

# Epidemiological Profile of Thoracic Trauma in Brazil: A Systematic Review

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## ABSTRACT

**Background:** One of the main injuries found in traumatized patients is thoracic trauma (TT) and corresponds to 25% of deaths in polytrauma patients. According to the World Health Organization, more than nine people die per minute from some type of trauma, with an expense equivalent to 12% for all diseases.

**Materials and methods:** This is a study that addresses the epidemiology of TT in Brazil through a systematic review of the literature on TT in Brazil, conducted in electronic databases following the guidelines of Preferred Notification Items for Systematic Reviews and Meta-analyses (PRISMA). Exclusion criteria were: case reports of other causes of trauma, animal studies, literature reviews, and studies that did not cover chest trauma. The Statistical Package for Social Sciences (SPSS) version 21.0 was used to analyze the results.

**Results:** Initially, 760 studies were found, of which 36 articles were selected as relevant to the study on the epidemiological characteristics of TT. With a high global prevalence, trauma is considered a public health problem, associated with high morbidity and mortality, in developed and developing countries.

**Interpretation:** The Southeast Region had greater statistical relevance ( $p = 0.033$ ) for mechanisms and causes of TT. The penetrating chest trauma [gunshot wounds (GSW) and stab wounds (SW)], showed greater statistical relevance in the South ( $p = 0.04$ ) and Midwest ( $p = 0.04$ ), among the other regions, the value was ( $p \geq 0.5$ ).

**Keywords:** Thoracic trauma, Trauma, Trauma epidemiology thoracic lesions, Trauma in Brazil.

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## INTRODUCTION

Thoracic trauma (TT) is part of the main injuries found in trauma patients and corresponds to 25% of deaths in polytraumatized patients.<sup>1,2</sup> According to the World Health Organization (WHO), over nine people die per minute from some type of trauma, with a health expense equivalent to 12% to all diseases.<sup>3-5</sup> External causes are closely related to TT, such as physical assault, automobile accidents, and other forms of urban accidents, which are the third leading cause of death in Brazil, corresponding to 12.5% of all deaths in the country.<sup>2</sup> With high global prevalence, trauma is considered a public health problem, associated with high morbidity and mortality, in developed and developing countries.

Since 1980, deaths from external causes have increased in Brazil. However, the Brazilian Public Health System (SUS) only adhered to the codification of diseases in a data system in 1997.<sup>6</sup> Thus, information has become essential for monitoring and creating means of prevention of this serious reality in the country.<sup>7</sup> The national policy for the Reduction of Morbidity and Mortality from Accidents and Violence, established by Ordinance No 737/GM by the Ministry of Health May 2001, proposes preventive measures against accidents and violence, in addition to ensuring the treatment of the victims.<sup>8</sup>

Thoracic trauma is classified as being either blunt or penetrating. The most common cause of blunt trauma is motor vehicle collision (MVC), which is responsible for up to 80% of the injuries. Other circumstances include crashes, vehicles hitting pedestrians, acts of violence, and explosion injuries. Most penetrating injuries are due to gunshot wounds (GSW) and stab wounds (SW), which together account for 20% of all serious trauma in the United States.<sup>1,9,10</sup>

Treatment of most thoracic lesions is done through chest tube thoracostomy associated with analgesia and ventilatory

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support. Only 15–30% of TT need thoracotomy or other invasive intervention.<sup>10-15</sup> In the United States, <10% of blunt trauma requires surgical intervention, while in open trauma 15–30% will require surgery.<sup>1</sup>

This study aims to provide an epidemiological analysis of TT in Brazil by means of a systematic review.

## MATERIALS AND METHODS

A systematic review addressing TT in Brazil was conducted in the electronic databases of PUBMED/NCBI, SciELO, LILACS, MEDLINE, WHOLIS, COCHRANE, and WHO. The analysis also based its results through System of Death Information (SIM), which is the computing department of the Brazilian Public Health System (SUS), following

the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The search took place by articles published from January 2008 to January 2018 using the keywords "Injuries", "Thoracic Trauma", "Drainage", "Thorax", "Pneumothorax", "Hemothorax", "Epidemiology", "Traumatology Centers", "Cardiac Trauma", "Penetrating Wounds", and "Chest Trauma". Three variables present in external causes were analyzed: transport accidents (TA), intentionally self-inflicted injuries (ISII), and aggressions (AGRs). The analysis includes researches published in Portuguese and English.

The following exclusion criteria were applied: case reports of other trauma causes, animal studies, reviews of the literature, and studies that did not cover TT.

The Statistical Package for Social Sciences (SPSS) version 21.0 was utilized to analyze the results. The patients were divided into three groups according to the type of death from external causes [traffic accidents (TA), ISII, and AGRs] which were compared employing the Kruskal–Wallis test. *p* values <0.05 were considered statistically significant.

## RESULTS

Initially, 760 studies were identified in the databases searched (390 in SciELO, 37 in LILACS, 108 in PUBMED, 35 in WHOLIS, and 490 in COCHRANE). Following exclusion based on title and abstract, 133 articles were selected for full-text analysis. Finally, 36 articles were selected as relevant to the present study on the TT epidemiological characteristics as shown in Flowchart 1. The findings by regions were also described (Table 1).

