood of a crash occurring and to the severity of the consequences. For example, every 1% increase in mean speed produces a 4% increase in the fatal crash risk and a 3% increase in the serious crash risk (European Conference of Ministers of Transport 2006; WHO 2017b).
- **Alcohol** has long been known to be associated with an increased risk of road traffic crashes. In the early 1970s the risk of a road traffic crash was shown to increase exponentially after a Blood Alcohol Concentration level of 0.05 g/dl had been reached (Borkenstein et al. 1974). Alcohol coupled with inexperience increases the risk for young drivers by up to 2.5 times when compared with an adult. Likewise, alcohol coupled with speeding or other drugs also increases the risk of a crash and is reported by alarmingly high numbers of young drivers (Scott-Parker et al. 2014).
- The risk of crash involvement as a result of the use of **psychoactive drugs** is dependent on the drug taken. For instance, amphetamine use increases crash risk by about five times (WHO 2016).
- Failure to use **seat belts and child restraints** is also a significant risk factor associated with injury severity in vehicle occupants, especially in many LMICs that lack requirement for these to be used by all occupants (Peden et al. 2004). Wearing a seat-belt reduces the risk of death among drivers and front seat occupants by up to 50%, and the risk of death and serious injuries among rear seat occupants by 25%. The use of child restraints can lead to a 60% reduction in child deaths (Toroyan and Peden 2007).

- A significant risk factor for increased injury severity among motorized two-wheeler users is nonuse or inappropriate use of **motorcycle helmets**. Correct helmet usage can lead to a 42% reduction in the risk of fatal injuries and a 69% reduction in the risk of head injuries (Liu et al. 2008).
- Varying levels of risk have been shown with behaviors such as driving while fatigued, using a handheld mobile phone and walking or cycling in poor visibility (Peden et al. 2004).

Inadequate Law Enforcement

Road safety laws are very useful tools to encourage positive behaviors. Sadly many countries still do not have laws on drink-driving, seat-belt wearing, speed limits, helmet usage, and child restraints or they are not properly enforced (WHO 2018b). If traffic laws are not enforced or are perceived by the public as not being well enforced, then they will have very little chance of influencing behavior.

Vehicle-Related Risk Factors

The exponential increase in vehicles around the world is, without a doubt, one of the main contributing factors to the increase in road traffic collisions, injuries, and deaths particularly in middle-income countries. As economies grow, so too does the number of vehicles – with the number of vehicles in circulation surpassing 2 billion in 2018 (WHO 2018b). Unfortunately, not all vehicles made, assembled, and sold in developing countries adhere to strict safety standards such as the United Nations World Harmonization of Vehicle Standards and thus there has been a proliferation of substandard vehicles – 2-wheelers, 3-wheelers, and 4-wheelers with concurrent increases in the risk of collisions. Implementation of these standards could save many lives (Bhalla and Gleason 2020).

Furthermore, the growth in powered 2-wheelers – not only in LMICs, but also seen in high income countries (HICs) – is a worrying trend as they afford little protection to the rider in the event of a collision, particularly when they are involved in collisions with much heavier, faster vehicles.

Infrastructure

Poorly designed and maintained road networks exposure all road users to unnecessary risks. However, there are many countries which lack basic safe infrastructure such as sidewalks, bicycle lanes, safety barriers, and paved shoulders putting vulnerable road users at very high risk of collision with a fast moving or heavy vehicles (WHO 2017b).

In addition, roadside hazards, such as trees, poles, and road signs, may contribute to between 18% and 42% of road crash fatalities (Peden et al. 2004).

Trauma Care

The lack of access to good quality prehospital, in-hospital care and rehabilitation has a major influence on the outcomes for patients who have sustained injuries in a collision. There are clear differences between LMICs and HICs in the proportions of injured individuals who die before reaching a hospital, in large part reflecting the limited access to prehospital medical services in LMICs. Furthermore, factors that determine survival and outcome include early availability of care, the time interval between the injury and the patient's arrival at a definitive-care hospital, referral based on triage, and availability of physical and human resources and appropriate treatment and rehabilitation. Thousands of lives could be saved through improvements in prehospital care alone in LMICs (Mock et al. 2012).

Conclusions

Understanding risk factors is the key to the prevention of road traffic crashes, injuries, and deaths. Implementing primary prevention strategies – which aims to prevent a collision or injury before it happens – by better planning of cities and roads, reducing exposure to risks through sustainable transportation, altering unsafe behaviors, and improving crash avoidance of vehicles and designing roads that minimize interaction between vulnerable road users and high-speed vehicles should be the basis of all road safety programs. Secondary prevention strategies which aim to minimize damage to humans in the event of a collision and tertiary prevention strategies which reduce the sequelae once a collision has resulted in an injury should back up the upstream prevention programs.

Falls

A fall is often defined as "inadvertently coming to rest on the ground, floor, or other lower level, excluding intentional change in position to rest in furniture, wall, or other objects." They are broadly classified as same level, upper level, and other unspecified fall. Globally falls are a significant cause of fatal and nonfatal injury second only in magnitude to road traffic injuries. Of the 646,000 fall-related deaths that occur each year, over 80% take place in LMICs (WHO 2018a). Approximately 37 million falls require medical attention each year, with injuries ranging from minor lacerations and fractures to serious head injuries, in total amounting to more than 17 million DALYs lost worldwide. In lower resource settings, a serious fall can have devastating consequences not just for the individual's health but also for whole family both financially and socially.

