

Burden and Epidemiological Profile of Injuries in Ghaziabad District, Uttar Pradesh: A Community-Based Cross-Sectional Study

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ABSTRACT

Background: Injuries are a significant public health problem contributing to morbidity, disability, and mortality worldwide. Rapid urbanization, motorization and changing lifestyles have increased exposure to injury risks in developing regions. District-level data are essential to guide local prevention strategies. **Objective:** To assess the burden and epidemiological profile of injuries in Ghaziabad district with respect to prevalence, nature, patterns, and mortality. **Methods:** A community-based cross-sectional study was conducted among 1,668 individuals in rural and urban areas of Ghaziabad. Injuries occurring in the past one year that resulted in loss of at least one day of normal activity and all injury-related deaths were included. Data were collected using a pre-tested structured questionnaire and analysed using descriptive statistics. **Results:** Out of 1,668 participants, 391 reported injuries in the past year, giving an annual prevalence of 23.4%. Injuries were more common among males and young adults. Falls (36.3%) and road traffic injuries (27.4%) were the leading mechanisms. Post-injury mortality was observed in 6.4% of injured cases. **Conclusion:** Injuries constitute a considerable public health burden in Ghaziabad district. Targeted interventions focusing on home safety, road safety enforcement, and community awareness are essential to reduce injury incidence and related mortality.

KEYWORDS

Injury, Prevalence, Epidemiology, Falls, Road Traffic Injury, Mortality, Ghaziabad

INTRODUCTION

Injuries are a major cause of morbidity and mortality across all age groups. They occur due to acute exposure to mechanical, thermal, chemical, or electrical energy beyond the body's tolerance. Both unintentional and intentional injuries contribute to premature death and long-term disability. (1,2) Globally, injuries account for millions of deaths annually and a large proportion of disability-adjusted life years. Low and middle-income countries bear the highest burden due to rapid urbanization, unsafe environments, occupational hazards, and limited trauma care services. (3)

India is experiencing rapid socio-demographic and economic transitions that increase injury risks. Urban expansion, industrial growth, and motorization have increased exposure to road traffic and workplace hazards. Domestic environments also contribute to falls, burns, and poisoning. (4) Ghaziabad district, located in the National Capital Region, is characterized by dense population, high vehicular movement, construction activities, and mixed rural-urban settings. These factors create a complex environment for injury occurrence. However, district-level epidemiological data remain limited. (5)

Aims:

To assess the burden and epidemiological profile of injuries in Ghaziabad district.

Objectives:

To determine the prevalence of injuries in Ghaziabad district

To describe the nature of injuries among the study population

To analyse the patterns of injuries with respect to their causes and distribution

To assess the magnitude of injury-related mortality in the district

MATERIAL & METHODS

Study Type and Study Design: A community-based cross-sectional study was conducted to assess the burden and epidemiological profile of injuries.

Study Setting: The study was carried out in both rural and urban areas of Ghaziabad district, Uttar Pradesh.

Study Population: The study included individuals of all age groups who had been residing in Ghaziabad district for more than one year.

Study Duration: The study considered injuries that occurred within a recall period of one year preceding the survey.

Sample Size Calculation: Sample size was determined by Fisher's formula:

$$n = \frac{z^2 pq}{e^2} \times 1.1 \times \frac{1}{HH}$$

where,

n = sample size,

z = 1.96 (95% confidence limit), p = 19.7% (7)

1.1 = factor necessary to raise the sample size by 10% to allow for non-responses

q = (1 - p), e = 2% and HH = 4.4 (House Hold)

Thus, $n = [(1.96)^2 (0.197) (0.803) / (0.02)^2] \times (1.1) (1 / 4.4)$

The required sample size came out to be 379 household
A total of 1,668 individuals were studied

Sampling Technique: Multistage random sampling with probability proportional to size was used. Urban wards and rural villages were selected in the first stage, followed by random selection of households in the second stage.

