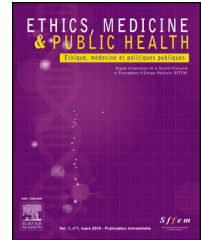




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ORIGINAL ARTICLE

Overview of the suicidal phenomenon in twenty-years autopsies at the Legal Medicine Unit of Pavia

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Method of death;
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Summary

Background. – Suicide still represents an unsolved issue worldwide and suicidal behaviours are often difficult to detect and prevent. The aim of the study is to investigate the phenomenon of suicide in cases analysed by the Unit of Legal Medicine of Pavia, North-Western Italy, from 1999 to 2019, providing qualitative-statistical data, representing a starting point to investigate further the risk factors related to suicide.

Methodology. – For each autoptic case, the following variables were taken into consideration: personal data (age and sex), social status (employment, marital status), medical history (organic and/or psychiatric conditions) and forensic evaluations (time, circumstances and method of death, the presence or not of a 'suicide note' and previous anticonservative behaviours).

Results. – Were found 724 confirmed suicide cases, with an average annual rate of 34 ± 12 . Mean age at suicide 50.2 ± 20.2 -year-old, male/female ratio 3. Some characteristics linked with suicide were discussed: male sex (71.8%), age range 31–60 years (50.7%), asphyxia method of death (46.1%) of which 68% by hanging, cardiovascular disease (3%), previous anti-conservative attempts (7.7%), retirement (22.4%), unemployment (7.2%), separation/divorce (8%). We detected a lower percentage of mental illness: depression (26%), alcohol (4%) and drugs abuse (3%).

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Conclusion. – It is essential to monitor suicidal risk factors to efficiently intervene through targeted prevention campaigns, according to cross-national and temporal variation. Forensic medicine approach, as shown, could give a wide perspective over the suicide phenomenon, mainly in its social and ethical connotations.

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Introduction

Considering most recent analysis conducted by the World Health Organization (WHO), dated back to 2016, approximately 800,000 suicides have been documented worldwide, with an annual standardized global rate of suicide of 10.5 individuals per 100,000 inhabitants, and in particular 15.0 for males and 8.0 for females [1]. In Europe, Eurostat study, were published in June 2020 but referred to 2017, reporting 10.8 suicides per 100,000 inhabitants [2]. Europe still reports the highest absolute suicide rates for both sexes, despite the consolidated application of preventive measures [3]. Italy ranks among countries with low suicide rates: 5.95 per 100,000 inhabitants died of suicide in 2017, a much lower value if compared with the European rate [4]. The suicides distribution per area, in Italy, as in other countries, is subjected to a substantial intra-country variability [5]; for example, in 2017, as reported by ISTAT (Italian National Statistics Institute), 3861 suicides has been detected: 1093 in the North-Western area, 971 in the North-East area, 766 in the Centre area, 626 in the South area and 405 in the Islands (Sicily and Sardinia) [4]. Suicides remains a psychiatric emergency and a complicated public health issue, linked to a multiplicity of risk factors [6]. The evaluation of the characteristics of suicides in the population might represent a starting point to plan effective prevention and educational campaigns [7].

Aims

The primary endpoint of the study was to describe the suicide phenomenon through autopsies carried at Legal Medicine Unit of the University of Pavia, North-Western Italy, between 1999 and 2019. The secondary endpoint was to evaluate the role of personal and social variables over suicide, for further statistical analysis.

Patients and Methods

An observational retrospective study was carried out. In detail, the online restricted database, with autoptic records of all autoptic examinations, for both judicial and clinical reason, performed by forensic pathologists of the Legal Medicine Unit of the University of Pavia, between 1999 and 2019, were examined. The staff of the Legal Medicine Unit

of Pavia covers an area that approximately includes the Italian regions of Lombardia, Piemonte, and Liguria, and here so matches with North-Western Italy, as defined by the Italian National Institute of Statistics (ISTAT), with an overall population of nearby 16 million inhabitants [8].

The last twenty-years were selected, because the rate of autopsies performed was quite stable, with minor variations along the years. A total of 7111 autoptic case records, with routinely histopathological description and toxicological reports when needed, were collected.

