



**3 RD. KOSOVO – TÜRKİYE FORENSIC SCIENCES
CONGRESS**

25-26 May 2024 Kosovo

KONGRESI I 3-TË FORENZIKËS SË KOSOVË – TÜRKİYE

25-26 Maj 2024 Kosovë

3. KOSOVA -TÜRKİYE ADLİ BİLİMLER KONGRESİ

25-26 Mayıs 2024 Kosova

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FOREWORD

Prof. Dr. Edmond Hajrizi

President & Rector – University for Business and Technology (UBT)



The information age, with its rapid pace of development, is bringing profound transformations to all areas of life – including justice, security, and legal systems. In this new reality, forensic sciences are assuming an increasingly vital role, becoming a key factor in ensuring effective justice based on precise scientific evidence.

In this context, it is both an honor and a responsibility for UBT to host the 3rd Kosovo–

Turkey Forensic Science Congress – an event that brings together the highest level of scientific and professional expertise from two friendly and strategically partnered countries, Kosovo and Turkey.

This platform for inter-institutional cooperation began as an academic initiative and has now evolved into an annual tradition with wide-reaching impact, providing space for the exchange of ideas, the presentation of innovative research, and the strengthening of professional networks in the field of forensic science.

Our collaboration with Katip Çelebi University in Izmir, Yozgat Bozok University, and the Turkish Society of Forensic Sciences represents a successful model of international academic partnership that supports the development of advanced knowledge and new solutions for security and justice challenges.

UBT is a leading institution in Kosovo in the development of higher education and interdisciplinary scientific research, with a particular commitment to the fields of criminology, security, and digital forensics. Within this framework, we have established the Institute of Forensic Sciences, where, in addition to research, practical projects are developed with an impact on the legal and security systems of our country and beyond.

The 3rd Forensic Science Congress is being held at UBT’s Smart City, which houses over 300 scientific and technological laboratories, including the new crime identification lab inaugurated as part of this event. This stands as yet another testament to our commitment to connecting knowledge with practice and developing sustainable solutions that enhance the safety of our citizens.

This congress book documents the scientific contributions, in-depth discussions, and multidisciplinary approaches presented by distinguished researchers and professionals in the field, and we hope it will serve as a valuable reference in the scientific and legal literature of our region.

On behalf of UBT, I extend my sincere gratitude to all participants, paper authors, academic partners, the organizing committee, and supporting institutions from Kosovo, Turkey, and beyond.

Believing in the power of knowledge, collaboration, and professional dedication, I am confident that this congress will open new horizons in forensic sciences and will contribute positively to improving justice and security practices in our region.

**With respect,
Prof. Dr. Edmond Hajrizi
President & Rector
University for Business and Technology (UBT)**

FOREWORD

Prof. Dr. İ. Hamit HANCI

İzmir Katip Çelebi University Faculty of Medicine, Department of Forensic Medicine –President of the Association of Forensic Scientists

To Many More Congresses...

With the aim of fostering international cooperation in the field of forensic sciences, during the



10th Anatolian Forensic Sciences Congress held in 2013 in Malatya—of which I had the honor of serving as Co-Chair—we had a productive discussion with Mr. Altay Suroy, Judge of the Constitutional Court of Kosovo. It was during this exchange that the idea was born to organize a congress series between Kosovo and Turkey, conducted in both countries' native

languages.

In line with this vision, we successfully held the first “Kosovo–Turkey Forensic Science Days” on August 12–14, 2014, in the historic city of Prizren, Kosovo. The official languages of the congress were Albanian and Turkish. The event welcomed the participation of two ministers and numerous high-level officials from Kosovo, alongside a strong delegation of distinguished scholars from Turkey.

The primary objective of this congress series has been to strengthen scientific exchange and foster friendship not only between Kosovo and Turkey but also among the broader Balkan region, thereby promoting interdisciplinary cooperation and establishing lasting academic networks.

The presidency of the first congress was undertaken by:

- Mr. Altay Suroy, Judge of the Constitutional Court of Kosovo,
- Director of the Kosovo Institute of Forensic Medicine,



- Cengiz Çesko, President of the Association of Turkish Alumni in Kosovo (TÜMED), and myself.

Continuing this scientific legacy, the second Kosovo–Turkey Forensic Sciences Congress was organized on April 25–26, 2023, in Foça, İzmir (Turkey). The leadership of the congress included:

- Honorary President: Prof. Dr. Saffet Köse
- Congress Presidents:
 - Prof. Dr. İ. Hamit Hancı (Department of Forensic Medicine, Faculty of Medicine, İzmir Katip Çelebi University – President of the Association of Forensic Scientists)
 - District Governor Mehmet Türköz (Foça District Governor)
 - Prof. Dr. Edmond Hajrizi (Rector, University for Business and Technology – Kosovo)

Our second congress reached a new level of international participation, with scholars joining not only from Kosovo and Turkey but also from North Macedonia, Albania, Greece, Azerbaijan and Turkish states affiliated with the Russian Federation. Simultaneous translation in Albanian and Turkish was provided throughout the congress to ensure maximum academic engagement.

A particularly noteworthy contributor to the success of these congresses has been Prof. Dr. Cengiz Çesko, whose tireless dedication, organizational leadership, and visionary commitment since the inception of this initiative have served as a cornerstone of this academic bridge between nations.

Looking forward to many more scientific congresses together...

The congress, which was attended by the Governor of İzmir, the Chief Public Prosecutor of İzmir, the Mayor of Foça and many police officers and forensic scientists, was very successful.





2. KOSOVA TÜRKİYE ADLI BİLİMLER GÜNLERİ

2. KOSOVA TURQIA DITËT TË FORENZIKËS

25 - 26 Nisan 2023 / 25 - 26 Prill 2023 Foça- İZMİR

Mark Warner Phokaia Beach Resort

Kongre Başkanları

Presidentët e Kongresit



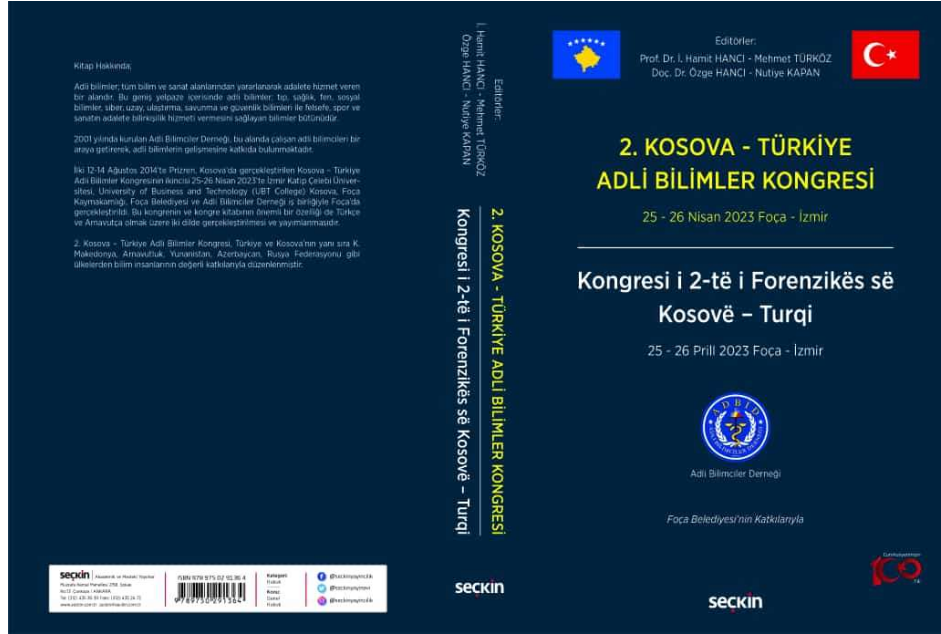
Prof. Dr İ. Hamit Hancı.
İzmir Katip Çelebi
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Adli Tıp A.D- Adli
Bilimciler Derneği
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Kryetar i Shoqatës së
Shkencëtarëve Ligjor

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At the end of the congress, the book of proceedings was published under the editorship of İ. Hamit HANCI - Mehmet TÜRKÖZ - Özge HANCI - Nutiye KAPAN.



The 3rd Congress was held in Kosovo on 25-26 May 2024 under the honorary chairmanship of Prof. Dr. Edmond Hajrizi, Mr.Sci. Arsim Gerxhaliu, Prof. Dr. İ. Hamit Hancı and Mehmet Türköz.



I was able to share the successes of this congress, which I could only attend online due to Esin Gökçe, remotely.

We were going to hold the 4th Congress, but unfortunately the conflicts in our region prevented this. We were growing bigger in this congress. Albania was also among the organizers. But the conjuncture temporarily prevented us.

But we will be together with our new congresses very soon

Prof. Dr. İ. Hamit HANCI

İzmir Katip Çelebi University Faculty of Medicine, Department of Forensic Medicine -

President of the Association of Forensic Scientists

FOREWORD

Mr. Sci. Arsim Gerxhaliu PhD Cand.

Congress President

Institute of Forensic Sciences – UBT



Ensuring justice based on accuracy, impartiality, and scientific principles is one of the fundamental needs of modern societies. In this process, forensic sciences serve as a cornerstone, representing objectivity, precision, and scientific reliability in the service of the law.

The 3rd Kosovo–Türkiye Forensic Sciences Congress, which we have the honor of organizing this year, has served not only as a venue for scientific exchange but also as a bridge for friendship, cooperation, and a shared vision for the future. By bringing together distinguished scientists and forensic professionals from Kosovo and Türkiye, our aim has been to contribute meaningfully to the advancement of forensic sciences on both regional and global levels.

Throughout the congress, the diverse presentations – from forensic toxicology to digital forensics, from forensic nursing to criminal laboratory practices – have highlighted the power of interdisciplinary approaches and the scientific richness of this field. These contributions remind us that forensic science is not merely a technical discipline, but a universal value system that upholds human rights.

Each study, research, and idea presented in this congress book will leave a meaningful mark on the scientific literature. I extend my sincere gratitude to all colleagues who contributed, the organizing committee, and the institutions that supported us.

Guided by the light of forensic science, we will continue walking together toward a safer and more just world.

Respectfully,

Mr.Sci. Arsim Gerxhaliu PhD Cand.

Congress President

Institute of Forensic Sciences – UBT

FOREWORD

Assoc. Prof. Dr. Cengiz ÇESKO

Congress Secretary

Director Institute of Forensic Sciences – UBT

Justice is built not only on laws but also on scientific methods that uncover the truth. In this context, forensic sciences play an indispensable role in solving crimes, strengthening the legal system, and ensuring public safety. Forensic sciences go beyond technical analyses; they embrace a multidisciplinary perspective, serving as a guiding force in the pursuit of justice. Today, various scientific and artistic disciplines—ranging from medicine to chemistry, cybersecurity to psychology, and even philosophy and the arts—contribute to the advancement of forensic sciences.

In line with this understanding, the Kosovo - Türkiye Forensic Sciences Congress was established to promote scientific knowledge sharing in forensic sciences and to strengthen international collaboration. The first congress was held on August 12-14, 2014, in Prizren, Kosovo, organized by Cengiz Çesko, then-President of the Türkiye Alumni Association; Altay Suroy, President of the Constitutional Court of Kosovo; and Prof. Dr. Hamit Hancı, President of the Forensic Scientists Association. We extend our deepest gratitude to Prof. Dr. Hamit Hancı for his significant efforts in making this congress a reality and for his contributions to the advancement of forensic sciences.

The second Kosovo - Türkiye Forensic Sciences Congress took place on April 25-26, 2023, in Foça, Türkiye, in collaboration with İzmir Katip Çelebi University, the University of Business and Technology (UBT College) Kosovo, the Foça District Governor's Office, the Municipality of Foça, and the Forensic Scientists Association. One of the most remarkable aspects of this congress was the publication of its proceedings in both Turkish and Albanian. The congress welcomed esteemed scientists not only from Turkey and Kosovo but also from North Macedonia, Albania, Greece, Azerbaijan, and the Russian Federation.

The third Kosovo - Türkiye Forensic Sciences Congress was hosted by the University of Business and Technology (UBT) in Kosovo on May 25-26, 2024. Such congresses make invaluable contributions to scientific progress by enabling researchers to exchange knowledge and discuss new developments in the field.

Additionally, the UBT Forensic Sciences Institute was established, with Assoc. Prof. Dr. Cengiz Çesko appointed as its director. Moreover, for the first time in Kosovo, a forensic science laboratory was founded within a university. This laboratory was developed entirely with the scientific expertise and guidance of Mr. sci Arsim Gërxfhaliu PhD Cand. FMD. The inauguration of the UBT Forensic Sciences Laboratory was attended by Kosovo's Chief Prosecutor Besim Kelmendi, the Ambassador of the Republic of Türkiye in Pristina, Sabri Tunç Angılı, UBT Rector Prof. Dr. Edmond Hajrizi, and UBT Forensic Sciences Institute Director Assoc. Prof. Dr. Cengiz Çesko.

This book has been prepared to comprehensively present academic studies, advancements, and international collaborations in the field of forensic sciences. We express our profound gratitude to

all scientists who illuminate the path of justice through science, especially Prof. Dr. Hamit Hancı for his invaluable efforts and guidance, and to UBT Rector Prof. Dr. Edmond Hajrizi for his unwavering support throughout this process.

Assoc. Prof. Dr. Cengiz ÇESKO

Congress Secretary

Director Institute of Forensic Sciences – UBT

SCIENTIFIC PROGRAM

May 25, 2024	SATURDAY (FIRST DAY)
09.00-09.30 am	CONGRESS REGISTRATION
09:30-10.00	OPENING SPEECHES
<p>Prof. Dr. Edmond HAJRIZI- Rector of University for Business and Technology, Kosovo Prof. Dr. İrfan KARADEDE- İzmir Kâtip Çelebi University, Faculty of Dentistry, Türkiye Protocol Speeches</p>	
10.00 – 10.30	ADLİ LABORATUVARLARIN AÇILIŞI
CONFERENCE - Hall A	
Session Chairs	<p>Prof. Dr. Muhammet Fevzi POLAT - Yozgat Bozok University, Faculty of Medicine, Head of Department of Basic Medical Sciences, Department of Medical Biochemistry, Türkiye</p> <p>Prof. Dr. Sevinç POLAT-Yozgat Bozok University, Dean of Faculty of Health Sciences- Forensic Scientists Association, Co-chairman of the Forensic Nursing Commission, Türkiye</p>
10.30-11.00	<p>What is this Forensic Science?</p> <p>Prof. Dr. İ. Hamit HANCI - İzmir Kâtip Çelebi University, Faculty of Medicine, Department of Forensic Medicine, President of Forensic Scientists Association, Türkiye</p>
11.00-11.15	COFFEE BREAK
PANEL I	Hall A
Session Chairs	<p>Prof. Dr. Blerim KRASNIQI- University for Business and Technology, Kosovo Ass. Prof. Cengiz ÇESKO- Director of the Institute of Forensic Sciences, University for Business and Technology, Kosovo</p>
11.15-12.15	<p>UBT Smart City as an Convergence Platform for Forensics education and research, UBT Institute of Forensics</p> <p>Prof. Dr. Edmond HAJRIZI- Rector of University for Business and Technology, Kosovo Forensic Toxicology, Kosovo</p> <p>Forensic Toxicology</p> <p>Prof .Dr. Sinem Ezgi TURUNÇ ÖZOĞLU- Izmir Kâtip Çelebi University Faculty of Pharmacy, Head of Biochemistry Department, Türkiye</p>

	<p>Forensic Fragrance</p> <p>Prof. Dr.L Didem KOZACI- Yıldırım Beyazıt University, Faculty of Medicine, Department of Medical Biochemistry, Türkiye</p> <p>Crime Scene Investigation in Explosions</p> <p>Prof. Dr. Ercan SEYHAN- Retired Gendarmerie Colonel, Hasan Kalyoncu University, Faculty of Economics, Administrative and Social Sciences, Political Science and International Relations, Gaziantep, Türkiye</p> <p>Dental Age Assessment through Machine Learning Approach</p> <p>Dr. Valon NUSHI- University of Lisbon, Faculty of Medicine Degree on Specialization courses on Forensic Odontology at University of Lisbon, Faculty of Medicine</p>
12:15-13:30	LUNCH BREAK
PANEL II	Hall B
Session Chairs	<p>Prof. Dr. Ayşegül TAYLAN ÖZKAN-TOBB-ETÜ Faculty of Medicine, Department of Medical Microbiology, Türkiye</p> <p>Prof. Dr. Elmi KERMENDI - University for Business and Technology, Kosovo</p>
13.30-14.15	<p>Current CBRN Threat on Balkan Countries and Proposals for an Effective Multinational Counter-Response</p> <p>Prof. Dr. Levent KENAR -Faculty Member of the Medical CBRN Branch of the University of Health Sciences - Head of CBRN Defense - Chairman of the CBRN Commission of the Association of Forensic Scientists</p> <p>Forensic Science in Biology</p> <p>Prof. Dr. Fulya TEKŞEN - Ankara University, Faculty of Medicine, Türkiye</p> <p>Possible Misidentification Applying "Classic Identification Methods"</p> <p>Mr.sci Arsim Gërxhaliu PhD Cand. FMD- University for Business and Technology, Kosovo</p> <p>Forensic Dentistry and Identification</p> <p>Dr. Dt. Müge AĞIR- Türkiye Health Ministry, Türkiye</p> <p>An Evaluation of Web3 Concepts and Technologies and Relation with Digital Forensics</p> <p>Prof. Dr. Blerim KRASNIQI- University for Business and Technology, Kosovo</p>

PANEL III	Hall A
Session Chairs	<p>Mr.sci Arsim Gërxhaliu PhD Cand. FMD - University for Business and Technology, Kosovo</p> <p>Prof. Dr. Ercan SEYHAN- Retired Gendarmerie Colonel, Hasan Kalyoncu University, Faculty of Economics, Administrative and Social Sciences, Political Science and International Relations, Gaziantep, Türkiye</p>
14.15-15.30	<p>Poison And Poisoning from The Past to The Present</p> <p>Prof. Dr. Elmi KELMENDI- University for Business and Technology, Kosovo</p> <p>Psychological Disorders in Women Who Commit Crimes</p> <p>Prof. Dr. Hatice DEMIRBAŞ- Ankara Hacı Bayram University, Department of Psychology</p> <p>Parasites as Biological Weapons</p> <p>Prof. Dr. Ayşegül TAYLAN ÖZKAN- TOBB-ETÜ Faculty of Medicine, Department of Medical Microbiology, Türkiye</p> <p>Bite Mark Analysis</p> <p>Prof. Dr. İrfan KARADEDE, İzmir Kâtip Çelebi University, Faculty of Dentistry, Türkiye</p> <p>Forensic Chemistry and Forensic Biochemistry</p> <p>Prof. Dr. M. Fevzi POLAT, Yozgat Bozok University, Faculty of Medicine, Department of Medical Biochemistry, Head of Department of Basic Medical Sciences, Türkiye</p>
15.30-15.45	COFFEE BREAK
PANEL IV	Hall B
Session Chairs	<p>Prof. Dr.L Didem KOZACI- Yıldırım Beyazıt University, Faculty of Medicine, Department of Medical Biochemistry, Türkiye</p> <p>Ass. Prof. Hyrije KORAQI- University for Business and Technology, Kosovo</p>
15.45-17.00	<p>Forensic Nursing in Disaster Situations</p> <p>Prof. Dr. Ayşe GÜROL- Erzurum Technical University, Director of Institute of Health Sciences, Türkiye</p> <p>Service Dogs Areas and Training Process</p> <p>Prof. Dr. Emine Ümran ÖRSÇELİK- Kırıkkale University Faculty of Veterinary Anatomy Department, Türkiye</p>

	<p>Investigation of the Effect of Pesticides Used in Apple Cultivation Through PPO Enzymatic Activity Ass. Prof. Cengiz ÇESKO- Director of the Institute of Forensic Sciences, University for Business and Technology, Kosovo</p> <p>Chemical Analysis of Addictive Substances Büşra BESLER- Ege University, Faculty of Science, Department of Chemistry, 2nd Grade Student, İzmir, Türkiye</p>
PANEL V	Hall A
Session Chairs	<p>Prof. Dr. Levent KENAR -Faculty Member of the Medical CBRN Branch of the University of Health Sciences - Head of CBRN Defense - Chairman of the CBRN Commission of the Association of Forensic Scientists</p> <p>Prof. Dr. Sinem Ezgi TURUNÇ ÖZOĞLU- Izmir Kâtip Çelebi University Faculty of Pharmacy, Head of Biochemistry Department, Türkiye</p>
17.00-18.15	<p>Kosovo’da Kamulaştırılmış Mülkün İadesi (Restitütasyon) Dr. Altay SUROY</p> <p>Savaşlar, Savaş Cerrahisi ve Savaşlar da Hekimin Sorumluluğu Prof. Dr. Gürkan ERSOY- Dokuz Eylül Üniversitesi Hastanesi Acil Tıp Anabilim Dalı, İzmir, Turkey</p> <p>Tümörlerde, Yanlış Teşhis, Yanlış Evreleme, Aileyi Yanlış Bilgilendirme Dr.Hüseyin BEKİR, Greece</p> <p>Afetlerde Kimiklendirmede Adli Antropologların Rolü Tuğçe ELGÜN-Ankara, Türkiye</p>
19.00-21.00	GALA YEMEĞİ
May 26, 2024	SUNDAY (SECOND DAY)
PANEL VI	Hall A
Session Chairs	<p>Prof. Dr. Fulya TEKŞEN - Ankara University, Faculty of Medicine, Türkiye</p> <p>Ass. Prof. Beni KİZOLLİ- University for Business and Technology, Kosovo</p>
09.00-10-00	<p>The role of the community health nurse in prevention Juvenile delinquency Prof. Dr. Yurdağül ERDEM- Kırıkkale University, Dean of Faculty of Health Sciences- Forensic Scientists Association, Chairman of the Forensic Nursing Commission, Türkiye</p>

	<p>Violence in the School Environment and the Role of the Nurse Prof. Dr. Sevinç POLAT- Yozgat Bozok University, Dean of Faculty of Health Sciences- Forensic Scientists Association, Co-chairman of the Forensic Nursing Commission, Türkiye</p> <p>Forensic Interview Rooms and Child Monitoring Centers Assoc. Prof. Dr. Özge HANCI- İzmir Bar Association, Türkiye</p> <p>Consent in Forensic Cases Nurse Nutiye KAPAN-İzmir, Türkiye</p>
11.00-11.15	COFFEE BREAK
HALL A	ORAL PRESENTATION SESSION I
Session Chairs	<p>Prof. Dr. Ayşe GÜROL- Erzurum Technical University, Director of Institute of Health Sciences, Türkiye</p> <p>Dr Hüseyin BEKİR- Greece</p>
10.00-11.00	<p>Infection Risks of Autopsy Personnel Tolga Nebi YILMAZ, Nisa KOCAMAN, Prof. Dr. Ayşegül TAYLAN ÖZKAN</p> <p>Postmortem Interval and Biochemistry Fatma Zehra Nur POLAT</p> <p>Poison And Poisoning from The Past to The Present Rahime CİNDORUK, Deniz Eylül ŞENLİK, Prof. Dr. Ayşegül TAYLAN ÖZKAN</p> <p>The Investigation of The Relationship Between Fingerprint Patterns and Crime Types Fatma Elanur POLAT- Yozgat, Türkiye</p>
HALL B	ORAL PRESENTATION SESSION II
Session Chairs	<p>Prof. Dr. Yurdagül ERDEM- Kırıkkale University, Dean of Faculty of Health Sciences- Forensic Scientists Association, Chairman of the Forensic Nursing Commission, Türkiye</p> <p>Prof. Dr. Hatice DEMİRBAŞ- Ankara Hacı Bayram University, Department of Psychology</p>

10.00-11.00	<p>Çok Dalga Boylu Işık Kaynakları İle Parmak İzi İnceleme Erdem KARA</p> <p>Afetlerde Kimliklendirme Çalışmaları: Kahramanmaraş Depremi Örneği. Ali Osman ELMAS</p> <p>Türkiyede Kriminal Labratuvarların İşleyişi Tuncay ANKARA</p> <p>Medyaya Yansıyan Yaşlı Şiddeti Haberlerinin Değerlendirilmesi Prof. Dr. Muhammet Fevzi POLAT</p>
HALL C	POSTER PRESENTATION SESSION I
Session Chairs	<p>Prof. Dr. Emine Ümran ÖRSÇELİK- Kırıkkale University Faculty of Veterinary Anatomy Department, Türkiye</p> <p>Bayram POMAK-Kosovo</p>
10.00-11.00	<p>Emniyet Genel Müdürlüğü. Ankara Bölge Kriminal Afet Kriminal İnceleme ve Antropolojik İncelemeler Semih BOL- Ankara, Türkiye</p>
HALL D	POSTER PRESENTATION SESSION II
Session Chairs	<p>Ass. Prof. Hyrije KORAQI- University for Business and Technology, Kosovo</p> <p>Dr. Dt. Müge AĞIR- S.B Tepebaşı Oral and Dental Health Center, Türkiye</p>
10.00-11.00	
11.00-11.15	COFFEE BREAK
11.15-12.00	CLOSING SPEECHES
	<p>* Congress Outcome Report * Awarding Prizes to the Winning Abstracts * Wishes and Expectations</p>
12.00-13.30	LUNCH BREAK
13:30-18:00	SOCIAL PROGRAM-CITY TOUR

(Congress Center -UBT Campus Lipjan)

3RD KOSOVO - TÜRKIYE FORENSIC SCIENCES CONGRESS

25-26 May 2024 Kosovo

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BITEMARK ANALYSIS

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ABSTRACT

A bitemark, formed when teeth make contact with a surface—often food but also various objects and human skin—presents as a unique pattern. When found on human skin, it constitutes a patterned injury, leading forensic odontologists to investigate and analyze these marks as part of their duty. The identification, collection of evidence, and analysis of bitemarks or injuries patterned by them are fraught with complexity and difficulty. Particularly contentious within forensic odontology are the comparisons of the teeth of alleged biters, the subsequent reporting of these findings, and the contentious expert testimony that follows.

Forensic dentistry combines the realms of dentistry and law into a fascinating and multifaceted discipline. Bite mark analysis stands out as a crucial component within this field, instrumental in crime resolution and the identification of individuals implicated in criminal acts. As the field of bitemark science emerges, there's a growing demand for skilled professionals proficient in recognizing, collecting, and analyzing such evidence. In criminology, identifying individuals holds significant importance, and forensic odontologists play a pivotal role in discerning unique dental characteristics that could leave a bitemark. These marks, whether found on skin, wax, indirectly from dental models through photographs or scanned images, or even on food, serve as crucial evidence that could either implicate or exonerate a suspect. The main purpose of this article is to review the analysis methods of bite marks and clarify their importance for forensic medicine.

INTRODUCTION

For over half a century, bite mark analysis has served as a means to establish a link between a defendant and a crime scene (1). Bite marks are predominantly found in cases related to sexual offenses, instances of child abuse, and crimes involving physical violence, including homicide (2).

The roles of forensic odontology encompass a variety of tasks, including matching dental records to identify unidentified human remains, providing assistance in the aftermath of mass disasters, estimating the ages of both living individuals and the deceased, analyzing bite marks found on victims of assaults, identifying bite marks left on various substances like wood, duct tape, pencils, leather, and food items, applying principles of bite mark analysis to analyze weapon marks, presenting evidence of bite and weapon marks in court, and reconstructing lifestyle and dietary habits at archaeological sites (3).

The primary stage of bite mark assessment entails two key aspects: firstly, establishing whether a mark is attributable to a bite, and secondly, discerning whether an identifiable individual or animal is responsible for the impression on a substrate, whether it be human skin or an inanimate object.

Gender appears to influence the distribution of bite marks. In cases involving male victims, bites are most frequently found on their arms and shoulders, whereas female victims tend to exhibit bites more commonly on their breasts, arms, and legs (4).

The proficiency, knowledge, and expertise of experts are paramount in investigations. When bite marks are discovered, consulting forensic odontologists or members of interdisciplinary teams skilled in bite mark analysis is recommended. Bite marks are used in many areas in forensic odontology, and accurate diagnosis as a result of careful examination and analysis of bite marks is very important. For this reason, literature review is very important for bite mark studies.

LITERATURE RESEARCH

Bite mark evidence indeed has a long history, and the *Ohio v. Robinson* case is often cited as one of the earliest instances of its use (5, 6). In this case, the presence of distinct bite marks on the victim's arm became crucial evidence. A.I. Robinson, the accused, had a unique dental characteristic that matched the bite marks found on the victim. Dr. Taft's testimony regarding this dental match played a significant role in the court proceedings. This case set a precedent for the use of bite mark evidence in criminal trials, although its reliability and validity have been questioned in more recent years due to advancements in forensic science and concerns about subjective interpretation

Bite marks are considered unique to each individual due to variations in the shape, size, and alignment of teeth. This uniqueness forms the basis of bite mark analysis in forensic investigations. Just as fingerprints and DNA are used to identify individuals, bite mark analysis relies on the premise that no two people have identical dentition (6). Therefore, when a bite mark is found at a crime scene or on a victim's body, forensic experts can compare the characteristics of the bite mark with the dental records of suspects to potentially identify the perpetrator. However, it's important to note that the reliability and accuracy of bite mark analysis have been called into question in recent years, leading to increased scrutiny and calls for more research and standardization in this field of forensic science.

Absolutely, there are all crucial questions to consider during the investigation of a bite mark (7). These are among the questions to be asked;

- Is it a bite mark? Initially, forensic experts need to determine whether the observed mark is indeed a bite mark or if it has been caused by another mechanism.
- Is it caused by a human or an animal? Differentiating between human and animal bite marks is essential for narrowing down potential suspects and understanding the circumstances of the incident.
- Is it caused by a child or an adult, or is it self-inflicted? The size and pattern of the bite mark can provide valuable insights into the age and physical characteristics of the biter. Additionally, determining if the bite mark is self-inflicted or inflicted by someone else can significantly impact the investigation.
- Is it identifiable? Forensic experts assess the quality and clarity of the bite mark to determine if it contains enough detail for comparison and identification purposes.

- Do the teeth marks present enough unique characteristics to be attributable to one particular perpetrator? This is perhaps the most critical question in bite mark analysis. Forensic odontologists examine the specific features of the bite mark and compare them to dental records or impressions from potential suspects to determine if there is a match.
- Answering these questions methodically and accurately is essential for the proper investigation and analysis of bite marks in forensic cases.
- Those are indeed accurate characteristics of bite marks (8, 9):
- Origin of bite marks: Bite marks can be found on the victim, typically left by the attacker, or on the perpetrator, often as a result of self-defense by the victim or during a struggle. Additionally, bite marks may also be found on inanimate objects at the crime scene, such as food items or materials touched by the perpetrator.
- Location on the body: Human bite marks on victims are commonly found on various areas of the body, especially on skin and soft tissue. These areas can include the arms, legs, torso, neck, face, and other accessible parts of the body.
- Duration: The duration of a bite mark is influenced by the force of the bite and how long the victim was bitten. More severe bites may leave deeper impressions and cause more significant injuries, while the duration of the bite can sometimes be estimated based on factors like tissue response and healing.
- Shape and characteristics: Human bite marks typically exhibit an elliptical or circular shape, reflecting the arrangement and characteristics of the teeth involved. The specific features of the teeth, such as size, shape, spacing, and dental restorations, can be recorded in the bite mark and used for comparison during forensic analysis.
- Understanding these characteristics is essential for forensic investigators when examining and analyzing bite marks as part of criminal investigations.
- These additional characteristics provide further insight into the appearance and composition of bite marks (10):
- Doughnut shape: Some bite marks may exhibit a doughnut shape, with characteristics recorded around the perimeter of the mark. This unique shape can result from the arrangement of the teeth and the pattern of pressure applied during the bite.
- Two U-shaped arches: In some cases, a bite mark may consist of two U-shaped arches that are separated at their bases by an open space. This distinctive pattern can be caused by the alignment and arrangement of the teeth involved in the bite.
- Diameter: Bite marks typically have a diameter ranging from 25 to 40 millimeters. This size range can vary depending on factors such as the size of the perpetrator's mouth and the force applied during the bite.
- Central bruising: Often, bite marks may exhibit a central area of bruising within the mark. This bruising is caused by the pressure exerted by the teeth as they compress the tissue inward from the perimeter of the mark. It provides additional evidence of the force and intensity of the bite.

These characteristics, along with others previously mentioned, contribute to the uniqueness and individuality of bite marks, making them valuable evidence in forensic investigations.

Indeed, there are various methods used in the analysis of bite marks in forensic investigations. Among these methods, the following are some of the most commonly employed (11):

- Comparing acetate overlay from study models to a life-size photograph: This method involves creating an acetate overlay from dental study models, which are then manually fabricated to match the bite characteristics. This overlay is then compared to a life-size photograph of the bite mark to assess similarities. Photography is indeed a standard method for registering bite marks in forensic investigations. By capturing high-quality images of the bite mark, forensic experts can document its size, shape, and other characteristics in detail. These photographs serve as crucial evidence and are often enlarged to life-size proportions for comparison with dental records or other evidence related to potential suspects' dentition (12). Photography provides a non-invasive and reliable method for documenting bite marks, ensuring that the evidence is preserved effectively for further analysis and presentation in legal proceedings.
- Comparing study models to a life-size photograph: In this method, dental study models are directly compared to a life-size photograph of the bite mark to identify potential matches in tooth patterns and characteristics.
- Comparing acetate overlay from bites in wax to a photograph of the wound: Dental impressions are made in wax to replicate the suspected biter's dentition. An acetate overlay is then created from these wax impressions and compared to a photograph of the bite mark for analysis.
- Comparing acetate overlay from x-rays to a life-size photograph: X-rays of radiopaque material placed in a wax bite are used to create an acetate overlay. This overlay is then compared to a life-size photograph of the bite mark to determine similarities.
- Comparing acetate overlay from a photocopy of study models to a life-size photograph: This method involves creating a photocopy of dental study models and then fabricating an acetate overlay. The overlay is compared to a life-size photograph of the bite mark to assess potential matches.

These methods vary in their techniques and complexity, and forensic experts may use one or a combination of these methods depending on the specific case and available evidence. Each method aims to accurately compare the characteristics of the bite mark with the dental features of potential suspects to aid in identification and investigation. Following main three steps systematically and accurately, forensic experts can provide critical insights into the identification and analysis of bite marks in criminal cases (13).

- **Registration of the bite mark and dentition:** This step involves accurately documenting and preserving the bite mark evidence found on the victim's body or at the crime scene. Forensic experts may use various methods to capture the bite mark, such as photography, casting, or creating impressions. Similarly, the suspect's dentition is also documented through dental records, dental impressions, or other available evidence.

- **Comparison of the dentition and bite mark:** Once the bite mark and suspect's dentition are registered, forensic odontologists or experts compare the two sets of evidence. This comparison involves examining the size, shape, spacing, alignment, and other characteristics of the teeth present in the bite mark and comparing them with the known dental features of the suspect.
- **Evaluation of similarity or dissimilarity:** In this final step, the points of similarity or dissimilarity between the bite mark and the suspect's dentition are evaluated. Forensic experts assess the degree of correspondence between the observed features in the bite mark and the known characteristics of the suspect's teeth. This evaluation helps determine the likelihood of a match and provides valuable evidence for the investigation.

Exactly, those steps serve as the backbone of bite mark analysis, guiding forensic experts through the systematic examination and comparison of evidence to aid in criminal investigations. Each step plays a crucial role in ensuring the accuracy and reliability of the analysis, ultimately contributing to the proper identification and interpretation of bite mark evidence in legal proceedings. A potential bite must be recognized early, as the clarity and shape of the mark may change in a relatively short time in both living and dead victims.

Bite marks serve as crucial evidence in forensic investigations, offering insights into the nature and severity of injuries inflicted during criminal acts. Seven distinct types of bite marks have been identified, each characterized by specific features and implications (14). Haemorrhage marks, indicated by small bleeding spots, suggest localized damage to blood vessels caused by the pressure exerted by teeth. Abrasions, superficial marks resulting from friction or scraping, may occur without significant tissue damage. Contusions, commonly known as bruises, manifest as ruptured blood vessels beneath the skin, often caused by the compression of tissues during a bite. Lacerations, deep cuts or tears in the skin, occur when teeth penetrate tissues, causing tearing and injury. Incisions, characterized by clean-cut wounds with distinct edges, result from teeth puncturing the skin with force. Avulsions involve the tearing or removal of skin or tissue due to the bite's force. Artefacts may occur when a piece of the victim's body is bitten off or detached. Understanding these types of bite marks is essential for forensic experts in analyzing and interpreting bite mark evidence to aid in criminal investigations, reconstructing events, and identifying perpetrators.

In addition to the seven types of bite marks, forensic analysis further categorizes them into four degrees of impressions based on their clarity and severity (15). Firstly, "Clearly defined" impressions result from the application of significant pressure, yielding distinct and well-defined marks on the skin. Secondly, "Obviously defined" impressions are the result of first-degree pressure, exhibiting clear outlines and identifiable characteristics, albeit with slightly less force compared to the previous category. Thirdly, "Quite noticeable" impressions occur due to violent pressure, resulting in clearly visible marks on the skin, though possibly with some irregularities or variations in clarity due to the intensity of the bite. Lastly, "Lacerated" impressions occur when the skin is violently torn from the body, often leaving jagged or irregular marks that may be less distinct but indicative of significant force applied during the bite. These degrees of impressions provide forensic experts with a framework for assessing the severity and characteristics of bite marks, aiding in the analysis and interpretation of such evidence in criminal investigations.

