



## Article

# Five Years of Suicide in the Governorate of Sidi Bouzid, Tunisia: A Retrospective Medico-Legal and Epidemiological Study

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## Abstract

**Background/Objectives:** The governorate of Sidi Bouzid, an inland region of Tunisia, had not previously been the subject of a medico-legal study of suicide. We described the epidemiological profile of suicide deaths identified through the medico-legal autopsy system during 2019–2023 and identified prevention-relevant hypotheses for future research. **Methods:** This retrospective descriptive study included 91 suicide deaths undergoing medico-legal autopsy at Sidi Bouzid Hospital. Demographic characteristics, circumstances of death, and autopsy findings were extracted from medico-legal files. Emergency-department suicide-attempt counts from the same region and period provided complementary descriptive context. **Results:** Suicide accounted for 10.6% of 857 autopsies. Men represented 59.3% of cases and the mean age was 35.5 years. A documented psychiatric history was recorded in 57.1% of victims. Hanging was the leading method (70.3%), followed by poisoning (15.4%). The annual number of forensically identified cases increased from 10 in 2019 to 27 in 2023, but no formal temporal trend was inferred from only five annual observations. The mean annual incidence based on forensic cases was 3.99 per 100,000 person-years (95% CI 3.21–4.90), interpreted as a lower-bound estimate because deaths not referred for forensic investigation could not be captured. Females represented 55.7% of 587 emergency-department suicide attempts recorded over the same period. **Conclusions:** The study provides a regional medico-legal description of suicide in Sidi Bouzid and identifies patterns that may inform future surveillance and hypothesis-generating prevention research. These findings should not be interpreted as estimates of subgroup-specific suicide risk or as evidence of intervention effectiveness.

**Keywords:** suicide; hanging; forensic autopsy; epidemiology; prevention; Tunisia



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## 1. Introduction

Suicide is a complex, multifactorial public health problem affecting populations worldwide, disproportionately so in low- and middle-income countries, where it accounts for up to 77% of deaths by violent causes [1], and is the third leading cause of death among people aged 15–29 years [2]. More than 720,000 people die by suicide every year, with WHO estimating more than 20 attempts for every death [2]; it ranks as the 15th leading cause of death globally [3] and usually results from an interplay of psychological, social, and environmental factors, including emotional distress, mental disorders, social isolation, and traumatic life events [1,3].

In Tunisia, official statistics reported a suicide incidence of 3.29 per 100,000 inhabitants in 2016 [4]. A study at the Department of Forensic Medicine of Tunis documented a 1.7-fold rise in suicides in northern Tunisia following the January 2011 revolution, with the annual prevalence increasing from 1.8 to 3.12 per 100,000 inhabitants [5]. More recent Tunisian forensic evidence includes a 17-year autopsy-based study from northern Tunisia (2005–2021), which identified 2153 suicides among 32,321 autopsies [6], and forensic studies of suicide and unnatural death in children and adolescents [7–9]. Suicide methods vary considerably by sociocultural context [10]; worldwide, pesticide poisoning accounts for nearly 20% of suicide deaths, hanging and firearms are also common, and self-immolation remains comparatively rare [11]. Tunisian law requires the certifying physician to flag any suspected suicide as a “medico-legal obstacle to burial” on the death certificate, since suicide is legally a violent death, which triggers a forensic investigation [5]; medico-legal series conducted in Tunisia therefore capture suicide deaths that are recognised and referred through the forensic system in their catchment area.

Although several medico-legal studies of suicide have been conducted elsewhere in Tunisia, none had previously addressed the governorate of Sidi Bouzid, an inland region marked by significant socioeconomic vulnerability, particularly since 2011. The objective of this study was to describe the epidemiological profile of suicide victims in Sidi Bouzid and to identify prevention-relevant hypotheses for future research.

## 2. Materials and Methods

### 2.1. Study Design, Population and Setting

We conducted a retrospective descriptive study at the Department of Forensic Medicine of Sidi Bouzid Hospital, Tunisia, covering all suicide cases whose bodies underwent medico-legal autopsy between 1 January 2019 and 31 December 2023.

#### 2.1.1. Inclusion Criteria

All subjects who died by suicide, as established by the judicial investigation and thanatological findings, and whose bodies underwent medico-legal autopsy at the department during the study period, whatever the post-mortem interval before autopsy.

#### 2.1.2. Non-Inclusion Criteria

Suicide deaths for which no medico-legal autopsy was performed at the department (e.g., referral to another centre) and files with insufficient exploitable data. Under Tunisian law, every suspected suicide death constitutes a “medico-legal obstacle to burial” and must be referred for judicial investigation and autopsy [5]. The series is therefore a near-exhaustive count of judicially recognised suicide deaths identified through the forensic autopsy system in Sidi Bouzid. It cannot establish complete population ascertainment: a small number of deaths might have been classified as accidental at the scene and never referred, or referred to another centre. This possibility is acknowledged as a limitation.

## 2.2. Data Sources and Collection

Data were extracted from the medico-legal files of victims, each of which included the judicial requisition, a standardised data-collection form, a copy of the autopsy report, a copy of the medical file when available, and results of complementary examinations. Data were organised into three domains: (i) victim characteristics (age, sex, marital status, occupation, geographic origin, medical/surgical/psychiatric history, socioeconomic level, and vulnerability factors such as social isolation); (ii) circumstances of the suicide (date, time, place, motive, and method); and (iii) autopsy findings and toxicological results. Educational level was not analysed because it was inconsistently and incompletely recorded across files (it is not a standard item on the judicial requisition or autopsy report and depends on ad hoc reporting by relatives).

