УДК 614.862:340.6
МРНТИ 76.75, 76.35.43

S.B. RAKHMANOV[1,2], B.B. SAGINDYKOV[1]

EVALUATION OF FORENSIC EVIDENCE IN ROAD TRAFFIC ACCIDENT CASES

[1]Aktobe Interregional Center of Forensic Examinations, Aktobe, Kazakhstan
[2]Marat Ospanov West Kazakhstan Medical University, Aktobe, Kazakhstan

S.B. Rakhmanov – https://orcid.org/0000 0002 0561 5931
B.B. Sagindykov – https://orcid.org/0000 0002 5124 8714

Библиографиялық сілтеме:

Рахманов СБ, Сагиндыков ББ. Жол көлік оқиғаларына байланысты жүргізілген сот-медициналық сараптама нәтижелерін бағалау. *Ǵylym aliansy.* 2025;2(1):35-40

Citation:

Rakhmanov SB, Sagindykov BB. Evaluation of Forensic Evidence in Road Traffic Accident Cases. *Ǵylym aliansy.* 2025;2(1):35-40

Библиографическая ссылка:

Рахманов СБ, Сагиндыков ББ. Оценка результатов судебно-медицинской экспертизы, связанной с дорожно-транспортными происшествиями. *Ǵylym aliansy*. 2025;2(1):35-40

Жол көлік оқиғаларына байланысты жүргізілген сот-медициналық сараптама нәтижелерін бағалау

С.Б. Рахманов[1,2], Б.Б. Сагиндыков[1]
[1]Ақтөбе өңіраралық сот сараптамалары орталығы, Ақтөбе, Қазақстан
[2]Марат Оспанов атындағы Батыс Қазақстан медицина университеті, Ақтөбе, Қазақстан

Өзектілігі. Сот-медициналық сараптама барлық сот сараптамалары өндірісіндегі күрделі зерттеу болып саналып, Қазақстан Республикасында жалпы сараптама өндірісінің 75-80% құрайды. Соның ішінде жол – көлік оқиғасына байланысты жүргізілетін сот-медициналық сараптамалардың күрделілігі, сарапшы мамандарға үлкен жүктеме тудырып, сараптаманың осы түріне сәйкес әдістемені оңтайландыруды міндеттейді.
Зерттеу мақсаты. Жол-көлік оқиғасына қатысты мәйітті зерттеу кезіндегі жарақат түрлеріне байланысты сот-медициналық сараптама нәтижелерін бағалау.
Зерттеу әдістері. Зерттеу Ақтөбе өңіраралық сот сараптамалары орталығы өндірісінде 2023 жылдары жүргізілген мәйітті зерттеудің қорытындылары бойынша талдау жүргізу арқылы орындалды. Зерттеу дизайны – ретроспективті зерттеу, тұтас таңдау. Барлығы 2132 мәйіттің сот-медициналық сараптама қорытындылары талданып, зерттеу мақсаты мен міндеттерін шешу үшін жол – көлік оқиғасымен байланысты 190 зерттеу қорытындысы зерттеуге алынды.
Зерттеу нәтижелері. Зерттеу нәтижесінде анықталған автокөлік салонының ішінде алынған жарақаттардың өзіндік ерекшелігі болатындығы, жарақаттану шеңберінің ауқымдылығы, тіркескен жарақаттардың басым болатындығы белгілі болып отыр. Біздің зерттеуде анықталған жол-көлік оқиғасына қатысушылар көрсеткішінде негізінен басым жолаушылар алатындығы, ал жүргізуші жарақаттануы көрсеткіші аз болатындығы анықталды. Бұл өз кезегінде қатысушылар категориясының ерекшеліктерін білдіреді. Зерттеу нәтижесі көрсеткендей жалпы мәйіттің сот-медициналық сараптамасы үлесінде жол-көлік оқиғасына байланысты сараптамалар 15,8% құрап, жалпы көлік жарақаттарының ішінде автокөлікпен алынған жарақаттар 80% жуық болып отыр. Бұл өз кезегінде жалпы жол-көлік оқиғасы кезінде алынатын жарақаттар, соған қатысты жүргізілетін сот-медициналық сараптама өндірісі үлесінің үлкен екенін көрсетеді. Сонымен қатар, автокөліктермен алынған жарақаттар көлемі бойынша тіркескен, көптік жарақаттардың болуында ішкі мүшелердің зақымдалуы, автокөлік жарақаттарының түрлеріне байланысты да ерекшеліктер болатындығын, жарақат түрлері автокөлікте оқиғаға қатысушының орналасу орнымен де байланыстылығы анықталып отыр.
Қорытынды. Жарақаттардың кездесу жиілігіне, алыну механизміне, сипатына байланысты көлік жарақаттарының түрлеріне қатыстылығын болжауға болады. Жол - көлік оқиғасына байланысты болатын жарақаттар көрсеткіштерін жан-жақты талдау, салыстырмалы зерттеулер арқылы осы түріне байланысты сот-медициналық сараптама өндірісіндегі зерттеу әдістемесін толықтыруға болады және сот-медициналық сараптама үлесінде жол-көлік оқиғасымен байланысты болатын жарақат түрлерін саралауда септігін тигізеді.

