Medical Research | Published by Faculty of Medicine University of Belgrade

ORIGINAL ARTICLE

Defensive injuries in homicide victims: a ten-year retrospective autopsy study

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Submitted: 23 December 2025
Revised: 16 March 2026
Accepted: 20 March 2026
Online First: 23 March 2026

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Summary

Background: Defensive injuries represent a key forensic indicator of a victim's attempt to resist an assault and hold substantial value in distinguishing homicide from suicide. This study aimed to analyze the frequency, forensic, and other characteristics of defensive injuries in homicide victims and to assess their relationship with demographic factors, injury mechanisms, and weapon types.

Methods: A retrospective cross-sectional analysis was conducted on 161 homicide autopsies performed between 2014 and 2023 at the Institute of Forensic Medicine in Belgrade, Serbia. Data on demographics, weapon type, and injury patterns were statistically evaluated using descriptive and analytical statistical methods, with significance set at $p < 0.05$.

Results: Defensive injuries were identified in 56 cases (34.8%), most commonly bilateral and polymorphic, localized in the upper third or diffusely along the forearms. They occurred significantly more often in sharp- and blunt-force homicides ($p < 0.001$) and were nearly absent in firearm-related deaths. Male and elderly victims exhibited higher rates of defensive injuries.

Discussion: Defensive injuries are typically located on the upper limbs. The distribution of defensive injuries depends on multiple factors, including the weapon used, the direction of the attack, the assailant's approach, and the relative positions of both individuals. Numerous, widely distributed defensive injuries may point to a prolonged and dynamic struggle.

Conclusion: The recognition and interpretation of defensive injuries provide valuable insight into the dynamics of homicide, enabling accurate forensic reconstruction and contributing to the legal classification of homicide cases.

Keywords: homicide, defensive injuries, weapon, autopsy, interpersonal violence

Cite this article as: Subakov N, Ciric M, Milosevic V, Gojkovic T, Cibic A, Bogdanovic M et al. Defensive injuries in homicide victims: a ten-year retrospective autopsy study; Medicinska istraživanja 2026; DOI: 10.5937/medi0-63646

INTRODUCTION

In cases of violent death, one of the primary responsibilities of the forensic pathologist is to determine the manner of death – whether it resulted from an accident, suicide, or homicide. According to the World Health Organization, approximately 475,000 people die from homicide each year worldwide, with rates varying considerably across regions. In addition to its public health relevance, homicide also presents complex forensic challenges, particularly regarding injury interpretation and reconstruction of the event (1). By analyzing the number, type, distribution, and other morphological characteristics of injuries, forensic experts can draw well-supported conclusions regarding the origin of the injuries and, consequently, the nature of death (2).

Differentiating among homicide, suicide, and accidental death is often highly complex. Forensic pathologists rely on multiple indicators to guide this determination, among which the type, location, distribution, and number of injuries are particularly informative. Injuries indicative of homicidal violence – especially when found in specific anatomical regions – may strongly refer to homicidal manner. The anatomical location of injuries also assists in distinguishing homicidal from suicidal injuries. Injuries located on inaccessible or less reachable body areas, such as the back of the head, neck, back, or posterior areas of the limbs, are more indicative of homicidal violence. Conversely, injuries localized in easily reachable areas, such as the anterior torso or wrists, are more consistent with suicidal behavior. However, exceptions to these generalizations exist and must always be interpreted within the broader forensic context (2).

Defensive injuries represent one of the most important morphological indicators of interpersonal violence. Their presence, absence, and anatomical distribution provide insight into the victim's attempt to resist the assault, the proximity of the perpetrator, and the dynamics of the attack. Correct identification of these injuries is therefore essential for distinguishing between homicidal and self-inflicted trauma and for accurate forensic reconstruction (2, 3).

Defensive injuries, therefore, represent an essential morphological indicator of a victim's attempt to resist or ward off an attack. Their identification and interpretation hold high forensic value in distinguishing homicidal from self-inflicted injuries and in reconstructing the dynamics of violent events (3, 4).

The present study aims to examine the morphological and anatomical characteristics of defensive injuries in homicide victims and to identify potential differences according to victim gender, age group, injury mechanism, and the weapon used.

