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## Determinants of Out-of-Hospital Death Certification In Pediatric and Adolescent Forensic Cases: A Retrospective Study From Türkiye

### Türkiye’de Çocuk ve Ergen Adli Olgularında Hastane Dışı Ölüm Belgelendirmesinin Belirleyicileri: Retrospektif Bir Çalışma

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### Öz

**Amaç:** Hastane içi ve hastane dışı ölüm belgelendirmesi arasındaki ayrım, önemli adli ve epidemiyolojik sonuçlar doğurmaktadır. Pediatrik ölümlerin klinik sonuçları üzerine birçok çalışma yapılmış olsa da, adli uygulamalarda hastane dışı ölüm belgelendirmesinin demografik, durumsal ve nedene özgü belirleyicilerini inceleyen araştırmalar sınırlıdır.

**Metod:** 2019–2023 yılları arasında kaydedilen 2.214 pediatrik ve adolesan adli olgu retrospektif olarak incelendi. Değişkenler arasında ölüm nedeni, cinsiyet, uyruk, ölüm yaşı, olay yeri ve mevsim yer aldı. Ölüm nedenleri; kasıtlı yaralanmalar, kasıtsız yaralanmalar, tıbbi veya işlemsel nedenler ile diğer veya belirlenemeyen nedenler olarak sınıflandırıldı. Ölüm yeri, kurum/ambulans içi ve hastane dışı olarak iki kategoriye ayrıldı. Tanımlayıcı analizler, ki-kare testi, parametrik olmayan karşılaştırmalar ve çok değişkenli lojistik regresyon analizleri uygulandı.

**Bulgular:** Olguların genelinde %17,9’u hastane dışında belgelendirilmişti. Hastane dışı ölüm belgelendirmesi, tıbbi veya işlemsel nedenlere kıyasla kasıtsız yaralanmalar (OR=1,97; %95 GA: 1,45–2,67), kasıtlı yaralanmalar (OR=1,96; %95 GA: 1,15–3,35) ve diğer veya belirlenemeyen nedenler (OR=26,89; %95 GA: 18,10–39,97) için anlamlı derecede daha olasıydı. Yabancı uyruk (OR=1,90; %95 GA: 1,42–2,54) ve artan yaş (her yaş için OR=1,14; %95 GA: 1,12–1,17) de bağımsız belirleyicilerdi. Mevsimsel değişim açısından yaz mevsiminde, kışa göre daha düşük olasılık saptandı (OR=0,65; %95 GA: 0,46–0,93). Cinsiyet ile ölüm yeri arasında anlamlı ilişki bulunmadı. Model tanılamaları, yaş için logit doğrusalığı, düşük kollinearlık ve güçlü genel uyum ile geçerliliği destekledi.

**Sonuç:** Çocuk ve adolesanlarda hastane dışı ölüm belgelendirmesi; dışsal ve belirlenemeyen nedenler, ileri yaş ve yabancı uyruk ile güçlü şekilde ilişkiliydi. Bu bulgular, pediatrik mortalitede adli uygulamalar, sağlık hizmetine erişim ve sosyal belirleyiciler arasındaki etkileşimi ortaya koymaktadır. Hastane öncesi yanıtın güçlendirilmesi ve sağlık hizmetine erişimde eşitliğin artırılması, adli gözetimin kalitesini iyileştirebilir ve eşitsizlikleri azaltabilir.

**Anahtar Kelimeler:** Adli patoloji, Ölüm belgeleri, Çocuk ölümleri, Adolesan (ergen) ölümleri, Hastane dışı ölüm

### Abstract

**Aim:** The distinction between in-hospital and out-of-hospital death certification carries important forensic and epidemiologic implications. While many studies have examined clinical outcomes of pediatric deaths, few have investigated the demographic, circumstantial, and cause-specific predictors of out-of-hospital certification in forensic practice.

**Methods:** We conducted a retrospective analysis of 2,214 pediatric and adolescent forensic cases recorded between 2019–2023. Variables included cause of death, sex, nationality, age at death, place of incident, and season. Causes of death were grouped as intentional injuries, unintentional injuries, medical or procedural causes, and other or undetermined. Place of death was dichotomized into in-facility/ambulance and out-of-hospital. Descriptive analyses, chi-square test, nonparametric comparisons, and multivariable logistic regression were applied.

