4. Discussion

Part A: Main findings of this study

Part B: Injury prevention and control
The first World Conference on Injury Prevention and Control held at Stockholm, in 1989, passed a resolution that emphasized the need to identify ways to prevent and reduce the harm caused by injuries. The Conference stressed the need to treat injuries and identify mechanisms to rehabilitate and reintegrate the injured persons into their communities and workplaces. The Stockholm Conference recognized that there was a serious shortage of information to base plans for action in all these areas pertaining to injuries. (2) Twenty years later, India still suffers from a paucity of information on injuries. Media reports make it evident that unintentional injury incidence in India is rising due to rapid urbanization and motorization accompanied by lack of appropriate road engineering and lack of injury prevention programs in the public health sector. The steady achievement in combating the burden of infectious diseases makes the burden of injuries more prominent. In comparison to the likely magnitude of the problem, there is little awareness of their contribution to the burden of disease. This lack of epidemiological, economic and risk factor data at the national level has been the primary reason in a serious neglect in injury policy.

Injury information is primarily obtained from mortality and hospitalization data which usually addresses severe injuries. In contrast, population-based studies identify the incidence of all injuries in geographically defined communities and therefore, include all those injury events that may not be captured by a routine injury surveillance system. Population-based studies, therefore, are important since they gather information on all injuries regardless of their severity. Such studies, therefore, have important implications in terms of being able to estimate the cost, transient disability, loss of school time, associated anxiety and overall quality of family life as a consequence of the injury event. Additionally, survey data including detailed information on severe and minor injuries are valuable in the assessment of risk factors and conditions with the goal of formulating injury prevention programmes. This study is one amongst the few population-based studies in an urban setting in India.
4.1 Part A: Main findings of this study

4.1.1 Burden of Injury

4.1.1.1 Prevalence, disability and mortality of unintentional injury

The findings of this study showed an annual incidence rate of unintentional injuries as 174 (95% CI 164-184) incidents per 1000 individuals. This incident rate was higher than the annual incidence rate in Delhi reported by Verma and Tewari (109.64/1000 individuals). The unintentional injury incidence rates show a spectrum amongst developing countries. Incidence varies from 24.5/1000 in urban Tanzania, 55.9/1000 in individuals above 5 years in Pakistan, 65.1/1000 in rural China, 89/1000 in rural Vietnam, 116/1000 in Uganda to as much as 183.4/1000 in Ghana. This variation in the reported incidence rate of injuries may be due to the wide variations in the socioeconomic status as well as the likely variations in the risk exposures of different study populations. However, one of the factors that need to be considered in the estimate of injury incidence rate is the methodology adopted in various studies including the definition of injury used in the study and the recall period used for estimation of incidence rate. In the study done in Delhi, the recall period of one month was used for minor injuries and one year for major injuries. The annual incident rate of minor injuries was added to the annual incident rate of major injuries and the result was considered as total annual incident rate of injuries. The exclusion criteria were based on recall and those injuries that were not remembered by the respondent were considered as negligible and excluded from the study. In the study done in Vietnam, the recall period was three months. However the study was a prospective study, which eliminated recall bias to a greater extent than retrospective studies. The studies in Pakistan and Tanzania had a recall period of one year, regardless of the severity of injury. In the Tanzanian study, injuries reported one month prior to the interview were used for calculation of incidence rate, in order to minimize the recall bias.
The effect of recall period on injury studies has been discussed in different publications. It has been shown that varying recall periods had profound effects on both the magnitude and composition of injury estimates. It has also been suggested that recall bias, in varying degrees, was present for all subpopulations, regardless of the injury severity, although the effects of recall bias were significantly lower for severe injuries. It is probable that the decline in injury rates across recall periods is a function of two factors, namely, loss of memory and the tendency to report injury events if they occurred at a more recent date than they actually did. Thus, a recall period of less than one month may lead to telescoping of the results and causing overestimation, whilst a long recall period may lead to loss of memory and underestimation of the reality.

From the results of this study, the annual occurrence rate of injuries amongst households was 75.9%, which means that three-fourths of households suffered the occurrence of one episode of injury in one of the family members. More than 87% of the injured required medical services, reflecting the burden on families. The disability rate was found to be 189/100,000 individuals and case disability rate of 0.04, which was half of the case disability rate of 0.08 reported in Delhi. This difference could also be ascribed to the methodological differences of the recall period.