Inclusion Criteria:

- Residents living in Ghaziabad for ≥1 year
- Individuals who sustained injuries causing at least one day of activity loss in the past year
- All injury-related deaths occurring in the past year

Exclusion Criteria:

- Any household who refused to give consent

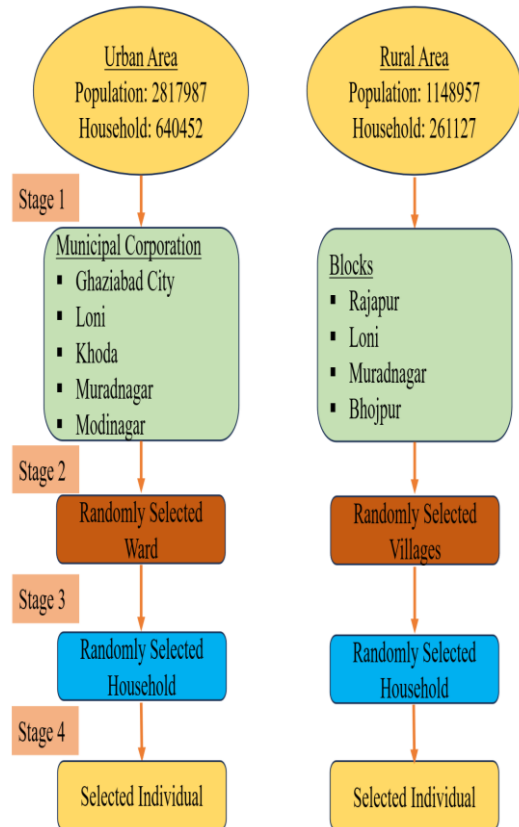
Strategy for Data Collection: Data were collected using a pre-tested structured questionnaire. Information on socio-demographic characteristics, mechanism of injury, and outcomes was obtained through interviews.

Working Definition: An injury was defined as any event resulting in physical harm that led to at least one day of restriction of normal activities or resulted in death within the past one year.

Ethical Issues and Informed Consent: Informed consent were obtained from all participants. Confidentiality and anonymity of the collected data were strictly maintained.

Data Analysis: The data was collected and entered into Microsoft Excel 2020 (version 16) to confirm any missing value and error. SPSS software (trial version 26) was used to conduct the statistical analysis. For both qualitative and categorical data, descriptive statistics such as frequencies, percentages, means, and standard deviations were used. The connection between categorical variables was determined using the Chi-Square test, where a p-value of less than 0.05 was considered statistically significant and a p-value of more than 0.05 was considered statistically insignificant.

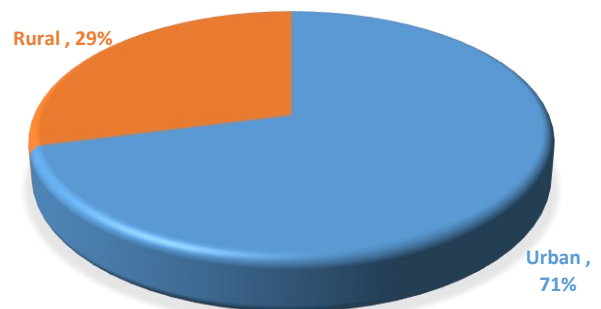
Sampling Technique: A multistage random sampling technique of study participants.