The bite mark analysis, forensic experts meticulously examine the physical characteristics of both the bite mark wound and the suspect's teeth to establish potential matches (16). These characteristics encompass various aspects of dental anatomy and morphology, including the distance between cuspid to cuspid, the shape of the dental arch, and measurements such as width, thickness, and spacing between the teeth. Additionally, the presence of missing teeth, the curves of biting edges, and wear patterns on the teeth are carefully scrutinized. These details provide critical points of comparison between the observed bite mark and the suspect's dentition. By assessing the alignment and similarity of these characteristics, forensic experts can determine the likelihood of a match, aiding in the identification and prosecution of individuals involved in criminal acts where bite mark evidence is present.

In bite mark analysis, understanding the characteristics of individual human teeth is essential for identifying potential matches between bite marks and suspects' dentition. Each type of tooth—incisors, canines, premolars, and molars—leaves distinct markings on the skin or other surfaces (17):

- **Incisors:** Bite marks from incisors typically exhibit rectangular-shaped impressions, occasionally with perforations at the incisal angle areas. These marks reflect the straight, cutting edges of the incisor teeth.
- **Canines:** Bite marks from canines often display triangular markings, with the apex pointing towards the lip (labial) side and the base towards the tongue (lingual) side. These triangular impressions mirror the pointed shape of canine teeth.
- **Premolars:** Premolars may leave single or dual triangle-shaped impressions, with the bases of the triangles facing each other or converging to form a diamond-shaped pattern. These markings represent the biting surfaces of premolar teeth.
- **Molars:** While less common, molars can leave bite marks that are typically quadrilateral in shape. These markings are broader and may exhibit a more rectangular or square appearance compared to those left by other teeth due to the larger size and flatter biting surfaces of molars.

Understanding these distinctive characteristics of individual teeth aids forensic experts in accurately identifying and analyzing bite mark evidence, ultimately contributing to the successful resolution of criminal investigations.

Bite marks from both animals and humans hold significant importance from practical, health, welfare, and legal perspectives. Bitemark wounds caused by animals, particularly mammals, can lead to injuries, infections, or even death in humans and other species. The appearance of a bite mark is influenced by various factors, including the number of teeth involved, the force and direction of the bite, the type of biting action, the biter's occlusion and oral health, and whether the victim was alive or deceased at the time of the bite (18). The examination of bite marks, whether inflicted by humans or domestic animals, represents one of the most challenging and complex tasks in forensic dentistry. Scientifically analyzing the dental characteristics, both class and individual, of a bite mark can play a crucial role in identifying the perpetrator (10). By meticulously assessing the details of the bite mark and comparing them to known dental records or impressions, forensic experts can provide valuable evidence for criminal investigations, legal proceedings, and public safety measures.

CONCLUSION

Forensic dentistry represents a captivating intersection of dental science and the legal system, offering a multifaceted and rewarding career path. Within this field, bite mark analysis stands out as a critical aspect, providing invaluable assistance in crime-solving and the identification of individuals involved in criminal activities. While the field of bitemark science is relatively new, its potential value is significant, particularly given the growing demand for trained professionals skilled in recognizing, collecting, and analyzing this type of evidence.

Bite mark analysis holds immense promise as a forensic tool, offering insights into the circumstances surrounding a crime and providing evidence that can link suspects to specific incidents. However, this area of forensic science requires specialized expertise and training due to its complexity and the need for meticulous attention to detail. Trained individuals with experience in bite mark recognition, collection, and analysis are essential for ensuring the accuracy and reliability of forensic investigations.

As the field of forensic dentistry continues to evolve, there is a growing recognition of the importance of bite mark analysis and the need for skilled professionals to contribute to this specialized area of forensic science. By advancing our understanding of bitemark science and expanding the pool of trained experts, we can enhance the effectiveness of forensic investigations, promote justice, and contribute to public safety.

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FORENSIC DENTISTRY AND IDENTIFICATION

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ABSTRACT

Forensic Odontology is a branch of science that uses the dentist's knowledge to serve the judiciary. Forensic dentists around the world perform human identification, bite mark analysis, craniofacial trauma detection, and expert witness work in malpractice cases. Identification of human remains depends largely on the quality of antemortem dental records, but forensic odontologists can contribute to identification by evaluating the dental characteristics of the deceased and creating a dental profile in cases where dental records are not available.

INTRODUCTION

Forensic dentistry: can be defined as the application of dental practice to in order to law and justice. It is one of the important branches of forensic medicine (1). Forensic dentistry is the study of dentition, and the application of dentition features to the identification of people. Forensic dentists apply the knowledge and techniques of all branches of dentistry in order to identify the dental characteristics of forensic cases, to solve the identification problem of living people and archaeological remains with scientific methods, and to illuminate the dark aspects of all kinds of deaths, accidents, crimes, abuse and violence (2).

The purpose of forensic dentistry is; to ensure the identification or elimination of the victim and the deceased with the help of teeth, dental restorations, jaw, and oral tissue in living and dead people. The use of teeth and dental restorations as a result of consultations with the dentist in medical identification has revealed the importance of forensic dentistry(2).

Identification from teeth is based on the theory that all individuals are unique as a result of the presence of some kind of hereditary features in every person and then acquired features. An individual has 32 teeth in their mouth and each tooth has 5 surfaces, 160 different surfaces can be examined, and it is not possible to find the same set of teeth even in identical twins. (2). Teeth are the last ones in the body to undergo postmortem decomposition. Therefore, teeth are an excellent source of DNA (3). Two types of remains can help in the identification of burned corpses to obtain DNA; bones and teeth. DNA analysis from teeth is faster than bone; It gives more accurate results than blood, sweat, and other body fluids (3).

WORKING AREAS OF FORENSIC ODONTOLOGY

Working Areas of Forensic Odontology; (4)

- Identification of human remains
- Assessing bite mark injuries
- Assessment abuse cases (child, elder)
- Civil cases involving malpractice

The first findings about forensic dentistry date back to ancient times. The first dental identification from this period dates back to A.D. It took place between 15-59 BC and was carried out by Agrippina, the wife of the Roman Emperor Claudius, to identify the body of Lollia Paulina, her husband's mistress. Agrippina wanted to see the head of her husband's mistress and made the identification by highlighting her discolored, maloccluded front teeth (4).

The first dental identification performed by an individual recognized as a “dentist” was performed by Paul Revere. In 1776, Dr. Joseph Warren was killed in the Battle of Breed’s Hill from a gunshot wound to his face leaving him unrecognizable. Dr. Warren was identified from a dental prosthesis that Paul Revere had fabricated for him (4).

One of the most used methods for dental identification is a comparison of antemortem clinical records with data which are found on the body (existing, missing, decayed, filled, and restored teeth in the mouth, various structural defects in teeth and jaws, and prostheses, etc.) (5). The factor that makes dental findings important are the individual characteristics of both the teeth and related oral tissues. The characteristics of human teeth are like fingerprints and differ even in twins. For this reason, fillings, prostheses, orthodontic appliances, as well as bite marks, play a very important role in identification. By analyzing bite marks, the suspect can be found and the purpose of the attack can also be determined (5).

Gender Differences in Teeth and Jaws

Some characteristic features of teeth and jaws may also be helpful in the discrimination of sex (7). However, since these are not very reliable, they can be used in cases where there are no remains other than teeth and jaw (7). The skull and teeth in men appear rougher and harder than in women. In men, tooth roots are larger and teeth are more voluminous. In addition, the mandible is V-shaped and right-angled in men, and U-shaped and wide-angled in women. Odontometry is the analysis method of dental measurements that reveals gender differences (7).

Biodiversity Differences in Teeth

Teeth may show population-specific differences in shape and size. However, these differences are a weak criterion for distinguishing biodiversity differences. In Mongoloid societies shovel-shaped incisors (shovel-shaped) 85 -99% prostostylitis; In mandibular M1, accessory tubercle on the mesio buccal surface, Elliptical maxillary arch structure, vertical wide ramus (angled in others), flat lower border of the mandible and flat palatal dome are seen, while in Caucasoid societies, carabelli, long and narrow parabolic arch, deep palate, and flat palatal dome are seen in the maxillary M1. A distinct chin tip is visible. In negroid societies, alveolar prognathism, protrusion in both jaws, open bite, and 2-3 lingual tubercles in Mandibular P1 are common.

Teeth Marks (Bite Marks)

Teeth are powerful tissues in terms of creating trauma. It is used as an attack and defense tool when desired. Bite marks are patterned injuries that can differ in arrangement, size, and surface configuration, and can be found on human skin, on foods or some items at the crime scene (8). They can appear on the victim as an attack, or on the attacker as a defense. By comparing the locations and measurements of teeth marks in a bite mark with those of the suspect questionable. Recent research studies have compared digitally of teeth and bite marks at a 3-dimensional level (8).

Forensic age assessment is defined as the scientific process of estimating the chronological age of an individual by evaluating skeletal and dental development and maturation (15,16,17). Classically, dental age assessment is basically divided into three categories:

- (1) tooth formation and developmental growth changes;
- (2) postformation changes within the tooth;
- (3) biochemical changes.

Dental formation and developmental growth changes are changes that occur through the process. Progressive morphological development of the crown, root, and apex of any tooth and/or based on its timed eruption (15,16). Techniques that use these criteria are those that estimate the age of infants, children, and adolescents. During human dental and skeletal development, techniques that use dental morphological development criteria are the most reliable and accurate way to relate growth and development to actual chronological age. Researchers have developed numerous staging systems to correlate a specific interval of dental development. Each staging system typically has an associated diagram showing each stage of development. However, when using any staging system, the researcher must rely on written descriptors that precisely describe the beginning and ending aspects of each stage of development. Failure to do so will always lead to phasing errors. The most important criteria for dental age assessment in this method are to determine accurate and consistent staging systems for tooth development and, in particular, to use population-specific data sets (15,16,17).

Dental age estimation

Infant/child age range: Age assessment techniques used in this age range are based on the evaluation of the maturation and development of primary and permanent teeth. Dental age assessment techniques have long been considered the most accurate method for chronological age indicators in subadult individuals (15). Current methods for assessing age in infants and children require the use of atlases and charts and good-quality radiographs showing the staging of developing teeth (15).

Age estimation in adolescents: Adolescence can be defined as the time in human development from the beginning of adolescence until the time the individual reaches adulthood (17,18). During adolescence, dental and skeletal structures continue to show morphological development; therefore, as with pediatric techniques, the methodology that assesses these changes in growth is still used to assess chronological age. However, during and after the onset of puberty, sexual dimorphism becomes more pronounced, requiring the methodology used to take into account the

sex and hereditary characteristics of the individual. Therefore, population-specific data that most closely matches the individual's heredity should always be used (17,18).

Dental age estimation in adults: Adult dental age assessment techniques are based on radiographic or morphological assessment or macroscopic and microscopic observation of post formation changes within the dentition following the cessation of morphological tooth development (19,20,21).

Biochemical techniques: Biochemical and histological dental age assessment techniques can be used in all age groups and provide a high degree of accuracy. However, the procedures in these techniques are time-consuming, expensive, require the use of special equipment and require sacrifice of tooth structure. As a result, the use of these techniques can only be ethically performed in special cases on deceased individuals or living creatures where tooth extraction is necessary for medical reasons (19,20,21,22,23).

Mass Disaster Identification

Mass disaster identification is also complete as the same manner as individual identification. But large-scale problems can occur. The term Disaster evokes a chaotic event. Mass disasters can be classified in three ways; natural, accidental, and criminal. They all contain a large number of fragmented, incinerated human remains (9,10). Mass fatality incidences represent an enormous challenge to local native authorities. Another challenge is the damage inflicted on basic infrastructure including hospitals, transportation services, communications methods, etc. that impedes recovery (9). The identification of deceased victims in those circumstances necessitates putting a hierarchy system consisting of an antemortem, post-mortem and reconciliation teams. Those teams are headed by team leaders, with liaison officers to coordinate the work. The results are reported to an identification board which is headed by a commander, who in most cases is a senior police officer. Forensic Odontologists have contributed to the resolution of the many mass disasters (9,10).

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THE INVESTIGATION OF THE RELATIONSHIP BETWEEN FINGERPRINT PATTERNS AND CRIME TYPES

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ABSTRACT

It has been known for thousands of years that people have unique marks on their fingertips. Fingerprints, which are considered the unique signature of a person, have been used for security purposes for a long time. No human fingerprint is similar to another, that is, each person's fingerprint is unique. Even identical twins with similar DNA have different fingerprints. Latest studies on this subject; It has been shown that a person's fingerprints are related to their gender, genetic characteristics, diseases, blood type and even character.

Nowadays, special attention is paid to the relationship between fingerprints and crime. Despite the different studies carried out on this subject, the question that is wondered and emphasized meticulously is related to which crime the person with which fingerprint is more likely to commit.

In this speech, the importance of fingerprints from past to present, the relationship between fingerprints and crime, and the latest developments on this subject are discussed.

INTRODUCTION

Our fingerprints are our unique signature. We touch things such as a coffee cup, a car door, a mobile phone, and a computer keyboard every day. Each time we do, it is likely that we leave behind our unique signature in our fingerprints. No two people have the same fingerprints. Even identical twins, with similar DNA, have different fingerprints.

WHAT ARE FINGERPRINTS?

Fingerprint identification is a sub-branch of biometric identification. Fingerprints are impressions or marks made on a surface by a person's fingertip and can be used for identifying individuals from the unique pattern of whorls and lines on the fingertips. These are some of the most important evidence found on the scene of crime and if processed carefully can help to identify and individualize the culprit within a short time. One of the most important uses for fingerprints is to help investigators link one crime scene to another involving the same person.

Fingerprint identification also helps investigators:

- to track a criminal's record,
- their previous arrests and convictions,

to aid in:

- sentencing,
- probation,

- parole and
- pardoning decisions.

Fingerprints are patterns of friction ridge skin. Fingers and palms of hands, soles of feet, and are characterized by ridges (hills) and valleys (furrows). Patterns form on the skin surface early in embryonic development and are carried through life. Fingerprint ridges are formed during the third to fourth month of fetal development and their formation is completed by the sixth month. The ridges thus, formed during the fetal period to not change their course or alignment throughout the life of an individual, until destroyed by the decomposition of skin, after death.



Figure 1. Criminal Alvin Karpis had his fingerprints surgically removed in 1933
<https://themobmuseum.org/blog/leave-no-trace/>

Briefly three specific classes – each divided into smaller groups

Arch

- Plain arch
- Tented arch

Loop

- Radial Loop
- Ulnar Loop

Whorl

- Plain whorl
- Central pocket whorl
- Double loop whorl
- Accidental

Approximately 60% of people have loops, 35% of people have whorls, and 5% of people have arches.

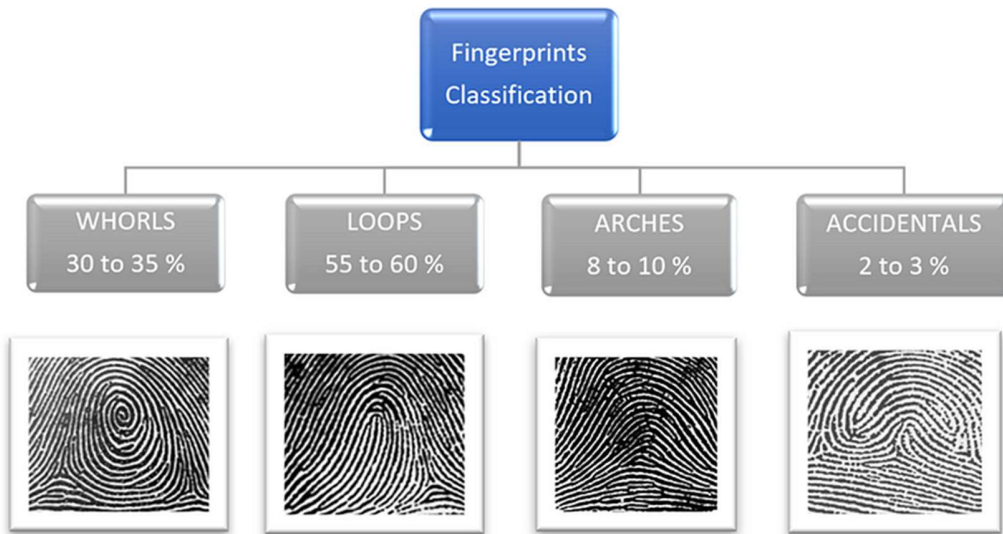


Figure 2. Fingerprints Classifications <https://brainography.com/what-is-brainography/>

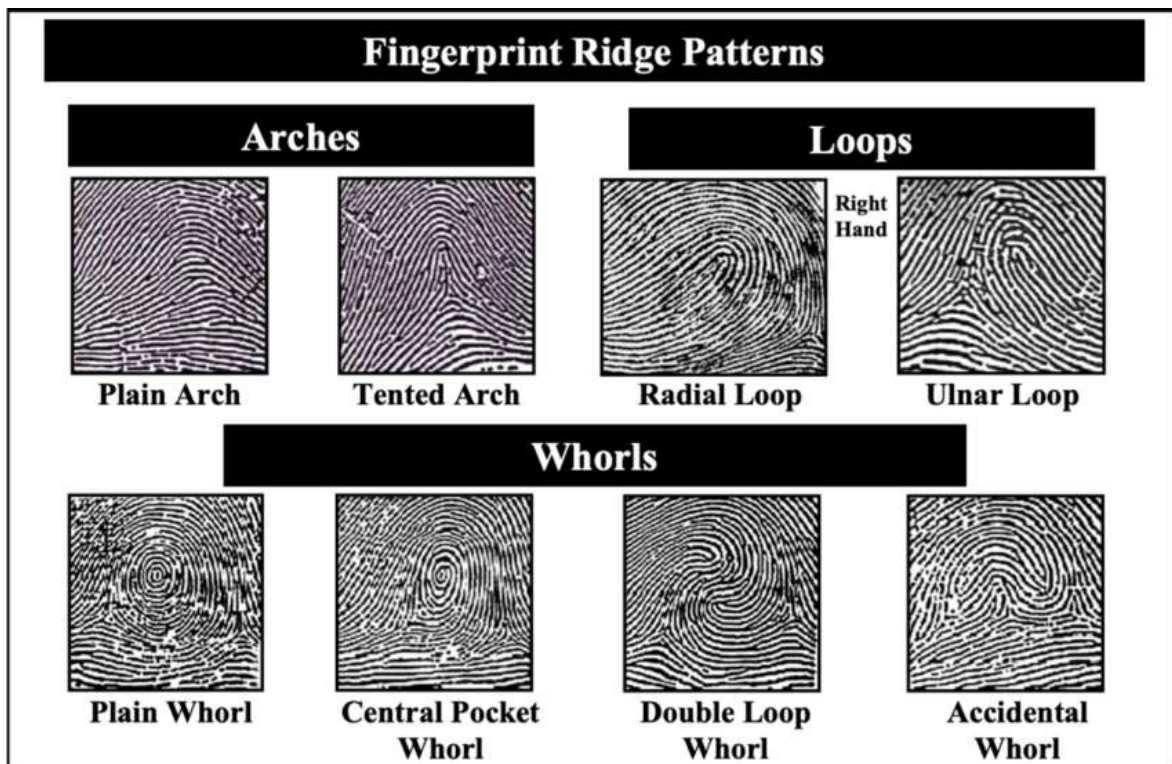


Figure 3. Fingerprint Ridge Patterns https://www.researchgate.net/figure/Different-types-of-Fingerprint-Ridge-Patterns-on-a-Human-Fingerprint_fig2_374169606

FINGERPRINT PATTERNS

The Scientific Working Group on Friction Ridge Analysis, Study, and Technology (SWGFAST) maintains a list of terms generally used and accepted within the fingerprint analysis community.

The three basic patterns of fingerprint ridges are the arch, loop, and whorl:



Figure 4. The three basic patterns of fingerprint ridges <https://www.nosm.ca/wp-content/uploads/2020/07/CSI-Fingerprint-Analysis-Handout.pdf>

Arches: Arch is the ridges enter from one side of the finger, rise in the center forming an arc, and then exit the other side of the finger. No deltas are present. Arches create a wave-like pattern and include plain arches and tented arches. Tented arches rise to a sharper point than plain arches. Arches make up about five percent of all pattern types.

Arch, plain - A type of print pattern in which the friction ridges enter on one side of the print and flow out the other side with a rise or wave in the center.

Arch, tented - A type of print pattern similar to the plain arch but that possesses an angle, upthrust (central rise), or two of the three basic characteristics of the loop.

Loops: Loop is the ridges enter from one side of a finger, form a curve, and then exit on that same side. Loops must have one delta and one or more ridges that enter and leave on the same side. These patterns are named for their positions related to the radius and ulna bones, i.e. the bone the loop opening is facing towards.

Loops: radial or ulnar, depending on whether the direction of the slope of the pattern is towards the inner bone (radius) or outer arm bone (ulna).

Whorls: Whorl is the ridges form circularly around a central point on the finger. Whorls are the most complex and contain a central pocket, double loop, and accidental. They have at least one ridge that makes (or tends to make) a complete circuit. They also have at least two deltas. If a print has more than two deltas, it is most likely an accident.

Draw a line between the two deltas in the plain and central pocket whorls. If some of the curved ridges touch the line, it is a plain whorl. If none of the center core touches the line, it is a central pocket whorl.

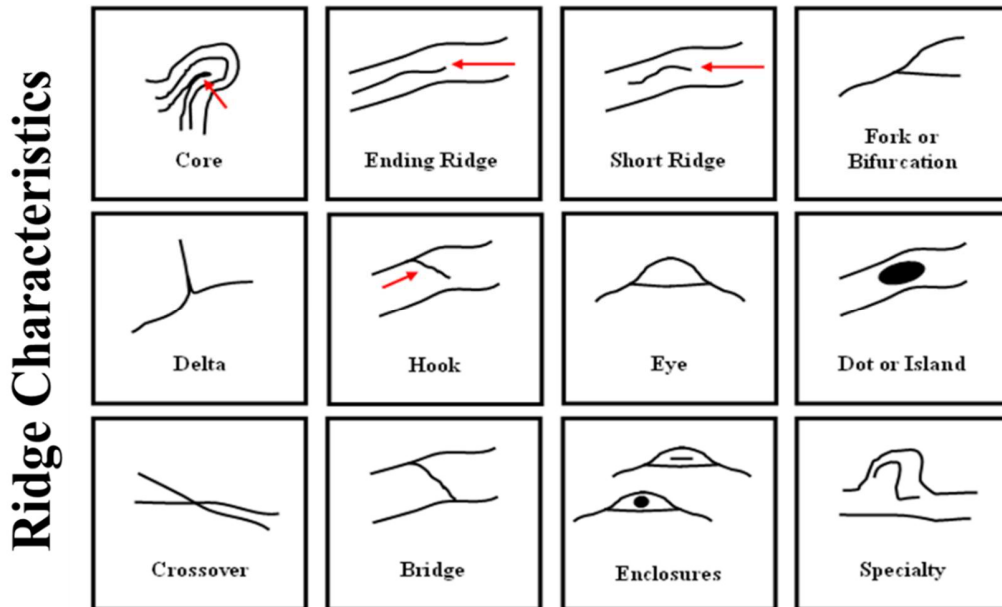


Figure 5. Ridge Characteristics

https://www.researchgate.net/publication/374169606_Identification_Of_Sex_in_The_Emirati_Population_Through_the_Study_of_Fingerprint_ridge_Density

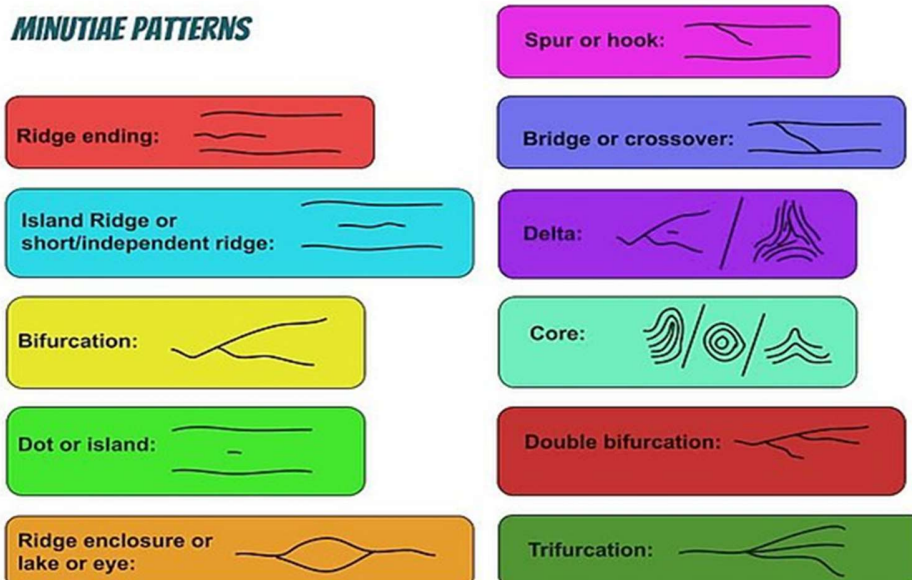


Figure 6. Minutiae Patterns <https://en.wikipedia.org/wiki/Fingerprint>



Figure 7. Ridge Characteristics (<http://cnx.org/content/m12574/latest/properties.jpg>)

FINGERPRINT IDENTIFICATION

Fingerprint identification, known as dactyloscopy, ridge-ology, or handprint identification, is the process of comparing two instances of friction ridge skin impressions, from human fingers or toes, or even the palm or sole, to determine whether these impressions could have come from the same individual.

The flexibility and the randomized formation of the friction ridges on the skin means that no two finger or palm prints are ever exactly alike in every detail; even two impressions recorded immediately after each other from the same hand may be slightly different.

Fingerprint identification, also referred to as individualization, involves an expert, or an expert computer system operating under threshold scoring rules, determining whether two friction ridge impressions are likely to have originated from the same finger or palm (or toe or sole).

Ridgeology is the study of the uniqueness of friction ridge structures and their use for personal identification. **Points of matching depend on location:**

- United States – 8-16 points
- United Kingdom – 16 points
- Australia – 12 points

Henry Classification System is developed by Sir Edward Henry (British police) in 1899. Prints are assigned a score based on where whorls show up within a te-finger set of prints. The total score is used to narrow down matches into all sets with the same scores (1,024 different groups).

There are two methods for collecting fingerprints

- Roll Prints: Rotating the finger around on the monitor
- Plain prints: By touching the fingertip directly on the monitor

TYPES OF FINGERPRINTS

- Latent: All partial fingerprints found at a crime scene
- Patent: Readily visible fingerprints
- Plastic: Fingerprints impressions that are found on soft material, such as soap, cement, or plaster

While the police often describe all partial fingerprints found at a crime scene as latent prints, forensic scientists call partial fingerprints that are readily visible patent prints. Chocolate, toner, paint, or ink on fingers will result in patent fingerprints. Latent fingerprint impressions that are found on soft material, such as soap, cement, or plaster, are called plastic prints by forensic scientists.

In forensic science, a partial fingerprint lifted from a surface is called a latent fingerprint. Moisture and grease on fingers result in latent fingerprints on surfaces such as glass. But because they are, contrary to earlier assumptions, that fingerprints from different fingers of the same person as raying of ninhydrin, iodine fuming, or soaking in silver nitrate. Depending on the surface or the material on which a latent fingerprint has been found, different methods of chemical development must be used. Forensic scientists use different techniques for porous surfaces, such as paper, and nonporous surfaces, such as glass, metal, or plastic. Nonporous surfaces require the dusting process, where fine powder and a brush are used, followed by the application of transparent tape to lift the latent fingerprint off the surface.

FINGERPRINTING ON CADAVERS

The human skin itself, which is a regenerating organ until death, and environmental factors such as lotions and cosmetics, pose challenges when fingerprinting a human. Following the death of a human, the skin dries and cools. Fingerprints of dead humans may be obtained during an autopsy.

The collection of fingerprints of a cadaver can be done in varying ways and depends on the condition of the skin. In the case of cadavers in the later stages of decomposition with dried skin, analysts will boil the skin to recondition/rehydrate it, allowing for moisture to flow back into the skin and resulting in detailed friction ridges.

Another method that has been used is brushing a powder, such as baby powder over the tips of the fingers. The powder will embed itself into the furrows of the friction ridges allowing for the lifted ridges to be seen.

CHEMISTRY WITH PRINTS

- Cyanoacrylate vapor
- Iodine fuming
- Ninhydrin
- Silver nitrate

DIGITAL FINGERPRINTING

AFIS (Automated Fingerprint Identification System) is a computerized system capable of reading, classifying, matching, and storing fingerprints for criminal justice agencies. This system:

- Scanning and digital encoding of fingerprints
- Searches 500,000 prints per second!
- Once a match is found, an agent hand-checks the file(s). However, compatibility issues arise due to different software systems.
- Problem: Many AFIS systems are not compatible -Different software

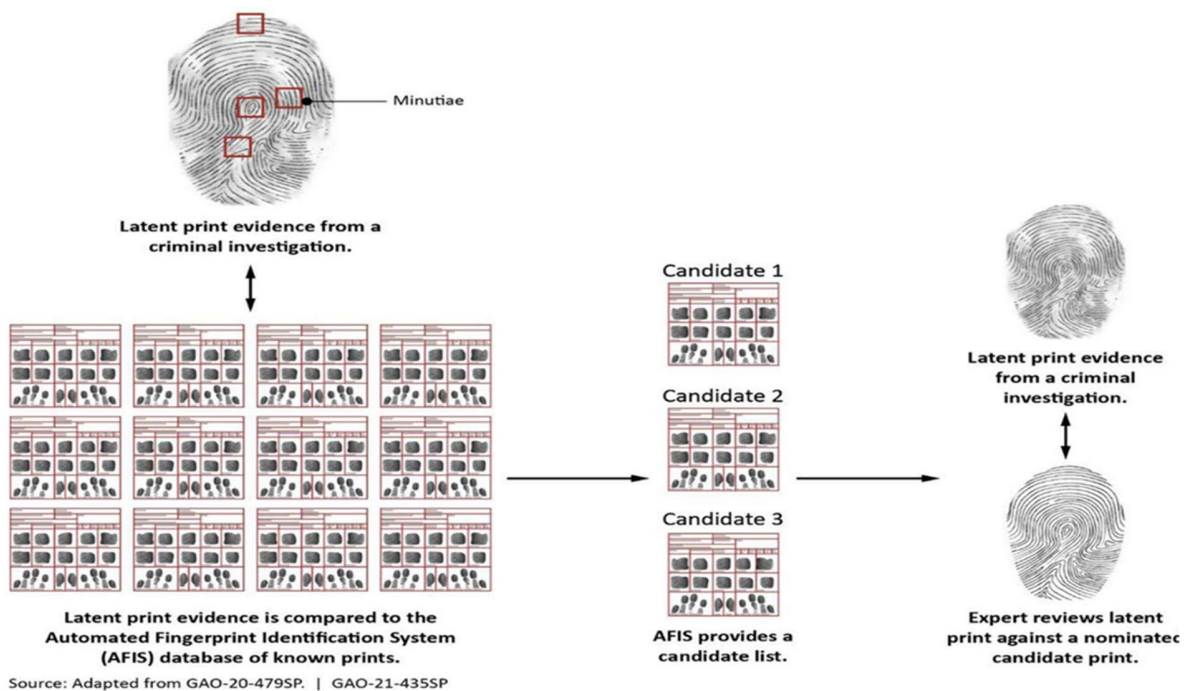


Figure 8. The workflow for latent print analysis for law enforcement investigations.

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17. <https://www.frontiersin.org/journals/chemistry/articles/10.3389/fchem.2020.594864/full>
18. <https://www.grunge.com/425254/famous-murders-that-remain-unsolved/>

FORENSIC CHEMISTRY AND BIOCHEMISTRY

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ABSTRACT

In this presentation, the parts related to the development process of forensic chemistry and forensic biochemistry are summarized and no information was given about analysis methods. The subjects of forensic chemistry and forensic biochemistry are discussed, historical stages are summarized, and the current position of forensic biochemistry in terms of forensic sciences and its role in the future are briefly explained. In the postmortem evaluation, toxicological substances were discussed from a biochemical perspective and biochemical markers that could be used to explain the time and cause of death were emphasized, and it was aimed to raise awareness on the importance of the biochemistry laboratory in terms of forensic sciences in the future.

INTRODUCTION

Chemistry is a science of matter. Biochemistry, on the other hand, focuses on the study of substances in biological structures. Biochemistry is a branch of science that studies the chemical events occurring in living cells at the molecular level (Biochemistry-Medical Biochemistry). Clinical Chemistry is a branch of science in which various fluids, secretions, and tissue samples of the body are analyzed at the molecular structure level in order to diagnose diseases, distinguish similar ones from each other, and examine the disease process. Although the concept of clinical chemistry is still widely used, after the German chemist Carl Neuberg used the term 'Biochemie: Biochemistry' in 1903, this term began to be used as the equivalent of Clinical Chemistry within the framework of the definition stated above. Forensic Chemistry-Forensic Biochemistry concepts; when paired with the concepts of Chemistry-Clinical chemistry, besides their differences, also have similar features.

Forensic chemistry (Forensic biochemistry) reveals qualitative and quantitative data with “what-how much?” questions, thus providing options for comparison and matching/similarity questions and allowing evidence to be used reliably, favorably, or unfavorably, in courts. Forensic Biochemistry includes both routine biochemical tests and advanced research techniques used together with different newly designed instruments.

Why is the laboratory so important? Research shows that 70% of all medical decisions are based on laboratory results. In line with the latest technological developments, new tests, and new with the introduction of molecular biological tests, this rate is predicted to rise even further. Biochemistry laboratory is of central importance in health and forensic applications.

According to the latest evaluations made at the end of the research, the definitions of forensic chemistry, forensic biochemistry, and forensic pharmacology, which are intertwined with these disciplines, are made as follows: “Forensic chemistry is the field of chemistry that performs chemical analysis of evidence to be used in courts”.

Forensic Chemistry (Intersection of Detective Science, Science, and Law): It is the branch of chemistry that carries out the chemical analysis of the evidence collected from the crime scene.

Forensic Biochemistry: (Clinical) The branch of science concerned with forensic problems encountered in all applications and processes related to biochemistry. We can also say that it is the application of law to biochemical applications and processes.

According to the Turkish Language Association, Dictionary of Drug and Pharmacy Terms, forensic Pharmacy is the branch of science related to the pharmacy profession and forensic problems encountered in drug treatment.

HISTORY

Forensic Biochemistry is a new concept. However, its subject and application are not new. The foundations of modern clinical chemistry began to be laid in the early years of the 20th Century. The first device designed specifically for the Clinical Chemistry Laboratory was Thomas Van Syke's volumetric blood gas measuring device, which was developed in 1917 for the determination of carbon dioxide concentration.

As a chemical agent, poisons began to be used in ancient Egypt, Greece and Rome. Democritus was the first chemist to deal with poison and shared some of his findings with Hippocrates. Poison was used in both murder and executions. Arsenic is a very popular poison. It is the most popular poison of the ancient Roman period. In the eighth century, Arab alchemist Abu Musa Jabir Ibn Hayyan (or Geber, A.D. 721- 815) transformed elemental arsenic (a gray-metallic-looking substance) into arsenic (III) oxide (As_2O_3 ; tasteless, odorless, and white powder). Arsenic in its oxidized form can easily be added to a person's food or drink. It was not possible to detect arsenic in the human body until the 19th century.

Developments in forensic biochemistry/chemistry accelerated in the mid-19th century.

- Blood tests were developed, and the Marsh test, discovered in 1832, was the first reliable scientific analysis showing the presence of arsenic in the victim's body (Saferstein, 1998).
- Fingerprint determination studies accelerated in the 1880s.
- In 1863, German-Swedish chemist Christian Friedrich Schönbein (1799–1868) found that blood foams when hydrogen peroxide is added, which is a reliable method for determining human blood.
- In 1985, Sir Alec Jeff Reys used the DNA fingerprint technique for the first time (Jeff Reys, 1985). After this date, DNA analysis has become an indispensable part of criminal investigations.

Forensic chemistry, forensic toxicology, forensic pharmacology cannot be separated from other forensic sciences such as forensic nursing, forensic biology, forensic toxicology, that is, they interact in practice in terms of methods and materials. Forensic biochemistry covers the clinical practice and operational/administrative aspects of biochemistry. If a court decision is taken, the

information provided by the forensic biochemist/chemist is very important for the judiciary. However, the forensic biochemist/chemist analyzes the evidence, but cannot make a judgment.

A forensic biochemist/chemist is a professional person who analyzes the evidence obtained from the crime scene and reaches a conclusion by applying tests. **In the biochemistry laboratory, within the scope of forensic sciences:**

- Analysis of Toxic Substances (poisons),
- Drug and Drug Analysis and
- Alcohol Determination (Blood, serum, plasma; unit Promil, mg/dL) are performed.

FORENSIC PROCESS AND FORENSIC BIOCHEMISTRY

- Clarity of legal duties and responsibilities in all processes when requesting a test from a forensic case, taking a sample, transporting, accepting, analyzing and reporting the result?
- Legal situation in case of loss of biological samples?
- Transfer of the report to persons other than the relevant clinician and the individual from whom the biological material was collected?
- At this point, relevant legal regulations in Turkiye
- •Personal Data Protection Law:
- Turkish Penal Code No. 5237,
- Regulation on Physical Examination, Genetic Examinations and Physical Identity Determination in Criminal Procedure,
- 'Health Control Section' of the Regulation on Apprehension, Detention and Taking Statements,
- Circular of the Ministry of Health on the Principles to be Followed in the Performance of Forensic Medicine Services,
- Issues specified in the "Forensic Medicine Evaluation of Injury Crimes" defined in the Turkish Penal Code;
- Inpatient Treatment Institutions Operation Regulation
- Job Descriptions etc.
- University law no. 2547,
- Civil Servants Law No. 657

What are the legal problems that may arise during the stages of biochemical research?