MATERIALS AND METHODS

A cross-sectional retrospective autopsy study was conducted at the Institute of Forensic Medicine in Belgrade, Serbia, encompassing homicide cases autopsied over a ten-year period from 2014 to 2023. Autopsy reports were analyzed alongside relevant case materials, including police reports, medical documentation, and data obtained from the victims' family members or acquaintances. From these sources, data were collected on the victims' demographic characteristics (age and gender), as well as on the type of weapon used and the type, location, and distribution of both fatal and defensive injuries..

Inclusion criteria comprised confirmed cases of homicide with complete autopsy documentation, in which victims died at the scene or during transport to a medical facility. Cases with insufficient data, unclear manner of death, prolonged survival after injury, or advanced postmortem changes that could alter injury appearance and compromise the reliability of findings were excluded. In total, 161 homicide cases met the inclusion criteria and were analyzed.

Defensive injuries were defined as trauma located on anatomical regions consistent with an attempt to fend off an assault – most often on the upper extremities, forearms, and hands – and morphologically classified as abrasions, contusions, or wounds (laceration, incised wound, stab wound, gunshot wound). Defensive injuries included both passive defense lesions (located on the dorsum of the hands and the ulnar aspect of the forearms) and active defense lesions (incised or stab wounds on the palms and fingers resulting from attempts to grasp or block a weapon). Each case was evaluated for the presence, type, and location of these lesions. All autopsies and injury classifications were performed independently by two board-certified forensic specialists, and disagreements were resolved by consensus.

The study was approved by the Ethics Committee for Scientific Research of Students of the Faculty of Medicine, University of Belgrade, the decision of January 9, 2025.

Statistical analyses were performed using IBM SPSS Statistics, version 22. Descriptive statistics were applied to summarize demographic and injury-related variables. The Kolmogorov–Smirnov test was used to assess the normality of continuous data. Depending on distribution, differences between continuous variables (e.g., age) were analyzed using the Student's t-test. Categorical variables (e.g., gender, presence of defensive injuries, weapon) were compared using the Chi-square test or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

RESULTS

Demographic data

Among the 161 analyzed homicide cases, 117 victims (72.7%) were male and 44 (27.3%) were female. The mean age of victims was 46.11 ± 19.26 years (range: 5–93 years). The mean age for male victims was 42.25 ± 17.64 years (range: 5–93 years), while for female victims it was 56.39 ± 19.81 years (range: 8–91 years). The largest proportion of victims belonged to the 21–40-year age group, with a gradual decline in older groups. The T-test revealed that female victims were statistically significantly older than male victims ($p < 0.001$). The distribution of cases by age and gender is presented in **Figure 1**.

Type of weapon used and forensic characteristics of fatal injuries

Slightly more than half of the victims were killed by firearms (82 cases; 50.6%), followed by sharp or pointed objects (41 cases; 25.3%) and blunt force trauma (26 cases; 16.0%). Other homicide methods were less frequent (**Table 1**). Fatal injuries in the majority of cases were localized in at least two body regions (61 cases, 37.9%), followed by isolated injuries of the head (55 cases, 34.2%) and chest (31 cases, 19.3%).

Forensic characteristics of defensive injuries

Defensive injuries were identified in 56 cases (34.8%). The most common localizations were the upper third of the forearm (29 cases; 18.0%) and diffuse distribution across the entire forearm (22 cases; 13.7%), as shown in **Table 1**. Defensive injuries were most often bilateral (41 cases, 25.5%), while unilateral injuries occurred in fewer than 10% of cases. Among the cases with defensive injuries, 27 (16.8%) were more extensive on the left side, 21 (13.0%) on the right side, and 8 (5.0%) were symmetrical.

The average number of defensive injuries per affected case was 7.54 ± 6.20 (range: 1–31). In most cases, defensive injuries were polymorphic—comprising multiple injury types (abrasions, contusions, lacerations, etc.) - observed in 38 cases (23.6%). Contusions as isolated injuries were recorded in 10 cases (6.2%), while wounds alone were found in 6 cases (3.7%). The distribution of injury types is shown in **Table 1**.