Autoptic records were archived with a unique number, there so anonymity and confidentiality were granted. Moreover, data are uploaded to the online database only at the end of all the autoptic investigations, recording and integrating circumstantial data with autoptic and histological findings, and, if performed, with toxicological one. On this occasion, the cases are so classified according to the manner of death: homicidal, suicidal, accidental, or natural.

Therefore, suicidal autoptic case records were found through the selection in the database of the manner of death as 'suicidal'; further check on the recorded data was made to avoid lack of cases. For each case, personal data (age and sex), social status (employment, marital status, criminal restriction), medical history (organic and/or psychiatric conditions), and forensic evaluations (time, circumstances and method of death, the presence or not of a 'suicide note' and previous anticonservative behaviors) were collected and discussed.

Results

Among 7111 autopsies for every manner of death performed between 1999 and 2019 at the Legal Medicine Unit of the University of Pavia, North-Western Italy, 724 (10.2%) cases were classified as suicide. All the 724 cases are judicial autopsies, performed by request of the Prosecutor; in 163 cases (22%), medico-legal on-site inspection was also carried out. In all cases, (100%), histological investigations were routinely performed, whereas toxicological analysis in only 264 cases (36%). The average annual suicides, for which an autopsy was requested, in the period analyzed, was 34 ± 12 subjects per year (Fig. 1). Overall, 541 were males and 183 females, male/female (M/F) ratio of 3; mean age at death was 50.2 ± 20.2 -year-old (min 12yo, max 100yo), with further age distinction shown in Fig. 2.

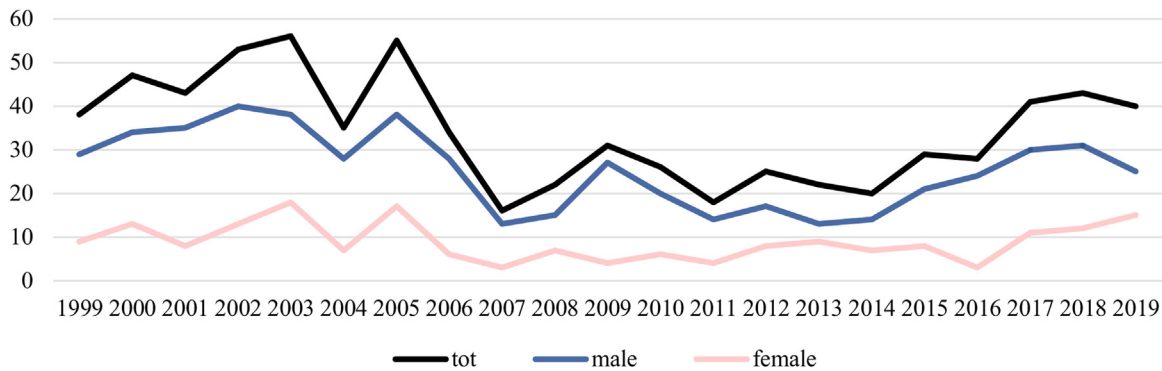


Figure 1. Suicide-related autoptical examinations performed at the Department of Legal Medicine of the University of Pavia per year (1999–2019).

	Number of subjects	Percentage %
Depression	189	26
Alcohol abuse	30	4
Drug addiction	23	3
Cardiovascular diseases	22	3
Psychosis	21	3
Neoplasm	13	2
Neurological diseases	12	2
Anxiety-depressive syndrome	11	1.5
Others	5	0,6
Negative history for any pathology	398	55
Total of suicide	724	100

Methods of death in suicide

A description of the suicidal methods is summarized in Fig. 3, with a clear prevalence of asphyxia (334 subjects, 46.1). Most deaths were due to asphyxia in both sexes, 45.6% in males (247/541) and 47.5% in females (87/183). The second most common cause, however, differs between sexes as shown in Fig. 3. Looking in detail at the subjects died due to asphyxia (334 overall), further distinction over the specific methods of asphyxia is made and are shown in Fig. 4, with a prevalence of hanging (68%, 227/334), followed by drowning (22.5%, 75/334). The use of more than one method simultaneously for suicide was reported in 5 subjects, all prisoners, as further stated, to define complex or combined suicide, with the association of plastic bag suffocation and inhalation of butane gas. It is also interesting to distinguish the method used according to sex, as could be seen in Fig. 4.