RESULTS

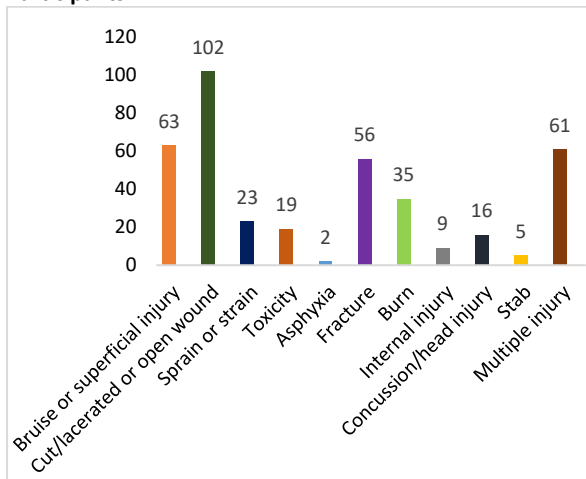
Among 1,668 study participants, 391 reported at least one injury in the preceding year, yielding an annual injury prevalence of 23.4%. Injuries were more frequent among males and young adults.

Figure 1: The Prevalence of Injury According to Locality among the Study Participants in the Past 12 Months



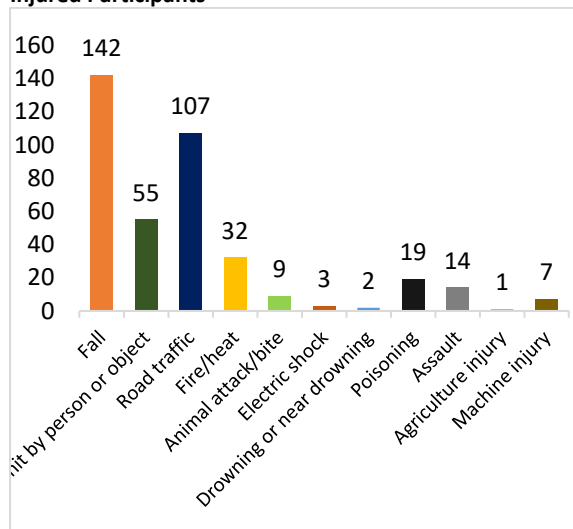
Of the 391 participants who sustained injuries, a majority were from urban areas 278 (71%), while 113 (29%) belonged to rural areas, showing that most injuries occurred among the urban population.

Figure 2: Distribution of Nature of Injury Among Injured Participants



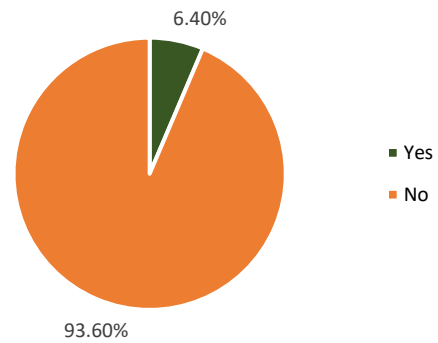
Among the 391 injured participants, cut/lacerated or open wounds were the most common injury 102 (26.1%), followed by bruise or superficial injuries 63 (16.1%) and multiple injuries 61 (15.6%). Fractures accounted for 56 (14.3%) and burns for 35 (9.0%). Other injuries included sprain or strain 23 (5.9%), toxicity 19 (4.9%), and concussion or head injury 16 (4.1%). Internal injuries 9 (2.3%), stab injuries 5 (1.3%), and asphyxia 2 (0.5%) were relatively uncommon.

Figure 3: Distribution of Mechanism of Injury Among Injured Participants



Out of the total 391 injuries, the most common mechanism was fall, reported in 142 (36.3%), making it the leading cause of injury. This was followed by road traffic injuries with 107 (27.4%). Injuries due to being struck or hit by a person or object were noted in 55 (14.1%). Fire or heat-related injuries accounted for 32 (8.2%), while poisoning was seen in 19 (4.9%). Assault contributed 14 (3.6%), and animal attacks or bites were reported in 9 (2.3%). Machine-related injuries formed 7 (1.8%). Less frequent mechanisms included electric shock with 3 (0.8%), drowning or near drowning with 2 (0.5%), and agriculture-related injury with 1 (0.3%).

Figure 4: Distribution of Post-Injury Death Among Study Participants



Among 391 injured study participants, 25 individuals resulted in post-injury death, accounting for 6.4% of the injured cases. The remaining 366 participants (93.6%) survived following the injury.