**Results:** Overall, 17.9% of cases were certified out of hospital. Out-of-hospital certification was significantly more likely for unintentional injuries (OR=1.97, 95% CI: 1.45–2.67), intentional injuries (OR=1.96, 95% CI: 1.15–3.35), and other or undetermined causes (OR=26.89, 95% CI: 18.10–39.97) compared with medical or procedural causes. Foreign nationality (OR=1.90, 95% CI: 1.42–2.54) and increasing age (OR=1.14 per year, 95% CI: 1.12–1.17) were also independent predictors. Seasonal variation showed lower odds in summer relative to winter (OR=0.65, 95% CI: 0.46–0.93). Sex was not associated with place of death. Model diagnostics supported validity, with acceptable collinearity, linearity of the logit for age, and strong overall fit.

**Conclusions:** Out-of-hospital death certification among children and adolescents was strongly associated with external and undetermined causes, older age, and foreign nationality. These findings provide context-specific evidence from Türkiye and suggest that out-of-hospital death certification may reflect differences in case circumstances, access to care, and social vulnerability. Better integration of forensic data with public health surveillance may improve the interpretation of pediatric mortality patterns.

**Keywords:** Forensic medicine, Death certificates, Child mortality, Adolescent mortality, Out-of-hospital death

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## INTRODUCTION

Death certification and medico-legal documentation represent an important intersection of forensic medicine, clinical care, and public health. In cases of sudden, unexpected, suspicious, or injury-related deaths, the circumstances in which death is identified and documented, including whether death is documented or recorded in hospital or outside hospital settings, carry both procedural and epidemiologic significance. Despite this importance, relatively few studies have systematically examined the factors associated with out-of-hospital death certification, particularly among pediatric and adolescent populations (1).

In younger age groups, mortality often results from sudden events occurring outside the medical environment. External causes such as traffic injuries, drowning, poisoning, falls, and interpersonal violence are especially relevant in this population and frequently lead to deaths that occur before hospital arrival or are documented outside hospital settings (1,2). In medico-legal investigations of such deaths, standardized postmortem evaluation protocols are important for improving diagnostic consistency and reducing reliance on broad undetermined classifications (3-5). Previous literature has shown that prehospital deaths are common in trauma and other acute fatal events, underscoring the importance of emergency response, access to timely care, and the broader social context in which deaths occur (6-8). However, while these patterns have been widely addressed in clinical and epidemiologic research, their implications within medico-legal record systems remain less well characterized.

In Türkiye, the medico-legal documentation of sudden, unexpected, suspicious, or injury-related deaths involves a multi-actor structure that may include physicians working in prehospital, primary care, and emergency settings, as well

as forensic medicine specialists and judicial authorities, depending on the circumstances of the case. Accordingly, the recorded place of death certification in forensic files should be interpreted within this legal, institutional, and procedural context rather than as the product of a single-profession certification model. This distinction is particularly important in pediatric and adolescent forensic deaths, where the place of documented death may reflect not only the immediate circumstances of the fatal event but also differences in case trajectory, access to care, and medico-legal handling.

Against this background, the present study analyzes a large series of pediatric and adolescent forensic death cases to examine factors associated with out-of-hospital death certification. We focused primarily on variation according to cause of death, while also examining the influence of demographic characteristics such as age and nationality, as well as seasonal variation. Based on prior literature, we expected external and undetermined causes to be more frequently associated with out-of-hospital certification than medical or procedure-related deaths, and we explored whether older age, foreign nationality, and seasonal differences were also associated with this outcome. Rather than proposing a new general model of pediatric mortality, this study aims to provide context-specific evidence from forensic case records that may contribute to improved mortality surveillance and a better understanding of pediatric and adolescent deaths documented outside hospital settings.