Medical Conditions

Depression (26%) was the most common diagnosis in our cohort. Other pathological disorders followed with a relevant rate reduction: alcohol abuse (4%), drugs addiction (3%), cardiovascular diseases (3%) and psychosis (3%). Further details were reported in Table 1.

Previous unsuccessful attempts and suicidal note

Fifty-six subjects (7.7%) divided into 29 males (4% of the total, 5.4% of men) and 27 females (3.7% of the total, 14.6% of women) had a history of previous unsuccessful attempts or deliberate self-harm. Among these, 16 subjects had a diagnosis of the depressive syndrome, corresponding to 2.2% of the population. The number of people who wrote a suicidal note before dying was 58 (9%).

Occupational status

Retirees were the category with the highest frequency in our study (22,4%, 162/724). Among those with known occupational status, first place was occupied by manual workers (10.4%, 75/724) followed by housewives (4.1%, 30/724). Among the healthcare professionals (1.9%, 14/724), 6 were doctors and 8 nurses and most of them (4 doctors and 5 nurses) died of poisoning or drug overdose. Policeman and security guards (1.9%, 14/724) had instead a high prevalence (10 out of 14) of deaths by self-inflicted gunshot wounds. The only case of electrocution reported was by an electrician. Unemployed subjects were 7.2% (52/724). In the autoptical records, 198 subjects (27.3%) showed only their occupation, without further distinction, whereas 131 subjects (18%) had no occupational data available.

Marital status

Regarding marital status, most of the subjects were married (38%). 111 (15%) subjects were dealing with the end of their relationship, of which 38 (5.2%) were already separated at the time of death. Other 93 (13%) subjects had an unknown marital status. Moreover, in 35% of the suicidal cases unmarried subjects were involved, and they on average were younger than all the subjects involved in the study (mean age: 39 ± 17 versus 50.16 ± 20.2 -year-old).

Prisoners

23 (3.2%) subjects were detainees, mean age 35 ± 9 -year-old, all males, 6 (26%) were married, only 3 (11%) were affected by depression. Previous employment was not recorded. About the methods of death: 15 (65% of the