Table 1 demonstrates that the nature of injury varied significantly across age groups ($\chi^2=116.65$, $df=70$, $p<0.001$), with bruises 15 (26.3%) and cuts 14 (24.6%) being most common among children ≤ 10 years. In 11–20 years, cuts 32 (35.2%) predominated followed by multiple injuries 21 (23.1%), while the 21–30 years group also showed higher proportions of cuts 25 (27.5%) and bruises 16 (17.6%). Among 31–40 years, burns 16 (20%) and fractures 12 (15%) were notable, and in 41–50 years fractures 11 (22%) were the leading type, whereas older age groups (51+ years) showed relatively more cuts, sprains, and fractures. A statistically significant association was also observed with gender ($\chi^2=59.15$, $df=10$, $p<0.001$), where cuts 70 (24.8%), multiple injuries 57 (20.2%), and fractures 45 (16%) were more frequent among males, while among females cuts 32 (29.4%) and burns 25 (22.9%) were prominent; head injuries were reported only among males 9 (3.2%), and toxicity and burn injuries formed a relatively higher share among females.

Table 2 shows that the mechanism of injury differed significantly by age ($\chi^2=116.19$, $df=70$, $p<0.001$), with falls emerging as the dominant mechanism across most age groups, particularly in ≤ 10 years 34 (59.6%), 51–60 years 8 (57.1%), and 61–70 years 4 (66.7%). Road traffic injuries were more common among young and middle-aged adults, especially 21–30 years 31 (34.1%) and 41–50 years 14 (28%), while fire-related injuries were noticeable in 31–40 years 14 (17.5%) and 21–30 years 9 (9.9%). Assault and struck injuries showed moderate distribution in adolescents and adults. A statistically significant association was also observed with gender ($\chi^2=68.91$, $df=10$, $p<0.001$), where among males falls 99 (35.1%) and road traffic injuries 86 (30.5%) were most frequent, whereas among females falls 51 (46.8%) remained the leading mechanism followed by fire-related injuries 25 (22.9%); struck injuries and assaults were proportionally higher among males, while poisoning and fire injuries formed a relatively higher share among females. Overall, the findings indicate that age and gender are significantly associated with the mechanism of injuries among participants.

Table 1: Association between Age, Gender and Nature of Injury among Study Participants

Variables	Nature of injury												
	Bruise	Cut	Sprain	Toxicity	Asphyxia	Fracture	Burn	Internal Injury	Head Injury	Stab	Multiple Injury	Total	
Age in Yrs													
≤10	15 (26.3%)	14 (24.6%)	2	5	0	10	2	2	5 (8.8%)	0	2	57	116.65
			-3.50%	-8.80%		-17.50%	-3.50%	-3.50%			-3.50%		70
Nov-20	17 (18.7%)	32 (35.2%)	6	0	2	10	1	0	2 (2.2%)	0	21	91	0
			-6.60%		-2.20%	-11%	-1.10%				-23.10%		
21-30	16 (17.6%)	25 (27.5%)	5	4	0	9	9	2	3 (3.3%)	2	16	91	
			-5.50%	-4.40%		-9.90%	-9.90%	-2.20%		-2.20%	-17.60%		
31-40	13 (16.3%)	15 (18.8%)	1	8	0	12	16 (20%)	2	3 (3.8%)	0	10	80	
			-1.30%	-10%		-15%		-2.50%			-12.50%		
41-50	2	7	5	2	0	11	5	3	3	3	9	50	
	-4%	-14%	-10%	-4%		-22%	-10%	-6%	-6%	-6%	-18%		
51-60	0	5	2 (14.3%)	0	0	3	2 (14.3%)	0	0	0	2	14	
			-35.70%			-21.40%					-14.30%		
61-70	0	2	2 (33.3%)	0	0	1	0	0	0	0	1	6	
			-33.30%			-16.70%					-16.70%		
71-80	0	2	0	0	0	0	0	0	0	0	0	2	
			-100%										
Gender													
Male	42	70	16	12	2	45	10	9	14	5	57	282	59.15
	-14.90%	-24.80%	-5.70%	-4.30%	-0.70%	-16%	-3.50%	-3.20%	-5%	-1.80%	-20.20%		10
Female	21	32	7	7	0	11	25	0	2	0	4	109	0
	-19.30%	-29.40%	-6.60%	-6.40%		-10.10%	-22.90%		-1.80%		-3.70%		

