

Logging-related fatalities in the Eastern Black Sea region of Türkiye: a forensic–epidemiological analysis

● Hüseyin Çetin Ketenci,¹ ● Talip Vural²

¹Department of Forensic Medicine, Recep Tayyip Erdoğan University Faculty of Medicine, Rize-Türkiye

²Department of Forensic Medicine, Atatürk University Faculty of Medicine, Erzurum-Türkiye

ABSTRACT

BACKGROUND: Logging is widely recognized as one of the most hazardous industries. Despite the prominence of this sector in Türkiye's Eastern Black Sea region, comprehensive forensic investigations of logging-related deaths are limited.

METHODS: This retrospective study examined 102 logging-related fatalities identified among 4,878 forensic autopsies performed between 2013 and 2023 by the Recep Tayyip Erdoğan University. Demographic, occupational, environmental, seasonal, and medical response characteristics were extracted from autopsy reports and supplemented with information from police and judicial records.

RESULTS: The victims were predominantly male (93.1%) with an average age of 57.4 years. Two-thirds of them were unregistered workers, and 5.9% were foreign nationals. Tree-strike injuries were the leading cause of death (51.0%), followed by falls from trees (30.4%). Fatalities most frequently occurred in the fall (32.4%), with cranial trauma predominating in the summer and thoracic injuries in the spring. Autopsy findings revealed extensive polytrauma, including pelvic and extremity fractures (71.6%) and intracranial hemorrhage (53.9%). Most incidents were witnessed (78.4%); however, unwitnessed deaths occurred disproportionately among older informal workers on private lands. Female victims (6.9%) primarily died while performing auxiliary tasks and frequently lacked medical intervention (83%).

CONCLUSION: This study represents the first comprehensive medico-legal evaluation of logging-related fatalities in the Eastern Black Sea region. The findings highlight the pivotal role of unregulated labor, hazardous seasonal working conditions, and limited emergency response capacity in shaping mortality patterns. Targeted interventions, including stricter enforcement of occupational safety regulations, training for informal workers, and improved access to rural emergency services, are urgently needed to reduce preventable deaths in forestry and logging activities.

Keywords: Forensic autopsy; occupational injury; logging fatality; seasonal risk; Türkiye.

INTRODUCTION

Logging is recognized as one of the most hazardous industries worldwide, with some of the highest occupational fatality rates across sectors.^[1] Activities such as tree felling, pruning, climbing, and transporting logs expose both professional forestry workers and amateurs to a high risk of severe traumatic injuries and deaths.^[2] These incidents are often associated with environmental challenges, including rugged terrain,

remote and hard-to-access work areas, and adverse weather conditions, as well as occupational exposures such as the use of heavy motorized and cutting tools and contact with allergenic flora and fauna.^[3] Individual vulnerabilities, such as advanced age, pre-existing health conditions (e.g., cardiovascular disease or balance disorders), inadequate use of personal protective equipment (PPE), and noncompliance with safety protocols, further increase the risk of fatal outcomes.^[4] However, beyond individual-level factors, the hazardous physical

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Address for correspondence: Hüseyin Çetin Ketenci

Department of Forensic Medicine, Recep Tayyip Erdoğan University Faculty of Medicine, Rize, Türkiye

E-mail: hçetin.ketenci@erdogan.edu.tr

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Figure 1. Primitive cable car system and challenging terrain conditions.

environment of forestry operations requires systemic protective measures. These measures include mechanized transport systems (e.g., cableways/teleferiks), proper terrain stabilization, controlled felling zones, and collective safeguards designed to minimize exposure to falling trees, rolling logs, and unstable slopes (Fig. 1). Therefore, effective prevention requires strict adherence to PPE standards along with comprehensive environmental and organizational interventions tailored to the high-risk nature of logging sites (Fig. 2).^[5]

Several large-scale studies from the United States underscore the magnitude of this problem. An analysis of occupational deaths between 2009 and 2013 identified blunt trauma from falling trees or branches as the leading cause of death, with head injuries being most common and victims predominantly middle-aged males.^[6] The authors emphasized the importance of mechanization and enhanced fall-prevention training. Simi-

larly, a multi-state study conducted across 19 western states between 2011 and 2017 estimated an occupational fatality incidence of 3.5 per 100,000 full-time workers, with male mortality rates nearly ten times higher than those of females. Certain regions, such as Alaska and New Mexico, demonstrated disproportionately high fatality rates across different ethnic groups.^[2] Long-term surveillance of tree care workers from 1987 to 2023 revealed that nearly one-quarter of fatalities occurred within the first year of employment, highlighting inexperience as a critical risk factor. The same study reported that only 39% of employers provided systematic training, and more than half lacked written safety protocols.^[7] Age also plays a significant role. A study among farmers aged ≥ 55 years in Indiana between 1988 and 2017 reported a mean age at death of 67.4 years, with most fatalities resulting from blunt trauma caused by falling trees. Reduced physical capacity, insufficient use of protective equipment, and unsafe cutting



