

## Sociodemographic and Autopsy Findings in Hanging-Related Deaths: Evidence from Isparta, Türkiye

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### Abstract

#### Objective

Suicide is a major public health issue affecting millions of people worldwide. In particular, hanging has increasingly become a more frequently chosen method of suicide. Understanding the characteristics of suicide cases is of great importance for the development of effective prevention strategies. This study examined suicide cases by hanging that occurred within a specific region. Autopsy findings, along with the location and time of the incident and the sociodemographic characteristics of the individuals, were evaluated collectively to identify factors associated with this type of suicide.

#### Material and Method

This retrospective observational study examined findings from 80 autopsies conducted due to hanging-related deaths in Isparta province, Türkiye, between 2012 and 2020, as well as data about the individuals. Variables such as sociodemographic characteristics, type of hanging, autopsy findings, material used, history of psychiatric illness, suicide note, and contributing factors were defined categorically. Statistical differences between variables were assessed using the chi-

square test, and the significance level was set at  $p < 0.05$ .

#### Results

The majority of the examined cases consisted of male individuals ( $n = 58, 72.5\%$ ). Cervical vertebral fractures were significantly more frequent among individuals aged 65 years and older compared to other age groups ( $p < 0.05$ ). The use of scarves among women and the presence of hyoid bone fractures among men were found to be statistically significant ( $p < 0.05$ ). Suicide cases were most frequently observed during the autumn season ( $n = 30, 37.5\%$ ) and predominantly occurred within home environments ( $n = 56, 70\%$ ).

#### Conclusion

The findings reveal that suicide is associated with demographic and environmental factors and that age and gender are significantly correlated with certain autopsy findings. The data obtained indicate that suicide prevention strategies should be developed by focusing on both individual and environmental risk factors.

**Keywords:** Autopsy, Forensic medicine, Prevention, Suicide

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## Introduction

Suicide is a major social problem that causes the loss of approximately one million lives globally each year (1). Highly associated with psychiatric disorders, suicide stands out as one of the most preventable causes of death. The World Health Organization emphasizes the vital importance of early assessment of individuals exhibiting suicidal behavior and the adoption of a multidisciplinary approach to increase awareness and reduce suicide-related deaths (2, 3).

Stigmatization related to mental disorders and suicide constitutes one of the main barriers preventing individuals with suicidal ideation from accessing necessary professional support (4). Cultural and moral beliefs regarding suicide, along with negative or hopeless attitudes toward suicide prevention and intervention centers, are among the primary factors limiting help-seeking behavior (1). In this context, the insufficiency of medical records and reports concerning various suicide methods leads to significant shortcomings in intervention processes (3).

Hanging emerges as a frequently used method in both suicides and suicide attempts and is characterized by a high mortality rate (5). It has been reported that the frequency of using this method in suicides is increasing and that prevention is becoming increasingly difficult due to its easy accessibility. Several studies have shown that various factors such as marital status, education level, unemployment, and age influence deaths resulting from hanging (3, 6).

Among deaths caused by asphyxia, hanging cases present with factors such as the type of material used and the location and time of the incident that directly affect autopsy findings (7). In particular, the use of easily accessible objects such as ropes or scarves and the availability of suitable spaces where the hanging mechanism can be applied, such as private indoor environments (e.g., homes), play a decisive role in the occurrence of suicide (8, 9). Although hanging is a lethal and increasingly common method, it is also considered a preventable cause of death (10). However, the high fatality rate and easy accessibility of this method make the implementation of preventive measures difficult. This situation once again underscores the critical importance of early intervention and risk assessment before the suicidal act takes place (11).

It is of great importance to evaluate the psychosocial characteristics of individuals at risk and plan preventive interventions accordingly. In this regard, examining autopsy findings of individuals who have died due to

hanging may contribute to suicide prevention strategies. Many previous studies have thus investigated autopsy findings of deaths by hanging in conjunction with related psychosocial factors (12–14).

Several studies have reported an increasing use of hanging in certain regions and the need for comprehensive regional data. We aimed to evaluate the sociodemographic, clinical, and forensic characteristics of deaths resulting from hanging to identify possible relationships between these variables and the type of hanging and autopsy findings, thereby contributing epidemiologically to the literature on suicide prevention.