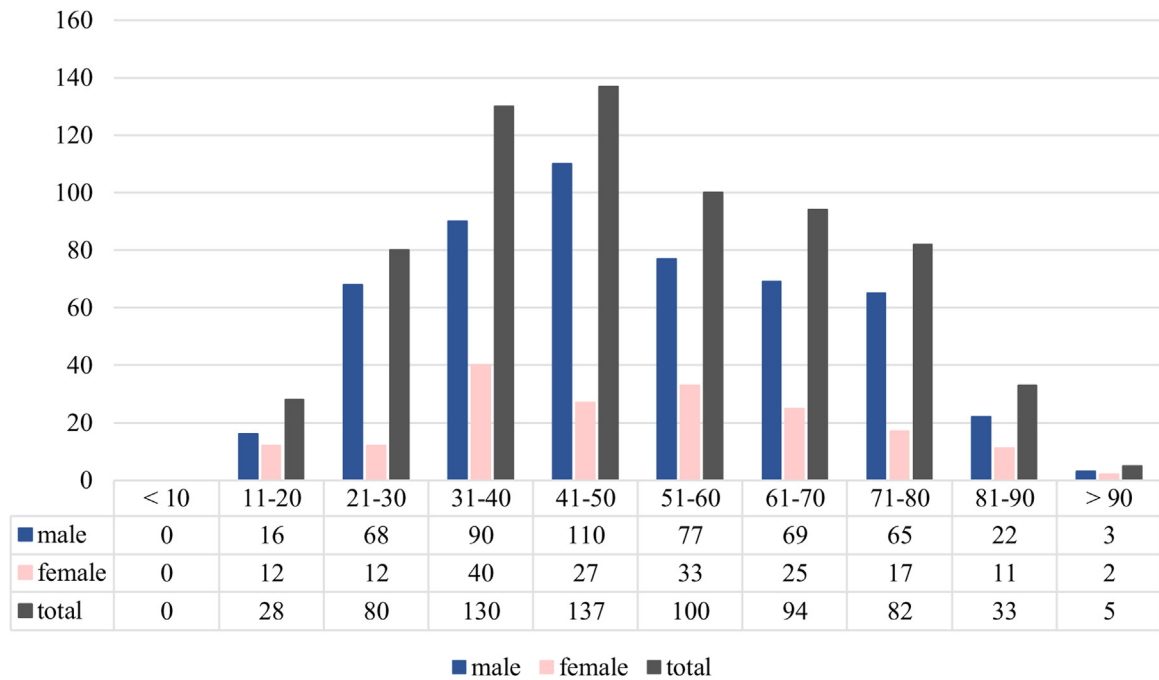


Figure 2. Age distribution in the sample.

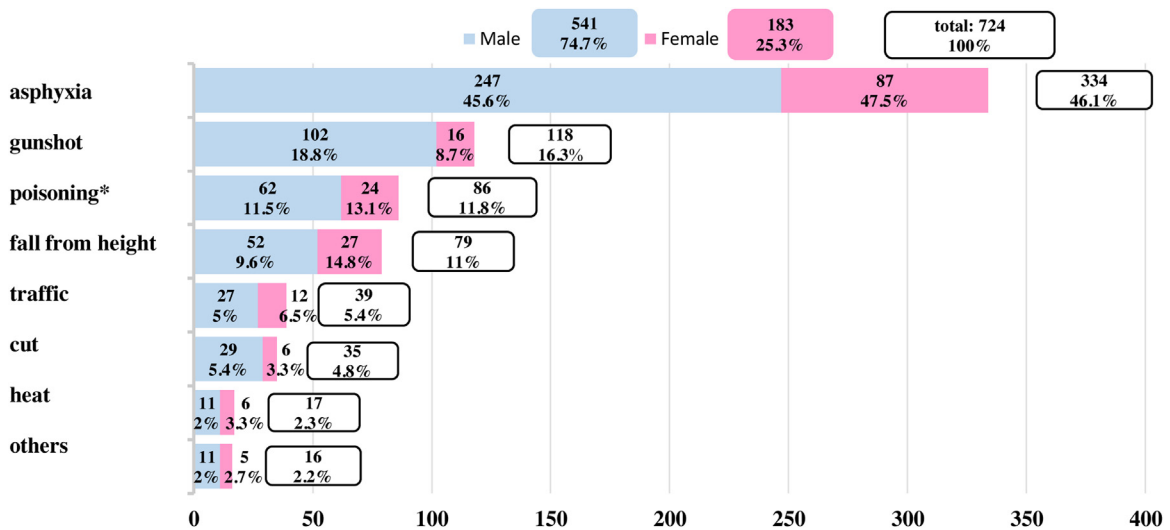


Figure 3. Methods of death in suicide cases registered at the Departmental Section of Legal Medicine of the University of Pavia (1999–2019), reporting absolute number of subjects, followed by the relative percentage. Legend: * 5 cases of the 62 died by poisoning among males, as to be acknowledged as complex suicide, combining two method: butane intoxication with plastic bag suffocation (the 5 subjects were not added to asphyxia category to avoid duplication).

detainees) of those hanged themselves, using sheets or belts, 3 (13% of the detainees) died from plastic bag suffocation, while 5 (21.7% of the detainees) died because of the association of plastic bag suffocation and butane intoxication, obtained from the gas stoves supplied to prisoners in their cells.

Discussion

Our study shows a framework of suicidal reality in the last twenty years in a selected population in North-Western

Italy. A great strength of this study is the ascertainment of suicidal methods of death, and a careful insight on suicidal backgrounds and related factors, following strictly the 1999 European Directives for the harmonisation of autoptic assessment and procedure [9]. Is advocated by Authors plain ratification of 1999 EU Directives, granting for all suicides an autoptic evaluation, for wide-spectrum investigations. Our evaluation of suicide-related factors tries to enrich with the forensic point of view the data already present in the scientific, mainly psychiatric, literature.