- Plagiarism, deviation from ethical rules, poisoning, environmental pollution, and similar situations.
- The task of the biochemistry laboratory begins with the clinician's question "Which tests should I order?" and ends when the results are used for the benefit of the patient.
- Biological sample diversity and the number of tests to be performed in the biochemistry lab increase the workload of the laboratory and, accordingly, the responsibilities of providing services in accordance with quality rules.

In this process preparation of the individual to be taken as a biological sample,

- Taking a biological sample,
- Analysis,
- Reporting/sending the result to the clinician,
- Quality control programs.

POSTMORTEM BIOCHEMISTRY

Forensic Medicine looks for two answers:

1. Determination of the reason of death
2. Determination of death time

The first studies on "Postmortem Biochemistry" were conducted in 1993.

- Coe, in the intraocular fluid (GIS), determined only glucose, electrolyte, and urea nitrogen, and with this study, he pioneered the beginning of studies on postmortem biochemistry.
- Coe described Forensic Chemistry as an "important ancient sciences for forensic pathologists." He emphasized that in the intraocular fluid (GIS) just by determining glucose, electrolytes and urea nitrogen, the time of death can be determined in more than 5% of cases, and more importantly, it can contribute 10% to the solution of forensic investigations.

Changes observed in the levels of biochemical markers in Postmortem Intervale (PMI):

Biochemical Markers Levels	Glucose Levels as a Marker
Na/Cl ↓	Portal vein ↑
pH ↓	Vena Cava ↑
K ↑	In the Right Atrium ↑
Mg ↑	In Vitreous Humor ↔, ↓
Lactate ↑	Arterial Blood examples ↑, ↓
Hypoxanthine ↑	In brain tissue ↓
ATP ↓	
RNA degradation products ↑	
Glucose ↑, ↓	

- Many researchers approach this issue from different angles such as sampling, selection of appropriate analysis techniques and measurement accuracy. They have worked on these subjects.
- Thus, in many biological samples to date, a wide variety of post-mortem detection of substances can be done with appropriate technical infrastructure.

We can discuss postmortem biochemical markers under the following main headings:

1. Markers related to carbohydrate metabolism
2. Markers related to kidney function
3. Markers related to liver function
4. Markers of heart function
5. Markers of sepsis, inflammation and infection
6. Markers of anaphylaxis
7. Hormones
8. Other tests

Postmortem studies on biochemical tests besides the inadequacy, time elapsed after death of test analytes, method/place of obtaining test materials, the physiopathological condition of the deceased, and analytical methods used, vary depending on what the normal value restricts the routine use of these tests.

CONCLUSION

Biochemical tests, which are not yet widely included in routine examinations in clinical practice but are important to be used in many cases and evaluated during a full autopsy, are used in special cases (diabetes mellitus, diabetic and alcoholic ketoacidosis, electrolyte disorders, insulin injection, hypo/hyperthermia, anaphylaxis, sepsis), metabolic and hormonal disorders) and include it in routine postmortem analyses.

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POSTMORTEM INTERVAL AND BIOCHEMISTRY

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ABSTRACT

Determining the cause and time of death in forensic medicine is important in terms of homicide cases and the proper execution of legal proceedings that will develop in this direction. In evaluating postmortem cellular death, the nutrient status of the cells of all tissues, their way of obtaining energy (anaerobic and aerobic), and the resistance of anoxic cells should be well known. In the autopsy process, there are also examinations in which histopathological-microscopic and biochemical measurement techniques are used.

Various biochemical samples such as serum, blood, hair, nails, semen, urine, feces, saliva, vomit and swabs, cerebrospinal cord, intraocular and intraarticular fluids, and tissue samples are used for postmortem interval determination. In postmortem biochemical evaluations, the status of proteolytic enzymes and the increase of cytosolic calcium ions should be well evaluated. In order to distinguish internal bleeding from blunt and similar conditions, attention should be paid to the details of hemolysis and coagulation. Biochemical markers evaluated postmortem include Metabolism(carbohydrate) markers, kidney, liver, and heart function markers, sepsis, inflammation and infections markers, anaphylactic markers, and hormones.

INTRODUCTION

The situation that occurs when biological beings lose their vital abilities is defined as death in medical and legal terms. Postmortem interval (PMI), "time of death" or "estimation of the time elapsed since death," is a critical issue in the field of forensic sciences and criminal investigation due to possible legal consequences, among other factors (Cordeiro, Ordóñez-Mayánd, Lendoiroe, et al., 2019). Witness testimonies can often contain a high rate of inaccuracies, manipulation, forgery, and biases of witnesses against the suspect. However, PMI detection is an effective method to verify the course of events and limit the number of suspects (Zieba, Wiergowski, Cie'slik, 2023; Henßge & Madea, 2004; Mathur & Agrawal, 2011).

Classical methods used in determining the time of death include signs of death, degree of freezing of blood, measurement of beard and hair, stomach content, blood sugar measurement, changes in bone marrow cells, and measurement of blood pH (Henßge & Madea, 2004). Signs of death include the beginning, spreading, and ending of necrotic spots and rigor mortis, body temperature measured from the rectum, parchmentation of external genitalia, stages of decay, and properties of muscles and bones. If the hair-cutting time is known, the time of death can be estimated by measuring the hair (Henßge & Madea, 2004; Mathur & Agrawal, 2011). With the development of laboratory analyses, many biochemical markers such as protein fractions, urea, creatinine, glucose,

iron, potassium, calcium, and enzymes have been used in postmortem interval determination (Donaldson & Lamont, 2013, Kikuchi, Kawahara, Biswas, 2010; Emiral, 2016).

Biochemical procedures provide valuable data to investigate the cause and process of death, contributing conditions, and predisposing disorders. For this purpose, various formulas have been developed to calculate this interval using a combination of different statistical methods and the concentrations of substances present in the vitreous humor (VH). Corrective factors such as ambient temperature, cause of death, or age, which may alter the concentration of these substances and thus the estimate of the postmortem interval, have been included in these models (Cordeiro, Ordóñez-Mayá, Lendoiroe, et al., 2019).

Studies on PMI have shown that mRNA of biological reactants in tissues using Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) is helpful in postmortem molecular biological analysis and in investigating the pathophysiology of death. Postmortem biochemistry and molecular biology primarily aim to investigate the systemic pathophysiological changes usually not detected by morphological methods and occur in the staining process. These are called pathophysiological vital reactions and are classified in practice as reactive or degenerative products in blood and body fluids, immunohistochemical markers in tissues, and molecular biological markers that play up/down roles. Postmortem biochemistry and molecular biology have several advantages in investigating systemic pathophysiological functional changes in the staining process. To this end, the usefulness of comprehensive analyses of pathological and biochemical findings is recommended as part of laboratory investigations on 'full autopsy' in the context of risk management (Donaldson & Lamont, 2013; Topçuoğlu, 2011).

It has been reported that the amount of HMGB1 protein detected in serum during the postmortem period from biochemical parameters can be used to determine postmortem interval (PMI). HMGB1 protein can be actively released from immune cells, including macrophages, monocytes, NK cells, dendritic cells, endothelial cells, and platelets, and passively from necrotic, apoptotic, and damaged cells. Necrotic cells cause more HMGB1 release than apoptotic cells (Yang & Tracey, 2010). As a result of the changes that occur in the postmortem period, necrosis occurs in the cells, and HMGB1 protein is released from the cells that undergo necrosis. In a study conducted on the subject, it was stated that HMGB1 measurement can be used to determine PMI. It has also been shown that this method can be combined with other existing methods to entirely and accurately determine PMI (Kikuchi, Kawahara, Biswas, 2010). After death, the cells' carbohydrate, fat, and protein structures break down due to cell necrosis, disrupting their typical biochemical and morphological structures. DNA protected by the nucleus and cell membranes is exposed. With death, the amount of extracellular free DNA in the peripheral blood is expected to increase due to necrosis, especially in the vascular endothelium. The increase in cell necrosis in parallel with time, especially in the first 72 hours of the postmortem interval, causes possible changes in the amount of extracellular free DNA. In this context, it is reported that determining the amount of extracellular free DNA can be an important indicator in determining the postmortem interval (Emiral, 2016).

Within the scope of postmortem biochemistry, Biochemical procedures have been and continue to be frequently applied to investigate deaths without definitive pathological evidence, including hypothermia, hyperthermia, electric shock, drowning, uremia, and acute cardiac death. However, the procedures are also helpful for investigating the process of death to support and strengthen morphology/toxicology and to screen for morphologically unexpected causes of death in routine case studies. In this context, postmortem biochemistry and molecular biology have several advantages in investigating systemic pathophysiological functional changes involved in the staining process. For this purpose, the usefulness of comprehensive analyses of pathological and biochemical findings is recommended as part of diagnostic imaging procedures and laboratory investigations involving morphology, toxicology, microbiology, biochemistry, and molecular biology (Donaldson & Lamont, 2013).

CHARACTERISTICS OF POSTMORTEM BIOCHEMICAL PROFILES

Biochemical profiles at autopsy may show significant case variation due to various factors such as pre-existing disorders, cause of death, complications, survival time, and postmortem changes due to environmental factors as well as chemical properties, distribution, and localization of analytes (Figure. 1). Postmortem interaction with biochemical markers may be due to various factors including condition at the time of death, possible supravital reactions, leakage due to cell disruption, diffusion/redistribution due to concentration gradients and analytical procedures. Due to these uncontrollable factors, traditional concepts in postmortem biochemistry are limited to using relatively stable markers in peripheral blood and some body fluids by applying clinical reference intervals, excluding agonal or postmortem changes. However, several studies have suggested that positive assessment may be possible by using more than one marker and adjusting postmortem reference intervals, considering agonal and postmortem changes. Analysis of topographic distributions in cardiac and peripheral blood and body fluids may also be helpful. For practical application, constructing postmortem databases in biochemistry, immunohistochemistry, and molecular biology is essential (Hitoshi & Bao-Li, 2009).

Studies for biochemical markers are available and mass production has been validated for postmortem interferences. However, further analysis of the cause of death has highlighted features that provide more useful information during postmortem examination of death (Figure 1) (Hitoshi and Bao-Li, 2009).

There is a need for a reliable and independent assessment and validation of the postmortem postmortem interval (PMI) based solely on objective factors other than postmortem postmortem changes or temperature measurements. For example, estimating PMI by examining the concentration of potassium ions in the vitreous humor (VH) has a tradition in forensic toxicology dating back to the mid-20th century. However, until now, methods for determining the presence of potassium ions have not been directly characterized concerning determining the time of death (Zieba, Wiergowski, Cie'slik, 2023). However, the K⁺ and hypoxanthine (Hx) concentrations of the vitreous fluid (VH) increase gradually after death and provide a means of estimating the postmortem postmortem interval (PMI). The correlation between these analytes and PMI is good because the vitreous chamber is partially isolated from autolytic events occurring elsewhere; therefore, the recorded [K⁺] and [Hx] are the result of changes within the eye (Carreiro Da Cunha, Ordóñez-Mayán, Rodríguez Vázquez, et al., 2023).

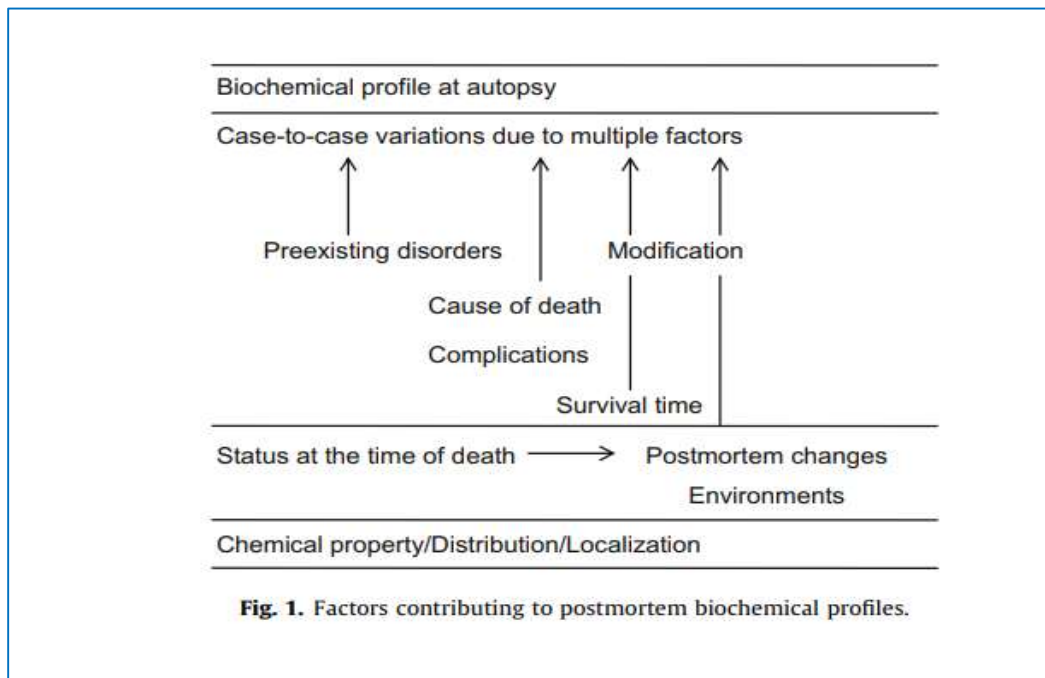


Figure 2. Factors contributing to postmortem biochemical profiles (Hitoshi ve Bao-Li, 2009).

The postmortem concentration of potassium ions in the VH has a limited PMI time range, usually not exceeding four days. It can be affected by intervening factors, including analytical factors (e.g., sample viscosity, dilution requirement, failures, and non-selectivity of ISE) and non-analytical factors (e.g., age, cause of death, and ambient temperature). The cause of death also affects the postmortem concentration of potassium ions in the VH. Caution should be exercised if death occurs due to suspension or electrolyte disturbances, as these can significantly affect the measurement results and, thus, the estimated time of death (TOD) (Zieba, Wierowski, Cie’slik, 2023). Therefore, it is important to consider the measurement methods that can yield results for various biochemical parameters in determining the estimated time of death.

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FORENSIC SEROLOGY

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ABSTRACT

Forensic serology is the branch of science that detects and examines the relationship of various body fluids (such as blood, semen, saliva, sweat, urine, breast milk, vomit, and feces) with the crime scene. Serology plays an active role in examining body fluids as well as other biological materials such as hair and epithelial cells. The science of serology, which includes many techniques for examining body fluids; is competent in analyses such as blood group systems, use of paternity tests, examination of seminal fluid, and bloodstain patterns. Through this science, the location and class of micro-level liquids that can be found at the crime scene can be determined. A Forensic Serologist uses a variety of presumptive and confirmatory testing methods to identify points of interest in evidence to identify a perpetrator, victim, or other individual(s) involved in a criminal investigation. A presumptive serology test can indicate the presence of biological material but cannot scientifically identify the substance, whereas a confirmatory serology test can scientifically determine the presence of biological material. In addition, identity determination can be carried out by DNA separation and profiling appropriate to the class of sample fluid taken from determined areas. In most forensic cases, blood constitutes a large part of the material sent for analysis, and the color, amount, and type of material on which it is found are important in analysis. Some factors may cause serological tests to give different results than expected. It is important to prevent factors that may doubt the accuracy of the results before, during, or after the test as much as possible.

THE ROLE OF FORENSIC SEROLOGY

All branches of science that include analysis methods and information used for the legal system are Forensic Sciences (Eckert, 1992). Serology is the science that studies biological body fluids such as saliva, blood, semen, vaginal secretions, urine, and sweat. Forensic serology is a unit that develops, applies, and identifies tests that will obtain and react with these body fluids that connect suspects and victims to each other or to the crime scene. In other words, forensic serology is the application of the examination of body fluids to legal matters.

A body fluid found at the scene can provide important information in linking the crime to evidence. Therefore, analysts in the forensic serology unit document physical evidence, visually examine it, screen for evidence of the presence of biological materials, and collect and store biological samples under appropriate conditions for further analysis. A forensic serologist performs presumptive testing of body fluids in a laboratory setting and then performs confirmatory tests to prove biological material. The analyses to be performed by scientists according to predetermined protocols may include appropriate chemical, enzymatic, immunological, and/or microscopic techniques. These analyses usually consist of detection of seminal stains or blood grouping (ABO and secretory status) and enzymes and antigens (Rana, 2023).

Table 1. Common biological samples for forensic serology

Biological Fluids in Forensic Serology		
Blood	Phlegm	Vaginal secretion
Semen	Purulence	Vernix caseosa
Saliva	Mecanium	Amniotic fluid
Snot	Stool	Breast milk
Vomit	Pee	Colostrum stain

The Common Questions for Forensic Serology

Basic questions a forensic serologist should ask before examining a case; Is the substance to be analyzed a body fluid? Does the substance to be analyzed belong to humans or animals? What is the condition and physical appearance of the substance to be analyzed when it is found? What is the best way to remove and preserve the substance from the surface to be analyzed? How much sample can be taken to use when analyzing? What is the most appropriate research method in item analysis and how appropriate answers can it give to the researcher? (Sensabaugh, 2016)

The Role of Blood in Forensic Serology

Since blood stains are found at the crime scene in most forensic cases, blood stains constitute a large part of the material sent for examination. Blood; It is a very important evidence in serology as it provides enlightening and reliable information about events. For many years, microscopes were used to identify blood cells, but this can only be applied to blood from which liquid can be obtained. For this reason, since the 1800s, many tests such as the hematin test, Teichmann and Takayama tests, and Guaiacum test have been developed to identify dried blood samples (Kozacı, 2023).

Serological Analyses

When it is decided that the stain is a blood stain, it must be investigated whether it is human blood before proceeding with the group assignment. For this purpose, cytological methods (preparation of blood staining preparations, leukocyte counting) and immunological methods (precipitating serum-tube technique, capillary test, agar-gel diffusion test and antiglobulin human test) are applied.

It is often difficult to determine the age of a blood stain. The spots of newly formed blood are red in color. Over time, as a result of the oxidation of the hemoglobin in the blood stain, the color of the old stains turns from red to brown with the emergence of methemoglobin. The age of blood stains is tried to be understood by comparing them with the colors of stains of known standard age, according to their solubility in different solutions, or by artificial aging method. However, considering that different characteristics of the stain and the environment affect the color of the stain, it is not correct to try to determine the age of the stain by comparing colors (Lyle, 2012).

When blood is taken as evidence of a crime, it can be determined by the Kastle-Meyer test whether it is actually blood or not. In the Kastle-Meyer test, three reagents (ethanol, KM reagent and hydrogen peroxide) are applied to the suspected blood stain, respectively. If there is blood, a pink color change will occur within seconds. Luminol Test is another possible test for blood. Luminol reacts in the presence of hemoglobin and emits blue light. According to this test, when phenolphthalein is sprayed on a blood trace, its color turns pink within a few minutes. With the Precipitin test, it can be determined whether a blood sample belongs to an animal or a human. These tests can detect very small traces of blood even after attempts to clear the blood. However, these are not a definitive test for blood because it can give false positive results with other materials (Lyle, 2012; Newton, 2007).

Blood may come from the mouth, nose, lungs, stomach, uterus, vagina, or it may come from that wound in case of any injury. However, it may not always be possible to determine exactly where the blood comes from.

The Role of Other Body Fluids for Forensic Serology

Among other samples encountered at the scene, semen, vaginal secretions, saliva, urine and sweat are the most common. It is of great importance to detect such body fluids and separate them from physically and chemically similar substances. There are physical observation, preliminary examination, and verification protocols for the identification of various body fluids (Rana, 2023).

One of the common biospecimens examined at a crime scene is saliva. Because amylase in saliva is unique to humans, it was distinguished and used for forensic saliva tests (Mueller, 1928). Nowadays, it is possible to examine even micro saliva stains.

The other bio-sample is semen. Acid Phosphatase Test is a possible test for semen. Acid phosphatase is an enzyme found in high concentrations in seminal material. If a purple color change occurs within one minute, the test is considered positive for the possible presence of semen (Keil et al., 1996; Bauner and Patzelt, 2003). Since acid phosphatase is also found in other substances, although at lower concentrations, confirmatory tests should be performed.

CONCLUSION

The results of scientific analysis of a suspicious body fluid are the most reliable way to identify or exclude a person as a suspect. These fingerprint-like investigations have the ability to directly link the victim to the criminal or the crime scene in solving forensic cases (Fennelly, 2018). Therefore, the establishment of protocols for newly created scientific techniques for serological analyses and their application in the laboratory represent an important advance in forensic serology.

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FORENSIC ODOUR

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“A sick body smells different and that their breath and skin should be taken into consideration when examining patients”

Hippocrates

ABSTRACT

Forensic odour science, combined with scientific verification techniques, is a powerful tool in forensic investigation processes. Odor analysis has many uses in forensic science applications such as toxic substances, explosive and flammable residue research, identification with human odour, and understanding post-mortem changes. Due to the complexity of evaluating active molecules in odour research, those who will work must have experience and at the same time have in-depth knowledge of odour chemistry. The cause of the odours studied by this science depends on specific molecules, combinations of different molecules, changes in molecules, and often volatile organic compounds. In particular, postmortem examinations are very important in any criminal investigation, and odour analysis therefore serves as evidence for forensic investigations. Understanding the volatile chemical profile of the cadaver is essential in post-mortem odour analysis in forensic cases. Nowadays, with the establishment of standard protocols in the detection of volatile organic compounds, the reliability of odour as evidence is increasing day by day. With improved methods and increased sensitivity, specificity and reliability in detecting volatile organic compounds, it is possible to use odour as forensic evidence.

FORENSIC ODOUR

Every animal, human or living species produces and emits a unique scent depending on its type or characteristics. The amount of odour produced by organic matter and living things depends on a number of basic factors. In living beings, changes in this scent are observed in mental or health related metabolic states such as fear or anger. Individual skin odours are influenced by genetic differences (major histocompatibility complex; MHC), bacterial influence, diet, and the sum of glandular secretions (Blaskovich et al., 2019).

The main cause of odour is volatile organic compounds. Volatile organic compounds (VOCs) are substances released into the environment from living things by the dissolution of organic substances, and each organic substance causes the formation of a distinctive, distinguishing odour (Nebbio and Piccolo 2013; Forbes and Perrault, 2014; Lehtola et al., 2004). Organic matter concentration can cause changes in odour characteristics. For example, linoleic acid, which we get with food, has an odor in low concentration similar to watermelon. As the concentration

increases first melon like, finally, a waxy aroma is observed. While short chain aliphatic alcohols have a pleasant aroma, short chain alkenes with the same carbon number are odourless and carboxylic acids have an astringent aroma. On the other hand, double bonds in unsaturated fatty acids such as arachidonic acid, linoleic acid and oleic acid, which are found in large amounts in human epithelial tissue including the skin and mouth, are prone to oxidation and the formation of volatile aldehydes and ketones, which are the source of undesirable bad odours formed during the decomposition of organic substances (Buck LB. 2004; Lekholm and Svennerholm 1977).

One of the areas of interest in contemporary forensic science is to understand the molecular composition of human odour as it relates to the human genome, gender, lifestyle, disease, mental health, and other conditions. Evidence such as mitochondrial DNA, semen, footprints, fingerprints, ear prints, and odours can be examined in court cases and influence decisions (Broeders 2006). Since human scent contains components that are stable regardless of diet or environmental factors, smell as evidence, which also uses working dogs, is one of the most important tools used in the "identification" processes. (Cuzuel et al. 2017). Detection of volatile organic compounds is also the subject of medicine, toxicology and environmental sciences.

During the post-mortem stages, the body still releases a series of VOCs, which produce the odour profile of decomposition. These VOCs are the result of post-mortem degradation processes, driven by the breakdown of macromolecules (Alisha et al., 2019). Immediately after death, human body begins to deteriorate and spontaneous postmortem changes begin to be observed. As a result of enzymatic reactions and the activities of microorganisms such as bacteria and fungi, the soft tissues of the body are destroyed. In the destruction process defined as decomposition (decay, putrefaction, decomposition), small molecules, gases and liquids are formed (Vass, 2001). The decomposition process is examined in two stages: autolysis and putrefaction (decay). In autolysis, the aseptic chemical deterioration of tissues by intracellular enzymes occurs. In putrefaction, the structures of tissues and organs are deteriorated mainly due to bacteria (Açıköz N et al., 2002). Intestinal bacteria and fungi and bacteria in the environment support this process. The deterioration of the body (decay) is a complex event that occurs under the influence of various external (temperature, moisture, location of the cadaver, types of bacteria in the environment, clothes of the corpse) and internal factors (physical characteristics, body size, weight, stomach content) (Alisha et al., 2019).

The specific odour of decay is due mainly to sulfur compounds and various inorganic gases. Gases such as CO₂ (carbondioxide), H₂S (hydrogen sulfide), CH₄ (methane) NH₃ (amonia), SO₂ (sulfuroxide), H₂ (hydrogen) are emitted from tissues that begin to decay and swell. These gases are accompanied by various VOCs and spread into the environment. In studies conducted on corpses with different degrees of decomposition, dimethyl disulphide was detected as the most prevalent VOC. Cadaverine, putrescine and other biological amines are strong, foul-smelling compounds formed as a result of bacterial contamination. The character of the odour changes over time depending on the rate and formation rate of VOCs. The formation of VOCs cannot be continuous, it occurs in phases (Dekeirsschieter et al., 2012).

Almost all living creatures have a sense of smell. The olfactory area that we use as the basis for smelling is located in the middle of the nose. VOCs stimulate electrophysiological changes in the olfactory regions of the nasal epithelium (Zhao et al., 2004). Among living creatures, dogs are one of the most hyperosmic ones. The way dogs experience the world is different from most humans, as olfaction replaces vision as the dominant sensory modality. Dogs have a much stronger olfactory threshold than humans. The olfactory molecules reach the olfactory area by diffusion in the air. In order to smell, fat/water soluble compounds must come into contact with the olfactory mucosa of the nose. In the nose, molecules reaching the olfactory area are recognized by sensory neurons in the epithelium. Olfactory receptors are located in the upper and posterior nasal septum and the lateral wall of the nasal cavity. Different olfactory nerve cells are stimulated by different molecules on the basis of the size and shape or the charge of the molecule. The number of olfactory cells is 225-300 million receptors in dogs. The olfactory cells are bipolar neurons. The axons of these neurons reach the olfactory bulb. The odour code is formed in the glomeruli here and the odour perception is transmitted to the central pathways (Patel and Pinto 2014). A dog's olfactory cortex is more developed, so dogs can distinguish many different odours that they have memorized. In humans, the olfactory threshold level is impaired in hypobaric conditions, in a humid environment people have lower olfactory thresholds. Search and rescue dogs, on the other hand, perform better in environments with high humidity (due to increased nasal moisture and scent retention ability). Humidity (not rain) increases the efficiency of dogs in tracking and searching tasks by increasing scent intensity and also increases their capacity to capture pheromones (mating activity) (Osterkamp 2020) . Today, dogs are widely used in security and safety tasks due to their excellent olfactory perception abilities. Working dogs are used in forensic sciences in the search for missing persons, dead bodies, narcotics, explosives, etc. (Martinez and Moraud 2013; Forbes and Perrault 2014; Vass et al., 2004).

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POISON AND POISONING FROM THE PAST TO THE PRESENT

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ABSTRACT

Although toxicology has developed as a science over the past 3-4 centuries, poisons and poisoning have a broad history spanning 6500 years. Throughout history, sorcerers, poisoners, potion makers, and physicians have committed the greatest evil a person can do to another by poisoning many people, and the fight against poisoning has persisted throughout history. Toxicology is a science inherently associated with murders, intrigues, passions, and betrayals. A person who acquires and understands this science and commits to using it for the benefit of humanity can, under the influence of uncontrolled passions and a momentary lapse, become an irreversible danger.

The sciences that have shaped human history have had good and bad effects on humanity throughout history. Poisons have contributed to the development of medical sciences, toxicology, and technology. In the 21st century, the rise of toxicity tests has led to significant advancements in detecting and managing poisoning cases. Poisoning, a major global health issue, has seen significant changes in its epidemiology in the 20th and 21st centuries. For example, carbon monoxide poisoning remains one of the leading toxicological causes of morbidity and mortality. *In vitro* screening and *in silico* methods are increasingly used to assess the potential health risks of environmental agents. Despite these advancements, intentional poisoning remains a significant public health issue. The wide range of potential toxic agents, often combined with delayed onset of symptoms, has made timely diagnosis and treatment challenging. Moreover, it has been observed that actions are often associated with other forms of violence, contributing to the complexity of management. In light of this information, the poisons used from past to present and the methods by which famous people were poisoned have been examined from a period perspective. In conclusion, poisoning is a complex issue that requires a multifaceted approach. Although advancements in toxicity testing have improved detection and management, more research is needed to assess the issues related to this topic.

INTRODUCTION

Although it is known that the history of poisons has a history of 6500 years, modern toxicology is a science that has developed in the last 3-4 centuries. Toxicology is the science of the study of poisons and poisons on living systems (Encyclopedia Britannica, 2005). Toxicology is a multidisciplinary science that overlaps with biochemistry, pathology, pharmacology and many other disciplines. Today, toxicology is defined as the science that investigates the adverse effects of chemical and physical agents on living organisms. While these adverse effects sometimes occur as sudden deaths, they may sometimes occur months or years later. The domain may vary. It can

sometimes affect a cell, sometimes an organ, and sometimes a biochemical process. How they harm has emerged with medical development (Akoğlu, 2017; Borzelleca, 2000).

POISON AND POISONING IN EARLY AGES

The Beginning of Humanity and Poison

The history of poisons is thought to be as old as the existence of humanity. People have begun to distinguish between good and bad based on their nutritional needs and the food they collect from their environment. They have formed their own feeding habits both through trial and error and by observing the feeding habits of the living creatures around them. In this way, they became aware of not only the foodstuffs that provided their nutrition but also the substances that were poisonous or lethal. We do not have evidence for all this information, but the fact that primitive and wild races use different types of poisons in hunting and wars gives us reason to believe them. For example, in prehistoric times, people observed that some plants could cause the death of animals, and they used these poisonous plants to hunt by poisoning the tips of arrows (Smith, 1952). It was discovered that the most popular poison used was curare. Curare is an alkaloid that kills the animal by stopping its respiration without poisoning its flesh. In the prehistoric period, curare was obtained by isolating the *Strychnos toxifera* plant (Bisset, 1992).

Over thousands of years, primitive people became civilized people and developed awareness. Civilized people were aware of plants and poisons and found them useful, unlike primitive people (Bloch, 1987). Human beings attach importance to the knowledge of poisons to distinguish between good and bad. With the development of societies in ancient times, poisons and their use also developed. The symptoms of poisoning are similar to some diseases, making the diagnosis and treatment of poisoning difficult. The invention of writing and the beginning of historiography enabled the transfer of these cases from past to present (Nepovimova & Kuca, 2019).

Poison Science in the Middle Ages

In the Middle Ages, toxicology was significantly influenced by Islamic and Greek civilizations. Pharmacists, among the medieval scientists who studied poisons and conducted the first scientific studies on poisons, produced and sold preparations for various uses. It should be noted that in the Middle Ages, the harms of poisons as well as their benefits were well known. The first scientific studies on poisons were influenced by Indian and Iranian societies. The identification of poisonous substances and the distinction of toxic substances obtained from animals and plants were mostly studied by the Islamic civilization, but studies on their effects on humans and their treatment methods were mostly carried out by Greek physicians. Muslim physicians used and developed these methods. Poisoning was also a popular topic in writings written by monks during this period. Priests played an important role in compiling and documenting information on various subjects, as they were generally among the educated members of society. Monasteries served as centers of learning in a society with low literacy rates and were often called upon for assistance with such matters as treating the sick or assisting the elderly. In this context, this knowledge was vital, as knowledge of poisons was frequently intertwined with medical practice. The poison, although dangerous, was classified as a type of medicine and was considered the fourth degree of medicine due to its potential to trigger the destruction of tissue or death. Accidental poisonings were

common and often resulted from the widespread use of toxic substances used as medicine. For example, mercury was commonly used to treat diseases such as syphilis and leprosy, while lead was used to coat ceramics, both of which could lead to accidental poisoning (Akoğlu, 2017; hemrekocalar.com, 2017).

Poison in Renaissance

The foundations of toxicology as it is known today were laid in the Renaissance and the Age of Enlightenment. In this period, moving away from the dogmatic and unscientific understanding of the Middle Ages, scientific research and efforts to understand the human body and natural events with more rational and experimental methods gained importance. This change led to advances in medicine and chemistry. During this period, Paracelsus and some scientists conducted studies on the effects of the dosage of poisons on humans and emphasized the importance of the effect of dosage, challenging traditional beliefs on this subject. At the same time, they made significant contributions to toxicology becoming a scientific discipline by supporting these ideas with experiments and observations. Paracelsus said, "Everything is poison. "What matters is the dose." The phrase has become the basic principle of toxicology. Alchemists and early scientists studied the properties of various plants, minerals and animal poisons and discovered the beneficial and harmful properties of these substances (Joseph, 2000). During this period, studies began to be conducted on suspicious deaths, and the foundations of forensic toxicology began to be laid. During the Renaissance, toxicological analyzes began to be used in murders and sudden death cases. These developments have strengthened the connections between forensic science and toxicology and laid the groundwork for the development of forensic toxicology methods used today. The advances in the Renaissance and the Age of Enlightenment, the separation of science from dogmatism and the environment of free thought paved the way for revolutionary changes in the science of toxicology, as in every science. The introduction of toxicology and forensic sciences on a systematic basis has also contributed to developments in the fields of law and medicine (Akoğlu, 2017).

POISON AND POISONING IN THE RECENT PAST AND PRESENT

Poison and Toxicology in the 20th Century

In the 20th century, the use and management of poisons played an important role in wars, industry and medicine, creating effects in various areas of society, and these effects paved the way for steps to be taken to control poisons and understand their dangers. The use of chemicals such as mustard and chlorine gas as weapons in World War I caused mass deaths. The devastating effects of chemical weapons on humans resulted in the adoption of the Geneva Protocol in 1925. This protocol is the first major agreement banning the use of chemical and biological weapons. World War I was not the only event in this century where poisons caused mass death. In 1984, as a result of an industrial disaster in a factory producing pesticides in Bhopal, India, 40 tons of methyl isocyanate gas was accidentally released, approximately 18,000 people died and approximately 150,000 people were poisoned. In the measurements made by Greenpeace in the region in 2004, 20 years after the accident, 6 million times more toxic substances than normal were found in the soil.

The effects of this accident, whose environmental effects were even greater than the Chernobyl disaster, still continue today. This disaster led to stricter security measures around the world. The technology and scientific methods that developed in the 20th century also affected medical science. Side effects and toxicities of drugs have been examined, and advances in the fields of pharmacology and toxicology have allowed the development of safer versions of drugs. During this period, pharmacological studies became more systematic with clinical studies and control mechanisms to test the safety of drugs. Toxicological analyses have gained an important place in the detection of criminals in forensic cases (Acilci, 2024; Ganesan *et al*, 2010).

Poisoning and Murders in the 20th Century

In the 20th century, many cases of murder and suicide using toxic substances were observed. We will talk about some of these cases in the rest of our article. Grigori Rasputin is one of the most controversial and enigmatic figures in Russian history. In December 1916, Prince Felix Yusupov and his co-conspirators hatched a plan to kill Rasputin. The details of this plan have been a matter of debate throughout history due to the mystery of Rasputin's death. Rasputin was invited to Yusupov's palace and an attempt was made to poison him with food contaminated with cyanide (Harkup, 2017). Cyanide, which was normally expected to be fatal, had no effect on Rasputin. Realizing that the cyanide was ineffective, Yusupov and his associates shot Rasputin several times, but soon realized that Rasputin was still alive and trying to escape. As a last resort, the assassins threw Rasputin into the Neva River so that he could not move. After his body, which was found a few days later, was examined, it was seen that Rasputin died by drowning in the river, although he was alive when he was thrown into the river. Rasputin's mysterious death had a great impact in Russia and the world (Fuhrmann, 2012).

Belle Gunness is known for being one of America's most famous serial killers of the late 19th and early 20th centuries. She usually poisoned her victims with arsenic and buried their bodies in the garden of her farm. Although the exact number of victims of Belle Gunness is unknown, it is thought that she killed at least 14 people. In 1908, a huge fire broke out on Belle Gunness's farm, and during the examinations after the fire, the lifeless bodies of a woman and three children with damaged bodily integrity were found. It could not be determined who the female body belonged to, it was thought that it did not belong to Belle Gunness. Most of the public believed that Belle Gunness continued her life with a different identity (Akoğlu, 2017).

Hermann Göring, one of the officials of Nazi Germany, was convicted of war crimes at the Nuremberg Trials, and committed suicide by taking a cyanide capsule the night before his planned execution. Göring's suicide left behind many unanswered questions (Goeschel, 2009).

Adolf Hitler and his wife Eva Braun committed suicide with cyanide the day after their wedding (TIME Magazine, 1968).

Famous French Writer Emile Zola died of smoke poisoning in the hotel where he stayed. Zola's death has caused various speculations. Although officially recorded as an accident, a reactionary organization was suspected to be behind this death (Akoğlu, 2017).