Describing the main characteristics of TT in the North, Westphal and Luiz showed that penetrating TT with a lethal anatomical score (>15 points) associated with important vascular lesions, such as the aorta and vena cava, are the main predictors of death. In the Northeast region, Cuba and Bezerra, through the study of 168 cases,

described that penetrating trauma as the most frequent type in TT, the majority being treated conservatively. On the other hand, some patients required surgical specialists and a high-level trauma support hospital, which is a need not compatible with hospital services offered in this region.

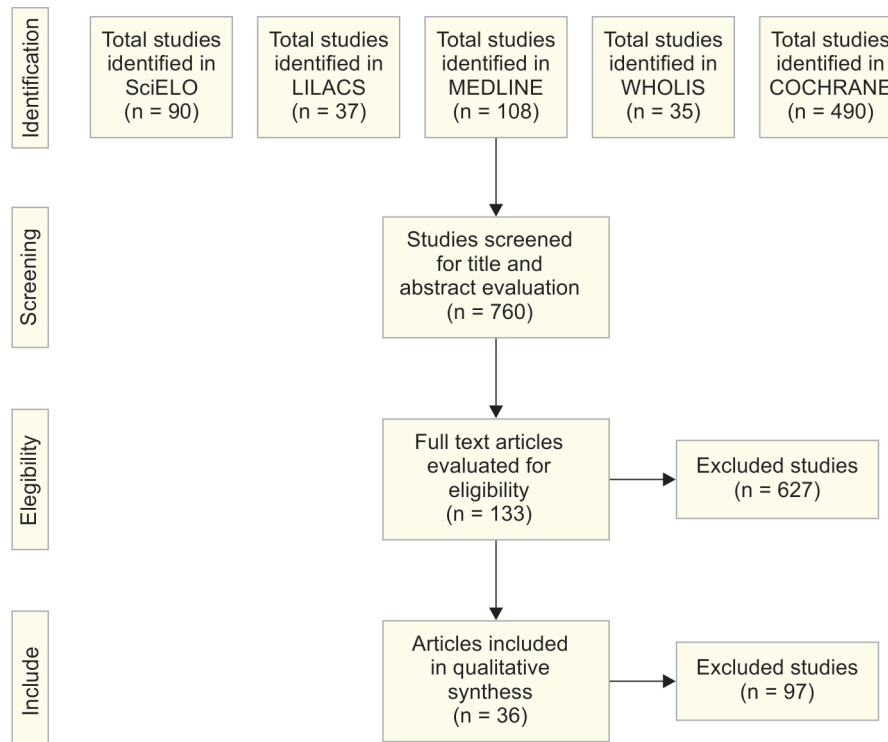
Souza et al. presented in their study the profile of TT victims in the Midwest region, consisting mainly of young men with SW or motorcycle accidents. Jorge et al. showed in that same region that the total number of homicides and suicides doubled in frequency and TA are approximately 90% higher than the official report, demonstrating that TT data in Brazil is underreported.

Potlabathin and Scapolan through the analysis of 400 cases and medical records of 100 consecutive, respectively, that the TT patients profile consisted mainly of young men, with chest wall trauma, resulting from blunt TT by a TA. However, Silva and Gawryszewski reported that the high number of trauma cases in the region can be reduced by means of accident prevention measures, investments in traffic education programs, and improvement of public safety. Mesquita Filho et al. discussed the external causes of death, which are poorly known and addressed in the public health network in the Southeast region.

Naufel Júnior, Zanette, and Oliveira in a study carried out in the South region concluded that the profile of patients affected by blunt TT consisted of men aged between 15 and 29 years. Saldanha et al. compared the use of alcohol and drugs between men and women victims of TA, showing higher incidence in TT also in men. Broska Júnior et al. stated that the chest drainage time, hospital stay, and severe complications associated are factors that worsen the prognosis of TT victims.

Guevara Rubio et al. argue that the general epidemiological profile found in Brazil is similar to that of other countries, the main difference is found in the injury mechanism. Gawryszewski

**Flowchart 1:** Summarizing the search strategy for study



and Giannini claim that homicides and TA are the main factors for increased morbidity and mortality in Brazil. Campeão et al. add by stating that trauma is an important public health problem in Brazil, being among the main causes of death. Edgecombe and Whizar-Lugo described that through a diagnosis during the investigation of primary and secondary evaluation, the rate of death by TT can be reduced according to ATLS.

The division between penetrating and blunt trauma can be analyzed through the three variables selected in the study: AGRs, ISII, and TA, where the total number of deaths was 934,588 ( $p = 0.99$ ). Of this total, blunt chest trauma is represented by TA, responsible for 350,684 (37.5%) deaths being more prevalent in the Southeast 35.7% ( $p = 0.033$ ), likely due to greater urbanization and road stretches, followed by the Northeast 28.4% ( $p = 0.99$ ), South 17.4% ( $p > 0.99$ ), Midwest 10.6% ( $p = 0.99$ ) and North 7.9% ( $p = 0.73$ ). In this same perspective, penetrating trauma accounted for 583,904 (62.5%) deaths, mainly caused by aggression (61%) and ISII (1.5%). Regarding deaths from aggression, the Northeast region has the

highest incidence 39.9%. Deaths from ISII are more common in the Southeast (37.1%), followed by the South (27.3%), Northeast (18.7%), Midwest (9.8%), and North (7.1%) (Table 2).

