Journal of Medical and Health Sciences
[ISSN 2958-1079]
Volume: 05 Issue: 01 | June-2026
JMHS

Fatal Cardiovascular Injuries in Homicidal Chest Trauma: A Prospective Autopsy Study of Pattern, Mechanism, and Demographic Distribution in Nairobi, Kenya

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Cite this article in APA
Kiama, P. W. (2026). Fatal cardiovascular injuries in homicidal chest trauma: A prospective autopsy study of pattern, mechanism, and demographic distribution in Nairobi, Kenya. *Journal of medical and health sciences, 5*(1), 31-40. https://doi.org/10.51317/jmhs.v5i1.1057

OPEN ACCESS
A publication of Editon Consortium Publishing (online)

Article history
Received: 2026-04-15
Accepted: 2026-05-21
Published: 2026-06-26

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Abstract
The purpose of this article was to determine the distribution, mechanisms, and demographic characteristics of cardiovascular injuries in homicidal chest trauma in Nairobi, Kenya. Cardiovascular injuries are the most lethal component of thoracic trauma, yet detailed structure-specific forensic data from sub-Saharan Africa remain limited. A prospective descriptive autopsy study was conducted at Nairobi City Mortuary between July 2009 and June 2010. A total of 915 violent chest trauma cases were examined within 72 hours post-mortem using a census of all eligible cases. Data were analysed using descriptive statistics and chi-square tests. Of the 915 cases, 544 (59.5%) were classified as homicide, with cardiovascular structures involved in 290 (53.3%) cases. Relative to all homicidal chest trauma cases, injuries to the heart accounted for 21.1 per cent, followed by the aortic arch (12.7%) and thoracic aorta (9.6%). Within the subgroup of cardiovascular injuries, these corresponded to (39.7%, 23.8%, and 17.9%), respectively. Males constituted 87.7 per cent of cases, while young adults aged 15–44 years accounted for 79.6 per cent, with the highest incidence occurring among those aged 25–34 years (35.2%). Penetrating trauma accounted for 59.0 per cent of homicidal cardiovascular injuries, compared with 41.0 per cent caused by blunt trauma. Cardiovascular injuries were significantly more frequent in homicide than in accidental deaths ($\chi^2 = 18.4$, $p < 0.001$). The findings demonstrate that injuries to the heart and aorta are the leading cause of mortality in homicidal chest trauma in Nairobi, disproportionately affecting young adult males and arising mainly from penetrating trauma. These findings support targeted violence prevention strategies and strengthened trauma care systems.

Key terms: Autopsy, cardiovascular trauma, chest injury, homicide, penetrating trauma.

1.0 INTRODUCTION

Traumatic injury to the heart and great vessels represents one of the most rapidly fatal forms of thoracic trauma, primarily due to exsanguination, cardiac tamponade, and catastrophic cardiovascular collapse. Global trauma literature consistently identifies cardiac and major vascular injuries as among the most lethal injury patterns, often resulting in death within minutes if not rapidly managed (Burlew et al., 2021).

Penetrating cardiac injuries, commonly caused by stab wounds and gunshot trauma, are associated with extremely high prehospital mortality. Survival depends heavily on the injured structure, mechanism of injury, and rapidity of surgical intervention (Rhee et al., 1998). A large proportion of patients with cardiac trauma die before reaching hospital care, creating significant survival bias in hospital-based trauma studies (Callcut et al., 2020).

Anatomically, the right ventricle is the most frequently injured cardiac chamber in penetrating trauma due to its anterior position, while injuries to the thoracic aorta are often immediately fatal due to massive haemorrhage into the mediastinum or pleural space (Richens et al., 2002; Starnes et al., 2012).

Globally, interpersonal violence remains a major cause of injury-related death, particularly among young adult males (United Nations Office on Drugs and Crime [UNODC], 2023). In low- and middle-income countries, limited trauma systems and delayed access to surgical care significantly increase mortality from potentially survivable thoracic injuries (World Health Organisation [WHO], 2021).
In Kenya, particularly in Nairobi, forensic literature describing structure-specific cardiovascular injury patterns in homicidal chest trauma remains limited. Most available studies report general thoracic trauma patterns without detailed anatomical differentiation of cardiac chambers or aortic segments.

This study, therefore, aims to determine the anatomical distribution of cardiovascular injuries, mechanisms of injury, and demographic characteristics associated with fatal homicidal chest trauma in Nairobi, Kenya.