The death of Joseph Stalin, the long-term leader of the Soviet Union, deeply affected both the Soviet people of the period and the world public opinion. Although the official cause of Stalin's death was announced as brain hemorrhage, speculations behind his death still continue. Stalin, who attended a dinner party a few days before his death, became ill after the meal, and as his

condition worsened, doctors were called, but despite all the interventions, Stalin died. After Stalin's death, the doctors who cared for him in his last days were arrested and it was claimed that they poisoned Stalin. However, the doctors were later found not guilty. According to allegations made shortly before Stalin's death, allegations were made that the KGB chairman of the time, Lavrenti Beria, conspired against Stalin. These speculations were strengthened by Beria's execution in the same year. Allegedly, Beria poisoned Stalin with a high dose of warfarin at a dinner they attended. However, these claims have not been proven. The allegations behind Stalin's death have not been established. However, one thing is certain: Stalin's death deeply affected the future of the Soviet Union and left its mark on world history (Turner, 2023).

Poison in the 21st Century

Poisons constitute an important problem that continues to affect society with both positive and negative consequences in the 21st century, as it has for centuries. With advances in medicine and technology, various chemical substances and their toxic effects on the human body are better understood. In this period when the use of poisons as tools in criminal events increases, the science of toxicology is also making significant progress. Since the beginning of the 21st century, the use of poisons in criminal activities has continued to increase. The use of poisons as a tool in crimes such as murder and terrorism worries the authorities. In turn, with the advancement of medicine and technology, the science of toxicology is improving our understanding of the effects of poisons and our efforts to prevent and treat poisonings. Toxic substances play vital roles in some cases. In medicine, some toxic substances are used in the treatment of diseases. For example, chemotherapy drugs are essentially toxic chemicals used to treat cancer. Botulinum toxin, another toxic substance, is used in appropriate doses in the treatment of various medical conditions and cosmetic procedures. In the agricultural sector, pesticides and herbicides are essentially toxic substances and are known to significantly increase agricultural productivity. Despite their toxic effects, these chemicals are important for food safety and sufficiency. However, their use must be kept under control to prevent negative effects on human health and the environment. The use of toxic substances continues in industrial areas. For example, chlorine, a toxic chemical, is used in drinking water disinfection in appropriate doses. The use of toxic substances in industry is essential in the manufacturing process. The difficult part is to minimize the risk of these toxic substances for employees and the environment and to manage these processes. Poisons continue to be an issue whose safe use requires attention in the 21st century. Control of poisons is critical to public and environmental health. Therefore, the development of toxicology science and awareness-raising studies on the use of poisons are of great importance in order to minimize future social impacts (Akoğlu, 2017).

Poisoning and Murders in the 21st Century

In the 21st century, many criminal incidents involving toxic substances have occurred and continue to occur. In the continuation of our article, we will talk about some criminal events that took place in the 21st century and were closely followed by the whole world.

Kristen Rossum, a toxicologist, poisoned her husband, Gregory Villers, with fentanyl, an opioid, in 2000 and made it look like a suicide. Fentanyl is considered the “perfect poison” because it is colorless and odorless, it is lethal even at very low doses, and it was rarely found in toxicology

laboratories at the time of the murder. In 2002, Rossum was tried and convicted of murder (Littlefield, 2016).

Alexander Litvinenko, a former Russian agent, was poisoned in 2006 with polonium-210, a radioactive substance that can cause serious damage to the body and cause death in a short time, even when exposed to low doses (Goldfarb, 2010). In the examinations carried out after Alexander Litvinenko's death, doctors detected a high amount of radioactive polonium-210 in his body (Gander, 2016). Litvinenko's death had great repercussions in the international arena and caused diplomatic crises. Litvinenko's poisoning showed that radioactive substances were used as weapons and could be used as a threat in the future (Harrison, 2007).

The poisoning of Ukrainian politician Viktor Yushchenko with dioxin while he was a candidate for the Ukrainian presidential elections is one of the events that attracted international attention (Saurat *et al*, 2012). Yushchenko, who was poisoned with dioxin, an extremely toxic substance, suddenly fell ill during the election campaign and his face was seriously deformed due to dioxin, which caused serious problems during the election process and attracted the attention of the international public (Sorg *et al*, 2009).

CONCLUSION

The history of poisons shows us a deep impact and evolution process extending from the beginning of human civilization to the present day. From ancient times to the modern period, poisons have been used in various fields such as hunting, war, political assassinations and medical practices. Thus, poisons have an important role in shaping societies. This process shows us that poisons present not only threats but also opportunities for scientific and medical advances.

Modern toxicology has and continues to enable us to better understand the effects of poisons and to develop effective methods to minimize these effects. Prevention and, if not prevention, treatment of poisonings are of vital importance for public health and public safety. In addition, the use of some poisons in medical treatments shows that the potential benefits of these substances should not be ignored.

Environmental toxicology contributes to creating a sustainable environment and a healthy society by reducing the negative effects of industrial and agricultural activities on human health. Knowing the effects of poisons and pollutants helps us develop safe policies and practices.

In conclusion, the history and present-day roles of poisons demonstrate humanity's desire to increase scientific knowledge and efforts to create a safer world. This is a reflection of the struggle to survive since the beginning of humanity. Recognizing the fact that poisons are both a threat to life and beneficial elements, conscious and effective strategies for their management and use are being developed and should be developed further. With scientific approaches and correct practices, important steps should be taken to create a healthier and safer world in the future. The study and control of poisons offers opportunities for medical and scientific advances. These opportunities will also strengthen our efforts to protect human health and the environment.

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TOXIC FOOD AND BEVERAGES OFFERED TO CHILDREN

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ABSTRACT

In this oral presentation, the chemicals added to ready-made foods and beverages served to children for preservative, sweetening or coloring purposes, and the chemicals used in the materials in which these foods are stored or sold, are briefly explained and focused on what kind of health problems they may cause in the future. In order to better understand the subject, important concepts are explained and the harmful effects of these chemicals are discussed, taking into account historical processes, with reference to the importance of toxic chemicals, which are the common subject of toxicology and biochemistry, within the scope of preventive health services and forensic sciences.

INTRODUCTION

In our daily lives, we as adults and children are exposed to toxic substances very intensely. They are exposed to toxic substances, from food and drink to the air they breathe. To protect children's health as much as possible and raise a healthy generation we need to know poisonous substances very well and be careful to use them less.

Toxicology is the study of the adverse effects of chemical, physical, or biological agents on living organisms and the ecosystem, including the prevention and amelioration of such adverse effects. It involves observing and reporting symptoms that arise following exposure to toxic substances.

Considered the father of modern toxicology Paracelsus (1493-1541), drew attention to the concept of dose and said "All substances are poisons; there is none which is not, the dose differentiates a poison from a remedy." According to this statement, everything can be toxic if the dose is high enough.

IMPORTANCE OF DOSE

The dose of the substance is an important factor in toxicology, as it has a significant relationship with the effects experienced by the individual. As a result, the dose is the primary means of classifying the toxicity of the chemical, as it reflects the quantity of the chemical that the affected person has been exposed to. Taken together, any substance has the potential to be toxic if administered under certain conditions and at a given dose.

What is a LD₅₀ and LC₅₀?

LD stands for "Lethal Dose". LD₅₀ is the amount of a material given at once that causes death of 50% (half) of a group of experimental animals. LD₅₀ is a way to measure the short-term toxicity potential (acute toxicity) of a material.

LC stands for "Lethal Concentration". LC values usually refer to the concentration of a chemical in air but in environmental studies, it can also mean the concentration of a chemical in water.

The concentrations of the chemical in air that kills 50% of the test animals during the observation period is the LC₅₀ value. Other durations of exposure (versus the traditional 4 hours) may apply depending on specific laws. Most toxicologists work to assess and understand how chemicals affect living systems. Toxic substances are found in many products sold to children and adults, especially food and drink. Exposure of children in developmental age to harmful chemicals may cause serious and permanent diseases in different organs of children in the future.

COMMERCIAL PRODUCTS OFFERED TO CHILDREN CAN BE CONTAIN TOXIC SUBSTANCES

- Food and Beverages Served in Accommodation Businesses and Markets
- Materials Provided for Use in Educational Activities
- Products Offered for Clothing Purposes
- Cleaning Materials and Medicines
- Some Personal Care Products and Cosmetic Products

When children's menus and packaged commercial products are examined in accommodation facilities and markets, they contain many additives and preservatives that are consumed with pleasure by the guests in the children and adolescent group, but which are discussed in terms of health.

- Foods made from red or white meat and containing preservatives (hamburgers, pizzas, nuggets and schnitzels, sausage and salami sandwiches)
- French fries and onion rings prepared in different ways and containing trans fat.
- Foam ice creams.
- Additive flour products and colored cakes and desserts
- Ready-made milk desserts
- Fizzy drinks, fruit juices and fruit syrups
- Gel candies
- Microplastic materials in which food and beverages are served (especially long-term storage in unsuitable weather conditions).

TOXIC SUBSTANCES IN FOOD AND BEVERAGES

On the packages of ready-made foods, there are Food Additives (special names and "E" numbers) according to their intended use. "E" numbers were developed as a practical coding method for food additives in European Union countries. With the "E" number system, the classification of Food Additives according to its basic functions is as follows:

1. Colorants E100-180
2. Protectors E200-297
3. Antioxidants E300-321
4. Emulsifiers and Stabilizers E322-500
5. Acid-base enhancers E500-578
6. Sweeteners, fragrances E620-637
7. Broad-purpose food additive E900-927

Preservative additives are used to extend the shelf life of food. Preservative food additives are used to prevent food spoilage caused by microorganisms such as bacteria, mold, yeast and fungi. Today, there are more than 10,000 additives approved by the U.S. Food and Drug Administration (FDA) to preserve, package, or modify the taste, look, texture, or nutrients in foods. But increasing evidence suggests some chemicals used as food additives should be avoided—especially for children. Some of those preservatives allowed in the food that create a colored appearance (such as Sunset Yellow, Tartazin) are stated to cause asthma, skin rashes, migraine and/or hyperactivity. Some preservatives added to foods and the health problems they cause are summarized in Table 1.

Nitrite and nitrate are used in pizzas offered to children and adults and in many products prepared from meat products. Nitrite and nitrate improve both shelf life and product quality in processed meat products, but they convert to a toxic compound called nitrosamine in the body. Nitrosamine causes many types of cancer. The use of these substances, which have been approved by the World Health Organization for toxic and cancerous effects, has been restricted in many European countries and even completely banned in New Zealand. Studies are carried out on the relationship between nitrate, nitrite and N-nitrosodimethylamine (NDMA) intake and gastrointestinal cancers (colon cancers). It is stated that the risk of colorectal cancer is high when NDMA is taken in excess, especially in addition to excessive beer consumption. In addition, although not significant, a slight increase in head and neck cancers was observed.

Benzoates (Sodium benzoate-E211) are used in many products such as fruit juices, pickles, ketchup, tomato paste, carbonated drinks, jams, margarines and ready-made bakery products and toast bread. It is stated that many Benzoates can cause ailments such as allergies, asthma, ulcers, heartburn, eczema, and acne. It has been proven in many studies that it causes circulatory and nervous system disorders and hyperactivity in children.

Table 1. Some preservatives are added to foods and the health problems they cause (Adapted with modified from “Food Additives: What Parents Need to Know-HealthyChildren.org”).

Chemical	Food-Related Use	Selected Health Concerns
Bisphenol A (BPA)	Hardens Plastic Containers. Prevents rust on metal food and beverage cans.	In the body it Can act like estrogen. May chance the timing of puberty. Decreased fertility. Increased body fat. Affecting nervous and immun systems.
Pthalates	Makes plastic and vinyl flexible. Used cosmetics and personal care products, such as nail polish, perfume, shampoo, and lotion.	May affect the cardiovascular system Can increase childhood obesity. Chronic exposure to phthalates will adversely influence the endocrine system and functioning of multiple organs
Perflouroalkyl Chemicals (PFCs)	Widely used in the manufacture of textiles, lubricants, food packaging, nonstick coatings, electronic products, fire suits, flame-retardant foams, shampoo, and so forth	Can reduce immune response, birth weight and fertility May also affect the thyroid hormone system, thus affecting children's brain and bone development.
Perchlorate	The use of some fertilizers containing high levels of perchlorate causes perchlorate contamination in fruits and vegetables.	Exposed to excessive amounts of perchlorate for a long time may develop a decreased production of thyroid hormones.
Synthetic Artificial Food Colors (AFCs)	Widely used to color foods and beverages	Cause disturbed behaviour in children
Nitrates/Nitrites	Added to foods as preservatives, they can form nitrosamines.	In infants and toddlers can cause methemoglobinemia. Linked with tumors in the digestive and nervous systems.

Sodium benzoate has a Bacteriostatic and Fungitatic (fungicide) structure. In other words, it has the feature of inhibiting the reproduction of bacteria and fungi. Therefore, it is widely used in the Food Industry as a food preservative with the code E211. It has been determined that when used in fruit juices, it combines with ascorbic acid (vitamin C) and causes the formation of benzene. Central nervous system symptoms are seen as a result of short-term high-level exposure to benzene, which is a carcinogen. Long-term exposure to benzene can adversely affect bone marrow and blood production. In addition, genotoxic, immunological and urogenital adverse effects may occur with chronic benzene exposure.

It has been reported by the World Health Organization that sodium bisulfite, which is used in some ready-made bakery products, especially biscuits, triggers asthma when combined with benzoate.

Benzoate additives take first place in urticaria, asthma, and hyperactivity disorders. Sodium metabisulfite/potassium bisulfite (Sodium pyrosulfite, Sodium disulfide-E223 additive), an inorganic salt, is the cheapest and most effective anti-browning agent. Quinones produced by the catalysis of polyphenol oxidase with the effect of sulfites are reduced to less reactive and colorless

compounds. Sodium Metabisulfite reactions prevent this pigmentation from occurring. In the manufacture of frozen potatoes, the preservative is also used to prevent darkening

Besides being an additive that prevents the oxidation of oils and the darkening of foods, Sodium metabisulfite is a white chemical obtained from coal tar. This additive is used as a source of sulfur dioxide for preservative and sterilization purposes in the food and beverage industry and as a whitener for sugar and flour. Sodium metabisulfite (SMBS) is found as an antimicrobial agent in baked goods, teas, condiments, seafood, jams, jellies, dried fruit, juices, canned and dehydrated vegetables, frozen potato and soup mixes, and beverages such as beer, wine, and cider. The Ministry of Agriculture reported that the highest dose of SMBS that can be used should be 300 µg/ml. Sulfites cause symptoms such as chest tightness, hives, abdominal cramps, diarrhea, decreased blood pressure, burning sensation in the head, weakness, and increased pulse. In addition, sulfites can trigger asthma attacks in asthmatic patients who are sensitive to them

More than 250 sulfite-related cases have been reported in the United States, including anaphylactic shock, asthma attacks, urticaria and angioedema, nausea, abdominal pain and diarrhea, and seizures. An asthma exacerbation has been observed within 10-20 minutes following ingestion of sulfites in 5-10% of patients with asthma sulfites (sulfide dioxide, sodium sulfite, sodium and potassium metabisulfite, sodium and potassium bisulfite). In some cases, asthma is seen alone; In some, it has been reported that skin swelling, urticaria, angioedema, runny nose, abdominal pain, seizures, and anaphylaxis are seen together with asthma. Sulfur dioxide and sulfites have been reported to cause gastric hyperplasia and inflammation.

Butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are antioxidants used in a variety of foods, including breakfast cereals, cake mixes, chewing gum, beverage mixes, and processed potatoes. Although antioxidants are considered safe in low amounts due to their accumulation in the body, it has been determined that they cause toxic effects as a result of their long-term use. It has been reported that with the accumulation of antioxidants, skin rash and itching, urticaria and eczema, respiratory difficulties, sneezing, gastrointestinal disorders, and hyperkinesia come to the fore.

Microplastics, defined for the first time by Thompson in 2004 as plastics smaller than 5 mm, are plastic materials (polymeric substances) used for the storage and preservation of food and beverages. It has been reported that when microplastics are taken into the body, they can cause mutations in human chromosomes, which may cause infertility, obesity, and even cancer. Phthalates soften the plastics and enable them to take shape. It is stated that the induction of immune release in cells interacting with plastic parts and the interaction of microplastics in different organisms after translocation causes inflammation, dermal problems by accumulating on the skin, and negative conditions in the lung by aerobically respiration of the accumulated particles.

Heavy metals (HMs) are defined as those elements having an atomic number greater than 20 and atomic density above 5 g cm^{-3} and must exhibit the properties of metal. The heavy metals can be broadly classified into two categories: essential and nonessential heavy metals. Essential HMs are those required by living organisms for carrying out the fundamental processes like growth, metabolism, and development of different organs.

There are numerous essential heavy metals like copper (Cu), iron (Fe), manganese (Mn), Cobalt (Co), zinc (Zn), and nickel (Ni) required by plants as they form cofactors that are structurally and functionally vital for enzymes and other proteins. Essential elements are often required in trace

amounts in the level of 10–15 ppm and are known as micronutrients. Nonessential heavy metals like cadmium (Cd), lead (Pb), mercury (Hg), chromium (Cr), and aluminum (Al) are not required by plants, even in trace amounts, for any of the metabolic processes. Especially in medicine and some other disciplines the definition of heavy metal, regardless of the atomic weights of the elements, is commonly used only according to their toxic properties. Arsenic (5.77 g/cm^3 - semi-metal) and Selenium (4.81 g/cm^3) which are non-metal, are also accepted as heavy metals regarding their toxic statuses. Each of the heavy metals affects different body organs. Some metals that affect body organs are summarized in Table 2.

Table 2. Some metals that affect body organs

Metals	Affected organs
Mercury	It affects the kidney, liver, and especially brain functions.
Lead	Damages nervous system and bone tissues
Aluminum	It causes problems such as memory impairment and Alzheimer's disease
Copper	Reduces the amount of beneficial elements such as iron, zinc
Arsenic	Causes damage to the liver, kidney, and respiratory system
Flouride	Causes stains on teeth and bone weakness
Cadmium	Causes damage to the kidney, nervous system, respiratory system, bone tissues, and hypertension.
Nickel	Causes DNA damage and allergic sensitization
Zinc	Impairs the absorption of calcium, iron, and copper
Manganese	Causes Parkinson's-like neurological findings
Chromium	Causes gastrointestinal disorders, liver inflammation, lung cancer, increased allergic sensitivity

Copper is both essential and toxic to living systems. As an essential metal, copper is required for adequate growth, cardiovascular integrity, lung elasticity, neovascularization, neuroendocrine function, and iron metabolism. An average adult human ingests about 1 mg of copper per day in the diet; about half of which is absorbed.

An expert committee of the World Health Organization recommends 30 micrograms (μg) per kilogram (kg) of body weight per day, which equates to about 2 mg per day for an average adult. The Food and Nutrition Board (FNB) recommends dietary copper intake of 1.5–3.0 mg per day for adults.

In summary, forensic scientists should always fight and try to raise awareness about toxic substances that poison children and us.

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INFECTION RISKS OF AUTOPSY PERSONNEL

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ABSTRACT

An autopsy is a surgical procedure performed to determine the cause of death by examining the body and its organs. Autopsies can be requested by the deceased's family or mandated by legal authorities. Essential conditions for conducting autopsies include proper lighting, ventilation, and precautions to prevent infectious diseases. The process begins with an external examination, followed by the opening of major body cavities for tissue analysis. There has been a decline in autopsies since the 1950s due to increased risks of occupational exposure to pathogens such as tuberculosis, AIDS, and hepatitis. Knowing the deceased's medical history is crucial for preventing infections. Various transmission routes of infectious agents in autopsy rooms are discussed, including bioaerosols, bloodborne, direct contact, and oral transmission. Infectious agents are categorized into four groups based on their treatability, preventability, and transmissibility. Safety measures to protect personnel include maintaining appropriate environmental conditions, using personal protective equipment, regular health checks, and training.

INTRODUCTION

An autopsy is a thorough examination of a corpse by dissection to determine the cause of death, evaluating how the organs were affected and to what degree. Autopsies not only help ascertain causes of death but also provide valuable insights for preventing similar fatalities in other patients (Lishimpi *et al.*, 2001).

Typically, autopsies are performed at the request of the deceased's family with written consent. In forensic cases, however, an autopsy can be mandated by legal authorities without needing family permission. It is practically impossible for the assigned doctor to refuse this task due to legal and ethical obligations (Madea & Saukko, 2007).

ESSENTIAL CONDITIONS AND PRECAUTIONS FOR CONDUCTING AUTOPSIES

Autopsies should be performed in an environment with proper lighting and ventilation, ensuring the room is easily cleaned. Personnel must take necessary precautions to protect themselves from infectious diseases. This includes verifying that the necessary permission is obtained and confirming the correct identification of the deceased before beginning the procedure (Miller *et al.*, 2012; Brandner *et al.*, 2022).

At the onset of the autopsy, a thorough external examination of the body is conducted visually and through palpation to identify any abnormalities or signs that may provide insight into the cause of death. Classically, three major body cavities—the head, chest, and abdomen—are carefully opened during the autopsy. Tissues within these cavities are meticulously examined, and samples are extracted as necessary for histopathological analysis. This microscopic analysis aids in uncovering underlying pathological conditions. After the autopsy is complete, these cavities are sutured shut. The deceased individual possesses rights akin to those of a living patient, including respect for dignity, privacy, and confidentiality throughout the autopsy process (Buja *et al.*, 2019).

In addition to proper environmental conditions, it is essential to use appropriate personal protective equipment (PPE) such as gloves, gowns, masks, and eye protection (Dolinak *et al.*, 2005). Regular health checks and vaccinations for personnel are crucial preventive measures. Training on the risks associated with autopsies and the proper use of PPE should be mandatory for all personnel involved (Aydin *et al.*, 2009; Miller *et al.*, 2012).

CONTAMINATION IN AUTOPSY

The death of Dr. Bichat, a famous French surgeon, from tuberculosis in the early 1800s was attributed to his contracting the disease during an autopsy (Dufayet *et al.*, 2023). The frequency of autopsies has significantly decreased since the 1950s, largely due to increased occupational exposure to dangerous pathogens (Lundberg, 1998). When the deceased's medical history is not accurately known, the risk of contamination increases substantially. Unfortunately, there have been instances of healthcare workers losing their lives due to contamination in autopsy rooms. Transmission occurs by direct cutaneous inoculation or inhalation of aerosols and droplets. Diseases transmitted by these means include tuberculosis, AIDS, hepatitis B virus (HBV), hepatitis C virus (HCV), rabies, and diphtheria (Sönmez, 2006; Özbek, 2022; Dufayet *et al.*, 2023).

To mitigate these risks, it is crucial to conduct thorough medical history reviews and implement rigorous safety protocols. The presence of biohazardous waste should be managed through proper disposal methods to prevent accidental exposure. Additionally, using advanced autopsy techniques that minimize the generation of aerosols, such as manual dissection tools instead of power tools, can reduce the risk of airborne transmission (Burton, 2003).

Infectious Agents in the Autopsy Room

Sterilization and hygiene are critical in operating rooms but often neglected in autopsy rooms. Upon death, the mononuclear phagocyte system and the blood-brain barrier no longer restrict the spread of microorganisms, creating a high-risk environment for personnel. Common contraction risks include tuberculosis and blood-borne viruses such as HBV, HCV, and HIV. Notably, tuberculosis, anthrax, and tetanus bacilli can survive in dead bodies for many years under appropriate conditions, and viral particles can remain alive for 6 to 7 days (Sönmez, 2006; Özbek, 2022).

Knowing the medical history of the deceased is the most basic yet crucial step in preventing infection. High-risk groups for HIV, HBV, and HCV infections include intravenous medication users, male homosexuals, sex workers, homeless people, alcoholics, and patients who use blood medication regularly, such as hemophiliacs (Madea & Saukko, 2007). AIDS is most commonly seen in intravenous medication users, and tuberculosis is most commonly seen in alcoholic individuals (Lundberg, 1998).

Advanced diagnostic tools and pathogen screening can be employed to identify potential risks before conducting an autopsy. Incorporating molecular techniques, such as polymerase chain reaction (PCR), can help detect latent infections that may not be apparent through standard medical history reviews. This proactive approach can further reduce the risk of infection among autopsy personnel (Buja *et al.*, 2019).

Different Types of Transmission

Infectious agents are classified into four groups according to their treatability, preventability, and transmissibility (WHO, 2020):

Group 1: Low probability of causing disease.

Group 2: Can cause illness and is possibly dangerous but has no possibility of spreading to society. Treatment is available.

Group 3: Causes severe illness, is highly dangerous, and poses a risk of spreading. Treatment is available.

Group 4: Causes very serious illness, is extremely dangerous, and has a very high risk of spreading to society. No treatment is available.

Bioaerosols: Bioaerosols in autopsy rooms can be generated when powered cutting tools are applied to tissues or when water is sprayed onto tissue surfaces with a hose. Certain procedures, such as the use of oscillating saws or the examination of infected lungs, can generate aerosols that may carry infectious agents. These aerosols can form while infected tissues and organs are being removed, potentially spreading far beyond the immediate area of the autopsy. A significant amount of respirable dust and bacteria can be released, posing a respiratory hazard to personnel. *Mycobacterium tuberculosis* can be aerosolized during autopsy procedures, particularly during the examination of the lungs or respiratory tract. Influenza and other respiratory viruses can be transmitted through aerosols, making them a concern during the examination of the respiratory system. Fungal spores, especially from molds such as *Aspergillus*, which can be aerosolized during autopsy (Dolinak *et al.*, 2005; Aydin *et al.*, 2009).

Bloodborne Transmission: Bloodborne transmission occurs when infected blood comes into contact with open wounds or percutaneous injuries. The use of autopsy instruments can result in injuries, particularly if the protective equipment is compromised. Such breaches provide a gateway for bloodborne pathogens. HIV is a significant concern due to its potential for transmission through contact with infected blood and bodily fluids. Hepatitis B and C viruses pose a high risk of transmission through needlestick injuries or mucocutaneous exposure to contaminated blood. Torn gloves may also facilitate transmission (Brandner *et al.*, 2022).

Direct Contact Transmission via Mucous Membranes and Skin: Pathogens can enter through splashes to the eyes, nose, or mouth, or contact with broken skin. The primary agents transmitted through this route are parasites and fungi. Additionally, bloodborne viruses and bacteria of the genus *Proteus* can enter the body through contact with the conjunctiva. Caused by *Bacillus anthracis*, anthrax spores can be encountered in individuals who have died from the disease (Burton, 2003).

Oral Transmission: Pathogens can contaminate surfaces, tools, and personal protective equipment (PPE), leading to indirect transmission if proper hygiene protocols are not followed. While the risk of oral transmission for agents such as hepatitis A virus (HAV) and typhoid-

paratyphoid bacteria is relatively low for autopsy and laboratory workers, it still poses a potential risk. Creutzfeldt-Jakob disease (CJD) is a prion disease with no effective sterilization method for prions, making them a unique and dangerous risk (Sönmez, 2006).

SAFETY MEASURES SHOULD BE TAKEN IN AUTOPSY

To protect personnel from infections, several safety measures are recommended (Aydin *et al.*, 2009):

- **Environmental Controls:** Maintaining appropriate ambient temperature, humidity, and pressure characteristics in the room. Effective ventilation and air conditioning systems should be in place to reduce airborne contaminants (Miller *et al.*, 2012).
- **Personal Protective Equipment (PPE):** Use gloves, protective gowns, goggles, and masks. Double-gloving and using cut-resistant gloves can provide additional protection against needlestick injuries (Dolinak *et al.*, 2005).
- **Safe Handling and Disposal of Sharps and Decontamination Procedures:** Implementing safe handling techniques for needles, scalpels, and other sharp instruments is crucial. Immediate disposal of sharps in puncture-resistant containers is needed. Rigorous cleaning and disinfection of work surfaces and equipment after each autopsy, and proper disposal of contaminated PPE and waste according to biohazard protocols should be realized.
- **Vaccination, Post-Exposure Prophylaxis, and Health Monitoring:** Regular vaccination for preventable diseases (e.g., hepatitis B) and periodic health checks for personnel. Access to post-exposure prophylaxis for HIV and hepatitis B should be available immediately in case of potential exposure. Monitoring for any signs of infection and providing prompt medical intervention if necessary (Miller *et al.*, 2012).
- **Training and Education:** Providing comprehensive training for personnel on specific risks, proper use of PPE, and emergency protocols. Continuous education on emerging pathogens and updated safety guidelines is essential (Madea & Saukko, 2007).
- **Engineering Controls:** Implementing advanced autopsy techniques that minimize aerosol generation and using appropriate disinfection methods for tools and surfaces. Autopsy suites should be equipped with negative pressure ventilation to reduce the risk of airborne pathogen transmission. Use of biosafety cabinets or containment devices during procedures that generate aerosols. (Burton, 2003).
- **Incident Reporting and Response:** Establishing a protocol for reporting and responding to exposure incidents. Ensuring that all personnel are aware of the procedures to follow in case of accidental exposure (Brandner *et al.*, 2022).

These factors help create a safer workplace for autopsy personnel, reducing the risk of occupational infections and ensuring a high safety standard in forensic pathology.

SPECIAL CONSIDERATIONS

Handling of High-Risk Cases: Autopsies on individuals who died from highly infectious diseases (e.g., Ebola, COVID-19) require enhanced precautions, such as the use of full-body suits and powered air-purifying respirators. In some cases, limited autopsy or external-only examinations may be advised (Mazuchowski and Meier, 2005).

Legal and Ethical Considerations: Autopsy personnel must adhere to legal regulations regarding the handling of infectious bodies, including reporting to public health authorities. Ethical considerations include balancing the need for autopsy with the potential risk to personnel, particularly in cases involving novel or highly virulent pathogens (Mazuchowski and Meier, 2005).

CONCLUSION

Personnel involved in autopsy, such as physicians, pathologists, technicians, and assistants, are critically important in postmortem examinations, primarily in determining the cause of death. The thanatomicrobiome of the corpse, existing infections, and agents transmitted to the corpse can expose personnel involved in autopsy to many dangerous diseases. Safe autopsy procedures that implement strict infection control measures are the most basic way to reduce these risks. Proper use of personal protective equipment, compliance with safety protocols, and ongoing education are the most basic components of protecting those involved in postmortem examinations from occupational infection risks.

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THE ROLE OF FORENSIC ANTHROPOLOGISTS IN SKELETAL IDENTIFICATION FOLLOWING DISASTERS

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ABSTRACT

The critical role of forensic anthropologists in identifying victims after natural and human-made disasters has been examined. Forensic anthropologists systematically collect skeletal remains and create biological profiles using their expertise in osteology, taphonomy, and archaeological excavation techniques. These disciplines help us understand the legal, humanitarian, and emotional aspects of disaster response. From a legal standpoint, the collection of skeletal remains in accordance with legal procedures and their use as evidence in judicial processes is ensured. The humanitarian aspect is important for providing closure to the families of the missing and addressing their emotional needs. The emotional aspect contributes to the creation of societal memory, ensuring that past events are remembered and passed on to future generations. The multidisciplinary approach of forensic anthropologists is crucial in minimizing the impact of disasters and aiding in the recovery of communities.

INTRODUCTION

Forensic anthropology is a specialized discipline within biological anthropology that involves the legal examination and identification of human skeletal remains. Following natural or human-made disasters, forensic anthropologists play a crucial role in determining the identities of victims. Their expertise in osteology, taphonomy, and archaeological excavation techniques is essential for ensuring accurate identity determination and assisting in the legal, humanitarian, and emotional dimensions of disaster response. This study highlights how forensic anthropologists' systematic and scientific approaches ensure the meticulousness of the identification process (Byers, 2016).

SYSTEMATIC COLLECTION OF REMAINS

Forensic anthropologists are trained in meticulous recovery techniques critical in scenarios where remains are dispersed or buried due to disasters. Their archaeological expertise allows them to systematically excavate sites and collect all remains with minimal disturbance. This meticulous process helps preserve contextual information vital for subsequent analysis and identification efforts. Systematic recovery also involves mapping the location of remains, providing crucial insights into the disaster event itself (Burns, 2013).

ESTABLISHMENT OF BIOLOGICAL PROFILES

A primary task of forensic anthropologists in disaster response is to establish biological profiles. This profile includes determining the age, sex, ancestry, and stature of the deceased, as well as identifying trauma and pathologies reflected in the bones. These characteristics are critical for identifying victims. The biological profile is established through detailed examination of skeletal remains using both metric and non-metric analysis techniques, ensuring accurate estimation of the parameters mentioned above (Smith, 2020).

Sex Determination

1. Pelvic Sex Determination: The pelvis is a significant skeletal structure for sex determination due to distinct differences between males and females. Some key features used in sex determination include:

- Ventral Arch (Pubic Arch): Females typically have a more pronounced swelling on the ventral surface of the pubic bone (Hoşşöz, 2022).
- Ischiopubic Ramus: This structure, located just below the pubic symphysis in females, appears sharper, while in males, it is flatter and wider (White & Folkens, 2005).
- Greater Sciatic Notch: Females generally have a wider and more open angle, whereas males have a narrower and deeper angle (Hoşşöz, 2022).

2. Cranial Sex Determination: The skull is the second most commonly used area for sex determination, especially when the pelvis is unavailable or inadequate. Some basic features include:

- Nuchal Crest: Typically smoother and less distinct in females, more prominent and rugged in males.
- Mastoid Process: Usually larger and more conspicuous in males compared to females (Hoşşöz, 2022).
- Supra-Orbital Ridge: More pronounced and robust in males; thinner and sharper in females.
- Glabella: More prominent and outwardly projecting in males; flatter and more delicate in females.
- Mental Eminence: Generally narrower and less distinct in females; broader and more prominent in males (Hoşşöz, 2022).

Age Estimation

1. Age Estimation from Non-Adult Individuals

- Tooth Eruption: Examining the development and eruption stages of teeth is crucial for determining age during young ages.
- Skeletal Development: Based on the degree of epiphyseal fusion of long bones and diaphyseal length measurements (Çeker, 2018).

2. Age Estimation from Adults

- Symphyseal Surface: Bones in our bodies undergo degeneration over time after completing growth and development. One of the bones where this degeneration is most observed is the pubic symphysis (Çeker, 2018).
- Cranial Suture Closure: Studies by Acsádi and Nemeskéri use the closure of endocranial sutures for age estimation (Görgülü, 2019).
- Auricular Surface: Changes on the auricular surface are considered another significant indicator for age estimation (Çöloğlu & İşcan, 1998).
- Medial Clavicular Epiphysis Fusion: Fusion of the medial epiphysis of the clavicle widens and closes with age.
- Sternal Rib End: The sternal ends of ribs are another indicator used in age estimation (Hoşsöz, 2022).

IDENTIFICATION AND RECONCILIATION

The process of identification involves matching the biological profile with ante-mortem records such as dental records, medical records, and reports of missing persons. Forensic anthropologists collaborate with forensic odontologists, pathologists, and other specialists to provide a comprehensive approach. DNA analysis is frequently used as a complementary tool, especially in cases where skeletal remains are fragmented or degraded. The reconciliation process entails verifying the biological profile and ante-mortem data with post-mortem findings to confirm the identities of victims (Byers, 2016).

Dental records are particularly valuable in the identification process due to the durability of teeth and the unique dental characteristics individuals often possess. Forensic odontologists compare dental radiographs and other records with the dental structure of remains. Additionally, DNA analysis has become indispensable in forensic anthropology, providing a means to identify individuals in cases where other methods may not be definitive. DNA samples can be obtained from bones, teeth, or personal belongings and subsequently compared with samples from potential relatives (Byers, 2016).

TRAUMA ANALYSIS AND CAUSE OF DEATH

Forensic anthropologists analyze skeletal trauma to determine the cause and manner of death. The nature, location, and severity of trauma can provide significant insights into the events leading to a victim's death. Osteological analysis includes identifying mechanical trauma (fractures, crush injuries), sharp and blunt force trauma (stab wounds), and firearm injuries. Additionally, determining whether specific trauma was fatal is also possible. These analyses are conducted in collaboration with forensic pathologists and other relevant professionals, enhancing the accuracy of forensic investigations (Burns, 2013).

CONCLUSION

Forensic anthropologists play a critical role in disaster response and victim identification. Their expertise in osteology, taphonomy, and archaeological excavation techniques ensures the systematic collection and analysis of skeletal remains. These disciplines contribute significantly to the establishment of biological profiles, identification processes, and reconciliation efforts. By collaborating with other experts, forensic anthropologists facilitate the achievement of accurate and comprehensive results. Therefore, their expertise and methodological approaches are vital in ensuring justice and maintaining societal harmony.

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CURRENT CBRN THREAT ON BALKAN COUNTRIES AND PROPOSALS FOR AN EFFECTIVE MULTINATIONAL COUNTER-RESPONSE

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ABSTRACT

CBRN weapons are chemical, biological, radiological, and nuclear (CBRN) agents employed in military operations and terrorist activities to cause fatalities and injuries among living populations and disrupt biological systems. The Balkan region faces significant vulnerabilities to CBRN threats due to geopolitical instability, sensitive borders, and industrial hazards. This article summarizes the multifaceted nature of these threats, highlighting the roles of terrorist groups, criminal networks, and regional infrastructural weaknesses in exacerbating the risk. The methodology focuses on evaluating existing vulnerabilities, potential targets, and the effectiveness of current response frameworks. Key findings underscore the urgent need for a coordinated multinational counter-response strategy encompassing enhanced regional cooperation, specialized training, resource allocation, disease surveillance, public awareness, and robust crisis management systems. Recommendations include establishing intelligence-sharing networks, upgrading detection technologies, and implementing comprehensive public education campaigns to improve preparedness and mitigate potential mass-casualty incidents. These measures aim to strengthen the Balkan nations' resilience against CBRN threats and ensure effective cross-border crisis management.

