ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

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Evaluation of Deaths Related to Railway Accidents in İzmir, Türkiye: Retrospective Original Research

İzmir'de Demir Yolu Kazalarına Bağlı Ölümlerin Değerlendirilmesi: Retrospektif Özgün Araştırma

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This study was presented as an oral presentation at 2nd International and 18th National Forensic Sciences Congress, October 14-17, 2021, Online.

ABSTRACT Objective: In autopsy series; although not frequently in rail transportation systems, deaths are seen as a result of suicide attempts and severe traumas caused by accidents. The present study aims to discuss the data of death cases in the rail transportation systems of our region by evaluating the locations and the origins of the incidents. **Material and Methods:** Autopsy reports made in İzmir Forensic Medicine Institute between May 1, 2010 and May 1, 2020 crime scene investigation reports, hospital records, identity witness statements, and toxicology reports were retrospectively analyzed. **Results:** Rail transport system accidents accounted for 0.26% of the 25.349 autopsies performed in İzmir between 2010 and 2020, and 54 of the cases were male and 14 were female. In these death cases, the mean age of which was 43.1±19.6 years, the most common origin was determined as suicide (52.9%). The origin of suicide is followed by the origin of accident with 42.6%. It was determined that 60.3% of the cases occurred in the city, and 80.9% of them occurred as a result of the crushing of pedestrians by the trains in motion. Multiple system injuries were found in 74.9% of the deaths. In the current study, it was seen that deaths were most frequently due to head trauma. **Conclusion:** In the study, it was noted that accidents in rail transport systems occur more often in the city and suicides occur more often than accident-related deaths, and it was evaluated that measures should be increased and awareness should be raised at rail transport.

Keywords: Forensic medicine; suicide; railway accidents

ÖZET Amaç: Otopsi serilerinde; raylı ulaşım sistemlerinde sık olmamakla birlikte meydana gelen intihar girişimleri ve kazaların yol açtığı ağır travmalar sonucu ölümler görülmektedir. Bu çalışma, bölgemizin raylı ulaşım sistemlerinde meydana gelen ölüm vakalarının verilerini, olayların konumlarını ve kökenlerini değerlendirerek tartışmayı amaçlamaktadır. **Gereç ve Yöntemler:** 1 Mayıs 2010-1 Mayıs 2020 tarihleri arasında İzmir Adli Tıp Kurumunda yapılan otopsi raporları, olay yeri inceleme raporları, kimlik tanığı beyanları, hastane kayıtları ve toksikoloji raporları retrospektif olarak incelendi. **Bulgular:** İzmir'de 2010-2020 yılları arasında yapılan 25.349 adli otopsinin %0,26'sını raylı ulaşım sistemi kazaları oluşturdu ve olguların 54'ü erkek, 14'ü kadındı. Yaş ortalaması 43,1±19,6 olan bu ölüm olgularında en sık neden intihar (%52,9) olarak belirlendi. İntiharı %42,6 ile kaza orijini takip etmektedir. Vakaların %60,3'ünün kentte meydana geldiği, %80,9'unun ise hareket hâlindeki trenlerin yayalara çarpması sonucu meydana geldiği belirlendi. Ölümlerin %74,9'unda çoklu sistem yaralanmaları saptandı. Mevcut çalışmada ölümlerin en sık kafa travmasına bağlı olduğu görüldü. **Sonuç:** Çalışmamızda raylı ulaşım sistemlerindeki kazaların şehir içinde daha sık meydana geldiği ve intiharların kazaya bağlı ölümlerden daha sık meydana geldiğine dikkat çekilerek, raylı ulaşımda önlemlerin ve farkındalığın artırılması gerektiği değerlendirilmiştir.