Table 2: Association between Age, Gender and Mechanism of Injury among Study Participants

Age in Yrs	Mechanism of Injury												
	Fall	Struck	Traffic	Fire	Animal Attack	Electric Shock	Drowning	Poisoning	Assault	Agriculture	Machine	Total	
≤10	34	9	7	2	0	0	0	5	0	0	0	57	116.19
	-59.60%	-15.80%	-12.30%	-3.50%				-8.80%					70
Nov-20	34	18	24	1	5	0	2	0	7	0	0	91	0
	-37.40%	-19.80%	-26.40%	-1.10%	-5.50%		-2.20%		-7.70%				
21-30	29	10	31	9	2	0	0	4	4	0	2	91	
	-31.90%	-11%	-34.10%	-9.90%	-2.20%			-4.40%	-4.40%		-2.20%		
31-40	23	14	17	14	0	2	0	8	0	0	2	80	
	-28.70%	-17.50%	-21.30%	-17.50%		-2.50%		-10%			-2.50%		
41-50	18	2	14	5	2	0	0	2	3	1	3	50	

	-36%	-4%	-28%	-10%	-4%			-4%	-6%	-2%	-6%		
51-60	8	2	2	1	0	1	0	0	0	0	0	0	14
	-57.10%	-14.30%	-14.30%	-7.10%		-7.10%							
61-70	4	0	2	0	0	0	0	0	0	0	0	0	6
	-66.70%		-33.30%										
71-80	0	0	2	0	0	0	0	0	0	0	0	0	2
			-100%										
Gender													
Male	99	47	86	7	5	3	2	12	14	1	6	282	68.91
	-35.10%	-16.70%	-30.50%	-2.50%	-1.80%	-1.10%	-0.70%	-4.30%	-5%	-0.40%	-2.10%		10
Female	51	8	13	25	4	0	0	7	0	0	1	109	0
	-46.80%	-7.30%	-11.90%	-22.90%	-3.70%			-6.40%			-0.90%		

DISCUSSION

In the present study, injuries during the last one year were reported by 391 (23.4%) of the study participants, while 1277 (76.6%) did not report any injury. A comparable prevalence was documented by Wani et al. (4), who reported injuries among 129 (19.7%) participants. Gosalia et al. (12) also observed a similar magnitude, with an overall injury prevalence of 14% among 2367 study participants. These variations may be attributed to differences in injury definitions, types of injuries considered, and the reference period used for assessment.

Cut or lacerated/open wounds were the most common nature of injury, reported in 102 (26.1%) cases, followed by bruises or superficial injuries in 63 (16.1%) cases and multiple injuries in 61 (15.6%) cases. Similar patterns were observed by Lahare et al. (5), where superficial and open wounds predominated.

Falls were the most common mechanism of injury, reported in 142 (36.3%) cases, followed by road traffic injuries in 107 (27.4%) cases. Similar findings were reported by Lahare et al. (5), where falls were the leading cause of injury. In contrast, Rajan et al. (7) reported lower population-level prevalence of falls, reflecting differences in study design and injury categorization.

Post-injury death was reported in 25 participants, accounting for 6.4% of the injured study population, while 366 participants (93.6%) survived following injury. A comparable finding was reported by Wani et al. (4), where post-injury death occurred in 4.6% of injured participants, which is slightly lower than that observed in the present study. In contrast, Gosalia et al. (8) reported a much lower proportion of fatal outcomes, with death at the crash site accounting for only 1.2% of cases. The relatively higher proportion of post-injury deaths in the present study may be related to differences in injury severity, mechanisms of injury, and access to timely medical care.