Figure 2. Warning and safety signs in logging areas.

techniques were identified as major contributing factors.^[8] A recent U.S.-based study retrospectively evaluated injuries and fatalities among forestry and logging workers over a 16-year period (2003–2019) using data from the Bureau of Labor Statistics. The analysis found that contact with objects and equipment was the leading cause of both injuries and fatalities, followed by transportation-related incidents for fatalities and falls, slips, and trips for nonfatal injuries.^[9] The authors emphasized that persistent gaps in occupational health and safety practices remain and highlighted the need for collaborative preventive strategies between researchers and the forestry industry.^[10]

Findings from Türkiye mirror these international observations. Field studies report that head trauma, falls from height, and chainsaw-related injuries are more common among individuals with limited education and inadequate use of protective equipment.^[11,12] However, systematic research on logging-related deaths based on forensic autopsy data remains scarce. This gap is particularly notable given the critical role of forensic medicine in elucidating causes of death, identifying environmental and individual risk factors, and providing reliable evidence for occupational safety policies. Comprehensive evaluation of autopsy findings alongside crime scene evidence, witness reports, and trauma patterns offers a unique opportunity to generate robust data for preventive strategies.

Against this background, the present study retrospectively examines logging-related fatalities in the Eastern Black Sea region of Türkiye over an eleven-year period (2013–2023), based on forensic autopsy data collected at the Recep Tayyip Erdoğan University. The study aims to characterize the mechanisms of death, distribution of traumatic lesions, autopsy findings, environmental and seasonal patterns, and occupational profiles of the victims. By including individuals engaged in unauthorized or non-professional logging activities, this research provides novel insights into the multifaceted risks associated with logging in Türkiye. The findings are expected to contribute to the forensic literature and to support the development of region-specific occupational safety interventions, including training and awareness programs in rural communities. By also incorporating cases related to unauthorized or non-professional logging activities, this study addresses a critical research gap and provides evidence-based recommendations for targeted occupational safety interventions in rural Türkiye.

MATERIALS AND METHODS

Data Source

This retrospective, autopsy-based study was conducted at the Recep Tayyip Erdoğan University, Türkiye, which is the sole authority responsible for performing forensic autopsies in the Eastern Black Sea region. The study period extended from January 1, 2013 to December 31, 2023. During this period, a total of 4,878 forensic autopsies were performed, all

of which are mandatorily conducted in cases of violent, suspicious, or unnatural deaths under Turkish law.

Selection of Subjects

From the total autopsy population, 102 cases were identified in which death occurred in the context of occupational or non-occupational logging activities. Inclusion criteria required that the fatal event be clearly associated with tree felling, pruning, climbing, or wood-handling operations, as documented in the autopsy report and supported by supplementary materials (e.g., police reports, judicial records from the National Judiciary Informatics System [UYAP], and crime scene documentation). Cases with ambiguous activity contexts or deaths resulting from natural, non-traumatic causes were excluded.

Quality Control of the Autopsy Procedure

All autopsies included in this study were performed by specialists in forensic medicine at the Recep Tayyip Erdoğan University in accordance with national forensic protocols and institutional guidelines. Each case underwent a complete forensic autopsy, including external examination and internal dissection of all major body cavities. Toxicological samples were collected when indicated. As this was a retrospective study, the authors did not perform all of the autopsies themselves; instead, official autopsy reports and related documentation were systematically reviewed. During data extraction, the completeness and internal consistency of each case were verified by cross-checking relevant variables (e.g., correspondence between the cause of death, trauma patterns, and toxicological results) to ensure that all autopsies had been conducted and recorded in accordance with the institution's standardized quality procedures.

Variables Analyzed

Standardized data were extracted retrospectively for each case. The variables analyzed in this study included demographic characteristics (age, sex, and occupation), environmental factors (incident location, season of occurrence, and presence of witnesses), and injury mechanisms, such as being struck by a falling tree, falling from a tree, electrical injuries, and other trauma-related events. The cause of death was determined based on autopsy findings (e.g., multiple body trauma, head trauma, or thoracic injury) and was supported by toxicological analyses, including ethanol and other relevant substances when available.

Statistical Analysis

Statistical analyses were performed using SPSS software, version 25.0 (IBM Corp., Armonk, NY, USA). Categorical variables were analyzed using Pearson's chi-square test or Fisher's exact test when expected cell counts were <5. The normality of continuous variables was assessed using the Kolmogorov–Smirnov test. Depending on the distribution, comparisons between two groups were performed using either the Student's t-test or the Mann–Whitney U test, while analysis of



Figure 3. Unsafe and informal logging practices in rural areas.

variance (ANOVA) or the Kruskal–Wallis tests was used for comparisons involving more than two groups. Post hoc analyses with Bonferroni correction were conducted where applicable. A p value <0.05 was considered statistically significant.