The first consideration is related to the sex of people who died of suicide. Suicides are notoriously more common in

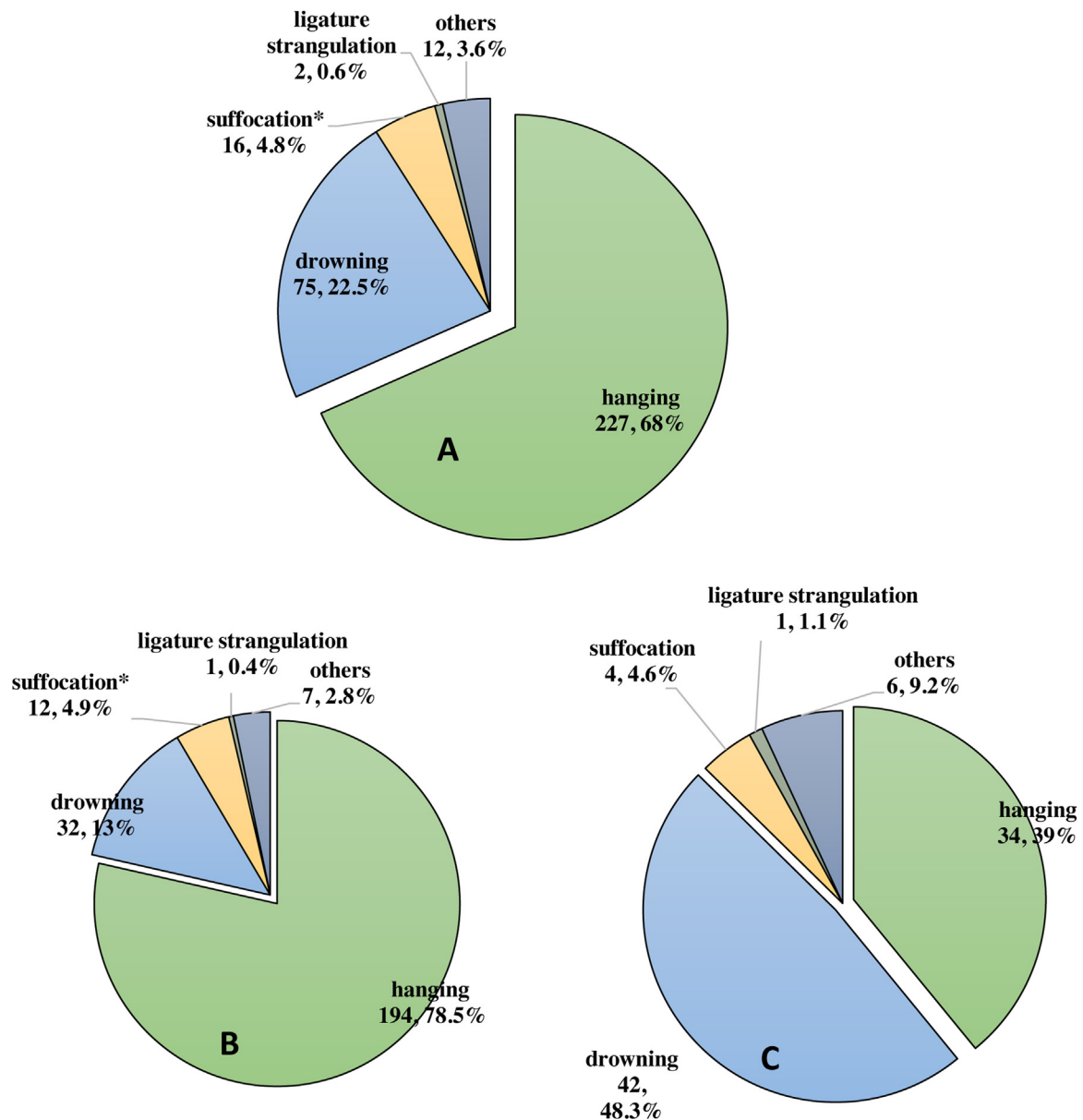


Figure 4. A. Description of the different methods of asphyxia used in 334 subjects. B and C. Description of the different methods of asphyxia according to sex: in B among males (247) while in C among females (87). Legend: absolute number of subjects followed by the relative percentage. * from the count were excluded the 5 cases of complex suicide, combining two method, butane intoxication with plastic bag suffocation; the 5 subjects were added among the 62 died by poisoning among males, and not to asphyxia category to avoid duplication.