Негізгі сөздер: *жол-көлік оқиғасы, сот-медициналық сараптама, зерттеу әдістері, жарақат түрлері*

Sapargali Bekjanovich Rakhmanov
e-mail: srrakhmanov@gmail.com

Келіп түсті/ Received/ Поступила: 25.11.24

Басылымға қабылданды/ Accepted/ Принята к публикации: 22.01.25

Evaluation of Forensic Evidence in Road Traffic Accident Cases

S.B. Rakhmanov[1,2], B.B. Sagindykov[1]
[1]Aktobe Interregional Center of Forensic Examinations, Aktobe, Kazakhstan
[2]Marat Ospanov West Kazakhstan Medical University, Aktobe, Kazakhstan

Forensic medical examinations related to road traffic accidents (RTAs) represent a significant portion of forensic casework in Kazakhstan, accounting for 75–80% of total forensic examinations. The complexity of these examinations imposes a substantial workload on forensic experts and necessitates methodological optimization.
Purpose. This study aims to evaluate forensic medical examination findings concerning injury types in deceased individuals involved in RTAs.
Methods. A retrospective analysis was conducted on forensic medical examination records from the Aktobe Interregional Center for Forensic Examinations in 2023. A total of 2,132 forensic cases were reviewed, with 190 cases specifically related to RTAs selected for analysis.
Results. The study revealed distinct characteristics of injuries sustained inside vehicles, including extensive trauma and a predominance of combined injuries. Passengers were found to sustain more injuries compared to drivers, reflecting the distribution of accident participants. Forensic examinations of RTA-related cases accounted for 15.8% of all forensic medical examinations, with injuries from automobile accidents comprising approximately 80% of traffic-related injuries. The findings also highlighted the high prevalence of multiple and combined injuries, with specific patterns of internal organ damage varying according to the individual's location within the vehicle.
Conclusion. The frequency, mechanism, and nature of injuries allow for the prediction of injury patterns in RTAs. A comprehensive analysis of RTA-related injuries, alongside comparative forensic studies, can contribute to the refinement of forensic examination methodologies and improve injury classification within forensic practice.
Keywords: *traffic accident, forensic medical examination, injury classification, forensic methodology, road traffic injury.*

Оценка результатов судебно-медицинской экспертизы, связанной с дорожно-транспортными происшествиями

С.Б. Рахманов[1,2], Б.Б. Сагиндыков[1]
[1]Актюбинский Межрегиональный центр судебных экспертиз, Актобе, Казахстан
[2] Западно-Казахстанский медицинский университет имени Марата Оспанова, Актобе, Казахстан