A statistically significant association between age and nature of injury was observed among injured study participants ($\chi^2 = 116.65$, $df = 70$, $p = 0.001$). Among participants aged ≤ 10 years, bruise or superficial injuries were most common, reported in 15 cases (26.3%), followed by cut injuries in 14 cases (24.6%). In the 11-20 years age group, cut injuries accounted for 32 cases (35.2%), followed by multiple injuries in 21 cases (23.1%). Participants aged 21-30 years also showed a predominance of cut injuries (25 cases; 27.5%) and multiple injuries (16 cases; 17.6%). In the 31-40 years age group, burn injuries were relatively higher at 16 cases (20%), followed by fractures in 12 cases (15%). Fractures were most frequently observed in the 41-50 years age group, accounting for 11 cases (22%), indicating increasing injury severity with advancing age. A similar age-related pattern was reported by Lahare et al. (5), where cut, bite, and open wounds constituted 36.5% in individuals ≤ 20 years and 30.1% in the 21-40 years age group, while fractures increased to 23.2% in the 21-40 years and 22.3% in the 41-60 years age groups, with a statistically significant association ($p = 0.01$). These findings from both studies confirm that injury patterns vary significantly with age. Gender showed a statistically significant association with the nature of injury ($\chi^2 = 59.15$, $df = 10$, $p = 0.001$). Among male participants ($n = 282$), cut injuries were most common, reported in 70 cases (24.8%), followed by multiple injuries in 57 cases (20.2%) and fractures in 45 cases (16%). Among female participants ($n = 109$), cut injuries accounted for 32 cases (29.4%), while burn injuries were notably higher at 25 cases (22.9%), followed by bruises in 21 cases (19.3%) and fractures in 11 cases (10.1%). A comparable gender-wise distribution was reported by Lahare et al. (2023)5, where cut and open wounds were more common among males (32.6%) than females (26.1%), while burn injuries were significantly higher among females (14.3%) compared to males (5.2%), with a statistically significant association ($p = 0.01$). These findings suggest that gender-specific roles and exposures influence the nature of injury.

In the present study, age demonstrated a strong and statistically significant relationship with the mechanism of injury among the participants ($\chi^2 = 116.19$, $df = 70$, $p = 0.001$). Children aged ≤ 10 years were predominantly affected by falls, which constituted 59.6% of injuries, followed by struck injuries (15.8%) and road traffic injuries (12.3%). Among adolescents and young adults aged 11–20 years, falls remained the leading cause (37.4%), while road traffic injuries (26.4%) and struck injuries (19.8%) also contributed substantially. A shift in pattern was observed in the 21–30 years age group, where road traffic injuries emerged as the most common mechanism (34.1%), followed closely by falls (31.9%), with fire-related injuries accounting for 9.9%. Participants aged 31–40 years exhibited a more varied distribution, with falls accounting for 28.7%, road traffic injuries for 21.3%, and fire-related injuries for 17.5%. In the 41–50 years age group, falls (36%) and road traffic injuries (28%) continued to predominate, whereas the older age groups reported fewer cases with diverse injury mechanisms. Comparable age-related variations were reported by Lahare *et al.* (5), where falls were most frequent among individuals aged ≤ 20 years (48.1%) and those above 60 years (75%), while road traffic injuries were highest in the 21–40 years age group (49.1%) and remained substantial in the 41–60 years group (35.5%), with statistically significant findings ($p < 0.01$). These observations confirm that injury mechanisms vary markedly across different age groups. Gender also showed a statistically significant association with the mechanism of injury ($\chi^2 = 68.91$, $df = 10$, $p = 0.001$). Among male participants, falls constituted 35.1% of injuries, followed by road traffic injuries (30.5%) and struck injuries (16.7%), while smaller proportions were attributed to assault (5%), poisoning (4.3%), and machine-related injuries (2.1%). In contrast, females experienced a higher proportion of falls (46.8%), with fire-related injuries accounting for 22.9%, road traffic injuries for 11.9%, and poisoning for 6.4%. Similar gender-specific patterns were observed by Lahare *et al.* (5), who reported falls in 47.9% of females and 33.2% of males, road traffic injuries in 40.9% of males compared to 25.2% of females, and burn injuries in 10.9% of females versus 4.7% of males, all showing statistically significant associations. These findings reflect differential exposure and activity patterns between males and females.