## Material and Method

This retrospective observational study was conducted at Süleyman Demirel University Hospital and examined 80 cases of deaths resulting from hanging among autopsies performed in Isparta province, Türkiye, between 2012 and 2020. In this study, cases that underwent autopsy between 2012 and 2020 and were determined to have died by hanging were retrospectively reviewed. Cases with complete autopsy reports, crime scene investigation findings, and forensic records were included in the study. The analysis excluded cases where the cause of death was attributed to factors other than hanging, alongside those with advanced decomposition where the mechanism of death could not be ascertained with certainty. Data were obtained from sources such as hospital records, autopsy reports, crime scene investigation records, and witness statements. For each case, the following variables were evaluated: age, gender, marital status, year and month of death, season, place of hanging, presence of a suicide note, material used for hanging, type of hanging according to knot position (typical/atypical), hemorrhage in neck muscles, carotid artery injury, hyoid bone fracture, thyroid cartilage fracture, hemorrhage in soft tissues around the hyoid and thyroid, hemorrhage in cervical paravertebral muscles, and presence of dislocation or fracture in cervical vertebrae.

Sociodemographic data, such as age, gender, marital status, date, and place of death, were obtained from the "Death Certificate" included in the death notification system of the Turkish Statistical Institute. Through witness statements recorded in the autopsy reports, information was collected regarding whether the individuals had psychiatric diagnoses, the nature of such diagnoses if present, whether they were receiving treatment, and whether they had prior suicide attempts. The presence of suicide notes was also determined through crime scene investigation records.

Cases with reported psychiatric illness or medication use but lacking a definitive diagnosis in the system were classified as “undiagnosed.” All stages of the study were conducted in accordance with the latest revision (2024) of the 1995 Declaration of Helsinki. As the sample size included all eligible cases, no power analysis was conducted.

**Statistical Analysis**

In this study, data from 80 cases were analyzed using the Statistical Package for the Social Sciences v. 25.0 (IBM SPSS Statistics 25, Armonk, NY: IBM Corp). All variables were defined categorically, and descriptive statistics were presented as the number and percentage of cases. Statistical differences between categorical variables were tested using the chi-square test. In all analyses, the criterion for statistical significance was set at  $p < 0.05$ .

**Results**

**Sociodemographic Characteristics**

Tables 1 and 2 summarize the relationship between age, gender, and factors leading to suicide, along with

various characteristics of suicide. The characteristics related to hanging showed no statistically significant relationship with variables such as marital status, the presence of a suicide note, history of previous suicide attempts, place of death, or history of psychiatric illness ( $p > 0.05$ ). Statistically significant differences were identified between genders in terms of hanging material and hyoid bone fracture. Among female individuals, the use of scarves as a hanging material was found to be significantly more frequent ( $p < 0.01$ ).

**Psychiatric and Suicide-Related Characteristics**

Upon examining the distribution of cases based on the presence of a suicide note, it was determined that 7 cases (8.7%) had a suicide note, while 73 cases (91.3%) did not. According to the analysis based on the history of suicide attempts, 38 cases (47.5%) had no history of suicide attempts, information was unavailable for 35 cases (43.8%), and 7 cases (8.7%) had a documented history of suicide attempts. Analysis of the distribution of cases according to the presence of psychiatric illness showed that 57 cases (71.3%) had no psychiatric illness, 21 cases (26.3%) had a psychiatric illness, and information could not be obtained for 2