RESULTS

A total of 4,878 forensic autopsies were conducted between 2013 and 2023. Among these, 102 deaths (2.1%) were confirmed to be related to forestry and logging activities and were included in the study.

Demographic and Occupational Characteristics

The victims were predominantly male (93.1%, $n=95$), with only seven females (6.9%). Ages ranged from 20 to 81 years (mean 57.4 ± 15.5), with 71.6% of deaths occurring between 41 and 65 years of age. This distribution reflects the predominance of middle-aged and older men engaged in logging activities in the region. With respect to occupation, 38.2% ($n=39$) were officially employed forestry workers, whereas 61.8% ($n=63$) belonged to other occupational groups or were unregistered individuals. Many individuals in the latter group died while cutting wood on private or unauthorized land (Fig. 3). Foreign nationals accounted for six cases (5.9%), all of whom were Georgian workers. Statistical analysis revealed significant differences between forestry workers and non-workers in terms of incident location ($p < 0.001$), presence of witnesses ($p = 0.002$), and mechanisms of fatal injury ($p = 0.028$). Forestry workers were more often involved in witnessed incidents occurring in forested areas (92.3%), whereas non-workers more frequently died on private lands without witnesses (Table 1).

Mechanisms and Causes of Death

The leading fatal mechanism was being struck by a falling tree

(51.0%, $n=52$), followed by falls from trees (30.4%, $n=31$), falls from cliffs or slopes (6.9%, $n=7$), and cutting tool injuries (5.9%, $n=6$). Electrocutation (5.9%, $n=6$) was observed exclusively among non-forestry workers. Autopsy findings identified blunt trauma or multiple body trauma as the most frequent cause of death (81.4%, $n=83$), followed by cardiovascular events (6.9%, $n=7$), electrocutation (5.9%, $n=6$), and sharp force injuries (5.9%, $n=6$).

Medical Response and Scene Characteristics

In 64.7% of cases, death occurred at the scene (Fig. 4). Basic life support or resuscitation was attempted in 27.5% of cases, while only 7.8% of victims reached a hospital where surgical intervention was possible. Chainsaw use was recorded in 62.7% of incidents, and in 65.7% of cases the deceased was the individual directly engaged in felling the tree.

Seasonal Distribution and Anatomical Injury Patterns

Fatalities occurred most frequently in fall (32.4%), followed by summer (25.5%), winter (22.5%), and spring (19.6%). Incidents involving individuals struck by falling trees were particularly concentrated during the fall season (Fig. 5, left). Seasonal analysis revealed that cranial trauma predominated in summer, thoracic trauma in spring, and more evenly distributed trauma patterns during fall and winter. These differences appear to reflect both the seasonal intensity of forestry work and environmental conditions (Fig. 5, right).

Associations Between Age, Occupation, and Injury Type

Significant associations were identified between age and occupational status, incident location, and mechanism of injury. Forestry workers had a lower mean age (50.1 ± 14.9 years) compared with non-workers (61.9 ± 14.2 years; $p < 0.001$). Victims of falls from trees were older (mean 66.9 ± 8.3 years; $p = 0.011$). Similarly, deaths occurring in forested areas in-

Table 1. Demographic and incident characteristics of logging-related fatalities

Variable	Forestry workers	Non-forestry/unregistered	Total
	n (%)	n (%)	
Sex			
Male	36 (92.3)	59 (93.7)	95 (93.1)
Female	3 (7.7)	4 (6.3)	7 (6.9)
Age (years)			
Range	20–79	22–81	20–81
Mean±SD	50.1±14.9	61.9±14.2	57.4±15.5
41–65 years	28 (71.8)	45 (71.4)	73 (71.6)
Nationality			
Turkish	39 (38.2%)	59 (61.8%)	98 (94.1)
Georgian	2 (5.1)	4 (6.3)	6 (5.9)
Incident characteristics			
Location: forest land	36 (92.3)	22 (34.9)	58 (56.9)
Location: private land	3 (7.7)	41 (65.1)	44 (43.1)
Witnessed events	34 (87.2)	46 (73.0)	80 (78.4)
Unwitnessed events	5 (12.8)	17 (27.0)	22 (21.6)
Mechanism of fatal injury			
Struck by falling tree	29 (74.4)	23 (36.5)	52 (51.0)
Fall from tree	7 (17.9)	24 (38.1)	31 (30.4)
Fall from cliff or slope	2 (5.1)	5 (7.9)	7 (6.9)
Cutting-tool injury	1 (2.6)	5 (7.9)	6 (5.9)
Electrocution	0 (0.0)	6 (9.5)	6 (5.9)

**Figure 4.** Images from the scene of the incident.

involved younger individuals (mean age 51.2 years) than those occurring on private land (mean age 64.5 years; $p < 0.001$). These findings suggest that older individuals are more vulnerable to fall-related fatalities (Fig. 6A).