men. However, these data change with the socio-economic conditions of the country analysed: in high-income countries, the suicide rate is 300% higher in men, whereas in low-middle income countries it is only 57% higher in men [10]. In Italy, the risk to die of suicide is about three times higher in men than in women [4,10]. Along the period analysed, the male-female ratio was 3, therefore, our data upholds that of national and international literature [6]. Many possible explanations for the different suicide rates in men and women have been proposed: gender equality issues [11], differences in methods of dealing with stress, social disparities in alcohol consumption and a reduced tendency of men to seek help for mental disorders, the handling

of masculinity [12–14]. Of particular interest, discussing the role of masculinity, is the article of Rasmussen et al.: they conclude pointing out that suicide in young men is the endpoint of a series of abnormal behavioural processes realized to compensate difficulties in managing self-masculinity, with a competent social façade. Authors show the complexity of identifying this hidden and unsolved issue [14]. The aforementioned difference resulted, in Kposowa et al., less relevant when related to the occupation, as further discussed [15].

In relation to age, suicide rates are significantly lower in people under 15 and higher in people over 70, in almost all areas of the world. On the other hand, the suicide rate

among the population between 15 and 70 years of age differs according to the country: in some regions of the world, it constantly increases with age, while in others, including Italy, as documented in our sample, suicides occur in young adults and gradually decrease in elderly people [6]. It is also important to highlight that recent reports have shown a significant increase in suicide rates worldwide, in the age group between 50 and 74. In particular, an American study regarding the 2000–2011 decade, recorded an increase of 100% in the number of suicides among this age range [13]. In our study, the mean age of deceased is 50.2-year-old, and 50.7% of the subjects are in the 31–60 years range, with the highest peak (18.9%) in 41–50 years range. The explanation could lie in a greater psychological/mental difficulty in managing and processing personal, family- and work-related problems, in an age group that modern society recognizes as one with greater productivity and efficiency and overwhelms with great expectations and consequent consistent stress [16–18].

Overall, the most frequent cause of death, in both sexes, is mechanical asphyxia, and it is interesting that the most frequently chosen method in males is hanging (78.5%), while in women is drowning (48.3%), partially consistent with the retrospective study conducted by the University of Parma [19], and with the report of Värnik et al. (2008) on the suicidal phenomenon across Europe [20,21]. According to Haw et al. (2016) on suicide by drowning, the overall proportion of drowning in our analysis (22.5%) is coherent with this wide review. However, no clear reason for the predominance among females could be proposed, as just like in this review, a large variability among countries and studies could be seen [22]. The second most common method of suicide diverges among sexes, in males was firearm whereas in females fall from height/jumping. The possible explanation, at least at Italian background, lies firstly on strictly regulated licence for firearms, and secondly on their greater availability, as job equipment, to males, because security remains still predominantly male [23].

A particular mention should be reserved to complex or combined suicide, i.e. more than one method simultaneously for suicide [24]. In our study, 5 cases were identified: they were all males, mean age 33 years-old, all prisoners and all with the association of plastic bag suffocation and inhalation of butane gas. These complex suicides cases coincide with the data available in the study performed by the Forensic Institute of Milan (Northern Italy); they have reported 53 complex suicides, showing as the most frequent cause of death a combination of plastic bag suffocation and gas inhalation (10 cases) [25]. Differently, in a study of the Forensic Institute of Genua (North-Western Italy), among 19 complex suicides were analyzed, the association mentioned was never reported; however, the association of wrist cuts and hanging was the most frequent (8 cases) [26]. Simonit et al. had reviewed the literature about complex suicide, in which one method in self-incineration: 46 cases were found in 22 articles, and self-incineration was combined with one or more of the following methods: fall from height (9 cases), drug intoxication (7 cases), hanging (6 cases), gunshot (10 cases), cut (15 cases), and other methods as drowning, thinner poisoning and ingestion of rat poison (1 case each) [27,28]. Complex suicide remains an uncommon, misreported, and misunderstood event, and represent a

serious interpretative challenge that need careful examination. About complicated suicide, i.e. suicides characterized by the failure of the method chosen by subject, followed by an accidental trauma [29,30], is of very infrequent presentation, no cases were identified in our study.