The likelihood of having a fall is not equal among all population groups, children and adolescents, individuals working in certain occupational settings, individuals in hospital or in residential care, and community dwelling adults aged 65 years and above are at higher risk of experiencing a fall. Intrinsic and extrinsic factors interplay to influence both the risk (see Table 4) and severity of fall injuries. Variables such as

Table 4 Haddon Matrix applied to the risk factors for childhood falls[a]

Phases	Factors			
	Child	Agent	Physical environment	Socioeconomic environment
Preevent	Age; gender; level of activity; preexisting disability	Unsafe product or equipment; unprotected rooftop, balcony, or staircase; tree	Lack of access to safe play spaces and opportunities; lack of preventives measures such as stair gates and guard rails	Poverty; single-parent family; family size; maternal education; awareness of fall risks among caregivers, childcare providers and educators
Event	Size and physical development of child	Lack of protective equipment or barriers that reduce the severity of an injury in the event of a fall	Height of fall, type of surface onto which surface falls; lack of impact-absorbing surfaces	Lack of awareness of potentially serious injuries associated with falls, e.g., concussion and brain injury
Postevent	Child's general health; disability; postinjury complications	Sharp objects and other hazards that increase risk of cuts and infections	Lack of adequate prehospital care, acute care, or rehabilitation	Lack of first aid skills; lack of access to health care; lack of resources to manage postinjury outcomes

[a]Adapted from WHO Child Injury report (Peden et al. 2008)

the height of the fall and the properties of the surface that the individual lands on will affect the likelihood of head injury, hospitalization, and death.

Falls in Children

Higher rates of falls in children can be attributed largely to their evolving developmental abilities (mental and physical), their curiosity, and their "risk taking" behaviors. Childhood falls in both high- and low-income settings are commonly attributed to inadequate adult supervision; however, in many cases there is complex interplay of contributory factors such as poverty, sole parenthood, and unsafe environments which undermine parenting abilities and shape the risk of child injury.

Key risk factors for falls of children in HICs include male gender, age under 6 years, disability, and low socioeconomic status. Specific higher environmental risks exist for some children in HICs, for example, those living on farms. The circumstances for common childhood falls in HICs include incidents on playgrounds, on pedestrian conveyances, on bunk beds and equipment, such as baby change tables or baby walkers, being dropped by a carer, or falling from windows (Harris et al. 2011; Khambalia et al. 2006). A retrospective analysis of pediatric hospital data from the

USA found a seasonal variation in risk of fall injury from a window increasing in spring and summer months, as well as both a higher rate and severity of fall injury from children under four compared with children aged 5–17 years (Harris et al. 2011). A distinction was also made between falls from windows that were accidental compared with those that involved "risky behavior" such as jumping, the former more likely to sustain injuries to the head and have worse outcomes.

The risk factors for falls in LMICs are less well understood due to the limited quantity and mostly hospital-based data available, but appear to be similar to those in HICs. An analysis of hospital records in Bangladesh, Colombia, Egypt, and Pakistan pediatric falls frequently occurred in and around the home or while playing, often falling from ladders or stairs (23%), or beds or other furniture (19%) (Hyder et al. 2009) and from animals. More falls occur in boys under 5 years of age and in rural locations. Falls were the most common injury reported by children in the longitudinal Young Lives Study, the prevalence of a serious fall was 7.1% in Ethiopia, 10.6% in India, 5.6% in Vietnam, and 7.1% in Peru (Howe et al. 2006). Caregivers with probable "common mental disorders" were consistently associated with an increased risk of a childhood injury (by almost two-fold); however, it is not appropriate to conclude that it is causative from this study, better understanding of carer characteristics for child injury prevention is needed.

Country specific factors include children young people sustaining fall related injuries from trees in places with productive tree crops (coconut, mango, nut) such as the Pacific and Solomon Islands (Mulford et al. 2001). Other environmental factors including inappropriate building design features, poorly maintained buildings and poor lighting, as well as child labor practices also pose significant risks for falls in LMICs. By adolescence most participants in the Young Lives Study were engaged in paid and/or unpaid work, and falls were a commonly cited work injury in all four countries with poverty and rural residence increasing the risk (Howe et al. 2006).

The burden of injury weighs heavily upon LMICs accounting for 95% of adolescent fatal injuries globally. In part, this can be attributed to the dangerous physical environments; however, cultural factors such as competing priorities/concerns, fatalistic attitudes, and country or region specific differences (as highlighted in the Young Lives Study) are likely also relevant and warrant further research to inform prevention efforts (Howe et al. 2006). Among adolescents in some Pacific, South-east Asian, and Sub-Saharan African countries, literature suggests an association with psychosocial correlates including mental health status, substance use and experience of bullying, hunger, loneliness, and a higher likelihood of injuries, particularly from falls (Peltzer 2008; Peltzer and Pengpid 2012).

Falls in People of Working Age

Research to examine risk factors for falls in people of working age in HICs is scarce; however, data from four population based cohort studies in Ireland, Australia, Great Britain, and the Netherlands found the prevalence of falls increased for women from 8.7% at 40 years to 29.9% by 60 years with the prevalence for men remaining fairly constant at around 15% (Peeters et al. 2018).

Studies of falls in the home have highlighted the role of alcohol as well as structural or environmental hazards such as stairs, ladders, poor lighting, etc. Some recent studies also describe alcohol consumption risk in LMICs and the lack of public health policies to address this, indicating that the role of acute alcohol use in falls in working adults requires investigation through surveillance of fall injuries and development of interventions to prevent alcohol related falls (Kool et al. 2009). Falls in people of working age in LMICs are reported more commonly for men, including those on farms. In China, for example, mortality from falls was highest among males from rural areas, with falls from a building or from level to another the main mechanism of injury for this age group (Cheng et al. 2019). Falls related to the construction industry are also reported in the literature. The large proportion of unorganized labor sector with no regulatory authorities or poor enforcement of regulations makes occupational falls a major challenge in the context of LMICs. The data on magnitude is scarce and socio-economic burden associated with falls is high in the age group, as it is for road traffic injuries.