Analyzed deaths in males (826,527) occurred due to aggression (63.9%), TA (34.7%), and ISII (1.5%). On the other hand, of the 68,550 deaths in females, the same categories represented the following figures: TA (59.6%), AGRs (39%), and ISII (1.5%). However, while comparing each cause separately, it is noted that men die mainly from the three categories: aggression (92.5%), TA (81.7%), and ISII (88.4%). Therefore, those male deaths occur especially by penetrating trauma (AGRs and ISII) and female deaths from blunt trauma, particularly TA (Table 2).

The object gunshot or stab wound (GSW/SW) used in the mechanism of open injury can be evaluated, the total of which, as previously stated, was 583,904 deaths ( $p = 0.99$ ), and statistical analyses represented Northeast ( $p = 0.99$ ), Southeast ( $p = 0.99$ ), South ( $p = 0.04$ ), North ( $p = 0.99$ ), and Midwest ( $p = 0.04$ ). Lesions due to GSW were responsible for 77.3% of the total number of

**Table 1:** Description of studies

<i>Author, date, citation</i>	<i>Theme of review</i>	<i>Outcomes</i>
Edgecombe et al., 2020 <sup>1</sup>	Thoracic trauma	Diagnosed during the secondary trauma survey and successfully managed by applying the fundamental principles of advanced trauma life support (ATLS)
Souza et al., 2013 <sup>2</sup>	Clinical and epidemiological profile	The profile of victims of chest trauma requiring surgical care consisted mainly of young men with injuries caused by stab wound or motorcycle accidents, presenting hemopneumothorax or hemothorax
Batista et al., 2006 <sup>3</sup>	Mechanisms and severity of trauma	Traumatized, and mainly affected the lower limbs and the pelvis. Most of the victims suffered superficial injuries, resulting from minor trauma
Guevara Rubio et al., 2012 <sup>4</sup>	Epidemiological profile	The epidemiological profile found in this study was similar to those made in other countries, the main difference was found in the mechanism of injury
Potlabathin and Kanala, 2016 <sup>5</sup>	Analysis of 400 cases	The profile of patients with thoracic trauma is young men, with a rib fracture, affected by blunt thoracic trauma due to a traffic accident
Gawryszewewski et al., 2004 <sup>6</sup>	Mortality and morbidity	Based on the findings, preventive programs should aim to decrease both mortality and morbidity, with special emphasis on homicides, traffic accidents, and falls
Jorge et al., 2002 <sup>7</sup>	Information systems	The total number of homicides was five times higher; suicides doubled in frequency; and transport accidents have become 90% more than reported by the original, significantly reducing deaths from external causes of an ignored type
Ministério da Saúde, 2000 <sup>8</sup>	Accidents and violence	Official diary of mortality and traffic violence in Brazil
Campeão et al., 1990 <sup>9</sup>	Trauma care	Trauma is an important public health problem in Brazil, being among the first three causes of death. The trauma registry provides useful information capable of improving care for victims, defining preventive measures, providing information for the application of resources
Scapolan et al., 2010 <sup>10</sup>	Analysis of 100 consecutive cases	The thoracic trauma patient is most prevalently young male with stab wound penetrating injury, without associated injuries, hemodynamically stable, presenting hemothorax, with a high probability of survival
Fontelles and Mantovani, 2000 <sup>11</sup>	Thoracic trauma	In the multivariate logistic regression analysis, the variables length of stay, blunt trauma, and blood volume drained >500 mL, when associated, positively influenced the occurrence of complications
Calhoon and Trinkle, 1997 <sup>12</sup>	Chest trauma pathophysiology	Molecular generic response to injury that can lead to multiorgan failure. For many years, basic physiology and biochemistry were considered to be the systemic mechanisms of injury
Silas et al., 1990 <sup>13</sup>	Thoracic injuries	Study reports the treatment of patients in the emergency system for thoracic trauma
Symbas, 1989 <sup>14</sup>	Chest drainage	Tube thoracostomy results in complete drainage of the collected air and fluid in the pleural space and allows full expansion and occupation of the entire pleural space by the lung, thus protecting the lung and pleural space from subsequent complications