### 2.2.1. Psychiatric History

Psychiatric history was defined as a psychiatric disorder documented in the medico-legal or medical file or reported by relatives. No psychological autopsy or standardised diagnostic interview was performed. When relatives reported a psychiatric history, they were asked to provide a medical document concerning the victim's mental health status or the contact details of the treating psychiatrist, who was then contacted to verify the diagnosis. These data therefore reflect information available in the records and are not a standardised assessment of psychiatric disorders.

### 2.2.2. Occupation

Occupation was taken from the medico-legal file. For 10 women, occupation was not specified in the medico-legal file; it was subsequently verified in the corresponding police/investigative records, in which all 10 were documented as housewives. These women are identified separately in the Results so that the original and the subsequently verified information remain distinguishable.

Suicide was defined as any act of violence intended to voluntarily cause one's own death, whatever the method used. Hanging was defined as any act of violence consisting of cervical constriction produced by the total or partial weight of the body, classified as complete when suspension was total and incomplete when part of the body rested on the ground. Reported substance use history was obtained from interviews with relatives.

### 2.2.3. Autopsy Protocol, Histology, and Toxicology

A complete medico-legal external and internal examination was performed in all included cases. Histological sampling was systematic and included the heart, liver, kidneys, brain, spleen, and pancreas; the hyoid bone was sampled in hanging cases. Toxicological investigations were systematic. Samples were referred to the Toxicology Department of Farhat Hached University Hospital, Sousse, targeting the substances most commonly used in Tunisia (cannabis, cocaine, opiates, amphetamine derivatives, and alcohol). Blood alcohol was quantified by the Cordebard method; urine drug screening was qualitative; and systematic screening included salicylates, tricyclic antidepressants, benzodiazepines, paracetamol, and phenothiazines, with targeted analyses when specific substances were suspected.

### 2.2.4. Forensic-Case Incidence

Annual incidence was calculated as the number of suicide deaths recorded in a given calendar year divided by the resident population of the governorate of Sidi Bouzid on 1 January of that year, multiplied by 100,000. Population figures were obtained from official statistics published by the National Institute of Statistics (INS), Tunisia [12], for each year of the study period (2019: 450,744; 2020: 454,053; 2021: 457,664; 2022: 458,232;

2023: 459,891 inhabitants; Table 1). The mean annual incidence was calculated as the total number of cases divided by the sum of the five annual population figures (total person-years, 2,280,584), multiplied by 100,000. Exact Poisson 95% confidence intervals (CIs) were computed for the annual and overall estimates. These figures are forensic-case estimates based on deaths identified through the forensic autopsy system. They are interpreted as lower-bound estimates rather than confirmed true population incidence, because deaths never referred to or recognised by the judicial/forensic system cannot be captured.

**Table 1.** Year-by-year number of forensically identified suicide deaths, governorate population (National Institute of Statistics, Tunisia), and annual forensic-case incidence with exact Poisson 95% CI, Sidi Bouzid, 2019–2023. Figures are counts of suicide deaths identified through the forensic autopsy system and are interpreted as lower-bound estimates, not confirmed true population incidence.

| Year             | Population of Sidi Bouzid Governorate (1 Jan, INS) | Suicide Cases ( <i>n</i> ) | Incidence/100,000/Year | 95% CI    |
|------------------|----------------------------------------------------|----------------------------|------------------------|-----------|
| 2019             | 450,744                                            | 10                         | 2.22                   | 1.06–4.08 |
| 2020             | 454,053                                            | 17                         | 3.74                   | 2.18–5.99 |
| 2021             | 457,664                                            | 13                         | 2.84                   | 1.51–4.86 |
| 2022             | 458,232                                            | 24                         | 5.24                   | 3.36–7.79 |
| 2023             | 459,891                                            | 27                         | 5.87                   | 3.87–8.54 |
| 2019–2023 (mean) | 456,117                                            | 91 total (18.2/year)       | 3.99                   | 3.21–4.90 |

### 2.3. Statistical Analysis

Data were entered in Microsoft Excel and analysed using SPSS version 22 and Python 3.14 (SciPy 1.18.1/statsmodels 0.15.0). Descriptive statistics were computed for all variables. The primary analyses were descriptive. Fisher’s exact test was used for comparisons of two categorical variables in  $2 \times 2$  tables (documented psychiatric history by sex; economic activity by sex), with statistical significance set at  $p < 0.05$ . Fisher’s exact test remains valid with small cell counts; however, sparse multi-category tables (e.g., suicide method by age group, sex, season, month, or motive) make individual comparisons unstable and difficult to interpret, particularly without pre-specified hypotheses and with many possible comparisons. Such tables are therefore presented descriptively, without inferential testing. The comparison of economic activity between sexes was a post hoc, exploratory analysis, and its sensitivity analyses were also post hoc. With only five annual observations (2019–2023), no formal temporal trend model was fitted, because such a model could not reliably distinguish a secular trend from year-to-year fluctuation; changes in annual case counts are reported descriptively.