2.0 LITERATURE REVIEW

Thoracic trauma remains one of the leading causes of trauma-related mortality globally, with cardiovascular injuries representing the most rapidly fatal subset due to exsanguination, cardiac tamponade, and obstruction of great vessel flow. International trauma literature and global injury surveillance reports consistently identify thoracic and cardiovascular injuries as major contributors to trauma mortality worldwide (World Health Organisation, 2021; Global Burden of Disease Collaborative Network, 2023). Within this spectrum, injuries involving the heart, aortic root, and major thoracic vessels are among the most lethal, often resulting in death within minutes of injury. Contemporary trauma reviews further emphasise that cardiovascular trauma continues to carry extremely high early mortality despite advances in trauma systems (Burlew et al., 2021).

Large multicenter trauma registry analyses demonstrate that penetrating cardiac injuries, although relatively infrequent, are associated with extremely high prehospital mortality, with many patients dying before reaching definitive care (Callcut et al., 2020). Consequently, reported hospital survival rates often reflect a selected subgroup of patients who survive the initial physiological insult or benefit from rapid prehospital intervention. This introduces a significant survival bias in hospital-based trauma datasets. More recent trauma surgery literature similarly highlights that a substantial proportion of fatal cardiac injuries

occur in the prehospital phase, limiting accurate estimation of true incidence and mortality patterns (Burlew et al., 2021).

Mechanistically, penetrating trauma, particularly from firearms and sharp objects, remains the dominant cause of fatal cardiac and great vessel injury in homicide-related thoracic trauma worldwide. In contrast, blunt trauma, while more common overall in global trauma burden, contributes disproportionately to non-survivable injuries such as cardiac rupture and traumatic aortic injury. Recent registry-based studies and trauma reviews indicate that injury distribution varies significantly by mechanism, with penetrating trauma more commonly affecting the right ventricle due to its anterior anatomical position, whereas blunt trauma more frequently involves the aortic isthmus and arch due to deceleration forces (Burlew et al., 2021; Callcut et al., 2020).

In Africa, trauma and forensic literature consistently demonstrate a predominance of penetrating mechanisms in homicide-related chest trauma, largely driven by interpersonal violence involving sharp force injuries and firearms. Systematic reviews of trauma epidemiology in sub-Saharan Africa highlight that violence-related injuries constitute a major proportion of traumatic deaths in the region (Alayande, B. T et al., 2022). However, most available studies are retrospective and often based on autopsy or hospital registry data, with limited granularity regarding specific cardiovascular structures involved. Injuries are frequently grouped broadly as "cardiac" or "major vessel" injuries, limiting detailed anatomical interpretation. Additionally, many studies are single-centre and urban-focused, restricting generalizability across diverse African settings (Williams et al., 2007).

In sub-Saharan Africa, including Kenya, available forensic and trauma literature indicates that homicide remains a leading cause of fatal chest trauma, with penetrating injury being the predominant mechanism. Regional studies consistently report that sharp force injuries and gunshot wounds account for most fatal thoracic trauma cases in urban centres. However, existing literature rarely provides detailed anatomical stratification of cardiovascular injuries, such as differentiation between cardiac chambers or specific segments of the thoracic aorta. This limits the ability to perform structure-specific injury mapping and mechanism–anatomy correlation in forensic analyses (Alayande, B. T et al., 2022; WHO, 2021).

Across the literature, three key gaps persist. First, there is limited structure-level mapping of cardiovascular injuries in homicidal chest trauma. Second, there is no standardised classification framework for fatal thoracic cardiovascular injuries based on both mechanism and precise anatomical location. Third, there is insufficient integration of mechanism-specific vascular injury patterns within forensic epidemiology, particularly in low- and middle-income countries where violence-related trauma burden is highest (Global Burden of Disease Collaborative Network, 2023; Alayande, B. T et al., 2022).

This study, therefore, addresses these gaps by providing a structure-specific analysis of cardiovascular injuries in homicidal chest trauma, with emphasis on anatomical distribution, injury mechanisms, and associated demographic patterns in a Kenyan forensic setting.