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Author, date, citation	Theme of review	Outcomes
Westphal and Luiz, 2009 <sup>15</sup>	Thoracic trauma	The most contributing death factors were the lethal anatomical score, >15 points, and the association with major vascular lesions, like the aorta and vena cava
American College of Surgeons, 2018 <sup>16</sup>	Student course manual	ATLS 10th ed.
Whizar-Lugo et al., 2015 <sup>17</sup>	Chest trauma	Chest trauma is a modern major health problem with high mortality, even in trauma center hospitals. It is a life-threatening condition, which often involves other anatomical regions that merit simultaneous diagnosis and treatment
Giannini et al., 2001 <sup>18</sup>	Chest trauma	Thoracic trauma is still frequent, and the majority of cases are simple. On the other hand, some will require surgical skill and a high-level support hospital
Naufel Júnior et al., 2014 <sup>19</sup>	Thoracic trauma profile	Men aged between 15 and 29 years were the most affected, submitted to pleural drainage due to blunt trauma, most often associated with hemopneumothorax
Aucar et al., 2007 <sup>20</sup>	Trauma computed tomography	Increasing use of multi-image studies is facilitated by improvements in technology and medical-legal pressures. However, extensive imaging can stress overburdened trauma systems
Brink et al., 2010 <sup>21</sup>	Blunt trauma patients	Selective CT results in less radiation dose exposure but a slightly higher cost and less certainty
Fenili et al., 2002 <sup>22</sup>	Thoracic trauma	Discussion of the main types of injuries and injuries resulting from chest trauma found
Rowan et al., 2002 <sup>23</sup>	Traumatic pneumothorax detection	Us was more sensitive than supine chest radiography and as sensitive as CT in the detection of traumatic pneumothoraces
Flato et al., 2010 <sup>24</sup>	EFAST-extended focused assessment	This type of complementary exam replaces computed tomography and diagnostic peritoneal lavage
Secretaria de Assuntos Estratégicos, 2015 <sup>25</sup>	Traffic accidents on Brazilian federal highways	Numerical data from the federal police on traffic accidents in Brazil
Zanette et al., 2019 <sup>26</sup>	Epidemiological profile of thoracic trauma	Chest X-ray was used to confirm most of the diagnoses, and there was a prevalence for conservative treatment
Mesquita Filho et al., 2007 <sup>27</sup>	Morbidity due to external causes at emergencies	Status of external causes is very little known and approached in public health
Silva et al., 2017 <sup>28</sup>	Valence and epidemiological profile of trauma	A high number of trauma cases in Paracatu-MG, which demonstrates the need for measures to prevent domestic accidents, investments in traffic education programs, and improvement of public safety
Cuba and Bezerra, 2005 <sup>29</sup>	Study of 168 cases	Thoracic trauma is still frequent, and the majority of cases are simple. On the other hand, some will require surgical skill and a high-level support hospital
Broska Júnior et al., 2017 <sup>30</sup>	Thoracic trauma	The time of drainage, hospitalization, and complications were higher than in the literature, which can be explained by the drainage being made at the emergency room and the presence of associated injuries
Mahrán et al., 2016 <sup>31</sup>	Thoracic injuries and trauma	Increasing the awareness of the community, making policies, and establishment of a trauma system are important to decrease the burden of injuries
Oliveira et al., 2017 <sup>32</sup>	Mortality in traffic accidents	Hospitalization rate due to trauma in Brazil may be the result of some factors, such as an increasing number of accidents and cases of violence
Saldanha et al., 2014 <sup>33</sup>	Victims of traffic accidents	Compare alcohol and drug use among men and women who were the victims of traffic accidents
Spencer Netto et al., 2001 <sup>34</sup>	Predictors of mortality	The majority of patients treated for cardiac injuries presented good predictors for survival, justifying our low mortality rates
Cerqueira et al., 2015 <sup>35</sup>	Firearms maps	Map of firearm deaths in Brazil, the federal government
Ministério da Saúde <sup>36</sup>	SIM-SUS	Unique health system, the federal government

Description of all articles selected for analysis.

penetrating chest trauma deaths and accounted for 79.3% of male deaths (Table 3).

From the GSW deaths, the Northeast is the main representative (41.1%), followed by the Southeast (28.2%), South (12%), North (10.2%), and Midwest (8.3%). Those caused by SW totaled 22.1%,

which represents 86.7% of deaths in that region. The distribution between the regions is as follows: Northeast (33.1%), Southeast (26.8%), North (16.4%), South (12%), and Midwest (11.5%). In fact, according to female deaths, 60.9% were caused by GSW and 39.1% by SW.



**Table 2:** Deaths from external causes in Brazilian regions

Brazilian region	Sex	Large group ICD-10				Total	Statistic
		TA	ISII	AGRs			
North	Male	22.778	867	62.243		85.888	$p = 0.73$
	Female	5.005	98	4.519			
	Ne	28	0	118			
	Total	27.811	965	66.880			
Northeast	Male	84.256	2.312	212.895		299.463	$p = 0.99$
	Female	15.254	234	14.309			
	Ne	42	0	181			
	Total	99.552	2.546	227.385			
Southeast	Male	101.202	4.444	144.744		250.390	$p = 0.033$
	Female	24.062	620	13.008			
	Ne	67	0	183			
	Total	125.331	5.064	157.935			
South	Male	48.539	3.253	60.674		112.466	$p > 0.99$
	Female	12.354	472	5.733			
	Ne	17	0	39			
	Total	60.910	3.725	66.446			
Midwest	Male	29.821	1.195	47.304		78.320	$p = 0.99$
	Female	7.248	146	4.244			
	Ne	11	0	69			
	Total	37.080	1.341	51.617			
Total general	Male	286.596	12.071	527.860		826.527	$p = 0.99$
	Female	63.923	1.570	41.813			
	Ne	165	0	590			
	Total	350.684	13.641	570.263			