### 2.4. Emergency-Department Data

To provide complementary context on non-fatal suicidal behaviour, we obtained retrospective emergency-department data on suicide attempts recorded at the Emergency Department of Sidi Bouzid Hospital for the same region and the same period (2019–2023). These data are routinely transmitted by the Emergency Department to the statistical services of the Tunisian Ministry of Health. The data comprised the annual number of recorded attempts, their distribution by sex, and the recorded age range. The emergency-department and forensic datasets were not individually linked and may differ in ascertainment, inclusion criteria, referral pathways, and population coverage; they were therefore not treated as equivalent populations, and no case-fatality ratio was calculated.

2.5. Ethical Considerations

This study was approved by the Ethics Committee of the University Hospital of Sidi Bouzid (approval reference: cmsbz02/2025) and was conducted in accordance with the principles of the Declaration of Helsinki. As this was a retrospective study based on routinely collected medico-legal case files of deceased individuals, the requirement for individual informed consent was waived by the ethics committee. All data were fully anonymized prior to analysis, with victims’ names replaced by identification numbers.

3. Results

3.1. Frequency and Incidence

During the study period, 91 suicide deaths were identified through the forensic autopsy system (mean 18.2 cases per year). This series is a near-exhaustive count of judicially recognised suicide deaths identified through the forensic autopsy system in Sidi Bouzid, but it cannot establish complete population ascertainment. The mean annual forensic-case incidence was 3.99 per 100,000 person-years (95% CI 3.21–4.90), based on official INS population figures [12] (Table 1), and is interpreted as a lower-bound estimate. The annual number of forensically identified cases increased from 10 in 2019 (2.22 per 100,000; 95% CI 1.06–4.08) to 27 in 2023 (5.87 per 100,000; 95% CI 3.87–8.54), a 2.7-fold increase; the confidence intervals of these two years overlapped only marginally. Because this observation rests on only five annual data points, no formal trend test was performed, and the mechanisms underlying the increase remain undetermined. Over the same five-year period, 857 autopsies were performed at the department, so suicide accounted for 10.6% of total thanatological activity.

3.2. Sociodemographic Characteristics

Male victims predominated (59.3%,  $n = 54$ ; sex ratio 1.46). The mean age of the whole population was  $35.5 \pm 17.9$  years (range 11–81 years); it was  $37.5 \pm 16.3$  years for men and  $30.3 \pm 13.6$  years for women. Minors (<18 years) accounted for 20/91 cases (22.0%); 13/91 (14.3%) were aged 11–14 years and 7/91 (7.7%) were aged 15–17 years. No victim was younger than 11 years. The individual ages of the 13 younger adolescents were 11 years ( $n = 3$ ), 12 years ( $n = 5$ ), 13 years ( $n = 2$ ), and 14 years ( $n = 3$ ). Among the 13 victims aged 11–14 years, 11 died by hanging and 2 by poisoning; among the 7 aged 15–17 years, 5 died by hanging and 2 by jumping from height (Table 2). Victims aged over 60 years were the least represented broad age band (11.0%,  $n = 10/91$ : 7 aged 60–69 years and 3 aged  $\geq 70$  years, Table 2). The 30–49-year age group was the most affected (37.4%,  $n = 34/91$ ). A male predominance was observed across all age groups except the 15–17-year group.

**Table 2.** Suicide method by age group, with method-specific totals. Cells show  $n$  (row %); each row (method) sums to approximately 100% across age groups. Table 2 is presented descriptively; no inferential test is reported because of the small cell counts. Age groups are not cross-tabulated by sex.

| Method        | 11–14     | 15–17    | 18–29     | 30–49     | 50–59    | 60–69    | $\geq 70$ | Total $n$ (% of $N = 91$ ) |
|---------------|-----------|----------|-----------|-----------|----------|----------|-----------|----------------------------|
| Hanging       | 11 (17.2) | 5 (7.8)  | 13 (20.3) | 21 (32.8) | 6 (9.4)  | 5 (7.8)  | 3 (4.7)   | 64 (70.3%)                 |
| Poisoning     | 2 (14.3)  | 0        | 0         | 9 (64.3)  | 3 (21.4) | 0        | 0         | 14 (15.4%)                 |
| Jumping       | 0         | 2 (33.3) | 2 (33.3)  | 0         | 2 (33.3) | 0        | 0         | 6 (6.6%)                   |
| Electrocution | 0         | 0        | 0         | 3 (75.0)  | 1 (25.0) | 0        | 0         | 4 (4.4%)                   |
| Drowning      | 0         | 0        | 0         | 1 (33.3)  | 0        | 2 (66.7) | 0         | 3 (3.3%)                   |

Single victims were slightly more frequent than married victims (53.7% vs. 46.3%); a sex-specific breakdown of marital status was not available in the dataset used for this analysis and is therefore not presented in Table 3 to avoid displaying incomplete or unverifiable figures. Of the 91 victims, 45 (49.5%) were of urban origin and 46 (50.5%) of rural origin overall. Within each sex, however, the pattern differed: among men, urban origin predominated (31/54, 57.4%), whereas among women, rural origin predominated (23/37, 62.2%). Sociodemographic characteristics are summarised in Table 3.