Anahtar Kelimeler: Adli tıp; intihar; demir yolu kazaları

The rail transportation system is known as an economical and safe mode of transportation. The first railway construction in Türkiye was started in 1856 with the İzmir-Aydın Railway and İzmir Town Railway lines. As of the end of 2020, the total length of railways in Türkiye is 12,803 km, 1,213 km of which is high-speed railway lines. The High-Speed Train (HST), which constitutes the rail transportation sys-

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tems, carried a total of 99.5 million passengers in 2020 in urban and conventional systems. Only 6.9% of freight and passenger transport in Türkiye is carried out by railways. However, compared to countries where this rate is much higher, injuries and deaths occur in railways are higher.[1]

Our country has a widespread railway network. Approximately 600 km of this is located in İzmir.[2] İZBAN, the rail transportation system in İzmir, has a line length of 136 km and carries approximately 550,000 passengers per day.[3] In addition to the national railway (İZBAN), there are metro and tram lines in İzmir. Today, İzmir Metro, which is a part of the integrated transportation system with the number of passengers reaching 100 million (~250,000 daily passengers per year), has 18.4 km metro line and 21.4 km tram line.[4] Recent developments in transportation diversity in the modern world have made injuries and deaths as a result of accidents inevitable. Frequency of transport-related accidents, in descending order, includes vehicles on land, trains on rails or railroad tracks, and aircraft in the air.[5] In 2019, 1,516 major rail accidents were reported in the member states of the European Union. While 802 people lost their lives in these accidents, 612 people were seriously injured.

Suicides on railways were reported separately. With 2,313 cases reported in 2019, the number of suicides is greater than deaths caused by railroad accidents. Germany was the country with the highest number of railway accidents among the EU member states with 298 accidents in 2019, followed by Poland with 214 accidents.[6] It was seen that there were 11,714 train accidents and 878 deaths in the USA in 2019.[7] In the current 2019 data of Turkish Statistical Institute (TSI), it was seen that there were 1,168,722 accidents and 5,614 people died in these accidents. It was observed that 0.007% (n=83) of these were train accidents and the death rate due to train accidents was 0.96%.[8] According to the data of the Republic of Türkiye State Railways, 71 train accidents occurred in our country in 2019, resulting in a total of 76 deaths and 51 injuries. Train crashes caused death of 76 people, 32 of them as passenger, 22 of them due to the train crashing into people, 15 of them due to crash at level crossing, six of them who are workers at train, one of them due to the train crashing into an obstacle.[1]

Trains considered as a safer means of transportation because statistically there are less accidents and fatalities in rail systems compared to vehicles we have today.[9] Railway transport is considered the safest form of modern transportation, although railway catastrophes with a large number of victims and injuries occur in many countries.[10] The present study aims to investigate the data of autopsy railway-related death cases in İzmir and to determine the origins of the events according to the trauma findings.

MATERIAL AND METHODS

The study was carried out with the approval of İzmir Kâtip Çelebi University Non-Interventional Research Ethics Committee, dated May 12, 2020 and protocol number 696. The study was conducted in accordance with the Principles of the Declaration of Helsinki.

Autopsy reports made in İzmir Forensic Medicine Institute between May 1, 2010 and May 1, 2020 crime scene investigation reports, hospital records, and toxicology reports were retrospectively analyzed. Ages and genders of the cases, incident dates (season/day/year), incident locations, information about whether incidents were urban/out-of-town train accidents, whether incidents were accident/suicide/natural death, whether cases had alcohol/narcotic substance effects, whether they had a history of hospital treatment, and the exact causes of death were included in the study. To determine the origin of death; along with the autopsy report, court files containing all the information and findings related to the incident such as crime scene investigation reports, witness statements, judical investigation information and the final decision were examined. The obtained data were analyzed with the SPSS 25.0 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) statistical program. In statistical analysis, quantitative variables were expressed as mean±standard deviation (SD), median, minimum-maximum, and range, while qualitative variables were reported as numbers and percentage (%). Mean and SD were used for homogeneous distributions, median value and number ranges were used for heterogeneous distributions. The Fisher's chi-square test was used to

compare qualitative variables. A p value below 0.05 was considered statistically significant.

RESULTS

In this study, it was determined that 68 (0.29%) of 25,349 cases autopsied at İzmir Forensic Medicine Institute between May 1, 2010 and May 1, 2020 were death related to the rail transportation system. Of the 68 cases, 54 (79.4%) were male and 14 (20.6%) were female. The mean age was 43.1±19.6 years. When the distribution of cases according to age is examined, it was seen that 19.1% (n=13) of the cases were between the ages of 15-20, 11.7% (n=8) between the ages of 21-30, 17.6% (n=12) between the ages of 31-40, 16.1% (n=11) between the ages of 41-50, 11.8% (n=8) between the ages of 51-60, 13.3% (n=9) between the ages of 61-70, 8.9% (n=6) between the ages of 71-80, and 1.5% (n=1) over the age of 80. It was observed that there were no railway deaths in the 0-15 age group (Figure 1).