Autopsy Findings

The most frequent traumatic lesions were pelvic and extremity fractures (71.6%), followed by cranial trauma and intracranial hemorrhage (53.9%), cranial fractures (39.2%), rib and

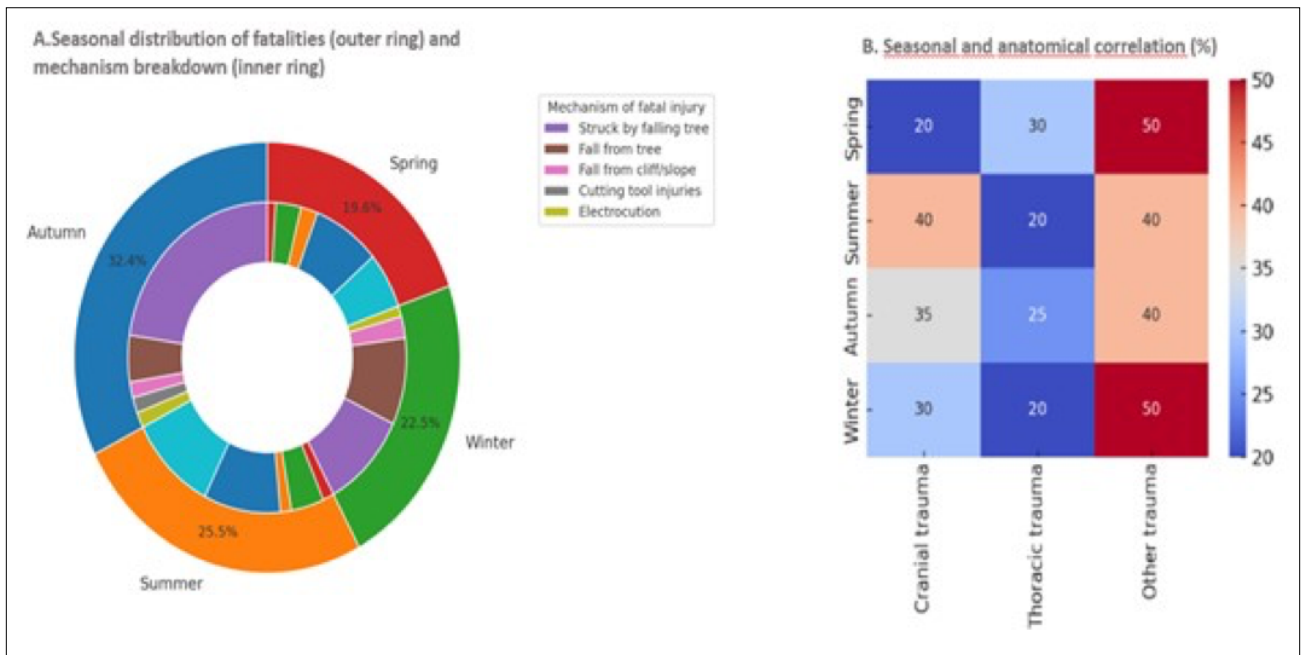


Figure 5. Seasonal distribution of logging-related fatalities by mechanism of injury and heatmap of anatomical injury correlations.

