



# The Changing Pattern of Chest Trauma in Sokoto: A 10-Year Institutional Review

Ukwuani Solomon Ifeanyi<sup>1,\*</sup>, Salisu Ismail<sup>1</sup>, Ray Bayo<sup>1</sup>, Maishanu Moyijo<sup>1</sup>, Isah Abdullahi<sup>1</sup>,  
Abdullahi Abdulkarim Aitek<sup>2</sup>, Abdulrahman Aliyu<sup>2</sup>, Galadima Ibrahim<sup>2</sup>, Abubakar Umar<sup>1</sup>

<sup>1</sup>Cardiothoracic Surgery Unit, Department of Surgery, Usmanu Danfodiyo University Teaching Hospital, Usmanu Danfodiyo University, Sokoto, Nigeria

<sup>2</sup>Department of Anaesthesiology and Intensive Care, Usmanu Danfodiyo University Teaching Hospital, Usmanu Danfodiyo University, Sokoto, Nigeria

## Email address:

[solomonukwuani@yahoo.com](mailto:solomonukwuani@yahoo.com) (U. S. Ifeanyi)

\*Corresponding author

## To cite this article:

Ukwuani Solomon Ifeanyi, Salisu Ismail, Ray Bayo, Maishanu Moyijo, Isah Abdullahi, Abdullahi Abdulkarim Aitek, Abdulrahman Aliyu, Galadima Ibrahim, Abubakar Umar. The Changing Pattern of Chest Trauma in Sokoto: A 10-Year Institutional Review. *International Journal of Cardiovascular and Thoracic Surgery*. Vol. 8, No. 4, 2022, pp. 42-48. doi: 10.11648/j.ijcts.20220804.12

Received: May 28, 2022; Accepted: June 28, 2022; Published: July 28, 2022

---

**Abstract:** *Background:* Chest trauma is a public health problem because it is a major contributor to the burden of trauma-related morbidity and mortality. Low and middle-income countries (LMICs) account for 90% of these poor outcomes, which dominantly affect the younger age groups and men. Blunt chest trauma and road traffic accidents are the main type and mechanism of injury respectively. We aimed to describe the changing epidemiology of chest trauma in terms of the demographic characteristics of patients, mechanism and pattern of injuries, treatment and outcomes over a 10-year period. *Method:* This is a retrospective descriptive study of all patients who required hospitalization following trauma and were managed for chest trauma by the cardiothoracic surgery Unit of the Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, between 1st January 2012 and 31st December 2021. *Results:* A total of 287 patients were managed for chest trauma over this period. The mean age was  $36.02 \pm 15.64$  years, with a male:female ratio of 8.6:1. There was a significant increase in the yearly number of cases in the later 3 years (2018 - 2021) compared to the first 7 years ( $p < 0.0001$ ), and more males were affected within this period ( $p < 0.0001$ ). Overall, blunt chest injury and road traffic accidents were the commonest mechanism and aetiology of injury respectively however penetrating chest injury from gunshot has superseded blunt chest injuries as the predominant mechanism and aetiology respectively in the last 3 years. Pleural space collections (haemopneumothorax, haemothorax and pneumothorax), rib fractures and pulmonary contusion were the commonest injury patterns and 24.04% had extrathoracic injuries which were significantly associated with mortality ( $p < 0.000$ ). The majority of patients were managed conservatively or with tube thoracostomy. Only 12.5% required surgery and diaphragmatic injury was the commonest indication. The mortality rate was 9.1%. *Conclusion:* Chest trauma in Sokoto is predominantly a disease of young and middle-aged men. The rising incidence is mainly due to increasing cases of penetrating chest trauma from a gunshot in the last 3 years. This period also coincides with the increasing proliferation of small arms and light weapons in the region.