It was observed that deaths due to train accidents included in the study were most common on thursday (22.1% n=15) and least on wednesday (2.9% n=2).

When analyzed by months, 14.7% (n=10) of the incidents occurred in december, 13.2% (n=9) in october, 1.5% (n=1) in june, and 2.9% (n=2) in may. It was seen that most of the events occurred in the autumn months (september-october-november: 35.3% n=24), at least in the summer months (june-july-august 14.7% n=10) (Figure 2).

When the distribution of deaths due to train accidents by years is examined, it was seen that 16.2% (n=11) of the cases occurred in 2019, 14.7% (n=10) in 2017 and 4.4% (n=3) in 2020. In 2019, when deaths due to train accidents were the highest (16.2%), it was determined that the origin of death in most of the cases was suicide (72.7% n=8).

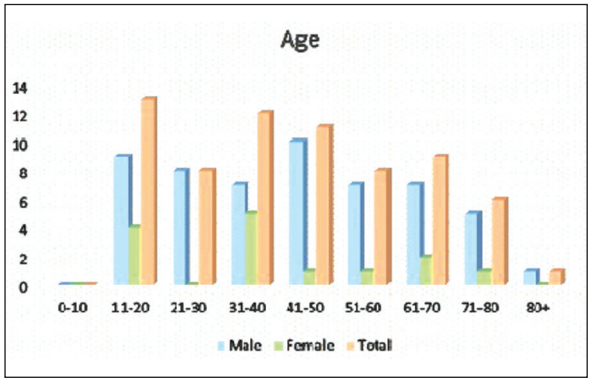

FIGURE 1: Distribution of cases for age.

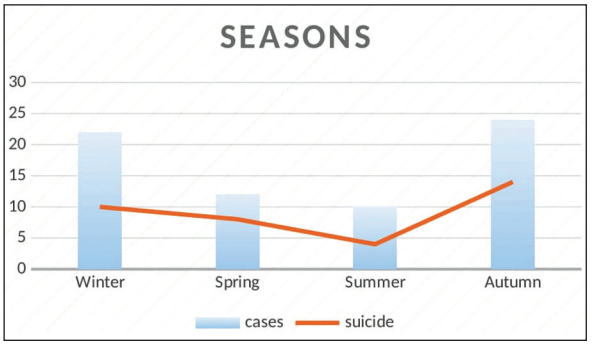

FIGURE 2: Accidents and suicides according to the seasons.

As a result of railway related deaths, the majority of the cases (79.4% n=54) died at the scene (no hospitalization), nine of them (13.2%) on the same day, four of them (5.9%) in a week, or longer than a week. It was determined that one of them (1.5%) person died in the same period.

Railway related deaths in this study were more common on urban roads (60.3% n=41) and they were found to occur mostly in İZBAN transportation (50.0% n=34).

As a result of railway related deaths, it was seen that the majority of the cases (79.4% n=54) died at the scene (no hospitalization) and nine (13.2%) people died on the same day, four (5.9%) people died within a week, and one (1.5%) person died in more than a week.

When the origin of railway related deaths were examined, it was determined that 52.9% (n=36) was suicide, 39.7% (n=27) was accident, and 7.3% (n=5) was natural death.

In the analysis of blood, vitreous humor and urine samples; There was no additional substance use in 42 of the deaths (61.8%) and alcohol use was found in nine (13.2%) of the cases, sedative-stimulant-drug use was found in nine (13.2%), and psychiatric medication was used in eight of the cases (Figure 3). It was found that the substances are not in letal dose.