In this study, it was shown that the annual mortality rate of injuries was 58 per 100,000 population per year, similar to the findings of other population-based studies in India with reported mortality rate of 54.9/100,000 and 68/100,000. Mortality rates due to unintentional injuries in other developing countries ranged from of 68.6/100,000 in Ghana, 63.6/100,000 in Brazil, and 46.3/100,000 in Iran (rural). The burden of injuries in India and other developing countries can be understood by comparison of the mortality rates in developing countries with that of developed countries. In the USA for example, the mortality rate of injuries was reported as 37/100,000.

Findings of the present study suggested that unintentional injury case fatality rate was 0.01. A study based on hospital records in Pune reported
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a case fatality of 0.03\(^{(72)}\). This higher case fatality rate could be due to the inherent nature of hospital-based studies which report data from cases which have a higher severity. The case fatality rate reported in this study, however, was much less than the 0.8 case fatality rate reported in rural Vietnam, which could be due to better trauma care in urban settings or a different pattern of injury in rural versus urban areas. \(^{(12)}\) The findings of this study showed that the maximum number of deceased (nearly one third of all cases of death) were in the age group 30 to 45 years, providing another evidence of the high burden of unintentional injury affecting the most productive strata of the society.

Joshi et al., \(^{(10)}\) in their study of causes of mortality in a rural area of Andhra Pradesh found that injury and external causes of mortality was the second leading cause of mortality, ranking next only to infectious and parasitic disease mortality rates. The mortality rate of unintentional injuries found in the present study is much higher than the mortality rate of other well known infectious diseases like malaria (3/100,000) and tuberculosis (34.8/100,000). \(^{(19)}\) 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.

The pyramid of injury calculated in this study was one case of death for 14 cases of major injuries (hospitalization) and 72 cases of mild and moderate injuries (1:14:72). These estimates considerably differ from the estimates made by Gururaj \(^{(9)}\) which showed one case of death for 20 cases of hospitalization and 50 cases of minor injuries (1:20:50). The pyramid constructed on the basis of the thesis data, however, was similar to the population based study by Varghese and Mohan \(^{(8)}\) in Haryana which showed one case of death for 29 cases of hospitalization and 70 cases of minor injuries (1:29:70).

In this study, road traffic injuries were found to be the first leading cause of unintentional injuries with an annual incidence rate of 93.2/1000 population. Road traffic injuries also contributed to 50% of mortality rate. The mortality rate of road
traffic injuries was 29/100,000 per year. This data showed a higher incidence and mortality rate as compared to other reports. The Delhi study showed an annual incidence rate of road traffic injuries of 29/1000 \((73)\) with road traffic injuries being the second leading cause of injury. This difference in incidence of road traffic injury occurrence could be due to the methodological context discussed above. Gururaj \((9)\) estimated a mortality rate of 8/100,000 which is threefold less than the mortality data reported in this study and may be a reflection of under-reporting of road traffic mortality in India. Reports from other developing countries like Vietnam (26.0/1000) \((12)\) and Pakistan (17/1000) \((13)\) also show a less burden of road traffic injuries. The global estimate of road traffic injuries was 21/100,000. \((3)\)

Fall, in this study, was found to be the second leading cause of injury with the annual incidence rate of 35.5/1000. This estimate was less than the reported annual incidence rate of 40.7/1000 by Verma and Tewari. \((11)\) The animal related injuries, which are not considered in the global literature as the major contributor towards injury occurrence, is known to be a major cause of injury in the SEA region. In this study, the annual incidence rate of animal-related injuries was found to be 12.0/1000 individuals, which was similar to the reported result of 7.8/1000 individuals in the Delhi study. \((11)\)

4.1.1.2 Utilization of medical care

This study showed that there is a major difference in the utilization of private and public medical services by the injured with more than 77.7% of cases using the private services. A similar result was found by Verma and Tewari in Delhi \((11)\) where 71.4% of cases used private medical services. This difference in utilisation of private and public care services is seen universally in India and has been extensively discussed. \((124-126)\) Private medical services were available at the vicinity of the place of occurrence of the injury in three-fourths of the cases whilst the availability of public medical services in the vicinity of the injury side was reported only in one third of the cases.
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The hospitalization rate of 16% of the total reported cases of unintentional injuries calculates to a hospitalization rate of 765.5/100,000. This rate was similar to the findings reported by Dandona et al.\(^{(25)}\) in Hyderabad who reported a hospitalization rate of 13.3%. The hospitalization rate was more than that reported in a developed country like Canada (682.9 /100,000)\(^{(127)}\) and the USA (659 /100,000).\(^{(128)}\) The average duration of hospitalization was found to be 11.4 days which was more than the average duration of hospitalization reported in Delhi (1 to 4 days hospitalization for majority of injured)\(^{(11)}\). The duration of hospitalization estimated in this study was less than the 20 days estimated by Odero.\(^{(50)}\) This study found that only 17.9% of the injured received first aid before reaching the care centre and this proportion was only 10.2% for severe and moderate to severe cases of injury, which was less than the report of 29.8% in Delhi.\(^{(11)}\)