Falls in Older People

Same level falls are most common among older populations. Many falls in the older populations are probably multifactorial, resulting from the convergence of several intrinsic, pharmacologic, environmental, behavioral, and activity-related factors. However, knowledge regarding the etiologic mechanisms of these risk factors and how they combine to lead falls remains limited. Perhaps even more limited is an understanding of situational and environmental factors that precipitate a fall in persons with predisposing characteristics. Situational and environmental factors may be among the most important determinants of risk in healthy older persons (see Box 2).

Box 2 Case Study Falls Among the Elderly in Brazil

Brazil is the largest country in South America, with an estimated population of over 211 million in 2019. Nearly 9% of the population are over the age of

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65 years, 57% of whom are female. The prevalence of falls among the elderly in Brazil is high – a recent survey across 23 states found a prevalence of 27.6% (95 CI 26.5–28.7) (Siqueira et al. 2011). A study in the city of Campinas, Sao Paulo, found the following risk factors for falls after adjusting for age and sex (Rodrigues et al. 2014):

- Being female (Prevalence Rate [PR] = 2.39; 95%CI 1.47–3.87)
- 80 years old and older (PR = 2.50; 95%CI 1.61–3.88)
- Widowed (PR = 1.74; 95%CI 1.04–2.89)
- Elderly adult with rheumatism/arthritis/arthrosis (PR = 1.58; 95%CI 1.00–2.48) Osteoporosis (PR = 1.71; 95%CI 1.18–2.49)
- Comorbidities such as asthma/bronchitis/emphysema (PR = 1,73; 95%CI 1.09–2.74)
- A mental health disorder (PR = 1.72; 95%CI 1.12–2.64)
- Dizziness (PR = 2.82; 95%CI 1.98–4.02)
- Insomnia (PR = 1.75; 95%CI 1.16–2.65)
- Taking multiple medications (five or more) (PR = 2.50; 95%CI 1.12–5.56)
- Use of cane/walker (PR = 2.16; 95%CI 1.19–3.93)

These findings are quite typical of falls among the elderly and call for interventions such as screening living facilities for fall risks; reviewing medications, treating low blood pressure, providing vitamin D supplementation, and treating visual problems; prescribing appropriate assistive devices; encouraging muscle strengthening and balance programs and using hip protectors for those at risk of a fracture due to a fall.

Falls risk factors are often described as intrinsic and extrinsic. Risk factors for falls in older people include impaired balance and gait, polypharmacy, vitamin D deficiency, dehydration, history of previous falls, advancing age, female gender, visual impairments, cognitive decline, and environmental factors (Stewart Williams et al. 2015).

Risk factors for falls in clinical settings such as nursing homes and hospitals in high income settings have considered both intrinsic and extrinsic factors (see Table 5). Intrinsic factors include age, gender, and underlying conditions, as well as cognitive impairment, visual impairment, previous history of falls, continence problems, postural instability, and syncope problems. Falls from beds as well as other environmental (extrinsic) risk factors related to flooring, lighting, furniture, and fittings such as hand holds are also associated risks.

Risk factors in LMICs are less known, but available research shows they are largely similar to those in HICs: age, female gender, previous falls, mobility problems, declining vision, medication use, unsafe environments, and chronic health problems. Depression, sleeping problems, and having two or more chronic conditions were also found to be significant risk factors for falls in the past year in the recent SAGE study in LMICs (Hestekin et al. 2013).

Table 5 Intrinsic and extrinsic risk factors for falls

Intrinsic factors	Extrinsic factors
Advanced age Previous falls Muscle weakness Gait & balance problems Poor vision Polypharmacy and psychotropic medications Postural hypotension Chronic conditions including arthritis, stroke, incontinence, diabetes, Parkinson's, dementia Fear of falling	Lack of stair handrails Poor stair design Lack of bathroom grab bars Dim lighting or glare Obstacles and tripping hazards Slippery or uneven surfaces Improper use of assistive Device

In India, people living in slums and in rural areas are at higher risk of falls likely due to the intersection of multiple risk factors including poorer health and more dangerous environments (Tripathy et al. 2015). The nature of the environmental risks differs in LMICs, with more falls resulting from factors relating to street and house design, transport, violence, and rural locations. Often, access to water is limited only to locations outside of the home. Data from China suggests that the sex differences for risk of falls in this age group are reduced, with slipping, tripping, or stumbling on the same level the major cause. The risk factors for fall-related injuries, including osteoporotic fractures, may differ across settings due to variations in diet and in load-bearing exercise.

Fire, Heat, and Hot Substances Burns

Burns are a global public health problem, accounting for an estimated 180,000 deaths annually, burns mortality rate of 3.6/100,000 population (WHO 2018c). A burn is an injury to the skin or other organic tissue primarily caused by heat or due to radiation, radioactivity, electricity, friction, or contact with chemicals. Burn or thermal injuries are a cause of major injury, disability, and death globally, 95% occurring in LMICs, 57% in South East Asia, followed by the Eastern Mediterranean (6.4 deaths per 100,000 population per year) and Africa (6.1 deaths per 100,000 population per year).