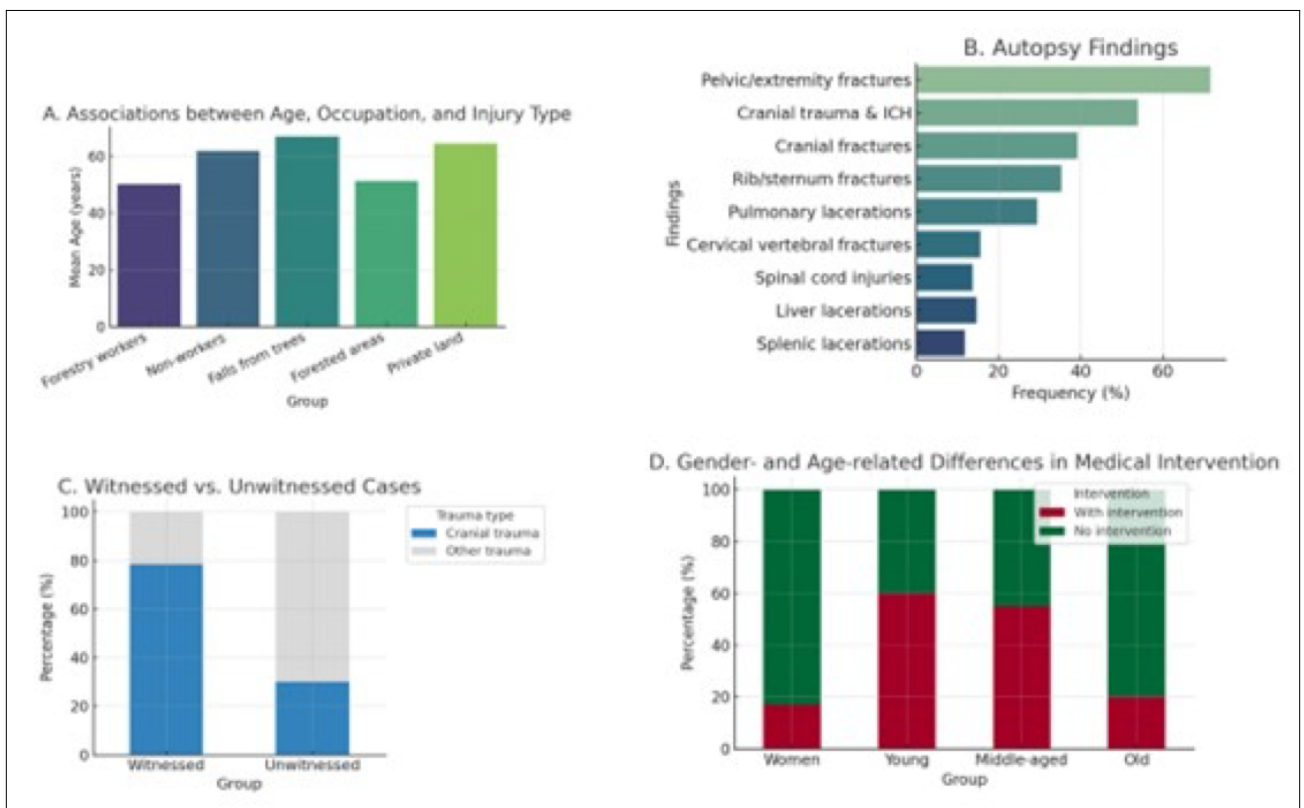


Figure 6. Multi-panel visualization of key findings in logging-related fatalities. (a) Mean age distribution according to occupational status, injury type, and incident location. (b) Prevalence of traumatic lesions identified at autopsy. (c) Distribution of trauma mechanisms in witnessed versus unwitnessed events. (d) Medical intervention rates according to age group and sex.

sternum fractures (35.3%), pulmonary lacerations (29.4%), cervical vertebral fractures (15.7%), and spinal cord injuries (13.7%). Abdominal organ injuries were also documented, including liver lacerations (14.7%) and splenic lacerations (11.8%), findings consistent with high-energy polytrauma (Fig. 6B).

Witnessed vs. Unwitnessed Cases

Most incidents were witnessed (78.4%), with cranial trauma being the predominant cause of death in this group. In unwitnessed cases, trauma mechanisms were more heterogeneous and often reflected delayed discovery of the victims (Fig. 6C).

Gender- and Age-Related Differences

Among female victims (6.9% of cases), 83% died without receiving medical intervention. Younger and middle-aged victims were more likely to receive resuscitative attempts, whereas older individuals more frequently died at the scene without intervention (Fig. 6D).

DISCUSSION

Demographic and Occupational Characteristics

Consistent with the gendered structure of forestry labor worldwide, fatalities were overwhelmingly male (>90%).^[13,14] The 6.9% of female deaths were not associated with tree felling but rather with auxiliary tasks, such as wood transport. This pattern reflects the peripheral involvement of women in forestry-related activities. The mean age of 57.4 years indicates the heightened vulnerability of middle-aged and older men, contrasting with the younger professional cohorts reported in Northern Europe and North America.^[15,16] Notably, two-thirds of the victims were unregistered workers, and many of the deaths occurred on private or unregulated land, highlighting systemic gaps in occupational safety oversight similar to those observed in Eastern Europe.^[17] The presence of foreign nationals among the fatalities (all of whom were Georgian workers) further underscores how migrant laborers are often assigned the most hazardous tasks while lacking adequate protection. Limited access to training, language barriers, and informal employment conditions restrict their ability to benefit from occupational safety measures, thereby increasing their exposure to hazards and systemic vulnerabilities.^[18]

Mechanisms and Causes of Death

In our cohort, the mortality pattern was dominated by tree-strike injuries, a finding consistent with global data on logging-related fatalities. Unlike Scandinavian forestry systems, where mechanized harvesting has progressively reduced such incidents, rural regions of Türkiye remain largely dependent on manual tree felling, perpetuating structural risk. Falls from trees and steep slopes represented the second most common cause of death and disproportionately affected older men, whose physiological decline—including impaired balance, slower reaction times, and reduced musculoskeletal re-

silience—increases their susceptibility to high-energy trauma. Although less frequent, chainsaw-related injuries remain a preventable subset of fatalities, reflecting gaps in training and inadequate enforcement of protective measures.^[19] Electrocutions, which were largely confined to private lands near overhead power lines, highlight infrastructural hazards that could be mitigated through improved intersectoral planning.^[20] Taken together, these mechanisms reveal a dual burden: the unavoidable dangers of heavy timber work and the preventable risks arising from inadequate regulation, insufficient training, and the lack of modernization in forestry practices. These findings underscore the need for urgent policy measures that combine mechanization, stricter enforcement of occupational safety standards, and community-level education to reduce both structural and modifiable hazards in forestry work.

