

Analysis of the Pattern of Firearm Injuries in Medico-Legal Autopsy Cases Conducted at a Tertiary Care Centre in the Malwa Region of Punjab

Arun Garg¹, Shilekh Mittal^{2*}, Ishwer Tayal³, Rajiv Joshi⁴, Chatanya Tapsvi⁵

¹MD (Forensic Medicine) Medical Officer, Civil Hospital, Bathinda

²Professor, Forensic Medicine, GGS Medical College, Faridkot

³Associate Professor, Forensic Medicine, GGS Medical College, Faridkot

⁴Professor & Head, Forensic Medicine, GGS Medical College, Faridkot

⁵Professor & Head, Radiology, GGS Medical College, Faridkot

ABSTRACT

Firearm-related injuries constitute a major medico-legal and public health challenge in India, where both licensed and unlicensed weapons contribute significantly to violent deaths. Punjab reports a disproportionately high number of firearm fatalities due to sociocultural, geopolitical, and economic factors. Understanding the characteristics of fatal firearm injuries is essential for accurate forensic interpretation, effective legal adjudication, and the development of preventive public health strategies.

This autopsy-based descriptive study was carried out at Guru Gobind Singh Medical College & Hospital, Faridkot, Punjab, over 18 months. About 50 consecutive deceased individuals with alleged firearm injuries were examined. Detailed information regarding socio-demographic characteristics, circumstances surrounding the incident, clothing examination, wound features, and internal autopsy findings was documented and analysed quantitatively.

A total of 94% of the bodies were identified, and males constituted 86% of the cases. The most affected age groups were 21 to 30 years (30%) and 31 to 40 years (32%). Rural residents accounted for 64% of cases, with farmers/zamindars forming the largest occupational category (36%). Homicide was the predominant alleged manner of death (64%), followed by suicide (30%) and accident (6%). Blood staining was present on the clothing in nearly all cases (96%), with tears (76%), foreign bodies (56%), and blackening (48%) also frequently observed. Most victims (86%) were brought dead, highlighting the lethality and rapid fatality of firearm injuries.

The study concludes that firearm deaths in Faridkot predominantly affect young rural men of productive age, are largely homicidal, and frequently involve close-range injuries. The findings underscore the need for stricter regulation of illegal weapons, improved forensic documentation standards, and enhanced trauma response systems in rural Punjab. This study contributes region-specific forensic evidence that may support both medico-legal investigation and policy formulation.

Keywords: Firearm injury, Gunshot wound, Medico-legal autopsy, Homicide, Punjab, Forensic pathology, Ballistics, Rural violence.

Int J Eth Trauma Victimology (2026). DOI: 10.18099/ijetv.v12i01.03

INTRODUCTION

Firearm-related violence has emerged as a profound public health, legal, and forensic challenge in many parts of the world. According to global health statistics, violent injuries rank among the leading causes of mortality, and firearm injuries represent a considerable proportion of these deaths.¹⁻³

Firearm mortality and morbidity vary widely across countries, influenced by firearm accessibility, legislation, political stability, cultural norms, and socioeconomic variables. In 2016 alone, an estimated 251,000 firearm-related deaths were reported worldwide, excluding those occurring in war zones.³ High-income countries like the United States continue to grapple with firearm-related homicides and suicides, with more than 90 firearm-related deaths occurring each day, according to some estimates.²

In low and middle-income countries, including regions in South Asia, Africa, and Latin America, firearm injuries are

Corresponding Author: Shilekh Mittal, Professor, Forensic Medicine, GGS Medical College, Faridkot, e-mail: shilekh@gmail.com

How to cite this article: Garg A, Mittal S, Tayal I, Joshi R, Tapsvi C. Analysis of the Pattern of Firearm Injuries in Medico-Legal Autopsy Cases Conducted at a Tertiary Care Centre in the Malwa Region of Punjab. *Int J Eth Trauma Victimology*. 2025;12(1):20-23.

