



## Femicide and forensic pathology: Proposal for a shared medico-legal methodology

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### ABSTRACT

In a previous work, authors have proposed a medico-legal definition of femicide as the *murder due to the failure to recognize the right of self-determination of women*. The aim of this paper was to apply the proposed definition to a cohort of cases to characterise femicides and female homicides and assess whether femicides can be considered a distinct entity or not. A comparison between female and male homicides was performed to assess common and distinctive features. Femicides were identified and compared to the cohort of non-femicide female murder. Results were compared to those reported in published forensic studies.

Significant associations between female and male homicides were found for sex and partner/ex-partner offender, sex and indoor homicide and sex and asphyxia as dynamic of death emerged. A higher prevalence of indoor homicides and asphyxiation and of partner relationships were documented in female homicides. Gunshot, blunt injuries and cut wounds are well represented in both types of homicides. Most affected sites are back and chest in male homicides, and head, breasts, pubis, and limbs in female homicides. When comparing femicides and female homicides, a positive association between strangulation as harmful mean and a negative one between femicides and indoor homicides were found.

Male and female homicides can be considered as two distinct victimological phenomena. Focusing on femicide allows to establish injuries and circumstantial patterns, that could represent evidence of a specific murder. More studies with a standardized data collection are needed to corroborate the theory of this paper.

### 1. Introduction

Violence against women and its extreme form, murder, is a global scourge and no country is spared [1]. Although many attempts have been made to deepen the understanding of societal, cultural and individual circumstances at the root of those heinous crimes, “the sciences in the field are still young [...]” [2]. Understanding of such factors is necessary both for medico-legal reasons and to enable affective prevention. For instance, JC Campbell’s Danger Assessment was an attempt

to use a scientifically validated method to identify those factors indicating imminent risk of extreme violence against a woman [2]. Interestingly, the adoption of this tool also demonstrated that women victims of such crimes are relatively unaware of the risk [3]. In the past 20 years, knowledge of these phenomena has increased, possibly favoured by the spread of new methods for communication (e.g. social media), but the increasing number of these crimes proves that effective prevention is still lacking. In addition, as previously discussed, legislation in many states has not followed suit [1].

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In a previous work, the authors have proposed a medico-legal definition of femicide inspired by the ethical principles of autonomy at the foundation of medical practice [4]. The starting point was the framing of femicide in national legislations, international documents, and forensic studies on violence against women. In South America there is extensive legal documentation on femicide, whilst the issue is not as widely explored in most of the rest of the World [5–8]. International documents highlighted that a major limitation to understanding and preventing the phenomenon is the lack of statistical data on murder of women that can be considered femicides. This issue is attributed to the heterogeneous definitions of femicide, which would hence need a global consensus [9].

We proposed that femicide should be defined as the “*murder perpetrated because of a failure to recognize the victim’s right of self-determination*”, which must be shown to be the motive for the crime [4]. This medico-legal definition would be applicable both in court and in research to design standardised methodology for data collection and allow more accurate and reproducible analyses of this issue.

A general consensus on femicide definition would also lead to a distinction between femicides and “mere” female murders and to specific research to distinguishing their forensic-pathological features. To this day, there is good literature on forensic pathology research in the field of female homicides [10–27], although at an international level, comparison is severely limited by the heterogeneous classification of the murder of women around the world. Briefly, most reduce the phenomenon to cases of intimate partner violence, while others include all cases of murder of women. These discrepancies often hinder direct data comparison and may prevent a thorough understanding of this issue.

Application of a univocal definition offers the opportunity to standardize the method to be applied for data collection and simultaneously allows a differential diagnosis. In addition, a scientifically robust analysis based on shared methodology can give important information for social and statistical studies and develop tools to be used in Court.

The aim of this paper was to apply the proposed definition (*murder due to the failure to recognize the right of self-determination of women*) to a cohort of cases to characterise femicides and female homicides and assess whether femicides can be considered a distinct entity or not. Firstly, a comparison between female and male homicides was performed to assess common and distinctive features. Secondly, femicides were identified and compared to the cohort of non-femicide female murder to assess whether there were some specific characteristics that could allow discrimination of the two. Lastly, the characteristics of the identified cohort of femicide were compared to those reported in published forensic studies identified through systematic screening of the literature.

## 2. Materials and method

### 2.1. Data collection

Necropsy reports and photographic documentation of all autopsies performed at the Institute of Forensic Medicine of the University of Parma (Italy) between 1st January 1990 and 31st December 2020 were retrospectively screened and all cases of homicide selected. Data collected in this study were: sex and age of the victim, dynamic of death, means used, murder/victim relationship, place of murder, anatomic sites and type of injuries, number of lesions, toxicological findings, medico-legal notes. Face, mouth, neck, breasts, pubis, anus, upper limbs and thighs were considered as erogenous sites. A form, inspired by the Parma Protocol of the European Council of Legal Medicine [28], was used for the data collection. This form is available as electronic material.

After a thorough review of each case, an experienced medico-legal doctor subdivided murders of women into those fitting the proposed definition of femicide and those that did not. A second assessor reviewed the subdivision to ensure consensus. When no sufficient information on the motives of the homicide was available, the case was included into the non-femicide subgroup, to avoid bias.

A literature review was performed in the following international databases using as keywords “killing” & “women” & “forensic” & “pathology” & “autopsy”: PubMed, MEDLINE, Google Scholar, Embase and Scopus, considering publications and issues up to June 2022. A first screening of the articles was completed by reading their headlines and abstracts to ensure that the topic and content was correlated with autopsic activities specifically oriented on female murders. Potentially relevant studies which did not appear in the main search were also identified from the References of other articles.

Through screening of the literature, all studies reporting characteristics of femicides were reported in two tables, the first including geographical area assessed, number and description of the murders, motive, place of murder and cause of death. The second table reported the anatomical site of lesions, whether lesions were present on erogenous zones and the number of injuries. The literature review was then used to compare own primary results to those in other international publications.