Medical Response and Scene Characteristics

In our series, most incidents were witnessed (78.4%), enabling prompt resuscitative efforts. In contrast, unwitnessed deaths, which frequently occurred on private lands, were typically discovered hours later, eliminating any chance of survival. This contrast underscores the critical importance of immediate intervention, a finding consistent with occupational injury research indicating that the presence of bystanders significantly improves emergency response and survival outcomes.^[21] The predominance of cranial trauma in witnessed cases reflects the inherently fatal nature of severe head injuries, which are often resistant to resuscitative efforts. Conversely, unwitnessed events more often involved thoracic or abdominal trauma, patterns consistent with delayed discovery and prolonged post-injury survival. Informal loggers, particularly non-forestry workers, died disproportionately in unwitnessed circumstances, highlighting the risks associated with working alone. In professional forestry operations, team-based protocols often mitigate these risks. Therefore, preventive strategies should emphasize discouraging solitary tree felling, mandating the use of communication devices in remote areas, and strengthening first-aid preparedness. In regions where informal labor predominates, community-based safety awareness programs are essential.

Seasonal Distribution and Anatomical Correlations

Our analysis revealed a clear seasonal clustering of fatalities, with fall (32.4%) representing the peak period, followed by summer, winter, and spring. Fall-related deaths were predominantly caused by tree-strike incidents, coinciding with intensive fuel preparation and woodcutting in the Eastern Black Sea region. Similar seasonal patterns of forestry injuries have been documented internationally, reflecting the influence of climatic and socio-economic cycles on labor intensity.^[15,22,23] Seasonal, anatomy-specific patterns further highlighted this interaction. Cranial trauma predominated during summer, likely due to longer daylight hours and increased tree-felling activity, during which head injuries caused by falling trees and branches are well documented. In spring, thoracic trauma

was most common, possibly linked to rainfall-induced slippery slopes and crush injuries to the chest. Fall and winter showed a more balanced distribution of injury types, suggesting that harsher and more unpredictable environmental conditions may amplify diverse risks. These findings underscore that forestry hazards are not static but fluctuate with environmental conditions. From a preventive perspective, targeted, season-specific strategies—such as helmet enforcement in summer, enhanced fall-prevention measures in spring, and broader safety campaigns in fall—are critical. Incorporating seasonal risk calendars and raising forensic awareness of these correlations within occupational health policies may substantially reduce mortality.

Associations Between Age, Occupation, and Injury Type

Our analysis revealed strong associations between age, employment status, and injury mechanisms. Forestry workers were significantly younger (mean age: 50.1 years) than unregistered individuals (mean age: 61.9 years). This pattern reflects the physical demands of professional logging, which require strength, agility, and specialized training. Similar trends have been reported in occupational safety literature, where formal logging work is primarily performed by middle-aged men, whereas older individuals more frequently engage in informal woodcutting on private lands. Fatal falls from trees predominantly occurred among elderly individuals (mean age: 66.9 years), consistent with evidence indicating that reduced balance, diminished muscle strength, and slower reflexes increase the risk of falls.^[24] Spatial patterns further underscored this socio-occupational divide. Younger forestry workers most often died in official forest areas, whereas older, unregistered individuals died on private lands while preparing firewood. These findings emphasize the need for prevention strategies tailored to different demographic groups. Such strategies should include technical training and protective equipment for younger workers, as well as community education, assistance programs, and fall-prevention initiatives targeting older populations. These tailored approaches may help address both occupational and broader socioeconomic vulnerabilities associated with logging-related fatalities.