Death by Region: Large group ICD-10: TA, Traffic accidents; ISII, Intentional Self-inflicted injuries; AGRs, Aggressions  
 Source: MS/SVS/CGIAE—Mortality Information System—SIM  
 Period: 2008–2018

In that sense, it is noted that lesions by GSW are the most prevalent in both sexes and the Northeast has the higher prevalence of the two categories (Table 3).

## DISCUSSION

In TT, the determining injuries for immediate risk of death are airway obstruction, hypertensive pneumothorax, open pneumothorax, cardiac tamponade, tracheobronchial injury, and massive hemothorax. Those with a potential risk of death and should be diagnosed and treated on secondary evaluation are pneumothorax, hemothorax, pulmonary contusion, flail chest, blunt heart trauma, traumatic aorta rupture, and traumatic rupture of the diaphragm.<sup>16</sup> Hence, penetrating or blunt chest trauma, as long as it is associated with these consequences of chest trauma, is subject to higher mortality as chest injuries correspond to the highest death rate during primary evaluation.

Lesions can also be divided into four large groups of associated injuries: chest wall, pulmonary, mediastinal, and diaphragmatic lesions.<sup>17</sup> These lead to six main types of clinical situations: airway obstruction, hypertensive pneumothorax, flail chest, cardiac tamponade, open pneumothorax, and massive hemothorax.<sup>16</sup> In addition, abdominal organs may also be affected—such as the liver and spleen—more often in thoracoabdominal or those due to a high energy mechanism.<sup>18</sup> Therefore, early diagnosis and treatment

are essential in the first hour of trauma (Golden Hour) and are associated with lower morbidity and mortality.<sup>1,16,19</sup>

Chest computed tomography (CT) is considered a more sensitive method and should be used only in special situations and for stable patients.<sup>20,21</sup> The gold standard in the care of TT for blood detection in the pleural cavity and pericardium has been extended focused assessment with sonography for the trauma (E-FAST).<sup>16,22</sup> It can also be used in the detection of pneumothorax, with sensitivity similar to that of chest CT and higher than chest X-ray.<sup>22–24</sup>

Of the total deaths in trauma patients, 25–35% are caused by TT.<sup>1,2</sup> The mortality with only one isolated chest injury ranges from 4 to 8%, however, it rises to 25% when another organ is reached and up to 35% when multiple organs are hit.<sup>13</sup> Thus, according to the Brazilian Ministry of Health, about 30,150 trauma patients die during surgical treatment during the analyzed period (2008–2018). Therefore, it is concluded that, of this total, >10,000 people died from chest trauma in these 10 years.

In TT, 85% of victims normally are treated under ventilatory support, analgesia, and chest tube thoracostomy. Only 15–30% will require surgical treatment, in most cases severe patients who need some type of intervention, a fact that justifies the demand for trauma centers.<sup>10,15,18</sup>

According to the Institute for Applied Economic Research (IPEA), in 2004 TA increased by 50.3% on Federal Highways, with a rise of 34.5% in deaths and 50% in general injuries. However, between 2010



**Table 3:** Deaths from penetrating blunt chest trauma in Brazilian regions

Brazilian		Category ICD10						
Region	Sex	GSW	SW	Total		GSW (%)	SW (%)	Total (%)
North	Male	43.975	19.135	63.110	$p = 0.89$	69.7	30.3	100
	Female	2.604	2.013	4.617		56.4	43.6	100
	Ne	63	55	118		53.4	46.6	100
	Total	46.642	21.203	67.845		68.7	31.3	100
Northeast	Male	177.378	37.829	215.207	$p = 0.99$	82.4	17.6	100
	Female	9.700	4.843	14.543		66.7	33.3	100
	Ne	113	68	181		62.4	37.6	100
	Total	187.191	42.740	229.931		81.4	18.6	100
Southeast	Male	120.459	28.729	149.188	$p = 0.99$	80.7	19.3	100
	Female	7.798	5.830	13.628		57.2	42.8	100
	Ne	152	31	183		83.1	16.9	100
	Total	128.409	34.590	162.999		78.8	21.2	100
South	Male	50.697	13.230	63.927	$p = 0.04$	79.3	20.7	100
	Female	3.872	2.333	6.205		62.4	37.6	100
	Ne	34	5	39		87.2	12.8	100
	Total	54.603	15.568	70.171		77.8	22.2	100
Midwest	Male	35.555	12.944	48.499	$p = 0.04$	73.3	26.7	100
	Female	2.457	1.933	4.390		56.0	44.0	100
	Ne	34	35	69		49.3	50.7	100
	Total	38.046	14.912	52.958		71.8	28.2	100
Total general	Male	428.064	111.867	539.931	$p = 0.99$	79.3	20.7	100
	Female	26.431	16.952	43.383		60.9	39.1	100
	Ne	396	194	590		67.1	32.9	100
	Total	454.891	129.013	583.904		77.9	22.1	100