INTRODUCTION

CBRN weapons are chemical, biological, radiological and nuclear agents used in both military operations and terrorist activities in order to kill and injure the living populations and dysfunction the organisms. These food stocks leading ineffective use and reducing the mobility via protective equipment requirement. These are indirectly forwarding the military forces to the untargeted directions. Chemical, Biological, Radiological and Nuclear agents can possess some hazardous effects which can be categorized as in the following:

1. Chemical Warfare Agents (CWAs)

These substances which include military chemical warfare agents, toxic industrial chemicals and household chemicals may cause poisoning or injury. So, these agents are designed to injure, kill, or incapacitate individuals through toxic chemical exposure. They can also contaminate food, water, and the environment, leading to prolonged consequences.

- Nerve agents (e.g., Sarin, VX, Novichok) – Highly toxic and rapidly acting.
- Blistering agents (e.g., Mustard gas, Lewisite) – Cause severe burns and tissue damage.
- Choking agents (e.g., Chlorine, Phosgene) – Affect the respiratory system.
- Blood agents (e.g., Hydrogen cyanide) – Prevent oxygen uptake, leading to suffocation.
- Incapacitating agents (e.g., LSD, BZ) – Cause temporary mental and physical impairment.

2. Biological Warfare Agents

Biological weapons use viruses, bacteria, and toxins to infect populations, causing mass casualties and panic. These agents are particularly dangerous due to their ease of production, difficulty in detection, and potential for rapid spread. Common biological agents include:

- Bacteria: Anthrax, Plague, Cholera, Brucellosis.
- Viruses: Ebola, Smallpox, Crimean-Congo hemorrhagic fever.
- Toxins: Ricin, Botulinum toxin.

3. Radiological and Nuclear Threats

Radiological and nuclear incidents can result from deliberate attacks, industrial accidents, or reactor failures. The consequences include acute radiation sickness, long-term cancer risks, and environmental contamination. Extreme life-threatening health effects that are caused by exposure to harmful radiation, thermal, or blast arising from a nuclear deployment are also mentioned here.

Key concerns include:

- Dirty bombs (Radiological Dispersal Devices - RDDs).
- Nuclear reactor accidents (e.g., Chernobyl, Fukushima).
- Nuclear weapons detonation and its fallout.

A CBRN attack differs from a normal terrorist attack significantly in many aspects. CBRN agents cause contamination and specific health hazards depending on the type of agent utilized and the amount of the agent deployed into the environment. Conclusively, CBRN attacks can present complete destruction and mass casualties with the sole intent of harming a whole population.

Terroristic threat is a dangerous potential crisis for large populations of people. The development and use of CBRN weapons has proven a lethal threat that one must be prepared in advance. The full extent of the potential CBRN threats cannot be estimated since they can appear in unanticipated routes depending on a number of external factors. The unpredictability and uncertainty of these threats can create a challenge in preparing for a possible CBRN threat.

Also, before a CBRN threat occurs, there are no warnings that are initiated prior to the threat, so being alert of potential indicators that may appear is critical. Indicators can occur suddenly and seem out of place such as powders, liquids, or strange smells.

Some general indicators of a chemical attack are listed as below:

- Unusual numbers of patients with very similar symptoms seeking care virtually simultaneously (especially with respiratory, ocular, cutaneous or neurological symptoms, e.g. nausea, headache, eye pain or irritation, disorientation, difficulty with breathing, convulsions and even sudden death)
- Clusters of patients arriving from a single locality
- Definite pattern of symptoms clearly evident
- Existence of sick or dying animals
- Devices, unusual liquid spray or vapour (Suspicious devices or packages Droplets, oily film Unexplained odour Low clouds or fog unrelated to weather)

Potential indicators of a bioterror /bioweapon attack:

- A highly unusual event with large numbers of casualties
- Higher morbidity or mortality than is expected
- Unnatural spread of a disease outbreak which is uncommon for a certain geographical area.
- Multiple epidemics or multiple perpetrators that could release single or multiple agents at different locations.
- Lower attack rates in protected individuals which have some type of respiratory protection, such as mission-oriented protective posture gear or high-efficiency particulate air-filtered masks (indicates that a biological agent has been released via aerosol)
- Dead animals (Because many biological agents that could be used for BW/BT are zoonoses, which indicate a biological agent release that may also infect humans)
- Unusual disease manifestation (For example, more than 95% of worldwide anthrax cases are cutaneous illness. Therefore, a single case of inhalational anthrax should be considered highly suspicious for BW/BT until proven otherwise)

Some indicators of a radiological dispersal device /radionuclear agent attack include:

- Thefts, transactions or seizures of radioactive materials from related companies, organizations or laboratories
- Inappropriate inquiries regarding radiological material usage, storage or transportation
- Tampering with facilities that store radioactive materials or radioactive wastes
- Multiple, unexplained human or animal radiation burns or radiation sickness

It is a fact confirmed by various sources that our country has neighboring countries and terrorist groups which possess the CBRN weapons and have the potential to use them at any time. Although prohibited by international conventions, these elements continue their efforts to improve their existing facilities and capabilities in the means of producing CBRN weapons. It is understood that these efforts pose a potential threat to Turkey. Furthermore, the possibility that these weapons can be used by terrorist groups on the civilian population is another fact that should always be considered. In the face of such a possible mass-casualty chemical incidents, it is necessary to put forward the necessary measures and activities against such attacks throughout the country. Because of this understanding a National CBRN Defense System should be established and this system should be implemented when necessary.

This study will focus on how such a system can be realized in the field of health, administrative organization and civil defense, and how the organization and coordination between these units can be established. Through this subject, CBRN teams are established for the first aid and treatment system and with these teams general organization and coordination is realized. In addition, it is aimed to perform the training on the subject and to evaluate the intelligence resources and data. Especially decontamination units, CBRN first aid and treatment units, CBRN diagnosis and analysis laboratory and related scientific research opportunities will be examined. Moreover, necessary coordination and planning between the units will be standardized and systematized with a central organization that should be established in case of a possible CBRN attack in our big cities. It also aims to determine the application conditions of this system.

From the beginning of the crisis starting at 2013, chemical weapons have been used in Syria and at least more than 15000 Syrians have suffered from chemical exposure since the beginning of the conflict. Attacks using chemical weapons have been taking place in Syria since 2012. As of April 2018, official reports put the number of chemical attacks at 163. Some intelligence analysis data reported that Syria had an important chemical weapon capability, which included blister agents, like sulfur mustard, and nerve agents, like sarin and Vx.

In July 2012, a spokesperson of the Syrian Foreign Ministry admitted that Syria possessed CWs and Syria would not use them if there were no external aggression. At the same time, Syrian government sources claimed that terrorist groups were using CWs. In March 2013, 25 people had died and 110 civilians and soldiers were injured as the result of a chemical rocket attack in Khan Al Asal near Aleppo. Subsequently, France and the United Kingdom briefed the striking event of those which occurred in Syria was the attack of chemical weapons used on 21 August 2013 during the ongoing conflict between the parties in the Syrian Arab Republic also against civilians, including children, on a relatively large scale according to the UN Mission team reports. Syria declared a total of 41 CW stockpile and production facilities at 23 locations. 18 of them were CW production facilities, 12 were storage facilities and there were 8 mobile filling units. A thousand tons of schedule 1 chemicals annexed at CWC were declared.

This type of CBRN system should be transformed into practice with various CBRN attack scenarios and this should be updated and implemented in our country. In the existing duties and responsibilities of possible institutions and organizations involved in such an attack, the participation of the functions that should be undertaken against such an attack necessitates their establishment on a legal basis. As a result, a specific National CBRN Defense System to our country should be established and relevant institutions should be informed and acted on. Thus, it is thought that the CBRN system to be formed in a possible mass-casualty chemical incidents will be accelerated to be implemented and some sample units will be established such as laboratory, first aid teams and decontamination units.

CBRN THREATS IN THE BALKANS

The Balkan region faces significant vulnerabilities to Chemical, Biological, Radiological, and Nuclear (CBRN) threats due to a combination of geopolitical instability, porous borders, and industrial hazards. The potential for terrorist organizations, criminal networks, and radical groups to exploit these weaknesses further increases the risk of CBRN incidents. Additionally, the presence of nuclear plants near regional borders and the smuggling of hazardous materials exacerbate security concerns. Given the cross-border nature of these threats, a coordinated

multinational response is essential to enhance preparedness, mitigate risks, and ensure effective crisis management.

Several factors contribute to the region's vulnerability to CBRN incidents, making proactive measures a necessity:

Firstly, ethnic and political conflicts have historically created an environment conducive to terrorism and instability, increasing the likelihood of CBRN weaponization. Secondly, CBRN material smuggling remains a pressing concern, as weak border controls allow the illicit movement of hazardous substances, which could be used for nefarious purposes.

Moreover, the proximity of nuclear plants near regional borders poses an ongoing radiological risk. Facilities such as Metsamor Nuclear Power Plant in Armenia and Kozloduy Nuclear Power Plant in Bulgaria are within close range of multiple Balkan countries, heightening the potential for nuclear-related incidents.

Additionally, terrorist organizations and radical groups in the region may exploit security gaps to launch CBRN attacks. Their access to dual-use technologies, toxic industrial chemicals, and biological agents presents a significant challenge for counterterrorism efforts.

Lastly, industrial hazards and chemical storage facilities pose an accidental risk of CBRN contamination. Poor safety regulations, outdated infrastructure, and insufficient emergency response mechanisms further contribute to the threat landscape.

POTENTIAL CBRN TARGETS IN THE BALKANS

Certain locations in the Balkans are particularly susceptible to CBRN threats, either due to their symbolic importance, high population density, or critical infrastructure value. Key potential targets include:

- Government offices and judicial buildings, which serve as symbols of national authority.
- Hospitals and health centers, where a CBRN attack could overwhelm medical resources.
- Military bases and embassies, representing strategic and diplomatic interests.
- Airports, metro stations, and transportation hubs, which could facilitate the rapid spread of CBRN agents.
- Water supply systems, power plants, and fuel depots, where contamination could have devastating public health and economic consequences.

MULTINATIONAL COUNTER-RESPONSE STRATEGIES

Given the complexity and transnational nature of CBRN threats, a coordinated regional strategy is essential for effective risk mitigation. The following measures can enhance the preparedness, response, and recovery efforts of Balkan nations.

1. Strengthening Regional Cooperation

To effectively combat CBRN threats, Balkan nations must establish joint preparedness and response initiatives. This includes the formation of CBRN Defense Advisory Committees, which should incorporate medical professionals, military experts, and civilian authorities to ensure a holistic approach to threat management.

Additionally, the establishment of intelligence-sharing networks is critical to monitor and prevent the smuggling of CBRN materials across borders. Strengthening law enforcement coordination and counterterrorism efforts will further enhance the region's ability to detect and neutralize threats before they materialize.

2. Training and Capacity Building

Building human expertise and institutional capabilities is essential in CBRN defense. One crucial step is the introduction of specialized PhD and MSc programs focused on CBRN preparedness, detection, and response. These programs can equip professionals with the necessary knowledge and skills to handle CBRN emergencies effectively.

Furthermore, joint military and civilian exercises should be conducted to simulate real-world CBRN scenarios. Training first responders, including firefighters, paramedics, and police forces, in decontamination techniques, medical countermeasures, and evacuation procedures is vital for minimizing casualties and containing the spread of hazardous agents.

3. Enhancing Equipment and Resources

To increase resilience against CBRN incidents, it is imperative to upgrade protective equipment and detection capabilities. Governments should supply hazmat suits, gas masks, and advanced protective gear to frontline personnel.

Additionally, CBRN detection systems should be deployed in airports, border checkpoints, and densely populated areas to enable early threat identification. Stockpiling vaccines, antidotes, and decontamination materials will further ensure rapid medical response in case of exposure.

4. Disease Surveillance and Reporting

Given the potential use of biological warfare agents, robust epidemiological surveillance is necessary. The creation of a dedicated epidemiological investigation unit can aid in the early detection and containment of biological threats.

Furthermore, the development of CBRN incident databases can track patterns, analyze risks, and facilitate real-time reporting. Hospitals must also be equipped with advanced decontamination units and negative pressure isolation wards to effectively manage and treat victims of biological and radiological attacks.

5. Public Awareness and Psychological Management

Public awareness plays a critical role in reducing the impact of CBRN incidents. Educational campaigns should be launched to inform citizens about CBRN risks, protective measures, and emergency procedures.

Training medical professionals and the general public on self-protection techniques, such as recognizing CBRN symptoms and using personal protective equipment (PPE), will enhance community resilience.

Additionally, psychological support teams should be established to address the mental health impact of CBRN incidents, including trauma, anxiety, and panic management.

6. Crisis Management and Emergency Response

A unified command and control system is essential for coordinating emergency responses in the event of a CBRN incident. Governments should develop specialized rapid response units trained in containing and neutralizing hazardous agents before they spread.

One of the most critical aspects of CBRN response is decontamination. Immediate action within the first two minutes of exposure can significantly reduce the severity of contamination. Victims must be quickly evacuated from affected areas, and decontamination protocols should be implemented without delay.

CONCLUSION

The healthcare provider and first responders must be prepared to recognize military or civilian casualties of CBRN warfare or terrorism. They must be able to clearly recognize agent-exposure symptoms against a varying background of typical injury and CBRN exposure stress behaviors and must also be informed, to the fullest extent possible, about anticipated CBRN attacks by hostile forces or terrorist activities. This intelligence requires consideration of an adversary's political factors and motivation, CBRN agent or any related substances possession or access, CBRN warfare offensive and defensive capabilities, and any strategic advantage to be realized through agent use. As a healthcare provider or first responder manages individuals suspected to have been exposed to chemical warfare agents, initial recognition of the type of agent used may be facilitated through an understanding of tactics, modes of agent dissemination, likely routes of casualty exposure, physical agent properties, and other factors determining the persistence of these toxicants in the environment.

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WARS, WAR SURGERY AND THE RESPONSIBILITY OF THE PHYSICIAN IN WAR. TRIAGE IN DISASTERS

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ABSTRACT

In this section, the most important subject of medical treatment in disasters, the word "triage", what it means, its importance, by whom, for what, and to whom, and how it is applied are explained. A few suggestions from triage practices are presented in case studies and the subject is summarized. In this chapter, the word "triage", which is the most important medical issue treatment in disasters, what it means, its importance, by whom, on what, and accordingly to whom it is applied, and how it is applied, is explained. A few suggested cases from Triage practices are also presented and the subject is summarized

INTRODUCTION

It is a word that comes from French. From the time of Napoleon. Its literal meaning is to sort and separate the sick/wounded according to their urgency.

Triage applied in disasters is different from triage applied in emergency services in daily life. The purpose of triage applied in daily life is to save the most urgent patient at that moment. For example, 40 patients in our emergency service are undergoing examination and treatment, and if a patient enters the door with complaints such as an ex-patient, gunshot wound, or sudden loss of consciousness, the entire senior team of the emergency service (doctor, nurse, etc.) will give all their attention and care to that patient and try to keep him/her alive. Other patients who are less urgent wait. The purpose of triage applied in disasters is very different and is 180 degrees opposite to triage applied in routine life. The purpose is to save as many patients as possible, not just the single and most urgent patient. Although it is very difficult to implement, in order to save as many people as possible, it is necessary to accept the death of some people. Otherwise, while trying to save a few seriously/critically ill patients, we may cause the death of dozens/hundreds of injured people on the other side.

In the event of a disaster, the first team to arrive at the scene is responsible for the health organization there. This team does not rush to treat patients. First, it carefully observes the scene. In other words, the first step is observation. The intensity, size, seriousness of the incident, the condition of the injured, the general condition of the patients, the number of injured, how many need to be transferred, the necessary need are immediately reported to the main center and, if necessary, additional reinforcements are requested. The existing patients and injured are gathered in a safe assembly area. This area can be a stadium, an empty garden, or a park. Here, the patients

will be subject to triage again. Because triage is an ongoing, continuous and dynamic application. The conditions of the existing injured and/or patients change at any moment. In other words, their condition can worsen and become even more serious within minutes or hours.

Triage is a skill learned. In order to perform proper triage, it requires the resources at hand, the number of patients and injuries, the seriousness and size of the incident, the simple assessment of the injury, and of course experience. It should not be forgotten that triage is an “undemocratic” practice with “ruthless” rules. The goal is to save as many lives as possible. However, research has shown that triage applied to disasters that have occurred all over the world to date has not been very successful. It should not be forgotten that with serious triage practice, the number of deaths and injuries can be reduced to a minimum. In order to achieve this, it is absolutely necessary to plan very well in advance and to test these plans in drills.

RULES OF TRIAGE

- The first person who arrives at the scene and who is familiar with the situation starts triage and becomes the person in charge. If someone more senior arrives in the following minutes, the task is handed over to them.
- Triage area should be established in many areas and should be continuous (incident scene, hospital garden, emergency room entrance, etc.),
- The triage area should be clean, and free from debris and debris.
- The triage area must be safe,
- Triage cards in the appropriate color for patients' priorities should be attached,
- Following this, the transfer priorities of the patients and the hospitals to which they will be sent should be determined.

MULTIPLE INJURY ACCIDENT

In such cases, the team usually uses START (Simple triage) and rapid. They use the (Simple Triage and Rapid Treatment) technique. The criteria looked at here are;

- The patient's breathing,
- Circulation and mental state.

At the scene, all patients who can walk are asked to leave the scene first. These patients/injured are given “green” and “standing injured” tags and are only checked after all seriously ill patients have been assessed. Because they have no priority.

Then, as shown in the algorithm, the triage officer walks around each casualty and checks their respiratory rate, pulse, and compliance with orders (mental state). According to his findings, he divides the people into 3 different categories.

- **Red** : (Immediately),
- **Yellow**: (Can wait),
- **Black** : (Hopeless, dead).

At this stage, the only intervention performed on the patient is to open the airway (with an airway) and apply direct pressure to the bleeding areas. From here, patients are sent to the relevant hospital for treatment. Before patients enter the emergency room, it is necessary to apply triage again. Because the general condition of the patient may have changed and/or deteriorated in the meantime.

In cases where there are many injured/patients, triage is simpler and more effective. Injured/patients can generally be divided into 3 different groups.

1. Those who will die no matter what you do, (black)
2. Those who will recover whether they are treated or not (yellow, green)
3. Those who will benefit even from inadequate field treatment (red)

We can give the following examples regarding triage to be applied in extreme cases:

- For example, there are 3 patients/injured people in the environment. Two of them have unilateral pneumothorax and the third person has bilateral pneumothorax. We only have 2 chest tubes. So, which patient and/or patients do we insert the 2 tubes we have? Of course, the 2 patients with unilateral pneumothorax. Because our goal is not to save just one patient but to save as many patients as possible. Another reason for this is that the morbidity and mortality of patients with bilateral pneumothorax is higher than the others.
- We can give another example. One of the great disasters of our time, such as the Marmara earthquake, occurs. While I, Dr. Gürkan ERSOY and the Mayor of Izmir Metropolitan Municipality were driving to the scene to bring medical aid and support, we had an accident. I had a right pneumothorax and the Mayor had a left pneumothorax, but the doctor in the emergency room who treated us only had one chest tube. Who would get this tube? Of course, me, Dr. Gürkan Ersoy. Why me? Not because I am Gürkan Ersoy, but because I am a doctor. Since I am a doctor, I am the priority since I will be treating the patients we go to.

During triage, patients who would benefit from immediate transfer to the nearest healthcare facility are marked as “priority” and are referred first. These patients are those who would benefit from hospital treatment but cannot receive this treatment in the field or even those with serious life-threatening conditions. The best examples of this are:

- Intra-abdominal bleeding,
- Intracerebral hemorrhage,
- Hemothorax, pneumothorax,
- Epidural, subdural bleeding etc.

DISASTER HAPPENED, WHAT WILL HAPPEN? HOW WILL TRIAGE BE DONE?

First, a triage area is set up in a suitable place. The first healthcare personnel who arrives and knows triage becomes the triage officer and starts triage. Incoming patients are classified according to their urgency. Here, 4 different colors are used for patients and cards of the appropriate color are placed around the patients' necks.

Triage colors and case examples representing these 4 triage categories are as follows:

- **Yellow:** Mild cases. Never admitted to the emergency room. For example, simple cuts, and anxiety due to disaster. Immediately sent to the relevant polyclinic for treatment.
- **Green:** Again, relatively mild cases. Never admitted to the emergency room. For example, humerus fracture, etc. These patients are sent to the relevant polyclinic for treatment.
- **Red:** These are real emergencies. In other words, they are the patient groups we want to find, separate, and send to the hospital/emergency room as a priority when triaging. If these patients can be diagnosed in time and their treatment is started, their chances of survival are high (intra-abdominal hemorrhage, intracerebral hemorrhage, hemothorax, pneumothorax, epidural, subdural hemorrhage, etc.). These patients constitute 5-10% of all injuries.
- **Black:** Here, injured/patients with little chance of survival, that is, hopeless and dead are accepted. For example, patients with very large burns, patients whose breathing is about to stop, unconscious patients, etc.

Triage Time:

Normally, it is recommended that triage be done in 2 minutes in disasters. Here, too, the points to look at are: Pulse, respiration and brief neurological examination of the patient. For example, a bus overturned, there were 60 people inside. If we were to triage these accident victims, it would take 120 minutes, or 2 hours, which is an unacceptable time. In such a case, the recommendation is as follows. Perform triage by simply looking into the eyes of the injured.

Factors Affecting Our Triage Decision:

Chronic diseases such as heart, diabetes, cancer, kidney, COPD that the patient already has increase the severity of the injury. Therefore, when performing triage, the patient's advanced age, the presence of such chronic diseases, and multiple injuries must be taken into consideration. The placement of such patients in the triage category causes them to be kept waiting in the triage area and to be sent to the treatment center by ambulance last.

- In large-scale disasters, basic life support is not applied to patients. Because our goal is not to save a single patient but to save as many patients as possible. While trying to save this patient who dies, on the other hand, dozens of patients die because we cannot apply triage. Moreover, 5-10% of the patients apply resuscitation to continue living, and perhaps even intubated. So, how will we find a ventilator or an intensive care bed in such an environment? Maybe there will be a power outage.
- If patients are in the emergency department, direct radiographs and/or tomography are not taken except for very specific indications.
- Routine biochemistry and/or hemogram tests are not performed,
- External bleeding is stopped only by direct pressure.
- If the patient has stopped breathing, it is considered again before intubation. Instead, a nasopharyngeal or oral airway is inserted, that is, the airway is opened and sent to the relevant department,

- For example, a burn dressing is not applied to a patient with a large area of burn such as 60%. Instead, intravenous access is opened, narcotic analgesics are administered, the patient is sent to the “black” area with his/her relatives and an exitus is expected there. Because dressing this patient is difficult and takes a very long time. After the first treatment, care is difficult. There is no intensive care bed where we can admit the patient and treat him/her and again the patient’s morbidity/mortality is very high. Therefore, instead of this patient whose chance of survival is very low, it is necessary to try to save many other patients.

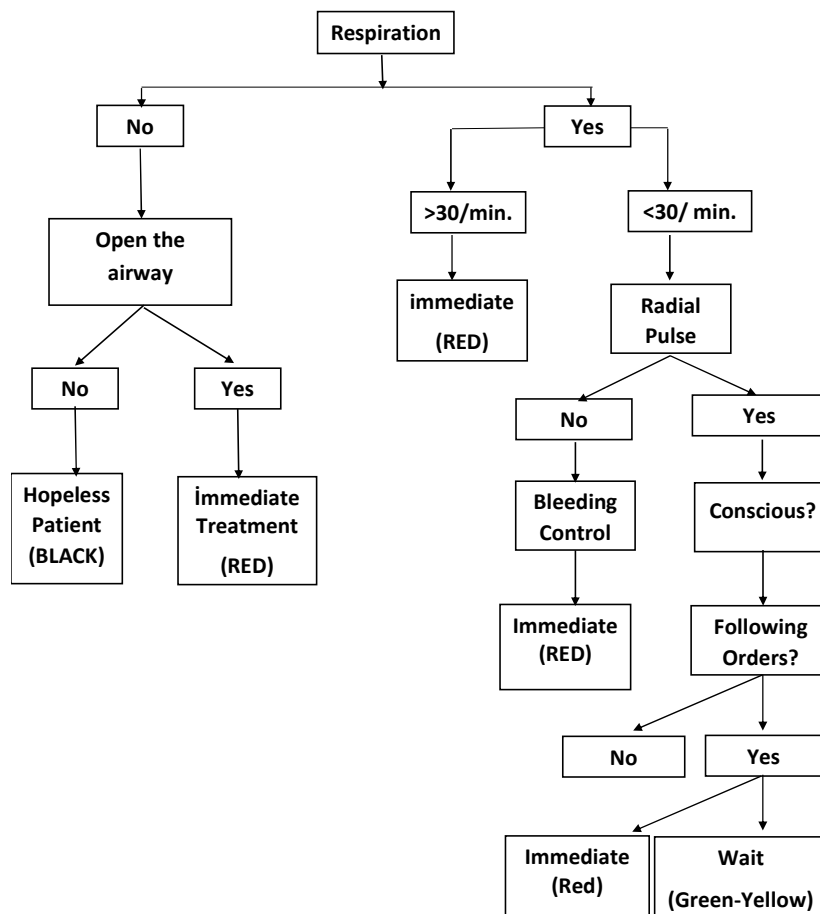


Figure 1. Flowchart in triage

Special Triage Categories:

In the event of a disaster, healthcare personnel can also get sick and injured. In the Marmara earthquake, which was the largest and most massive disaster of the century (year: 1999), all hospital staff were also disaster victims. They were also crushed under the earthquake disaster both physically and mentally and became disaster victims.

In the meantime, for example, if a doctor or nurse sprains or breaks their hand, the patient's hand can be put in a cast/splint and this person can be used again in the field because there is always a serious need for him/her.

Qualities That an Ideal Triage Officer Should Have

- He must be blind not to see those scenes of horror,
- He must be deaf so that he doesn't hear the screams and groans of the injured people,
- He has the wisdom of King Solomon and
- He must have the patience required for his duty.

CONCLUSION

The secrets of being successful, especially in large-scale disasters, are clear. Being prepared for disasters in advance, being educated (in order to do this, we must have our institution's disaster plans ready, they must be tested with continuous and regular drills, and triage must be applied in the event of a disaster). The rules of triage are ruthless and not democratic at all. In other words, while applying and complying with the rules, we must not let our emotions get involved in the incident. Otherwise, doing triage becomes much, much harder.

In our article written above, we listed the rules of triage in disasters and how they should be applied, but I must admit that if such a disaster were to happen one day and they announced me as the triage officer, I don't know if I could do it, if I could apply these ruthless rules. Hopefully, with the hope of meeting on healthy and disaster-free days...

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With the desire to respect them and not to forget the voice of those hearts;

Happy 18 March Çanakkale Martyrs' Memorial Day.

They lived like that, They made others live like that...

We had 18,000 martyrs on the Anafartalar-Ariburnu line alone between 6-22 August 1915.

We had at least 30,000 wounded. Doctors in field hospitals were serving the wounded for days without sleep.

On such an attack day, the draft officers were constantly carrying the wounded, and the doctors could only dress the wounds. They were not very interested in those who had lost hope in life. Just when the work was at its busiest, they laid a young patriot in front of a doctor. One of his legs was about to be torn apart and his intestines were outside. There was nothing that could be done! While the doctor was telling the medics to "lift him", the young boy called out "Dad!"

He looks at his own son. He hugs and kisses his son, "This is my son! Take him to a shady place," he says. Another wounded son of the country has already been laid on the table. The doctor has begun to deal with him. There are many more Mehmetts waiting in line. The doctor finds time to take care of his son the next day. However, his son has already been buried.

Now take the stethoscope and place it right over your heart. Listen, listen carefully.

Can we love this heavenly land more than our children?

Can we give all the children of this nation the same value as we give to our own children?

How did they love this country?

While those at the front were caught up in a war, how did those behind the lines live in a war?

Can you hear the sound of those hearts?

PARASITES AS BIOLOGICAL WEAPONS

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ABSTRACT

Biological weapons have been used in wars and terrorist attacks throughout history and have caused great destruction. While bacteria, viruses, and toxins are the most well-known agents among these weapons, studies on the use of parasites as biological weapons are relatively limited. Parasites are organisms that survive by disrupting the health of their hosts and have a wide variety of species worldwide. These organisms have the potential to have serious effects on human health and can cause widespread harm if used as biological weapons. Evaluating the use of parasites as biological weapons is important in terms of their biological properties as well as their transmission routes and treatability. The fact that parasites are resistant to environmental conditions, can spread easily, and do not have an effective treatment method makes them attractive for bioterrorism. In this context, the use of parasites as biological weapons can have serious effects not only on health but also on socio-economic structures. This study examines the use of parasites as biological weapons in detail and compiles the existing literature in this field. Topics include the classification of parasites, their potential role in bioterrorism, historical events, and biosecurity measures. The purpose of this review is to raise awareness of the use of parasites as biological weapons and to discuss precautions that should be taken against such threats.

INTRODUCTION

The survival of a living being at the expense of another living being on or inside it is called “parasitism”. Parasites, which are considered to have important roles in biological evolution as agents of death and disease, are an important part of the ecosystem and are found all over the world, representing almost half of its global diversity. More than one parasite species usually infects a host, and the dynamics of the interaction between parasite species affect the health or disease of the host. It has been shown that the host's initial immune response is critical to the parasite's ability to infect the host (Taylan Özkan & Göçmen, 2023).

Parasites that are important for human health are considered in three groups protozoa, metazoa (helminths), and ectoparasites. Pathogenic protozoa, which are single-celled, are divided into four classes Sarcodina (amoebas), Sporozoa (spring-dwellers), Mastigophora (flagellates), and Ciliata (ciliates). The most common protozoa in humans can also be grouped according to their location in the body. For example, *Giardia intestinalis*, *Entamoeba histolytica*, and *Cryptosporidium* are digestive system parasites; *Trichomonas vaginalis* is urogenital system parasites; *Leishmania*, *Trypanosoma*, *Toxoplasma*, and *Plasmodium* are blood and tissue system parasites. Multicellular helminths (worms, worms) that have successfully adapted to parasitic life are divided into three groups Trematoda (flatworms), Cestoda (tapeworms), and Nematoda (roundworms). Some

researchers combine cestodes and nematodes under flatworms and consider helminths in two groups. Tapeworm and cyst hydatid are examples of cestodes, *Ascaris* are examples of nematodes, and *Schistosoma* is an example of trematodes (Aksoy & Taylan Özkan, 2006; Taylan Özkan & Göçmen, 2023).

Clinical parasitology investigates disease agents such as protozoa, metazoans, and arthropods and carries out the processes of diagnosis, treatment, and follow-up. Direct, serological, and molecular methods are used in clinical diagnosis. These methods can also be applied in the investigation of parasites in living and dead bodies within the scope of judicial prosecution. In judicial cases, parasitic agents can provide important clues in solving crimes such as sudden death, rape, and incest. Thanks to forensic parasitology, the identity of the deceased or harmed individual can be determined, the scene and material of the crime can be determined, the instrument or source of the crime can be determined, the cause and time of death can be determined, the criminal can be identified, the epidemic, the source of infection or the bioterror agent can be determined. In addition, forensic parasitology experts who collaborate with archaeology and paleontology can access important data from ancient times. Parasitic infections can negatively affect human behavior and can also be a source of violence (Taylan Özkan & Göçmen, 2023).

In this section, parasites and parasitic diseases that have been used as biological weapons or have this potential from the past to the present in the context of forensic parasitology will be emphasized.

BIOTERRORISM

Terrorism is carried out in the form of actions aimed at pressuring, intimidating, or demanding ransom by using force or violence against people by attempting to kill them. Bioterrorism, on the other hand, is the deliberate spread of biological agents into the environment through air, water, food, and various distribution systems and the creation of these diseases in both humans and animals. Measures taken to prevent the spread of biological agents by malicious people are defined as “biosafety” (Keremidis, *et al.*, 2013; Aşılıoğlu & Gökpınar, 2022; Cansaran Duman, *et al.*, 2023).

Bioterrorism agents have many advantages: These weapons are cheap and can be easily produced in large quantities; even very small amounts can cause infection, can be easily transmitted from person to person and generally do not have therapeutic agents, are highly lethal; can be easily spread by air, water, and food; are resistant to environmental conditions; can be easily stored and quickly prepared for distribution (Aşılıoğlu & Gökpınar, 2022; Genişel, *et al.*, 2023).

10 tons of a biological weapon can kill 25% of the people in a 100,000 km² area and make 50% sick, while a 15-ton chemical weapon can kill 50% of the people in a 60 km² area and a megaton nuclear bomb can kill 90% of the people in a 300 km² area (Aksoy & Taylan Özkan, 2006; Aşılıoğlu & Gökpınar, 2022; Cansaran Duman, *et al.*, 2023; Genişel, *et al.*, 2023).

For a biological attack, it is necessary to obtain a pathogenic organism or toxin, to reproduce it in a way that preserves the viability and pathogenic properties of the agent, and to develop a method that will allow the agent to infect enough people to cause disease. For the final stage of dissemination, pathogenic agents must be inhaled or ingested by the target population, i.e., they must be secretly contaminated in air, food, or water. Therefore, even a full bottle containing pathogenic strains cannot be considered a full biological weapon. As with the Aum Shinrikyo

attack, unless technological hurdles are successfully overcome, the outcome can be a “fiasco.” The uncertainty of the outcome of biological weapons can act as a deterrent to terrorists, who may turn to more conventional weapons (Jansen, *et al.*, 2014).

Terrorists considering an act of bioterrorism may consider a range of organisms that may be more or less suitable for this purpose. In both the U.S. and former Soviet biological weapons programs, the long list of candidate conventional bioterrorist agents was carefully reviewed and eventually narrowed down to a few. The selected agents have several common features and are suitable for causing mass casualties (Jansen, *et al.*, 2014):

1. High morbidity and potentially high lethality,
2. Highly contagious or highly toxic (low ID₅₀ or IC_{t50}),
3. Suitable for mass production and storage until delivery without losing pathogenic potential,
4. Able to be delivered to a wide geography and resistant to the delivery process,
5. Stable in the environment for a sufficiently long period after dissemination,
6. Potential to be developed as a more effective bioterrorist weapon agent through genetic engineering and weaponization processes.

Although the fact that bioterrorist weapons do not require long-term storage or mass delivery means that terrorists have a wider range of opportunities, bioterrorist agents must first be accessible. In this context, Ricin, which is used in many attacks, is particularly preferred due to its toxicity and accessibility (Jansen, *et al.*, 2014)

CLASSIFICATION OF BIOTERRORISM AGENTS

Bioterrorism agents can be divided into three main groups as categories A, B, and C (Erenler, *et al.*, 2018; Etukudoh, *et al.*, 2020; Genişel, *et al.*, 2023; Taylan Özkan & Göçmen, 2023):

Category A biological agents are agents used in bioterrorism that can easily spread or be transmitted from person to person. These agents can cause high mortality rates and have the potential to create serious public health impacts. Agents falling into this category can create panic and social disruption in society and require special measures to be taken for public health preparedness.

Category B agents constitute a category that is relatively easy to spread. They cause moderate morbidity and low mortality. They also require special strengthening of CDC’s diagnostic capacity and disease surveillance. Disease-causing parasites are often included in this group.

Category C agents include novel pathogens that can be engineered for mass dissemination in the future and are important because of their accessibility, ease of production and distribution, and potential for high morbidity and mortality rates. This category includes emerging infectious diseases such as coronavirus, Nipah virus, and Hantavirus.

WHY PARASITES?

Parasites are organisms that survive by disrupting the health of their hosts and are widely distributed worldwide. These organisms have the potential to have serious effects on human health and could cause widespread harm if used as biological weapons. Assessing the use of parasites as biological weapons is important not only in terms of the biological properties of these organisms but also their modes of transmission and treatability. The resistance of parasites to environmental conditions, their easy spread, and the lack of an effective treatment method make them attractive for bioterrorism (Etukudoh, *et al.*, 2020; Taylan Özkan & Göçmen, 2023).

Helminths as Biological Weapons

Today, studies on biological weapons have largely focused on bacterial and viral agents and biological toxins. Prions and fungal pathogens have also been discussed to a limited extent. However, despite their widespread impact on public health and some cases of their use as biological weapons, helminths have not received sufficient attention. Helminths have several biological characteristics that make their use as biological weapons theoretically dangerous and effective. Since most helminth infections are transmitted through ingestion of contaminated food, the risk of accidental exposure during the weaponization of these agents is much lower than other commonly used biological agents. The group is taxonomically diverse, and many potentially dangerous helminths can be easily collected because they are also common in domestic or cosmopolitan animal species. These agents can be obtained cheaply and easily without attracting the attention of local, national or international security organizations. The low risk of transmission makes helminths very attractive to state and non-state actors who want to target specific individuals or groups. Many helminths are known to cause larval migration and neuropathological symptoms in the host they infect. In addition, the diseases they cause usually appear late and it is difficult to make a differential diagnosis of the symptoms (Kwak, *et al.*, 2016; Taylan Özkan & Göçmen, 2023).