In HICs, burn death rates have been decreasing. HICs have the lowest burn fatality rates in the world up to 11 times lower (0.4/100,000) than LMICs (4.3/100,000), that is, over 95% of global burns mortality in in LMICs (WHO 2018a). This is one of the largest discrepancies for any injury mechanism. Further, the risk of burn injury within countries is not equal among their residents.

Fire-related mortality rates are especially high in South-East Asia (11.6 deaths per 100,000 population per year). Differences in burn mortality rates vary across different age groups and between the sexes. Burns is also the only cause of unintentional injury with higher incidence and mortality among women, as compared to men. Nonfatal burns are a leading cause of morbidity, including

prolonged hospitalization, disfigurement, and disability, often with resulting stigma and rejection.

Risk factors for burns are multivariate and interrelated. These include socioeconomic status, race and ethnicity, age, and gender, as well as those factors pertaining to region of residence, intent of injury, and comorbidity. All risk factors combine and overlap, exponentially exacerbating the risk.

Age

Fire-related burns are the sixth leading cause of death among 5- to 14-year-olds and the eighth leading cause death among 15- to 29-year-olds from LMICs. In South Asia, specifically in India the 18–35 age group is the most at risk of burn injuries, the ratio of female to male burn deaths in this group was not balanced with a ratio of 3:1 (Peck 2011). This age risk groups reflects the cultural and gendered distribution of cooking, household, and paid work with younger children and elderly less exposed, but it also contains the age group most at risk for dowry and interpersonal domestic violence. Childhood burns are predominantly caused by accidents resulting from lack of supervision; however, maltreatment also contributes to childhood burn incidents. In sub- Saharan Africa, children aged 10 years and below represented over 80% of the burn incidence. It was also reported that almost always the parent and carer is nearby at the time of the burn event (Nthumba 2016). Firework related burns are also responsible for many burns injuries and deaths in children and teenagers at cultural events.

In Australia the 25–44-year age group was the most represented, accounting for 30% of hospital admissions, followed by children under 10 (22%) (Goltsman et al. 2016). A systematic review reports that children accounted for 40–50% of severe burn injuries in Europe (Smolle et al. 2017). In Australia the majority (63%) of childhood burn injuries were in children under 3 years old, similarly in Europe they reported between 50% and 80% of childhood burns occurring under age five. The next highest risk age group in children was 15- to 19-year-olds. Across most HICs a similar pattern is found with approximately halve of the burns occurring in children. Only between 10% and 16% of severe burn cases in the European populations were in the elderly (Smolle et al. 2017).

Poverty, low literacy rates of parents, and living in overcrowded or poor-quality accommodation increase children's risk of burn injury. Risk factors for childhood burn injuries include a lack of supervision at time of injury, families who are already known to social services and a history of siblings with previous burn injuries. The death rates (for exposure to fire, smoke or flame) of children whose parents were unemployed or had never worked were 37.7 times higher than those whose parents had higher managerial jobs (from UK census data) (Edwards et al. 2006; Kemp et al. 2011). Different ages are exposed to different risks and teenage boys are at risk of injury or death from fireworks. Regulations on housing quality, safe equipment, childproof lighters, fireworks, and flammable clothing and household materials also attenuate risk of childhood burns.

Gender

Burns are the only type of unintentional injury that affect women (4.9/100,000 fire related deaths) more than men worldwide (3/100,000) (WHO 2018c). According to WHO, globally slightly more women are injured by burns than men, associated in part with gendered domestic jobs (cooking) but also interpersonal violence (Box 3). In India 65% of the 141,000 burn deaths annually were women. Consistent with global findings a systematic review from Nepal found more women are injured in the house and more men in the workplace, reflecting the gendered nature of domestic and paid work in many countries. Traditional gendered clothing also contributes to burns risk, in South Asia, for example, loose fitting saris and dupatta pose risks when working in unsafe home kitchen environments.

In Australia, boys represented 58% of burn injuries with variation among specific age groups, and in Europe boys accounted for 60–65% (Steinvall et al. 2011; Toppi 2017). By adulthood there is agreement that men have a higher risk of burn injury. One Australian review found that 75% burn patients were male. The type of burn injury varies between sexes, more men than women suffered flame and electrical burns (58% of 792 men and 46% of 327 women) and (6% of 792 men and 2% of 327 women), respectively (Bhate-Deosthali and Lingam 2016). Women were more likely to have scald burns (23% of 792 men and 39% of 327 women), the differences attributable to the gendered nature of domestic and paid work. As older adults the gender differences in risk of burns changes, in Europe they found elderly women overrepresented with for burn injuries.

Other Factors

Lack of basic safety education surrounding injury prevention and lower household literacy rates both increase risk for burn injury. Other risk factors include underlying medical conditions such as epilepsy, cognitive and physical impairments, as well as use of alcohol, drugs, and cigarettes. An Australian review found a quarter of patients were affected by drugs or alcohol at the time of the incident (Gielen et al. 2012).

Higher rates of childhood burns can be seen in winter in colder climates and peaks have been recorded during public or religious holidays. Festivals such as Diwali lead to increased incidence of burn injuries from unsafe and unsupervised use of firecrackers. In Asian countries such as Sri Lanka, bamboo cannons are a traditional firecracker used at cultural celebrations (Karunadasa and Perera 2010); in Malaysia, they have been made illegal due to safety concerns.

Physical Environment

Most burns are a result of a fire in the home, commonly associated with leisure, food preparation, self-harm, and work. Approximately 30% of burns in adults occurred at work. In children scalds are the most frequent burn injury (60–75% of hospitalizations); in adults, flames, scalds, and contact burns were most frequent (Peck 2011).

