1. Background and significance of the study

The World Health Organization (WHO) defines injury as "a bodily lesion at the organic level, resulting from acute exposure to energy (mechanical, thermal, electrical, chemical or radiant) in amounts that exceed the threshold of physiological tolerance. In some cases (e.g. drowning, strangulation), the injury results from an insufficiency of a vital element". Injuries are classified according to the intent or human purpose in occurrence of events, as unintentional injuries and intentional injuries. Unintentional injuries are classified according to the mechanism leading to the injury, as road traffic injuries, poisoning, falls, burns, drowning and other unintentional injuries.

Injuries are considered as a major health problem worldwide. The Global Burden of Disease study reported that injuries accounted for 12.3% of the total burden of disease and for 9.8% of the world's deaths in 2004. Unintentional injuries constitute 67% of all injury deaths and 74% of injury Disability Adjusted Life Years (DALYs) (i.e. nearly four million deaths in 2004). The share of unintentional injuries amongst the total burden of diseases is increasing rapidly. For example, the rank of road traffic injuries as the main contributor towards the burden of unintentional injuries is estimated to increase from 9 to 3 between the years 2004 to 2030.

Low and Middle Income Countries (LMICs) are disproportionately affected by the burden of unintentional injuries with a higher injury related mortality rate. It is estimated that the number of annual deaths and DALYs lost in LMICs were ten times higher than those of HICs. The WHO estimated the risk of road traffic injuries for people living in LMICs as being 1.5 times than that of people in HICs. South East Asian (SEA) countries alone are responsible for more than a quarter of total injury death. India suffers from a scarcity of injury data. A study by Joshi et al. on causes of death in rural India using verbal autopsy showed that 13% of total deaths were due to injury and external causes. Deaths due to accidents were estimated to have increased by 47% during the period 1990–2000. Data from a population
based-study in Delhi revealed that the incidence rate of unintentional injuries was 109.6 per 1000 population (11).

In India, injury prevention and control in national or regional health planning is lacking. Insufficiency of information on the pattern of unintentional injuries and lack of authentic studies providing information on the etiology of unintentional injuries in India are the major obstacles towards designing injury prevention and control plans. Thus, this population-based study on the burden, pattern and risk factors of unintentional injuries was conducted in Pune city.

1.1 Objectives

1- To assess the burden of unintentional injuries in Pune city.
2- To determine the pattern of unintentional injuries amongst different socio-demographic strata in Pune city.
3- To identify risk factors associated with unintentional injuries in Pune city.

1.1.1 Specific Objectives:

1.1- To measure the incidence of unintentional injuries in Pune city.
1.2- To determine the burden of unintentional injuries upon private and public medical services in terms of utilization.
1.3- To assess the burden of unintentional injuries on families in terms of absenteeism from school or employment or any productive activity and the direct cost of treatment.

2.1- To measure the distribution of the direct mechanism leading to injuries.
2.2- To measure the magnitude and type specific distribution of unintentional injuries among different demographic and socioeconomic groups.

3.1- To assess the demographic and socioeconomic risk factors for incidence of unintentional injuries.

2. Research methodology

The study was population-based, cross sectional with a reference period of one month and one year for unintentional injuries, which met the inclusion criteria, and five years for death due to injuries.

Multistage stratified cluster random sampling was used to select a sample of 2100 households (150 households from 14 administrative wards of Pune city). A semi-structured general questionnaire (Questionnaire A, appendix C) was used to elicit socioeconomic and demographic information, information related to vehicular risk factors like mode of transport or helmet use and information regarding the occurrence of any type of unintentional injuries (as listed below) in the last one month, and in the last one year and any cases of death in last five years due to unintentional injuries. In case of report of any type of injury, seven type-specific questionnaires (Questionnaire B to H, appendix C) were used to elicit information related to general aspects of each injury (like time, date, nature, site, place, activity, type of medical care used, health outcome of injury, duration of treatment, associated factors leading to the injury, expenditure, productive work lost due to injury) in addition to type-specific information for each type of injury. In case of report of death there was a specific questionnaire (Questionnaire X, appendix C) to get a brief history of cause and demographic information of deceased persons.