The biological weaponization and distribution of helminths is simpler, lower risk, and cheaper compared to the technology and knowledge required for the weaponization of other pathogenic organisms such as bacteria and viruses. The production of biological weapons from helminths can be divided into three main stages: acquisition, purification, and weaponization: The **acquisition stage** is the collection of infectious material from the environment or for culturing purposes. Extensive research on many cosmopolitan helminth species has elucidated their life cycles and simplified the material collection process relatively. There are comprehensive taxonomic guides for the identification of helminths, and some can also be cultured *in vitro*. Techniques such as flotation, which provide the concentration of infective forms, larvae, and eggs, are used for the **purification stage**. Since it is easy to purify and concentrate the infective stages of helminths, there is no significant technological barrier for those who want to do so. The **weaponization stage** is the transfer of concentrated infected material to food or drink to cause disease in target individuals. Many helminth species are more resistant to environmental conditions than other traditional agents when weaponized due to their ability to survive for long periods (Kwak, *et al.*, 2016; Taylan Özkan & Göçmen, 2023).

Although there are thousands of helminth species, the number of species suitable for biological weaponization is small. Potential candidate species share some common characteristics such as prevalence, ease of weaponization, and high pathogenicity. In terms of **prevalence**, the candidate species must be parasitic on a cosmopolitan host such as a domestic animal or humans in developing countries. The parasite must also be able to spread within the host. The **ease of weaponization** is related to the simplicity of collecting, culturing, and then preparing the species for dissemination. Although all these steps are less complex than weaponization with other biological agents, a certain level of helminth biology is still required. High pathogenicity refers to the level of disease that parasitic infection produces in the target. Species with **high pathogenicity** cause severe morbidity and/or mortality in those infected. Humans are the most likely targets, but in some cases, animals may also be targeted (Kwak, *et al.*, 2016; Etukudoh, *et al.*, 2020; Taylan Özkan & Göçmen, 2023)

PARASITE-CAUSED EPIDEMICS, BIOTERRORIST ATTACKS, AND BIOCRIMES

Malaria Epidemic in the Pontine Marshes

During World War II, signatory states, including Germany, pledged not to cause unnecessary harm to civilians and to renounce chemical and biological weapons. In contrast, Nazi Germany aimed to reverse the successes of Italian Fascism, slow down allied armies, and increase exposure, and to this end, the ground was set for a malaria epidemic in the Pontine Marshes. The German army violated the Hague Convention and the Geneva Convention by using malaria as a tool for bioterrorism. Although the Littoria region was declared malaria-free in 1939, a major epidemic occurred due to Nazi policies (Snowden F., 2012).

The malaria epidemic project was led by Erich Martini, one of Europe's leading malaria experts. Martini was a professor of medicine in Hamburg, an early Nazi Party member, a supporter of Heinrich Himmler, and an expert in biological warfare. Martini and his Italian colleague Alberto Missiroli had discovered that the *Anopheles labranchiae* mosquito could breed in both fresh and salt water. The Nazi strategy aimed to turn the lands back into swamps by stopping the water pumps installed by Mussolini and increasing the salinity level by running the pumps in reverse. This action not only damaged crops and animals, but also ensured that the *A. labranchiae* species became dominant in the mosquito population. In addition, the German army put mines, destroyed the water pumps and the boats that kept the drainage channels clean, and seized the quinine stocks, destroying the health infrastructure. This process caused an epidemic of "man-made malaria," as the Italian malaria expert Alberto Coluzzi put it. Between 1944 and 1946, almost all the 150,000 inhabitants of the Pontine Marshes contracted severe and fatal malaria caused by *Plasmodium falciparum* (Snowden, 2012).

The 1970 Ascariasis Poisoning Case

The ascariasis poisoning incident that occurred in Quebec in February 1970 was caused by Eric Kranz, a postdoctoral fellow in parasitology at Macdonald College in Sainte-Anne-de-Bellevue, Quebec, who infected his victims with *Ascaris* larvae while sharing a house with Kranz. It has been reported that one of the victims may have been infected with approximately 400,000 larvae. Due to disagreements with his roommates, Kranz threatened them, "I will put parasites in your food, and you will wake up dead." Kranz was evicted from the house on January 31, despite paying

the rent in full. Then, around February 1, he prepared a dinner for his housemates and allegedly contaminated it with *Ascaris* larvae stolen from the university laboratory (Phills, *et al.*, 1970; Carus, *et al.*, 2001; Gunn and Pitt, 2012; The Bulletin, 2024; The Gazette, 2024).

The infected individuals developed symptoms approximately one week after the meal and included cough, shortness of breath, weight loss, and fever. Kranz's housemates presented to the emergency department at Queen Elizabeth Hospital on February 12 with symptoms of acute respiratory distress, wheezing, and hives. Initially diagnosed with pneumonia, the patients did not respond to antibiotics. Four days later, live larvae were isolated from sputum and stomach washings, confirming the diagnosis of ascariasis, indicating that they had been exposed to fertilized and embryonated *Ascaris* eggs (Carus, *et al.*, 2001).

Following the life cycle, the larvae migrated from the intestine to the lungs via the bloodstream and when they ascended to the trachea, they were returned to the small intestines by swallowing and developed into adult worms four weeks after infection. Many immature eggs were seen in the feces of the victims. The infestation was successfully controlled with piperazine treatment, and the victims were discharged from the hospital on March 5. However, it was noted that one victim may have suffered permanent lung damage. In the legal process, Kranz was tried on charges of attempted murder (Carus, *et al.*, 2001).

He returned to Quebec voluntarily on March 9, surrendered to the authorities, and pleaded not guilty. At his trial in June 1971, he was charged with willfully endangering the lives of his roommates. Expert evidence was presented to the court regarding the presence of *Ascaris* larvae in the bodies of two plaintiffs. The defense claimed that the infection could have been caused by sewage backflow into the kitchen sink of the house. Kranz claimed that he could have been exposed to ascariasis eggs by contact with his roommates' clothing. Judge Gerard Laganier, who reviewed the evidence, ruled that Kranz was acquitted, stating that there was insufficient evidence to prove the defendant's guilt beyond a reasonable doubt (Carus, *et al.*, 2001).

From a medical perspective, this case provided an index case for *Ascaris* infection used as a biological weapon in humans. Doctors initially consulted Walter Reed Military Medical Center but could not find a precedent for human infection. This incident highlighted the serious health effects of ascariasis and its potential for use as a biological weapon and highlighted the need for awareness and preparation from both a medical and legal perspective (Phills, *et al.*, 1970; Gunn and Pitt, 2012).

Milwaukee *Cryptosporidium* Outbreak

The *Cryptosporidium* outbreak that occurred in Milwaukee in 1993 is considered the largest documented waterborne outbreak in the United States and the world. This incident, which affected more than 400,000 people, exposed critical weaknesses in municipal water systems and highlighted the importance of meticulous water quality monitoring and treatment protocols (Taylan Özkan & Göçmen, 2023).

Cryptosporidium is a parasite that causes a diarrheal disease called cryptosporidiosis. This parasite is extremely resistant to chlorine-based disinfectants commonly used in water treatment and can survive for long periods outside of a host. Transmission occurs through ingesting contaminated water or food or contact with infected individuals. Risk factors for outbreaks include inadequate water treatment, contamination of water sources, and high population density. The outbreak in

Milwaukee illustrates how these factors can combine to create a public health crisis (Taylan Özkan & Göçmen, 2023).

The first cases of gastroenteritis in Milwaukee began to appear in March 1993. By early April, the number of cases had increased rapidly, and hospitals and clinics were overwhelmed with patients with severe diarrhea, abdominal cramps, and fever. On April 7, 1993, the Milwaukee Health Department announced that the likely cause of the outbreak was *Cryptosporidium*. The outbreak affected more than 400,000 people, about a quarter of Milwaukee's population, and resulted in a significant increase in the number of patients requiring emergency and intensive care. The sudden increase in the number of patients put a serious strain on the healthcare system. Healthcare costs and lost productivity have also been a major economic cost (Jennifer, *et al.*, 2021; Taylan Özkan & Göçmen, 2023)

Arboterrorism

One of the most dangerous yet rarely recognized bioterrorism threats is arboterrorism, using pathogen-infected arthropods (insects, ticks, or mites) to spread disease and terror. The greatest risk of such an arboterrorism attack is that countries are unprepared for such attacks and have not taken adequate precautions for protection. The Graham/Talent Report, which assessed weapons of mass destruction, found that a bioterrorist attack on American soil would pose a greater threat than an atomic bomb. In contrast, little has been done to prevent or mitigate the threat of arboterrorism. The complacency in arboterrorism planning is likely based on the belief that a serious arboterrorism attack has not yet occurred or is unlikely to occur (Tabachnick, *et al.*, 2011).

During World War II, Nazi scientists facilitated the transmission of malaria to local people by using the aggressive *Anopheles labranchiae* mosquito species as the dominant species. During the same war, the Japanese developed "bombs" containing plague bacilli-infected fleas and dropped them from airplanes (Tabachnick, *et al.*, 2011; Gunn and Pitt, 2012; Snowden, 2012).

Agroterrorism

Another method that can be described as terrorist activity is the deliberate contamination of animals and food with pathogenic microorganisms or toxic chemicals (Gyles, 2010). It is alleged that in 1985, Mexican contract workers working in the screwworm (*Cochliomyia hominivorax*) eradication program intentionally spread screwworm to animals in the region of Mexico close to the US border. It is thought that the workers, who thought they would lose their jobs due to the success of the eradication program, intentionally caused this outbreak for sabotage purposes, but the perpetrators have not been fully identified (Keremidis, *et al.*, 2013)

CAN PARASITES PROTECT FROM WAR?

Schistosomiasis is a disease that affects approximately 240 million people worldwide and is classified as a Neglected Tropical Disease (NTD). It is prevalent in underdeveloped countries, especially in regions with high poverty rates. Schistosomiasis ranks right after malaria in tropical and subtropical regions (such as Africa, the Middle East, China, Indonesia, Brazil, and Venezuela) due to its public health impact and economic burden. Schistosoma species require both snails and mammals to complete their complex life cycle, which includes asexual and sexual reproduction.

When *Schistosoma* eggs, excreted in feces or urine, come into contact with water, they hatch into free-swimming ciliated larvae (miracidia) and settle in the intermediate host, the snail. They go through various stages inside the snail and eventually develop into the free-swimming forked-tailed cercariae. Cercariae that leave the snail invade the skin of mammals that enter the water. They leave their forked tails and enter the bloodstream with only their head (schistosomula). They first settled in the lungs, heart, and finally liver, and from there in the deep mesenteric veins. Depending on the species of *Schistosoma*, the parasite's spiny eggs cut through the bladder or colon tissue and are excreted in feces or urine. Patients may also experience symptoms such as urinating blood or passing bloody stools. The acute phase of the infection is called Katayama fever. However, the main effect depends on the chronic disease. Eggs that are thrown into the external environment by cutting the veins can cause bladder cancer in the advanced stages of the disease or can cause serious damage to the liver or even the central nervous system (Derr, 2021; ASM, 2024; The Senior, 2024).

When Napoleon's soldiers landed in Egypt in 1798, they described it as "the land of menstruating men." In fact, the locals were infected with *Schistosoma*, and the parasite eggs caused blood in the urine, which caused concern among the soldiers. During the 1949 Chinese Revolution, tens of thousands of soldiers of the Chinese Communist Party moved to invade the island of Taiwan, then known as Formosa. Since there was no port on the island, the soldiers had to swim to the island, but they became ill from a blood parasite called *Schistosoma japonicum* found in the canals. It took the army more than six months to recover from this disease. In the meantime, the allies had already entered the region and prevented the Chinese communist invasion (ASM, 2024; The Senior, 2024).

DEFENSE AGAINST BIOTERRORISM AGENT PARASITES

As a result of globalization, migration, climate change, and political developments, the impact of biosecurity on agriculture, the environment, and health has increased. Bioterrorists particularly target foodstuffs and agricultural products. Various biosecurity practices and precautions are required to prevent and minimize global and local bioterrorism threats. All measures taken to reduce or eliminate the effects of biological warfare agents are called "biological defense". The precautions to be taken against the threat of a bioterrorist attack that may be carried out through parasitic agents have similar characteristics to those for other bioterrorist agents (Aksoy & Taylan Özkan, 2006):

Surveillance: It is the detection of an unexpected or unusual disease. Thanks to surveillance studies and early diagnosis of infectious agents, it is possible to minimize human loss with prophylaxis, vaccination, or other medical interventions.

Rapid Diagnosis: Rapid detection of unusual or unexpected outbreaks is possible with laboratories that can make accurate diagnoses. These laboratories should be equipped to provide accurate results to health institutions at local, regional, or national levels and should be able to provide 24-hour service.

Epidemiological Analyses: Regional and national collaboration should be established with experts on the subject, primarily public health experts, to determine the source and spread of unusual diseases.

Communication: The use of media to raise public awareness and the use of communication networks to inform health institutions are essential.

Planning and Reporting: Education, plans, and protocols should be developed in collaboration with specific professional groups in response to bioterrorism. These protocols should cover critical issues such as the epidemiological characteristics of the outbreak, contact lists, index case surveys, sample collection, transportation, and control measures (Aksoy *et al.*, 2006).

CONCLUSION

Parasitology has the potential to be used as a biological weapon. Parasites can cause serious diseases in humans and animals, and this is worrisome in terms of bioterrorism. The use of parasites as biological weapons can lead to epidemics that can spread rapidly in a society. Such attacks threaten public health and can also create panic and fear. The use of parasites as biological weapons creates major challenges, especially in identifying and controlling the source of outbreaks. Therefore, the development of experts in parasitology and effective response strategies is vital to protecting against bioterrorist threats.

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BIOLOGY IN FORENSIC SCIENCE

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ABSTRACT

The place of biological tests in Forensic Science is evaluated in this paper. Most of the techniques are DNA based and being processed every day. The techniques used today are described briefly

INTRODUCTION

Biologic Material has been used in Forensic Science, since ancient times, but as the Sequencing Technologies continue to improve, there has been a corresponding expansion of DNA-based applications in the forensic sciences. For the definition of the structure of DNA, the Watson-Crick model was first described by two researchers, Watson and Crick in 1953. This is the MILESTONE time in BIOLOGY for the researches as by the investigation of the structure, many experiments started to be done easily and trustworthy date was obtained in a short period of time. For the usage in Forensic Science; DNA from dust and environmental debris; is used firstly by French Criminologist Edmond Locard in the early 20th century. The available material that can be used are; Ova, Insect matter, Larvae, Textile materials, Feathers, Feces, Hair, Bone, Blood, Muscle, Microbes, Gelatin, Epidermis, Fats, Leather, Tissue etc. The advantages are; to enlighten sample origin or geolocation and investigate individual identification.

Metabarcoding, is another new technique, used to facilitate the testing of the environmental material high-throughput sequencing to simultaneously process of hundreds of different samples. In criminal cases, The factors that influence the personal microbiome of individuals are also important. Such as; mobile phone, computer mice, shoes, surface of the home etc. In testing material, standardization is another important point. In order to be standardized; The tests must be accurate, reproducible and reliable. In recent years there is a great progress in Biological Techniques. Forensic science was compatible with many biological subjects. Several topics in this field includes human development molecular biology fingerprinting DNA typing In order to explain the concept and the application of tests, a course was given to the students to improve students' attitudes towards Science in general. And finally, it was found to be successful as students felt more confident in their own scientific abilities after taking the course. In forensic Science, there are some biological common tests used in forensic case.

MOLECULAR TECHNIQUES USED IN FORENSIC BIOLOGY

Sequencing: DNA Sequencing is the identification of all nucleotides in any specific part of a DNA region. Sanger technique investigated in 1975 is widely used.

Restriction Fragment Length Polymorphism (RFLP): This is a technique based on the polymorphic difference between individuals that can be recognized by restriction endonucleases. Polymorphism is the occurrence of two or more genotypes, each at a frequency greater than that which could be maintained by recurrent mutation alone in a population.

Short Tandem Repeat (STR): STRs are small sections of DNA, usually 2-6 nucleotides in length, that are repeated consecutively at a given locus, in the human genome. STR's make up at least 6.77% of the human genome and are highly polymorphic.

Species- Specific Priming: It is the relating to or being a substance (as an antigen or drug) that is limited in action or effect to a particular species and especially to the species from which it is derived.

Single Nucleotide Polymorphism (SNP): Is observed at every 200-500 base pair in the genome. SNPs are found in non-coding DNA or lead to silent mutation in coding DNA.

Polymerase Chain Reaction (PCR): It is a technique in which a short DNA or RNA sequence can be amplified > 10⁶ times, by means of two flanking oligonucleotide primers and repeated cycles of amplification with DNA polymerase. It is widely used, as the procedure of the technique is simple in application and only a very small amount (even one cell) is sufficient. Another advantage is that it can be applied to ancient material such as fossils and old forensic cases.

Probabilistic Genotyping (PB) Systems: Are designed to compare complex biological samples found at crime scenes with the DNA of possible suspects. A common application is analyzing genetic data from mixed samples that include genetic material from multiple people.

OMICS IN FORENSIC SCIENCE

Omics is a multidisciplinary field of scientific methodologies that measure the characteristics of certain molecules such as metabolites, proteins, and genes. These characteristics are roles, relationships, and actions. As a result, branches such as Metabolomics, Proteomics, Genomics, and Transcriptomics arose.

Metabolomics: It is the omics of small molecules, called METABOLOME. It was first described by Fiehn, for the detailed analysis of all the metabolites of an organism in 2002. Molecular weight is nearly < 1000 Da., and one of the best examples of metabolome molecules is amino acids. Methods such as; Gas chromatography, Mass spectrometry, Nuclear Magnetic Resonance, etc. are used.

Proteomics: It is the study of PROTEOME, that is THE PROTEINS found in the cell of an organism and the total number is more than 100 000. This can be examined by several methods such as; ELISA (Enzyme-linked immunosorbent assay), Mass spectrometric immunoassay (MSIA) etc. in forensic science, the identification of proteins in biological fluids such as blood, saliva, lacrimal fluid, seminal fluid, vaginal fluid, sweat, hair, etc. in criminal cases is widely used.

Genomics: It is the study of all the genomes, that's to say genome-related functions of an organism. Techniques such as Real-time Polymerase Chain Reaction (RT-PCR), Microarray Sequencing are used. They are preferred for the cases at Postmortem interval (Bacterial community), DNA analysis or Intoxication and abuse of drugs.

Transcriptomics: As are the technologies for studying the transcriptome of an organism, which is the whole set of transcripts produced by the entire genome. Microarray, PCR methods that are used for investigation. As, OMICS in Forensic Science is considered, all types of omics methodologies are used for searching, post-mortem interval, anaphylaxis, intoxication, abuse of drugs, DNA analysis, intoxication, diagnosis of disease, and cause of death.

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WORKING DOGS AND THEIR TRAINING PROCESS

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ABSTRACT

The term "labor" or "working dogs" is used to describe canines that have undergone specific training to perform a job that requires responsibility. Specially trained dogs are widely used by major police units to search for drugs, smuggled cigarettes, tobacco, tea, bombs, explosives, live people, corpses and to identify criminals among suspects by their scent. Working dogs in some jobs other than military or police work can be called assistance or service dogs. These dogs are mainly used as medical sniffer dogs, guide dogs and therapy dogs.

As a consequence of the long-standing selection and training processes, certain breeds have been widely acknowledged as the optimal choice for these roles by those who require them. In order to be considered suitable for service, canines must exhibit certain characteristics that are deemed necessary for the specific task in question. In the selection and training of working dogs, there is a consensus among professionals in the field that the most important factors to consider are genetics, anatomy, physiology, temperament, and health. The training process comprises a number of distinct phases. The selection of a working dog for breeding represents a pivotal decision that can significantly reduce costs, expenses, and time wastage. The training period encompasses five distinct processes: puppy training (0-8 weeks), socialisation training (8-20 weeks), drive reinforcement/impairment, skill and self-confidence training (20th-32nd weeks), preparation for special work training and obedience training (32nd-52nd weeks), and branch (specific work) training (after 52 weeks).

It is evident that working dogs contribute to the betterment of our world. It is therefore imperative that they are provided with optimal living, training, and working conditions. Given the sensitivity and importance of their work, it is imperative that the educational standards of those involved in the process are clearly defined. It is imperative that veterinarians, dog behaviour specialists, and scientists be involved in the training and working processes of these animals. It is recommended that legal regulations on working dogs and working dog trainers be prepared as soon as possible, with the involvement of international scientific collaborations. Given the high cost and expenses associated with working dog breeding, selection and improvement, studies on genetic archives for stock dog breeds are of particular priority. The capabilities of dogs extend beyond those that have been previously documented. It is imperative that further scientific research be conducted in order to gain a deeper understanding of the behaviour and training of dogs.

INTRODUCTION

In the earliest periods of history, humans domesticate animals for various purposes. The primary motivation for this was to facilitate the easier and more efficient completion of tasks, particularly those related to the protection and transportation of people, goods, and materials. A significant amount of work was carried out by animals. A labour animal is defined as an animal that is distinct from those that work for care and feeding, primarily due to its physical strength. The term "labor" or "working dogs" is used to describe canines that have undergone specific training to perform a job that requires responsibility. Amongst others, dogs' domestication and history of relationship between dog and human being makes them the most prominent working animal. In addition, dogs were the first species to be domesticated by humans (Driscoll et al., 2009). This is evidenced by their larger prefrontal cortex area of the brain, tendency to play and learn, fabulous smelling ability, instinct of loyalty due to their previous living in a pack, and physical endurance. These characteristics have led to their use in a wider range of jobs than other animals (Kayabaşı, Doğan, Hancı, 2017).

In approximately 600 BC, the Lydians used dogs to prevent the Cimmerians from crossing borders. This is the earliest documented instance of canines being utilised in conjunction with humans in a military area. The myths indicate that the Romans used dogs for protection and military operations. The dog has become a duty animal due to its capacity to convey information through facial expressions and body language, which allows us to comprehend its emotional state and responses to our actions. Additionally, its high level of adaptation to living alongside humans has contributed to its suitability for this role (Kayabaşı, Doğan, Hancı, 2017). In ancient Rome, large dogs with large, spiked collars were used in combat and, on occasion, were equipped with armour in order to inflict harm on their enemies. In medieval England, dogs were employed as a means of distracting and disconcerting cavalry units engaged in combat by instilling a sense of unease and trepidation in the horses. It is known from historical documents that Alexander the Great had a dog named Peritas, which saved his life by attacking an elephant during the Battle of Gaugamela.

Canines were employed for intelligence and other military purposes during the Second World War, particularly by the American and German armies. In the United States Army, approximately twenty thousand dogs are employed in a variety of roles, including guarding outposts and supplies in Coast Guard areas, carrying messages, and rescuing downed pilots. (Auel, 1996).

In the First and Second World Wars, canines were employed as suicide bombers with the intention of destroying tanks. This practice is considered unacceptable in the present day. The roles performed by military dogs varied according to their size, intelligence and training. The canines were employed to patrol the area, with their primary function being to bark or growl in the event of the detection of an unknown or suspicious presence within a secure zone, such as a military camp or base. The canines have undergone training to enable them to detect the enemy, locate the wounded on the battlefield, and assist with the administration of medical supplies to soldiers who are able to tend to their own wounds. Additionally, canines were trained to remain by the side of severely injured military personnel, providing them with companionship as they passed away (Trueman, 2015). Some canines, such as Sergeant Stubby during the First World War and Chips during the Second World War, were awarded medals for their bravery and exemplary service (Conrad, 1998).

WORKING DOGS AND THEIR WORKS

The primary function of working dogs is to assist individuals employed in forensic science and law enforcement (Table 1). Dogs trained in specific techniques are employed by police units in a variety of roles. These can include narcotics detection, the search for smuggled cigarettes, tobacco, tea, explosives, the location of corpses, and the identification of criminals through olfactory cues (Yıldız et al., 2019). Using dogs in forensic investigations offers a number of advantages such as their searching ability in adverse conditions (for example, among debris following a disaster) and their retrieving ability to important evidence without compromising other search or forensic techniques (Cooper and Cooper, 2008).

Table 1. Working dogs and their duties

WORKING DOGS			
MILITARY/POLICE DOGS		ASSISTANCE DOGS	
Search and rescue		Medical detection	
Tracking	Person (alive) tracking	Guide dogs (For blind and deaf people)	
	Cadaver (body)	Therapy dogs	
	(Under) water cadaver	Herding dogs	Transferring of herds
Explosive detection	Protection of herds		
Substance detection	Narcotic detection	Hunting dogs	
	Other material detection (tea, tobacco, banknote, fungi...)	Sled dogs	
	Guard and attack		

It is fortunate that, at the present time, dogs are not only employed in armies in combat. Dogs also take part in search and rescue operations, which may involve locating living individuals, bodies, or underwater corpses. They assist law enforcement agencies in maintaining public order. Detector dogs search for explosives, including bombs and mines, as well as narcotic substances (Gerritsen ve Haak, 1999), and other substances such as tea and tobacco, banknotes, fungi, and even digital equipment like cell phones. Dogs working with security forces play a pivotal role in combating illicit activities such as smuggling, criminal offences and terrorism (Yıldız et al., 2023). In addition to their use in the military and in the context of security, dogs are employed as service animals in a number of other areas. The term "assistance dog" is used to describe canines that have been trained to assist individuals with disabilities. These dogs are also known as "service dogs". Furthermore, they are employed as medical detection dogs in the diagnosis of various types of cancer, the detection of blood sugar drops, the administration of first aid in epilepsy seizures, and the detection of diseases such as COVID-19, Alzheimer's, malaria, and dog cancers. Guide dogs assist visually impaired and hearing-impaired individuals in facilitating their daily lives. Therapy dogs provide psychological support to disadvantaged groups of society, including the elderly,

juvenile delinquents, prisoners, autistic children or children with pervasive developmental disorders, and soldiers and civilians suffering from post-traumatic stress disorder in rehabilitation centres (Zaiontz, 2022). Herding dogs are employed to transport sheep, cattle, and goose flocks to another field. Herd guard dogs are used to protect animal herds against predatory strangers and dangers such as theft (Örsçelik, 2021). Helping humans while hunting may be the oldest job of dogs. The use of sled dogs for the transportation of humans and cargo in polar regions is continue.

The classification of working dogs is a complex process, involving a number of different approaches. It would be beneficial to categorise them according to their primary functions or the areas in which they are employed. However, it is evident that the training imparted to these canines is of a distinct nature. Search and rescue, police dogs, and disease detection dogs all undergo training in "odor discrimination." Therefore, it can be argued that all of these dogs should be classified as scent detection canines. A further classification of working dogs can be made as follows.

WORKING DOG BREEDS

Dogs that have undergone specialized training program are employed in the performance of tasks that are of the utmost importance. It is possible for different purebred dogs or mixed-breed dogs to perform a given task. However, it is not possible for a single dog to perform all tasks. Additionally some dog breed clubs and dog federations have classified specific dog breeds as "working dogs".

Although a variety of dog breeds were utilized in military contexts, the most populars were those of medium size, high intelligence, and trainability, including Labrador retrievers, Doberman Pinschers, German Shepherds, and Belgian Shepherd Dogs. Border Collies are used for transporting flocks of sheep, cattle, and geese from one location to another while herd guard dogs like Anatolian shepherds (Kangal dogs) are used to protect domestic animal herds from predatory strangers and dangers such as theft. One of the oldest jobs dogs do is to help humans while hunting. Golden retrievers, Labrador retrievers, Border Collies and Pointers are the most common breeds for hunting assistance (Blunkett, 1993). Saint Bernards are durable search and rescue dogs that work in snowy mountains. Siberian Huskies are preferred for sled pulling, and Labrador retrievers are preferred as guide dogs for deaf and blind people. Dobermann Pinscher and Rottweiler breeds help police and law forces in dangerous public events. As a consequence of the long-standing selection and training processes, certain breeds have been widely acknowledged as the optimal choice for these roles by those who require them (Örsçelik, 2021).

TRAINING REQUIREMENTS

Dogs to serve must have certain characteristics required by the task. In the selection and training of working dogs, there is a consensus among professionals in the field that the most important factors to consider are genetics, anatomy, physiology, temperament, and health.

Genetic: All working dogs must be the offspring of genetically character-selected parents. Furthermore, working dogs must not have genetically transmitted diseases such as deafness, hip joint dysplasia, or allergies. The offspring of working dogs should be preferred.

Anatomy: Size: Working dogs should have a body size that matches the requirements of the task. St. Bernards and Great Danes cannot search collapsed buildings after earthquakes, and toy breeds (small-bodied dogs) cannot work in heavy field conditions. Special body conditions: Brachycephalic dog breeds (Shih Tzu, Bulldog, French Bulldog, Boston Terrier, Cavalier King Charles Spaniel, Boxer, Pekingese, and Pug) are characterised by a flat face and a short nose. It is generally accepted that these breeds are predisposed to respiratory issues, which may impact their ability to perform scent recognition tasks.

Short-legged breeds (Dachshunds, Basset Hounds, Scottish Terriers, Pomeranians) aren't suitable for working in tough ground and land conditions. The sluggish breeds with limited mobility ability (short-legged breeds) are unsuitable for search and rescue and police work as they lack the necessary agility.

Stenotic nares are a common genetic condition and congenital problem in some dog breeds, particularly brachycephalic breeds. It is unreasonable to expect these dogs to be proficient in search and rescue or substance detection.

Physiology: It is recommended that working dogs be in good body condition. The ideal body condition score (BCS) for performance dogs has yet to be determined. However, it is advised that the BCS of working dogs be maintained between 4/9 and 5/9, according to the dog body condition score chart for common dogs. A good-conditioned body minimizes injury risks and maintains optimal health and performance of the dog. It is important to consider that the sexual cycle and pregnancy in female dogs may have an impact on the working period. It is imperative that guide dogs be castrated and rendered sterile to preclude the possibility of sudden, unpredictable reactions to pheromones.

Temperament, attitude, awareness and personality/character: In addition to the requisite physical fitness, working dogs must also possess the character traits required by the task. Dogs, like humans, exhibit a range of behavioural characteristics, including laziness, hard work, playfulness, indifference, sensitivity and curiosity. Dogs, which are often assigned responsibility and important roles in jobs that are too sensitive and do not accept mistakes, require careful training in a controlled environment from puppyhood. Puppies and dogs must not have any distractions, focusing problems, or phobias. Since the introduction of the search material will be done through play, dogs should have a high interest in games and a strong preference for play. They must have sensitive, and curious characters, and they mustn't be lazy and indifferent (Bognár & Kubinyi, 2023).

An individual who is self-confident, has not experienced trauma in the past, and has a known history of working with dogs will be a reliable business partner and team worker in carrying out important work. In the case of siblings born in the same litter, the most dominant character is selected for certain roles, while the calmest is chosen for others. For instance guide dogs must be the offspring of genetically calm character-selected parents. It is possible that dogs belonging to the same breed may exhibit different behavioural characteristics, and that even the offspring of the same parents may display varying personalities (Dodurka, 2011). Dogs employed in work settings are expected to demonstrate a combination of traits, including hard work, reliability, strength, and friendliness, with the understanding that certain tasks may require a different set of skills.

Health: It is a prerequisite that working dogs have been vaccinated and administered anti-parasitic drugs since infancy and do not exhibit any health problems (Yılmaz, 2020). Some checks must be repeated on a daily, weekly, monthly, or annual basis.

TRAINING PROCESS

Although it has been asserted that there is no clear truth in dog training (Sakallıoğlu, 2023), a number of regulations have been enacted in different countries around the world, particularly in light of the necessity for a uniform standard in the training of working dogs (FCI, 2018; ESAAT, 2004; INSARAG, 1999). The training period encompasses five distinct processes, in addition to and subsequent to the choice of stock breeding.

- Puppy training (0-8 weeks)
- Socialisation training (8-20 weeks)
- Drive reinforcement/impairment, skill and self-confidence training (20th-32nd weeks)
- Preparation for special work training and obedience training (32nd-52nd weeks)
- Branch (specific work) training (after 52 weeks)

Choose for stock breeding: Selecting the optimal puppy for breeding represents a pivotal decision that can significantly impact costs, expenses, and time investment. It is recommended that parents be chosen from the most successful working dogs, and that they should be educated and working in the field.

The absence of a consanguineous relationship between the parents serves to safeguard future generations from the potential risks associated with genetically related health issues. The age at which parents mate has an impact on the health of their offspring. It is recommended that male dogs reach at least 24 months of age and female dogs at least 18 months of age before their first mating. In order to achieve a high fertility rate, female dogs should be selected from among those who have given birth to 6-9 puppies in each litter and who have only given birth once a year. It is generally accepted that male dogs must mate a maximum of four to five times per year in a natural manner. It is necessary to emphasize the importance of artificial insemination in increasing the number of offspring from parents who are good working dogs.

Puppy training (0-8 weeks): It is possible for breed and behavioural characteristics, as well as learned skills, to be transferred to puppies during pregnancy, breastfeeding and training with the mother (Santos, Beck, Fontbonne, 2020; Lezama-García et al., 2019; Jones & Gosling, 2005). During the lactating period of puppies, it is crucial for them to learn to communicate with their mother and siblings, establish dominance, socialise with other animals, understand the concept of hierarchy, conserve resources, protect themselves and defend themselves (Sakallıoğlu, 2023). During this period, the trainer or handler employs a variety of techniques to train the puppy, including observation, touch, and voice (calling). At approximately one month of age, the trainer motivates the puppy to smell by placing food at a distance from the puppy as part of the training process. The objective of the personality test administered in the eighth week is to ascertain the puppy's physical development, temperament, and motivation to engage in play. The test also evaluates the puppy's drive, shyness, and sensitivity levels.

Socialisation training (8-20 weeks): It is challenging to work with an unsocialised dog. Without socialisation, dogs experience high stress. Social dogs demonstrate enhanced adaptability and training them is more straightforward. During this period, puppies should be exposed to a diverse

range of stimuli in a controlled manner to enhance their curiosity and socialisation. In training, puppies must be exposed to a variety of conditions, including different types of terrain (slippery, hard, soft, rocky, grass), weather conditions (sunny, rainy, snowy, foggy, thunder, lightning), vehicles (trolley, bicycle, motorbike, cars, bus, garbage truck, lawn mower, helicopter, plane, scooter, ATV). The training must encompass a wide range of individuals and objects, including children, young people, older people, sportspersons, uniformed officers, women and men with disabilities, households (vacuum cleaners, TV/radio digital devices, wheelchairs, walking sticks, umbrellas), toys (balls, balloons, Frisbees, soft and noisy toys, mobile toys), and other animals (dogs, cats, horses, birds, cows and sheep) of all breeds and ages. At the end of the 20th week, a "performance test" must be administered to the puppy in order to ascertain its physical development, its capacity to adapt to diverse circumstances, its drives and motivation for play, its biting and aggression levels.

Drive reinforcement/impairment, skill and self-confidence training (20th-32nd weeks): At this stage, the primary objective of training is to foster individuality, game motivation, and a willingness to search for the dog. This training encompasses a range of activities conducted in various environmental contexts, including indoor and outdoor settings, as well as in rooms, buildings, fields, and vehicles. Preselection and performance tests must be conducted at the conclusion of the 32nd week, immediately following the training period. These tests must ascertain the extent to which the dogs' body and personality development, drives, play motivation, focusing, biting, and aggression levels have been influenced by the training.

Preparation for special work training and obedience training (32nd-52nd weeks): "All working dogs demonstrate complete obedience to their handlers". In obedience training, commands such as "walk," "step," "sit," "stay," "wait," "lie down," "come," "search," "find," and "bring" should be executed by the dog both with and without a leash. In the training process for special work, all searching, and all plays, and obedience commands must be performed in the field, building, hospital, laboratory, ruin, wreck, water, and vehicles... with a toy by the dog. It is necessary to administer a series of tests at the 52nd week of training, which will allow for the determination of the subject's personality, development, drives, play motivation, focusing, biting, and aggression levels. These tests may be conducted using a variety of instruments, including, but not limited to, the dog bite sleeve, bite pillow, harness, and other similar devices.

Branch (specific work) training (after 52 weeks): Only dogs that have completed all previous training may participate in branch training. Branch training is conducted for varying periods of time, depending on the branch. The primary training equipment utilized in specific work training is always the dog's most preferred toy. The dog encounters the searching substances (the odor of the substances) through this toy. The searching item is initially paired with the toy, and then the dog that finds the item is rewarded with the toy. The dog is capable of potentially smelling any scent. The approximate training periods for the various training programmes are provided below for Türkiye (Sakallıoğlu, 2023).

- Search and rescue (about 20 weeks)
- Cadaver and underwater cadaver search (about 24 weeks)
- Narcotics (about 16 weeks)
- Explosives (bomb) (about 16 weeks)
- Explosives (mine) (about 20 weeks)
- Special substances (8-20 weeks)

- Tracking (about 14 weeks)
- Guarding/Attacking (about 20 weeks)
- Operations (about 20 weeks)

The handler and the dog have developed a synergic relationship, whereby the dog is able to perform tasks at the handler's command. It is of great importance to establish a harmonious relationship between the dog and its handler. The dog must be able to distinguish between different amounts of substances among different odours in different environmental conditions. Dogs that have completed their training and achieved a passing grade in the initial, fourth, ninth, and eleventh weeks of evaluation tests are assigned to their duty positions in conjunction with their handlers. Teams are evaluated annually by an authorised commission, which is comprised of experts in the field. This evaluation is conducted through a series of examinations, which are attended by both the dog and its trainer.

Tests and annual exams: It is unfortunate that the training topics, contents, timetable, test standards and exams vary considerably between countries. The collaboration of institutions would be a significant factor in achieving a positive outcome (between armies and police departments, Red Cross, and AFAD in Türkiye). There are numerous examples of successful scientific collaboration between institutes in different countries. Although the format of the examinations is similar, it is necessary to demonstrate that the standards of international education have been met in order to obtain international certification.