It is well established that considerable number of suicides could be correlated to diagnosed or latent psychiatric disorder, and that current suicide risk in people with mental illness is around 5–8% [31]. Recent investigations observed the presence of a psychiatric disorder in as much as 87% of cases analysed [32], with depression and substance abuse [33], especially alcohol [34], constituting the most common diagnoses. In particular, the co-occurrence of these two disorders increases the relative risk of suicide [35–37]. Although in our sample, subjects with the psychiatric disorder as a whole (37.8%) appeared to be less than in the literature data, whereas depressive disorder is likewise well represented (22%). It is important to point out, however, how these data could be potentially underestimated, considering that some subjects could have died of suicide before obtaining a psychiatric diagnosis. In turn, the high prevalence of cardiovascular diseases is well in line with previous literature. These data confirm the negative impact that cardiovascular diseases may exert on the quality of life [38,39] and the importance of psychological intervention in these patients [40–43].

Cancer patients should not be understated, whereas our sample is small (13). Cancer is acknowledged to negatively impact over the quality of life, and these patients need psychological support. Talking about cancer patients, suicide risk reached up to 1.7 time for both sexes [44].

Several studies evaluated suicidal ideation, analysing whether the death occurred because of premeditation or as a result of an impulsive action [45–47]. In the post-mortem investigation, assessing premeditation is rather complex. Indeed, it is only possible to rely on anamnestic-circumstantial data, considering the presence of a 'suicide note', and previous reported self-injurious behaviours. The subjects who presented these specific characteristics were mostly middle-aged individuals, and in our sample, such an act was more distinctive of age groups below 60 years. While previous literature highlighted the role of impulsivity in adolescent suicidality [48,49], proving that premeditation and planning are more distinctive of adulthood, it could be argued that writing a suicide note would be a proxy for forethought and intent. Also, these data may be interpreted from another point of view, considering leaving a suicide note, rather than a surrogate for forethought and intent, a reflection of broad customs and norms of social groups and times [50,51].

Another interesting aspect is the relation between the subjects' employment and the circumstances of death. In literature, it is also reported how occupation can shape the methods chosen and used for self-inflicted death [52–55]. For instance, it is to be noted that most healthcare professionals died because of drugs poisoning (benzodiazepines, curare, antipsychotics, and potassium chloride), which may be a result of their relative ease of access [56]. In summary, 69% of doctors and nurses who died of suicide chose drug poisoning, a method used only by 11% of the total subjects studied. Similarly, the only case of electrocution involved an electrician. The same correlation was detected among

policemen and security guards, categories that are also characterized by a higher suicide rate compared to the general population [57,58]. Indeed, 71% of these subjects died of self-inflicted gunshot wounds, while in the entire study this involved only 16.3% of the cases. Therefore, both previous literature and our study seem to support the hypothesis of a strong association between occupations and methods of suicide.

A recent Italian study conducted on medical students investigated the relationship between profession and method of death in suicide, highlighting that unemployed and studying people remain with a general perception of suicidal methods, mainly derived from newspapers, internet, and movies. The conditioning role of work appears later on, with work-specific experience [56].

The impact of unemployment, for example, often relies on the contextual psychiatric issues [57] and in general, the job-related stress would be conditioned by sex, with a different perception and approach to work, and just by the presence of psychiatric comorbidities. In particular, in a recent study [59] in relation to employment-unemployment, and job-related stress, remains a clear difference determined by sex, with the role of depression for men, and job issues for woman, resulting in a higher suicide rate in unemployed women, compared to general population [14].

In literature, moreover, the absence of relationships, the presence of an abusive or negative relationship, have all been identified as risk factors for suicide, together with inadequate parental care, the absence of friends, divorce or never getting married [60–62]. In our study, the evaluation of the role of marital status was certainly impaired by the similar percentage of married and unmarried subjects, and by unavailable data of familiar situation. However, we acknowledged a very limited number of marital issues (separation or divorce).