## METHODS

This retrospective study analyzed forensic death cases recorded between 2019 and 2023. The study protocol was reviewed and approved by the Council of Forensic Medicine (No: 21589509/2025/I475). Forensic case records were obtained from official investigation files. Demographic information and case characteristics were

systematically extracted. Three core forensic variables were evaluated: cause of death, place of incident, and place of death. In addition, demographic variables of sex, nationality, and age at death were included. Synonymous terms were merged prior to coding, and near-duplicate categories collapsed to reduce misclassification and avoid sparsely populated strata. This ensured internal consistency and improved comparability with prior forensic and public health literature based on intent and setting classifications. Variables included sex (0=male, 1=female), nationality (0=Turkish, 1=foreign), cause of death, place of incident, and place of death. Age at death was recorded in decimal years, allowing continuous treatment in statistical analyses and facilitating precise modeling of age effects. Causes of death were grouped as intentional injuries, unintentional injuries, medical or procedural causes, and other/undetermined causes, following classifications commonly used in injury epidemiology and ICD-10 external cause groupings (9,10). Place of incident was categorized as home/residence, hospital/medical facility, public/outdoor location, vehicle/transportation, and other. Place of death was dichotomized as in facility/ambulance or out-of-hospital, a distinction widely applied in mortality studies to reflect pre-hospital versus hospital-level outcomes (12). Temporal variables were derived from the trauma date, including year, month, and season (Winter: December-February, Spring: March-May, Summer: June-August, Autumn: September-November). Descriptive statistics were calculated for all variables. Categorical variables were summarized as frequencies and percentages, and continuous variables as mean with standard deviation (SD) and median with interquartile range (IQR). Comparisons between groups for categorical variables were performed using Pearson's chi-square test. Age differences between place-of-death groups were assessed with Welch's t-test, after testing assumptions of normality (Shapiro-Wilk test) and variance homogeneity (Levene's test). Given significant deviations

from normality expected in large samples, Mann-Whitney U test was also conducted as a non-parametric sensitivity analysis. Both parametric and non-parametric tests yielded consistent results, supporting robustness. For Table 2, exact chi-square statistics with degrees of freedom and p-values were calculated from the underlying count matrices and are reported alongside the tables. To identify independent predictors of out-of-hospital death, a multivariable logistic regression model was fitted with place of death as the dependent variable (0 in facility or ambulance, 1 out of hospital). Explanatory variables included cause of death, sex, nationality, age in decimal years, and season. Reference categories were medical or procedural causes for cause of death and winter for season. Model diagnostics were performed systematically. Multicollinearity was assessed by computing variance inflation factors after one-hot encoding the categorical predictors. The linearity of the logit for the continuous age variable was examined with a Box-Tidwell transformation by adding an  $\text{age} \cdot \ln(\text{age})$  term to the model. Model calibration was evaluated with Hosmer-Lemeshow goodness-of-fit test based on deciles of predicted risk. Model fit was summarized by the likelihood ratio chi-square test comparing the fitted model with the null model and by McFadden's pseudo- $R^2$ . In addition to Hosmer-Lemeshow goodness-of-fit test, graphical calibration analysis was performed by comparing observed and predicted probabilities across deciles of estimated risk. Overall calibration performance was further quantified using the Brier score.

Results are presented as odds ratios with 95% confidence intervals and two-sided p-values. A two-sided  $p < 0.05$  was considered statistically significant. All analyses were performed using Python (pandas, scipy, and statsmodels libraries).

### Cause of Death

Reported causes of death varied widely, including explicit mechanisms such as traffic accidents, firearm injuries, and drug intoxication, as well as ambiguous entries such as “body found.” To harmonize the data, cases were classified into four categories based on the International Classification of Diseases, Tenth Revision (ICD-10) external causes framework: intentional injuries, unintentional injuries, medical or procedural causes, and other or undetermined. Intentional injuries included homicide and interpersonal violence such as firearm-related deaths and assault. Unintentional injuries comprised accidents and environmental causes, including drowning, poisoning, transport-related trauma, falls, crash or compression injuries, burns, and electrocution or explosions. Medical or procedural causes included surgical complications, vaccine-related adverse events, obstetric and postpartum deaths, neonatal outcomes, and peri-procedural complications. Cases without sufficient detail were classified as other or undetermined. Where multiple descriptors referred to the same mechanism, they were consolidated into a single category. This approach reflects widely adopted injury epidemiology practices that separate deaths by intent and mechanism to improve analytical clarity (11).