The majority of burns in HICs occurred in the kitchen or bathroom and predominantly are reported to be accidental.

Majority (80–90%) of burns occur at homes. Homes with less separation between cooking and living areas place their occupants at more risk, single room dwellings accounting for the highest proportion of burn injuries. Lack of controlled water temperature can cause scald injuries and a paucity of (working) smoke alarms also contribute to an increased risk of burn injury compared with HICs.

Heating, lighting, or cooking equipment at ground level as well as storing fuels in the home and cooking on open fires pose burns risks to children and account in part for the higher rates in LMIC's. Gas leaks from LPG stoves burn injuries. Flame injuries commonly resulted from the malfunctioning of cheap kerosene stoves with no safety features which accounted for approximately half the kerosene burns the other half were deemed "stove mishaps." Design of equipment and safety features varies between countries; Sri Lanka, for example, has trialed designs of safer stoves to reduce risk of burn injury. Burning kerosene also produces air pollution which the WHO estimates contributes to 4.3 million deaths worldwide affecting disproportionately women, children, and the poor (WHO 2018a).

Box 3 Gendered Patterns of Burns: A Case Study from India

India has one of the largest burdens of burns with an estimated seven million burn injuries per year, a mortality rate of over 8.3/100,000 population, disfigurement and permanent disability in 250,000 people annually, and five million disability-adjusted life years. Burn deaths among women in India are reported to be higher than maternal deaths. The ratio of fire-related deaths of young (15- to 34 years) women to young men is 3:1 (Sanghavi et al. 2009).

Nearly 80% of the Indian household own liquid petroleum gas (LPG) stoves. However, it is reported that despite ownership of safe fuels, solid fuels, and kerosene oil stoves are preferred. Most commonly reported cause of burn incident is kerosene stove burst while cooking.

The high risk of burn injuries among women arises from increased exposure through use of kerosene during cooking, suicides, and homicides

(continued)

Box 3 (continued)
associated with domestic violence. Women's rights groups and health researchers have long advocated to address the underlying causes of burns: "busting the kitchen accident myth" and understanding the role of domestic and "dowry" related violence (Bhate-Deosthali and Lingam 2016).

India is largely a patriarchal society and has a highly skewed sex ratio resulting from over half a million female feticides each year and health inequities across the lifespan. Differential exposure and access to treatment, and consequent poorer outcomes, exacerbate the burden of burns among women. Burns survivors are also financially distressed, vocationally challenged, and socially excluded.

Conclusions

Risk factors for burn injury differ according to region, but typically include alcohol and smoking, use of open fires for space heating, use of ground level stoves for cooking, the wearing of long, loose-fitting clothing while cooking, high set temperature in hot water heaters, and substandard electrical wiring. Many of these risk factors are eminently amenable to prevention efforts.

Drowning

Drowning is defined as the process of experiencing respiratory impairment from submersion/immersion in liquid, with drowning outcomes classified as death, morbidity, and no morbidity. Fatal drowning is estimated to be 320,000 drowning deaths per annum globally. Majority (91%) of global drowning deaths occur in low- and middle-income countries. Drowning disproportionately impacts LMICs. More than half of all drownings occurred in the Southeast Asia and Western Pacific regions of WHO, and drowning rates in LMICs are more than three times higher than those in high-income countries. Unintentional drowning is preventable and is linked to exposure to water.

The International Life Saving Federation World Drowning Report (International Life Saving Federation 2007) classifies drowning risk factors as human and environmental factors.

Human Factors

Sociodemographic factors, socioeconomic conditions, behavioral factors, and medical conditions have all been postulated or shown to be risk factors for drowning. Higher rates among men and boys purportedly result from their increased exposure to water and riskier behaviors. Children under age five years have the highest

drowning mortality rates worldwide, and children aged 1–2 years are at the highest risk (Box 4). Globally, the highest drowning rates are among children 1–4 years, followed by children 5–9 years. In the WHO Western Pacific Region children aged 5–14 years die more frequently from drowning than any other cause. In China, drowning is reported to be the leading cause of death among children aged 1–14 years (Franklin et al. 2020). In Bangladesh, 43% of deaths in children aged 1–4 years are caused by drowning (WHO 2014). Vietnam reports drowning rates to be twice among 0- to 4-year-old children than in other age groups. In Australia, most child deaths by drowning occurred in children aged 0–4 years (Royal Life Saving – Australia 2019). Drowning is also a major contributor to child morbidity from nonfatal drownings, particularly in boys.

Deaths in this age group frequently occur as a result of children's inherent vulnerability – the inability to keep their airway clear of water – combined with a lapse in adult supervision. Individuals with lower education levels are at increased risk of drowning; across all regions and countries, lower socioeconomic groups are more vulnerable to drowning than higher socioeconomic groups. Higher rates of child drowning are associated with lower educational attainment for mothers and a larger number of siblings (Rahman et al. 2019). The absence of, or a lapse in, adult supervision has been shown to be an important, potentially modifiable risk factor for drowning incidents in children (World Health Organization 2017a; b). For children above 6 years and adults with few swimming skills or those who have not received swimming lessons have been shown to be at increased risk (WHO 2017a; Yang et al. 2007).

Alcohol consumption is one of the most frequently reported contributory factors associated with adolescent and adult drowning (Peden et al. 2017). Some medical conditions such as epilepsy, which are often poorly controlled in LMICs, also place individuals at increased risk (Bell et al. 2008). The leading contributory medical condition in HICs is reported to be cardiovascular disease, followed by dementia, depression, epilepsy, and Parkinson disease (Mahony et al. 2017). Drowning rates are also disproportionately high among minority populations in places where overall drowning rates are low, including in HICs (WHO 2014).