Source of support: Nil

Conflict of interest: None

Received: 27/01/2026;

Received in revised form: 27/05/2026;

Accepted: 05/06/2026;

Published: 28/07/2026;

often linked to social conflict, economic disparities, organised crime, interpersonal disputes, and inadequate firearm regulation. Beyond fatalities, millions suffer non-fatal injuries that result in long-term disability, hospitalisation, economic loss, and psychological trauma.^{1,2}

India presents a unique socio-legal landscape regarding firearm violence. Although strict firearm legislation exists under the Arms Act, illegal firearms remain widely available, especially country-made “kattas,” which are inexpensive and accessible. Sociocultural dynamics—such as land disputes, political rivalry, caste-based tensions, familial feuds, and celebratory firing—further contribute to the widespread use of firearms.^{4,5}

Data from the National Crime Records Bureau (NCRB) reveals that more than 1,000 firearm deaths were recorded in 2022 alone. A significant proportion of these deaths occur in northern Indian states such as Punjab, Haryana, Uttar Pradesh, and Bihar.⁴

While the overall number of cognizable crimes in India saw a minor decline in 2022, firearm-related incidents remained a persistent concern. Punjab and Haryana reported 697 and 681 gun-related deaths, respectively, marking some of the highest firearm mortality rates in the country.⁴

- Punjab, the geographical setting of this study, has long been associated with a high prevalence of gun culture. Multiple factors contribute to this pattern: Easy access to illegal country-made firearms.⁵
- Cultural acceptance of weapons as symbols of status and masculinity.⁶
- Cross-border trafficking from neighbouring regions^{1,7}
- Agrarian and landownership disputes^{6,8}
- High interpersonal violence in rural belts⁷

Faridkot district, situated in the Malwa region, reflects these broader patterns and presents unique forensic challenges due to the mixture of licensed, unlicensed, and country-made firearms used in violent incidents.^{6,7}

Gunshot wounds are among the most complex traumatic injuries faced by forensic experts.^{9,10}

Firearms can broadly be classified into rifled and smooth-bore weapons. Rifled weapons, including pistols and rifles, fire single projectiles at varying velocities. Smooth-bore weapons, such as shotguns, typically release multiple pellets that disperse after leaving the muzzle.⁹⁻¹¹

The injury severity and pattern depend on muzzle velocity, bullet shape and mass, range and angle of fire, interposition of clothing or barriers, and anatomical location of impact.¹⁰⁻¹²

REVIEW OF LITERATURE

Firearm-related injuries have long been recognised as a distinct and complex medico-legal domain within forensic pathology. Unlike many other trauma categories, firearm wounds incorporate physiological damage, ballistic mechanisms, environmental factors, behavioural characteristics, and socio-legal contexts.⁹⁻¹¹

Global firearm injuries contribute substantially to injury-related mortality. According to WHO and the Institute for Health Metrics and Evaluation (IHME), approximately 251,000 firearm deaths occurred globally in 2016, with 64% attributed to interpersonal violence, 27% to suicide, and 9% to unintentional injuries.^{1,3}

Despite strict regulations under the Arms Act, India

continues to experience substantial firearm violence. The NCRB reports that more than 1,200 firearm-related homicides occur annually, with additional accidental and suicidal firearm deaths.⁴

A major factor for firearm violence in India is the dominance of unlicensed and improvised weapons. Around 85–90% of firearm injuries in some northern states involve country-made weapons, which are cheap, easily available, and highly prevalent in regions such as Uttar Pradesh, Bihar, Jharkhand, Punjab, and Haryana.^{6,7,8,13}

Punjab, being a border state with a history of insurgency, has its own pattern of weapon prevalence and usage. Various studies in Punjab highlight that firearm deaths constitute 5–12% of total autopsies, with a consistently high proportion of homicidal cases.^{6,7,13,14}

MATERIALS AND METHODS

Study Design

This study employed a quantitative, descriptive, autopsy-based research design, focused on analysing the epidemiological, medico-legal, and pathological characteristics of fatal firearm injuries. Autopsy data were used to interpret wound morphology, injury mechanisms, and correlating socio-demographic variables.

The study was conducted in the Department of Forensic Medicine & Toxicology at Guru Gobind Singh Medical College & Hospital, Faridkot (Punjab), a tertiary care government medical institution serving a largely rural population.

Study Period

The study was carried out over 18 months, during which 50 consecutive autopsy cases with alleged firearm injuries were examined.

Study Population

All deceased individuals brought to the mortuary during the study period with a documented or alleged history of firearm injury were included.