Category ICD-10 including summation (ISII and AGRs): (**GSW**) gunshot: injury firing handgun; gunshot firing weapon over caliber; injury firing another firearm and unspecified; handgun shooting; firing gunfire of greater caliber; Aggression firing another firearm or unspecified; (**SW**) non-gunshot: injury penetrating cutting object; Aggression sharp or penetrating object; Injury by a blunt object; Aggression by means of a blunt object  
 Source: MS/SVS/CGIAE—Mortality Information System—SIM  
 Period: 2008–2018

and 2014, there was a reduction from 40 to 30% in the number of accidents and serious victims.<sup>25</sup> This information corroborates the results of TA found in our study, although the number is smaller, it is still necessary to reduce it even more. In Itajaí, a municipality in the state of Santa Catarina (South region), in 2019, 89% of TT were due to blunt injuries and 57% to TA.<sup>26</sup>

Penetrating TT was responsible for more than half of the deaths from TT assessed, mainly due to external causes. A study published in 2009, points out that in Manaus (North region), TT occurred mainly owing to physical aggression, especially in males (98.8%).<sup>15</sup> This fact corroborates with the results found in our study because the AGRs overcame self-harm and TA in the North of the country. Our data are in agreement with other studies carried out in São Paulo, Minas Gerais, Goiás, Paraná, and Maranhão, where penetrating trauma was predominant, mainly in males.<sup>2,10,27–30</sup>

The high prevalence of TT in males between 20 years and 40 years may not represent greater access to health services, but a greater tendency to exposure to external causes.<sup>31,32</sup> Besides that, a study carried out in two hospitals in Porto Alegre compared risk behavior among men and women involved in TA. Such a study revealed that 70% of the 609 victims were men, and of these, 75.2% were drivers and only 18.6% of women involved in accidents were female drivers. Evidence pointed to higher use of alcohol, marijuana, and cocaine among men and higher use of anxiolytics

among women.<sup>33</sup> Thus, males tend to be affected more by TA and get involved in violent situations, when compared to females.

In penetrating TT, there is a relationship between the type of weapon and the economic conditions of the study population. Stab wound predominates in poorer regions compared to the GSW.<sup>15</sup> Literature data revealed a prevalence of penetrating trauma by GSW in Manaus, São Paulo, Goiânia, Recife, São Luis, and Itajaí.<sup>2,10,15,26,30,34</sup>

The high rate of deaths by GSW and the difference between the Northeast and Southeast in deaths can be understood. According to IPEA, in 2010, in 20 microregions with the largest number of firearms in Brazil, 13 were located in the Northeast, 4 in the Southeast, 2 in the South, and 1 in the North. This fact confirms the distribution by regions regarding deaths to GSW. It is notable that, even after the Disarmament Statute in 2003—which prohibited the commercialization of firearms throughout Brazil—the reduction in the use of firearms has not occurred homogeneously in the country.<sup>35</sup>

Through the data obtained by the SIM system, referring to “Deaths due to External Causes in the Brazilian Regions”, according to the analyses of TA, ISII, and AGRs, the only region that presented statistical relevance was Southeast presenting ( $p = 0.033$ ) due to the extensive road providing a large number of TA. The North Region, although presenting a high rate of AGRs and with low population concentration and low income, did not demonstrate statistical



relevance ( $p = 0.73$ ). For the other regions, there was no statistical significance ( $p \geq 0.5$ ).

On the other hand, while analyzing deaths for penetrating TT in the Brazilian region, we found statistical relevance for GSW and SW in the South ( $p = 0.04$ ) and the Midwest ( $p = 0.04$ ) among the other regions, although the statistical significance is irrelevant ( $p \geq 0.5$ ).

During the literature search for this systematic review, the deficiency of data compilation was an important and present factor observed by the authors. In Brazil, there is no consistent database that presents reliable information about TT. The main studies on chest issues are descriptors of surgical procedures and techniques, leaving a gap on the epidemiology and specific characteristics of TT in Brazil. Thus, in this study, we seek to present the main epidemiological characteristics of TT in the country to fill this need by offering concisely compiled information.

## CONCLUSION

According to our analysis, TT is more prevalent in males. The most common type is penetrating TT and the highest mortality occurred due to GSW. As for blunt traumas, they are mainly caused by TA.

There is a need for a more accurate compilation of specific data regarding TT to ensure a safer epidemiological panorama since in Brazil the characteristics of TT are heterogeneous and thus, the lack of reliable data can demonstrate a fictitious reality of information.

## CONTRIBUTORSHIP STATEMENT

All Authors equally contributed to the execution of this text, discuss planning, conduct, reporting, conception and design, acquisition of data, analysis, and interpretation of data: Gabriel Antonio Roberto, Carolina Magalhães Britto Rodrigues, Sthefano Atique Gabriel, and Rodrigo Sardenberg.