### 2.2. Statistical analysis

The first step was to compare homicides of men to homicides of women. To do so, we tested for associations between the sex of the victim and each of the following parameters: offender status (partner/ex-partner or unknown/not close to victim), location of murder (indoor or outdoor/car), dynamic of death (beatings, cut wounds, asphyxiation, gunshot, vehicle to pedestrian collisions, fall from height), number of hits, and sex and number of perpetrators (single murderer or multiple murderers). Cases in which the numbers of hits were >10 were identified as overkilling and the value used as a binary variable.

Subsequently, to distinguish the features of femicide and non-femicide female homicide, we tested for associations between type of murder of woman (femicide or non-femicide) and the following: offender status (partner/ex-partner or unknown/not close to victim), location of murder (indoor or outdoor/car), means used (hands in cases of beatings, asphyxia in cases of compression of the neck, blunt or bladed instrument, firearm, xenobiotic), dynamic of death (beatings, gunshot, mechanical asphyxia, cut wounds, drug intoxication), number of hits (over 10 or not), and number of perpetrators (single murderer or multiple murderers). Since all tested associations were between dichotomous variables, the Phi correlation coefficient was used to assess strength of association and significance was set to a p value lower than or equal to 0.05.

Lastly, own primary results were compared to those emerging from the summarized literature on forensic studies.

## 3. Results

A total of 6179 autopsies were performed between 1st January 1990 and 31st December 2020. Of those, 114 cases were homicides: 46 cases of female murder (mean age  $46.9 \pm 21.4$ ) and 68 of male murders (mean age  $42.5 \pm 17.0$ ). All the known aggressors were male except in one case of a husband killed by his wife for mercy killing.

Among murders of women, 13 cases were related to refusal to cohabit, request for divorce, or jealousy; these cases were assigned to the femicide category as there was strong evidence of failure to recognize the right to self-determination of the murdered woman. The non-femicide group comprised 16 cases motivated by theft, mercy killing, or perpetrator’s psychiatric or addiction disorder, and 16 cases with unknown motives.

The motives identified in male homicides were quarrel for futile reasons in 32 cases, criminal activities (drug trafficking and/or organized criminality) in 16 cases, psychiatric pathology of the murderer in 10 cases, and mercy killing in 1 case. In 10 cases the motive was unknown. Notably, there were no cases in which the crime was conducted to curtail the right to self-determination of the male victim.

When comparing male and female homicides, an association was

found between sex and partner/ex-partner offender (Phi coefficient = 0.58, p-value < 0.01) (Fig. 1), with an evident prevalence of ex-partner and partner relationships in female homicides (Fig. 2). Further significant associations were found between sex and indoor homicide (Phi coefficient = 0.29, p-value < 0.01) (Fig. 1), and sex and asphyxia as dynamic of death (Phi coefficient = 0.21, p-value = 0.03) (Fig. 1): a higher prevalence of indoor homicides and asphyxiation were observed in female homicides. Gunshot, blunt injuries and cut wounds were homogeneously represented in both types of homicides and did not correlate significantly with sex, Fig. 3. Interestingly, in four cases of male homicides the dynamic of death was ultimately found to be a voluntary car-pedestrians collision (Fig. 3).

The anatomical regions affected showed an evident prevalence of the back and a slight prevalence of the chest in male homicides. In female homicides regions mainly hit were the head, breasts, pubis, and limbs (Fig. 4). To prevent overfitting, significance between areas most affected and sex was not assessed, as the number of assessed anatomical regions was too large compared to available sample size.

Female homicides were characterized by a higher number of hits, here reported as overkilling (i.e. >10 hits) compared to male homicide (Phi-coefficient = 0.30, p-value < 0.01). Interestingly, 18 cases of male homicides were perpetrated by more than one murderer, whereas female homicides were perpetrated by a single person.

When comparing femicides (homicides related to the failure to recognize the right of self-determination of the woman) with the whole sample of female homicides, we found a positive association between femicides and partner/ex-partner offender (Phi coefficient = 0.34; p-value = 0.02) (see Fig. 5 for comparing the distributions), cut wound as dynamic of death (Phi coefficient = 0.29; p-value = 0.05) (see Fig. 6 for comparing the distributions), and strangulation as harmful mean (Phi coefficient = 0.32; p-value = 0.03) (see Fig. 7 for comparing the distributions). A negative association was instead observed between femicides and indoor homicides (Phi coefficient = -0.32; p-value = 0.03), whereby they were less prevalent in femicides compared to the whole sample of female homicides, as illustrated in Fig. 8. A prevalence of overkilling, in which >10 hits were inflicted, although not statistically relevant, was found in femicides cases.

Results of this study and those identified in published literature are shown in Table 1.

Studies focusing on types of injuries and their anatomical distribution are reported in Table 2. Face, mouth, neck, breasts, pubis, anus, upper limbs and thighs were considered in our study as erogenous.

#### 4. Discussion

In this study we explored the differences between male and female

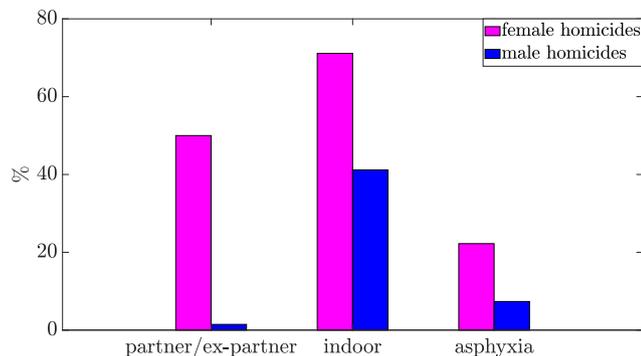


Fig. 1. Significant differences between female and male homicides. An association between sex and relative/partner/ex-partner offender (Phi coefficient = 0.73, p-value < 0.01), between sex and indoor homicide (Phi coefficient = 0.30, p-value < 0.01) and sex and asphyxia as dynamic of death (Phi coefficient = 0.21, p-value = 0.03) emerged. A higher prevalence of indoor homicides and asphyxiation was observed in female homicides.