CONCLUSIONS

Working dogs make our world better. Just like humans, they deserve better living, training, and working conditions. Given the sensitivity and importance of their work, clearer educational standards should be established for both the dogs and their handlers. It is imperative that veterinarians, dog behaviour specialists, and scientists be involved in the training and working processes of these animals. It is recommended that legal regulations on working dogs and working dog trainers be prepared as soon as possible, with the involvement of international scientific collaborations. Given the high cost and expenses associated with working dog breeding, selection and improvement, studies on genetic archives for stock dog breeds are of particular priority. The capabilities of dogs extend beyond those that have been previously documented. It is imperative that further scientific research be conducted in order to gain a deeper understanding of the behaviour and training of dogs. The most crucial area of research may be the heritability of their temperament traits.

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SCHOOL VIOLENCE AND THE ROLE OF THE NURSE IN THE PREVENTION

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ABSTRACT

A healthy, peaceful, safe, and violence-free school environment increases children's and adolescents' academic success and positively affects their spiritual development. However, today, due to policies that support violence and lead to social narcissism, the language of violence used, idealized violent figures in the media and similar visual communication tools, school gangs and domestic violence, aggression, tendency to violence, and impulsivity have increased worldwide. Significantly, since the traumatic and challenging life story of witnessing violence or being a victim of violence, which is a global problem, increases the risk of committing violence against another, violence has also been reflected in the school environment, negatively affecting children and adolescents' academic failure as well as physical and psychosocial health. It has made it necessary to take urgent measures regarding school violence, which is among the most common causes of mortality and morbidity in young people in the world and our country.

Preventing school violence and treating the perpetrators and victims requires a multidisciplinary team approach. School health nurses: School violence prevention trainings have an effective role in identifying risk groups, finding cases, providing guidance and counseling to victims of violence, and creating awareness in the school community. In this context, nurses can contribute to the creation of a safe and non-violent school environment where children and adolescents will use more constructive conflict and resolution approaches where there will be a decrease in violent tendencies and violent behaviors through training programs aimed at preventing school violence. At the same time, families, society, schools, health professionals, and relevant state institutions and organizations can support the prevention of school violence, which is an important public health problem, by effectively cooperating to fully implement preventive and protective intervention programs developed to prevent school violence and by strengthening the bonds between children and adolescents and their families and schools.

INTRODUCTION

The World Health Organization defines violence as the deliberate use of physical pressure or force, threats or actions against oneself, another person, a group, or society, causing injury, death, psychological harm, developmental disability or deprivation, or increasing the likelihood of these situations occurring. Today, violence has reached schools and has become one of the most important problems that all societies need to take urgent measures to fight, and thus, the concept of school violence has emerged. School violence is defined as the threat or use of force with the intent to harm at school or during school-related activities. School violence also refers to peer bullying and aggression in schools. Each year, millions of K-12 students get exposed to hostile

behaviors such as bullying, hate speech, and hate crimes while in school, and these hostile behaviors in schools negatively impact the short- and long-term mental health, education, income, and overall well-being of K-12 students. Violence in schools includes various types of violence experienced among students, teachers, and school administrators or each other (MEB, 2008). Violence in education includes physical, psychological, sexual, and verbal behaviors that damage the school climate and reduce the motivation of students and teachers. According to UNICEF data, every seven minutes in the world, an adolescent or child is exposed to some form of violence, and sometimes these acts of violence result in death. The same report states that children and adolescents may also encounter serious acts of violence at school and that nearly 130 million (more than 1 in 3) students between the ages of 13 and 15 worldwide are reported to have been subjected to physical or verbal bullying. Today, violence in schools has become a problem that concerns the entire world and threatens the cultural future of the world. A study conducted by the National School Board Association in the United States of America, which included 700 schools, determined that violence in schools has increased significantly compared to five years ago.

SCHOOL VIOLENCE IN TÜRKİYE

As part of the Programme for International Student Assessment (PISA), an international student evaluation program conducted every three years by the Organisation for Economic Co-operation and Development (OECD), the issue of school violence and bullying in Türkiye was examined in 2022. The program assesses the skills of 15-year-old students in science, mathematics, and reading, as well as their socioeconomic and cultural backgrounds. Before taking the PISA test, students were asked how frequently they had experienced behaviors associated with bullying at school in the past 12 months, covering four types of bullying: physical, relational, verbal, and extortion. Unfortunately, the findings of the study revealed that school violence remains a serious issue in Türkiye.

School Violence and Bullying in Turkey According to PISA Assessment

Türkiye's findings on school violence and bullying in 2022 show an overall decrease compared to 2018 (2015) (Figure 1) but are still above OECD averages. According to PISA data, the bullying status of students in Türkiye (compared with the average of OECD countries) is given in Figure 1.

According to PISA 2022 data, it determined that the rates of the themes of "Being mocked" and "Being left alone" regarding school violence and bullying in Türkiye were higher than in 2018. The most significant decrease was observed in the theme of "I was pushed or exposed to violence by other students" (Figure 2).

Students in Türkiye responded well above the OECD average on the themes of "Seeing a gang at school, witnessing a fight with injuries, seeing students carrying guns or knives." Accordingly, it determined that;

- ✓ The most common bullying experiences of students in Türkiye are verbal and relational bullying.
- ✓ While the rate of students who say there is a gang at school in Türkiye is 25.6%, this rate is 12.1% in the OECD average.

- ✓ The percentage of students who say they have witnessed a fight that resulted in injuries within school grounds is 28.5% in Türkiye and 20.2% in the OECD.
- ✓ 25.7% of students in Türkiye and 10.6% in the OECD average have seen students with knives or guns at school
- ✓ The majority of students in Türkiye feel safe at school and around school; however, when compared to OECD averages, the rate of students in Türkiye feeling safe at school and around school is low,
- ✓ According to OECD and Türkiye averages, it determined that the area where students feel safest is the classroom (Türkiye 87%, OECD average 93%).

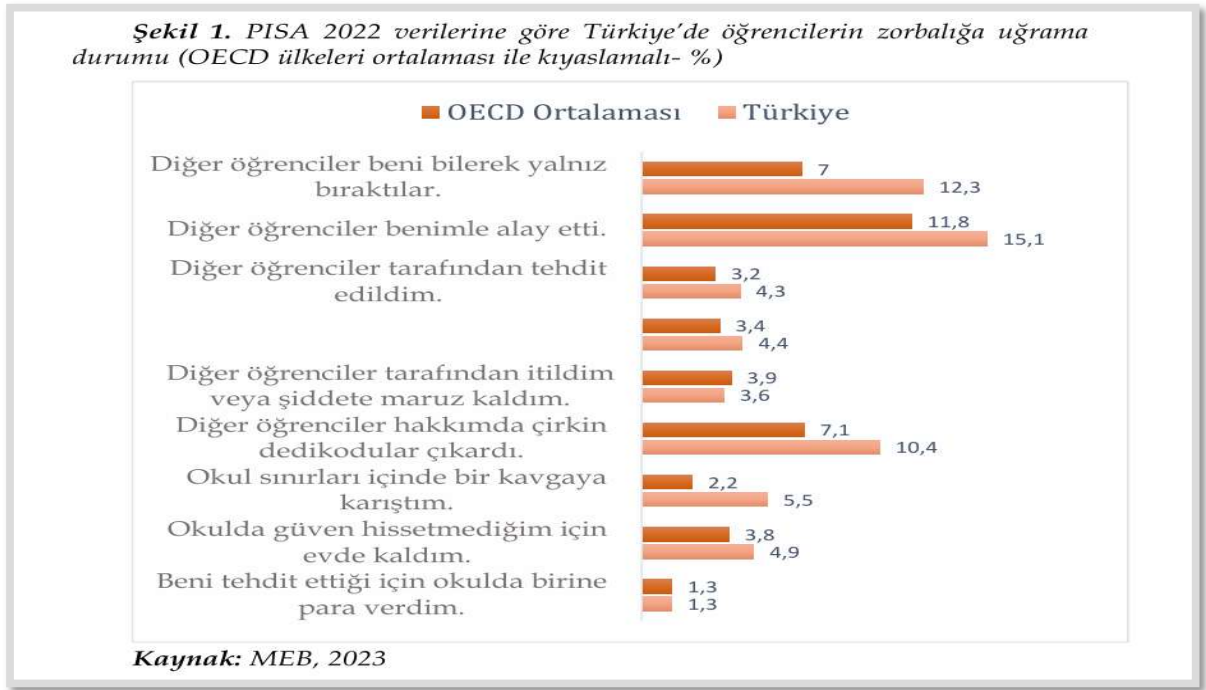


Figure 1. According to PISA data, the bullying status of students in Türkiye (compared with the average of OECD countries)

When all this data is taken into consideration, it is revealed that school violence is one of the important problems that need urgent solutions in our country as well as in the world. In fact, in a study conducted by Bahçeşehir University within the scope of the CSG Safe School Project in Türkiye, It was reported that 62% of teachers and 74% of students reported violent incidents in schools in Türkiye. School violence can be seen in many different ways, from physical violence to psychological violence. School violence is considered to be one of the elements that most negatively affects learning in an educational environment and hinders the child's motivation to learn; it is stated that in a school climate dominated by violence, the child's expected learning and socialization gains from education are directly negatively affected (Council of Europe, 2024). School violence, which usually occurs through behaviors such as bullying, intimidation, or

suppression, causes many students to drop out of school every day due to intimidation, assault, and bullying.

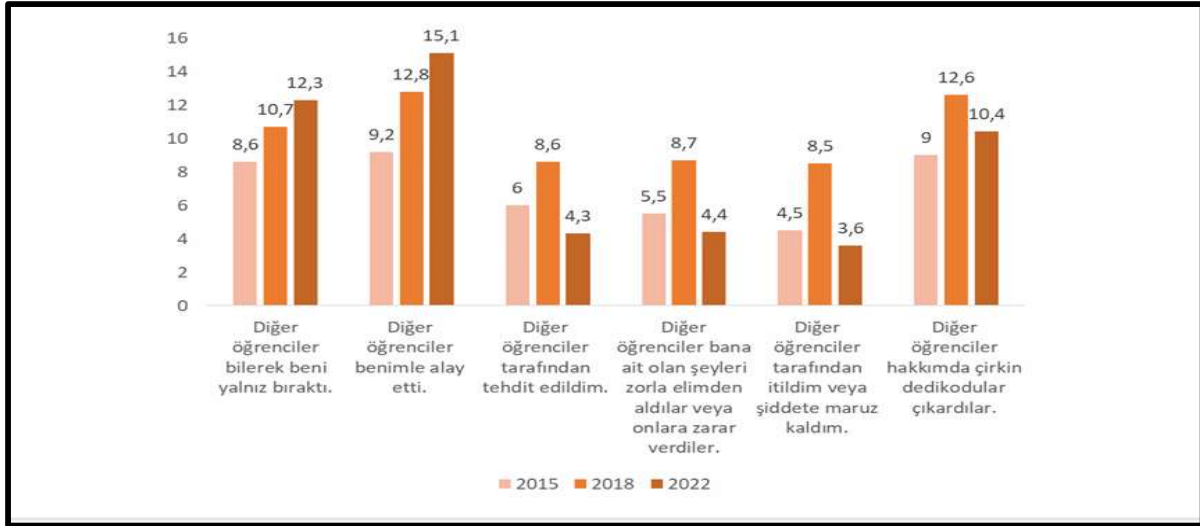


Figure 2. School violence and bullying in Türkiye according to PISA data (2015-2018-2022) (Ministry of National Education. PISA 2022 Türkiye Report. Ankara: MEB, 2023).

Aggression and Violence in Terms of Psychoanalysis and Psychoanalytic Psychotherapies

While some of the psychoanalytic and psychoanalytically oriented psychotherapy theories that examine human aggressive and violent behaviors argue that these behaviors are instinctive, others argue that the constructive aggression inherent in the individual evolves into a negative one for several reasons.

In reality, aggression and violence are often used interchangeably. However, there are differences between these two concepts. Aggression is a phenomenon that can contain elements of violence that have offensive, obstructive, and destructive purposes on the individual. It is directed at and expresses the mental and psychological state of the person. Violence refers to a state of aggression that has been turned into action. In other words, while violence refers to the behavior and movements exhibited, aggression reflects the mental state and emotions of the individual. Various approaches explain the process of aggression seen in individuals and the resulting violent behaviors. These approaches mostly explain destructive behaviors. In general, biologically based approaches, instinct-based approaches, sociologically based approaches, psychologically based approaches, and psychosocially based approaches are used to explain aggressive and violent behaviors. The approaches that explain aggressive and violent behaviors are given in Figure 3.



Figure 3. Approaches to explaining aggression and violent behavior

"Family, school, peers, and social environment" play important roles in children learning violence and finding a ground to implement it. According to Bronfenbrenner's (1994) Ecological System Theory, individuals' development and behaviors are shaped by the norms and understandings they obtain from "family learning, peer relationships, interactions with school and social inputs such as the media."

The theory defines five environmental systems (Microsystem, Mesosystem, Exosystem, Macrosystem, and Chronosystem) and reflects their effects on individual development. The individual's social environment consists of various layers, from micro to macro, and these layers affect the tendency to aggression and violence.

The family and school environment constitute the microsystem of children and adolescents. The microsystem, which refers to the closest social and physical environment to children and adolescents, affects psychosocial development and maturation. While healthy interpersonal relationships, success, and emotional and social support protect the individual, low-level interpersonal interactions can result in fighting, substance use, ganging, and slang.

The socio-cultural environment forms the mesosystem. The mesosystem includes the neighborhood and district culture where the child and adolescent live, the general structure of the schools in that neighborhood, education level, family relations, relatives, etc. If the microsystems function well and are harmonious, the individual will not tend to risky behaviors. However, if microsystems adopt and approve different values, a potential danger arises for the individual.

The exosystem defines the general official and private administrative structure that encompasses the mesosystem. Elements such as school administration, provincial and district national education directorates, municipal activities for young people in the neighborhood where the individual is located, etc., constitute the exosystem. The exosystem directly affects the daily life of the child and adolescent and whether they exhibit risky behavior.

The macrosystem refers to the highest level of institutional, political, religious, economic, and educational organizations and their effectiveness. According to Smith, Hayes, and Lyons (2017), the macrosystem includes the individual's culture and values, which are generally revealed in policies, such as the violence prevention projects implemented by the Ministry of National Education on a national scale.

The chronosystem, located in the outermost layer, represents important temporal processes. While wars and economic crises are experienced in the country, waves of migration constitute the collective chronosystem, parental separation and loss, and individual traumas constitute the individual chronosystem elements. According to ecological theory, each individual is affected by personal, familial, environmental, and social factors. These factors pose a risk for violent behavior, and protective factors also increase the risk of violent behavior.

Effects of Family and Pedagogical Communication on School Violence

A study conducted with 1,082 adolescents to determine the effect of interpersonal communication between parents and teachers on adolescent aggressors and victims in the school environment determined that aggression in adolescents at school differed according to interpersonal communication with parents and teachers and gender. At the family level, aggressive communication between parents and children was found to lead to an increase in school victimization. At the pedagogical level, it was determined that teacher communication aimed at disciplining students and making them see the importance of school and learning resulted in decreased aggressive behavior and adolescent school victimization. The findings prove the need to strengthen interpersonal communication between students, their parents, and teachers to achieve better results when implementing intervention strategies and prevention of school violence.



Figure 4. Specific outcomes of family and pedagogical communication related to school violence (<https://www.revistacomunicar.com/html/63/en/63-2020-07.html>)

The types of violence commonly seen in social work organizations such as schools are classified into five different categories. These are;

- 1- **Violence aimed at preventing the individual from showing himself/herself and communicating:** verbal threats, scolding, being disturbed by phone calls, being interrupted, not being given the right to defend himself/herself, being denied a relationship through insinuations, being shouted at face, etc.
- 2- **Violence against social relations:** a group ignoring the individual, ignoring the individual by not talking to anyone, separation from the workplace, isolation, etc.
- 3- **Violence against reputation and honor;** gossiping and backbiting about the individual, belittling their efforts, making fun of them, calling them names, imitating their speech, walk, and movements, making fun of their religious and political views, making sexual insinuations and mocking individuals' disabilities.
- 4- **Violence against the quality of life and professional position;** giving individuals excessive work that is not appropriate for their status and duties or not giving any work at all, taking back the work presented, not giving a specific task, giving work that will negatively affect self-confidence, harming the home/work environment or causing financial burden.
- 5- **Direct violence against health:** includes behaviors that are intended to humiliate and ridicule individuals, and that may harm their physical and mental health, such as heavy work that may cause physical harm to individuals, threats of physical harm, physical jokes, use of mild violence to intimidate, and direct sexual harassment.

Many different factors create violence against children in daily life. Table 1 shows the elements that create violence against children and their effects on the child.

Table 1. Elements of Violence Against Children

Deliberate use of force	Threat or actual force	By an individual or a group	Actual or potential damage	Effect on child
Physical	Written	Parents	Physical	Survival
Economics	Verbal	Extended family members	Mental	Development
Political	Emotional	Friends	Emotional	Dignity
Social	Social	Community	Cognitive	Health
Cultural		Caregivers	Social	
Sexual		Educators		
		Service Providers		
		Other		

Some children are at higher risk of exposure to violence. The groups of children at high risk of exposure to violence are listed below;

- Children who do not live with their biological parents and are in various forms of alternative care,
- Those who are not registered at birth,
- Children living on the streets,
- Those who are in actual legal trouble or are likely to be in such a situation,
- Those with physical, sensory, learning-related, psychosocial disabilities, genetic, acquired and/or chronic diseases or severe behavioral problems,
- Indigenous people and members of other ethnic minorities,
- Lesbians, gays, transgender and transgender people.
- Those who may be subjected to harmful traditional practices,
- Those who marry very young (especially girls, but not limited to forced marriages),
- Child laborers,
- Children who are on the move as migrants, refugees, internally displaced and trafficked persons,
- Children who are exposed to violence,
- Those who are subject to or witness violence in their homes and communities,
- Those who live in environments where firearms, drugs, and alcohol are readily available,
- Children living in urban settlements with low socioeconomic status,
- Those living in environments that are prone to accidents or disasters or are toxic,
- Children affected by HIV/AIDS or who are HIV positive,
- Those who are malnourished,
- Children whose caretakers are children,
- Children who take on the role of caregivers or act as the head of their household.
- Children of parents under the age of 18,
- Unwanted, premature, or twin-triplet babies,
- Those who are hospitalized and are not well cared for or cannot contact their caretakers,
- Children who use information and communication technologies without adequate security, supervision, or tools to protect themselves.

EFFECTS OF SCHOOL VIOLENCE

Data has shown that risks such as school violence, bullying, and insecurity have many adverse effects on education in the short or long term. Such risks can worsen students' physical and emotional health and negatively affect their academic and social success. Unfortunately, these traces can also be felt in their work and family life when they reach adulthood. At the same time, children and adolescents who are frequently subjected to bullying and violence experience a decrease in school satisfaction and sense of belonging.

It is not possible for a child not to be affected by violence in a psychological and developmental sense; every experience of violence leaves psychological scars on the child to varying degrees. The effects of violence on children can last for many years, and even years later, violence can disrupt the child's quality of life.

Short and long-term effects of school violence;

- Affecting intelligence development due to adverse outcomes in brain development and cognitive processes,
- Problems related to learning,
- Physical health problems such as injuries, fractures, etc.,
- Problems and deviations in personality development,
- Using alcohol or drugs,
- Exhibiting risky behaviors such as having sexual intercourse at a very young age,
- Difficulty in relationships with other people,
- Severe mental disorders or mental health problems (Post-Traumatic Stress Disorder, Depression, Anxiety Disorders, etc.),
- Desire to kill,
- Risk of death and disability.

EFFORTS TO FIGHT AGAINST SCHOOL VIOLENCE

The protection of children from all forms of violence is a fundamental right guaranteed by the Convention on the Rights of the Child, as well as other international agreements and standards. In this context, different institutions, organizations, and states make various legal arrangements and recommend that certain measures be taken to protect children from violence.

In this regard, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has shared the most comprehensive study ever conducted on violence and bullying in schools and emphasized the precautions that need to be taken. The End Violence Youth Manifesto, written by more than a hundred young people from all over the world who came together in December 2018, drew attention to "the daily dangers that young people face in schools, including fights, pressure to join gangs, physical or online bullying, sexual harassment and, armed violence." The manifesto was prepared within the scope of the "Safe Learning" campaign carried out in collaboration with UNESCO, the United Nations Children's Fund (UNICEF), the United Kingdom's Department for International Development (DFID), the Global Partnership to End Violence Against Children and the United Nations Girls' Education Initiative (UNGEI), which aims to end violence in schools and their surroundings, and the following recommendations were made for parents, guardians, schools, policymakers and communities;

- Taking students seriously, setting clear rules, enacting laws restricting guns, ensuring safety in and out of school, increasing security in schools, educating teachers and counselors on relevant issues, teaching compromise, and taking action against sexual violence,
- Encouraging students to be kind, report violent incidents, and take action themselves,
- Ensuring diversity and tolerance in schools regarding culture, gender, identity, disability, sexual orientation, citizenship, race, ethnicity, immigration status, and different religious beliefs,
- Protection for all students, including those who have experienced violence and those who exhibit violent behavior.

In addition, today, School-Based Prevention and Intervention Programs have been designed to address the problems that young people face both in and out of school and teamwork, especially the role and importance of the school health nurse in the team, has been emphasized in the successful implementation of these programs.

THE ROLE AND RESPONSIBILITY OF THE SCHOOL HEALTH NURSE IN PREVENTING VIOLENCE

School violence is the most common cause of mortality and morbidity among young people in our country and around the world. In addition to the academic failure of children and adolescents, violence also negatively affects their physical and psychosocial health, thus deteriorating public health.

Preventing school violence and treating the perpetrators and victims requires a multidisciplinary team approach. School health nurses play an effective role in school violence prevention training, case finding, guidance and counseling for victims of violence, and raising awareness in the school community. Violence is often seen as a subject area of the police or the judicial system and has not been the focus of health workers. However, studies on the problem draw attention to the cooperation of many sectors, especially the active role of health personnel in preventing school violence.

The International Council of Nurses (ICN) determines a theme for Nursing Week each year, and nurses worldwide work in this direction. In 2001, ICN determined the theme "Nurses are always against violence, for you" to draw attention to nurses' role in preventing violence. As can be understood from this theme, nurses have important roles and responsibilities in preventing individual and social violence.

According to the Behavioral Ecological Model, in cases of school violence, the person closest to resolving the incident is the "School Nurse." The school health team consists of a physician, nurse, teacher, student parent, psychological counselor, guide, psychologist, social worker, and dietician.

"While achieving the goals of school health services, which are to ensure and maintain the best possible physical, mental, and social health for all school-age children in the community, to support the development of schoolchildren in a healthy and safe environment, and to improve the health levels of children, their families, and the community, nurses can also easily identify children who are reluctant to attend school, have frequent absences, and are subjected to bullying due to physical stress symptoms such as headaches, vomiting, sleep disorders, concentration difficulties, urinary problems (incontinence, enuresis), and night terrors."

Nurses ask indirect questions to children such as "how things go at school, whether they like going to school, their relationships with their friends, whether they participate in group games, whether their friends choose them for these games or not, whether they use computers and phones" and evaluate the answers they receive to determine the bully and victim. In identifying the victims, identifying physical bruises, asking whether they constantly ask for money from their families or whether they frequently lose valuable clothing or accessories (such as shoes, watches, and ties) are helpful in diagnosis. In this context, the American Association of Pediatrics and the National Association of School Nurses have published reports that include the responsibilities of school nurses in cases of school violence. In these reports, the responsibilities of the school nurse are stated as:

- Identifying at-risk families and children,
- Educating students, families, and school staff,
- Being a positive role model,
- Participating in legal activities required to provide a safe school environment for children in school,
- Taking initiative to develop children's self-esteem.

Briefly, the school nurse's role in violence and bullying is defined in four dimensions. These are,

- Making a diagnosis; diagnosing the behavior,
- Providing counseling; implementing programs to prevent bullying in cooperation with the school and family,
- Being preventive; implementing programs to protect and improve health,
- Conducting scientific research, developing new measurement tools, and implementing initiatives and strategies to prevent bullying.

The school nurse also ensures service coordination by collaborating closely with team members. School nurses and students have a closer relationship than other school personnel. The American School Health Association (ASHA) defines the School Health Nurse as a professional member responsible for caregiver, educator, consultant, case manager, advocate, and researcher activities. In countries such as America, Canada, Sweden, and Norway, where health services are developed, school nurses, whose education and duties are legally determined, undertake important roles in school health services. The duties and responsibilities of the school nurse should be shaped according to each country's conditions and legal system. In our country, The "Nursing Law" was amended in 2007, and nurses' duties, authorities, and responsibilities are determined according to their educational status and field of work. "School Nursing" was defined as a field of work in the "Regulation on Amendments in the Nursing Regulation" published in the Official Gazette dated April 19, 2011, and numbered 27910. Accordingly, Among the 22 job descriptions of school nurses are the duties of "The school nurse ensures cooperation with teachers and families of students who have problems with substance addiction, eating disorders, attention deficit, learning difficulties, depression, anxiety, antisocial behavior, aggression, and conducts health counseling in relevant cases." However, unfortunately, in our country, the failure to systematically plan and implement school health services, which are an important part of preventive health services, or the lack of continuity in the service, and the lack of widespread school health nursing, in other words, the lack of a planned and continuous health service aimed at a healthier society and school health, cause students at school to encounter violence risks and their health to be negatively affected.

The first stage of school health nurses being able to prevent violent behaviors in schools will be possible by employing full-time nurses with at least a bachelor's degree who are trained in school health services in each school. Thus, the school health nurse first defines the problem by investigating the causes, types, nature, when, where, how, and by whom the crimes and violent incidents committed in the school are committed within the scope of the nursing process. They evaluate both the individual and the family and the psychosocial environment in terms of risk factors in terms of violent behavior. Defining the problem facilitates the analysis of violent incidents and ensures that the measures against violence are problem-oriented. In this way, a more effective process is operated, and a database is created that reveals the violent status of individuals in each school. This contributes to the monitoring of individuals and the holistic evaluation of the school community. As a result of the analysis of the obtained data, the characteristics of violence,

its frequency, and the characteristics of those who perpetrate and those who suffer from violence are determined, and decisions are made regarding which issues require how much effort and what kind of strategies should be applied for solutions. In this process, it would also be helpful to determine the feelings, thoughts, and attitudes of the stakeholders (school staff, students, parents, etc.) regarding violence through observation, interview, survey-type measurement tools, and appropriate research methods.

The initiatives to be carried out by the school health nurse within the framework of primary, secondary and, tertiary protection steps;

Primary protection

It aims to take precautions to prevent violent behavior from occurring in schools. To achieve this goal, nurses identify risk groups and the problem, then provide health education to help students develop problem-solving and coping skills, learn conflict resolution techniques, and develop a positive self-perception (the feeling of being valuable and important as a human being).

In school nurse training programs, the content of the training is prepared by the characteristics of the developmental period of the youth; visual figures, pictures, and videos are used to explain the importance of the subject, making it easier for the adolescents to remember by using clear and understandable language. In addition, scenarios are used in programs developed to prevent violence, helping the students gain information about what to do when faced with violent behavior and motivating them to take initiatives to prevent violent behavior. In an intervention study conducted in our country to prevent violence at school, it was determined that the anti-violence training given to the experimental group of students for two lessons for five weeks caused an increase in the mean scores of conflict resolution methods in favor of the experimental group and a significant decrease in the mean scores of violence tendency and violent behavior. It was concluded that the training given by the nurse was practical.

School nurses should also show children and adolescents that there are other approaches to solving interpersonal problems other than violence through conflict resolution programs. With these programs, they should inform adolescents about violence, conflict and, disagreement, ensure that they live in harmony with their peers, and develop anger management, stress management, self-esteem and, communication skills. They should explain to children and adolescents that coming to school with tools or equipment that could be considered crime items is prohibited.

The nurse should take into account the family structure of the student in dealing with violence and ensure that families at risk of violence (broken family, subject/witness to domestic violence) participate in a violence-coping program.

Adult supervision should be increased in areas of the school that are considered less safe to prevent violence. The school nurse should monitor the regular mental health screenings of adolescents and ensure that their peers respond appropriately to violence by collaborating with student leaders (by creating a peer group power) at school.

Nurses and teachers should emphasize the benefits of social, cultural, and sports activities at school, encourage them to increase their number, and support students' participation in these activities, thus transforming negative energy into positive energy.

School administrators should also know the approach to students and legal procedures well when faced with such a situation and should not hesitate to punish and implement them in terms of deterrence.

Secondary protection

Secondary prevention includes early intervention to reduce the discomfort or long-term effects of violence and aims to stop violence. The nurse undertakes the duty of identifying and immediately intervening in children and adolescents at risk of violent behavior and those who perpetrate violence, providing care for injuries resulting from violence, and directing those who need advanced assistance to appropriate health institutions where they will receive appropriate care.

School health nurses should perform the role of "case detection" to reveal the students who have been subjected to violence among those seeking treatment in the school infirmaries for reasons such as injuries, bleeding, and hurts. In this role, school nurses should work to reveal the frequency and characteristics of hidden violence occurring in schools and to ensure that the perpetrator and the victim receive treatment and counseling.

School health nurses should ensure that students who have been subjected to violence receive individual or group psychological counseling and evaluate all information reported or suspected when a violent incident occurs. Students who frequently apply to the school infirmary due to psychosomatic complaints (such as sleep disorders, headaches, and stomachaches) and physical complaints (such as hitting, hitting, and injuries) should be evaluated for exposure to violence.

School nurses should encourage students who have been subjected to violence to share their feelings, develop new friendships, or maintain existing friendships. In cooperation with the school administration, these students should be supported to become members of sports or art clubs, and opportunities should be created for them to develop their social skills and increase their self-esteem.

Violence is also learned through modeling. Teachers should be made aware not to engage in behaviors such as slapping, scolding, humiliating, and insulting, which can easily be modeled by students because the teacher's demonstration of these behaviors can lead students to consider violence acceptable. Those who use violence must be addressed. Children and adolescents who resort to violence are those who cannot control their anger, have difficulty expressing themselves, and often think that there is no other option for solving the problem. Suppose these children and adolescents are taught to control their anger appropriately, and their problem-solving skills are developed through health education programs. In that case, they have been observed to avoid violent behavior.

Tertiary protection

It covers the healing and rehabilitation processes of children and adolescents who have been harmed by violence or who have committed violence. Group support is provided to the victim of violence by counseling the student and family. The individual is supported in expressing himself/herself without using violence and using problem-solving skills. To prevent and reduce violence in schools, an understanding that does not tolerate violence should be created. For this,

every child and adolescent should be made to take responsibility and make an effort not to exhibit violent behavior.

When evaluated in all these aspects, school violence is one of the most important problems of our age that threatens children and adolescents and needs to be solved urgently. A multidisciplinary team approach is needed in which the nurse plays an active role in preventing school violence.

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THE ROLE OF THE COMMUNITY HEALTH NURSE IN THE PREVENTION OF JUVENILE DELINQUENCY

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ABSTRACT

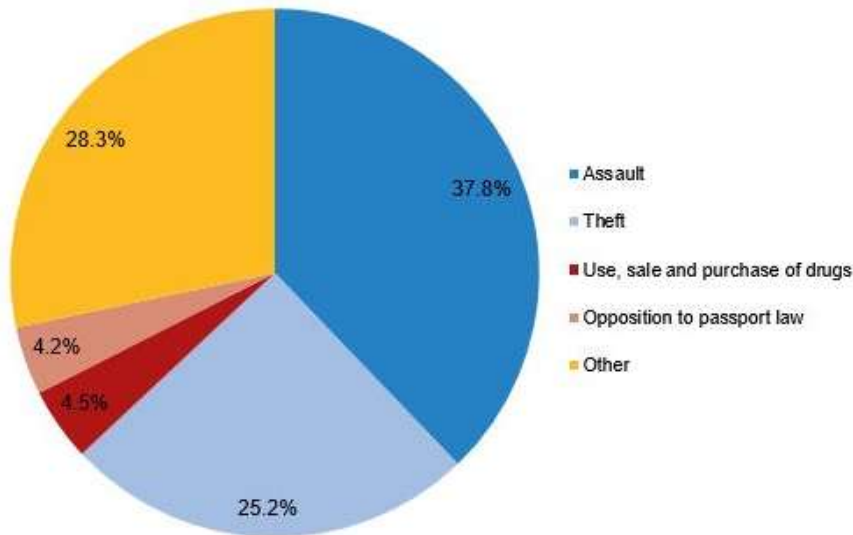
The definition of crime by the Ministry of Justice is acts that are accepted by legislature as harmful to society and dangerous, and therefore subject to punishment or security measures. A child pushed into crime is a child who is investigated or prosecuted for allegedly committing, or who is subject to security measures due to the act he committed. According to TUIK 2022 data in our country, 206,853 incidents involving children who came to the security unit occurred due to being dragged into crime. It has been determined that the number of incidents involving children coming to security units will increase by 20.5% in 2022 compared to 2021. It has been determined that the number of incidents involving children coming to security units will increase by 20.5% in 2022 compared to 2021. Of the children coming to the security unit, 37.8% were charged with injury, 25.2% with theft, 4.5% with using or buying drugs or stimulants, 4.2% with violation of the passport law, and 4.1% with threats. Juvenile criminals dragged into crime are divided into two main classes. Group that violates criminal laws: those who commit acts such as murder, forcible rape, robbery, or aggravated assault. These crimes are called “crimes of violence”. The second subcategory consists of criminals who participate in theft, motor vehicle theft, embezzlement, receiving or possession of stolen property, arson, fraud, drug-related activity, and sexual crimes. These crimes are known as “property crimes.” In our country, according to the Turkish Penal Code, the age limit for criminal liability of children is 12 years old. Children under the age of 12 are not criminally responsible. However, safety measures specific to children may be applied. According to TUIK 2022 statistics, distribution of children brought to security units and dragged into crime by age groups and gender, the majority of children dragged into crime are boys between the ages of fifteen and seventeen, followed by children between the ages of twelve and fourteen. Risk factors that cause a child to be dragged into crime include; individual, family, school, peer group, and society risk factors. Interdisciplinary work should be done. Children dragged into crime cost society a lot. These children require multidimensional services such as protective preventive programs, social work practices, mental health services, and family counseling. Collaborating with families and young people at the family (micro) level. It is important to make families and young people aware of the consequences of their behavior through educational programs, at the immediate environment (meso) level, cooperation with organizations, police headquarters, efforts to re-educate, and school-family cooperation. At the Social/Political (Macro) level, public health nurses should be aware of the growth of juvenile delinquency in society and its dangers, conduct social studies for families in need, investigate the reasons that push children to crime, ensure that employees in family health centers are aware of the problem.

INTRODUCTION

According to Article 3 of the Child Protection Law (No. 5395), a child is defined as a person who has not yet reached the age of eighteen, even if he/she becomes an adult at an earlier age (<https://www.mevzuat.gov.tr/mevzuatmetin/1.5.5395.pdf>). The definition of crime by the Ministry of Justice is as follows: acts that violate or endanger the existence of a society; living conditions or the basic benefits of individuals and society; acts that are accepted by the legislator as harmful or dangerous to society and therefore subject to penalties or security measures (<http://adlisicil.adalet.gov.tr>). A child dragged into crime is defined as a child who is investigated or prosecuted on the grounds that he/she has committed an act defined as a crime by law, or a child for whom a security measure has been decided due to the act he/she has committed (<http://adlisicil.adalet.gov.tr>). According to TUIK 2022 data in our country, 206,853 of the incidents involving children who came or were brought to security units were due to being dragged into crime. 37.8% of these children were charged with wounding, 25.2% with theft, 4.5% with using, selling or buying drugs or stimulants, 4.2% with the crime of violating the passport law, and 4.1% with threats. It was determined that the number of incidents involving children who came or were brought to security units increased by 20.5% in 2022 compared to 2021. According to the TUIK 2022 report, the distribution of children brought to security units who were dragged into crime is given according to the type of crime attributed to them (Figure 1).

Figure 1. According to the TUIK 2022 report, the distribution of juveniles pushed into security units who were dragged into crime is given according to the type of crime.

Distribution of juveniles pushed into crime by type of offence being charged (%), 2022



The figures in the chart may not give the total due to rounding.

MAIN CLASSES OF JUVENILE OFFENDERS

There are two main classes of juvenile offenders who are drawn to crime. The group that violates criminal laws: those who commit acts such as murder, forcible rape, robbery, aggravated assault. These crimes are called “crimes of violence”, and the second subcategory consists of offenders who participate in theft, motor vehicle theft, embezzlement, receiving or possessing stolen property, arson, fraud, drug-related activity, and sexual crimes. These crimes are known as “property crimes”. (Shabani, 2019 p. 107). The second important group is “status crimes” consisting of running away from home, escaping from school, not obeying parental authority or a private teacher, and not complying with curfew. It has been reported that the acts committed in this category are criminal acts if the perpetrators are legally accepted as children (Whitehead and Lab. 2013). These children are considered “children in need of supervision” (Shabani, 2019, p. 107). According to Article 31 of the Turkish Penal Code No. 5237, the age limit for children’s criminal liability is stated as 13 years of age in our country. Children who have not reached the age of 12 are not criminally responsible. However, security measures specific to children may be applied. In the event that the ability to perceive the legal meaning and consequences of the act committed by those who were twelve years old but under fifteen years old at the time of the act is considered, or to direct their behavior, a sentence of twelve to fifteen years is imposed in the case of a crime that requires aggravated life imprisonment; in the case of a life imprisonment, a sentence of nine to eleven years is imposed. In the case of persons who were fifteen years old but under eighteen years old at the time of the act, a sentence of eighteen to twenty-four years is imposed in the case of aggravated life imprisonment; in the case of a life imprisonment, a sentence of twelve to fifteen years is imposed. (TCK, 2004, Article 31). Table 1 shows the number of incidents involving children dragged into crime and brought to security units according to type of victimization and gender, according to TUIK 2022 statistics.