## REFERENCES

- Edgecombe L, Sigmon DF, Angus LD. Thoracic trauma. Treasure Island (FL): StatPearls Publishing; 2020. Jan last Update: January 31, 2020.
- Souza VS, Santos AC, Pereira LV, et al. Clinical and epidemiological profile of victims of chest trauma undergoing surgical treatment at a referral hospital. Clinical and epidemiological profile of victims of chest trauma undergoing surgical. treatment at a referral hospital. *Sci Med* 2013(2):96–101.
- Batista SEA, Baccani JG, Silva RAP, et al. Análise comparativa entre os mecanismos de trauma, as lesões e o perfil de gravidade das vítimas, em Catanduva - SP. *Rev Col Bras Cir* 2006;33(1):6–10. DOI: <https://doi.org/10.1590/S0100-69912006000100003>.
- Guevara Rubio N, Olivarez Bonilla M, Ortega Sánchez R. Perfil epidemiológico del paciente con trauma de tórax em el Servicio de Urgencias Adultos del Hospital. *General Archivos de Medicina de Urgencia de México* 2012;4(3):105–111.
- Potlabathin RP, Kanala A. Experience with chest trauma: analysis of 400 cases. *J Evid Based Med Healthc* 2016;3(73):3986–3989. DOI: [10.18410/jebmh/2016/852](https://doi.org/10.18410/jebmh/2016/852).
- Gawryszewski VP, Koizumi MS, Jorge MHPM. As causas externas no Brasil no ano 2000: comparando a mortalidade e a morbidade. *Cad Saúde Pública (Rio de Janeiro)* 2004;20(4):995–1003. DOI: <http://dx.doi.org/10.1590/S0102-311X2004000400014>.
- Jorge MHPM, Gotlieb SLD, Laurenti R. O sistema de informações sobre mortalidade: problemas e propostas para o seu enfrentamento II - Mortes por causas externas. *Rev Bras Epidemiol (São Paulo)* 2002;5(2):212–223. DOI: <http://dx.doi.org/10.1590/S1451-790X2002000200008>.
- Ministério da Saúde. Política nacional de redução da morbimortalidade por acidentes e violência. *Rev Saúde Pública (São Paulo)* 2000;34(4):427–430. DOI: <http://dx.doi.org/10.1590/S0034-89102000000400020>.
- Campeão HR, Copes WS, Sacco WJ, et al. Estudo dos principais resultados do trauma: estabelecendo normas nacionais para atendimento ao trauma. *J Trauma* 1990;30(11):1356–1365. DOI: [10.1097/00005373-199011000-00008](https://doi.org/10.1097/00005373-199011000-00008).
- Scapolan MB, Vieira NLP, Nitrini SS, et al. Thoracic trauma: analysis of 100 consecutive cases. *Einstein (São Paulo)* 2010;8(3):339–342. DOI: [10.1590/s167945082010ao1532](https://doi.org/10.1590/s167945082010ao1532).
- Fontelles MJP, Mantovani M. Trauma torácico: fatores de risco de complicações pleuropulmonares pós-drenagem pleural fechada. *Rev Col Bras Cir* 2000;27(6):400–407. DOI: [10.1590/S0100-69912000000600008](https://doi.org/10.1590/S0100-69912000000600008).
- Calhoun JH, Trinkle JK. Pathophysiology of chest trauma. *Chest Surg Clin N Am* 1997;7:199–211.
- Silas MG, Belluzzo BR, Miguel EG. Thoracic injuries – review of 231 cases. *Arq Med ABC* 1990;13(1-2):19–21.
- Symbas PN. Chest drainage tubes. *Surg Clin North Am* 1989;69(1):41–46. DOI: [10.1016/S0039-6109\(16\)44733-X](https://doi.org/10.1016/S0039-6109(16)44733-X).
- Westphal, Luiz F. Trauma torácico: análise de 124 pacientes submetidos à toracotomia. *Rev Col Bras Cir* 2009;36(6):482–486. DOI: [10.1590/S0100-69912009000600004](https://doi.org/10.1590/S0100-69912009000600004).
- American College of Surgeons. ATLS: advanced trauma life support for doctors: student course manual. 10th ed., Chicago (IL): American College of Surgeons; 2018.
- Whizar-Lugo V, Saucedo-Gastelum A, Hernández-Armas A, et al. Chest trauma: an overview. *J Anesth Crit Care Open Access* 2015;3(1):2–11.
- Giannini JÁ, Soldá SC, Saad Júnior R. Trauma de tórax. in *Emergências Traumáticas e Não Traumáticas*, ed. Coimbra RSM, Soldá SC, Casaroli AA, et al. São Paulo: Atheneu; 2001. pp. 57–69.
- Naufel Júnior CR, Talini C, Barbier Neto L. Thoracic trauma profile of attended victims at Hospital Universitário Evangélico De Curitiba (HUEC). *Rev Med UFPR* 2014;1(2):42–46. DOI: [10.5380/rmu.v1i2.40701](https://doi.org/10.5380/rmu.v1i2.40701).
- Aucar JA, Fernandez L, Wagner-Mann C. If a picture is worth a thousand words, what is a trauma computerized tomography panel worth. *Am J Surg* 2007;194(6):734–739. DOI: [10.1016/j.amjsurg.2007.08.036discussion.739-40](https://doi.org/10.1016/j.amjsurg.2007.08.036discussion.739-40).
- Brink M, Deunk J, Dekker HM, et al. , Criteria for the selective use of chest computed tomography in blunt trauma patients. *Eur Radiology* 2010;20(4):818–828. DOI: [10.1007/s00330-009-1608-y](https://doi.org/10.1007/s00330-009-1608-y).
- Fenili R, Alcacer JAM, Cardona MC. Traumatismo torácico: uma breve revisão. *Arq Catarin Med* 2002;31(1-2):31–36.
- Rowan KR, Kirkpatrick AW, Liu D, et al. Traumatic pneumothorax detection with thoracic US: correlation with chest radiography and CT – initial experience. *Radiology* 2002;225(1):210–214. DOI: [10.1148/radiol.2251011102](https://doi.org/10.1148/radiol.2251011102).
- Flato UPF, Guimarães HP, Lopes RD, et al. Usefulness of extended-FAST (EFAST-extended focused assessment with sonography for trauma) in critical care setting. *Rev Bras Ter Intensiva* 2010;22(3). DOI: [10.1590/S0103-507X2010000300012](https://doi.org/10.1590/S0103-507X2010000300012).
- BRASIL. Secretaria de Assuntos Estratégicos da Presidência da República. Instituto de Pesquisa Econômica Aplicada. Acidentes de trânsito nas rodovias federais brasileiras: caracterização, tendências e custos para a sociedade. Brasília, 2015 jul 20. Disponível em: [http://www.ipea.gov.br/portal/index.php?option=com\\_content&view=article&id=2627](http://www.ipea.gov.br/portal/index.php?option=com_content&view=article&id=2627). [access april, 2020].
- Zanette GZ, Waltrick RS, Monte MB. Epidemiological profile of thoracic trauma in a reference hospital of Foz do Rio Itajai. *Rev Col Bras Cir* 2019;46(2). DOI: [10.1590/0100-6991e-20192121](https://doi.org/10.1590/0100-6991e-20192121).
- Mesquita Filho M, Mesquita Filho J, Mello MHP. Features of morbidity due to external causes at emergency services. *Rev Bras Epidemiol* 2007;10(4):579–591. DOI: [10.1590/S1415-790X2007000400016](https://doi.org/10.1590/S1415-790X2007000400016).
- Silva LAP, Ferreira AC, Paulino RES, et al. Retrospective analysis of the prevalence and epidemiological profile of trauma patients in a secondary hospita. *Rev Med* 2017;96(4):246–253. DOI: [10.11606/issn.1679-9836.v96i4p246-254](https://doi.org/10.11606/issn.1679-9836.v96i4p246-254).