The unintentional injuries included in the scope of the study were road traffic injuries, poisoning, burns, fall-related injuries, suffocation, animal-related injuries and other injuries which were not included in any of the above mechanism (like piercing, mechanical force, electrocution)
Abstract

An injury was included in the study when it was serious enough to meet any of the following conditions:

- Need for any kind of medical care
- Need to stay in bed for at least one day
- Need to stop regular work or activity for at least one day after injury

Injuries were classified as mild, moderate, moderate to severe and severe according to the required medical services

- Mild injuries were those injuries wherein the injured did not require any medical services
- Moderate injuries were those wherein the injured required medical services but hospital admission was not required
- Moderate to severe injuries were those in which the injured were admitted to the hospital but intensive care or surgery was not required
- Severe injuries were those in which the injured were admitted to the hospital and required intensive care or surgery

3. Results

A sample of 2100 households were interviewed, of which 61 households refused to participate in the study. Data was, therefore, collected from 2039 households, consisting of 9014 individuals.

3.1 Burden of injury

Amongst 9014 individuals there were a total of 430 cases of unintentional injuries. Of these, 129 cases of injury were reported in a recall period of 30 days and 301 cases of injuries were reported in a recall period of one year. The maximum number of
Unintentional injuries were due to road traffic (49.5%, n=213) followed by falls (24.9%, n=107) and other injuries (10.5%, n=45). Animal-related injuries, burns, poisoning and suffocation contributed to 8.6% (n=37), 3.7% (n=16), 2.3% (n=10) and 0.5% (n=2) of all injuries respectively. Classification of injuries based on severity showed that 54 (12.6%) of the injuries were mild, 298 (69.3%) were moderate, 28 (6.5%) were moderate to severe and 41 (9.5%) were severe.

The annual incidence rate of unintentional injuries was calculated using the number of unintentional injury events in the duration of 30 day recall (n=129) amongst a sample of 9014 individuals. The annual incidence rate of unintentional injuries was 174 per 1000 (95% CI 164-184) individuals and 177.9 per 1000 after adjustment for age. The annual incidence rate of road traffic injuries was 93.2 per 1000 individuals. Fall-related injuries had an annual incidence rate of 35.9 per 1000 individuals and the annual incidence rate of animal-related injuries was 12.0 per 1000 individuals.

Amongst 430 reported cases of unintentional injuries, there were 17 reported cases of permanent disability corresponding to 3.9% of total reported cases of injuries, giving a disability rate of 189 per 100,000 individuals per year.

Twenty six cases of death were reported amongst the household members in the period of 5 years prior to the date of the interview. This corresponded to a mortality rate of 58 per 100,000 population per year and a case fatality rate of 10 per 1000 of the injured. Half of the reported cases of death were due to road traffic injuries (n=13), followed by falls (26.9%, n=7), suffocation (7.7%, n=2) and poisoning (3.8%, n=1) and electric shock (11.5%, n=3).

Sixty nine (16.0%) cases of injuries led to hospitalization of the injured. Road traffic injuries were the main reason for hospitalization in 42 cases (60.9%). The average duration of hospitalization was 11.4 days (range 1 to 120 days). Out-of-pocket direct cost of treatment paid by the injured was on an average Rs.7,256/- (range Rs. 25/- to Rs.250, 000/-) for those paying out of pocket. The average out of pocket cost of treatment in private hospitals was 11 times more than the out of pocket cost of
Abstract

treatment in public hospitals. In 15 cases (8.1%), the injured lost their jobs permanently and in 199 (67.7%) cases the injured suffered from loss of productive work or school days as a result of the injury event.

3.2 Pattern of injuries

Most of the injured were in the age group of 5-15 years (32.6%), males (67.9%), married (63.8%), belonging to the upper-lower strata (29.8%), occupied in business/service (34.4%), with secondary educational level (26.0%) and residents of non-slum areas (87.9%).