**Keywords:** Chest Trauma, Blunt Chest Injuries, Penetrating Chest Injuries, Epidemiology, Gunshot Injuries

---

## 1. Introduction

Trauma is one of the leading causes of mortality worldwide, accounting for 1 in every 10 deaths globally and the 3rd leading cause of death in the United States. [1]

It is the commonest cause of death in those 5-29 years. [2] According to the 2021 World Health Organization report, 90% of trauma mortality occurs in Low and Middle-

income countries (LMICs) and the incidence of trauma has been on the rise in Africa since the year 2000. [3] Chest injuries are the second leading contributor to the burden of trauma morbidity and mortality after head injury, contributing to as much as 25-35% of all trauma-related death. [4-6]

Chest trauma can be classified based on the mechanism of injury as either blunt (closed) chest injury or penetrating (open) chest injury. Chest injuries often involve one or more components of the thorax: the chest wall (ribs and sternum), pleural cavities/lung parenchyma, mediastinal content (the heart and great vessels, tracheobronchial tree, oesophagus and thoracic duct) and diaphragmatic injuries.

Certain aspects of the epidemiology of chest trauma are similar globally, affecting predominantly young to middle-aged men in both developing and developed countries, with blunt chest trauma the most common aetiology among civilian populations. [7-11] However significant differences exist in terms of the outcomes which are influenced by socioeconomic factors and the availability of functioning health systems. [12] This study aims to describe the epidemiology of chest injury in terms of demographic characteristics of patients, mechanism and pattern of injuries, treatment and outcome in patients managed in one of the university teaching hospitals in the Northwest of Nigeria over a 10-year period.

## 2. Patients and Method

### 2.1. Study Design and Population

This is a retrospective descriptive study of all patients who required hospitalization following trauma and were managed for chest trauma by the cardiothoracic surgery Unit of the Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, between 1st January 2012 and 31st December 2021. Those who had incomplete information or who were discharged against medical advice were excluded. Patients' information such as biodemographic data, the pattern of injuries sustained, type of treatment offered and outcomes in terms of survival or mortality were retrieved from the hospital records and cardiothoracic surgery unit database.

### 2.2. Study Setting

The Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto is one of the largest tertiary and referral hospitals in Northwestern Nigeria. It is a 700-bed facility that offers advanced trauma care and caters for patients from Sokoto, Kebbi and Zamfara states in the Northwest and Niger state in the Northcentral region, as well as patients from the neighbouring Niger Republic.

### 2.3. Statistical Analysis

Continuous variables were expressed as mean  $\pm$  standard deviation. Categorical variables were summarized and presented as absolute values and percentages. Differences in

means of continuous and categorical variables were compared between groups by independent-samples two-sided Student's t-test assuming equal variance; a P-value of  $< 0.05$  was considered statistically significant. Analysis was performed using the Statistical Package for Social sciences (IBM Corp. Released in 2017. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Ethical approval was obtained from the Hospital Research and Ethics Committee (HREC) of the Usmanu Danfodiyo University Teaching Hospital Sokoto.

## 3. Results

Over the period in review, a total of 316 patients were admitted into the trauma centre/accidents and emergency unit with chest trauma. Of these, 287 fulfilled the inclusion criteria while 29 were excluded from analysis (17 patients requested for discharge against medical advice, 12 patients had incomplete information). The mean age was  $36.02 \pm 15.64$  years with a median age of 35 years. The youngest patient was 2 years and the oldest patient was 87 years. Those 20 to 44 years old accounted for 57.5% of all patients. There were 257 males (89.5%) and 30 females (10.5%) with a male to female ratio of 8.6:1.

Overall, the predominant mechanism of injury was blunt chest trauma, accounting for 55.1% (158 patients) while 44.9% (129 patients) had penetrating chest injury. There was a significant increasing trend in the total number of chest trauma seen per year. In the first 7 years (January 2012 to December 2018), a total of 149 patients were managed, with an average of 21.3 patients/year compared with the latter 3 years (January 2019 to December 2021) in which a total of 138 patients were seen with a yearly average of 46 patients per year ( $p < 0.000$ ). Also within this period (2019 - 2021), the yearly number of penetrating chest injuries steadily increased and superseded blunt chest mechanism as shown in Figure 1. Table 1 shows the various aetiology of chest injuries. Road traffic accidents was the commonest aetiology, responsible for half (50.52%) of all patients with chest trauma, with gunshot injury the second commonest aetiology (39.02%). Pleural collections (haemothorax, pneumothorax), rib fractures and pulmonary contusion were the commonest types of injury seen, accounting for 75.61%, 49.83% and 37.28% respectively. Sixty-nine patients (24.04%) had associated extrathoracic injuries, with neurological injuries (traumatic brain and spinal cord) (27/69, 39.13%), musculoskeletal (24/69, 34.8%) and abdominal injuries (21/69, 30.4%) the most frequently associated.