CONCLUSION

The present study revealed that 391 out of 1,668 participants (23.4%) experienced at least one injury in the past year, indicating a considerable community-level injury burden. Injuries were more common among males (74.8%) and individuals in the 21–30 years (35.6%) and 31–40 years (29%) age groups, showing higher vulnerability in the economically productive population. Regarding injury characteristics, cut/lacerated wounds (26.1%), bruises (16.1%), multiple injuries (15.6%), and fractures (14.3%) were the most frequent types. Falls accounted for 36.3% of injuries and road traffic injuries for 27.4%, making them the two leading mechanisms. Post-injury death occurred in 25 cases (6.4%), highlighting the potential severity of injuries. Age showed a significant association with both nature ($\chi^2=116.65$, $p=0.001$) and mechanism of injury

($\chi^2=116.19$, $p=0.001$). Falls predominated in children ≤ 10 years (59.6%) and older adults 61–70 years (66.7%), while road traffic injuries were highest in the 21–30 years group (34.1%). Gender differences were also significant for nature ($\chi^2=59.15$, $p=0.001$) and mechanism ($\chi^2=68.91$, $p=0.001$). Males had higher proportions of cut injuries (24.8%) and fractures (16%), whereas females showed a higher proportion of burns (22.9%) and falls (46.8%).

Overall, the findings indicate that nearly one in four individuals sustained injuries, with clear age- and gender-based patterns and predominantly preventable causes such as falls and road traffic incidents, emphasizing the need for targeted injury prevention and safety interventions.

RECOMMENDATION

(Public health importance)

Strengthen fall prevention measures: Promote safer home and community environments through improved lighting, safe flooring, handrails on stairs, and removal of household hazards, especially for children and older adults.

Improve road safety: Enforce helmet and seatbelt use, follow speed regulations, and promote safe driving practices to reduce road traffic injuries. Pedestrian safety and traffic calming measures should also be encouraged.

Enhance community awareness: Conduct regular health education programs on injury risks, first aid, and safe behaviours at home, workplaces, and on roads.

Promote workplace safety: Encourage the use of protective equipment and adherence to safety guidelines, particularly for skilled and manual workers.

Strengthen emergency and trauma care: Improve access to timely first aid and trauma services to reduce complications and deaths after injuries.

Focus on vulnerable groups: Design targeted interventions for children, young adults, and the elderly, as injury patterns differ by age and gender.

Establish injury surveillance: Develop local injury reporting and monitoring systems to guide prevention strategies and policy decisions.

LIMITATION OF THE STUDY

The cross-sectional design limits causal inference. Data were based on a one-year recall, which may introduce recall bias. Self-reported information may lead to reporting bias. Findings from a single district may have limited generalizability.

RELEVANCE OF THE STUDY

This study provides recent district-level evidence on injury burden in Ghaziabad. It highlights a high prevalence of injuries with falls and road traffic injuries as leading causes. It also identifies important age- and gender-based patterns, useful for targeted prevention strategies and local health planning.

AUTHORS CONTRIBUTION

All authors have contributed equally.

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Nil

CONFLICT OF INTEREST

There are no conflicts of interest.

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DECLARATION OF GENERATIVE AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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