Extremities (43.4% of injury in leg/s and 28.7% in hand/s) were the most site of the body that was injured. Cuts and open wounds were the most prevalent nature of injuries (37.0% of total injuries). Fractures occurred in 14.5% of cases. The place where the injury event occurred most frequently was the street or highway (52.6%). Home or building premises was the second most frequent place of injury occurrence (29.5%). Maximum injury events occurred while traveling (45.6%). Leisure time activity was the second most frequent activity at the time of injury (25.8%). The maximum number of injuries (24.2%) occurred between 18 to 21 hours followed by 9 to 12 hours (18.6%) and during the month of November (12.3%) followed by January (10.3%).

Most of the injured individuals used private hospitals (41.9%) followed by private facilities (35.8%). Only 7.2% of households used public hospitals. Only 17.9% of individuals received first aid at the time of injury, and this proportion was 10.2% for severe and moderate to severe cases of injuries. The most frequently used transport facility to the medical centre for those who used medical services were three-wheeled motorized vehicle (auto-rickshaw) (30.9%). Ambulance was used only in 3.2% of the cases. The time between injury event and reaching the medical facility was more than 3 hours for 15.0% of severe cases of injuries.

Road traffic injuries were due to collision of two vehicles in 52.3% of cases. The mode of transport for maximum number of the injured was motorized two-wheeled
vehicles (69.0%) followed by bicycles (12.2%). Most of the injured were drivers (68.5%) followed by passengers or pillion riders (18.3%). Amongst those injured individuals using two-wheeled vehicles, 81.1% were not using a helmet at the time of the injury event.

3.3 Risk Factors for unintentional injuries

3.3.1 Socio-demographic risk factors

Amongst socio-demographic risk factors for unintentional injuries, a significant association was found between injury occurrence and age, gender, marital status, type of family, socioeconomic status and occupation of individuals.

Age was found to be a risk factor for type specific unintentional injury occurrence. Road traffic injuries were strongly associated with age group ($p=0.000$) with maximum occurrence in the age group of 15 to 30 years (3.4%). Road traffic injuries were minimum in the age group of 1 to 4 years (0.8%). Fall-related injury occurrence was significantly different amongst different age groups ($p=0.000$). The age group of 5 to 15 years experienced maximum number of fall-related injuries (2.4%) and the age group of 45 to 60 years experienced the minimum number of fall-related injuries (0.7%). Injury occurrence was significantly higher amongst males ($p=0.000$). Males had 2.05 (95% CI 1.66-2.52) times more risk of injuries as compared to females.

Marital status was significantly associated with injury occurrence ($p=0.00$), with maximum injury occurrence amongst never-married individuals (6.6%) and minimum amongst widows or separated individuals (3.0%). Injury occurrence was significantly ($p=0.000$) higher amongst individuals belonging to separated families (7.3%) compared to individuals belonging to separated families who live with their extended or joint families (3.1%). Socioeconomic status was found to be significantly associated with injury occurrence ($p=0.031$). Maximum injury occurrence was amongst individuals belonging to high socioeconomic status (7.7%) and minimum amongst individuals belonging to low socioeconomic status (3.9%). Occupation was strongly associated with male injury occurrences ($p=0.000$) with maximum injury
occurrence amongst skilled workers (15.8%) followed by students (9.1%). Female injury occurrence was also strongly associated with their occupation (p=0.002), with maximum injury occurrence amongst students (6.5%) followed by those who were working in the service/business sector (4.5%).

3.3.2 Health-related risk factors
Amongst health related risk factors, injury occurrence was significantly associated with disability (p=0.040), visual impairment (p=0.012) and regular alcohol use (p=0.000). The risk of injuries was 2.35 (95% CI 1.06-5.17) times higher amongst individuals with disability, 2.7 (95% CI 1.2 – 6.8) times higher amongst individuals with visual impairment and 2.619 (95% CI 1.8 - 3.8) times more amongst individuals with regular alcohol use.