The definitive treatment for the majority of patients (87.5%) was non-operative. Of these, 64 (22.3%) required only conservative management mainly of adequate analgesics, antibiotic prophylaxis, mucolytics, supplement oxygen or assisted ventilation. Another 64.8% (186 patients) required only closed tube thoracostomy drainage in addition to these measures to evacuate pleural space collections. Only 36 (12.5%) patients required operative intervention. Of these,

28 (9.8%) patients required emergency/urgent thoracotomy. The indications for surgery were acute diaphragmatic rupture in 11 (3.4%), evacuation of clotted haemothorax or massive haemothorax in 6 (2.1%), massive air leak with intraoperative findings of bronchial rupture or lung laceration 5 (1.7%), impalement injuries in 4 (1.4%) and massive chylothorax requiring ligation of the thoracic duct in 2 (0.70%) patient. The remaining 9 patients had non-emergent surgery on account of post-traumatic chronic empyema thoracis in 8 (2.8%) and fixation of a significantly displaced sternal fracture in 1 (0.35%) patient.

In terms of outcome, 261 (90.9%) were discharged home while there were 26 (9.1%) mortalities. The causes of death were severe traumatic brain injury (10 patients, 38.5%),

Sepsis resulting in multi-organ failure (8 patients, 30.8%), respiratory failure (5 patients, 19.2%), massive haemorrhage (2 patients, 7.7%) and suspected massive pulmonary embolism in one patient (3.8%). There was no statistically significant association between the outcome of chest trauma and age of the patient ( $p = 0.36$ ), gender ( $p = 0.85$ ) and mechanism of injury ( $p = 0.27$ ) however the involvement of an extrathoracic organ system was associated with mortality ( $p = 0.000$ ). Also, there was a statistically significant association between the period in review (2012 – 2018 vs 2019 – 2021) and the gender of the patient, mechanism of injury and presence of extrathoracic injuries but not with the mean age of the patients managed and the outcome as shown in table 6.

### THE CHANGING MECHANISM OF CHEST INJURY

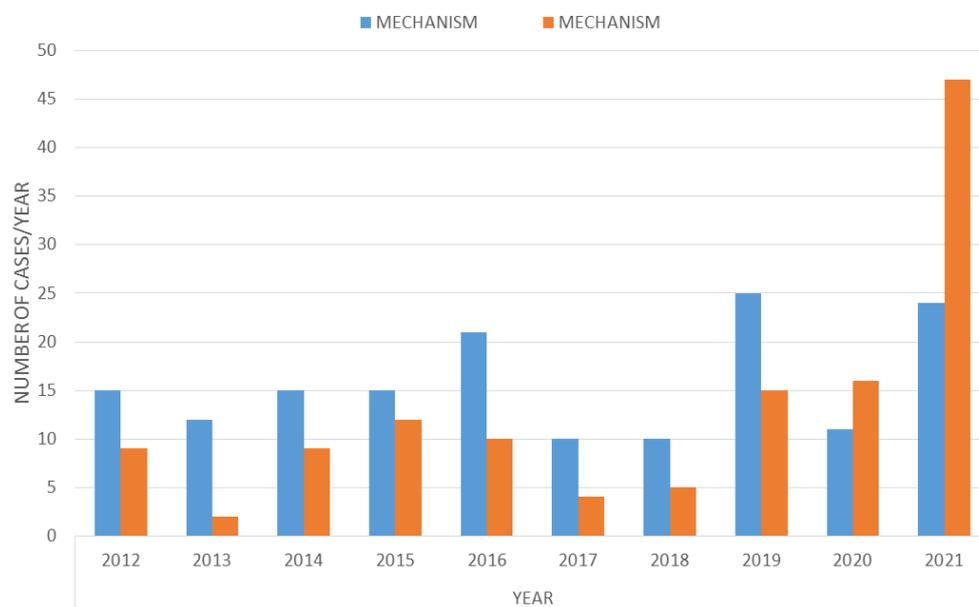


Figure 1. Yearly number of chest trauma from 2012 – 2021.

Table 1. Aetiology of chest trauma.