Box 4 Case Study Reducing Child Mortality Through Drowning Prevention

(continued)

Box 4 (continued)

The world made remarkable progress in child survival in the past few decades, and millions of children have better survival chances than in 1990–1995; 1 in 26 children died before reaching age five in 2018, compared to 1 in 11 in 1990. Moreover, progress in reducing child mortality has been accelerated in the 2000–2018 period compared with the 1990s, with the annual rate of reduction in the global under-five mortality rate increasing from 2.0 per cent in 1990–2000 to 3.8 per cent in 2000–2018 (WHO 2018d).

Drowning had been recognized as a serious impediment to achieving Millennium Development Goal 4 of a two-thirds reduction in child mortality and continues to be an ongoing challenge in achieving Sustainable Development Goal 3.2 to end all preventable deaths in under 5 years.

For several communities across South East Asia and Western Pacific region, ponds near houses are used for daily chores. Factors for all childhood drowning deaths reported in Bangladesh, Cambodia, Thailand, Vietnam, and India included (Linnan et al. 2012):

- Under 5 years is a high-risk group followed by 6–10 years. Children aged 1–2 years at highest risk across LMIC and HIC. More boys than girls drown, especially after age five.
- Most child drownings occur in rural areas, majority within 100 meters from house, 50% of these are in ponds.
- For children under 5, drowning contributes to nearly 20 of all-cause mortality.
- Most drownings occur between 8:00 am and 4 pm. Most of the time children are without supervision or being supervised by another child.

Environmental Factors

Children who live near open water sources are particularly at risk and often associated with rurality in LMICs (WHO 2014). People who work on or near water, travel on water, or use surface water or open wells for household water are all likely to face increased risk of unintentional immersion in a water hazard (Jagnoor et al. 2019a, b). Poor regulation of water transport leading to overcrowding, inadequate on-board safety equipment, and poor vessel maintenance may also contribute to drowning events, in addition to limited rescues and response mechanisms (Jagnoor et al. 2019a, b). In HICs child drowning is associated with backyard pool drowning, and pool fencing has been one of the effective interventions for drowning prevention (Franklin and Peden 2017).

Similarly, those who live in settings susceptible to flash floods, river flooding, storm surges, or tsunamis are at increased risk of drowning in all countries regardless of income level (Ashley et al. Ashley and Ashley 2008; Jagnoor et al. 2019a, b; Ohl and

Tapsell 2000). Climate change will increase the frequency and severity of water related disaster and likely to increase burden associated with drowning (WHO 2014). Similarly, sub-Saharan Africa some communities living along the rivers, lakes, and fishing communities are found to be at higher risk (Kobusingye et al. 2017).

The growing refugee crisis fueled by both poor economic conditions in much of the developing world and unwelcoming refugee policy in the developed world is also likely to increase drowning events. Refugees increasingly attempt risky water crossings to reach safety (Hatton 2016).

Conclusions

There has been significant progress in developing intervention for child drowning prevention in LMICs, a risk population. The burden of drowning has been observed to reduce, primarily attributed to some upstream factors such as access to safe water, safe transportation, and disaster risk reduction action. However, there is lack of evidence on the role and the intersections between drowning burden and developmental advancement.

Exposure and risk continue to be high in certain regions, age groups, and occupation. Better understanding of risk and evidence-based interventions can help accelerate drowning prevention.

Poisoning

Background

According to WHO there were 106,683 poisoning deaths in 2016. More than 90% of these occur in low- and middle-income countries (WHO 2018a). Furthermore, according to the Global Burden on Disease, there were 3,789,169 DALYs as a result of all poisoning. The majority of poisoning victims are men and boys (61%) with the highest rates found among those under the age of five years or over the age of 50 years.

Poisoning may be intentional – such as carbon monoxide poisoning or organophosphates poisoning – or unintentional from substances ranging from food to drugs, household products, alcohol to snake or scorpion bites. Sometimes the intentionality is blurred – for example, the USA has seen a recent upsurge in the incidence of opioid-related drug overdoses (see Box 5), some of which might be intentional, but most are probably the unintended consequence of addiction. The risk factors for poisoning are thus closely linked to intentionality and other factors such as age and development.

Risk Factors

The extended Haddon matrix (including both physical and socioeconomic environmental factor) is a useful framework to use to look at the risk factors for poisoning

Table 6 Risk factors for poisoning

		Risk factors			
		Human	Agent	Physical environment	Socioeconomic environment
Phases	**Preevent**	Age and developmental factors, gender, supervision	Ease of opening package, attractiveness of substance, inadequate labeling, poor storage	Cupboards in easy reach of children, unlocked cabinets, exposure to agents, availability	Lack regulations and standards for toxic products and packaging, lack of awareness of toxicity, poverty
	Event	Secrecy about ingestion, not noticing unusual behavior	Toxicity of chemical, dose consumed, ease of consumption (liquid v solid)	Places where ingestion can occur without being seen	Lack of knowledge on how to react to poisoning, no decontamination
	Postevent	Inability of person poisoned to communicate incident, lack of access to poison center	Chemical agent without an antidote	Lack of adequate prehospital care, acute care and rehabilitation	No poison control center, lack of access to emergency care

Source: Adapted from the World report on child injury prevention (Peden et al. 2008)

(Table 6). Some of these risk factors are amenable to modification, while others such as age, developmental stage, and sex are not.