4.1.1.3 Economic burden of injuries

In this study, the economic burden of injuries on households in terms of out-of-pocket cost of treatment, cost of damage to property, indirect economic loss due to absenteeism and productive work lost were investigated. The study revealed the high economic burden of injuries on households and the economic vulnerability of households to the injury event with around three quarters of households paying the medical cost of treatment out of their pocket, in situations that the out of pocket cost of treatment was nearly or more than the total monthly income of 15.1% of the households. A similar situation was reported for most developing countries. A study in rural Vietnam revealed that the average cost of injury corresponded to approximately 1.3 months of earned income, increasing to 7 months of earned income for a severe injury. Ninety percent of the economic burden of injury fell on households, only 8% on government and 2% on health insurance agencies.\(^{(12)}\) In this study the cost of treatment and cost of damage to the property were the only costs that were identified. However, some estimates of economic costs in occupational injuries showed that for every $1 of direct costs an estimated $3 to $5 of indirect costs were
incurred for injuries. In this study, the out of pocket cost of hospitalization was found to be 11 times more for those who used private hospitals in comparison to those who used public hospitals. This proportion was less than that reported by Gumbar who reported a 4.5 times higher cost in private hospitals as compared to public hospitals in an urban Indian setting. The difference in the data from that study and the present one could be ascribed to increase in the cost of private sector health services as compared to government health services in recent years. This study revealed that less than 10% of the cases used insurance for payment of medical service costs. Other studies in India also showed a poor usage of health insurance services. To reduce the vulnerability of the households to the injury event, the role of health insurance should be encouraged in India. This study showed that the average duration of hospitalization was 11.4 days (range 1 to 120 days) and the average cost of treatment for hospitalized cases was Rs. 43,211 (range Rs.200 to 500,000). These figures can be compared to the data for HIV/AIDS related hospitalization in Pune, where the median duration of HIV-1-related hospitalization was 10 days (range 2-48 days) and the median cost was Rs 17,464 (range Rs 400/- to 63,891/-).

The high burden of healthy days lost due to the injury event was estimated to be 5,600,000 healthy days lost per year. The high burden of absenteeism from productive work shows the adverse effect of injuries on industry and employers. The findings of this study revealed that 3% of the injured lost their jobs permanently due to the injury event, similar to the report from the Hyderabad study which showed that 1% of the injured had to give up their job as a result of the injury event.
4.1.2 Pattern of unintentional injuries

4.1.2.1 Mechanism of injuries

In this study it was seen that road traffic injuries were the main contributor of unintentional injuries followed by falls, other injuries and animal-related injuries. The mechanisms of injuries follow a similar pattern in most population-based studies in developing countries with small variations between studies. In the study done by Verma and Tewari in Delhi, \(^{(11)}\) falls were reported as the main contributory mechanism of injury (38%) followed by road traffic injuries (31%). Animal bites (7%) had a share similar to the findings of this study. In a hospital-based study in Pune, road traffic injury was identified as the main contributor (50%), followed by poisoning (24.5%) and falls as the third contributor. \(^{(72)}\) In a population based study in rural Vietnam \(^{(12)}\) it was shown that home injury was the main contributor (37/1000) followed by road traffic injuries (26/1000). In urban Ghana \(^{(14)}\) and Tanzania \(^{(17)}\) a similar pattern was reported, with road traffic injury constituting a major share of injury occurrence followed by fall.

4.1.2.2 Severity of injuries

This study revealed that the bulk of injuries (86%) were due to mild and moderate injuries, which cannot be identified through hospital-based studies. However they resulted in economic expenditure, absenteeism and suffering amongst the injured and their households. The results showed that maximum cases of severe injuries occurred amongst lower socioeconomic group and slum dwellers.

4.1.2.3 Site, nature, place of injury and activity resulting in injury

It was observed that the extremities were the sites of the body which were most frequently injured followed by injuries to the head and face. The head was the most frequently injured site amongst the deceased. The findings were similar to the findings of most other Indian studies. \(^{(11)}\) \(^{(28)}\) However the results of some hospital-based studies reported head and face injuries as the most common site of injuries or
similar proportion of injuries to the extremities and the head. This variation shows the differences in data obtained from population versus hospital-based studies.