Finally, data relating to prisoners is to be mentioned. Detention is associated with an increased suicide risk by three times, compared to the general population [63,64]. In particular, Italy is one of the countries with the largest gap in terms of anti-conservative behaviour and suicides when the population is compared to prisoners [65]. Even if our sample is small (23 subjects), some considerations could be made comparing our data with two papers provided by the Forensic Institute of Milan, focused on detainees cause of death, taking advantage of the same geographical area of investigation (North-Western Italy). The studies identify, among 24.101 autopsies performed between 1993 and 2017, 227 suicidal cases, among which 92 were prisoners; coherently with our results, the most frequent cause of death is hanging (82 cases), followed by plastic bag suffocation (6 cases), often associated with butane intoxication (4 cases) [66]. The use of other methods of suicide, besides hanging, highlights the need for a wider control in prisons, considering that the method is chosen according to the availability of absolutely common tools [67]. Taken together, these data highlight that in suicide in prison the victims are young males, died by hanging, even if are growing atypical methods, with psychiatric diseases, including drug/alcohol abuse, depression and history of anticonservative attempt and organic comorbidities. Prisons present till now few critical issues in terms of prevention of suicide risk, but also in

the prevention and treatment of mental illnesses and health in general. Reflections had to be made, urgently, on the detention system, starting from the re-educational purpose of the penalty.

Limitation of the study

It is important to consider that, in post-mortem investigation, suicide analysis is rather complex compared to 'in vivo' investigation, which assesses the risk of suicide using clinically recognized scales and focusing on suicidal ideation. Finally, we have to consider that the study sample is a subpopulation of the overall suicides, as not all suicidal subjects undergo an autopsy, and even less a medico-legal on-site inspection, in contrast with the aforementioned 1999 European directives [9] and with relevant impact on an appropriate and careful collection of data for epidemiologic studies. Some cases are in fact archived by Prosecutors based on circumstantial data.

Conclusions

In conclusion, important considerations regarding the characteristics of the subjects who die of suicide emerge from our study. A clear assessment of causes and methods of death has highlighted the relevance of asphyxia, and the role of specific occupation (healthcare practitioners and policemen) in the determination of the suicide method. Wide educational campaigns should focus on the role of emulation based on filmography and newspaper reports in the first place. Comorbidities like depression, cardiovascular disease and cancer, must be regarded considering their high prevalence and/or influence in the population. Also prison environment and penalty system, as a whole must be widely rethought, considering the Italian high suicide rate among detainees. Low rate of previous unsuccessful attempts is probably due to resolute ideation and acting, with enormous difficulties in the identification of fragile subjects and consequent prevention.

The suicidal phenomenon is certainly complex and if treated as a 'classical' disease, we could describe numerous etiopathogenetic factors: biological (including genetics), psychological (such as certain personality traits), clinical (such as comorbid illness), socio-environmental and cultural ones [5,68,69]. Therefore, no single approach can be decisive, but only combined and multiple actions, within the community, to unhinge a vicious circle that is still too widespread [70,71]. The identification of these factors is, therefore, the key point of any subsequent prophylaxis and treatment approach, with the invaluable protective position of healthcare professionals, who could identify risky circumstances and behaviours, guiding the specific take in charge of the subjects [7,72–74].

Concerning this reasoning, Legal Medicine, as a field, gains renewed interest and broader value as it represents a critical discipline not only for its forensic aspects but also for its first social and ethical application.

Human and animal rights

The authors declare that the work described has not involved experimentation on humans or animals.

Informed consent and patient details

The authors declare that this report does not contain any personal information that could lead to the identification of the patient(s) and/or volunteers.

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Author contributions

All authors attest that they meet the current International Committee of Medical Journal Editors (ICMJE) criteria for Authorship.

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We dedicate this study to the memory of our Professor Antonio Osculati, our greatest instrument, rethinking to Quintilian, “that without which the matter cannot be shaped to achieve its purpose”.

Disclosure of interest

The authors declare that they have no competing interest.

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