### Place of Incident

The place where the fatal event occurred was coded into five categories: home or residence, hospital or medical facility, public outdoor space, vehicle or transportation, and other. Rare or atypical locations, such as workplaces or undefined scenes, were grouped under “other” to avoid fragmentation. Synonymous descriptors were harmonized prior to recoding. This categorization follows established frameworks in mortality surveillance, which emphasize collapsing diverse locations into broader, interpretable groups to facilitate analysis (13).

### Place of Death

The place of death was defined as the location where death was officially documented. Recognizing that this may differ from the place of incident, the same five-category classification was applied: home or residence, hospital or medical facility, public outdoor space, vehicle or transportation, and other. This distinction allows for analysis of differences between where injuries occurred and where deaths were ultimately certified, an approach previously used in forensic and public health mortality studies (14).

In this study, “out-of-hospital death” refers to deaths that occurred outside a healthcare facility and were not preceded by in-hospital medical management, including deaths at the scene, at home, or in public locations. Primary outcome was the recorded location at which death was documented in the forensic file, used as an operational case-record variable rather than a direct indicator of certifier profession, legal authority, or complete clinical trajectory. Deaths occurring during ambulance transport or within healthcare facilities were classified as in-facility deaths. This definition reflects the operational classification used in forensic records rather than clinical outcome assessment.

## RESULTS

A total of 2,214 cases were included in the analysis. Majority of decedents were male (60.4%), while females accounted for 39.6% as shown in Table 1. Turkish nationals comprised nearly three-quarters of the sample (73.7%), with foreign nationals representing 26.3%. Most deaths were certified in medical facilities or during ambulance transfer (82.1%), whereas 17.9% occurred out of hospital. Regarding cause of death, medical and procedural causes represented the largest category (52.1%), followed by unintentional injuries (34.3%), other or undetermined causes (9.5%), and intentional injuries (4.1%). The mean

age at death was 5.72 years (SD=6.35), with a median of 2.34 years (IQR: 0.30-11.85), ranging from birth to 19.5 years.

**Table 1.** Sample characteristics

Variable	Category	n (%)
Sex	Male	1337 (60.4)
	Female	876 (39.6)
Nationality	Turkish	1631 (73.7)
	Foreign	582 (26.3)
Place of Death	In facility/ambulance	1817 (82.1)
	Out-of-hospital	396 (17.9)
Cause of Death	Medical/procedural	1153 (52.1)
	Unintentional	760 (34.3)
	Other/undetermined	210 (9.5)
	Intentional	90 (4.1)
Age (years)	Mean (SD)	5.72 (6.35)
	Median (IQR)	2.34 (0.30-11.86)
	Min-Max	0.00-19.52

Percentages are calculated over the total sample. For age, values are presented as mean (SD), median (IQR), and range

In As presented in Table 2, out-of-hospital death varied significantly according to cause of death ( $\chi^2=295.29$ ,  $p<0.001$ ). The proportion of out-of-hospital certification was highest for other or undetermined causes (55.7%) and intentional injuries (31.1%), while markedly lower for medical or procedural causes (8.1%). In contrast, unintentional injuries showed an intermediate proportion (20.8%). These differences highlight the divergent

pathways through which deaths of distinct etiologies reach certification. Sex was not significantly associated with place of death. Out-of-hospital occurrence was observed in 18.8% of males and 16.6% of females ( $\chi^2=1.63$ ,  $p=0.201$ ). Similarly, nationality did not show a significant difference, 19.8% of foreign nationals and 17.2% of Turkish nationals died outside hospital settings ( $\chi^2=1.70$ ,  $p=0.192$ ).