Inclusion Criteria

All deceased individuals with suspected or confirmed firearm injuries, irrespective of

- Type of firearm
- Weapon recovery
- Distance of fire
- Circumstances of death
- Time elapsed between injury and death

Exclusion Criteria

- Bodies decomposed to a degree that firearm injury assessment was impossible.
- Cases where firearm injury was secondary or incidental (e.g., postmortem animal scavenging)

Table 1: Distribution of firearm autopsy cases with respect to age

Age	Frequency	Percent
10–20	1	2.0
21–30	15	30.0
31–40	16	32.0
41–50	4	8.0
51–60	9	18.0
61–70	5	10.0
Total	50	100.0

Table 2: Distribution of firearm autopsy cases with respect to the state of clothing

	Frequency	Percent
Clothes blackening:	24	48.0
Tears	38	76.0
Blood stains	48	96.0
Foreign body	28	56.0

- Explosion-related deaths not involving firearm discharge

Statistical Analysis

Data obtained were entered into SPSS (version 26 Statistical tools included:

- Descriptive statistics (frequencies, percentages)
- Chi-square tests for categorical variables
- Cross-tabulation to explore associations

A p -value < 0.05 was considered statistically significant.

RESULTS

This section provides a detailed narrative interpretation of all observations documented across the 50 autopsy cases. Findings are presented under categorical headings for clarity.

Out of the 50 cases, 47 (94%) were identified. Firearm fatalities showed a highly skewed male predominance, 43 cases (86%).

The most affected age groups were 21 to 40 years, 62% of which 68% married, and 64% were rural residents. The major occupations were farmers/zamindars, employed 36% each, followed by unemployed, 14% (Table 1).

Table 3: Distribution of firearm autopsy cases with respect to entry wound characteristics

	Frequency	Percent
Abrasion collar	40	80.0
Blackening	25	50.0
Tattooing	24	48.0
Singeing	12	24.0
Bleeding (clotted blood)	46	92.0

About 43 cases (86%) were brought dead to the hospital with clothes bloodstaining in 96% and clothes torn in 76% of cases, with blackening in 24 cases (48%) with foreign bodies in clothing in 28 cases (56%). Alleged manner of death: majority 64% homicidal (Table 2).

Predominant entry wound features in the chest (38%), exit wound features observed in 38% of cases, with the most injured organs being the lungs (30 cases). Bullet/Pellet Recovered Projectiles recovered in 31 cases, Pellets (shotgun) in 19 cases, Deformed bullets in 7 cases and Intact bullets in 5 cases.

DISCUSSION

Firearm-related mortality reflects the intersection of interpersonal violence, weapons availability, sociocultural patterns, and forensic interpretation. The findings of the present study align with and add to the established body of literature on firearm fatalities in India and internationally.

Male predominance observed in this study is consistent with global and Indian studies, where males constitute most firearm fatality victims.^{6-8,13,15,16} Reasons may be higher involvement in conflicts, Weapon possession, Risk-prone behaviour, and social roles in rural societies

Age group Vulnerability

International research consistently notes that firearm violence disproportionately affects young adult males, regardless of geography.

Rural residents (64%) were more affected. rural Punjab has greater cultural acceptance of guns, easier access to illegal weapons, frequent land disputes, and a weaker law enforcement presence. Farmers/zamindars were the largest group (36%). Firearm injuries in this group often stem from land feuds, boundary disputes, agrarian rivalry, and family property conflicts.

The high identification rate (94%) highlights close community structure, Immediate reporting by families, and high visibility of firearm incidents. Unidentified bodies are generally rare in firearm deaths compared to rail or decomposed deaths.

Homicide dominance with (64%), these findings align with multiple Indian studies reporting 60 to 80% firearm deaths as homicidal may be due to interpersonal violence, gang rivalry, political disputes, property feuds, personal enmity, followed by suicidal cases (30%), accidental cases (6%).

- The predominance of homicidal firearm deaths aligns with Indian autopsy studies reporting 60 to 80% of firearm deaths as homicidal in nature.^{6-8,13-15}
- Chest involvement and injury to vital organs such as the lungs, heart, liver, and brain are well-documented patterns in fatal firearm injuries.⁹⁻¹²
- The high proportion of brought-dead cases reflects the lethality of firearm injuries and limited prehospital trauma care in rural India.^{17,18}
- The fact that 86% were brought dead due to immediate fatality, lack of prehospital care, and high severity of



injuries (Table 3).