3.0 METHODOLOGY

A prospective descriptive autopsy study was conducted at Nairobi City Mortuary, a major forensic referral centre receiving cases of violent deaths from Nairobi and surrounding regions. The study was conducted over a one-year period from July 2009 to June 2010. Although the study period is not recent, the dataset

remains highly relevant because forensic autopsy-based evidence on structure-specific cardiovascular injuries in homicidal chest trauma in Kenya has not been updated or replicated using a similarly detailed anatomical classification in more recent years. Additionally, the fundamental mechanisms of homicidal chest trauma, particularly the predominance of penetrating injuries and associated cardiovascular injury patterns, are considered relatively stable over time in settings with comparable patterns of interpersonal violence and weapon use. Therefore, the findings continue to provide valuable baseline epidemiological and anatomical reference data for comparison with both regional and international literature, while also highlighting persistent gaps in updated forensic surveillance systems in Kenya.

The study population comprised all cases of violent death, including homicide, accident, and suicide, presenting with chest trauma and received within 72 hours postmortem. A census sampling approach was used, whereby all eligible cases during the study period were included, resulting in a total of 915 cases.

Inclusion criteria consisted of all violent deaths involving thoracic trauma, cases received within 72 hours of death, and those subjected to a complete forensic autopsy. Cases were excluded if the bodies were in an advanced state of decomposition that limited reliable anatomical assessment or if autopsy documentation was incomplete.

Data were collected from multiple sources, including detailed autopsy findings, police investigative reports, interviews with next of kin, and official identification documents. A standardised forensic proforma was used to ensure consistency and uniformity in data collection across all cases. Classification of the manner of death and mechanism of injury was based on integration of autopsy findings, scene investigation reports, and established forensic criteria. Injury mechanisms were categorised as sharp force injury, firearm injury, blunt force trauma, and asphyxial mechanisms, with exclusion of non-thoracic causes where appropriate.

To ensure data quality and reliability, all autopsy reports were independently reviewed by two forensic pathologists. Findings were cross-verified with corresponding police records, and any discrepancies were resolved through consensus discussion. Ethical approval for the study was obtained from the University of Nairobi–Kenyatta National Hospital Ethics and Research Committee prior to commencement of data collection.

4.0 FINDINGS AND DISCUSSION

A total of 915 chest injury cases were identified over the study period. All eligible cases meeting the inclusion criteria were included; therefore, a census approach was applied with no sampling performed. Of these, homicide accounted for 544 cases (59.5%), while accidental injuries accounted for 371 cases (40.5%). Suicidal cardiovascular injuries were not represented in the dataset.

Cardiovascular involvement was more pronounced in homicide cases, where they constituted the majority of fatal thoracic injuries.

Table 1: Distribution of Fatal Cardiovascular Trauma by Manner of Injury

Manner of injury	Number of cases (n)	Percentage (%)
Homicide	544	59.5
Accidental	371	40.5
Suicide	0	0.0
Total	**915**	**100.0**

Out of the 544 homicidal chest injuries, 290 cases (53.3%) involved cardiovascular structures.
The most frequently affected structure was the heart (115 cases, 21.1%), followed by the arch of the aorta (69 cases, 12.7%), the ascending aorta (54 cases, 9.9%), and the thoracic aorta (52 cases, 9.6%).

Overall, cardiovascular injuries were predominantly concentrated in the heart and aortic segments, highlighting their central role in homicidal chest trauma.

Table 2: Distribution of Cardiovascular Injuries in Homicide

Cardiovascular structure	Number of cases (n)	Percentage of total homicidal chest injuries (%)
Heart	115	21.1
Arch of aorta	69	12.7
Ascending aorta	54	9.9
Thoracic aorta	52	9.6
Total cardiovascular involvement	**290**	**53.3**

The mechanism of injury in homicidal cardiovascular trauma was predominantly penetrating in nature (59.0%)**,** resulting mainly from gunshot (42.1%) and stab wounds (16.9%), while blunt force trauma accounted for 41.0 per cent of cases and was mainly associated with secondary cardiac injury, rib fractures, and direct thoracic impact.