**Table 1** Relationship between hanging characteristics and age, gender, and causes of suicide

Hanging characteristics	Age (years)				Gender		Causes of suicide					P-values		
	0-17 (n = 7)	18-40 (n = 34)	41-64 (n = 26)	≥65 (n = 13)	Male (n = 58)	Female (n = 22)	Unknown (n = 43)	Family problems (n = 13)	Economic problems (n = 8)	Health problems (n = 13)	Economic and health problems (n = 3)	Gender p-value	Age p-value	Cause p-value
<b>Hanging material</b>												<b>&lt;0.05*</b>	0.29	1.00
Rope	6 (86%)	13 (38%)	21 (81%)	10 (77%)	36 (62%)	14 (64%)	25 (58%)	9 (69%)	6 (75%)	8 (62%)	2 (67%)			
Shawl	1 (14%)	1 (2.9%)	0 (0%)	0 (0%)	2 (3.4%)	0 (0%)	1 (2.3%)	1 (7.7%)	0 (0%)	0 (0%)	0 (0%)			
Bag strap	0 (0%)	1 (2.9%)	0 (0%)	0 (0%)	1 (1.7%)	0 (0%)	1 (2.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)			
Unknown	0 (0%)	9 (26%)	3 (12%)	2 (15%)	12 (21%)	2 (9.1%)	7 (16%)	1 (7.7%)	1 (13%)	4 (31%)	1 (33%)			
Clothing	0 (0%)	1 (2.9%)	0 (0%)	0 (0%)	0 (0%)	1 (4.5%)	1 (2.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)			
Fabric	0 (0%)	3 (8.8%)	0 (0%)	1 (7.7%)	4 (6.9%)	0 (0%)	3 (7.0%)	1 (7.7%)	0 (0%)	0 (0%)	0 (0%)			
Nylon	0 (0%)	0 (0%)	1 (3.8%)	0 (0%)	1 (1.7%)	0 (0%)	1 (2.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)			
Scarf	0 (0%)	4 (12%)	1 (3.8%)	0 (0%)	0 (0%)	5 (23%)	3 (7.0%)	1 (7.7%)	0 (0%)	1 (7.7%)	0 (0%)			
Cable	0 (0%)	2 (5.9%)	0 (0%)	0 (0%)	2 (3.4%)	0 (0%)	1 (2.3%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)			
<b>Hanging type</b>												0.06	0.89	0.29
Typical	5 (71%)	19 (56%)	13 (50%)	9 (69%)	38 (66%)	8 (36%)	27 (63%)	5 (38%)	6 (75%)	6 (46%)	2 (67%)			
Atypical	2 (29%)	14 (41%)	12 (46%)	4 (31%)	19 (33%)	13 (59%)	15 (35%)	8 (62%)	1 (13%)	7 (54%)	1 (33%)			
Unknown	0 (0%)	1 (2.9%)	1 (3.8%)	0 (0%)	1 (1.7%)	1 (4.5%)	1 (2.3%)	0 (0%)	1 (13%)	0 (0%)	0 (0%)			

Data are presented as n (number of cases) and % (percentage). \*Statistically significant at  $p < 0.05$  (chi-square test). Data related to the causes of suicide were derived from the suicide note.