Mechanism/aetiology	Frequency	Percentage
<b>BLUNT CHEST TRAUMA</b>		
Road traffic accidents	145	50.52
Fall from a height	4	1.39
Blow to the Chest	3	1.05
Bomb blast	2	0.70
<b>PENETRATING CHEST TRAUMA</b>		
Gunshot	112	39.02
Stab injuries	15	5.23
Impalement	4	1.39
Animal bites/gore	2	0.70
<b>TOTAL</b>	<b>287</b>	<b>100.00</b>

Table 2. Pattern of thoracic injuries.

Spectrum of Thoracic Injuries	Frequency	Percentage
Pleural collection (Haemothorax, Pneumothorax)	217	75.61
Rib fractures	143	49.83
Pulmonary contusion	107	37.28
Flail chest	11	3.83
Diaphragmatic rupture	11	3.83

Spectrum of Thoracic Injuries	Frequency	Percentage
Lung laceration	6	2.09
Tracheobronchial injuries	5	1.74
Sternal fractures	4	1.39
Myocardial contusion	3	1.05
Chylothorax	2	0.70
Haemopericardium	1	0.35

Table 3. Types of interventions.

Interventions	Frequency	Percentage
Non-operative management	64	22.3
Tube thoracostomy	186	64.8
Operative management	37	12.9
Emergency thoracotomy	28	9.8
Repair of ruptured diaphragm	(11)	(3.4)
Massive or Clotted Haemothorax	(6)	(2.1)
Repair of Lung laceration/Tracheobronchial injuries	(5)	(1.7)
Impalement chest injuries	(4)	(1.4)
Thoracic duct ligation.	(2)	(0.70)
Sternal stabilization	1	0.35
Decortication of chronic empyema	8	2.8
	287	100

Table 4. Extrathoracic injuries.

Extrathoracic Injuries (n = 69)*	Frequency	Percentage
Abdominal injuries	21	30.4
Neurological injuries (Head and spinal cord injuries)	27	39.1
Musculoskeletal injuries	24	34.8
Genitourinary injuries	1	1.4

\*several patients had multisystem involvement.

Table 5. Factors associated with outcomes.

VARIABLE	Outcome		p
	RECOVERY (261)	MORTALITY (n=26)	
Age (years)	35.75 ± 15.51	38.73 ± 17.04	0.36
Sex			
	Male	23	0.85
	Female	3	
Mechanism of Injury			
	Blunt	17	0.27
	Penetrating	9	
Extrathoracic injuries			
	Yes	20	0.000
	No	6	
Period (Years)			
	2012 – 2018	13	0.84
	2019 – 2021	13	

Table 6. Factors associated with the period of trauma.

VARIABLE	Period of Review		p
	2012 - 2018 (n=149)	2019 - 2021 (n=138)	
Age (years)	35.75 ± 15.1	36.37 ± 16.2	0.71
Sex			
	Male	129	0.036
	Female	9	
Mechanism			
	Blunt	60	0.000
	Penetrating	78	
Extrathoracic injuries			
	Yes	43	0.007
	No	95	
Outcome			
	Survived	125	0.83
	Mortality	13	

## OUTCOME OF CHEST INJURIES

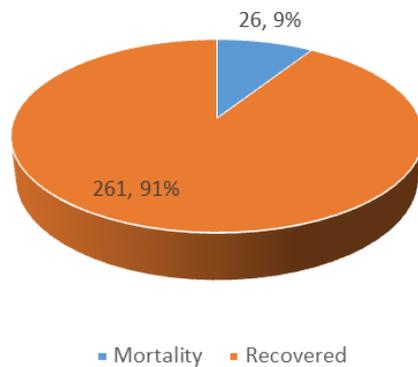


Figure 2. The outcome of chest injuries.

## 4. Discussion

Chest trauma is a public health problem because it is a major contributor to the burden of trauma-related morbidity and mortality. [13] The burden of trauma disproportionately affects LMICs more than developed nations, with the incidence projected to rise even further. [3, 14] The findings of this study support this projection, especially in the latter 3 years of the period of review, in which the yearly average number of patients more than doubled compared to the preceding years (21.3 vs 46,  $p < 0.0001$ ).