**Table 2.** Place of death by cause, sex, and nationality (n, row%) with chi-square

Variable	Category	In facility/ambulance n (row %)	Out-of-hospital n (row %)		p
Cause	Intentional	62 (68.9%)	28 (31.1%)	295.29	<0.001
Cause	Medical/procedural	1060 (91.9%)	93 (8.1%)		
Cause	Other/undetermined	93 (44.3%)	117 (55.7%)		
Cause	Unintentional	602 (79.2%)	158 (20.8%)	1.63	0.2019
Sex	Female	731 (83.4%)	145 (16.6%)		
Sex	Male	1086 (81.2%)	251 (18.8%)	1.70	0.1921
Nationality	Foreign	467 (80.2%)	115 (19.8%)		
Nationality	Turkish	1350 (82.8%)	281 (17.2%)		

Chi-square ( $\chi^2$ ) statistics and corresponding p values are reported once for each variable block and apply to all categories within that block, therefore, they are not repeated for individual rows.

Comparisons of age by place of death demonstrated significant differences. Shapiro Wilk tests confirmed non-normal distributions for both groups ( $p<0.001$ ), and Levene's test indicated heterogeneity of variance ( $F=49.68$ ,  $p<0.001$ ). Individuals who died out of hospital

were significantly older than those certified in medical facilities, with a mean age of 8.66 years (SD=6.96, median=7.0, IQR=2.0-15.0) compared with 5.08 years (SD=6.02, median=3.0, IQR=0.9-8.0) for in-facility or ambulance deaths (Welch's  $t=9.46$ ,  $p<0.001$ , Mann-

Whitney U=437,283, p<0.001).

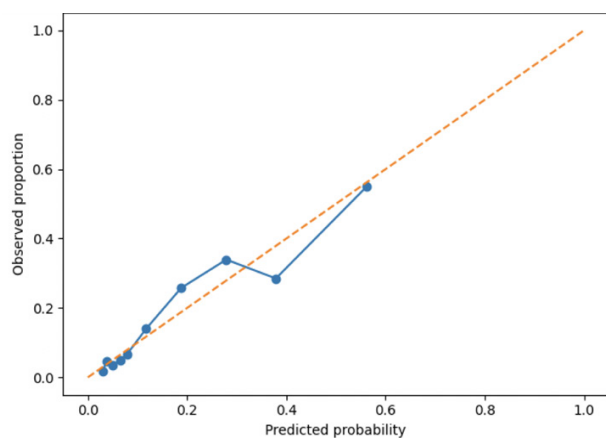
**Table 3.** Logistic regression for predictors of out-of-hospital death

Category	OR	SE (log-odds)	Z	95% CI		p
				Lower	Upper	
Intercept	0.036	0.198	-16.702	0.024	0.053	<0.001
Cause: Unintentional vs Medical/procedural	1.967	0.155	4.352	1.450	2.669	<0.001
Cause: Intentional vs Medical/procedural	1.961	0.273	2.466	1.148	3.350	0.0136
Cause: Other/undetermined vs Medical/procedural	26.89	0.202	16.289	18.100	39.969	<0.001
Season: Spring vs Winter	0.917	0.177	-0.485	0.647	1.299	0.6276
Season: Summer vs Winter	0.656	0.177	-2.370	0.463	0.929	0.0178
Season: Autumn vs Winter	1.016	0.179	0.089	0.715	1.443	0.9287
Sex (1=Female vs 0=Male)	1.010	0.131	0.082	0.781	1.307	0.9339
Nationality (1=Foreign vs 0=Turkish)	1.902	0.147	4.351	1.423	2.541	<0.001
Age (per year)	1.143	0.011	11.598	1.117	1.169	<0.001

OR denotes odds ratio. SE is the standard error of the log-odds. Z is Wald statistic. Confidence intervals are 95% for the odds ratio. Reference categories are Medical/procedural for Cause and Winter for Season

In the multivariable logistic regression model, predictors of out-of-hospital death were assessed while adjusting for cause of death, sex, nationality, age, and season (reference categories: medical/procedural causes and winter). The model demonstrated good overall fit ( $\chi^2=417.28$ ,  $p<0.001$ ) and explained approximately 20% of the variance ( $R^2=0.201$ ). Model diagnostics confirmed the robustness of the regression. Variance inflation factors were low (all VIFs<2.5), excluding problematic multicollinearity. The assumption of linearity in the logit was satisfied, as the Box-Tidwell interaction term for age\*ln(age) was not significant ( $p=0.241$ ). Calibration assessed by Hosmer-Lemeshow test suggested some lack of fit ( $\chi^2=23.94$ ,  $p=0.002$ ), which may reflect the large sample size rather than substantive model misspecification.