Defensive injuries were more frequent in homicides involving sharp or pointed weapons (26 cases; 46.4%), blunt force trauma (17 cases; 30.4%), and strangulation (5 cases; 8.9%) while rare in firearm-related deaths (2 cases; 3.6%), for which high statistical significance was demonstrated ($p < 0.001$) between the mechanism of injury and the presence of defensive injuries. A significant gender difference was also observed ($p = 0.001$), with

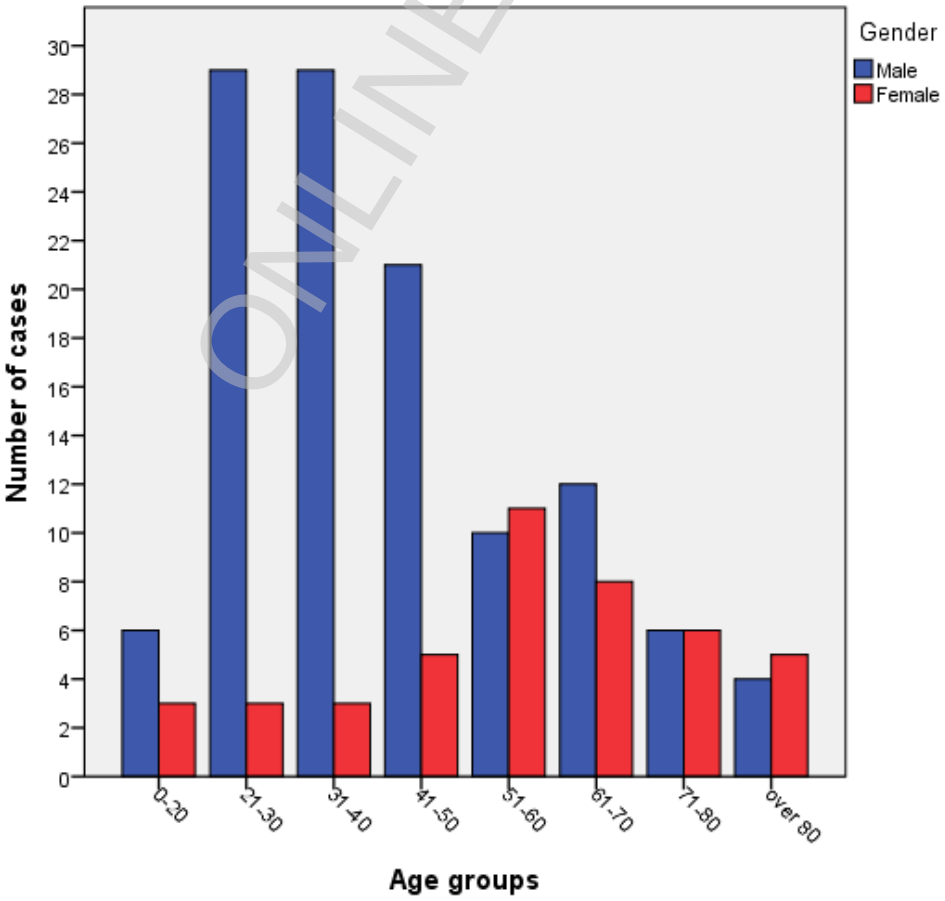

Figure 1. Distribution of cases by age groups.

Table 1. Demographic and forensic characteristics of the cases.

	PRESENCE OF DEFENSIVE INJURIES						
	TOTAL (161, 100.0)		YES (56, 34.8)		NO (105, 65.2)		
	N	%	N	%	N	%	p
Male	117	72.7	39	55.4	86	81.9	0.001
Female	44	27.3	25	44.6	19	18.1	
Older than 65	31	19.3	22	13.7	9	5.6	<0.001
Alcohol positive	30	18.6	9	5.6	21	13.0	0.691
HOMICIDE MECHANISM							
- Firearms	82	50.6	2	3.6	80	76.2	<0.001
- Sharp / pointed weapon	41	25.3	26	46.4	15	14.3	
- Blunt force	26	16.0	17	30.4	9	7.6	
- Strangulation	6	3.7	5	8.9	1	1.0	
- Combination	7	4.3	6	10.7	1	1.0	
FATAL INJURY LOCATION							
- Head	55	34.2	20	35.7	35	33.3	0.284
- Neck	7	4.3	5	8.9	2	1.9	
- Chest	31	19.3	11	19.6	20	19.0	
- Abdomen	4	2.5	0	0	4	3.8	
- Back	2	1.2	0	0	2	1.9	
- Extremities	1	0.6	0	0	1	1.0	
- Multiple body regions	61	37.9	20	35.7	41	39.0	
CHARACTERISTICS OF DEFENSE INJURIES							
Side of the injuries				N		%	
- No defense injuries				105		65.4	
- Bilateral				41		25.5	
- Left				8		5.0	
- Right				7		4.3	
Closer location of the injuries				N		%	
- Upper third of the forearm				29		18.0	
- Entire forearm				22		13.7	
- Dorsum of the hand				3		1.9	
- Palm				1		0.6	
- Middle third of the forearm				1		0.6	
Types of injuries				N		%	
- Polymorphic injuries				38		23.6	
- Contusions				10		6.2	
- Wounds				6		3.7	
- Abrasions				2		1.2	