Актуальность. Судебно-медицинская экспертиза считается сложным исследованием в рамках всех судебных экспертиз и составляет 75-80% общего объема экспертной деятельности в Республике Казахстан. Сложность судебно-медицинских экспертиз, проводимых в связи с дорожно-транспортными происшествиями, создает значительную нагрузку на экспертных специалистов и требует оптимизации методик, применяемых к этому типу экспертизы.
Цель исследования. Оценить результаты судебно-медицинских экспертиз, связанные с типами травм при исследовании тела, в контексте дорожно-транспортного происшествия.
Методы исследования. Исследование проведено на основе анализа материалов судебно-медицинских экспертиз тел, проведенных в Актюбинском межрегиональном центре судебных экспертиз в 2023 году. Дизайн исследования – ретроспективное исследование с полным выбором. Всего было проанализировано 2132 результата судебно-медицинской экспертизы, из них 190 результатов, связанных с дорожно-транспортными происшествиями, были выбраны для исследования.
Результаты исследования. В результате исследования было установлено, что травмы, полученные внутри салона автомобиля, имеют свои особенности, значительный объем травм и преобладание сочетанных повреждений. Результаты показали, что в дорожно-транспортных происшествиях в основном травмы получали пассажиры, тогда как травмы водителей имели меньший показатель. Это, в свою очередь, отражает особенности категорий участников. Результаты исследования показали, что судебно-медицинские экспертизы, связанные с дорожно-транспортными происшествиями, составляют 15,8% от общего числа судебно-медицинских экспертиз, при этом травмы, полученные в результате автомобильных аварий, составляют около 80% всех травм, связанных с дорожными событиями. Это указывает на значительную долю производственной деятельности в судебно-медицинской экспертизе, связанной с дорожно-транспортными происшествиями. Кроме того, было установлено, что травмы,

полученные от автомобилей, имеют значительное количество сочетанных и множественных повреждений, с характерными особенностями, связанными с повреждением внутренних органов, а также различиями в зависимости от типов автомобильных травм, которые были связаны с расположением участника происшествия.

Заключение. На основе частоты, механизма и характера травм можно предсказать типы дорожных травм. Комплексный анализ показателей травм, связанных с дорожно-транспортными происшествиями, наряду с сопоставительными исследованиями может усовершенствовать методику судебно-медицинской экспертизы, связанной с этой областью, тем самым способствуя классификации типов травм, связанных с дорожно-транспортными происшествиями, в рамках судебно-медицинской экспертизы.

Ключевые слова: *дорожно-транспортное происшествие, судебно-медицинская экспертиза, методы исследования, типы травм*

Introduction

Forensic medical examinations are a critical component of forensic investigations, comprising 75–80% of all forensic cases in Kazakhstan. Of these, post-mortem forensic examinations account for 35–45%, representing a substantial portion of the workload. The complexity of post-mortem forensic examinations, especially those involving traumatic injuries and criminal cases, often poses significant challenges in the organization of such investigations. A review of scientific literature on forensic medical examinations emphasizes studies focused on post-mortem investigations, particularly in the context of road traffic accidents, and discusses the organizational aspects and related challenges [1, 2, 3].

Road traffic accidents are a significant medical and social issue, not only in Kazakhstan but globally, contributing to high rates of traumatic injuries. Injuries resulting from road traffic accidents are classified as severe due to their significant socio-economic impact. Literature data indicate that 60–70% of fatalities resulting from road traffic accidents occur among individuals of working age. This underscores the importance of conducting comprehensive research into the procedural foundations of post-mortem forensic examinations in road traffic accident cases.

Forensic medical experts play a critical role in determining the severity of injuries sustained by participants during an incident. For living individuals, examinations identify the nature and extent of injuries, including bodily harm, health impairments, mechanisms of injury, and timing. The conclusions drawn from these examinations significantly influence the legal evaluation of incidents and may serve as key evidence in determining criminal or administrative liability [4, 5].

The complexity of forensic examinations related to road traffic accidents arises from several factors:

The involvement of multiple fatalities in a single incident.

Establishing the causal link between the incident and the fatalities.

Identifying and matching the vehicles involved to the incident.

Determining the cause of the accident.

These factors often necessitate comprehensive examinations, which can pose challenges for forensic experts. Limited expertise in specific areas may prolong the examination process, and in many cases, additional or repeated examinations are required.

Post-mortem forensic examinations in road traffic accidents involve three critical components aimed at determining the cause of death and injury mechanisms:

Comprehensive examination of the deceased.

Analysis of the vehicles involved in the incident.

Detailed examination of the accident scene.