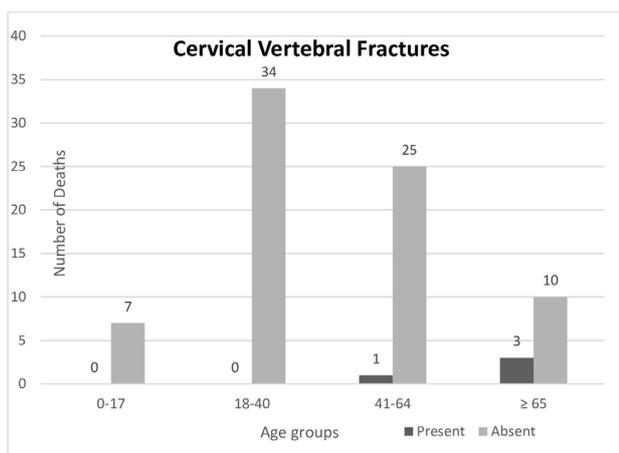


Figure 1

Relationship between the presence of cervical vertebral fractures and age groups

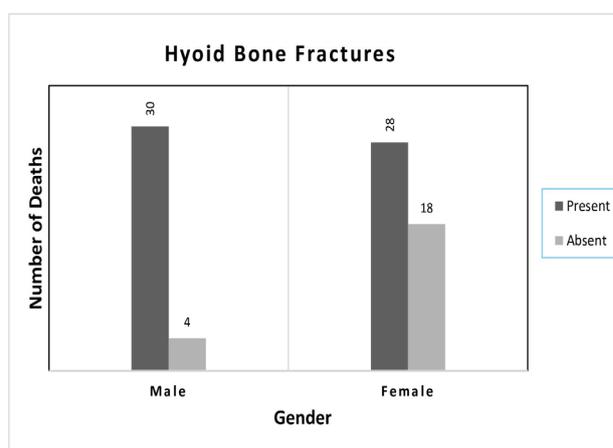


Figure 2

Relationship between the presence of hyoid bone fractures and gender

cases. Among the 21 cases with psychiatric illness, 10 were diagnosed with mood disorders, while 6 had a psychiatric diagnosis recorded but were categorized as “diagnosis unavailable” due to the lack of detailed information obtained from witness statements.

**Autopsy Findings**

In analyses in which the ligature material was reclassified as thick, thin, or unknown, no statistically significant differences were observed between groups with respect to demographic variables, clinical characteristics, fracture types, or muscle injuries (all  $p > 0.05$ ).

**Fracture Patterns**

No statistically significant relationship was found between hanging type and the presence of hyoid bone, thyroid cartilage ( $n = 14, 17.5\%$ ), or cervical vertebral fractures ( $p > 0.05$ ). In contrast, examination of the prevalence of cervical vertebral fractures across age groups revealed that this finding was significantly higher among individuals aged 65 years and older compared to other age groups ( $p = 0.011$ ) (Fig 1). On the other hand, hyoid bone fractures were observed significantly more often among male individuals ( $p < 0.01$ ) (Fig 2).

Table 2

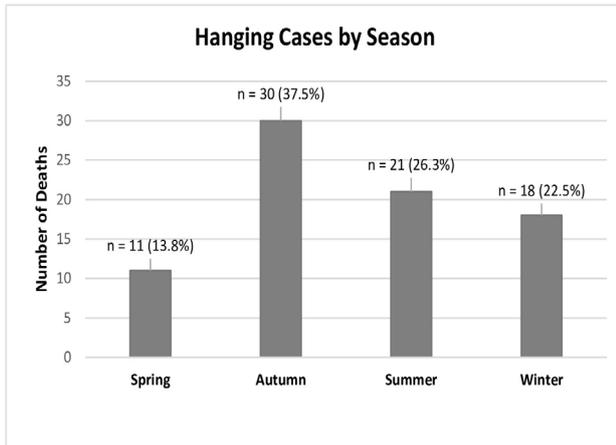
Relationship between fracture characteristics and demographic variables

Fracture characteristics	Age (years)				Gender		Gender p-value	Age p-value
	0-17 (n = 7)	18-40 (n = 34)	41-64 (n = 26)	≥65 (n = 13)	Male (n = 58)	Female (n = 22)		
<b>Hyoid fracture</b>							<b>&lt;0.05*</b>	0.06
Present	0 (0%)	14 (41%)	12 (46%)	8 (62%)	30 (52%)	4 (18%)		
Absent	7 (100%)	20 (59%)	14 (54%)	5 (38%)	28 (48%)	18 (82%)		
<b>Cervical vertebral fracture</b>							0.30	<b>&lt;0.05*</b>
Present	0 (0%)	0 (0%)	1 (3.8%)	3 (23%)	2 (3.4%)	2 (9.1%)		
Absent	7 (100%)	34 (100%)	25 (96%)	10 (77%)	56 (97%)	20 (91%)		

Data are presented as n (number of cases) and % (percentage). \*Statistically significant at  $p < 0.05$  (chi-square test). Data regarding the cause of suicide was obtained from witness statements in autopsy reports and suicide notes.