defensive injuries being more frequent in males (31 cases; 55.4%) compared to females (25 cases; 44.6%) and more common among victims aged over 65 years ($p < 0.001$) - 22 cases; 13.7% **(Table 1)**.

Data on alcohol consumption

Alcohol was detected in 30 victims (18.6%), with blood alcohol concentrations (BAC) reaching up to 2.78‰. Most cases with positive BAC values fell within the range of 0.01–0.5‰ **(Figure 2)**.

DISCUSSION

In Serbia, this rate is substantially lower – 1.2 per 100,000 (5). Demographic analyses show that homicide victims most frequently fall within the 21–30-year age group and that men are about four times more likely to be homicide victims than women (6, 7).

Homicide is an extremely violent act characterized by complex interactions among the perpetrator, weapon, and the victim's body. Such acts occur in diverse circumstances and involve varying relationships between victim and perpetrator, all of which influence the dynamics of the event. These contextual factors are crucial in legal proceedings. Alongside material and testimonial evidence, forensic autopsy findings and medico-legal evaluations of injuries on both the victim and perpetrator play a central role in the judicial process.

The results of this study show that most homicide victims were men aged 21–40 years. Over half (50.6%) involved firearms, followed by sharp or pointed weapons (25.3%) and blunt force (16.0%). Fatal injuries most commonly affected multiple body regions, followed by isolated head or chest injuries. Defensive injuries were