Additionally, it is crucial to identify whether the individuals involved had any medical conditions or were under the influence of alcohol or drugs that could have impaired their ability to operate a vehicle. This process plays a decisive role in determining the cause of death.

A review of the literature reveals numerous studies on injury types caused by road traffic accidents, their diagnostic criteria, and related issues. However, questions regarding the organizational mechanisms of post-mortem forensic examinations in road traffic accidents remain a pressing issue to this day [6, 7].

Therefore, the aim of our research is to evaluate the results of forensic medical examinations related to the types of injuries observed during the post-mortem examination of individuals involved in road traffic accidents.

Methods

The study was conducted by analyzing the results of post-mortem examinations carried out in 2023 at the Aktobe Interregional Center of Forensic Examinations. The research design is a retrospective study with a comprehensive sampling approach.

Inclusion criteria:

Pedestrian injuries caused by being struck by a vehicle.

Injuries sustained inside the vehicle cabin.

Injuries caused by being run over by a vehicle.

Injuries sustained from falling out of a vehicle.

Injuries resulting from being crushed between vehicle parts.

Exclusion criteria:

Injuries unrelated to road traffic accidents.

Acute and chronic diseases.

In the first stage, forensic medical examination results of 2,132 deceased individuals were analyzed. Out of these, 190 cases related to road traffic accidents were selected for further study to address the research objectives. The internal and external injuries of the deceased caused by

road traffic accidents, their diagnostic criteria, the timing and mechanisms of the injuries, and their morphological features were evaluated.

In the second stage, the obtained data were grouped based on case circumstances, internal and external injuries of the deceased, diagnoses, and causes of death. The data were then subjected to statistical analysis.

Statistical analysis was performed using descriptive statistics (mean values, standard deviations) and comparative analysis methods (t-test, ANOVA, and χ^2 test).

Results

The conducted study identified specific characteristics in the classification of injuries associated with road traffic accidents, including the nature of injuries, diagnoses, and causes of death. It highlighted the distinct features of road traffic accidents and the significant challenges they pose for forensic medical examinations.

Forensic medical examinations related to road traffic accidents accounted for 15.8±0.9% of all post-mortem examinations, representing a substantial share. This, in turn, directly impacts the workload of forensic experts.

Among the categories of injuries resulting from road traffic accidents, the highest proportion (80.0±0.01%) was attributed to injuries sustained inside the vehicle cabin. Of these, 92.1±0.7% involved passengers, while the remaining share involved drivers.

Cases of pedestrians being struck by vehicles accounted for 17.3±0.5%, with injuries caused by light vehicles comprising 90.9±0.01%, while heavy vehicles accounted for the smaller remaining share.

Injuries resulting from being run over by a vehicle (crushing) and those sustained from falling out of a vehicle represented 1.4–1.6±0.2% of the total injuries caused by road traffic accidents (Figure 1). According to the forensic examination results during the study period, no injuries caused by being crushed between vehicle parts were recorded ($p<0.5$).

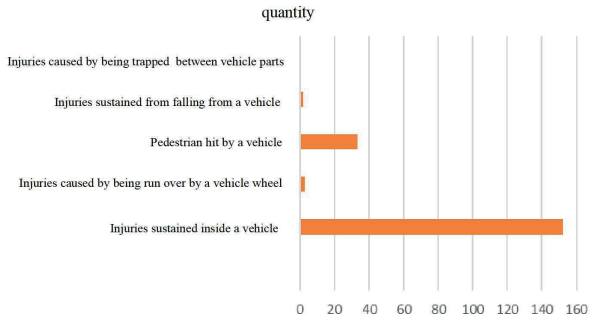

Figure 1. Comparative indicators based on the classification of injuries sustained from road traffic accidents.

In a comparative study of injuries sustained by passengers within the vehicle cabin, abrasions and bruises on the head, chest, and limbs, along with isolated rib fractures, were rare, occurring in only 3.2±0.7% of cases. In 96.8±0.3% of cases, combined fractures (involving vertebrae, limb bones, and skull damage) were observed. Isolated fractures of the cervical vertebrae (without associated fractures) were found in 1.9±0.02% of cases. This indicates that, in most cases, injuries to the musculoskeletal system involved multiple fractures.