Of the railway related deaths, 51 (74.9%) were due to multiple system injuries, 5 (7.4%) to non-trau-

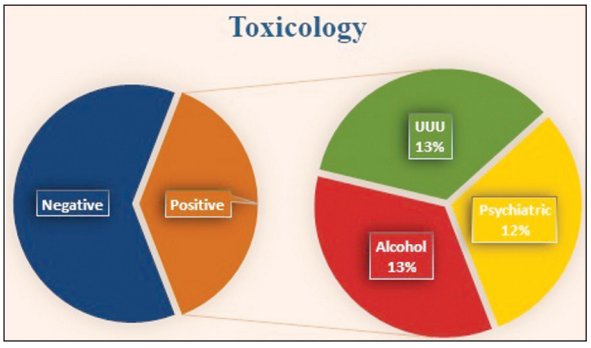

FIGURE 3: Toxicological results of the cases.

matic causes (myocardial infarction, embolism), 2 (2.9%) to burns, and 1 (1.5%) to asphyxia. It was determined that the death cases in the study were mostly due to head trauma. The multiple system injuries that caused the most deaths were the result of head+chest+abdominal+large vessel injuries with 14 (20.6%) cases (Table 1).

TABLE 1: Injured body area distribution.

Injured Body Area	n	%
Head	5	7.9
Head+Chest	2	3.1
Head+Abdomen	5	7.9
Head+Vertebra	3	4.7
Head+Chest+Abdomen	6	9.5
Head+Chest+Vertebra	1	1.5
Head+Chest+Abdomen+Vertebra	1	1.5
Head+Chest+Abdomen+Major Veins	**14**	**22.2**
Head+Vertebra+Extremity+Major Veins	2	3.1
Head+Chest+Abdomen+Vertebra+Extremity+Major Veins	**12**	**19.0**
Chest	1	1.5
Chest+Abdomen	1	1.5
Chest+Abdomen+Vertebra	1	1.5
Chest+Abdomen+Extremity+Major Veins	3	4.7
Major Veins	3	4.7
Hanging	1	1.5
Burn	2	3.1
Total	63	100

DISCUSSION

In this study, it was determined that 68 (0.29%) of 22,946 cases autopsied at İzmir Forensic Medicine Institute between May 1, 2010 and May 1, 2020 were rail-related deaths. In the study conducted by Kumral et al. in İstanbul in 2014, the rate was 0.39%, while this rate was determined as 1.5% in a study conducted by Özsoy et al. in Eskişehir in 2014, 6.5% in the study by Kowsil et al. in India in 2020, 1.33% in the study by Tirmizi et al. in Pakistan in 2017, and 5.62% in the study by Kumar et al. in India in 2007.[11] In the member states of the European Union, 802 people died due to train accidents in 2019 (1.8/death per million people) and Hungary had the highest train accident-related death toll at 8.9/per million deaths in proportion to its population, followed by Latvia with 6.8/per million deaths. In Türkiye, this rate was found to be 0.92/per million deaths. In İzmir, this rate was found to be 2.5/per million deaths.[1,5] In other studies conducted in Türkiye (İstanbul, Eskişehir) and Asian countries (India, Sri Lanka), deaths due to accidents in the rail transportation system are high.[12-17] Due to the fact that the national railway line passes through the city center and there is a tram line, deaths caused by the rail transportation system are frequently observed in İzmir.

This study of the 68 cases, 54 (79.4%) were male and 14 (20.6%) were female. The significantly higher proportion of males was found to be consistent with the literature.[5,12-15] The high number of male cases in our study may be associated with the fact that men take a more active role in daily life.

The subjects in the study were between the ages of 15-87 and the mean age was 43.1±19.6 years. When the distribution of the cases according to age was examined, it was found that 19.1% (n=13) was most common between the ages of 15-20. It was determined that 17.6% (n=12) of the cases were between the ages of 31-40 and 16.1% (n=11) were between the ages of 41-50. In a study evaluating the deaths in the rail transportation system in New York, the cases were between the ages of 14-85 and the average age was reported as 44. In a study evaluating the deaths in the rail transportation system in İstanbul, the cases were between the ages of 5-85 and the average age was reported as 38. When the cases in similar studies in the literature were evaluated according to age groups, it was reported that active working individuals were prevalent. In our study, there were no railway deaths in the 0-15 age group.

In the current study, it was determined that deaths were most frequently due to head trauma. It was observed that the multiple system injuries that caused the most deaths occurred as a result of head+chest+abdominal+large vessel injuries in 14 (20.6%) cases. The high rate of head trauma is one of the most important causes of high mortality in this type of injury.