**Table 3.** Sociodemographic and occupational characteristics of suicide victims by sex, Sidi Bouzid, 2019–2023. Occupation was not specified in the original medico-legal file for 10 women; it was subsequently verified in police/investigative records (all 10 were housewives), and these women are included in the housewife category below. Each of the 91 victims is classified into exactly one of the six occupational categories, so the “Total (N = 91)” column sums to 91/100%; cells marked 0 (0.0%) reflect categories not observed in that sex in this series (e.g., no woman was coded as a civil servant), not missing data.

| Characteristic                              | Female (n = 37) | Male (n = 54) | Total (N = 91) |
|---------------------------------------------|-----------------|---------------|----------------|
| Mean age (SD), years                        | 30.3 (13.6)     | 37.5 (16.3)   | 35.5 (17.9)    |
| Urban origin                                | 14 (37.8%)      | 31 (57.4%)    | 45 (49.5%)     |
| Rural origin                                | 23 (62.2%)      | 23 (42.6%)    | 46 (50.5%)     |
| Documented psychiatric history              | 21 (56.8%)      | 31 (57.4%)    | 52 (57.1%)     |
| Occupation—Day labourer/manual/agricultural | 10 (27.0%)      | 40 (74.1%)    | 50 (54.9%) *   |
| Occupation—Housewife                        | 27 (73.0%)      | 0 (0.0%)      | 27 (29.7%) *   |
| Occupation—Retired                          | 0 (0.0%)        | 5 (9.3%)      | 5 (5.5%) *     |
| Occupation—Unemployed                       | 0 (0.0%)        | 4 (7.4%)      | 4 (4.4%) *     |
| Occupation—Student                          | 0 (0.0%)        | 3 (5.6%)      | 3 (3.3%) *     |
| Occupation—Civil servant                    | 0 (0.0%)        | 2 (3.7%)      | 2 (2.2%) *     |

\* The cross-sex “active work” versus “no current paid occupation” comparison (Fisher’s exact  $p < 0.001$ ; see Section 3.2) is a post hoc, exploratory analysis and the only occupational comparison tested; the detailed categories above are not compared statistically between sexes, because “housewife” has no male equivalent in the source data.

A documented psychiatric history was recorded in 52/91 victims (57.1%): 31/54 men (57.4%) and 21/37 women (56.8%) (Fisher’s exact test, two-sided  $p > 0.99$ ). This figure is the proportion of forensic cases with a documented or reported psychiatric history; it is not an estimate of the prevalence of psychiatric disorders. In all 52 cases (52/52, 100%), the psychiatric history was confirmed either by a medical document supplied by the family or by direct contact with the treating psychiatrist. Depression was the most frequently specified diagnosis ( $n = 18$ , 19.8%), while the disorder was unspecified in 23 cases (25.3%) (Table 4).

Regarding occupation, most male victims were casual day labourers or manual/agricultural workers (74.1%,  $n = 40/54$ ), followed by retirees (9.3%), unemployed persons (7.4%), students (5.6%), and civil servants (3.7%). Among female victims, 27.0% (10/37) were agricultural/manual labourers and 73.0% (27/37) were housewives. Occupation was not specified in the original medico-legal file for 10 of the 27 housewives (27.0% of all women); it was subsequently verified in the corresponding police/investigative records, in which all 10 were documented as housewives. The remaining 17 housewives were recorded as such in the medico-legal file (Table 3).

Because the occupational categories are not identical for men and women (housewife being specific to women), a pooled test on the full category set would be tautological.

We therefore recoded occupation into a cross-sex economic-activity variable: “currently engaged in paid/active work” (manual/agricultural/day-labour and civil-servant categories) versus “no current paid occupation” (housewife for women; unemployed, retired, or student for men). This was a post hoc, exploratory analysis and should not be read as a confirmatory test or as a risk estimate. Women were less likely than men to be classified as engaged in paid/active work (10/37, 27.0% vs. 42/54, 77.8%; Fisher’s exact  $p < 0.001$ ). This result is largely definitional, since “housewife” is itself a non-paid category, and it is reported to describe the sex-differentiated occupational structure of the series. In a post hoc sensitivity analysis treating the 10 women with originally unspecified occupation as missing, the proportion engaged in active work was 10/27 (37.0%) among women versus 77.8% among men ( $p < 0.001$ ); even if all 10 had been engaged in active work, the proportion among women would have been lower than among men (20/37, 54.1% vs. 77.8%;  $p = 0.02$ ).

**Table 4.** Distribution of suicide victims according to documented psychiatric history and sex, with percentages shown within each sex and within the total sample ( $N = 91$ ). The 57.1% figure is the proportion of forensic cases with a documented or reported psychiatric history, not the prevalence of psychiatric disorders. Fisher’s exact test on the  $2 \times 2$  table of documented psychiatric history (present/absent) by sex:  $p > 0.99$ .

| Documented Psychiatric History     | Female $n$ (% of Females) | Male $n$ (% of Males) | Total $n$ | % of $N = 91$ |
|------------------------------------|---------------------------|-----------------------|-----------|---------------|
| None documented                    | 16 (43.2%)                | 23 (42.6%)            | 39        | 42.9%         |
| Any documented psychiatric history | 21 (56.8%)                | 31 (57.4%)            | 52        | 57.1%         |
| Depression                         | 6 (16.2%)                 | 12 (22.2%)            | 18        | 19.8%         |
| Schizophrenia                      | 2 (5.4%)                  | 3 (5.6%)              | 5         | 5.5%          |
| Bipolar disorder                   | 2 (5.4%)                  | 2 (3.7%)              | 4         | 4.4%          |
| Intellectual disability            | 1 (2.7%)                  | 1 (1.9%)              | 2         | 2.2%          |
| Unspecified disorder               | 10 (27.0%)                | 13 (24.1%)            | 23        | 25.3%         |