Chest trauma was noted to occur in all age groups but the most affected were those within the ages of 20-44 years, with marked male preponderance. This is the most economically productive age, especially in LMICs and this highlights the multifaceted consequence of chest trauma. [15] This predilection has been attributed to the fact that young to middle-aged men are often the most exposed to trauma as they go about their activities of daily living fending for their families. They are also more prone to risky activities such as overspeeding and involvement in violence. These findings are very similar to those from other studies within Nigeria [7, 16], Africa [8, 17] and other regions of the world. [18] Although we found blunt chest trauma to be the commonest mechanism of chest injury (55.1%) like in most reports, the prevalence of penetrating chest trauma was unusually high (44.9%) for a civilian population when compared to similar reports (28.6 – 33.3%). [16, 19] Okugbo and colleagues also reported a high prevalence in the Southsouthern part of Nigeria. [7] Also, road traffic accident was the commonest aetiology of chest trauma in most reported studies, however, the prevalence of gunshot injuries was also high (39%) compared to the reported prevalence of 4.8 – 25% in other parts of Nigeria and elsewhere. [7, 16, 19] We attribute this to the proliferation of small arms fire and light weapons due to the rising incidence of banditry, terrorism and civilian conflicts in the Northwestern and Northeastern of Nigeria. [20, 21] While the prevalence of blunt chest trauma was relatively within the range seen in previous years, that of

penetrating trauma has a significant increase in the last 3 years, with penetrating chest injury and gunshot to the chest the predominant mechanism and aetiology of chest injury in the period from 2020 to 2021. This period coincided with the upsurge in violence from banditry and terrorism currently plaguing Northwestern Nigeria. [22] Also recorded were some uncommon aetiological causes of chest injury from domestic animals that have been previously reported by Nayaranan *et al.* [10]

Pleural space collections either as haemothorax, pneumothorax or haemopneumothorax were the commonest abnormality encountered, occurring in three-quarters of patients, followed by rib fractures and pulmonary contusion which were seen in 49.8% and 37.2% respectively. These findings are similar to those in most reported studies. [7-9, 17, 23] Unsurprisingly, only a few (mainly cardiac contusion) injuries to the heart and great vessels were encountered. The majority of studies on chest trauma in Nigeria and sub-Saharan Africa are silent on this, with only a few case reports of successfully managed penetrating cardiac injuries found on literature search. [24, 25] We think the reason may be that majority of patients with penetrating cardiac injuries do not survive beyond the scene of trauma due to the catastrophic nature of such injuries and the absence of organized prehospital trauma care and emergency medical services (EMS), leading to delayed transportation to the major trauma centres. It is also possible that many patients with blunt cardiac injuries go undiagnosed due to the nonspecific nature of the symptoms in the immediate aftermath of trauma which can be overshadowed by other injuries in the absence of a high index of suspicion. [26, 27]

Almost a quarter of all the patients managed had associated extrathoracic injuries, of which the commonest was neurological trauma. Furthermore, the presence of extrathoracic trauma was associated with mortality ( $p < 0.000$ ). This finding was in strong consonance with other studies both within Nigeria and elsewhere. [8, 10, 17, 23, 28]

The findings of this study also support the well-established fact that most patients with chest trauma can be managed non-operatively, requiring only adequate conservative care such as optimum pain control, prophylactic antibiotics, judicious fluid resuscitation, supplemental oxygen with or without ventilator support and tube thoracostomy. [29] Only 12.5% required operative intervention for chest injuries with diaphragmatic rupture being the commonest indication. Our thoracotomy rate was similar to that reported within Nigeria and elsewhere. [7, 9, 16, 30] Furthermore, most patients who arrive at the hospital following chest trauma often survive and are discharged. From this study, 9 in 10 patients were successfully managed and discharged home. The presence of an extrathoracic injury was associated with a poor outcome of which the commonest cause of death was severe traumatic brain injury and multiorgan failure from sepsis especially in those who sustained thoracoabdominal injuries. This outcome reflects a regional and to a large extent the global picture in the management of chest trauma. [4, 5, 31-34]

## 5. Conclusion

Chest trauma is still a disease of young to middle-aged men who are the most economically productive group in our subregion. The rising trend and changing pattern of chest trauma are worrying. There need to be an urgent effort to improve security and also control the indiscriminate proliferation of small arms and light weapons in the Sahel region to stem the increasing prevalence of penetrating chest injuries. The retrospective nature of the study and lack of utilization of any of the trauma severity scores to characterize the severity of chest trauma were identified limitations of this study.