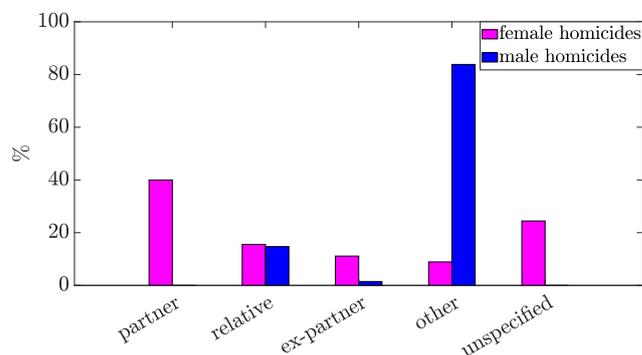


Fig. 2. Classification of female and male homicides by relationship with the murderer. Female homicides revealed an evident prevalence of relative and partner relationships between victim and murderer.

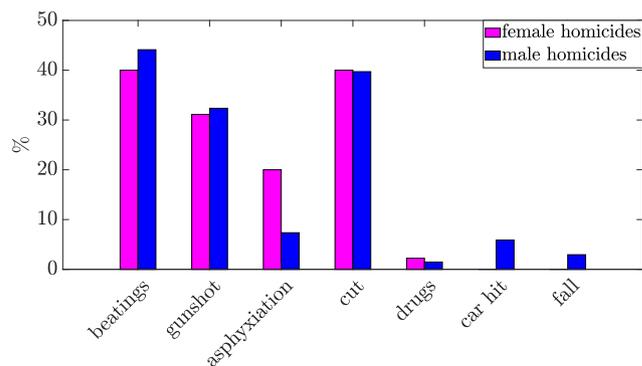


Fig. 3. Classification of female and male homicides by means used. Multiple means can be associated to the same homicide. Gunshot, blunt injuries and cut wounds were well represented in both types of homicides.

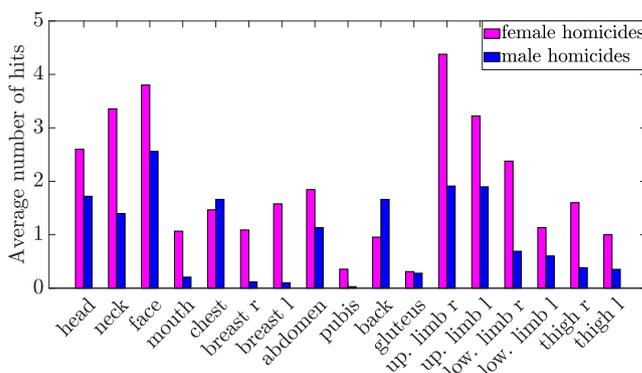
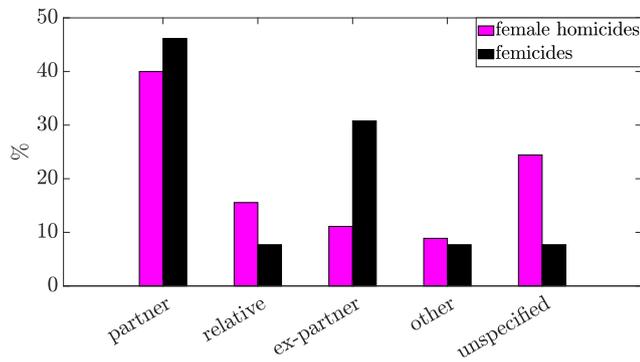


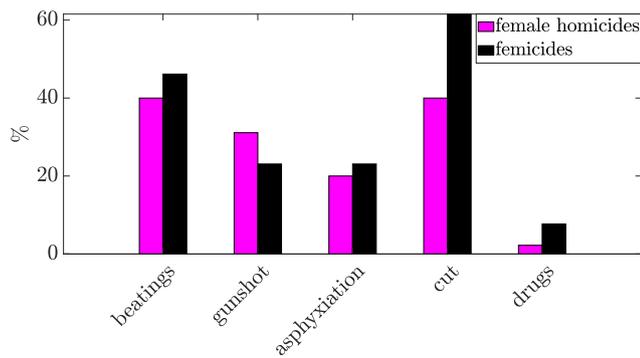
Fig. 4. Average number of hits to each anatomical region. There is an evident prevalence of the back and a slight prevalence of the chest in male homicides, whereas the head, breasts, pubis and limbs prevail in female homicides.

homicides and between femicides and non-femicide female murders utilising our proposed definition of femicide. To do so, we applied a forensic pathology approach by examining those data classically available to forensic pathologists (such as anatomic sites and types of injuries and information provided by police officers), to characterise the murders.

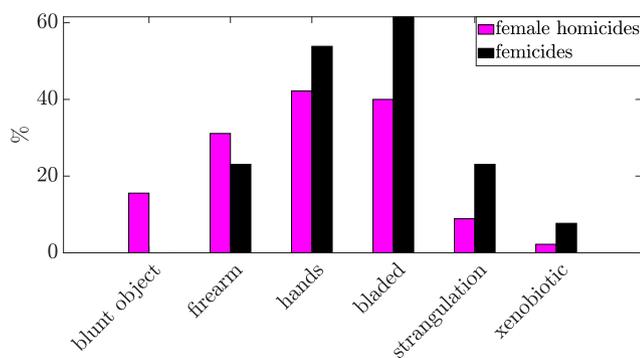
The homicides of men and women showed distinctive characteristics: they differed significantly in terms of motive of the crime, aggressor-victim relationship, type of injury suffered by the victim, and location of murder. Such distinctions support that the killing of a woman can be considered, from a victimology point of view, a distinctive crime with respect to that of a man.



**Fig. 5.** Classification of female homicides and femicides by relationship with the murderer. A positive association is observed between femicides and relative/partner/ex-partner offender (Phi coefficient = 0.34; p-value = 0.02).



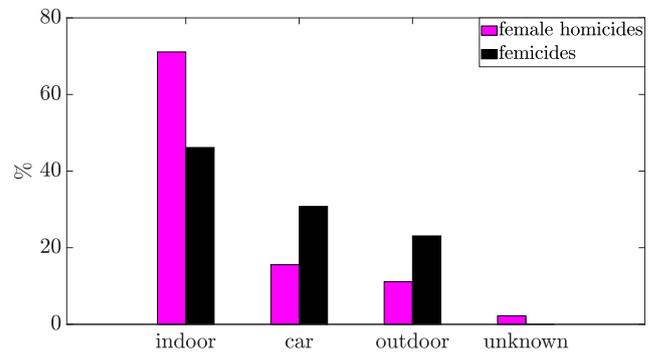
**Fig. 6.** Classification of female homicides and femicides by means used. Multiple means can be associated to the same homicide. A positive association emerged between femicides cut wound as dynamic of death (Phi coefficient = 0.29; p-value = 0.05).