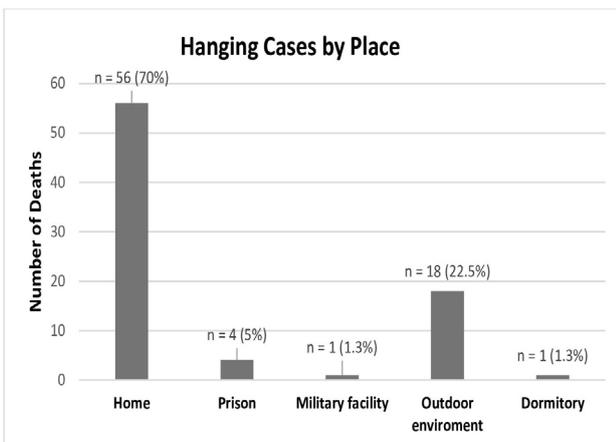
### Scene Characteristics

According to the analysis of the distribution of deaths by season, suicides occurred significantly more often during the autumn months ( $p < 0.05$ ). A significant difference was also found regarding the place of death, with the vast majority of cases occurring within home environments ( $p < 0.05$ ) (Fig 3 and 4).



**Figure 3**

Distribution of hanging cases by season  
n: number of deaths. Chi-square goodness-of-fit test,  $p < 0.05$



**Figure 4**

Distribution of hanging cases by place  
n: number of deaths. Chi-square goodness-of-fit test,  $p < 0.05$

### Muscle and Vascular Injuries

Muscle injuries were identified in the majority of cases. The most frequently affected muscle was the sternocleidomastoid muscle ( $n = 59$ ), followed by the sternohyoid ( $n = 24$ ), thyrohyoid ( $n = 13$ ), sternothyroid ( $n = 8$ ), platysma ( $n = 6$ ), paravertebral muscles ( $n = 5$ ), omohyoid ( $n = 3$ ), and cricoarytenoid muscles ( $n = 3$ ). Intervertebral ( $n = 2$ ), prevertebral ( $n = 2$ ), and mylohyoid muscle injuries ( $n = 1$ ) were observed less

frequently. Vascular injury was detected in only one case, presenting as Amussat's sign ( $n = 1$ ).

### Discussion

In this study, the characteristics of suicide cases by hanging were examined, and it was found that the vast majority of the cases consisted of male individuals. It was determined that suicides predominantly occurred during the autumn season and within home environments. The prevalence of cervical vertebral fractures was found to be higher among individuals aged 65 years and older, scarf use was more frequently preferred among women, and hyoid bone fractures were more commonly observed, particularly among men.

Both globally and in Türkiye, hanging is observed to be one of the most frequently preferred methods of suicide (15–17). The perception of this method as a rapid, painless, and definitive solution is regarded as one of the main reasons for its increasing preference (7).

As in our study, previous research also indicates that the proportion of men who commit suicide by hanging is higher than that of women (3). The male-to-female ratio among suicide cases by hanging has been reported as 3:1 (18). Women's greater inclination to seek social support and help compared to men is considered one of the factors explaining this difference (19). Particularly among young men, factors such as reluctance to seek help, higher tendencies toward dependency, and inadequate coping strategies have been reported to be associated with vulnerabilities imposed by social and cultural norms (20). It has been emphasized that men's decisiveness in choosing suicide methods may be associated with their lack of help-seeking behavior and the lethality of their attempts (21). This situation, together with the lower rate of psychiatric diagnosis among men, explains why violent methods such as hanging are more frequently chosen compared to women and renders the findings of our study consistent with the literature. Furthermore, men's tendency to employ more lethal methods in self-directed violent acts supports this relationship.

In a study conducted in 2002, Krug et al. revealed that individuals who attempted suicide impulsively tended to choose objects that were easily accessible and held significance in their daily lives (22). In the literature, it has also been emphasized that detailed media coverage of suicide methods increases the likelihood of imitation and use of similar methods (23). Studies have shown that materials frequently used in daily life

and easily obtainable are more commonly preferred in suicide attempts by hanging (10). The higher frequency of scarf use as a hanging material among female cases represents an observational finding. It is considered that gender-based differences in daily life substantially influence the selection of materials used for hanging.