## References

- [1] Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* (London, England) 2012; 380 (9859): 2095–128.
- [2] Norton R, Kobusingye O. Injuries. *N Engl J Med* 2013; 368 (18): 1723–30.
- [3] (WHO) WHO. Injuries and Violence [Internet]. 2021. Available from: <https://www.who.int/news-room/fact-sheets/detail/injuries-and-violence>
- [4] Ludwig C, Koryllos A. Management of chest trauma. *J Thorac Dis* 2017; 9 (Suppl 3): S172–7.
- [5] Bernardin B, Troquet J-M. Initial management and resuscitation of severe chest trauma. *Emerg Med Clin North Am* 2012; 30 (2): 377–400, viii-ix.
- [6] Osime OC, Ighedosa SU, Oludiran OO, Iribhogbe PE, Ehikhamenor E, Elusoji SO. Patterns of Trauma Deaths in an Accident and Emergency Unit. *Prehosp Disaster Med* [Internet] 2007; 22 (1): 75–8. Available from: <https://www.cambridge.org/core/article/patterns-of-trauma-deaths-in-an-accident-and-emergency-unit/4CDDF6E6826F456661DB7F4BF5D0CFC5>
- [7] Okugbo S, Okoro E, Iribhogbe P. Chest trauma in a regional tRAUMA centRE. *J West African Coll Surg* 2012; 2 (2): 91–101.
- [8] Baru A, Weldegiorgis E, Zewdu T, Hussien H. Characteristics and outcome of traumatic chest injury patients visited a specialized hospital in Addis Ababa, Ethiopia: A one-year retrospective study. *Chinese J Traumatol = Zhonghua chuanguang shang za zhi* 2020; 23 (3): 139–44.
- [9] Mazcuri M, Ahmad T, Abid A, Thapaliya P, Ali M, Ali N. Pattern and Outcome of Thoracic Injuries in a Busy Tertiary Care Unit. *Cureus* 2020; 12 (10): e11181.
- [10] Narayanan R, Kumar S, Gupta A, Bansal VK, Sagar S, Singhal M, et al. An Analysis of Presentation, Pattern and Outcome of Chest Trauma Patients at an Urban Level 1 Trauma Center. *Indian J Surg* [Internet] 2018; 80 (1): 36–41. Available from: <https://doi.org/10.1007/s12262-016-1554-2>
- [11] Orlas CP, Herrera-Escobar JP, Zogg CK, Serna JJ, Meléndez JJ, Gómez A, et al. Chest Trauma Outcomes: Public Versus Private Level I Trauma Centers. *World J Surg* 2020; 44 (6): 1824–34.
- [12] Haines KL, Zens T, Beems M, Rauh R, Jung HS, Agarwal S. Socioeconomic disparities in the thoracic trauma population. *J Surg Res* 2018; 224: 160–5.
- [13] LoCicero J 3rd, Mattox KL. Epidemiology of chest trauma. *Surg Clin North Am* 1989; 69 (1): 15–9.
- [14] Søreide K. Epidemiology of major trauma. *Br J Surg* 2009; 96 (7): 697–8.
- [15] Kerr-Valentic MA, Arthur M, Mullins RJ, Pearson TE, Mayberry JC. Rib fracture pain and disability: can we do better? *J Trauma* 2003; 54 (6): 1054–8.
- [16] Peter S, Ozoilo K, Isichei M, Ale F, Njem J, Ojo E, et al. Severe Chest Injury Revisited - An Analysis of the Jos University Teaching Hospital Trauma Registry. *Niger J Clin Pract* 2021; 24 (8): 1247–51.
- [17] Lema MK, Chalya PL, Mabula JB, Mahalu W. Pattern and outcome of chest injuries at Bugando Medical Centre in northwestern Tanzania. *J Cardiothorac Surg* 2011; 6: 7.
- [18] Al-Koudmani I, Darwish B, Al-Kateb K, Taifour Y. Chest trauma experience over eleven-year period at al-mouassat university teaching hospital-Damascus: a retrospective review of 888 cases. *J Cardiothorac Surg* 2012; 7: 35.
- [19] Edaigbini S, Delia I, Aminu M, Shehu H. Profile of chest trauma in Zaria Nigeria: A preliminary report. *Niger J Surg* [Internet] 2011; 17 (1): 1–4. Available from: <https://www.nigerianjsurg.com/article.asp?issn=1117-6806>
- [20] Hinshaw D. Nigerian Violence Spawns Homemade Responses [Internet]. *Wall Str. J.* Available from: <https://www.wsj.com/articles/nigerian-violence-spawns-homemade-responses-1403725272>
- [21] Ibrahim A. Contextualizing the proliferation of small arms and light weapons in Nigeria: the untold story. *Int J Bus Law Res* 2015; 3 (1): 1–14.
- [22] Lar JT. Violence and Insecurity in Northwest Nigeria: Exploring the Role and Resilience of Local Actors. *African Confl Peacebuilding Rev* [Internet] 2019; 9 (2): 123–42. Available from: <https://www.jstor.org/stable/10.2979/africanconfpeacerevi.9.2.07>
- [23] Yimam AE, Mustofa SY, Gebregzi AH, Aytolign HA. Mortality rate and factors associated with death in traumatic chest injury patients: A retrospective study. *Int J Surg Open* [Internet] 2021; 37: 100420. Available from: <https://www.sciencedirect.com/science/article/pii/S240585722100111X>
- [24] Nwiloh J, Edaigbini S, Danbauchi S, Aminu MB, Oyati A. Arrow injury to the heart. *Ann Thorac Surg* 2010; 90 (1): 287–9.
- [25] Aliyu I, Inuwa I. Arrow in the heart: Our experience. *Niger J Cardiol* [Internet] 2014; 11 (1): 54. Available from: <https://www.nigjcardiol.org/article.asp?issn=0189-7969>
- [26] Mishra B, Gupta A, Sagar S, Singhal M, Kumar S. Traumatic cardiac injury: Experience from a level-1 trauma centre. *Chinese J Traumatol* [Internet] 2016; 19 (6): 333–6. Available from: <https://www.sciencedirect.com/science/article/pii/S1008127516302644>
- [27] Shoar S, Hosseini FS, Naderan M, Khavandi S, Tabibzadeh E, Khavandi S, et al. Cardiac injury following blunt chest trauma: diagnosis, management, and uncertainty. *Int J Burns Trauma* 2021; 11 (2): 80–9.