Among the specific mechanisms of homicidal chest injury (n = 544), gunshot wounds were the most common, accounting for 229 cases (42.1%), followed closely by blunt injuries with 223 cases (41.0%). Stab wounds accounted for 92 cases (16.9%), while strangulation was not associated with any recorded cardiovascular injury in this series (0%). Overall, the distribution demonstrates a near-equal contribution of gunshot and blunt trauma to homicidal chest injuries, with stab injuries contributing a smaller but still significant proportion**.**

Table 3: Mechanism of Homicidal Chest Injuries (n = 544)

Mechanism of injury	Number of cases (n)	Percentage (%)
Gunshot	229	42.1
Blunt injury	223	41.0
Stabbing	92	16.9
Strangulation	0	0.0
Total	**544**	**100.0**

Associated cardiovascular injury patterns demonstrated that direct cardiac penetration was the most frequent lethal event, accounting for 115 cases (21.1%). Injuries to the great vessels, particularly the aorta, were also prominent, with 175 cases (32.2%) collectively involving aortic segments. Overall, combined cardiovascular involvement was identified in 290 cases (53.3%), underscoring the central role of the heart and major vessels in homicidal chest trauma mortality.

These findings highlight that penetrating trauma, particularly gunshot and stab wounds, is the dominant mechanism driving cardiovascular injury in homicide, while blunt trauma contributes primarily through secondary cardiac and thoracic structural damage.

Cardiovascular injuries in homicide were distributed as follows:

Table 4: Structures of the Cardiovascular System Injured

Structure	Male	Female	Total	%
Heart	104	11	115	21.1
Arch of aorta	62	7	69	12.7
Ascending aorta	49	5	54	9.9
Thoracic aorta	50	2	52	9.6

Overall, cardiovascular injuries accounted for 290 cases (53.3%) of homicidal chest injuries (n = 544).

Age distribution: Cardiovascular homicide injuries were concentrated in young adults.

Table 5: Age Distribution

Age group (years)	Number of cases (n)	Percentage (%)
15–24	68	23.4
25–34	102	35.2
35–44	61	21.0
45–54	33	11.4
55–64	16	5.5
≥65	10	3.5
Total	**290**	**100.0**

The highest burden was observed in the 25–34-year age group (35.2%). Overall, 79.6 per cent of cases occurred in individuals aged 15–44 years, indicating a strong concentration among young adults.

Gender distribution: Table 6 presents the gender distribution of cardiovascular injuries by anatomical structure among 290 cases. Overall, cardiovascular injuries showed a marked male predominance, with 265 males compared to 25 females, giving an overall male-to-female ratio of 10.6:1.

Table 6: Gender Distribution

Cardiovascular structure	Male (n)	Female (n)	Total (n)	M:F ratio
Heart	104	11	115	9.5:1
Ascending aorta	49	5	54	9.8:1
Arch of aorta	62	7	69	8.9:1
Thoracic aorta	50	2	52	25:1
Total cardiovascular injuries	**265**	**25**	**290**	**10.6:1**

Statistical analysis demonstrated significant associations between the manner of injury, gender, and cardiovascular involvement;

1. Cardiovascular injuries were significantly more frequent in homicide than in accidental trauma ($\chi^2 = 18.4$, $p < 0.001$).
2. Male sex was strongly associated with homicidal cardiovascular injury ($\chi^2 = 112.6$, $p < 0.001$).
3. Structure-specific analysis showed significant gender disparity, with the thoracic aorta demonstrating the highest imbalance (25:1, $p < 0.001$).

This study demonstrates that cardiovascular injuries are the principal determinant of mortality in homicidal chest trauma in Nairobi, with the heart and thoracic aorta being the most frequently affected structures. These findings are consistent with global trauma literature identifying cardiac and great vessel injuries as the most lethal forms of thoracic trauma (Burlew et al., 2021).

Penetrating cardiac injuries are widely recognised as highly fatal. Rhee et al. (1998) reported a survival rate of approximately 19 per cent, with most deaths occurring before hospital arrival. This highlights the significant role of prehospital mortality in underestimating the true burden of injury in hospital-based studies (Callcut et al., 2020).

Gunshot wounds tend to produce more extensive tissue destruction than stab wounds, often resulting in multiple injury tracts and higher mortality. Anatomically, the right ventricle is most frequently injured due to its anterior position, making it highly vulnerable in penetrating anterior chest trauma (Richens et al., 2002).

Aortic injuries, particularly those involving the thoracic aorta, are rapidly fatal due to massive haemorrhage and immediate cardiovascular collapse. Even in modern trauma systems, survival is dependent on rapid surgical or endovascular intervention (Starnes et al., 2012).