**Fig. 7.** Classification of female homicides and femicides by dynamics of death. A homicide can have compound dynamics. When comparing femicide and female homicide a positive association was found between strangulation as harmful mean (Phi coefficient = 0.32; p-value = 0.03).

Comparing male homicides to female ones, our study documents an evident difference in motive. Men are mostly killed during fights due to futile discussions, for criminal reasons related to drug trafficking and organized criminality, or in circumstances associated with mental illness of the offender. This may explain why, in most cases, male victims do not have a close relationship to their aggressors.

Behind the murder of a female victim, we found that a substantial proportion of homicides was attributable to the failure to recognize to the victim her right to self-determination (request for divorce or ending of a relationship), those were the homicides we defined as femicides. Albeit significant, these associations should be confirmed on larger



**Fig. 8.** Classification of female homicides and femicides by their location (indoor, outdoor, or in a vehicle). A negative association was observed between femicides and indoor homicides (Phi coefficient = -0.32; p-value = 0.03), whereby they were less prevalent in femicides compared to the whole sample of female homicides.

datasets, whereby only 13 out of the 46 cases of female murder could be classified unambiguously as femicides. Nevertheless, the literature reports that a demand to divorce or to terminate the relationship is the motive for most of the murders of women [17,19,21,24,26,29,30]. Some studies report honor killing as the motive for the murder [16,18], which we would intend as femicide according to our definition. Literature demonstrates an increase in research concerning this crime, but “unambiguous evidence of a decline in tolerance of honor killings remains elusive” [31]. In our study there were cases of mercy killing in which, following prolonged illness of the victim, the husband decided to put an end to her suffering, or other cases in which the offender, usually the son, was affected by mental illness or addiction. All these motives result in a close relationship between the woman and her aggressor. This is confirmed also in cases of apparently relationships that could be considered perhaps less intimate: an Italian study showed that most of murdered prostitutes knew their murder [32].

Close relationship between victim and aggressor is also most likely to result in cases of overkilling [27]. This term is typically used to describe situations when multiple injuries, (often provoked by sharp instruments and/or hands) are inflicted on the victim’s body, exceeding the number necessary to cause death [15,19,22,23,33]. In many studies the presence of multiple injuries, both superficial lesions and/or deep cut wounds, can be signs of the perpetrator’s frenzy, expressed in form of multiple, aimless injuries on the victim’s body. In our study in 34 cases overkilling was documented, with no statistically relevant differences between femicides and female murders. In all the cases of overkilling, there was one or more injuries that could have provoked the death, and hitting the victim with fewer blunt injuries or stab wounds would have been enough to kill her. All these observations document the irrational urge to bodily contact with the victim and define the carnal aspect of the gesture and should be considered by clinicians as a risk factor for femicide in survived patients [34].

Studies focusing on the murderers (Table 1) document a wide predominance of partners or ex-partners regardless of geographic region [10–20,22–27]. In the studies, most cases report current relationships rather than broken ones, this agrees with the finding of a substantial proportion of cases where the motive for the murder is the decision of the woman to end the relationship. In the published literature, there were reports of honour killings, with numerous murderers being brothers or fathers [16,18].

In our study, there was a significant prevalence of female murders perpetrated in indoor settings, this was in contrast to male murders that tend to occur mostly in public spaces. This observation agrees with other research [13–16,22,23,26,27] and can be indicative of the difficulty that other people may find when attempting to stop the hand of the murder [35]. Perhaps surprisingly, comparing femicide with the murder of women, our study shows a negative association between femicides and

**Table 1**

A comparison between results of our study with those emerging from literature is reported. Geographic area studied, victim-murderer relationship, dynamic of death, and, when reported, place and motive of murder, are specified. Reference numbers are given in brackets.

STUDY	GEOGRAPHIC AREA	MURDERER	MOTIVE	PLACE	CAUSE OF DEATH
[10] B. Sabri et al (2016) Doi <a href="https://doi.org/10.1177/1077801215604743">https://doi.org/10.1177/1077801215604743</a>	United States (Minnesota, Oregon, Texas, Washington, Wisconsin)	<b>Total cases = 123</b> Husband 53.2 % Ex-husband 17.1 % Partner (Unmarried) 17.1 % Ex-partner unmarried 12.6 %	Unknown	Unknown	<b>Intimate femicide-suicide cases (=35)</b> Gun shot 60 % (n = 21) Sharp object 14.3 % (n = 5) Unknown causes 8.6 % (n = 3) Blow to the head 5.7 % (n = 2) Multiple methods 5.7 % (n = 2) Car accident 2.9 % (n = 1) Decapitated 2.9 % (n = 1)  <b>Intimate femicide/non-suicide cases (=88)</b> Sharp object 39.3 % (n = 33) Gun shot 32.1 % (n = 27) Strangulation 10.2 % (n = 9) Others 9.4 % (n = 8) Multiple methods 7.4 % (n = 6) Run down with a vehicle 5.1 % (n = 4) Bludgeoned with a hammer 3.6 (n = 3)
[11] C.E. Jordan et al (2010) Doi <a href="https://doi.org/10.1177/1088767910362328">https://doi.org/10.1177/1088767910362328</a>	United States (Kentucky)	<b>Total cases: 148</b>  <b>1. Age 13–65n = 135</b> <b>2. Over 65n = 13</b> Intimate partner 1. 26.7 %, 2. 30.8 % Ex-intimate partner 1. 11.9 %, 2. 0.0 % Family member 1. 8.1 %, 2. 23.1 % Acquaintance 1. 3.7 %, 2. 7.7 % Stranger 1. 4.4 %, 2. 15.4 % Missing/unknown 1. 45.2 %, 2. 23.1 %	Unknown	Unknown	Unknown
[12] L.K. Gillespie et al (2013) Doi <a href="https://doi.org/10.1177/1077801213476457">https://doi.org/10.1177/1077801213476457</a>	United States	<b>Total cases = 226</b> Husband 38.1 % Boyfriend 30.1 % Ex-boyfriend 15.9 % Estranged husband 11.1 % Ex-husband 4.9 %	Unknown	Unknown	Gun shot 55.9 % Sharp object 19.8 % Person 14.4 % Other 9.9 %
[13] Canadian Femicide Observatory for Justice and Accountability	Canada	<b>Total cases = 128</b> <b>Known accused person = 72</b>  Current/former partners 50 % (Current legal spouse n = 12, Current common-law spouse n = 9, Current dating partner n = 6, Estranged legal spouse n = 3, Estranged common-law spouse n = 2, Estranged dating partner n = 2, Not clear n = 2) Other family 26 % Friends/acquaintances 14 % Strangers 10 %	Unknown	<b>Private location n = 94, 73 %</b> (victims or accused home, hotel rooms, unspecified residence) <b>Public location n = 17, 13 %</b> (parks, streets, work place, inside vehicle) Unknown location n = 17, 13 %	Gun shot 44 % Sharp object 32 % Beatings 13 % Other methods 13 %