Autopsy Findings

Autopsy examinations in our study revealed the multifocal and catastrophic nature of injuries sustained in logging-related fatalities. The most common injuries were pelvic and extremity fractures (71.6%) and cranial trauma with intracranial hemorrhage (53.9%), reflecting the high-energy transfer typically associated with impacts from falling trees. Similar findings have been reported in occupational accident studies, where blunt trauma to the head and torso represents the leading cause of immediate death. The substantial prevalence of cranial fractures (39.2%), rib and sternum fractures (35.3%), pulmonary lacerations (29.4%), and cervical vertebral fractures (15.7%) illustrates the extensive biomechanical forces involved. Such polytrauma configurations are often unsurvivable without immediate medical intervention, un-

derscoring the critical importance of rapid detection.^[25] Abdominal organ injuries, including hepatic (14.7%) and splenic (11.8%) lacerations, further support the frequent occurrence of combined thoracoabdominal trauma, which accelerates exsanguination and death. From a forensic perspective, the presence of both severe cranial and thoracic injuries indicates that death is rarely caused by a single lesion but rather by the combined effects of multiple traumatic injuries. This observation has important medicolegal implications. While helmets may reduce the risk of severe head trauma, they are insufficient to prevent fatal thoracoabdominal injuries. Similarly, autopsy-based research in other high-risk occupational sectors has shown that fatal trauma is seldom localized but commonly involves devastating injuries across multiple anatomical regions.^[26,27] Taken together, these findings highlight the need for preventive strategies that extend beyond head protection and include thoracoabdominal safeguards, increased mechanization of felling practices, and strict adherence to safe cutting techniques.

Witnessed vs. Unwitnessed Cases

In this study, 78.4% of incidents were witnessed, and cranial trauma predominated in these cases, reflecting the inherently lethal nature of severe head injuries that often cause immediate collapse in front of coworkers or bystanders. In contrast, unwitnessed fatalities exhibited more diverse trauma patterns and were often discovered on private or unauthorized lands, suggesting delayed recognition or solitary working conditions. Thus, the presence or absence of witnesses has crucial implications for survival. While witnessed events allow for rapid recognition and attempted resuscitation, unwitnessed cases highlight systemic vulnerabilities in emergency response. Similar associations have been reported in forestry literature, where solitary tree felling and lack of supervision significantly increase the risk of fatality.^[15] Comparable findings across occupational settings further confirm that immediate assistance and rapid medical intervention are critical determinants of trauma survival.^[28] Therefore, preventive strategies should prioritize discouraging solitary logging, enforcing communication protocols, and extending safety education to unregistered workers to facilitate earlier intervention and reduce mortality.

Gender- and Age-Related Differences

Although women represented only 6.9% of cases, they experienced disproportionately poor outcomes, with 83% dying without receiving medical intervention. This pattern reflects the gendered distribution of forestry labor, in which women are more likely to engage in informal or unregulated woodcutting in isolated settings with limited access to care. Similar disparities have been reported in rural occupational contexts, where female victims face barriers to timely medical attention due to geographical isolation and sociocultural constraints.^[29] Age-related differences were also pronounced. Younger and middle-aged individuals were more likely to receive resuscitative attempts, reflecting both their greater likelihood

of working in supervised environments and the stronger clinical motivation to intervene in patients with a potentially salvageable prognosis. In contrast, older victims often died at the scene without assistance in unwitnessed circumstances.^[30] This pattern aligns with evidence indicating that aging is associated with diminished physiological reserve and reduced trauma survival. These findings underscore the need for targeted prevention strategies for vulnerable populations and highlight the importance of integrating community-based emergency response systems in rural areas.

Strengths and Limitations of the Study

This study has several notable strengths. First, the eleven-year observation period enables the identification of temporal patterns and long-term trends in logging-related fatalities in the Eastern Black Sea region. Second, the analysis is based on autopsy reports, which provide objective and detailed insights into causes of death, mechanisms of trauma, and the distribution of anatomical injuries. Reliance on forensic evidence ensures a higher degree of accuracy and reliability than studies based solely on hospital or registry data. Third, the study adopts a multidimensional framework incorporating demographic and occupational profiles, incident characteristics, seasonal variation, witness status, and detailed autopsy findings. This comprehensive approach allows for a more nuanced understanding of the multifactorial dynamics underlying these fatalities. Another important strength is the comparative evaluation of officially employed forestry workers and unregistered individuals, which highlights critical differences in occupational risk profiles. Furthermore, integrating forensic pathology with occupational health perspectives enhances the translational value of the findings for preventive strategies. Finally, the study design and reporting are aligned with international standards, facilitating comparison with global evidence and supporting its contribution to broader scientific and policy discussions. Despite these strengths, this study has several limitations that warrant consideration. First, as a retrospective analysis of institutional autopsy records, the study depended on the accuracy and completeness of existing documentation. Although standardized forensic protocols were applied, variations in the scope of ancillary investigations (e.g., toxicology and histopathology) may have influenced the level of detail available for some cases. Second, the study included only fatal incidents and therefore does not capture the broader spectrum of nonfatal logging-related injuries, which are critical for understanding the overall burden of occupational risk. Third, certain contextual variables, such as working hours, use of protective equipment, level of training, and employment arrangements beyond formal registration, could not be assessed due to incomplete documentation. Fourth, the findings are specific to the Eastern Black Sea region of Türkiye, where forestry practices, terrain characteristics, and socioeconomic conditions may differ from those in other regions of Türkiye or other countries. Thus, the results should

be interpreted with caution when generalizing beyond this regional context. Finally, although autopsy data enable precise evaluation of injury mechanisms, they provide limited insight into occupational safety practices or systemic deficiencies that may have contributed to these fatalities.