### 3.3. Circumstances of Suicide

Nearly two-thirds of victims died on a Monday, Thursday, or Saturday, with the highest frequency on Monday (23.1%) and the lowest on Sunday (1.1%). More than a third of victims (36.4%) died in May, June, or July, with a peak in June (13.2%) and a trough in February (4.4%). Suicides were most frequent during summer (30.8%) and spring (24.2%). Hanging and poisoning were both more common during warm months; hanging peaked in May ( $n = 11$ ) and poisoning in June ( $n = 5$ ). These distributions by day, month, and season, and the distribution of method by season and month, are presented descriptively; the study was not designed to determine the mechanisms underlying these temporal patterns.

Most victims died at home, away from relatives (57.6%); 28.6% chose an isolated, unfrequented area, and 1.8% died within a medical setting. Suicidal motive was undocumented in the majority of cases (61.5%); this is a major limitation of the motive data, and we therefore do not present a dedicated motive table or any formal test involving motive (see Strengths and Limitations). Among the minority of cases with a documented motive, decompensation of psychiatric illness accounted for roughly a quarter of cases and family conflict for 9.9%; because these proportions are calculated on an incomplete and potentially non-representative subset, they are indicative only.

### 3.4. Medico-Legal Findings

Hanging was the method used in 70.3% of cases, followed by poisoning (15.4%), jumping from height (6.6%), electrocution (4.4%), and freshwater drowning (3.3%) (Table 2). Hanging predominated in both sexes (38 male, 26 female cases). Method by age group

is presented descriptively in Table 2 because most cells contain very small counts (many observed counts of 0–2): hanging was the leading method in every age group, and no method-specific or age-group-specific comparison was performed. In absolute terms, only 3 drowning cases were recorded (3.3% of  $N = 91$ ), two of which occurred in victims aged 60–69 years; jumping from height was similarly rare (6 cases, 6.6%) and dispersed across several age groups. These small numbers are purely descriptive observations and do not indicate an association with age.

Hanging was also the leading method regardless of whether a motive was documented, particularly among cases with unspecified motive ( $n = 43$ ) or psychiatric decompensation ( $n = 11$ ). Any analysis involving the motive variable should be interpreted cautiously: the 61.5% of cases with an undocumented motive are unlikely to be missing completely at random, and if the probability of a motive being recorded differs systematically by method, sex, or other victim characteristics, any motive-based comparison could be biased in either direction. We did not test the relationship between documented psychiatric history or diagnosis and suicide method, because several diagnosis-method cells (e.g., schizophrenia and electrocution, with only 5 and 4 cases respectively in the entire series) are very small and such testing would involve many combinations without a pre-specified hypothesis.

Among hanging cases, suspension was complete in 61.1% and incomplete in 38.9%; a rigid rope was the most common ligature (45.5%), followed by scarves, electrical cables, and metal wire. The ligature furrow was incomplete in 83.6% of cases. Five hyoid bone lesions were identified (two fractures, three ecchymotic infiltrations), with no thyroid cartilage or cervical spine involvement. Poisoning involved medication in 7 cases (valproate, metformin, bromazepam, haloperidol), pesticides in 5 cases, and hair dye in 2 cases, with toxic substances detected at lethal concentrations in all analysed samples. Jumping from height ( $n = 6$ ) and electrocution ( $n = 4$ ) occurred exclusively in men, the latter all with a documented history of depression or schizophrenia. Drowning occurred in a freshwater agricultural reservoir in 3 cases, with classic autopsy findings of froth in the airways and washed-out thoraco-abdominal viscera in two of them.

3.5. Complementary Emergency-Department Data on Suicide Attempts

Emergency-department records from the same region and period identified 587 suicide attempts: 112 in 2019, 88 in 2020, 104 in 2021, 132 in 2022, and 151 in 2023 (Table 5). Overall, 260 patients were male (44.3%) and 327 were female (55.7%). The sex distribution varied between years (Table 5). The recorded age ranges were 14–36 years in 2019, 12–42 years in 2020, 15–38 years in 2021, 14–48 years in 2022, and 12–58 years in 2023. By comparison, 59.3% of forensic suicide deaths were male. The two datasets were not individually linked, and no case-fatality ratio was calculated.

**Table 5.** Suicide attempts recorded in the emergency department, Sidi Bouzid, 2019–2023 (complementary descriptive data; not individually linked to the forensic series).

| Year  | Attempts ( <i>n</i> ) | Male <i>n</i> (%) | Female <i>n</i> (%) | Recorded Age Range (Years) |
|-------|-----------------------|-------------------|---------------------|----------------------------|
| 2019  | 112                   | 72 (64.3%)        | 40 (35.7%)          | 14–36                      |
| 2020  | 88                    | 22 (25.0%)        | 66 (75.0%)          | 12–42                      |
| 2021  | 104                   | 39 (37.5%)        | 65 (62.5%)          | 15–38                      |
| 2022  | 132                   | 74 (56.1%)        | 58 (43.9%)          | 14–48                      |
| 2023  | 151                   | 53 (35.1%)        | 98 (64.9%)          | 12–58                      |
| Total | 587                   | 260 (44.3%)       | 327 (55.7%)         | 12–58                      |

## 4. Discussion

### 4.1. Strengths and Limitations

To our knowledge, this is the first medico-legal study of suicide conducted in the governorate of Sidi Bouzid, an inland Tunisian region that had not previously been studied from this perspective. Strengths include a complete medico-legal autopsy with systematic histological and toxicological investigation in all cases, a five-year period, year-specific population denominators with confidence intervals, and complementary emergency-department data on suicide attempts.