The most frequently observed nature of injuries was cuts and open wounds followed by bruise and sprain/strain. Fracture was the third most frequent type of injury. These results were similar to the results of another population-based study in India and some hospital-based studies. The hospital-based study from Pune showed that cuts and open wounds were the main nature of injuries followed by fractures. However, some of hospital-based studies reported fractures as the main nature of injuries. Concussion was reported mainly in road traffic injuries followed by falls.

In this study, it was found that roads were the place of occurrence of the injury for maximum number of cases, followed by injuries occurring at home. In addition to road traffic injuries, maximum number of animal related injuries occurred on streets. Falls occurred mostly at home followed by streets and roads. This finding was similar to the finding in urban Uganda. Population-based studies in Delhi, Pakistan and Vietnam reported home as the most frequent place of injury occurrence followed by roads.

The main activity at the time of injury was travelling followed by leisure activity which included sports-related activities and recreation. The Delhi study, however, found that the most frequent activity at the time of injury was during daily routine work followed by recreation.

4.1.2.4 Time and month of injury occurrence

In this study it was found that maximum injuries occurred in the evening between 18 to 21 hours followed by the period during the morning hours of 9 to 12 o'clock. In case of road traffic injuries, maximum injuries occurred between 18 to 21 hours followed by 12 to 15 hours. Odero et al. in a comprehensive review of epidemiological studies on road traffic injuries in developing countries also estimated that maximum road traffic injuries occurred between 18 and 24 hours. Garg et al.
reported a distinct peak from 9 to 12 hours and from 6 to 9 pm for road traffic injuries. Verma and Tewari, \(^{(11)}\) in their study in Delhi reported that most of the injuries occurred between 12 to 4 pm followed by 16 to 20 hours and 8 to 12 hours. The NCRB report (2006) showed that maximum road accidents occurred between 15 to 18 hours. \(^{(72)}\)

4.1.2.5 Pattern of health care utilization

In this study it was shown that only in 14.7% of cases, ambulance was used for transportation of the injured and in more than one third of the cases the victim was transported by the auto-rickshaw. A similar situation was also reported from the Delhi study, \(^{(11)}\) where the use of auto-rickshaws/taxis was reported in 35.7% of cases and ambulances only in 4.9% of the cases of road traffic injuries. Another finding of this study was the time gap in reaching the medical centre. In this study, 64.4% of the injured reached the medical centre within one hour of the injury event, while the Delhi study reported that around 70% of the injured reached the medical centre within one hour. \(^{(11)}\)

4.1.2.6 Pattern of road traffic injuries

Road traffic injuries have increased at an alarming rate in all countries of the SEA region during the last two decades. \(^{(40)}\) In Bangladesh, the number of injuries had doubled from 1994 to 1999. \(^{(101)}\) In Pakistan, the number of vehicle crashes and deaths increased by nearly 16 times during 1956-1965. \(^{(101)}\) \(^{(132)}\) The findings of this study showed that nearly half of the burden of injuries was due to road traffic accidents. This study found that the main mode of transport of individuals was motorized two wheeled vehicles (37.7%), followed by public transport vehicles (31.5) and only 8.7% of individuals used cars as their only mode of transport. This pattern of transportation is in contrast with the pattern of road traffic in developed countries where about 70%–80% of people have cars and only 5%–10% have motorized two-wheeled vehicles. \(^{(133)}\) The findings also revealed that the mode of transport for most of the injured was whilst using a motorized two wheeled vehicle followed by injuries.
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whilst riding on bicycles. Pedestrians were the third group affected with maximum road traffic injuries. Similar results were reported by other Indian studies. However, in studies from some other developing countries like Tanzania, the number of pedestrian injuries exceeded the number of injuries in occupants of vehicles. The mode of transport of the other individual involved in the injury event was by motorized two-wheeled vehicle, by car and by 3-wheeled motorized vehicles, which was identical to the pattern seen in the Delhi study.

In this study it was shown that road traffic injuries were due to collision of two vehicles in 52.3% of cases. Dandona et al. in their study about the causes of road traffic deaths found that 87% of the crashes were the result of collision with another vehicle. The findings of this study showed that 5.7% of individuals were driving a motorized vehicle without a license, which is less than the 15.3% reported by Jha et al. in a hospital-based study in south India. Dandona et al. reported that 11% (95% CI 9.7–12.3%) drivers had not obtained a driver's license. The difference in data between these and the current study could possibly be due to underreporting in this study.