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Table 1 (continued)

STUDY	GEOGRAPHIC AREA	MURDERER	MOTIVE	PLACE	CAUSE OF DEATH
[14] S.N. Meneghel et al (2017) Doi <a href="https://doi.org/10.1590/1980-5497201700020004">https://doi.org/10.1590/1980-5497201700020004</a>	Brazil (Porto Alegre)	<b>Total cases = 64</b> Intimate 39/64 cases (Intimate: current or former partners - husbands, boyfriends, fiancées or dates)		House 67.1 % Public place 32.9 %	Gun shot 50 % Other (weapon/suffocation) 50 %
[15] W.L. Fong et al (2016) Doi <a href="https://doi.org/10.1016/j.foresci.2016.05.008">https://doi.org/10.1016/j.foresci.2016.05.008</a>	Taiwan	25 not reported <b>Total cases = 220</b>  <b>Intimate partner (n = 114)</b> Boyfriend 53.5 % Husband 29.8 % Ex-boyfriend 10.5 % Ex-husband 6.1  <b>Non intimate partner (n = 106)</b> Relatives 34.9 % Friend(s) 29.4 % Other acquaintance(s) 29.4 % Stranger(s) 6.6 %	Unknown	<b>Intimate partner (n = 114)</b> Victim's home 58.8 % Offender's home 9.6 % Public places 7.0 % Other 21.1 %  <b>Non intimate partner (n = 106)</b> Victim's home 54.7 % Offender's home 9.4 % Public places 8.5 % Other 25.5 %	<b>Intimate partner (n = 114)</b> Sharp object 52.6 % Strangulation 27.2 % Blunt force 13.2 % Poison 2.6 % Gun shot 2.6 %  <b>Non intimate partner (n = 106)</b> Sharp object 53.8 % Strangulation 22.6 % Blunt force 20.8 % Poison 1.9 % Gun shot 0.0 %
[16] H.O.G. Salameh et al (2018) Doi <a href="https://doi.org/10.1016/j.jflm.2018.03.015">https://doi.org/10.1016/j.jflm.2018.03.015</a>	Jordan	<b>Total cases:= 100</b>  Honour killings cases (n = 52) Brother 28 54 % Father 7 13 % Husband 5 10 % Uncle 3 6 % Cousin 3 6 % Son 2 4 % Unknown 4 7 %  <b>Intimate partner violence death (n = 33)</b> Husband n = 33 100 %	Honour killings n = 52 52 % Intimate partner violence n = 33 33 % Quarrel n = 7 7 % Other domestic violence, the woman having been killed by a son n = 5 5 % Robbery n = 3 3 %	Women's home 76 % (94 % for the Intimate partner violence death cases)	Gun 44 % Sharp object 21 % Blunt force 14 % Strangulation 8 % Multiple weapons 6 % Burning 4 % Poisoning 3 %
[17] K. Karbeyaz et al (2018) Doi <a href="https://doi.org/10.1016/j.jflm.2018.10.002">https://doi.org/10.1016/j.jflm.2018.10.002</a>	Turkey	<b>Total cases = 148</b>  Husband 48.6 % Boyfriend 20.3 % Ex-husband 16.9 % Ex-boyfriend 8.1 % Ex-fiancé 6,1 %	Request of women to divorce/to break up with boyfriend 61.5 % Jealousy (cheating claim) 15.5 % Economic reasons 10.2 % Unknown 12.8 % Domestic arguments and fights 22.1 % Followed by robberies 12.8 % Sexual causes 8.1 % Betrayal 4.7 % Honor killing 3.7 % Unknown 46.5 %	Unknown	Sharp object 49.3 % Gun shot 39.9 % Blunt force 6.8 % Garotte 4.1 %
[18] N.M. Zaghloul et al (2019) <a href="https://doi.org/10.1016/j.jflm.2019.05.018">https://doi.org/10.1016/j.jflm.2019.05.018</a>	Egypt	<b>Total cases = 93</b>  Unknown 50.53 % Husband 17.20 % relative 17.20 % caregiver 5.37 % stranger 5.37 % intimate partner 4.30 %		Unknown	Sharp object 34.41 % Other Blunt force 13.98 % Gun shot 10.75 % Throttling 10.75 % Smothering 7.53 % Strangulation 7.53 % Burn 7.53 % Falling from height 6.45 % Electrocution n = 1 1.08 %
[19] S. Mathews et al (2008) Doi <a href="https://doi.org/10.2471/blt.07.043786">https://doi.org/10.2471/blt.07.043786</a>	South Africa	<b>Total cases: 1349</b>  <b>Intimate femicide-suicide cases (=261)</b> Cohabiting partner 40.4 % Boyfriend 28.8 % Husband 30.8 % Other 0.0 %  <b>Intimate femicide/non-suicide cases (=1088)</b> Cohabiting partner 55.5 % Boyfriend 27.1 % Husband 15.5 % Other 1.9 %	<b>Intimate femicide-suicide cases (=261)</b> Argument 53.5 % Alleged infidelity of victim 19.7 % Female ended relationship 29.0 % Other 1.3 %  <b>Intimate femicide/non-suicide cases (=1088)</b> Argument 54 % Alleged infidelity of victim 19.7 % Female ended	Unknown	<b>Intimate femicide-suicide cases (=261)</b> Gun shot 82.7 % Sharp object 14.7 % Blunt force 11.4 % Strangled/Asphyxiated 2.6 %  <b>Intimate femicide/non-suicide cases (=1088)</b> Sharp object 38.0 % Blunt force 40.7 % Gun shot 18.1 % Strangled/