Despite the lack of fit, visual inspection of the calibration plot demonstrated close agreement between predicted and observed probabilities across most risk strata. Brier score was 0.118, indicating good overall model calibration. These findings suggest that the significant Hosmer-Lemeshow result is likely driven by the large sample size rather than by substantive model misspecification.



**Figure 1.** Calibration plot of the logistic regression model predicting out-of-hospital death. Observed proportions are plotted against mean predicted probabilities across deciles of risk. The dashed line represents ideal calibration

Compared with medical or procedural causes, out-of-hospital death was significantly more likely for unintentional injuries (OR=1.97,  $p<0.001$ ), intentional injuries (OR=1.96,  $p=0.013$ ), and especially for other or undetermined causes (OR=27.13,  $p<0.001$ ). Nationality was also an important determinant: foreign nationals had nearly double the odds of out-of-hospital death compared with Turkish nationals (OR=1.91,  $p<0.001$ ).

Age was a consistent predictor; each additional year increased the odds of out-of-hospital death by 14%

(OR=1.14,  $p<0.001$ ). Seasonal variation was modest. Summer deaths were less likely to occur out of hospital than winter deaths (OR=0.65,  $p=0.017$ ), while spring (OR=0.91,  $p=0.627$ ) and autumn (OR=1.01,  $p=0.928$ ) showed no significant differences. Sex was not associated with out-of-hospital death (OR=1.01,  $p=0.933$ ). Overall, the regression results highlight the strong association of cause of death, age, and nationality with the probability of out-of-hospital certification, while seasonal influences were limited and sex showed no effect.

## DISCUSSION

This study examined factors associated with out-of-hospital death certification in a large forensic series of pediatric and adolescent deaths. Consistent with prior literature, external causes, older age, and markers of social vulnerability were more frequently associated with out-of-hospital deaths. Accordingly, the contribution of the present study lies not in proposing a new general explanation for pediatric mortality, but in documenting these associations within a Turkish forensic case-file context and highlighting their relevance for medico-legal mortality surveillance.

Although medical or procedural causes accounted for the majority of deaths overall, out-of-hospital death certification was disproportionately frequent in cases involving intentional injuries and, most notably, those classified as other or undetermined. This pattern is consistent with prior forensic and injury epidemiology studies indicating that sudden, unexpected, or violent deaths are commonly discovered outside healthcare settings and therefore may bypass hospital-based evaluation before certification (15). In such circumstances, death determination may rely more heavily on scene investigation and postmortem findings than on contemporaneous clinical documentation, which may increase the likelihood of out-of-hospital death certification. The elevated proportion observed for intentional injuries also aligns with well-established

evidence that deaths due to interpersonal violence or self-harm, particularly among adolescents, frequently occur before medical contact can be established, contributing to a substantial burden of prehospital fatalities (1,15).

The exceptionally high out-of-hospital death certification proportion observed in the other or undetermined category warrants particularly cautious interpretation. Rather than suggesting a distinct etiological risk, this finding more likely reflects the heterogeneous and information-limited nature of these cases. Undetermined classifications are commonly assigned when deaths are unwitnessed, discovered after a delay, or lack sufficient circumstantial, clinical, or investigative information, conditions that are likely to be more prevalent in deaths occurring outside healthcare environments. Similar patterns have been described in forensic pathology literature, where undetermined causes often serve as a marker of investigative constraints rather than a discrete biological or behavioral category (3-5). Accordingly, the strong association observed for this group should be understood primarily as a methodological and contextual feature of forensic death investigation, reflecting limitations in available data rather than a causal relationship between undetermined mechanisms and out-of-hospital mortality.

Nationality emerged as an independent predictor of out-of-hospital death certification, with foreign nationals exhibiting higher odds compared with Turkish nationals after adjustment for age, cause of death, and season. This finding should be interpreted with particular care. Nationality itself should not be viewed as an inherent risk factor; rather, this association may reflect broader structural and systemic influences that have been widely documented in migration and health research, including barriers related to language, healthcare access, socioeconomic vulnerability, and familiarity with emergency medical systems (16,17). Such factors may contribute to delays in seeking care or difficulties in accessing emergency services, which in turn

may increase the likelihood that fatal events are documented outside hospital settings. Importantly, the present study lacked information on legal status, duration of residence, socioeconomic position, or geographic accessibility, precluding causal inference. The observed association is therefore best understood as a possible indicator of inequities in access to timely medical care, rather than as a feature inherently linked to migrant status.