The findings of this study showed that vehicles involved in the injury event were mostly private vehicles (93.7%) followed by commercial vehicles (5.8%). In Ghana, 81% of vehicles involved in crashes were commercial vehicles. This indicated that even among developing countries, the pattern of traffic related injuries vary. The findings of this study revealed that amongst drivers of two-wheeled vehicles, 66.6% possessed a helmet, out of whom only 31.0% reported regular use of the helmet and 24.4% reported irregular use of the helmet. Nearly eighty two percent of the injured did not have a helmet at the time of the injury event and 17.7% had used a helmet at the time of the injury. A similar situation was reported from other developing countries. In one study, of the 5000 motorcyclists, only 54% used helmets properly, 21% used them improperly, and 24% did not wear them at all. Younger people, men and those with less formal education were more likely to wear helmets improperly.
Dandona et al. (24) reported that 69.8% (95% CI 67.9–71.7%) drivers reported no or very occasional use of a helmet in Hyderabad.

The respondents' opinions about the causes of road traffic injuries show a striking similarity to those reported from the Delhi study. (73) This similarity in findings is indicative that the respondent's opinion on the cause of injury reflects the ground reality. In this study, the underlying causes of road traffic injury were ascribed to high speed (17.9%), driving without observing traffic rules (16.9%), bad road quality (16.6%), congested roads (14.0%) and road side hazards namely animals or trees (12.3%). In the Delhi study, (73) the causes listed were high speed (31.03%), congested roads with high vehicular density (20.44%) and badly-maintained slippery roads (16.47%). Many other studies also have shown high speed as the main underlying cause of road traffic injury. (9) (50) Driver's fatigue was reported to be one of the causes of road traffic injuries. Other studies too have shown similar results. According to the European Transport Safety Council (2001), driver's fatigue was responsible for 20% of commercial road transport crashes, especially on long journeys on trunk roads and motorways. Fatigue, caused by overwork, excessive hours of driving, lack of rest and nourishment, produced a state of reduced mental alertness which could include sleepiness or drowsiness. Fatigue, attributed to drowsiness, was the cause of around 300 deaths per year in the UK, typically when the driver had fallen asleep at the wheel. (100)

4.1.3 Risk Factors

Norton et al. (5) referred to the fact that in the past two decades, the evidence base for the identification of risk factors for unintentional injuries in HICs had increased dramatically as the number of injury researchers and research institutions had increased. However, because of the paucity of injury researchers and research institutions in LMICs, the evidence base for the identification of risk factors for unintentional injuries in these countries is growing albeit slowly.
4.1.3.1 Socio-demographic risk factors

The socio-demographic factors which were investigated for the possible association with the risk of injuries in this study included age, gender, marital status, type of family, living with nuclear family, being head of the household, socio-economic status, residency in slum versus urban area, education, occupation, religion and ward of residence. Age was considered to be a risk factor for type-specific injury occurrence. Maximum road traffic injury occurrence was amongst the age group of 15 to 30 years whilst fall was more common amongst the age group of 5 to 15 years and 60 years and above. Similar pattern was reported from other studies in India, however in none of the studies, the association between age and risk of road traffic injuries was statistically examined. Ganveer and Tewari (27) reported that three fourths of the victims were in the age group of 18-37 years. The same result was reported by another Indian study. (28) Even in the population based study reported from Delhi the risk factors were not identified by using any statistical test. Verma and Tewari (73) reported that of the total injuries, 69% occurred in the age group of 15 to 35 years.

Norton et al. (5) suggested that whereas young people aged 15 to 29 years accounted for the highest proportion of all unintentional injuries, those aged 45 to 59 accounted for the highest proportion of injuries from poisonings, while those aged 70 to 79 years accounted for the highest proportion of injuries from falls. This study like other studies done in other countries (83) (5) (59) and in India (28) (9) (11) (27) showed that males were at a higher risk of injury occurrence, 2.05 (CI 95% 1.66-2.52) times more compared to females. The ratio of male to female injury occurrence rate was approximately 2:1. Verma and Tewari (11) also reported a ratio of 2:1. Gururaj (9) reported a ratio of 3:1 amongst fatal cases and emphasized that there was significant regional variation. This ratio for road traffic injuries was reported to be 6:1 (27) and 4.5:1. (73)
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This study showed that never-married individuals especially females had a significant risk of injuries and specially for road traffic injuries. Similar results were reported from other studies conducted in India. \(^{(11)}\) \(^{(34)}\) This could possibly be explained by the fact that never married females belonged to a younger age group and were more mobile as compared to married or widowed females. The association between type of family and injury occurrence was complicated. Males from separated families showed the maximum injury occurrences which could be due to increased responsibility in separated families. However, significant association between type of family and risk of injury was not found amongst females. When the association between injuries in females and road traffic injuries were measured, it was found that road traffic injury occurrences were significantly higher amongst females belonging to nuclear families and minimum amongst females who lived with their extended or joint families.