Several limitations should be noted. First, the series comprises suicide deaths identified through the forensic autopsy system. Because Tunisian law makes medico-legal referral compulsory for suspected suicide [5], it is a near-exhaustive count of judicially recognised suicide deaths, but this legal argument is not epidemiological proof of complete ascertainment, and we had no external validation data (e.g., civil-registry or Ministry of Health mortality records). The incidence figures are therefore forensic-case lower-bound estimates. Residual under-ascertainment is unlikely to be entirely random: where suicide is stigmatised, families and, in some cases, local authorities may be more inclined to accept an “accidental” classification, and this may differ by method, sex, or social class, which would bias subgroup comparisons in an unknown direction. Second, information bias related to missing or incompletely recorded data is possible. Educational level, a recognised social determinant of suicide, could not be analysed, and the motive was undetermined in 61.5% of cases, most likely reflecting families’ reluctance to discuss a stigmatised death, the absence of a psychologist or psychiatrist in the medico-legal team, and the absence of a psychological-autopsy procedure. Third, psychiatric history was drawn from heterogeneous sources (medico-legal and medical files, medical documents supplied by families, and contact with treating psychiatrists) without a psychological autopsy or a standardised diagnostic assessment; the 57.1% figure is therefore a proportion of forensic cases with a documented psychiatric history, not a prevalence. All 52 cases with a documented psychiatric history were confirmed either by a medical document or by direct contact with the treating psychiatrist, which strengthens confidence in this proportion without substituting for a standardised diagnostic interview. Psychological-autopsy protocols have been implemented in a range of settings, including large case-control studies in Japan [13] and the Army STARRS study in the United States [14], and studies of child and adolescent suicide in Mexico [15]; in Tunisia, a psychological-autopsy study of suicide deaths and attempts among children and adolescents in the governorate of Mahdia provides a regional precedent [7]. Future prospective or mixed-method studies in Sidi Bouzid could adopt a structured psychological-autopsy protocol. Fourth, this descriptive study had no control group and no occupational or residential denominators, so it cannot estimate subgroup-specific suicide risk. Finally, the emergency-department data were not individually linked to the forensic cases and may differ in coverage and ascertainment; investigating the relationship between attempts and suicide mortality would require linkage of emergency, hospital, forensic, and civil-registration data.

### 4.2. Frequency of Suicide

Suicide accounted for 10.6% of all autopsies performed at the department during the study period. In a 17-year autopsy-based study from northern Tunisia, 2153 suicides were identified among 32,321 autopsies (6.7%) [6]; differences in catchment area, period, and referral patterns preclude a direct comparison. Suicide has historically been under-reported in Tunisia, often concealed by families because it remains religiously and socially taboo [16]. Older Tunisian series, such as a 12-year study at the Razi Hospital (1994–2005) that identified 1018 suicide cases, of which 166 had a documented psychiatric follow-

up [17], are cited here as historical background. The official national estimate was 3.29 per 100,000 inhabitants in 2016 [4].

Globally, more than 720,000 people die by suicide annually [2]. Within the Middle East and North Africa (MENA) region, reported national suicide rates are generally low relative to the global average, and Tunisia sits toward the lower end of this regional range alongside Jordan, Egypt, Lebanon, Syria, and Turkey [11]. The 2016 national estimate is provided for historical context only; differences in period, geographic scope, and case ascertainment preclude a direct comparison with the present forensic-case estimate of 3.99 per 100,000 person-years (95% CI 3.21–4.90). The annual number of forensically identified cases increased from 10 in 2019 to 27 in 2023 (Table 1). No formal trend test was performed, and the study was not designed to determine whether this increase reflects a change in suicide mortality or changes in referral, recognition, or recording; the underlying mechanisms remain undetermined.

The emergency-department data provide complementary information on non-fatal suicidal behaviour. Females represented 55.7% of the 587 recorded attempts, whereas males represented 59.3% of forensic suicide deaths. This is interpreted only as a descriptive difference between two data sources, and it is consistent with the broader literature describing a higher proportion of women among non-fatal attempts and of men among suicide deaths [18]. The annual sex distribution of attempts fluctuated considerably (Table 5), which warrants cautious interpretation. Because the datasets were not linked and may differ in ascertainment and coverage, we did not calculate a case-fatality ratio.

#### 4.3. Sociodemographic Profile

The mean age of our victims (35.5 years) and the predominance of the 30–49 year age group are broadly consistent with findings from the Razi Hospital series (mean age 36 years, predominant 30–39 year group) [17] and with a 12-year Sousse series in which the 18–30 year group predominated (42%) [19], reinforcing the pattern of a comparatively young age structure of suicide victims described across Tunisian medico-legal series. Age-specific patterns vary substantially outside this region, illustrating that the age structure of suicide is not universal but shaped by local demographic and cultural context [20,21].