In a study undertaken by Jayaprakash and Sreekumari, only three cases (1.6%) with cervical vertebral fractures were identified, all of whom were aged 38 years or older (24). The authors noted that the increased frequency of fractures in older individuals was related to the rise in calcification with age. Similarly, other researchers have reported that the incidence of fractures increases with age and is associated with degenerative changes (25). Another study conducted in 2012 also demonstrated that fractures in the neck region increased with age and that these fractures did not show a significant association with gender (3). In our study, the finding that cervical vertebral fractures were more frequently observed among elderly individuals is consistent with the literature. This observation is considered to be related to factors that increase fracture risk, such as decreased bone mineralization and the higher prevalence of osteoporosis with advancing age. Reported soft tissue findings in hanging cases include tissue hemorrhage, hemorrhage within the sternocleidomastoid and strap muscles, while vascular lesions may involve intimal tears, perivascular hematomas, or compression-related changes in the vessels (26). Consistent with the literature, vascular injuries were infrequent in our study, whereas soft tissue injuries, particularly involving the sternocleidomastoid muscle, were more common (27). This could reflect a bias in the inspection of a particular anatomical area and may also suggest an association with the superficial anatomical location of this muscle.

Lasota et al., who evaluated 317 suicide cases by hanging, reported that suicides occurred more frequently among men in the spring and among women in the autumn and that this seasonal distribution might be associated with alcohol consumption (28). The authors identified hanging as the most common method of suicide among both genders and noted that the influence of seasonality decreased with age, although this effect was more pronounced in men (29). A peak was identified in June, with this increase being particularly concentrated among men aged 45 years and older, and hanging again emerged as the most frequent method (30). A large-scale study conducted in Sweden and Finland involving 257,341 cases reported two separate suicide peaks, occurring in May and October, with a marked increase observed especially among Finnish men in October (31). In a study by Meel et al., the highest number of suicide deaths by

hanging was observed in May and November (32). All these findings indicate that seasonal variations in suicide exhibit a complex structure and may be influenced by numerous factors such as culture, age, and gender. Similarly, in our study, the proportion of individuals who committed suicide during the autumn months was found to be significantly higher. Some previous studies have similarly identified autumn as a period during which suicide attempts become more frequent. It is considered that geographic conditions and cultural factors may play a role among the underlying causes of seasonal differences. Findings suggesting that suicide exhibits seasonality highlight the importance of multidisciplinary approaches and inter-institutional collaboration, and factors such as seasonal concentration and the location of the incident can serve as guiding elements in suicide prevention efforts. In this context, our study presents findings consistent with the previous literature and underscores the necessity of further investigation into the seasonal aspect of suicide.

In our study, only 8.7% of the cases had a suicide note, and similarly, a history of previous suicide attempts was identified in 8.7% of the cases. These findings appear consistent with other studies reported in the literature. Although the presence of a suicide note does not definitively confirm that the incident was a suicide, it constitutes an important piece of evidence for understanding the factors that may have led the individual to take their own life. In rapid and highly lethal methods such as hanging, the sudden development of the act or the absence of a desire to express emotions in writing may increase the likelihood of not leaving a suicide note. Similarly, although a history of prior suicide attempts has been reported in 15–30% of cases, the lack of detailed information regarding the victim's background or the reluctance of families to disclose such information due to stigma may result in these rates being recorded lower than they actually are (33).

Many studies have reported that individuals most frequently choose their own homes as the place for suicide (16,34). In addition to requiring a specific material, hanging also necessitates a suitable location where that material can be used, and it generally involves a certain degree of preparation. The fact that this preparatory process can be monitored or interrupted may lead individuals to perceive less controlled environments (such as private spaces like homes) as more suitable settings for suicide, which may influence their spatial preferences accordingly. It has been emphasized that in institutions such as psychiatric wards, military facilities, and prisons,

access to materials required for suicide is restricted due to safety measures, whereas careful monitoring is necessary in relatively less controlled spaces such as rest areas (35). As observed in our study and many similar ones, the vast majority of suicides by hanging occurred within home environments. This finding once again underscores the importance of ensuring that individuals at risk are not deprived of social support and are not left alone, either by their families or social institutions, during exacerbation periods of psychiatric illness. The fact that individuals discharged from emergency or psychiatric services who live alone constitute a major risk group should be taken into serious consideration. Therefore, it is of vital importance to strengthen social support systems and implement protective measures aimed at reducing suicide risk for these individuals.