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Table 1 (continued)

STUDY	GEOGRAPHIC AREA	MURDERER	MOTIVE	PLACE	CAUSE OF DEATH
			relationship 8.4 % Other 17.3 %		Asphyxiated 3.9 % Fire 1.4 % Other 0.7 % Drowning 0.5 %
[20] N. Abrahams et al (2013) Doi <a href="https://doi.org/10.1371/journal.pmed.1001412">https://doi.org/10.1371/journal.pmed.1001412</a>	South Africa	<b>Intimate femicide-suicide cases (n = 1349(1999), n = 1024 (2009))</b>  Intimate 50.2 % (1999), 57.1 % (2009) intimate: a current or former husband/boyfriend, same-sex partner, or rejected would-be lover	Unknown	Unknown	<b>Intimate femicide-suicide cases (n = 1349(1999), n = 1024(2009))</b> Blunt force: 33.2 % (1999), 29.5 % (2009) Gun shot: 30.6 % (1999), 17.4 % (2009) Sharp object: 33.2 % (1999), 31.4 % (2009) <b>Non intimate femicide-suicide cases (n = 1335 (1999), n = 768 (2009))</b> Blunt force: 21.2 % (1999), 22.4 % (2009) Gun shot: 33.6 % (1999), 17.1 % (2009) Sharp object: 34.3 % (1999), 35.5 % (2009)
[21] B. Meel (2018) Doi <a href="https://doi.org/10.1016/j.jflm.2018.02.025">https://doi.org/10.1016/j.jflm.2018.02.025</a>	South Africa	Unknown	Unknown	Unknown	<b>Total cases = 1865</b>  Gunshot (n = 754) Sharp object (n = 559) Blunt force (n = 552) Gun shot 45.2 % Sharp object 27.4 % Blunt force 14.5 % Manual strangulation 4.8 % Multiple methods 4.8 % Heat trauma with burns 3.2 %
[22] A.R. Pereira et al (2013) Doi <a href="https://doi.org/10.1016/j.jflm.2013.09.015">https://doi.org/10.1016/j.jflm.2013.09.015</a>	Portugal	<b>Total cases = 62</b>  Marital 54.8 % Common-law 24.2 % Dating 11.3 % Extramarital 9.7 %	Context of separation of the couple 38.9 % Jealousy 31.5 % Conflicts 22.2 %	Private residences 61.7 % (n = 37) Public places 35 % (n = 21)	Gun shot 45.2 % Sharp object 27.4 % Blunt force 14.5 % Manual strangulation 4.8 % Multiple methods 4.8 % Heat trauma with burns 3.2 %
[23] A. Giorgetti et al (2022) Doi <a href="https://doi.org/10.1016/j.foresciint.2022.111210">https://doi.org/10.1016/j.foresciint.2022.111210</a>	Italy (Bologna)	<b>Total cases = 103</b>  Current husband/boyfriend 41.8 % Family member 17.5 % Previous husband/boyfriend 16.5 % Acquaintance 10.7 % Lover 4.9 % Customer 3.9 % Student/employee 3.9 % No relationship 0.8 %	Passionate reasons 26.7 % Familial problems 24.4 % General crimes and robbery 22.2 % Sexual femicides 4.4 % Mental illness - victim 13.3 % Mental illness - perpetrator 9 %	Home 77.1 % Hotel 4.2 % Car 8.3 % Road or abandoned place 10.4 %	Gun shot 37.9 % Sharp object 23.3 % Blunt force 17.5 % Strangulation 16.5 % Toxic 2.9 % Drowning 1 % Thermal injure 0.9 %
[24] A. Sorrentino et al (2020) Doi <a href="https://doi.org/10.3390/ijerph17217953">https://doi.org/10.3390/ijerph17217953</a>	Italy	<b>Total cases = 1204</b>  Husbands 33.8 % Cohabitants 6.8 % Ex-husbands 6.9 % Ex-boyfriends 5.8 % Boyfriends 3.6 % Ex-cohabitants 3.4 %	The inability to accept the end of the relationship 23.3 % Jealousy between the partners 15.6 % Escalation of violence started because of quarrels or conflicts in the couple 14.4 % The presence of physical or mental illness of the author 12.9 %	Unknown	Unknown

(continued on next page)

Table 1 (continued)