Being head of the household seemed to be a risk factor for increased risk of injuries. However this result could be biased due to the disproportionate distribution of males as heads of households. Males who were head of the households were significantly at more risk of road traffic injuries which could be ascribed to more exposure and more mobility.

In this study, higher socioeconomic status was found to be associated with increased risk of injury. However this association was not found to be significant when data was analyzed for males and females separately. The differences seen were mostly due to increased risk of road traffic injuries amongst females from higher socioeconomic group and the difference was more prominent amongst two extremes of the socioeconomic groups. This may be due to the fact that females from higher socioeconomic strata have higher mobility including more access to motorized two-wheeled vehicles. There is no consistency amongst different studies pertaining to the association of socioeconomic level and risk of injuries. In some studies in developed countries, poverty has been shown as a risk factor for injuries in children. There was a
strong association between belonging to higher socioeconomic status and risk of fall-related injuries. Maximum fall-related injuries were amongst individuals belonging to the upper socioeconomic strata (3.7%). Among Indian studies also, some reports indicated an increased risk of injury associated with poverty, but in Tanzania it was reported that poverty levels were not significantly associated with experiencing a nonfatal injury.

Occupation was found to be significantly associated with the risk of injury occurrence. Injuries were mostly amongst skilled male workers, and females who were students or individuals in the business or service sector. Minimum injury occurrences were observed amongst the unemployed and housewives. This association was mainly due to the increased risk of road traffic injuries and especially as a result of increased exposure to traffic for females, who were working, compared to the housewives and amongst skilled male workers due to increased risk of occupational injuries. Among Indian studies there are not many studies measured the association between occupation and risk of injuries. Most of the studies reported the occupation of the injured. Verma and Tewari have reported that most of the injured were professionals involved in business followed by workers. Housewives were reported to have the least incidence rate of injuries. Malhotra et al. reported that majority of road traffic victims were skilled or unskilled labourers (35.1%).

Religion was not found to be associated with the risk of injuries. However females in religious group categorized as others, mostly Zoroastrian and Christian, had significantly more risk of fall-related injuries mainly associated with sport related injuries compared to Muslim and Buddhist females. This difference can be attributed to a higher socioeconomic status and mobility of the females belonging to Zoroastrian and Christian religious groups compared to females from Muslim and Buddhist religious groups.

Place of residence was strongly associated with the occurrence of unintentional injuries. Those wards with colonies of minority religious groups like Sikh and
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Zoroastrian, which were belonging to higher socioeconomic strata, had increased risk of injury occurrence specially fall-related injuries. However the place of residence may play a more complicated and multi-factorial role on risk of injury occurrence, which needs further investigation.

4.1.3.2 Health related risk factors

The health related factors which were investigated for the possible association with the risk of injuries included disability, visual impairment and regular alcohol use. The findings of this study revealed that injury occurrences were significantly higher amongst individuals with disability as compared to individuals without disability. Ramirez et al. (103) in their study on disability and risk of school related injury have shown a similar association between disability and increased risk of injury amongst children. The risk of injury was 2.7 (95% CI 1.2 – 6.8) higher amongst individuals with visual impairment compared with individuals without visual impairment. This difference was mainly in association with fall related injuries. Individuals with the visual impairment had 6.2 (95% CI 1.9 -20.4) times more risk of fall related injuries. A similar association was reported by Legood et al. (102) which indicated that individuals with reduced visual acuity were 1.7 times more likely to have a fall and 1.9 times more likely to have multiple falls as compared to fully sighted populations.

There was a strong association between regular alcohol use and increased risk of injuries. The amount of alcohol consumed was not measured in this study. Males who consumed alcohol regularly had 3.07 (95% CI 1.9 - 4.9) times more risk of road traffic injuries. The information related to alcohol use in this study however does not show the dependency of individual to alcohol (just using alcohol and not alcohol use disorder) or the time gap between the last drink and injury occurrence, although some studies show that there is no significant difference in relative risk of being injured for individuals with alcohol use disorders (abuse or dependence) and other alcohol use. (99) Identifying regular alcohol consumption and increased risk of injuries in this study is consistent with the findings of other studies from other countries (99) (92) (5) and
India which shows that episodic and acute alcohol consumption is important risk factors for injury.\textsuperscript{(33) (30) (135)}