- [28] Ekpe EE, Eyo C. Determinants of mortality in chest trauma patients. *Niger J SurgOff Publ Niger Surg ResSoc* 2014; 20 (1): 30–4.
- [29] O'Connor J V, Adamski J. The diagnosis and treatment of non-cardiac thoracic trauma. *J R Army Med Corps* 2010; 156 (1): 5–14.
- [30] Chrysou K, Halat G, Hokschi B, Schmid RA, Kocher GJ. Lessons from a large trauma centre: impact of blunt chest trauma in polytrauma patients-still a relevant problem? *Scand J Trauma Resusc Emerg Med* 2017; 25 (1): 42.
- [31] Onakpoya U, Ogunrombi A, Owotade F, Oyenusi A, Ibrahim M. Predictors of death from chest trauma in a resource-poor community in Southwestern Nigeria. *Sahel Med J [Internet]* 2010; 13 (3): 135–40. Available from: <https://www.smjonline.org/article.asp?issn=1118-8561>
- [32] Barea-Mendoza JA, Chico-Fernández M, Quintana-Díaz M, Pérez-Bárcena J, Serviá-Goixart L, Molina-Díaz I, et al. Risk Factors Associated with Mortality in Severe Chest Trauma Patients Admitted to the ICU. *J Clin Med* 2022; 11 (1).
- [33] Beshay M, Mertzluft F, Kottkamp HW, Reymond M, Schmid RA, Branscheid D, et al. Analysis of risk factors in thoracic trauma patients with a comparison of a modern trauma centre: a mono-centre study. *World J Emerg Surg [Internet]* 2020; 15 (1): 45. Available from: <https://doi.org/10.1186/s13017-020-00324-1>
- [34] Demirhan R, Onan B, Oz K, Halezeroglu S. Comprehensive analysis of 4205 patients with chest trauma: a 10-year experience. *Interact Cardiovasc Thorac Surg [Internet]* 2009; 9 (3): 450–3. Available from: <https://doi.org/10.1510/icvts.2009.206599>