- Rural India often lacks ambulance services, trauma facilities, and trained paramedics
- Thus, victims rarely survive long enough for hospital intervention.

CONCLUSION

This autopsy-based study highlights crucial insights into firearm fatalities in Faridkot, Punjab. Young adult males, particularly from rural agrarian backgrounds, form most victims. Homicide is the dominant manner of death, followed by suicide and accidental cases. Clothing examination, wound characterisation, and internal injuries provide valuable forensic information for firing-range estimation and manner-of-death interpretation.

Firearm violence in this region is closely associated with sociocultural firearm acceptance, Personal enmity, Land and family disputes, and high availability of illegal firearms.

The study demonstrates the indispensable role of a detailed medico-legal autopsy in firearm death investigation.

LIMITATIONS

- Single-center study
- Limited sample size (50 cases)
- Lack of ballistic test reports for all cases
- No long-term follow-up with police investigations
- Some suicidal cases lacked psychological background data

RECOMMENDATIONS

For Public Health

- Rural injury surveillance systems
- Awareness programs on firearm safety
- Conflict-resolution community interventions

For Law Enforcement

- Crackdown on country-made firearms
- Strict monitoring of licensed guns
- Stricter penalties for celebratory firing

For Forensic Practice

- Mandatory X-rays for all firearm autopsies
- Standardised clothing examination protocols
- Training on wound documentation and ballistics correlation

For Policy Makers

- Strengthening Arms Act enforcement
- Improving trauma infrastructure in rural Punjab
- Integration of forensic medicine with district crime units

REFERENCES

1. World Health Organisation. Global status report on violence prevention. Geneva: WHO Press; 2020.
2. Krug EG, Dahlberg LL, Mercy JA, Zwi AB, Lozano R. World report on violence and health. Geneva: World Health Organization; 2002.
3. Global Burden of Disease Study. Global, regional, and national burdens of firearm injuries, 1990–2016. *Lancet Public Health*. 2018;3(6):e356-70.
4. National Crime Records Bureau. Accidental deaths and suicides in India 2022. New Delhi: Ministry of Home Affairs; 2023.
5. Reddy KSN, Murty OP. The Essentials of Forensic Medicine and Toxicology. 34th ed. Jaypee Brothers; 2017.
6. Mohanty MK, Kumar TS, Mohanty S, Pal SK. Firearm fatalities in southern India. *Med Sci Law*. 2005;45(3):244-8.
7. Sharma BR, Harish D, Singh VP, Bangar S. Firearm fatalities in Chandigarh—A six-year retrospective study. *Int J Med Toxicol Legal Med*. 2005;7(1):30-4.
8. Jha S, Singh A, Rastogi P, Kumar A. Pattern of firearm injuries in Bihar: A prospective study. *J Forensic Med Toxicol*. 2014;31(1):25-9.
9. Saukko P, Knight B. Knight's Forensic Pathology. 4th ed. CRC Press; 2015.
10. DiMaio VJM. Gunshot Wounds: Practical Aspects of Firearms, Ballistics and Forensic Techniques. 2nd ed. CRC Press; 1999.
11. Knight B. Gunshot wounds and ballistics. In: Saukko P, Knight B, editors. Knight's Forensic Pathology. CRC Press; 2015. p. 243-319.
12. Huelke DF. Injury patterns in gunshot wounds. *J Trauma*. 1968;8(2):200-7.
13. Kaur M, Sharma RK, Singh D. Trends of firearm injuries in northern India: A medico-legal study. *J Indian Acad Forensic Med*. 2010;32(4):358-60.
14. Mangal HM, Pathak A, Datta JK. Firearm fatalities in Ahmedabad: An autopsy-based analysis. *J Indian Acad Forensic Med*. 2007;29(1):42-7.
15. Gupta A, Pathak A. Analysis of homicidal firearm deaths in Delhi: An autopsy study. *Med Sci Law*. 2012;52(4):215-9.
16. Kumar A, Verma A, Singh R. Firearm injuries in northeast India: An autopsy-based study. *J Forensic Leg Med*. 2015;33:45-50.
17. Cole TB. Emergency medical management of firearm injuries. *N Engl J Med*. 2004;351:1383-91.
18. Zuraik M, Martin MJ. Ballistic trauma: Mechanisms and clinical management. *Trauma*. 2020;22(4):267-75.