STUDY	GEOGRAPHIC AREA	MURDERER	MOTIVE	PLACE	CAUSE OF DEATH
[25] G. Vignali et al (2021) Doi <a href="https://doi.org/10.1016/j.foresciint.2021.110890">https://doi.org/10.1016/j.foresciint.2021.110890</a>	Italy (Milano)	<b>Total cases = 82</b>  Intimate partner 72 % son or the grandson 9.3 % The jealous client of a prostitute 9.3 % An admirer 2.3 % Son in law 1.2 % Father 1.2 %	The presence of physical or mental illness of the victim 7.2 % Unknown	Unknown	Sharp object 34 % Gun shot 20 % Strangulation/suffocation 17 % Blunt force 14 % Combined methods of murders 10 % Burning 2 % Drowning 2 %
[26] C. Moreschi et al (2016) Doi <a href="https://doi.org/10.1016/j.jfr.2016.01.017">https://doi.org/10.1016/j.jfr.2016.01.017</a>	Italy (Udine)	<b>Total cases = 34</b>  Current partners 44.1 % Relatives 8.8 % Ex-partners 5.9 % Brother/Sister 5.9 % Friends/Acquaintances 5.9 % Father 2.9 % Strangers 11.8 % Not identified 11.8 % Killed by 2 people: Current partner and Relatives 2.9 %	Perpetrators' mental disorder 23.5 % Unknown 14.7 % Related to the ending of their relationship 11.8 % Trivial issues and Fighting 11.8 % Robbery 8.8 % Passion 8.8 % Compassionate reasons (mercy killing) 5.9 % Attempt to extort information 2.9 % Jealousy 2.9 %	Home 73.5 % Countryside/woodland 17.6 % Street 2.9 % Caravan 2.9 % Unknown 2.9 %	Sharp object 41.2 % Gun shot 38.2 % Asphyxiation 8.8 % Physical aggression 5.9 % Blunt force 5.8 %
[27] G. Zara, Gino S. (2018) <a href="https://doi.org/10.3389/fpsyg.2018.01777">https://doi.org/10.3389/fpsyg.2018.01777</a> . PMID: 30319489; PMCID: PMC6168672.	Italy (Turin)	<b>Total cases = 275</b>  Known murderer 88.3 % Stranger 11.6 %	Passion killing 31.1 % Family problems 18.7 % Consequence of another crime 15.2 % Predatory 14.0 % Loss of control after a row or a refusal 13.6 % Mental disorder 7.4 % Pietas n = 6, 13.0 % Jealousy n = 6, 13.0 % The inability to accept the end of the relationship n = 4, 8.7 % Psychiatric pathology n = 4, 8.7 % Quarrel n = 2, 4.3 % Possession n = 2, 4.3 % Robbery n = 1, 2.2 % Shooting n = 1, 2.2 % Daughter murdered by Mother n = 1, 2.2 % Unknown n = 19, 41.3 %	Victim's or perpetrator's house 73.9 % Public place (Car, Street, Countryside) 26.1 %	Most common: gunshot, stab wounds, and strangulation
The present study, Cecchi et al.	Italy (Parma)	<b>Total cases = 46</b>  Partner 39.1 % Not precise 23.9 % Family 15.2 % Ex-partners 10.9 % Mother 2.2 % Cohabitant of the mother 2.2 % Other 6.5 %  <b>-Femicide-Suicide cases</b> N = 9 Same gun = 6 Same knife = 1 1 Murder followed by suicide through precipitation 1 Murder followed by suicide through hanging	Pietas n = 6, 13.0 % Jealousy n = 6, 13.0 % The inability to accept the end of the relationship n = 4, 8.7 % Psychiatric pathology n = 4, 8.7 % Quarrel n = 2, 4.3 % Possession n = 2, 4.3 % Robbery n = 1, 2.2 % Shooting n = 1, 2.2 % Daughter murdered by Mother n = 1, 2.2 % Unknown n = 19, 41.3 %	home n = 26, 56.5 % car n = 8, 17.4 % farm n = 4, 8.8 % moat n = 1, 2.2 % unknown n = 1, 2.2 % hospital n = 1, 2.2 % park n = 1, 2.2 % guest-house n = 1, 2.2 % bridge n = 1, 2.2 % building n = 1, 2.2 % street n = 1, 2.2 %	Sharp object n = 16, 34.8 % Gunshot n = 14, 30.4 % Asphyxiation n = 10, 21.7 % Blunt force n = 3, 6.5 % Blunt force + Asphyxiation n = 3, 6.5 %

indoor homicides.

Literature shows that sharp injury and gunshot are the most common causes of death in female murders, although some variations exist probably related to different availability of guns and usage habits in geographic regions [10–14,16–23,25–27]. Only the study of Fong, in Taiwan, revealed 2,6% of intimate partner murderers using guns, while in non-intimate partner homicides guns were never used. The authors attributed this to the strict firearm legislation of Taiwan that led to a very low rate of gun ownership [15]. Interestingly, comparing studies of homicide/suicide, most homicides followed by suicide occurred using a gun, probably the same one [10,19,20]. In our study guns prevailed in murder of women, while sharp instruments in femicides, often associated with strangulation. In Italy, the Law n. 110 of April 18, 1975, considers revolvers, pistols, and rifles as common weapons. Their

purchase and use are subjected to the acquisition of the firearms license as indicated by the Decree Law August n. 104 of 10, 2018.

For what concern the use of sharp injuries, in our study it refers mainly to kitchen knives, with blades of 14 cm (steak knives), and, in two cases, of 27 cm (bread knives). In other two cases a switchblade and in one case a butcher's knife were used. A fishing harpoon was used in only one case. In the other cases the sharp instrument used is unknown. The authors believe that since kitchen knives are means commonly not perceived by the victim as harmful for themselves, their use in indoor homicides confirms how the victim often is killed in an environment that she experiences as familiar and safe.

From a victimological point of view, in our study, male and female homicides differ in the anatomical distribution of trauma: women are more hit on the face, mouth, head, and neck, (which may be regarded as

**Table 2**

Characteristics of injuries and anatomic sites affected, arising from studies that have considered them, are compared to those documented by our study.

STUDY	ANATOMIC SITE	EROGENOUS ZONE	N° OF INJURIES
[19] S. Mathews et al (2008) Doi <a href="https://doi.org/10.2471/blt.07.043786">https://doi.org/10.2471/blt.07.043786</a>	Unknown	Unknown	<b>Intimate femicide-suicide cases (=261)</b> Multiple injuries 41.1 % Single injury 58.9 % Undetermined 0.0 %  <b>Intimate femicide/non-suicide cases (=1088)</b> Multiple injuries 47.7 % Single injury 46.9 % Undetermined 5.6 % Unknown
[15] W.L. Fong et al (2016) Doi <a href="https://doi.org/10.1016/j.foresci.2016.05.008">https://doi.org/10.1016/j.foresci.2016.05.008</a>	<b>Intimate partner (n = 114)</b> Face 56.1 % Cranium 41.2 % Neck 58.8 % Chest 50.9 % Abdomen 21.9 % Back 25.4 % Buttock 1.8 % Upper limbs 53.5 % Lower limbs 31.8 % Ano-genitalia 1.8 %  <b>Non intimate partner (n = 106)</b> Face 65.1 % Cranium 62.3 % Neck 47.2 % Chest 49.1 % Abdomen 28.3 % Back 22.6 % Buttock 3.8 % Upper limbs 66.0 % Lower limbs 37.7 % Ano-genitalia 6.6 %	<b>Intimate partner (n = 114)</b> Ano-genitalia 1.8 %  <b>Non intimate partner (n = 106)</b> Anogenitalia 6.6 %	
[23] A. Giorgetti et al (2022) Doi <a href="https://doi.org/10.1016/j.foresci.2022.111210">https://doi.org/10.1016/j.foresci.2022.111210</a>	<b>Fatal injuries (n = 103)</b> Head 24.2 % Neck 17.7 % Chest 19.4 % Multiple localization 38.7 %	Unknown	One blow 24.2 % Multiple blows 64.1 % Multiple blows > 10 11.7 %
[27] G. Zara, Gino S. (2018) <a href="https://doi.org/10.3389/fpsyg.2018.01777">https://doi.org/10.3389/fpsyg.2018.01777</a> . PMID: 30319489; PMCID: PMC6168672.	Head, neck, face 53.6 % Torso, chest and arms 23.4 % Spread over entire body 23.0 %	Unknown	Overkilling 40.7 %