In this study, only a small proportion of the suicide cases were found to have a history of psychiatric illness. In a study conducted in Isparta involving 126 autopsy cases, 24.6% of the individuals had a psychiatric diagnosis, and 51.6% of these diagnoses were depression (36). In a study conducted in the USA on 394 cases, 54.1% of the individuals were found to have no psychiatric illness or no record of such, while 45.9% had a diagnosed psychiatric disorder (37). In another study undertaken by Persons et al., a psychiatric diagnosis was present in 37% of suicide cases (38). In their review, Milner et al. noted that the proportion of suicide cases without a psychiatric diagnosis was higher and attributed this discrepancy to differences in the identification and conceptualization of mental disorders, in addition to cultural and methodological variations (39). It has also been suggested that undiagnosed physical diseases, medical conditions causing severe pain, sudden and intense stress factors, lack of social support, and personality disorders associated with impulsivity may also predispose individuals to suicidal behavior (40). The low rate of psychiatric diagnosis and treatment in our study may be due to the limited representativeness of the sample size, as well as to factors such as the fear of stigmatization surrounding psychiatric disorders and regional limitations in accessing medical services. Further studies with larger samples that involve different suicide methods and take into account the cultural context would contribute to a more detailed identification of the related factors.

### Limitations

The retrospective design of this study resulted in an inability to directly control the data and relying solely on information previously recorded. This limitation may have led to the omission or incomplete documentation of certain significant variables. In addition, the fact that

the study was conducted in a single center and focused exclusively on cases from a specific region restricted its geographical and demographic representativeness and may have prevented an adequate evaluation of the influence of sociocultural factors. Furthermore, the relatively small sample size may have prevented the identification of certain potential subgroups or significant trends. The exclusive focus of the research on a single suicide method (hanging) made it difficult to analyze the differences among methods or the factors influencing method selection, which limited the opportunity to evaluate suicidal behavior from a broader perspective. Lastly, there is the possibility that some of the reporting systems and death records used in the study contained incomplete or inaccurate data. In particular, in cases where death records were not maintained in sufficient detail, data deficiencies or misclassifications may have negatively affected the accuracy of the analytical results.

### Conclusion

Hanging is one of the most common and lethal methods of suicide, and research focusing on this method plays a critical role in developing strategies for suicide prevention. Encouraging individuals to seek medical services promptly, increasing access to psychosocial support mechanisms, and developing effective intervention strategies for risk groups are fundamentally important in reducing suicide rates.

To better understand suicidal behaviors and develop preventive policies, it is essential to consider multidimensional factors such as seasonality, gender differences, cultural influences, and psychiatric treatment processes. In particular, studies based on autopsy findings contribute to the identification of individual and environmental risk factors, thereby providing important data to guide future research in this field.

Multidisciplinary collaboration in suicide prevention can generate positive effects at both individual and societal levels. In this regard, it is of great importance to expand psychosocial support services and maintain public awareness campaigns. When necessary, the implementation of legal regulations is also among the effective strategies to reduce suicide-related deaths. In addition, the effective treatment and regular monitoring of psychiatric disorders are vital in the suicide prevention process.

Considering the findings and limitations of our study, it is recommended that future research include broader geographical regions, involve different suicide methods,

and be conducted with larger sample sizes, using prospective designs. Furthermore, the improvement of death records and reporting systems is considered a critical requirement to improve the reliability of such studies.

### Conflict of Interest Statement

The authors declare that they have no conflicts of interest to disclose.

### Ethical Approval

Ethical approval for this study was obtained from the Non-Interventional Clinical Research Ethics Committee of Süleyman Demirel University on October 31, 2023, with decision number 14/218.

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### Availability of Data and Materials

Data available on request from the authors.

### Artificial Intelligence Statement

The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript, nor for the creation of images, graphics, tables, or their corresponding captions.

### Authors Contributions

M.C.Y: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Validation; Visualization; Writing-original draft; Writing-review and editing.

A.Y: Conceptualization; Formal analysis; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Writing-original draft; Writing-review and editing.

A.M: Investigation; Validation; Visualization; Writing-original draft; Writing-review and editing.

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