Age, Development and Gender

Age has a strong association with poisoning. Children – especially infants and toddlers – tend to put objects into their mouths which places them at an increased risk of exposure to toxins including household products, agricultural agents, and other liquid chemicals stored in an unsecured cupboard or on the floor. As children become more mobile, around the age of 2 years, the incidence of poisoning dramatically increases as their inquisitive nature draws them to potential danger. The lack of adequate supervision plays an important role in poisoning among children.

The risk of poisoning is exacerbated by a child's development and size, that is, less of a substance is required to cause poisoning in a small child. Lead poisoning, for example, remains a major public health problem. It can be inhaled through particles released by industry or recycling, ingested through contaminated toys or objects on the floor, from lead-containing food products or absorbed through the skin, for example, cosmetics. Children are the most vulnerable to lead as their nervous systems are still developing and they absorb approximately 4–5 times

more than adults which can result in intellectual disabilities, underperforming at school and behavioral issues (WHO 2019). This also applies to adolescents and the ingestion of alcohol and drugs which can result in toxicity at levels well below that of an adult (Peden et al. 2008).

Poisoning among adults is more likely to be intentional than accidental exposure. Pesticides, such as organophosphates, account for 15–20% of all self-poisoning around the world (Mew et al. 2017). However, unintentional poisoning in later life, particularly among those with loss of memory conditions, can arise as a result of repeated medication ingestion. Like most other types of injury, poisoning appears to have a strong male bias.

Box 5 Opioid Overdose in the USA

According to the American Society of Interventional Pain Physicians, the USA uses 80% of all oxycodone and 90% of hydrocodone manufactured around the world. This high consumption level has been related to the current high levels of drug overdoses seen in the country. In 2017, according to the Centers for Disease Control, 70,237 people died of a drug overdose making it the leading cause of injury-related death in country. Of these, 47,600 (67.8%) involved an opioid. While the first wave of opioid deaths in the early 2000s was driven by prescription drugs, this moved on to heroin in the second phase and more recently, the third phase, by synthetic opioids. Between 2016 and 2017, for example, synthetic opioids accounted for a 45.2% increase in overdose deaths (Scholl et al. 2019).

Risk factors for unintended opioid overdose in the USA include (Baird et al. 2017):

- Being male, white, and non-Hispanic
- Having a traumatic injury for which opioids are prescribed for pain relief

(continued)

Box 5 (continued)
- Using other psychoactive substances such as alcohol and benzodiazepines simultaneously
- Having a chronic disease such as Chronic Obstructive Pulmonary Disease, liver and renal disease, and congestive cardiac failure
- Requiring high daily doses of opioids

Prevention strategies including safe prescribing practices, increasing the availability of naloxone, expanding access to addiction management, and awareness raising across the country appear to indicate some potential improvements in overdose indicators.

Poisonous Agent

A number of characteristics of poisons have an impact on how severe the risk of morbidity or mortality will be if ingested. These include:

- The concentration of the substance – the more potent it is, the more toxic it will be.
- The nature of the substance – liquid preparations are easier to swallow than solid compounds or powered preparations because they don't stick to the mucosa of the mouth or burn the mouth and esophagus limiting ingestion.
- The appearance of the substance – this is particularly important in child poisoning. The more attractive a substance is, the greater the risk. Multiple studies have shown that clear liquids rather than dark ones, small solids rather than large ones, and brightly colored substances make them higher risk (Peden et al. 2008).
- The storage of the substance – those that are easily available, for example, under the sink, in an unlocked cabinet, decanted into cold drink bottles, in granny's handbag, etc., are at higher risk for children. Even child-resistant packaging of medication cannot compensate for unsafe storage.

Environmental Factors

Significant seasonal variations in poisoning have been observed, particularly among children who are more prone to play outside during the summer and can get bitten by snakes or scorpions or ingest kerosene, pesticides, or other garden/agricultural products. On the other hand, wintertime brings a higher risk of carbon monoxide poisoning from faulty heating appliances or indoor fossil fuel cooking appliances. Poor living conditions, local beliefs, customs, and ignorance of the dangers of certain products are also associated risk factors.

A number of studies have linked poisoning to lower socio-economic groups. Young parents, inattentive caregivers, or other supervisory lapses are often a factor in child poisonings (Peden et al. 2008). Certain occupations – in particular agriculture/farming – are a significant risk for organophosphate poisoning because it is readily absorbed through the skin, breathing in the vapors, as well as ingestion (accidental or suicidal). Pesticide-related accidental poisoning and suicide is particularly high is some Asian countries such as China and Sri Lanka as well as in Latin America and Africa (Bertolote et al. 2006).

Countries which lack appropriate policies and standards as well as those without laws that govern the manufacture, labeling, distribution, storage, and disposal of toxic substances place children and adults at higher risk. Environmental hazards, such as the uncontrolled storage or dumping of pesticides near residential homes or toxins which seep into the water supply, put those living in close proximity at increased risk of accidental poisoning (Peden et al. 2008).

Lack of Appropriate Management

Quick management of acute poisoning is essential. Most countries have a Poison Control Center (PCC) whose job it is to advise the public and health personnel on what to do in the event of a suspected poisoning based on a set of standard protocols. In addition, many commercially available products have a label on them stating where to phone in case of a suspected poisoning and what chemicals the product includes. Sadly, many low- and some middle-income countries do not have PCCs and therefore valuable time is lost when a patient reaches a health care facility because these PCCs have the most up to date information on how to manage specific poisons.