**Table 2 (continued)**

STUDY	ANATOMIC SITE	EROGENOUS ZONE	N° OF INJURIES
[16] H.O.G. Salameh et al (2018) Doi <a href="https://doi.org/10.1016/j.jflm.2018.03.015">https://doi.org/10.1016/j.jflm.2018.03.015</a>	<b>Fatal injury</b> Honour killings cases n = 52 Chest 40 % Bruising, Lacerations or Incised wounds on the arms 22 %  Intimate partner violence n = 33 Head 46 % Bruising, Lacerations or Incised wounds on the arms 6 %	Unknown	Honour killings n = 52 1n = 11 2-10n = 10 >10n = 29 Intimate partner violence n = 33 1n = 16 2-10n = 6 >10n = 6
[17] K. Karbeyaz et al (2018) Doi <a href="https://doi.org/10.1016/j.jflm.2018.10.002">https://doi.org/10.1016/j.jflm.2018.10.002</a>	Head n = 35 (23.6 %) Chest n = 82 (55.4 %) Abdomen n = 25 (16.9 %)	Unknown	Unknown
[22] A. R. Pereira et al (2013) Doi <a href="https://doi.org/10.1016/j.jflm.2013.09.015">https://doi.org/10.1016/j.jflm.2013.09.015</a>	<b>Fatal - Non fatal</b> Head - n = 25 (40.3 %)- n = 10 (28.6 %) Face - n = 13 (21.0 %)- n = 16 (44.7 %) Neck - n = 19 (30.6 %)- n = 15 (42.9 %) Thorax - n = 30 (48.4 %)- n = 17 (48.6 %) Abdomen - n = 10 (16.1 %)- n = 10 (28.6 %) Upper limbs -2 (3.2 %)- n = 26 (74.3 %) Lower limbs - n = 2 (3.2 %)- n = 6 (17.1 %)	Unknown	<b>Number - Fatal - Nonfatal</b> 1-2- n = 8 (45.1 %) - n = 2 (5.7 %) 2-9n = 26 (41.9 %)- n = 22 (62.9 %) >10n = 8 (12.9 %) - n = 11 (31.4 %)
The present study, Cecchi et al.	N = 46 Abdomen 39.1 % Right lower limb 32.6 % Left lower limb 23.9 % Right upper limb 60.9 % Left upper limb 56.5 % Mouth 28.3 % Head 54.3 % Neck 69.6 % Right thigh 32.6 % Left thigh 23.9 % Back 17.4 % Pubis/ Perineum 8.7 % Buttocks 15.2 % Mammary region (R) 28.3 % Mammary region (L) 32.6 % Chest 43.5 % Face 71.7 %	Mouth n = 13 28.3 % Neck n = 32 69.6 % Pubis/ perineum n = 4 8.7 % Buttocks n = 7 15.2 % Mammary region n = 18 39.1 %	<b>Multiple injuries n = 21 45.7 %</b>

areas representing someone's identity), as well as on breasts, pubis and limbs, (i.e. sexual areas). Breast and pubis are almost never affected in male victims. In female homicides there is mostly a close contact between offender and victim, and hands are often used bare or holding a weapon or a knife, thus violating intimacy.

In the studies on female homicides in which the injured anatomic sites are reported, they are situated mostly on the head, face, neck, and chest [15–17,22,23]. This observation is confirmed by reports from the emergency departments [36]. All studies report chest without specifying if breast is affected. Only one study refers specifically to the anal and genital areas [15]. According to our classification, we included in the “erogenous zones” specifically face, mouth, neck, breasts, pubis, anus, upper limbs and thighs. It can be argued that it would be helpful in future studies on femicide and forensic reports to ensure that “breasts” and “mouth” are specified (as opposed to using the more general “chest” and “face”).

In the literature there are some attempts to find tools useful to predict severe violence against women or the killing of a woman [2,37–42]. The present work proposes a medico-legal methodology to be followed in order to assess features of forensic pathology that could help distinguishing femicide from other women murder. Although it concerns a small sample size, our study shows that, compared to female homicides, in cases of femicides partner/ex-partner offender, cut wound, strangulation and overkilling prevail, and most murder are perpetrated outdoor.

This information, collected in larger samples, could help in the future to prevent fatal cases of violence against women. Homogenizing the methodology of research on a wider level could also lead to tools to be employed in the emergency department or in Court, when it is necessary to identify instances when the violence may degenerate into murder.

## 5. Conclusion

The comparison of male and female homicides demonstrate that they can be considered as two distinct victimological phenomena. Moreover, defining femicide as those cases related to the failure to recognize the right to self-determination of the woman allows to establish injuries and circumstantial patterns, that could represent evidence of a specific murder, deserving a specific regulatory framework.

More studies with a standardized data collection are needed to corroborate the theory of this paper. In addition, large scale international collaborations including casuistry from numerous centers would benefit the field and help identify physical and circumstantial markers of femicide. Ultimately, efforts will be aimed at preventing violence against women into degenerating into femicide and aiding the legislator on the advisability of considering femicide as an autonomous crime, or as an aggravating circumstance of murder.

Ethics statements.

This work does not involve human subjects, or animal experiments. No data were collected from social media platforms.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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