The male predominance observed in our series (59.3%) is consistent with Tunisian data from Razi Hospital (82%) [17] and Sousse (79%) [19], though notably less pronounced, and fits within the broader pattern in which suicide mortality is higher in men than women in most world regions [22]. This gap is commonly attributed to traditional constructions of masculinity that discourage men from seeking help [18], gender-related differences in occupational stress and unemployment vulnerability [18,23], and men's greater use of high-lethality methods [24]. Among minors, several studies—including a Sousse series covering 1998–2012—report a higher number of female suicide deaths [25,26], a reversal of the adult sex ratio that our own data, with a near-equal sex distribution among 15–17-year-olds, do not contradict.

Minors accounted for 22.0% of victims (20/91), and no victim was younger than 11 years. Recent Tunisian forensic studies of children and adolescents [7–9] have similarly documented suicide in this age group; in a northern Tunisian series, the suicides among children and adolescents most often involved female adolescents aged 15–18 years, at home, by hanging [8]. These findings underline the importance of paediatric and adolescent suicide surveillance in Tunisia. We did not calculate an age-specific rate because an appropriate paediatric population denominator was not available.

In our series, the predominance of day labourers among men (74.1%) mirrors the pattern reported in the Sousse cohort [19] and in a wider central-Tunisian series [27]; the relationship between unemployment or precarious labour and suicide appears context-

dependent rather than universal [28,29]. Among women, housewife status (73.0%) and agricultural/manual labour (27.0%) together accounted for the entire female sample, a distribution also described in other studies from central and rural Tunisia [27]; it may reflect the largely agricultural economy and limited female labour-force participation outside the home in this inland governorate, although this was not assessed here. The observed occupational and geographic distributions differed by sex among the forensic cases; these descriptive distributions should not be interpreted as evidence of differential suicide risk because appropriate population denominators and comparison groups were not available.

Overall, 45 victims (49.5%) were of urban origin and 46 (50.5%) of rural origin, but the distribution differed by sex: urban predominance among men and rural predominance among women, a distribution echoed in several other Tunisian series [19,25,27]. Explanations proposed in the literature for the rural pattern among women include limited access to care and delayed management of suicide attempts in isolated rural areas [30], alongside socioeconomic disadvantage; these are hypotheses that this study could not test. International data on the urban–rural gradient outside the region are inconsistent [31,32].

#### 4.4. Psychiatric Antecedents

Most suicide deaths are associated with an underlying psychiatric disorder, most reliably documented through psychological autopsy [33]. A large meta-analysis of 3275 suicides found a psychiatric diagnosis in 87.3% of cases, with affective disorders (including depression and bipolar disorder) in 43.2%, personality disorders in 16.2%, and psychotic disorders, including schizophrenia, in 9.2% [34]. Depression alone has been reported to be implicated in 60–70% of suicide deaths in some series [35]. In our series, a documented psychiatric history was present in 57.1% of victims, with depression documented in 19.8% and schizophrenia in 5.5%. These figures are not comparable with psychological-autopsy-based estimates: they reflect the information available in medico-legal and medical records and provided by relatives and treating psychiatrists, and they are likely underestimated given the difficulty of obtaining reliable psychiatric histories in a context where mental illness remains stigmatised.

An elevated risk of completed suicide has also been reported among people with schizophrenia [36], although suicide is rarely attributable to acute psychotic symptoms themselves and more often occurs during a period of relative remission or improved functioning.

#### 4.5. Circumstances of Death

The observed distribution by day and season is descriptive; the study was not designed to determine the mechanisms underlying these temporal patterns. A predominance during the warm season, peaking in June, and an excess on Mondays were also described in the Sousse series [19].

The predominance of the home as the place of death (57.6%), away from relatives, is consistent with Tunisian and international data, including a Turkish series reporting 57.9% of deaths at home [37]. Suicide occurring in public places associated with state authority has been interpreted elsewhere as a form of desperate public appeal reflecting conflict between marginalised individuals and institutions [5]. Workplace suicide, though less frequent in our series, has similarly been linked internationally to chronic occupational stressors including job insecurity and inadequate recognition [38].

A suicidal act generally reflects a singular psychopathological context rather than a simple accumulation of statistical risk factors. In our series, a conflict was identified as the principal precipitant in 10% of the (minority of) cases with a documented motive, a proportion that should be read in light of the major motive-ascertainment limitation discussed above. Interpersonal relationship difficulties, bereavement, and financial or

employment crises are consistently reported as leading precipitants across both regional and international series [39]; socioeconomic factors such as unemployment and poverty have similarly been linked to suicidal ideation in Tunisia and elsewhere [40,41]. These precipitants, well documented in the international literature, could not be reliably quantified in the present series owing to the high proportion of undocumented motives, and the parallel drawn here should not be read as an inference about the actual distribution of motives in our own cohort.

#### 4.6. Suicide Methods

Hanging was overwhelmingly the leading method in our series (70.3%), consistent with other Tunisian series—including Sousse (48.6%) [19]—reflecting its recognised lethality, low cost, and wide availability, and its greater prevalence in rural relative to urban settings [42], a pattern consistent with the largely rural distribution of female victims in our own cohort. Poisoning was the second method (15.4%), notably with a male predominance in our series, contrasting with the female predominance more typically reported internationally [24,43,44]. Globally, pesticide poisoning is a major contributor to suicide mortality, particularly concentrated in agricultural settings in low- and middle-income countries [11], consistent with the agricultural pesticides identified among our poisoning cases.