Once a patient has been admitted to a health facility, it is also vital that health care workers have been trained to recognize the signs and symptoms of various kinds of poisoning and have access to toxicology screening and appropriate management which includes:

- Removing the person from the source of contamination, for example, removal of clothing
- Assessing both the patient with regard to agent, dosage, time of dosage, clinical status, etc.
- Stabilizing the patient
- Decontaminating, if appropriate, with an appropriate agent
- Providing supportive therapy in the form of airway stabilization, antidote, electrolyte balancing, seizure management, etc.

Conclusions

Acute poisoning is a medical emergency. Community awareness of the risks of poisoning, appropriate laws, regulations and policies, and a PCC with well-trained

personnel are evidence-based interventions that all countries should have in place to prevent unintentional poisoning. These should be accompanied by an inter-sectoral response which includes industry who are encouraged to reduce the presence of potential poisons in household items as well as the safe packaging of such items.

Conclusion

Development of global estimates provides a strong foundation for understanding the burden and distribution of death and disability associated with unintentional injuries. However, the reliability and validity of data particularly risk factor data from LMICs remain uncertain, and improved data collection in these countries needs to be prioritized. As highlighted above, the risk factors for all injuries vary greatly across contexts. The scarcity of evidence on risk factors, context, and unique contributors to injuries impedes development of interventions, and investment for practice and policy changes.

Road traffic injury prevention needs multisectoral action by governments. It requires cohesive collective action by sectors such as transport, police, health, education, and actions that address the safety of roads, vehicles, and road users. The interventions need to be context specific and there is much greater need of research, particularly in low- and middle-income countries. Effective interventions include designing safer infrastructure and incorporating road safety features into land-use and transport planning, improving the safety features of vehicles, improving postcrash care for victims of road crashes, setting and enforcing laws relating to key risks, and raising public awareness.

Further research on sex differences in falls risk is needed to better inform prevention strategies and targeting of these interventions should also be sex and age specific. Equally important are multifaceted interventions to mitigate environmental risk factors. The support policies that create safer environments and reduce risk factors should promote engineering approaches to remove the potential for falls, the training of health care providers on evidence-based prevention strategies, and the education of individuals and communities to build risk awareness.

Effective fall prevention programs aim to reduce the number of people who fall, the rate of falls and the severity of injury should a fall occur. For older individuals, fall prevention programs can include a number of components to identify and modify risk, such as screening within living environments for risks for falls; clinical interventions to identify risk factors, such as medication review and modification, treatment of low blood pressure, vitamin D and calcium supplementation, treatment of correctable visual impairment; muscle strengthening and balance retraining prescribed by a trained health professional; community-based group programs which may incorporate fall prevention education and Tai Chi/yoga-type exercises or dynamic balance and strength training. For children, evidence base is scarce; however, it includes effective interventions include multifaceted community programs; engineering modifications of nursery furniture, playground equipment, and other products; and legislation for the use of window guards. Other promising

prevention strategies are use of guard rails/gates, home visitation programs, mass education campaigns for prevention, and appropriate acute pediatric medical care should a fall occur.

Varying context of burns injury is well established. Risk factors present for burns in HIC and LMICs settings, particularly urban environments of middle-income countries could benefit from some common strategies for burn prevention, such as smoke detectors, regulation of hot water heater temperature, and enacting and enforcing housing codes to make electrical wiring safer. However, in rural areas and among the urban poor, the epidemiologic pattern of, and risk factors for, burns differ markedly from those that characterize the high-income countries and thus very different strategies are going to be required. In this regard, some of the factors that are of prime concern include the use of cooking pots on ground level (pots on ground level are more readily knocked over, and can increase the risk of scald burns, for example, among toddlers and young children); the use of open wood fires; the use of kerosene (paraffin) stoves and lamps (these can be easily knocked over and then ignite); the wearing of loose fitting cotton clothing which can ignite while cooking on an open fire (a risk factor for women in Asia). In the given context, there are no known evidence-based intervention for burn prevention, some promising pilot projects addressing some of the above risk factors, such as efforts to promote safer paraffin stoves in South Africa and safer, more stable paraffin lamps in Sri Lanka. Further, as huge service gap with limited access to acute and rehabilitation care is recognized as a major determinant of poor recovery outcomes in LMICs. There is an urgent need to strengthen health system response to burns.

There are many actions to prevent drowning. Installing barriers (e.g., covering wells, using doorway barriers and playpens, fencing swimming pools) to control access to water hazards or removing water hazards entirely greatly reduces water hazard exposure and risk. Community-based, supervised childcare for preschool children can reduce drowning risk and has other proven health benefits. Teaching school-age children basic swimming, water safety, and safe rescue skills is another approach. Other approaches including setting and enforcing safe boating, shipping, and ferry regulations are an important part of improving safety on the water and preventing drowning. Building resilience to flooding and managing flood risks through better disaster preparedness planning, land use planning, and early warning systems can prevent drowning during flood disasters.

The global public health community has an important role to play in addressing this challenge, by facilitating the description of the problem, the development of solutions, the implementation of programs, and evaluating the impacts. Further, the public health community can play a leadership role in galvanizing a multisectoral response to injuries, recognizing the inequitable burden and response, advocating for investments at national and international levels, and catalyzing the sharing of experiences. The devastating health impacts of injuries make it imperative that the global public health community to not only research but proactively engage in efforts to address the burden of disease from injuries at local, national, and regional and global levels.

In summary, injuries are no "accident," and violence does not "just happen"; rather, these are highly predictable and preventable events. The global public health community has played an important role in taking this message forward. The challenge is to continue to do so, thereby ensuring that the predicted preventable epidemics of unintentional injuries in LMICs can be prevented.

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