In addition, according to the TUIK 2022 data, it was seen that the majority of children dragged into crime were between the ages of 15-17, the majority of whom were boys, followed by children between the ages of 12-14. As can be seen in Table 1, girls are more likely to be victims of sexual crimes than boys.

RISK FACTORS CAUSING CHILDREN TO COMMIT TO CRIME

Risk factors that cause children to commit crime include individual, family, school, peer group and community-related risk factors. These risks are presented in Table 2.

Risks during pregnancy and early infancy: Failure to develop a healthy parent-child relationship from infancy, the family's inability to discipline their child, to set limits on their behavior, parental substance use, and frequent changes of caregivers can cause these children to be limitless, irresponsible, unable to realize the consequences of their behavior, and lack of trust. In the United States, home visits by nurses to low socioeconomic status families and single parents to monitor mothers and babies up to two years of age after birth have been shown to be very beneficial, and a 15-year follow-up study of these visits found that mothers and children who participated in the program had a 79 percent lower rate of child abuse, a 56 percent lower rate of children running away from home and school, and a 56 percent lower rate of child arrest (delinquency). It was also shown that maternal behavioral problems in the study group decreased significantly (Olds et al., 1998). The preschool period is critical in terms of providing a foundation for preventing the development of destructive behaviors and, as a result, juvenile delinquency. Although the majority

of children who are drawn to crime have a history of destructive behaviors such as aggressive, careless, or impulsive behaviors during the preschool period, it has been stated that not every child has the potential to be drawn to crime, and that one of the factors affecting this may be the child's increased stress level due to delayed language development, preventing normal socialization, another may be negative moods such as anger and difficulty controlling behavior, and insecure attachment in mother-infant attachment (Loeber et al., 2003). It has been argued that the closer the child is to his/her mother, the lower the risk of being caught in crime (Loeber et al., 2003).

Table 1. The number of incidents of juveniles who received into security unit, by type of victimization and gender, 2021-2022

Type of victimization	2021			2022		
	Total	Male	Female	Total	Male	Female
Victim	207 999	112 609	95 390	259 106	141 493	117 613
Victim of crime	186 014	99 597	86 417	232 739	125 887	106 852
Homicide	1 187	741	446	1 990	1 318	672
Assault	106 742	68 149	38 593	136 094	87 517	48 577
Sexual offences	24 432	3 109	21 323	31 890	4 151	27 739
Threat	8 387	3 596	4 791	11 200	5 044	6 156
Kidnapping	5 512	1 125	4 387	7 412	1 568	5 844
Violations of housing immunity	210	86	124	333	127	206
Defamation	2 790	1 120	1 670	3 515	1 375	2 140
Theft	3 437	2 484	953	5 423	3 902	1 521
Robbery	2 057	1 823	234	3 622	3 276	346
Damage to property	473	284	189	713	465	248
Offences against public morality	1 035	412	623	1 016	421	595

Risks related to school years: Poor academic achievement, grade repetition, truancy, negative attitudes towards school, and inadequate guidance services for young people due to poor organization and poor school management may be problems.

Risks during adolescence: Gördeles and Çam (2009) conducted a structured study with adolescents, 73% of whom were male, who came to the police station because of a fight and received disciplinary punishment, and it was stated that although the adolescents' mental states were normal and they had a positive relationship style, they experienced problems due to angry outbursts due to emotional fluctuations and encountered problems due to the lack of people with whom they could positively identify (Gördeles and Çam, 2009). In a study examining 6914 children who were dragged into crime in the Central Black Sea region of our country, it was determined that boys were dragged into crime more, most of them were between the ages of 15-17, approximately one-third used substances and the vast majority were introduced to various addictive substances, and according to the characteristics of the crime attributed, it was seen that children committed the crime of wounding the most (Pelit and Alkan, 2022). According to crime statistics in the USA, children who are drawn to crime between the ages of 7 and 12 are reported to be two to three times more likely to become serious, violent and chronic criminals than adolescents whose criminal behavior begins in adolescence, and this is alarming for society (Loeber et al., 2003).

THE ROLE OF THE COMMUNITY HEALTH NURSE AND PREVENTION LEVELS

The application of punishment to children who are dragged into crime is not considered sufficient to reintegrate the child into society. It is important to investigate the ways to win these children over and to examine them sociologically. The solutions are as social as legal (Baysan Arabacı and Taş, 2017). In addition, these children who are dragged into crime are at high risk in terms of firearm injuries, drug use, alcohol use, unsafe sex, teenage pregnancy, mental health problems and other health-related problems (Baysan Arabacı and Taş, 2017). Interdisciplinary work should be done. Children who are dragged into crime are very costly to society. These children require multidimensional services such as protective and preventive programs, social service practices, mental health services and family counseling (Loeber et al., 2003; Shabani, 2019. p.107).

At the micro level, cooperating with families and youth. It is important to make families and youth aware of the consequences of their behaviors through educational programs, to make them aware of their health needs, to plan activities that encourage hope and create opportunities for youth. After-school free time activities and sports, dance, music, rock climbing, drama, karate, bowling, art and other activities will prevent children from getting involved in crime.

At the meso level, cooperating with organizations, police stations, efforts to reintegrate them into education, school-family cooperation. Preventive initiatives against bullying behaviors in schools, providing conflict management and anger management training.

At the social/political (macro) level, communities and societies have important roles such as raising awareness about the growth of the phenomenon of juvenile delinquency and its dangers, carrying out social service activities for families in need, combating the causes of child delinquency, healthcare professionals working in family health centers being aware of the problem, spending more time with the families under their care, and working with families with problems (Shabani, 2019).

Table 2. Risk factors causing children to become involved in crime

	Pregnancy-Early Infancy	From infancy to 12 years	13-18 ages
Children	<ul style="list-style-type: none"> -Pregnancy and birth complications -Neurological insult -Postnatal exposure to neurotoxins -Difficult temperament -Hyperactivity/impulsivity/ attention problems -Low intelligence -Male gender 	<ul style="list-style-type: none"> -Aggressive/destructive behavior -Persistent lying -Risk taking and thrill seeking -Lack of guilt, -Lack of empathy 	<ul style="list-style-type: none"> -Theft and general criminal involvement -Early onset of destructive behavior -Early onset of substance use and sexual activity -Depression -Withdrawal behavior -Exposure to violence -Weapon carrying -Drug dealing -Unemployment
Family	<ul style="list-style-type: none"> -Maternal smoking/alcohol consumption/drug use during pregnancy -Young mother -Frequent changes in caregiver -Inadequately educated parent -Maternal depression -Parent substance abuse/antisocial or criminal behavior -Poor parent-child communication -Poverty/low socioeconomic status Serious marital discord -Large family size 	<ul style="list-style-type: none"> -Hard and/or irregular discipline practices -Abuse or neglect 	<ul style="list-style-type: none"> -Inadequate parental supervision
School		<ul style="list-style-type: none"> -Poor academic performance -Grade repetition -Trunking -Negative attitude towards school -Poorly organized and poorly managed school 	<ul style="list-style-type: none"> -Dropping out of school
Peers		<ul style="list-style-type: none"> -Peer rejection -Relationship with deviant peers/siblings 	<ul style="list-style-type: none"> -Friends in a criminal group -Gang groups
Community		<ul style="list-style-type: none"> -Media coverage of violence 	<ul style="list-style-type: none"> -Residing in a disadvantaged neighborhood -Residing in a disordered neighborhood -Having access to a gun

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SENTENCING CRIMMIGRANTS: TÜRKİYE AND THE EU PERSPECTIVE

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ABSTRACT

This paper explores the sentencing of immigrant offenders in Türkiye and the EU, focusing on the intersection of immigration and criminal law. It examines common crimes committed by migrants, such as theft, drug offenses, and violence, and the legal frameworks governing these offenses. While both regions apply similar sentencing structures, the paper highlights that socio-economic challenges like poverty and unemployment, rather than migration status, are more significant drivers of criminal behavior. The study concludes that migration does not inherently lead to crime; instead, socio-economic conditions play a key role in shaping crime patterns.

INTRODUCTION

Migration is driven by multifaceted factors including conflict, economic instability, and social persecution. Although some commentators contend that migration correlates with increased crime rates, it is crucial to recognize that criminal behavior is influenced by a broader array of factors such as poverty, unemployment, and social exclusion. This paper presents a succinct overview of the sentencing of immigrant offenders in Türkiye and the European Union, summarizing key findings regarding legal frameworks, crime statistics, and the intersectionality of immigration law and criminal law.

CRIMINAL ACTIVITIES IN TÜRKİYE AND THE EU

Reports indicate that migrant populations within the EU are often associated with property crimes such as burglary, theft, and robbery, as well as drug-related offenses, including trafficking and substance abuse. Violent crimes, which encompass assaults, domestic violence, and homicide, have also been noted in specific areas, particularly among migrants who confront socio-economic disadvantages. Moreover, certain migrants may become involved in organized crime, including human trafficking, either as victims or perpetrators.

In Türkiye, statistics from correctional institutions as of December 31, 2022, highlight that the most prevalent offenses include theft, violations of residence security, intentional injury, and drug-related crimes. While notable similarities exist in the types of crimes committed by migrant populations across both regions, it is imperative to acknowledge the substantial differences in the regulatory frameworks governing these offenses.

SENTENCING FRAMEWORKS: TÜRKİYE AND THE EU

The sentencing of foreign nationals in both Türkiye and the EU does not substantially differ from that of domestic citizens. Nonetheless, specific regulations apply to migrants, particularly those engaged in criminal activities. Türkiye's sentencing structure is governed by the Turkish Penal Code and the Law on Foreigners and International Protection, with jurisdiction residing under Turkish Criminal Courts and the Directorate General of Migration Management. In the EU, domestic penal laws such as the Strafgesetzbuch (Germany) and the Code pénal (France), in conjunction with EU directives like the Return Directive 2008/115/EC, outline the sentencing framework. Moreover, the European Arrest Warrant and the European Convention on Human Rights (ECHR) provide further legal stipulations.

The implementation of the European Criminal Records Information System - Third Country Nationals (ECRIS-TCN) by the EU facilitates the sharing of criminal record information about non-EU citizens among member states. This system enhances judicial cooperation and helps prevent identity fraud.

Both Türkiye and the EU enforce deportation policies against foreign nationals convicted of crimes; however, exceptions exist for individuals facing the death penalty, torture, or inhumane treatment in their home countries, as well as those with serious health conditions or victims of human trafficking, who are accorded special legal protections.

REFUGEE CRIME STATISTICS AND PUBLIC PERCEPTION

Statistical data reveals that while refugees may sometimes seem overrepresented in crime statistics, the actual numbers of criminal migrants do not exceed those of native criminals, and socio-economic factors play a far more significant role in shaping these patterns.

Research has shown that migrants are not inherently more predisposed to criminal behavior than native populations. Instead, the effectiveness of integration policies, economic conditions, and the influence of media narratives have a profound impact on public perception and crime rates.

Reports from organizations such as Europol, the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), the European Commission, and Eurojust suggest that the crime patterns observed in migrant populations are often linked to socio-economic challenges rather than immigration status alone. Studies from institutions like the London School of Economics and the Swedish National Council for Crime Prevention emphasize the importance of socio-economic factors in influencing crime rates, asserting that migration status, by itself, does not determine an individual's likelihood of committing criminal acts. Additionally, findings from a study published in the *Journal of Economic Behavior and Organization* and the Center for International Prospective Research and Data further support the conclusion that there is no direct, inherent correlation between immigration and criminality.

CONCLUSION

In conclusion, the relationship between migration and crime in both Türkiye and the European Union remains complex and cannot be simplified to a direct correlation. While both regions have similar types of crimes reported among migrant populations, such as theft, drug-related offenses, and violent crimes, the legal frameworks governing these offenses and the treatment of migrants vary significantly. It is crucial to emphasize that socio-economic factors, such as poverty, unemployment, and social exclusion, play a more significant role in influencing criminal behavior than migration status itself. Research suggests that migrants, as a group, are not inherently more prone to criminal behavior than native populations. Ultimately, it seems that migration itself that leads to criminal behavior, but rather the underlying socio-economic challenges that accompany migration.

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FORENSIC TRANSLATION

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ABSTRACT

Regarding judicial processes, it is important to translate written or spoken texts from different languages into another language in a way that does not cause errors or violations of rights. In order to avoid errors and violations of rights, the terms in the translated languages must be translated in an accurate and understandable manner, as well as by accurately evaluating the semantic differences that may arise in cultural differences and other expressions such as idioms and proverbs. In this presentation, evaluations regarding the translation will be made.

INTRODUCTION

Forensic translation involves the written translation of documents required for administrative, criminal, and legal proceedings in public institutions and courts, as well as the oral translation of statements by parties and officials involved in cases. Forensic translation serves two primary functions:

1. To ensure communication between parties and officials.
2. To allow the judge to access the information content in the case file in a different language.

Forensic documents possess a unique language structure at different levels. When these documents concern specialized areas, language differences, i.e., differences in expression, emerge. At this point, the translator must be highly experienced and equipped in these areas. The consequences of errors in translations made by inadequately trained translators who lack proficiency in the source and target languages can be severe, potentially leading to loss of rights and legal complications.

Translation is not merely replacing a word in the source language with another from a dictionary in the target language. In this context, two types of errors can arise from a lack of knowledge at the linguistic and referential levels: translation and language errors.

ERRORS IN TRANSLATION

Translation errors include:

- Omitting a term in the text
- Skipping a crucial part
- Adding to the text unnecessarily
- Misinterpreting the text's meaning
- Confusing terms that look similar but have different meanings in the target language

Language errors include:

- Using homonyms incorrectly
- Improper word derivation
- Incorrect syntax
- Repetition of words with the same meaning

A major challenge in forensic translation is polysemy, where a word has multiple meanings, leading to misunderstandings and misinterpretations. This issue is considered the most significant problem faced by judicial translators. Polysemy necessitates that forensic translations be carried out by expert translators familiar with both the source and target languages and cultures. Mistakes made by incompetent translators are critical concerns in forensic sciences.

General translation mistakes to avoid include:

- Simple translation errors
- Lack of cultural nuance
- Incorrect tone
- Relying on automatic browser translations
- Inappropriate image use
- Inadequate research
- Failure to identify regional variations
- Using novice translators
- Lack of translation control

Another critical aspect of forensic translation is ensuring equivalence between the source and target languages. Equivalence is the ability of the translated text to have the same effect on the readers of the target language as the original text has on its readers.

EQUIVALENCES

There are four types of equivalences:

1. Linguistic equivalence: Similarity at the linguistic level in both languages, translating word for word.
2. Serial equivalence: Emphasis on the equivalence of grammatical elements.
3. Formal equivalence: Functional equivalence of elements in both languages.
4. Textual equivalence: Importance of form and content equivalence.

In forensic translation, these four equivalences must be considered. One of the challenges is that words, terms, and concepts in the source language may not have direct equivalents in the target language, or the existing equivalents may not fully convey the intended meaning. Therefore, common and technical meanings of the same term, multiple meanings for a single term, and differences in legal cultures must be considered. The aim is to convey the text or expression in the source language with the same effect in the target language.

Methods to achieve this include:

- Expressing concepts indirectly
- Finding functional equivalents in the target language
- Creating new words
- Using the original concepts
- Translating word for word without misinterpretation

Ethical principles are crucial for forensic translators, emphasizing their obligations and responsibilities toward recipients and themselves. These principles are vital in both written and oral translation because judicial decisions directly affect individual rights. Consequently, the translator's behavior and characteristics, such as reliability, competence, impartiality, and respect for duty, are essential.

In Türkiye, the ethical principles for judicial translators are specified in the Regulation on the Preparation of Translator Lists by the Code of Criminal Procedure: "Independence, impartiality, honesty, truthfulness, fulfilling one's duty personally, maintaining confidentiality, and adhering to the fundamental principles of trials" (Official Gazette, 05.03.2013, Issue: 28578). Forensic translators must inspire confidence in recipients, be objective, respect verbal expressions or written text, avoid subjective interpretations, and refrain from altering negative situations for political correctness. Unlike other translation types, forensic translation requires preserving structures, translating every word, avoiding summaries, and maintaining double meanings and ambiguities.

In case of doubt, translators should ignore suggestions and adhere to the text they must translate. The translator's personality, translation style, tone, and translation of slang or insults can lead to different perceptions by judges, witnesses, and defendants, potentially impacting judicial decisions negatively. Impartiality is required to respect the translator's duty, prohibiting translations for relatives or dependents. Translators must maintain professional secrecy and adhere to ethical conduct principles for public officials.

Judicial (sworn) translators are those who are fluent in their native language and another language(s), apply to become judicial translators, and, after verification at all stages, take an oath and begin working in courthouses. The status of these translators is regulated by the Regulation on the Preparation of Translator Lists by the Code of Criminal Procedure in Türkiye, based on Article 202 of the Criminal Procedure Code No. 5271.

CONCLUSION

Forensic translation, both oral and written, is vital for the accurate functioning of the legal process. Regardless of the document or discourse type, translators will encounter linguistic and technical challenges, such as expression form, tone, word levels, and phraseology. Translators must adhere to ethical rules, ensuring minimal loss of meaning, and remain as close to the source text/discourse as possible, similar to a traveler immersing in a foreign culture. The goal is to convey the source text/discourse in the target language with the same effect. Forensic translation demands a multifaceted approach to text/discourse and terminological choice, ensuring the translated document/discourse reflects the source language and judicial system accurately.

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RETURN OF NATIONALIZED PROPERTY IN KOSOVO (RESTITUTION)

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ABSTRACT

It is a study we carried out on "restitution", that is, the return of nationalized immovable properties to the original owners of the new states or state systems, regimes, regimes established in the past in today's Kosovo for the benefit of the state or public. International agreements that regulate the correction of unjust or unlawful expropriations, especially the United Nations Universal Declaration of Human Rights, the European Union Convention on Human Rights and its 1st Protocol, are directly implemented in the country with the Constitution of the Republic of Kosovo.

INTRODUCTION

Socialist systems are based on the nationalization of society's resources and means of production, often affecting individual property rights in the process. The expropriation of private real estate for the state or society leads to debates regarding property rights. In this study, we will examine the arguments and effects of returning expropriated private properties to their original owners in Kosovo, which declared independence in 2008 after breaking away from the Socialist Federal Republic of Yugoslavia in 1992.

REASONS AND CONSEQUENCES OF EXPROPRIATION

Expropriation in socialist systems is generally carried out with the aim of economic equality, fair distribution of resources, and increasing social welfare. However, the process may also have negative consequences by restricting individuals' property rights and economic freedoms. In Kosovo, which was an Autonomous Socialist Region within Yugoslavia, expropriation was often a political decision by the communist party aimed at impoverishing the non-Serb population and forcing them to emigrate. To facilitate this, numerous laws were enacted and implemented.

Debate on the Right of Restitution:

The restitution of expropriated private properties to their original owners is an important issue in terms of justice and property rights. While some argue that expropriation was unjust and that property rights must be respected, others claim that expropriation was necessary for the general interest of society and that restitution is not fair.

Advantages and Disadvantages of Restitution:

For property owners, restitution means reclaiming property rights and receiving fair compensation. However, the restitution process can lead to economic and legal complexities and may conflict with the fundamental principles of the socialist system.

Alternative Approaches:

Possible solutions include compensating former owners or implementing alternative property arrangements. These approaches could preserve the objectives of expropriation policies while also considering the rights of previous owners. Several potential historical dates for compensation exist, each influenced by different levels of political considerations, affecting the quantity and type of properties returned. Possible restitution periods include 1878, 1913, 1929, or 1945.

The restitution of properties covering the period from 1878 to 1912 and beyond primarily concerns properties owned by or taken from Ottoman Turks, lost during the Balkan Wars. Due to the existence and condition of cadastral records from this period, stored in the Ottoman archives in Istanbul, some argue that this period provides the most logical basis for restitution.

Although the best archival evidence exists for this period, implementing restitution would be burdensome for the state and would not reflect the political realities following the outcome of the Balkan War and the 1913 Treaty of London. Furthermore, evidence suggests that the type of land grants issued by the Ottoman sultans resembled usage rights rather than conventional private ownership. If so, it would be difficult to return land to previous owners in the traditional sense of private property rights. There seems to be an inconsistency between the perceived rights of land recipients and the actual rights conferred at the time of allocation.[1]

As a conclusion, the debates on the restitution of expropriated private properties in socialist systems reflect efforts to balance property rights with societal interests. Decisions on this matter must consider justice, economic efficiency, and social welfare.

The Universal Declaration of Human Rights (UDHR) and the European Convention on Human Rights (ECHR)

Both recognize property rights as fundamental human rights. These documents establish certain principles and protections regarding the restitution of expropriated properties:

Universal Declaration of Human Rights (UDHR):

Article 17 states that everyone has the right to own property and that this right cannot be arbitrarily taken away.

Article 17(2) emphasizes that fair and reasonable compensation should be provided in cases of expropriation.

It asserts that expropriated properties should either be returned to their owners or that fair compensation should be provided.

European Convention on Human Rights (ECHR):

Protocol No. 1 guarantees property rights and states that these rights can only be restricted in the public interest and through legal procedures.

The European Court of Human Rights (ECHR) emphasizes that fair compensation should be provided in cases of expropriation and that expropriated properties should be returned to their owners.

The ECHR assesses the legality of expropriation, whether a fair process was followed, and whether compensation was adequate.

These documents and ECHR rulings establish a crucial legal framework regarding the restitution of expropriated properties or the provision of fair compensation. This framework plays an important role in protecting property rights and ensuring justice.

The protection of property rights under the UDHR, ECHR, and related protocols is also guaranteed by Article 22 of the Constitution of the Republic of Kosovo, which states that these documents apply directly and take precedence over any conflicting laws or provisions issued by public institutions.

On March 23, 1989, when the Assembly of the Autonomous Socialist Region of Kosovo was dissolved by Serbia, it began to be governed by the laws of the Socialist Republic of Serbia. In 1981, Serbia amended its Law on the Purchase and Sale of Real Estate and introduced Article 8-a, which had a retroactive effect, allowing individuals to file lawsuits to correct past injustices. Under this law, expropriated properties were returned to Serbian Orthodox churches and monasteries through administrative decisions, while applications for the restitution of expropriated properties belonging to Ottoman-era Islamic endowments and Muslim places of worship were not considered.

Based on this law, claims submitted to the courts resulted in the restitution of expropriated private properties to former owners or their heirs. However, after the 1999 war, the United Nations Interim Administration Mission in Kosovo (UNMIK), established under UN Security Council Resolution 1244 on June 10, 1999, transferred the management of all state and socially-owned properties listed in the cadastral records as of December 31, 1988, to the Kosovo Trust Agency (KTA). On June 15, 2008, Law No. 03/L-067 on the Kosovo Privatization Agency was published in the Official Gazette No. 30 and entered into force. During the privatization process, expropriated properties were sold to new owners through auction without considering restitution to former owners.[2]

The Kosovo Supreme Court began rejecting claims for restitution on the grounds of statute of limitations. Consequently, applications for the restitution of expropriated properties were increasingly denied. Despite the complexity and sensitivity of the issue, the Kosovo Assembly has not included restitution of expropriated properties on its agenda, and a law on the restitution and compensation of expropriated properties in Kosovo has yet to be passed.

During that period, the Serbian government, which clearly acted with discriminatory intent, restored properties to Orthodox churches and monasteries while neglecting the return of properties belonging to the Islamic community, which had been nationalized by the communist regime.

Following Kosovo's separation from Yugoslavia, many properties were expropriated or seized during the war and conflict periods, resulting in the loss of property rights for many individuals. However, Kosovo has legal and institutional frameworks concerning the restitution and compensation of expropriated properties. The Constitution and relevant laws of Kosovo guarantee property rights and foresee compensation for expropriated property owners. Nevertheless, challenges and delays persist in practice.

The restitution and compensation process for expropriated properties in Kosovo is generally managed by the Kosovo Property Restitution and Compensation Commission, which evaluates applications and makes decisions. However, the process can be slow, and difficulties may arise in implementing decisions.

The international community closely monitors the restitution and compensation of expropriated properties in Kosovo. Many international organizations and actors are working to ensure that this process is conducted fairly and effectively.

However, since the political climate for the restitution of expropriated properties in the Republic of Kosovo has not yet been established, the laws that led to the expropriation of private properties have not been repealed. In contrast, the Socialist Republic of Serbia regulated in 2011 that properties expropriated from individuals and certain legal entities and transferred to public, state, social, or cooperative ownership under the following laws of the Democratic Federal Yugoslavia and the Republic of Serbia after March 9, 1945, would be subject to restitution and compensation:

1. Decision on the transfer of enemy properties to state ownership, state administration of the properties of absent persons, and seizure of properties forcibly alienated by occupying authorities ("Official Gazette of the Democratic Federal Yugoslavia," No. 2/45);
2. Law on Agrarian Reform and Colonization ("Official Gazette of the Federal Republic of Yugoslavia," No. 64/45 and "Official Gazette of the Federal Republic of Yugoslavia," No. 16/46, 24/46, 99/46, 101/47, 105/48, 19/51, 42-43/51, 21/56, 52/57, 55/57, and 10/65);
3. Law on Agrarian Reform and Internal Colonization ("Official Gazette of the People's Republic of Serbia," No. 39/45 and 4/46);
4. Law on Agrarian Reform and Internal Colonization ("PRS Official Gazette," No. 5/48, 11/49, and 34/56);
5. Decision on the establishment of a court for the trial of crimes against Serbian national honor ("PRS Official Gazette," No. 1/45);
6. Decision on the court for the trial of crimes against Serbian national honor ("PRS Official Gazette," No. 3/45);
7. Law on the Prevention of Illegal Speculation and Economic Sabotage ("DFY Official Gazette," No. 26/45);
8. Law on the Prohibition of Incitement of National, Racial, and Religious Hatred and Discord ("DFY Official Gazette," No. 36/45 and "FNRJ Official Gazette," No. 56/46);
9. Law on the Protection and Administration of National Property ("DFY Official Gazette," No. 36/45);
10. Law on Confiscation of Property and Execution of Confiscation ("DFY Official Gazette," No. 40/45);
11. Law on the Approval and Amendment of the Law on Confiscation of Property and Execution of Confiscation ("FRY Official Gazette," No. 61/46 and 74/46);
12. Law on Confiscation of War Profits Obtained During Enemy Occupation ("FRY Official Gazette," No. 36/45);
13. Law on the Approval and Amendment of the Law on Confiscation of War Profits Obtained During Enemy Occupation ("FNRJ Official Gazette," No. 52/46);
14. Law on Citizenship of the Democratic Federal Yugoslavia ("Official Gazette of the Federal Republic of Yugoslavia," No. 64/45);

15. Law on Citizenship of the Federal People's Republic of Yugoslavia ("FNRJ Official Gazette," No. 54/46 and 105/48);
16. Law on the Revocation of Citizenship of Former Officers and Non-Commissioned Officers of the Yugoslav Army Who Did Not Return to Their Homeland and Members of Military Formations Who Served the Occupiers and Fled Abroad ("DFY Official Gazette," No. 64/45 and "FNRJ Official Gazette," No. 86/46);
17. Law on Crimes Against the People and the State ("Official Gazette of the Federal Republic of Yugoslavia," No. 66/45 and "FNRJ Official Gazette," No. 59/46, 106/47, and 110/47);
18. Law on the Prevention of Illegal Trade, Illegal Speculation, and Economic Sabotage ("FNRJ Official Gazette," No. 56/46 and 74/46);
19. Law on the Transfer of Enemy Properties to State Ownership and Seizure of Properties of Absent Persons ("FNRJ Official Gazette," No. 63/46 and 74/46);
20. Law on the Procedures Concerning Properties That Owners Were Forced to Abandon During the Occupation and Properties Taken from Them by the Occupiers and Their Collaborators ("DFY Official Gazette," No. 36/45);
21. Law on the Approval and Amendment of the Law on the Procedures Concerning Properties That Owners Were Forced to Abandon During the Occupation and Properties Taken from Them by the Occupiers and Their Collaborators ("FNRJ Official Gazette," No. 64/46);
22. Law on the Protection of Public Properties and State-Managed Properties ("FNRJ Official Gazette," No. 86/46);
23. Law on the Nationalization of Private Commercial Enterprises ("FNRJ Official Gazette," No. 98/46 and 35/48); ...

Based on these laws, properties were expropriated in Kosovo and privatization was undertaken, yet a portion of the properties still retains public ownership status. With Kosovo's declaration of independence on February 17, 2008, and the entry into force of the Constitution of the Republic of Kosovo on June 15, 2008, Kosovo became completely independent from the disbanded Socialist Federal Republic of Yugoslavia and the Socialist Republic of Serbia. Consequently, the political and legal impact of these countries' laws has been nullified. The political structure of the socialist regime in Kosovo and the restitution of citizens who suffered due to these measures should be addressed.

In March 2007, former Finnish President Martti Ahtisaari, appointed by the UN Secretary-General as his Special Envoy for Kosovo's future status process in November 2005, submitted a Comprehensive Proposal for the Kosovo Status Settlement to the UN Security Council. Among the legislative measures deemed mandatory during and immediately after the transitional period was the enactment of a law on restitution (return of expropriated private properties).

After the death of Josip Broz Tito, increasing ethnic conflicts and economic crises made restitution of state-seized properties a concern for many European Council member states. Many countries decided either to return nationalized property or to compensate former owners. The scope and system of these measures varied significantly among states. The European Court of Human Rights ("European Court") holds that the European Convention on Human Rights does not impose general

measures for returning properties seized before its ratification. However, once a state initiates a restitution process, it must comply with the Convention's requirements.

Expropriation in Kosovo led to the collapse of private entrepreneurship, impoverishment of rural areas and farmers, migration to cities, and a massive socialist industrialization drive. Forced expropriation resulted in widespread impoverishment, sustaining a barren socialist economy. In 1995, the EU adopted a resolution prohibiting the admission of states that had not addressed denationalization and restitution issues.

Despite adhering to all conventions, Kosovo and Bosnia and Herzegovina remain the only two successor states of Yugoslavia that have yet to enact legal restitution measures, unlike Slovenia, Croatia, North Macedonia, Montenegro, and Serbia.

Restitution is the return of property or rights unjustly taken from a person, a group of citizens, or an entire class or ethnic group. A restitution framework is essential to ensure fair compensation, whether in kind or financial, for expropriated properties.

It is essential to organize the process of returning the properties taken from them to their private owners (in kind or in monetary form) in the form of adequate compensation or similar, based on the agrarian reform and the regulations on colonization, confiscation (forced seizure) and nationalization and expropriation.

Return of unjustly taken real estate: The Rule of Law is important for the correction of unlawful acts and the establishment of justice. It is necessary to protect the right to property and to prevent arbitrary seizure of individuals' properties. The lawful actions of the state and public institutions increase the sense of trust in society.

The process of returning the expropriated real estate to their former owners fulfills one of the fundamental human rights of citizens defined in the UN Universal Declaration of Human Rights, the European Union Convention on Human Rights and its First Protocol, namely the right to freely enjoy private property. There are many challenges in the development and implementation of such a law in Kosovo. The main challenges include budgetary concerns, determining the period that the law will cover, establishing a methodology for assessing claims, and ensuring compliance with the Kosovo Property Agency (KPA) and Kosovo Privatization Agency (KPA) regimes. However, the issue of restitution may arise in the process of Kosovo's accession to the European Union.

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ABSTRACTS

DENTAL AGE ASSESSMENT THROUGH LEARNING MACHINE APPROACH

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ABSTRACT

Background: Dental age assessment using convolutional neural networks remains unexplored and immature (3). This pilot study aims to investigate the possibility of using artificial intelligence-based methods in age assessment in the Portuguese Population.

Objective: The main objective is to establish the most suitable anatomical tooth stage to perform dental age assessment through several scoring systems and age estimation methods. To achieve this objective, deep learning techniques are used, namely convolutional neural network (CNN) methodologies for age estimation. Once implemented, the accuracy and precision of the traditional methods can be compared with those obtained by the deep learning method.

Materials and Methods: 1250 orthopantomographs (OPGs) from Portuguese population (625 females and 625 males) aged between 10 to 24 years old were collected from the database of Lisbon North University Hospital Center, using a procedure approved by the Ethic Committee.

The following scoring systems were applied on the third molar: Demirjian (1973); Moorrees, Fanning, and Hunt (1963); Gleiser and Hunt (1955). Applied age estimation methods were: Haaviko (1970), Liversidge (2008), and Kullman (1992), Lee et al. (2009), Caldas (2011), and Mincer (1993), and Köhler (1994).

The OPGs analysis was allocated to 2 observers. After performing intra and inter reliability validation, traditional and machine learning methods were applied to the data for age estimation. Hence, data were randomly divided into 80 per cent for training and the remaining 20 per cent for testing. After the learning procedure using the training data (model estimation), the classification reliability assessment was performed on the test data.

Results and conclusion: The task of clustering and classification of OPGs and classification of radiographs using CNNs will enable the researchers to discover patterns on collected data images. These patterns will be useful not only for enriching classification and prediction models, but also for designing explainable models. If the application of CNNs is successful at classifying radiographs, a specific architecture, data processing and hyperparameter values will be derived

with another larger OPG sample. This model will be integrated into a system to be developed and made available.

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Key words: Dental Age Assessment, Convolutional Neural Network, Legal Age Thresholds

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UBT SMART CITY AS A CONVERGENCE PLATFORM FOR FORENSIC EDUCATION AND RESEARCH

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ABSTRACT

The integration of smart city technologies into forensic education and research provides a unique opportunity for advancing investigative methodologies. The University for Business and Technology (UBT) has pioneered the establishment of a forensic science department, marking a significant milestone in higher education. UBT Smart City serves as a convergence platform where innovative digital tools, artificial intelligence, and big data analytics are employed to enhance forensic science. This paper explores the role of UBT Smart City in fostering interdisciplinary collaboration among forensic experts, law enforcement agencies, and academia. By leveraging smart infrastructure, IoT applications, and data-driven forensic techniques, the platform enhances crime detection, evidence analysis, and criminal profiling. The study highlights case studies demonstrating the effectiveness of smart city applications in forensic scenarios and underscores the potential of such initiatives in modernizing forensic education and research.

Keywords: Smart City, forensic education, forensic research, digital forensics, artificial intelligence.

AN EVALUATION OF WEB3 CONCEPTS AND TECHNOLOGIES AND RELATION WITH DIGITAL FORENSICS

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ABSTRACT

The World is experiencing a significant shift in how technology is being used and how new strategies are being developed to streamline and get around bureaucratic processes. Cannot continue without mentioning blockchain as a revolutionary decentralization concept that also serves as a foundational notion for Web3. One must admit that this is a struggle we are going through and that will continue into this new period as we add more approaches and technologies. In this study, the Web3 principles (like decentralization, trust and security, privacy and data protection), methodologies, and technologies are evaluated, along with their connections to digital forensics. Various viewpoints emphasizing the difficulties and current condition of these issues are offered. Authors discuss their viewpoints while highlighting their extensive background in digital forensics, keeping in mind that digital forensics is a relatively new profession. Based on their viewpoint's conclusions are being set. This work is currently being done by the authors as part of their research in the field of digital forensics and Web3.

Keywords: Web3 Technologies, Blokchain, Digital forensics, Technology

POSSIBLE MISIDENTIFICATION APPLYING CLASSIC IDENTIFICATION METHODS: THE CASE OF KOSOVO

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ABSTRACT

Forensic identification plays a crucial role in criminal investigations, ensuring the accurate determination of individuals involved in criminal activities. However, classical identification methods, such as fingerprint analysis, DNA profiling, and eyewitness testimony, are not without limitations. This study examines the potential risks of misidentification in forensic investigations conducted in Kosovo, emphasizing the factors that contribute to erroneous conclusions. Challenges such as sample contamination, human error, and environmental conditions are analyzed in the context of Kosovo's legal and forensic framework. Additionally, the study evaluates alternative and modern forensic techniques that can mitigate these risks, including biometric advancements and AI-assisted forensic analysis. The findings underscore the necessity for continuous improvement in forensic methodologies to enhance accuracy and reliability in criminal justice proceedings in Kosovo.

Keywords: Forensic identification, misidentification, classical methods.

THE ROLE OF FORENSIC BALLISTICS IN COMBATING MURDER CRIMES

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ABSTRACT

Forensic ballistics plays a crucial role in the investigation and resolution of murder crimes by analyzing firearms, ammunition, and related evidence to link suspects to crime scenes. This field involves the examination of bullet trajectories, gunpowder residues, and firearm markings to determine the type of weapon used and its potential source. By comparing ballistic evidence with databases such as the National Integrated Ballistic Information Network (NIBIN), forensic experts can identify links between different crime scenes and suspects. Additionally, forensic ballistics assists law enforcement in reconstructing shooting incidents, determining the distance and angle of fire, and distinguishing between homicide, suicide, or accidental shootings. Advanced techniques such as 3D imaging, scanning electron microscopy, and gunshot residue analysis enhance the accuracy of ballistic investigations. The integration of forensic ballistics with other forensic disciplines, including DNA and fingerprint analysis, further strengthens criminal cases in court. Despite its significance, forensic ballistics faces challenges such as firearm modifications, the use of unregistered or homemade guns, and limitations in evidence collection. However, continuous advancements in forensic technology and international collaboration in ballistic databases contribute to its effectiveness in combating murder crimes.

Keywords: Forensic ballistics, firearm identification, bullet trajectory analysis.