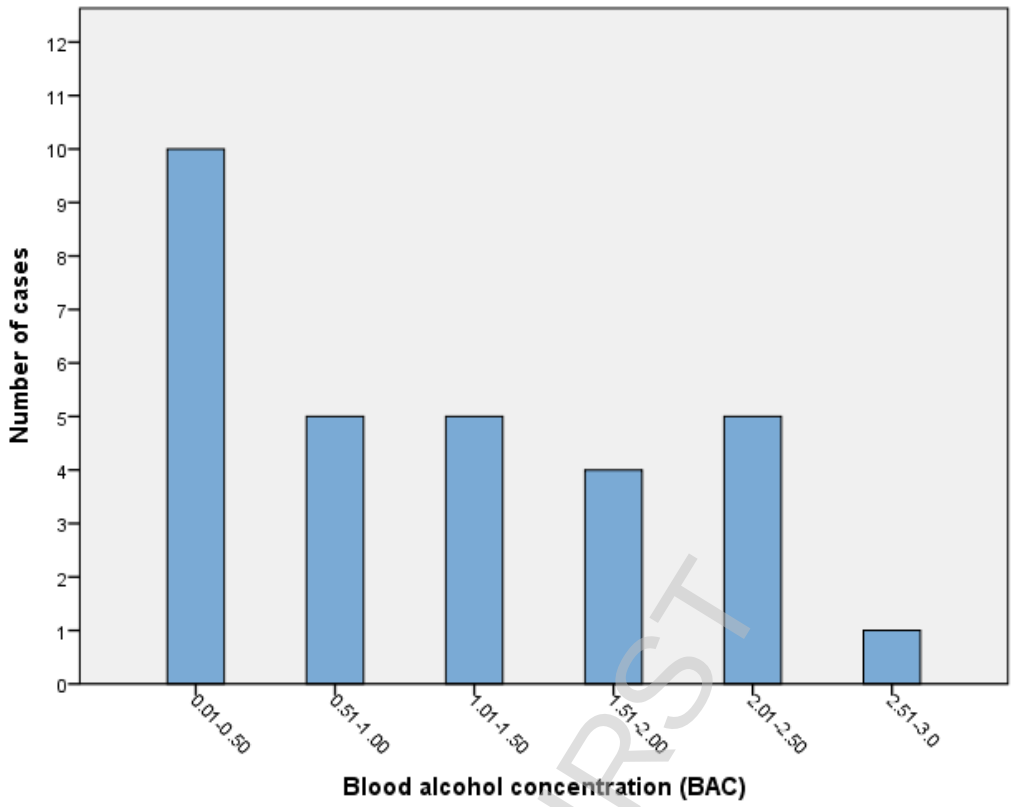

Figure 2. Blood alcohol concentration.

found in 34.8% of cases – mostly polymorphic, bilateral, and concentrated in the upper third or diffusely along the forearms. These injuries were significantly more common in sharp or blunt force homicides and almost absent in firearm-related deaths. Statistically significant differences were also identified by gender and age, being more frequent in men and victims over 65 years of age.

Men were more frequently homicide victims than women, consistent with prior studies (2, 3, 7, 8). Consequently, defensive injuries were also more prevalent among male victims. This gender pattern and the predominance of victims aged 21–40 years may be linked to behavioral and social factors – young men are generally more prone to aggression, alcohol or drug use, and risk-taking behaviors (8). The higher frequency of defensive injuries among elderly victims in our study may be related to the predominance of blunt and sharp-force mechanisms in this age group, which typically involve close-range assaults and allow time for defensive reactions. Alcohol was detected in 18.6% of cases, predominantly at low concentrations (0.01–0.50‰), and no significant correlation was found between alcohol intoxication and the presence or morphology of defensive injuries. The lack of association between alcohol presence and defensive injuries may reflect relatively low BAC values in most cases. It is also possible that alcohol levels were not sufficiently high to impair defensive reactions, which may explain the lack of correlation in our sample.

Defensive injuries occurred in more than one-third of the cases, consistent with other studies (3, 9). Their absence in most cases likely reflects the predominance of firearm-related deaths. Because firearms allow lethal force from a distance, physical contact between the victim and perpetrator is often absent, reducing the chance of a defensive response. In firearm-related homicides, the absence of defensive injuries is expected, as the inflicted trauma typically occurs at a distance and with little opportunity for the victim to interpose their limbs. Defensive wounds arise only when the extremities accidentally lie in the projectile trajectory or when the victim intentionally raises the arms in immediate anticipation of the shot, which appears uncommon in our series (10). In contrast, defensive injuries were far more common in sharp- and blunt-force homicides, where close physical struggle is typical. Cases in which victims were asleep, restrained, unconscious, or intoxicated diminish defensive capacity and often indicate particular cruelty (3).

The distribution of defensive injuries depends on multiple factors, including the attack's direction, the assailant's approach, and the relative body positions of both individuals (11). Also, the pattern of defensive injuries can be influenced by the number of assailants. Namely, multiple-offender assaults often produce more chaotic and asymmetrical injury distributions, although this information was not available in our dataset. More extensive left-sided injuries, as observed here, may be consistent with blows delivered from the victim's left side, although such an interpretation must be made with caution. side (10). Some authors explain the predominance of left-sided defensive wounds as a result of the victim's

instinctive use of the non-dominant hand to protect the dominant one (12, 13). Numerous and widely distributed defensive injuries, particularly when present in large numbers, may point to a prolonged and dynamic struggle involving repeated attempts to ward off blows. Extensive defensive injury patterns also support the interpretation of a sustained assault of marked intensity (12).

Defensive injuries are typically located on mobile body parts, especially the upper limbs. Although rare, they may occasionally appear on the legs (4, 14). They are generally divided into two categories: passive defensive injuries, which occur when the victim raises the arms to block blows; and active defensive injuries, which arise when the victim attempts to grasp or disarm a weapon – most often a sharp or pointed instrument. Depending on the weapon, these injuries may present as abrasions, contusions, lacerations, fractures, incised wounds, stab wounds, or chop wounds (2, 8, 15-17). Correct recognition and interpretation of these patterns are crucial for reconstructing the sequence of events leading to death, providing insight into the dynamics of the assault, the victim's level of consciousness, and the temporal order of injuries.