Studies conducted in the European Union countries (Germany, Belgium) have found that suicide-related deaths are more common in rail transportation systems.[18,19] In the present study, unlike other studies conducted in Türkiye, 52.9% (n=36) of the cases were found to be suicidal. The European Railway Agency (ERA) was established to increase safety in the rail transportation system in European Union member countries. In the data collected by the ERA, the suicide rate in rail transport system accidents in European Union member countries is 74.2% (n=2,319), which is consistent with the results obtained in the current study.[6]

In the study, when the distribution of deaths due to rail transportation system accidents by years is examined, it was seen that the most deaths were in 2019 (16.2% n=11) and at least in 2020 (4.4% n=3). In 2019, when deaths due to train accidents were the highest, it was seen that most of the deaths were caused by suicide (72.7% n=8). It was noted that 58.3% (n=21) of the suicide cases did not use any anesthetic-stimulant-drugs, alcohol or psychiatric medication. In the study, it was found that while the suicide rate was 50% (n=27) in male cases, it was 64.2% (n=9) in female cases. The high rate of suicide in train stations suggest that they prefer both high-energy traumatic methods and deaths that have a more dramatic effect in crowded environments.

It was observed that rail transport system suicides in the study were most common on friday (25% n=9) and at least on wednesday (2.7% n=1). Rail transport system suicides were seen most frequently in autumn (38.8% n=14) and at least in summer (11.1% n=4). Inconsistent with the present study, in the study by Akkaya-Kalayci et al., it was determined that the high rate of suicides occurred in the summer months (30.6% n=768).[20] In the study by Yarza et al., similarly, the suicide rate was found to be high in the summer months (32.9% n=771).[21]

According to the data of the World Health Organization, 13 out of every 100,000 young people between the ages of 15-24 commit suicide.[22] In the current study, 38.8% (n=14) of the cases who committed suicide were in the 15-25 age group. In TSI 2019 data, it was seen that 21.4% (n=730) of suicides in Türkiye occurred in the 15-25 age group.[8] In a study conducted in our country, it was reported that 53.4% of suicide cases admitted to the emergency department were in the 18-28 age group.[23] Our study was found to be compatible with the literature.

CONCLUSION

It was determined that the age group who committed suicide was in high school and university age and used public transportation frequently. By organizing trainings and seminars in high schools and universities, suicides in the 15-24 age group can be reduced.

Our study shows that the rate of suicide is high in the rail transportation system in Izmir and the majority of these suicides occur in the city (86.1% n=31). In the study by Matsubayashi et al., installing blue lights on platforms in Japan was found to reduce suicides by 84%.[24] In the sudies by Ueda et al. (2015) in Japan and by Chung et al. (2016) in Southern Korea, platform screen doors were found to reduce suicide cases by 76% in Japan and 89% in South Korea.[25,26]

The enormous human and economic loss from railroad suicides requires innovative and preventive measures. In order to reduce suicides in rail transportation systems in İzmir, it has been seen that it is important

1. To place physical barriers in strategic places,
2. To place blue lights at train stations, and
3. To organize awareness programs or gatekeeper training courses, and similar practices.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Alperen Uyan, Gülden Uyan;* ***Design:*** *Alperen Uyan;* ***Control/Supervision:*** *Ferhat Turgut Tunçez, Alperen Uyan, Gülden Ersen, Mehmet Tokdemir;* ***Data Collection and/or Processing:*** *Alperen Uyan, Gülden Ersen, Zafer Karadeniz;* ***Analysis and/or Interpretation:*** *Ferhat Turgut Tunçez, Alperen Uyan;* ***Literature Review:*** *Ferhat Turgut Tunçez, Alperen Uyan, Mehmet Tokdemir;* ***Writing the Article:*** *Ferhat Turgut Tunçez, Alperen Uyan, Mehmet Tokdemir;* ***Critical Review:*** *Ferhat Turgut Tunçez, Alperen Uyan, Mehmet Tokdemir;* ***References and Fundings:*** *Ferhat Turgut Tunçez, Mehmet Tokdemir;* ***Materials:*** *Ferhat Turgut Tunçez, Alperen Uyan, Gülden Ersen, Mehmet Tokdemir, Zafer Karadeniz.*

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