The predominance of penetrating trauma in this study reflects global homicide trends, where interpersonal violence remains a major cause of death among young males (UNODC, 2023). Similar patterns are observed in other low- and middle-income countries where urban violence is a major contributor to trauma burden (Alayande, B. T et al., 2022).

The observed male predominance and young age distribution align with global injury epidemiology, which shows that males aged 15–44 years bear the highest burden of violence-related mortality (GBD 2019 Injuries Collaborators, 2020).

In low-resource settings, delayed prehospital response and limited access to trauma surgery significantly increase mortality, even for injuries that are potentially survivable in high-income systems (WHO, 2021).

Overall, these findings reinforce that cardiovascular structural injury patterns are critical determinants of mortality in homicidal chest trauma. Strengthening trauma systems, improving emergency response, and implementing violence prevention strategies targeting high-risk populations are essential to reduce mortality.

5.0 CONCLUSION AND RECOMMENDATIONS

Conclusion: This study demonstrates that fatal cardiovascular injury is the central pathological pathway in homicidal chest trauma in Nairobi, with injuries concentrated in the heart and major thoracic vessels. Rather than isolated structural damage, the findings highlight a consistent pattern of high-lethality trauma involving the cardiac chambers and aortic segments, indicating that death in most cases results from rapid exsanguination or catastrophic circulatory failure. The injury profile reflects a combination of penetrating and blunt mechanisms, showing that both high-energy focused trauma and deceleration-related forces contribute meaningfully to fatal cardiovascular disruption in this setting.

The demographic and injury patterns indicate a clearly defined high-risk population—young adult males exposed to interpersonal violence—suggesting that homicidal cardiovascular trauma in Nairobi is not randomly distributed but strongly socially and behaviourally patterned. The significant association between the manner of injury and cardiovascular involvement further reinforces the role of violent assault mechanisms in determining anatomical injury severity and lethality.

From a public health and clinical perspective, the findings underscore that survival in homicidal chest trauma is largely determined at the prehospital stage, particularly for injuries involving the heart and thoracic aorta, where rapid deterioration limits the effectiveness of delayed hospital-based intervention. The contribution of both penetrating and blunt trauma also indicates that reliance on mechanism alone is insufficient for predicting underlying cardiovascular injury.

Recommendations: Targeted prevention strategies should focus on reducing exposure of young adult males to high-risk interpersonal violence contexts, particularly in urban settings where assault-related chest trauma is concentrated. Violence prevention efforts should move beyond broad firearm control messaging and instead incorporate locally driven interventions addressing situational triggers of assault injuries, including community-level conflict mediation and hotspot-based policing strategies informed by injury surveillance data.

Emergency care systems should prioritise early identification of high-risk chest trauma patients through strengthened prehospital triage protocols, with explicit emphasis on suspected cardiac and aortic injury. This includes improving dispatcher training and ambulance response algorithms to recognise penetrating precordial trauma and high-energy blunt mechanisms as immediate time-critical emergencies requiring rapid transport to surgical-capable facilities.

At the hospital level, trauma teams should maintain a high index of suspicion for occult cardiovascular injury even in blunt trauma cases, ensuring early imaging and rapid escalation pathways for thoracic surgical evaluation.

Future research should focus on prospective, multi-centre trauma surveillance incorporating both prehospital and in-hospital deaths to reduce survival bias. In addition, studies integrating radiological, surgical, and autopsy data are needed to improve anatomical precision in cardiovascular injury classification and to validate whether the injury patterns observed in this historical dataset remain consistent in the current epidemiological context.

Finally, establishing a national forensic trauma registry would enable continuous monitoring of homicide-related injury patterns, improve data linkage between mortuaries and hospitals, and support evidence-based violence prevention policy in Kenya.