From a medico-legal perspective, the systematic documentation of defensive injuries is essential not only for reconstructing the dynamics of the assault, but also for distinguishing between active resistance, incapacitation, and lack of opportunity for defense, each of which carries different implications for forensic interpretation.

This study is limited by its retrospective design and reliance on existing autopsy documentation. The high proportion of firearm-related homicides may have reduced the overall prevalence of defensive injuries in the sample. Variables such as the exact body position of the victim or the sequence of blows could not be reconstructed in all cases.

CONCLUSION

Defensive injuries were identified in slightly more than one-third of all analyzed homicide cases. They were most often bilateral, located in the upper third or diffusely along the forearms, and somewhat more extensive on the left side. The majority were polymorphic in nature. Defensive injuries occurred significantly more frequently in cases involving sharp or blunt force and were nearly absent in firearm-related deaths. Their recognition and interpretation are essential for understanding the nature and dynamics of violent acts, offering valuable insight into the relationship between victim and perpetrator. Accurate identification and documentation of defensive injuries during autopsy are indispensable for reliable forensic reconstruction and carry significant implications for the legal evaluation of the case.

Acknowledgments: This work was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, Grant No. 451-03-34/2026-03/200110.

Funding information: N/A

Conflicts of interest: The authors hereby declare that they have no conflict of interest.

Author contributions: All authors contributed significantly to the creation of the paper. Idea and conceptualization by I.B. and V.M., data collection and writing of the first draft by N.S., M.Ć., and A.Ć., statistics by M.B., T.G., supervision by T.P. and B.R. All authors read and approved the final manuscript.

Ethical approval: The study was approved by the Ethics Committee for Scientific Research of Students of the Faculty of Medicine, University of Belgrade, decision of January 9, 2025.

Informed consent: The study used fully anonymized data; therefore, informed consent from the individuals involved was not required.

REFERENCES

1. World Health Organization. Global Health Estimates: Homicide. Geneva: WHO; 2019
2. Hugar BS, Harish S, Girish Chandra YP, Praveen S, Jayanth SH. Study of defence injuries in homicidal deaths: An autopsy study. J Forensic Leg Med. 2012;19(4):207-10. doi:10.1016/j.jflm.2011.12.022.
3. Mohanty MK, Panigrahi MK, Mohanty S, Dash JK, Dash SK. Self-defense injuries in homicidal deaths. J Forensic Leg Med. 2007;14(4):213-5. doi:10.1016/j.jcfm.2006.06.031.
4. Rančić N, Djurović G, Pilipović F, Savić S. Medicolegal characteristics of defense injuries in cases of homicides. Vojnosanit Pregl. 2017;74(4):335-40. doi:10.2298/VSP150218186R.
5. World Health Organization. Violence Info: Homicide in Serbia. Geneva: WHO; 2019.
6. Kopacz P, Bolechała F, Strona M, Konopka T. Overkilling cases versus homicide cases in general: A preliminary report. Arch Med Sadowej Kryminol. 2018;68(4):259-65. doi:10.5114/amsik.2018.84528.
7. Gupta A, Rani M, Mittal AK, Dikshit PC. A study of homicidal deaths in Delhi. Med Sci Law. 2004;44(2):127-32. doi:10.1258/rsmmsl.44.2.127.
8. Rahimi R, Mohd Kasim NA, Zainun KA, Mohamad A'Azizan NA, Mansor MA, Ahmad Kamal NS, et al. Medico-legal autopsies of homicidal deaths: A five-year retrospective study in Hospital Sungai Buloh. Malays J Pathol. 2020;42(1):65-70.
9. Katkici U, Ozkök MS, Orsal M. An autopsy evaluation of defence wounds in 195 homicidal deaths due to stabbing. J Forensic Sci Soc. 1994;34(4):237-40. doi:10.1016/S0015-7368(94)72926-1.
10. Ambrosi L, Nicolì S, Ferorelli D, Vaglio R, Solarino B, Benevento M. Gunshot defense wounds: Three case reports and a literature review. Forensic Sci. 2024;4:588-97. doi:10.3390/forensicsci4040040.
11. Jainik SP, Mangal HM, Vora DH, Chotaliya DB, Chauhan VN, Doshi SM. Profile of defense injuries in homicidal deaths: A prospective study. Indian J Forensic Med Pathol. 2012;5(3):115-9.
12. Pollak S, Saukko P. Defense wounds. In: Encyclopedia of Forensic Sciences. 2000;374-8. doi:10.1006/rwfs.2000.0438.
13. Borsay BÁ, Halasi BD, Pórszász RK, Gergely PA. Homicide-suicide as domestic violence: A case report with a little literature review. Leg Med (Tokyo). 2025;72:102557. doi:10.1016/j.legalmed.2024.102557.