Regarding the causes of death, injuries sustained within the vehicle cabin were attributed to post-traumatic shock in 40.7±0.08% of cases, cerebral edema and compression in 9.8±0.01%, and brain contusion and crushing in one case. In other cases, injuries were accompanied by post-traumatic hemorrhage. A comparison of injuries sustained within the vehicle cabin revealed that drivers were involved in 5 cases, highlighting that passengers were significantly more likely to sustain injuries (Figure 2).

The forensic examination rate for cases involving pedestrians struck by vehicles ranks second among all traffic accident-related indicators. In all such cases, external injuries, including abrasions and contusions on the head, chest, and limbs, was observed.

Regarding internal injuries in pedestrians, fractures of the skull vault and base were identified in 27.2±0.03% of cases. Subdural hemorrhages without skull fractures occurred in 9.0±0.4% of cases, while brain tissue damage was observed in 10.2±0.2% of cases. Brain tissue damage was found to always accompany skull fractures. Additionally, the analysis of these types of injuries revealed rib fractures in 18.1±0.8% of cases and cervical vertebrae fractures in 9.1±0.03% of cases. Injuries involving ruptures of internal organs were noted in 12.1±0.1% of cases, while fractures of the limb bones occurred in 33.2±0.4% of cases.

During the analysis of case circumstances related to traffic accident examinations, two instances (accounting for 1.3±0.4% of the total) were identified as involving individuals jumping from moving vehicles. Injuries observed in these cases did not significantly differ from other types of traffic accident-related injuries.

External injuries included contusions, abrasions, and bruises on the head, chest, and limbs. Internal injuries comprised subdural hemorrhages, rib fractures, ruptures of internal organs, and femur fractures. The diagnosis in such cases was “combined injury,” with the cause of death being post-traumatic shock.

Collisions involving light vehicles with scooters (three cases) and bicycles (one case) were recorded as four instances (2.6±0.8%) during the study period. The injury characteristics in these cases were similar to those identified in incidents of jumping from moving vehicles, including external and internal injuries, diagnoses, and causes of death.

In cases of collisions between scooters and light vehicles, 66.7±0.03% of scooter riders exhibited fractures of the skull vault and base. In the remaining cases, rib fractures and internal organ injuries were identified. Among scooter riders, 66.6±0.7% were diagnosed with open head injuries and closed chest injuries, while 33.3±0.3% were diagnosed with closed injuries of the chest and abdominal cavity.

The causes of death included brain swelling and compression in two cases, and post-traumatic hemorrhage in one case.

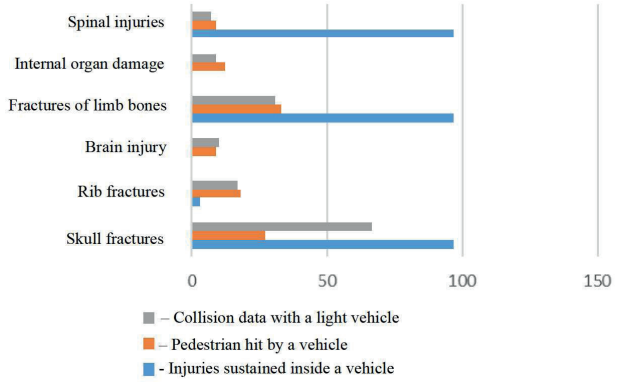

Figure 2. Comparative Characteristics of Injury Indicators Based on Types of Traffic Accidents.

The injuries identified in bicycle collisions with passenger vehicles were similar to those observed in scooter-related cases. However, the diagnosis was a closed head injury, and the cause of death was brain contusion and compression.

Discussion

The relevance of mortality indicators related to road traffic accidents remains a critical issue, particularly in the era of globalization, with the emergence of modern megacities and rapid technological advancements. Injuries sustained in incidents involving vehicles are diverse, extensive, and pose unique challenges in forensic medical diagnostics. During the examination of bodies in cases of road traffic accidents, forensic experts must analyze the location, mechanism, and nature of injuries. Additionally, they are often required to provide answers regarding the circumstances of the incident as requested by the appointing authorities. This highlights the need for comprehensive studies on the examination of bodies related to road traffic accidents and the organization of forensic investigations [8, 9].