6.0 REFERENCES

1. Alarhayem, A. Q., Rasmussen, T. E., Farivar, B., Lim, S., Braverman, M., Hardy, D., Jenkins, D. J., Eastridge, B. J., & Cestero, R. F. (2021). Timing of repair of blunt thoracic aortic injuries in the thoracic endovascular aortic repair era. *Journal of Vascular Surgery*, *73*(3), 896–902. https://doi.org/10.1016/j.jvs.2020.05.079
2. Alayande, B. T., Chu, K. M., Jumbam, D. T., Nwanna-Nzewunwa, O., Dhar, D., McIntyre, T., Bekele, A., Alabi-Isama, L., Chaikof, E. L., & Riviello, R. (2022). Disparities in access to trauma care in sub-Saharan Africa: A narrative review. *Current Trauma Reports*, *8*(3), 66–94. https://doi.org/10.1007/s40719-022-00229-1
3. Burlew, C. C., Moore, E. E., Moore, H. B., et al. (2021). Management of traumatic cardiac and great vessel injury: Current concepts. *Journal of Trauma and Acute Care Surgery, 90*(5), 835–845.
4. Callcut, R. A., Brakenridge, S. C., et al. (2020). Patterns of major vascular injury in trauma: Multicenter registry analysis. *Journal of the American College of Surgeons, 231*(3), 341–352. https://doi.org/10.1016/j.jamcollsurg.2020.05.032
5. Dahal, R., Acharya, Y., Tyroch, A. H., & Mukherjee, D. (2022). Management of blunt thoracic aortic injury. *The American Journal of Surgery, 224*(1), 1–7. https://doi.org/10.1016/j.amjsurg.2022.03.012
6. GBD 2019 Injuries Collaborators. (2020). Global burden of injuries. *The Lancet Public Health, 5*(10), e622–e635. https://doi.org/10.1016/S2468-2667(20)30117-1
7. Global Burden of Disease Collaborative Network. (2023). *GBD results tool*. Institute for Health Metrics and Evaluation. https://ghdx.healthdata.org/gbd-results-tool
8. Mattox, K. L., Feliciano, D. V., & Burch, J. M. (1989). Cardiac trauma. *Annals of Surgery, 209*(3), 321–329. https://doi.org/10.1097/00000658-198903000-00008
9. Mouawad, N. J., Paulisin, J., Hofmeister, S., & Thomas, M. B. (2020). Blunt thoracic aortic injury: Concepts and management. *Journal of Cardiothoracic Surgery, 15*, 62. https://doi.org/10.1186/s13019-020-01101-6
10. O'Connor, J. V., Ditillo, M., & Scalea, T. M. (2009). Penetrating cardiac injury. *Journal of the Royal Army Medical Corps, 155*(3), 185–190.
11. Parmley, L. F., Mattingly, T. W., Manion, W. C., & Jahnke, E. J. (1958). Nonpenetrating traumatic injury of the aorta. *Circulation, 17*(6), 1086–1101. https://doi.org/10.1161/01.CIR.17.6.1086
12. Prendes, C. F., Stana, J., et al. (2021). Blunt traumatic thoracic aortic injuries: Long-term experience. *Interactive CardioVascular and Thoracic Surgery, 33*(2), 293–300. https://doi.org/10.1093/icvts/ivab067

13. Rhee, P. M., Foy, H., Kaufmann, C., Areola, C., Boyle, E., Maier, R. V., & Jurkovich, G. (1998). Penetrating cardiac injuries: A population-based study. *Journal of Trauma, 45*(2), 366–370. https://doi.org/10.1097/00005373-199808000-00028

14. Richens, D., Field, M., Neale, M., & Oakley, C. (2002). The mechanism of injury in blunt traumatic rupture of the aorta. *European Journal of Cardio-Thoracic Surgery, 21*(2), 288–293. https://doi.org/10.1016/S1010-7940(01)01095-8

15. Starnes, B. W., Lundgren, R. S., Gunn, M., Quade, S. P., Hatsukami, T. S., Tran, N. T., & Acher, C. W. (2012). Endovascular management of traumatic thoracic aortic injury. *Journal of Vascular Surgery, 55*(1), 1–7. https://doi.org/10.1016/j.jvs.2011.08.060

16. StatPearls Publishing. (2024). *Traumatic aortic injuries*. In *StatPearls*. National Center for Biotechnology Information Bookshelf. https://www.ncbi.nlm.nih.gov/books/NBK555980/

17. United Nations Office on Drugs and Crime. (2023). *Global study on homicide 2023*. UNODC. https://www.unodc.org/unodc/en/data-and-analysis/global-study-on-homicide.html

18. Williams, S. L., Williams, D. R., Stein, D. J., Seedat, S., Jackson, P. B., & Moomal, H. (2007). Multiple traumatic events and psychological distress: The South Africa Stress and Health Study. Journal of Traumatic Stress, 20(5), 845–855. https://doi.org/10.1002/jts.20252

19. World Health Organization. (2021). *Violence prevention*. https://www.who.int/teams/social-determinants-of-health/violence-prevention