29. Cuba RMBF, Bezerra JAF. Thoracic trauma: retrospective study of 168 cases. *Rev Col Bras Cir* 2005;32(2):57–59. DOI: 10.1590/S0100-69912005000200002.
30. Broska Júnior CA, Botelho AB, Linhares AC, et al. Perfil das pacientes vítimas de trauma torácico submetidos à drenagem de tórax. *Rev Col Bras Cir* 2017;44(1). DOI: 10.1590/0100-69912017001005.
31. Mahran DG, Farouk O, Qayed MH, et al. Pattern and trend of injuries among trauma unit attendants in upper Egypt. *Traum Mon* 2016;21(2):e20967. DOI: 10.5812/traumamon.20967.
32. Oliveira NLB, Souza EM, Cunha GZ. Mortality in traffic accidents: temporary trend between 1996 and 2012. *Cien Cuid Saude* 2017;16(4). DOI: 10.4025/ciencuidsaude.v16i4.38343.
33. Saldanha RF, Pechansky F, Benzano D, et al. Differences between attendance in emergency care of male and female victims of traffic accidents in Porto alegre, Rio Grande do Sul state, Brazil. *Cien Saude Colet* 2014;19(9):3925–3930. DOI: 10.1590/1413-81232014199.12892013.
34. Spencer Netto FAC, Campos JM, Lima LFC, et al. Predictors of mortality in patients with cardiac trauma who arrive alive in the operation room. *Rev Col Bras Cir* 2001;28(2):87–94. DOI: 10.1590/S0100-69912001000200003.
35. Cerqueira D, Coelho D, Siqueira R, Brasil, Secretaria de Assuntos Estratégicos da Presidência da República. Instituto de Pesquisa Econômica Aplicada. Mapas de Armas de Fogo nas Microrregiões Brasileiras. Brasília, 2015 jul 20. Disponível em: <https://ipea.gov.br/agencia/images/stories/PDFs/relatoriopesquisa/mapaarmas.pdf>. [access april, 2020].
36. Brasil, Ministério da Saúde. Banco de dados do Sistema Único de Saúde-SIM. Disponível em <http://www.datasus.gov.br> [access april, 2020].