The study identified distinct characteristics of injuries sustained inside vehicle cabins, including their extensive range and the predominance of combined trauma. Similar findings have been reported in the works of various researchers. Injuries sustained in vehicle cabins frequently involve significant damage to the head, often affecting two or more anatomical segments, and are commonly associated with combined injuries, including traumatic brain injuries.

Moreover, according to research, the mechanisms of injuries sustained in vehicle cabins, particularly among front-seat passengers, are attributed to significant body displacement and impacts with wide, injurious surfaces (such as the instrument panel), resulting in severe trauma and fatalities. In contrast, the relatively fewer injuries observed in drivers are explained by their more stable and secured body position, as well as the limited range of injurious surfaces they come into contact with (e.g., steering wheel components) [10, 11].

The broad spectrum of injuries sustained during road traffic accidents poses significant risks to the lives of all participants involved. In this context, the severity of the injuries, their impact on health, the mechanism and timing of their occurrence, are of utmost importance. The forensic medical examiner's conclusions provide a legal evaluation of the injuries sustained in the incident, as well as the categories of participants involved. Therefore, determining the category of participants in road traffic accidents is crucial.

In our study, it was found that passengers predominantly constitute the majority of participants in road traffic accidents, while the proportion of injured drivers was comparatively lower. This reflects the distinctive characteristics of participant categories. According to A.V. Kovalev and several other authors, the mortality rate resulting from vehicular injuries ranges from 81.7% to 86.5%, with mechanical injuries being predominant. Similar findings were identified in our research.

The results indicated that forensic examinations related to road traffic accidents accounted for 15.8% of all forensic medical examinations, and injuries caused by motor vehicles comprised approximately 80% of all vehicular injuries. This underscores the significant contribution of traffic accident-related injuries to forensic medical examinations. Additionally, the extent of injuries caused by motor vehicles often involves combined or multiple traumas, internal organ damage, and variations depending on the type of vehicular injury. The type of injuries also correlates with the participant's position within the vehicle [12, 13, 14].

Injury indicators during road traffic accidents predominantly involve injuries to the musculoskeletal system. In our study, combined injuries (e.g., fractures of the skull, limbs, and ribs) were observed in 96% of cases, signifying a unique pattern. Regarding the causes of death, nearly 40% of injuries sustained inside the vehicle cabin were attributed to post-traumatic shock, likely due to the presence of combined fractures. Similar patterns were observed in literature reviews from various studies.

In road traffic accidents, injuries to the skull (head region) were found to occur more frequently than injuries to other body parts. Injuries to the limbs were equally common in both drivers and passengers (41%), while chest injuries were twice as prevalent in drivers compared to passengers. Additionally, in our study, injuries involving scooters or bicycles frequently resulted in skull damage, as evidenced in forensic medical examinations. Regardless of the type of road traffic accident, the patterns of injury were found to be similar [15, 16, 17].

Thus, forensic medical examination in relation to road traffic accidents holds a significant place within the overall forensic examination process. Based primarily on the mechanisms of injury, the characteristics of injury indicators vary according to the types of vehicular injuries. The frequency, mechanism, and nature of the injuries allow us to predict the types of vehicular injuries involved. A comprehensive analysis of injury indicators related to road traffic accidents, through comparative studies, can enhance the research methodology in this area and contribute to the classification of injury types in forensic examinations related to road traffic accidents.

Conflicts of interest – not declared. This material has not been published elsewhere and is not under consideration by other publications.There was no funding from any parties involved in conducting this work.

References:

1. Lastovetskiy AG, Ayvazyan AG, Averyanova DA. Multifactorial analysis of mortality on the example of road accidents. *Forensic medicine*. 2018;4(3):10-16. doi:10.19048/2411-8729-2018-4-3-10-16.
2. Kuchuk SA, Klevno VA, Maksimov AV. Analysis of mortality rates in the Moscow region in order to implement Decree of the President of the Russian Federation dated 05/07/2012 No. 598 «On improving state policy in the field of healthcare». *Forensic medicine*. 2018;4(3):17-21. file:///C:/Users/%D0%9F%D0%9A5/Downloads/205-425-1-SM.pdf
3. Lastovetskiy AG, Lebedev MV, Averyanova DA, Ayvazyan AG. Organization of medical care for victims of road accidents with maxillofacial trauma. *Bulletin of New Medical Technologies*. 2017;(2):4-2. doi: 10.12737/article_59156294138399.26231860.
4. Ostroborodov VV, Obukhov IA. Tactical features of the inspection of the accident site in case of traffic accidents, including fatal ones. *Law and legislation*. 2021;11:244-248. doi:10.24412/2073-3313-2021-11-244-248
5. Nafikova L. S. The role of forensic medical examination in road accidents. *Bulletin of Science and Education.* 2017;1(25):77-78. ISSN 2312-8089 (Print)
6. 6. Pigolkin Yu.I., Dubrovin I.A., Sedykh E.P., Mosoyan A.S. Forensic assessment of cervical spine injuries in the driver and passenger of the front seat of a modern passenger car in a frontal collision. *Forensic medical examination*. 2015;58(6):24-27. doi: 10.17116/sudmed201558624-27.
7. Kazuhiko K, Ryo S, Ken-ichiro N. Fatal traffic accidents and forensic medicine. *IATSS Research.* 2014;38:71–76. doi: 10.1016/j.iatssr.2014.07.002.
8. Gokalp MA, Hekimoglu Y, Gozen A, Guner S, Asirdizer M. Evaluation of severity score in patients with lower limb and pelvic fractures injured in motor vehicle front-impact collisions. *Med Sci Monit.* 2016;22:4692-98. doi: 10.12659/msm.898459.
9. Yafit H, Dror BH, Nir C, Michael JD, Gavriel Ch, Bahaa HY. The impact of helmet use on oral and maxillofacial injuries associated with electric-powered bikes or powered scooter: a retrospective cross-sectional study. *Head & Face Medicine*. 2021;17:36-43. doi: 10.1186/s13005-021-00288-w.
10. Pigolkin YuI, Dubrovin IA, Mosoyan AS, Bychkov AA. Forensic medical assessment of injuries in the cabin of a moving passenger car equipped with modern personal safety equipment. *Forensic medical examination*. 2018;1:16-20. doi: 10.17116/sudmed20186116-20.
11. Pankov IV, Sarkisyan BA, Votintsev AA. Injuries to the driver and passenger of the front seat in non-fatal interior injury in foreign-made passenger cars. *International Journal of Applied and Fundamental Research.* 2014;1:174-177. https://applied-research.ru/ru/article/view?id=4618
12. Leonov SV, Pinchuk PV. Forensic medical characteristics of pedestrian injuries during front-edge car collision. *Forensic medical examination*. 2016;59(4):21-24. doi: 10.17116/sudmed201659421-24.
13. Kovalev AV, Momot DV, Samokhodskaya OV, Zabrodsky YaD. The specifics of conducting forensic medical examinations of victims of road accidents, taking into account the modern development of automobile safety systems. *Forensic medical examination*. 2020; 63(2):14-18. doi: 10.17116/sudmed20206302114.
14. Arbel S, Zrifin E, Mahmoud R, Mijiritsky E, Groysman L, Shuster A, et.al. Maxillofacial Injuries Sustained by Riders of Electric-Powered Bikes and Electric-Powered Scooters. *Int. J. Environ. Res. Public Health*. 2022;19:15183-15191. doi: 10.3390/ijerph192215183.
15. Mayakova MV, Tenkov AA, Kochkarov VI. Forensic medical assessment of injuries sustained by living persons in the car interior. *Scientific Bulletin*. 2020; 22(93):86-93. https://core.ac.uk/download/pdf/151214332.pdf
16. Sokol VK. Features of complex forensic medical examinations (FME) of the lower extremities mechanical injury in non-fatal car trauma. *Morphologia.* 2020;14(3):76-84. doi: 10.26641/1997-9665.2020.3.76-84.
17. Indiaminov SI, Abdumuminov HN, Kim AA. Forensic medical characteristics of injuries suffered by cyclists in collisions with other vehicles. *Forensic medical examination*. 2023;66(1):14-18. doi: 10.17116/sudmed20236601114.