CONCLUSION

This eleven-year, autopsy-based study is the first to provide a comprehensive forensic evaluation of logging-related fatalities in the Eastern Black Sea region of Türkiye. The results confirm that tree-strike trauma is the primary cause of death, reflecting the continued reliance on manual tree-felling methods. The seasonal clustering of fatalities, particularly during the fall, demonstrates how environmental conditions and labor intensity influence mortality risk. Significant associations between age, occupation, and injury type highlight the increased vulnerability of older and unregistered workers. The disproportionate impact on women and foreign nationals reveals broader structural inequities in occupational safety. Autopsy findings demonstrated catastrophic multisystem trauma, reinforcing the limited survivability of such events in the absence of immediate intervention. These findings emphasize the need for integrated prevention strategies, including mechanization of logging operations, enforcement of team-based and supervised work practices, provision of protective equipment, and community-level safety awareness initiatives. Addressing these vulnerabilities ultimately requires bridging the gap between occupational safety regulations and the realities of informal labor, ensuring that preventive measures encompass both professional forestry workers and rural populations engaged in subsistence-level logging.

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ORİJİNAL ÇALIŞMA - ÖZ

Türkiye'nin Doğu Karadeniz Bölgesinde odunculukla ilişkili ölümler: Adli tıbbi ve epidemiyolojik analiz

AMAÇ: Ormancılık, dünyanın en tehlikeli iş sektörlerinden biri olarak kabul edilmektedir. Türkiye'nin Doğu Karadeniz Bölgesinde bu sektörün yaygınlığına rağmen, literatürde ormancılıkla ilişkili ölümlere yönelik kapsamlı adli incelemeler sınırlıdır.

GEREÇ VE YÖNTEM: Bu retrospektif çalışmada, 2013–2023 yılları arasında Recep Tayyip Erdoğan Üniversitesi tarafından gerçekleştirilen 4.878 otopsi arasından seçilen 102 ormancılıkla ilişkili ölüm olgusu incelenmiştir. Demografik, mesleki, çevresel, mevsimsel ve tıbbi müdahale ile ilgili veriler otopsi raporlarından elde edilerek polis ve adli kayıtlarla desteklenmiştir.

BULGULAR: Olguların büyük çoğunluğu erkekti (%93.1) ve ortalama yaş 57.4 idi. Vakaların üçte ikisi kayıt dışı işçilerden oluşmakta olup, %5.9'u yabancı uyruklu idi. En sık ölüm nedeni kesilen ağacın işçiye yüksek enerjili teması (%51.0) olup bunu ağaçtan düşmeler (%30.4) izlemekteydi. Ölümler çoğunlukla sonbahar mevsiminde (%32.4) görülürken, yazın kranial travmalar, ilkbaharda ise torasik yaralanmalar baskın bulunmuştur. Otopsi bulguları geniş yayımlı multitravmaları ortaya koymuştur; pelvis ve ekstremiteler kırıkları (%71.6) ile kafa içi kanamalar (%53.9) en sık bulgular-
dı. Olayların çoğu en az bir tanık huzurunda gerçekleşmiştir (%78.4); ancak tanıksız ölümler, genellikle özel arazilerde çalışan yaşlı ve kayıt dışı işçiler arasında daha sık gözlenmiştir. Kadın olgular (%6.9) çoğunlukla odunculuk ile ilişkili olan yardımcı işlerde çalışırken ölmüştür ve bu olgulara yapılan tıbbi müdahale oranı düşük bulunmuştur (%83).

SONUÇ: Bu çalışma, Doğu Karadeniz Bölgesinde ormancılıkla ilişkili ölümlerin kapsamlı adli-tıbbi değerlendirmesini sunmaktadır. Bulgular, düzensiz iş gücü, tehlikeli mevsimsel çalışma koşulları ve sınırlı acil sağlık hizmetlerinin ölüm örüntülerini belirlemedeki kritik rolünü ortaya koymaktadır. Kayıt dışı çalışanların eğitim almasının sağlanması, iş güvenliği mevzuatının daha sıkı uygulanması ve kırsal acil sağlık hizmetlerinin güçlendirilmesi, bölge insanına ilköğretim düzeyinde bazı temel eğitimlerin verilmesi gibi hedefe yönelik önlemler, ormancılık faaliyetlerine bağlı önlenebilir ölümleri azaltmak için acilen gerekli olduğu düşüncesindeyiz.

Anahtar sözcükler: Adli otopsi; iş kazası; mevsimsel risk; ormancılık ölümü; Türkiye.

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