4.1.3.3 Specific risk factors for child injury

The specific factors for child injury which were investigated for the possible association with the risk of injuries included playing on the streets, mother’s age and mother’s education for under five children. The finding of this study showed that:

No significant association was found between mother’s age and education and risk of injury occurrence amongst under five children. This finding can be attributed to the small number of under five children and small number of injury occurred amongst them. However some studies amongst developed nation showed that young maternal age and less than 12 years education was a risk factor for injury.\textsuperscript{(95-96)}

No significant association was found between playing on the road and streets and injury occurrence amongst children (less than 15 years) which may be due to small sample size or the fact that children playing on the streets are so common (one third of all children) that the children and those road users who have a vehicle are alert and careful enough to prevent injury occurrence.

4.1.3.4 Road traffic injuries specific risk factors

The specific factors for road traffic injuries which were investigated for the possible association with the risk of injuries included mode of transport, driving vehicle, possessing driving license, number of pillion riders of two wheeled vehicles users and using helmet.

There was significant association between mode of transport and road traffic injury. Maximum injury occurrence was amongst individuals who used both two-wheeled vehicles and cars as their main mode of transport. Similar association was found amongst male and female users of two-wheeled vehicle as sole mode of transport.
The risk of road traffic injuries was 1.6 (95% CI 1.2-2.4) times more for males who used two-wheeled vehicles as one of the main modes of transport and similarly was 2.11 (95% CI 1.2-3.7) times more for females. The risk of road traffic injuries was 1.40 (95% CI 1.0-1.9) times more for male users whose sole mode of transport was two-wheeled vehicles. The association between using two-wheeled vehicles and increased risk of injury is known and has been reported in many Indian studies. (25) (73) (30) However, the findings that those who used two-wheeled vehicle as well as a car as their main mode of transport had a higher chance of injury when compared to those who used only two-wheeled vehicles is a new finding which needs more investigation. This phenomena may be due to lack of proper two-wheeled vehicle use amongst those also use a car.

Driving a vehicle was a risk factor for road traffic injury occurrences. Male drivers had 2.6 (95% CI 1.8-3.6) times and female drivers had 4.54 (95% CI 2.7-7.6) times increased risk of road traffic injuries. This finding is a clear reflection of being more exposed to traffic mobility as well as driving skills. More road traffic injuries amongst drivers were also reported by Malhotra et al. (31)

There was no significant difference in road traffic injury occurrences amongst drivers with or without a driving license.

Not having helmet at the time of road traffic injury increased risk of head injury by 6.45 (95% CI 1.47-28.4) times however possession of helmet and regularity of its use was not associated with head injuries. This shows that using helmet is a protective factor when it is used regularly without failure. However in India as revealed by this and other studies, the percentage of people who regularly use a helmet whilst riding motorized two wheeled-vehicle regularly are very few. The less educated individuals, youth and females were amongst those who reported least use of helmets. Enforcement of helmet law has shown to have a direct effect on decreasing head injury. For example, introducing comprehensive motorcycle helmet legislation in Texas, USA was associated with a decrease in injuries and fatalities. In one of these
studies there was a decrease in injury rates of between 9–11%, while another showed more striking reductions of 52–59% in head injuries and fatalities. Conversely, repeal of helmet legislation in Florida led to increases of between 17.2%–20.5% in both fatalities and fatality rates.\(^{(133)}\)

4.1.3.5 Risk factors specific for home injuries

The specific factors for home injuries which were investigated for possible association with the risk of injuries included type of housing, type of building, number of individuals in the household and density of individuals per room. No significant difference was found in home injury occurrence between individuals who lived in permanent houses and those who lived in temporary houses in this study, which may be due to small sample of individuals who were living in temporary house.

The association between type of building and risk of home injury was rather complicated. Living in an apartment was a protective factor for males since males who were not living in apartments had 2.48 (95% CI 1.3 – 4.8) times more chance of home injury. Females who were living in apartments had 1.72 (95% CI 1.1-2.8) times more chance of injury. The underlying cause of this finding demands more specific etiologic research for home injuries. The individuals belonging to households with less density of individuals per room were at a greater risk of injury. This also is another finding which demands more etiological investigation.