Age showed a clear and consistent association with out-of-hospital death certification, with increasing age corresponding to higher odds of dying outside hospital settings. This age gradient aligns with established pediatric mortality patterns, whereby younger children are more often under continuous medical supervision due to congenital conditions or perinatal complications, while older children and adolescents experience a greater burden of external causes such as injuries and violence (18,19). Greater independence, increased exposure to environmental risks, and reduced routine healthcare contact among adolescents may collectively contribute to this pattern. Seasonal variation was modest, with summer associated with lower odds of certification compared with winter, a finding that may reflect differences in injury patterns, environmental exposure, or emergency response conditions. However, the relatively small effect size suggests that structural and circumstantial determinants may play a more prominent role than temporal factors in shaping where deaths are certified.

Overall, these findings suggest that out-of-hospital death certification in pediatric and adolescent forensic cases is not a random or purely procedural outcome, but is associated with the intersection of cause-specific mechanisms, age-related risk, investigative context, and broader social determinants. Better integration of forensic data with public health surveillance may help improve the interpretation of mortality patterns and identify potentially vulnerable groups. In addition, strengthening prehospital

emergency response systems, improving early recognition of life-threatening events, and promoting equitable access to emergency care, particularly for socially vulnerable populations, may be relevant considerations in efforts to reduce disparities in death location and enhance the value of both forensic practice and public health mortality surveillance.

### Limitations

This study has several limitations. First, this is a retrospective study relying on forensic records, which are prone to classification errors, especially in ambiguous or undetermined cases. The extreme odds ratio observed for the other or undetermined category likely reflects a heterogeneous group with diagnostic uncertainty. Second, the dataset includes only cases handled by forensic authorities, which may not represent all pediatric deaths in the region. Third, categorizing place of death dichotomously as facility or ambulance versus out-of-hospital does not fully capture nuances such as in-transit deaths or those occurring shortly after hospital arrival. Fourth, the inclusion of an undetermined cause category, while necessary for comprehensive forensic reporting, may have influenced effect size estimates due to diagnostic uncertainty and should be considered when interpreting the results. Finally, key covariates such as socioeconomic status, geographic location, or underlying health conditions were unavailable, limiting causal inference and leaving potential bias from unmeasured confounders. Despite these limitations, the study provides robust evidence on the demographic and circumstantial determinants of out-of-hospital death. The large sample size, standardized forensic coding, and systematic statistical diagnostics strengthen confidence in the findings, which carry both forensic and public health implications.

## CONCLUSION

In this study of pediatric and adolescent deaths recorded in the Turkish forensic system, out-of-hospital death certification was not randomly distributed across cases. It was more strongly associated with external and undetermined causes of death, older age, and foreign nationality. These findings are consistent with the view that out-of-hospital deaths in this population are shaped by differences in case circumstances, exposure patterns, and possible structural vulnerability.

In particular, the strong association with external and undetermined causes suggests that deaths documented outside hospital settings often involve sudden events, delayed discovery, or circumstances requiring a predominantly medico-legal investigation process. The association observed among older children and adolescents may reflect greater autonomy and exposure to environmental or behavioral risks, while the association with foreign nationality may indicate underlying inequalities affecting some groups within the case population. However, these interpretations should be made cautiously, as the present data do not permit direct causal inference regarding healthcare access, emergency response, or other systemic mechanisms.

Overall, the findings provide context-specific evidence from forensic case records in Türkiye and suggest that the recorded place of death documentation may be a useful indicator in pediatric and adolescent mortality surveillance. Better integration of forensic data with public health approaches may help identify vulnerable groups, improve interpretation of mortality patterns, and support more equitable prevention strategies.

## Declarations

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## Conflict of Interest

The authors declare that they have no conflict of interest related to this article.

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