14. Das NG, Das N, Sil A. Pattern and forensic significance of defense injuries in homicide cases: A cross-sectional study. Cureus. 2025;17(3):e79959. doi:10.7759/cureus.79959.
15. Schmidt U. Sharp force injuries in clinical forensic medicine. Forensic Sci Int. 2010;195(1-3):1-5. doi:10.1016/j.forsciint.2009.10.031.
16. O'Donovan S, Langlois NEI, Byard RW. "Defense-type" wounds in suicide. Forensic Sci Med Pathol. 2018;14(3):402-5. doi:10.1007/s12024-018-9957-y.
17. Chattopadhyay S, Sukul B. Pattern of defense injuries among homicidal victims. Egypt J Forensic Sci. 2013;3:81-4. doi:10.1016/j.ejfs.2012.11.002.

ODBRAMBENE POVREDE KOD ŽRTAVA UBISTAVA: DESETOGODIŠNJA RETROSPEKTIVNA AUTOPSIJSKA STUDIJA

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Sažetak

Uvod: Odbrambene povrede su jedan od glavnih pokazatelja pokušaja žrtve da se odbrani od napadača, a njihovo prepoznavanje olakšava diferencijaciju između ubilačkih od samoubilačkih smrti. Cilj ovog istraživanja je da ispita učestalost, forenzičke i druge karakteristike odbrambenih povreda kod žrtava ubistava i ispita njihovu vezu sa sociodemografskim karakteristikama žrtava, mehanizmom nastanka povreda i vrstom oružja korišćenog prilikom napada.

Metodologija: Sprovedena je retrospektivna studija preseka na 161 slučaju ubistava obdukovanih u periodu od 2014. do 2023. godine u Institutu za sudsku medicinu Medicinskog fakulteta u Beogradu, Srbija. Podaci o demografskim karakteristikama, oružju, rasporedu i vrsti povreda analizirani su metodama deskriptivne i analitičke statistike.

Rezultati: Odbrambene povrede identifikovane su u 56 (34.8%) slučajeva, pri čemu su najčešće bile polimorfne i obostrano prisutne, lokalizovane najčešće u gornjim trećinama ili difuzno, čitavom površinom podlaktica. Odbrambene povrede su statistički značajno češće bile prisutne u slučajevima gde je korišćena oštrica/šiljak ili tupina (p <0,001), dok su u slučajevima gde je korišćeno vatreno oružje bile gotovo odsutne. Odbrambene povrede češće su zabeležene kod muškaraca i starijih osoba.

Diskusija: Odbrambene povrede tipično su lokalizovane na gornjim ekstremitetima. Raspored odbrambenih povreda zavisi od brojnih faktora poput vrste oružja, odnosa žrtve i napadača prilikom sukoba, strane sa koje se zadaje udarac, načina na koji napadač prilazi i drugo. Prisustvo brojnih difuzno raspoređenih odbrambenih povreda ukazuje na dinamiku i trajanje sukoba.

Zaključak: Prepoznavanje i interpretacija odbrambenih povreda pružaju izuzetan uvid u dinamiku ubistva, omogućavajući preciznu forenzičku rekonstrukciju i daju doprinos pravnoj kvalifikaciji krivičnog dela.

Ključne reči: ubistvo, odbrambene povrede, oružje, obdukcija, interpersonalno nasilje

Primljen: 23. 12. 2025. I **Revidiran**: 16. 03. 2026. I **Prihvaćen**: 20. 03. 2026. I **Online First:** 23. 03. 2026.

Medicinska istraživanja 2026