Jumping from height (6.6%) and electrocution (4.4%) were comparatively rare, as in most published series [45]. Firearm suicide, a leading method in some countries with high civilian firearm ownership [46,47], was absent in our series, which limits comparability with series from countries where firearm access is less restricted. Self-immolation, which increased after the 2011 revolution in other Tunisian regions [48], was not observed in our cohort. This absence is notable given that Sidi Bouzid is the governorate where Mohamed Bouazizi's self-immolation in December 2010 triggered the revolution. Possible explanations include genuine local rarity, a small-sample effect, or coding practice (some burn deaths might be certified as accidental rather than referred as suspected suicide); none of these can be confirmed or excluded with the available data, and this remains a direction for further local research.

#### 4.7. Medico-Legal and Preventive Considerations

The medico-legal diagnosis of suicide rests on the concordance between investigative findings, autopsy results, and the instrument used [49]. Psychological autopsy, although recognised as valuable, remains rarely performed in Tunisia owing to the reluctance of families to discuss deceased relatives and the scarcity of trained professionals. Tunisian law does not criminalise suicide or attempted suicide, in contrast to many historical legal traditions shaped by religious prohibition [50]; physician liability may nonetheless arise in the specific context of a psychiatric patient's suicide, under mental health legislation permitting involuntary hospitalisation when a patient poses a danger to themselves [51,52].

Effective suicide prevention generally requires coordinated action across health, education, employment, agricultural, judicial, and media sectors, and is usually structured into tertiary prevention (crisis identification and management, follow-up after attempted suicide) [53], secondary prevention (management of psychiatric disorders and modifiable risk factors, including restriction of access to lethal means) [54–56], and primary prevention (community-level training, accessible support centres, and responsible media reporting) [57]. We did not evaluate any preventive intervention, and no intervention effectiveness is claimed; the points below are hypotheses for future research. Given that hanging accounted for 70.3% of cases and most deaths occurred at home, means-restriction approaches targeting this method could in principle be considered; however, hanging is generally regarded as one of the most difficult methods to restrict in the community,

since ligatures and ligature points are almost universally available at home, and means restriction has shown clearer benefit in controlled settings such as psychiatric wards or prisons than in the general community [58]. Future prevention research could examine whether interventions adapted to the occupational and geographic profiles observed in this cohort are feasible and effective. Given the high proportion of unspecified motive (61.5%) and of documented psychiatric history (57.1%), improved detection of suicidal crises in primary care may also warrant consideration, alongside efforts to reduce stigma, which appears to be a barrier to help-seeking in comparable settings [59].

## 5. Conclusions

This first medico-legal study of suicide in the governorate of Sidi Bouzid, Tunisia, identified 91 suicide deaths over five years through the forensic autopsy system, corresponding to a forensic-case incidence of 3.99 per 100,000 person-years (95% CI 3.21–4.90), interpreted as a lower-bound estimate. Among these cases, men were more frequently urban day labourers, whereas women were more frequently rural housewives or agricultural labourers; these descriptive distributions do not indicate differential suicide risk. Over half of the victims had a documented psychiatric history, and hanging was by far the leading method, followed by poisoning. Suicide was most frequent on Mondays, during the warm season, and at home. The annual number of forensically identified cases increased from 10 in 2019 to 27 in 2023, with undetermined underlying mechanisms. Emergency-department data recorded 587 suicide attempts over the same period, 55.7% of them in females. The findings may inform future surveillance and hypothesis-generating prevention research; no intervention was evaluated here.

## 6. What Is Known About This Topic

- Suicide is a major and likely under-reported public health problem in Tunisia, with a marked increase reported after the 2011 revolution;
- Hanging is consistently reported as the leading suicide method across Tunisian series;
- No medico-legal data on suicide had previously been published for the inland governorate of Sidi Bouzid.

## 7. What This Study Adds

- First regional medico-legal and epidemiological description of suicide deaths identified through the forensic autopsy system in Sidi Bouzid, Tunisia, during 2019–2023;
- Description of the sex, geographic-origin, occupational, documented psychiatric-history, temporal, and method distributions observed among the 91 forensic cases;
- A forensic-case lower-bound estimate of regional suicide incidence, with explicit acknowledgement that deaths not referred for forensic investigation cannot be captured.

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**Informed Consent Statement:** Patient consent was waived by the Ethics Committee of the University Hospital of Sidi Bouzid, as this was a retrospective study based on routinely collected medico-legal case files of deceased individuals. All data were fully anonymized prior to analysis, with victims' names replaced by identification numbers.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the sensitive, identifiable medico-legal nature of the underlying case files.

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## Abbreviations

The following abbreviations are used in this manuscript:

|      |                                                                                 |
|------|---------------------------------------------------------------------------------|
| WHO  | World Health Organization                                                       |
| INS  | Institut National de la Statistique (National Institute of Statistics), Tunisia |
| MENA | Middle East and North Africa                                                    |
| SD   | Standard deviation                                                              |
| CI   | Confidence interval                                                             |

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