3.3.3 Specific risk factors for road traffic injuries
Amongst specific risk factors for road traffic injuries, mode of transportation (p=0.001) and driving a vehicle (p=0.000) was associated with risk of road traffic injuries. Maximum injury occurrence was amongst individuals who used both two-wheeled vehicles and cars as the main modes of transport (3.6%), followed by users of two-wheeled vehicle as the exclusive mode of transport (3.0%). Road traffic injuries were minimum amongst those, who used a car as their main mode of transport (1.5%). Those who drove any vehicle had 3.65 (95% CI 2.8-4.8) times higher risk of injury in a road traffic injury event than those who did not. There was a significant difference in head injury occurrence amongst those who used helmets at the time of road traffic injury and those who did not (p=0.005). Those who did not use a helmet at the time of injury had 6.45 (95% CI 1.47-28.4) times more risk of having a head injury.

3.3.4 Specific risk factors for home injuries
Amongst specific risk factors for home injuries, the number of household members and the density of individuals per room were significantly associated with risk of injuries. There was a significant difference in home injury occurrences between
individuals resident in households with different number of members \( (p=0.001) \). The maximum injury occurred amongst individuals belonging to households with less number of family members (1 to 5 members) (1.8%) and minimum injury occurrence was amongst individuals belonging to households with more than 5 members (0.8%). There was a significant difference in home injury occurrence between individuals from households with differing densities of individuals per room \( (p=0.002) \). Home injury occurrence was 2.1% amongst households with a density of less than or equal to one individual per room and 1.2% amongst households with a density of more than one individual per room.

4. Conclusion

The findings of this study showed the burden of unintentional injuries in terms of incidence (annual incidence rate of 174 per 1000 (95% CI 164-184)), disability (189 per 100,000 individuals per year) and mortality rates (58 per 100,000 population per year), case fatality rate (0.01) and economic burden on households. The majority of the victims were males (67.9), in the young age group (5-15 years). A similar scenario was reported from most of developing countries \(^{(12-17)}\) and other parts of India \(^{(10-11)}\). However, the magnitude of this burden can be realized when this data is compared to the much lower mortality and burden of unintentional injuries in developed countries like the United States of America (USA) with unintentional injury mortality rate reported as 37/100,000 \(^{(18)}\).

The mortality rate of unintentional injuries found in the present study is much higher than the mortality rates of other well known infectious diseases like malaria (3/100,000) and tuberculosis (34.8/100,000) \(^{(19)}\) in India. It is to be noted that whilst there are extensive national plans for the control of tuberculosis and malaria, no plans for injury control exist in the country.

Road traffic injuries contributed to 50% of mortality rate and nearly half the incidence rate. The mortality rate of road traffic injuries was 29/100,000 per year
which is more than the overall global mortality rate of 22/100,000 \(^3\). This shows that road traffic injury prevention should be the main target of injury prevention program.

Need for strengthening the pre-trauma care services is evident from the rare report of using ambulance for transport of the injured (3.2%) and also from very few reports of the injured persons receiving first aid at the time of injury (10.2% for severe and moderate to severe cases of injuries).

Amongst the identified modifiable risk factors for unintentional injuries, the lack of helmet use resulted in increased risk of head injury (3.65 (95% CI 2.8-4.8) times) and increased risk of injury (by 2.619 (95% CI 1.8 - 3.8) times) amongst those who used alcohol regularly, thereby, demonstrating the need for enforcement of helmet use and prevention of drunken driving.

India’s rapid growth towards modernization and motorization accompanied by reduced burden of infectious diseases makes it the right time for India to initiate a national plan for injury prevention and control. To achieve this purpose, there is a need for large-scale awareness programs targeting policy makers, politicians, professionals, public and press. Unsafe transport and environment is the main underlying cause of injuries which need to be addressed by any preventive plan. There is a need for strengthening pre-trauma and trauma care system in order to control injury related disabilities and preventable mortalities. There are cost effective interventions which have demonstrated their efficacy in reducing the injury occurrence which can be adopted in India. Appropriate plans for injury prevention and control can be developed for India.