4.2 Part two: Injury prevention and control

Reducing the burden of injury is an international health goal. Injuries, whether due to fall or road traffic, have one thing in common. They are largely preventable. World Health Organization estimated that even in the European region, if all countries equalized injury prevention rates to those with the best performance, more than two out of three injuries could be prevented. This estimation would be much higher for developing countries.\(^{(7)}\)
In planning for injury prevention and control, the historical dilemma was the use of "active" (behavioural) strategies and "passive" (structural) strategies. Passive approaches rely on changing products or environments making them safer for all, irrespective of the behaviour of individuals. Active approaches encourage or require people to take an active role in protecting themselves, despite hazards in their environments. The passive strategies have been shown historically to be effective in reducing the burden of infectious diseases like reduction of tuberculosis in European countries through public health measures even before discovery of the etiologic agent or antibiotics. In case of injuries, creating a safe environment would reduce the burden of injuries and is the first responsibility of governments. It is however rarely possible to achieve injury reduction without some element of active approaches and behaviour change. In the active approach towards injury prevention, education is the main element, however education has been shown to be less effective in injury reduction especially in developing countries. A systematic review of randomized controlled trials of safety education programmes for pedestrians of all ages in developed nations has shown that pedestrian safety education can change observed road crossing behaviour, but whether this reduces the risk of pedestrian injury in road traffic crashes is unknown. There is lack of good evidence on effectiveness of safety education for adult pedestrians, especially elderly people and in low or middle income countries. Behavioural science is required to create a new way of education that can be inductive to injury prevention. For example, making roadways and vehicles safer has done more to decrease injuries from motor vehicle crashes than exhortations to drive carefully. Safety caps on medication bottles have been effective in reducing deaths from poisoning among children, whereas warning stickers and reminders to parents to lock up medications and household poisons are relatively ineffective. In practice, many injury-prevention programs consist of both passive and active strategies, but an emphasis on the passive components is more likely to result in a sustained decrease in injuries.

However in developing countries still predominantly focus on active approach.
Discussion

There are many cost effective known injury control interventions that can be used in India. The intervention models have been shown to have avert from US $5 to $ 556 per DALY depending on region. Enhanced enforcement of traffic regulations is the most cost-effective interventions with an average cost per DALY of $64. Legislation plays an important role in injury control in developed countries. One of the best example was shown in a case control study done in the year 2000, which showed that the bicycle safety helmet legislation in California, enacted in 1994, was associated with a reduction of 18.2% (99% CI 11.5% - 24.3%) in the proportion of traumatic brain injuries among youth bicyclists. However legislation alone may not be of a great use in developing countries. There is a more urgent need for identifying the means for enforcement of the law.

4.2.1 Implication of finding of this study in injury control

In India, the health sector has primarily focused its efforts on diagnosis and management of injuries and not on primary prevention. However the superiority of primary injury prevention over secondary prevention and treatment is widely accepted. Preventability implies a potential for reduction of incidence.

The findings of this study suggest the following implication for injury prevention.

The magnitude of injury as a public health problem, revealed in this study can be used for large-scale awareness programmes for policy makers, politicians, professionals, public and press. Injury prevention should be given high priority amongst policy makers, governmental and non-governmental sectors and general public. The fact that most causes of injuries and mortality due to injuries were related to unsafe environment should form the basis for emphasising the urgent need to implement passive injury control measures through environmental change.
Discussion

Safety education should be made part of the educational curriculum and media. The sudden increase in road traffic injury occurrences and the highest occurrence of road traffic injury in the age group 15 to 30 years suggests that the road traffic safety education should start at the age of 15 years or before.

Road traffic injuries should be the main target of interventions. Road design should prioritize the safety of road users and the most vulnerable groups which are the users of motorized two-wheeled vehicles and pedestrians. Traffic laws related to helmet use should be enforced through education and legal interventions. Youth and less educated individuals and females should be targeted for helmet use safety education as they were amongst least helmet users. Also concessions in price, designing more comfortable helmets and making purchase of helmet compulsory at the time of selling a two-wheeled vehicle should be considered. Law of prohibition of drunken driving should not only be enforced but also should accompany programs for rehabilitation of alcohol addicted individuals.

The need to strengthen the pre-trauma and trauma care system in order to control injury related disabilities and preventable mortalities is evident from the finding that very few injured individuals received first aid at the time of injury. Other evidences for strengthening trauma care was rare use of ambulance for transportation of the injured and the delay in reaching medical care facilities even in severe cases of injuries.

A high burden of animal related injuries was found in this study. Dogs, predominantly stray dogs, were responsible for more than three fourths of injuries primarily amongst slum dwellers. This observation demands the need of the Pune Municipal Corporation to intensify its activities to control stray dogs in the city.

Occupational injuries were reported by workers in the unorganized sector, but not from those working in industries. Thus there is need to improve working conditions by focusing on legislation and enforcement in this sector.