



# Homicide-Suicide in Italy Between 2009-2018: An Epidemiological Update and Time Series Analysis

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## Abstract

Homicide–suicide is an event in which an individual murders one or more persons and then takes his/her own life. The present study aimed to assess the incidence of homicide–suicide in Italy over a 10-year period (between 2009 and 2018) and to compare its findings with national and international data. Furthermore, a time series analysis was carried out employing an autoregressive integrated moving average model. Data regarding homicide–suicide cases were collected from press agencies and four major Italian newspapers. In the considered time frame, 368 cases of homicide–suicide were identified, with a total of 808 deaths. Findings aligned with international data, highlighting that the murderer is typically an older male who, for romantic jealousy, kills with a firearm his current or former female partner. The average rate of homicide–suicides was 0.06%, showing an increase compared to the previous decades. In addition, the forecasting model predicted a further increase in cases in the coming years, highlighting the need to systematically gather data on this phenomenon.

**Keywords** Homicide-suicide · Murder-suicide · Femicide · Romantic jealousy · Mercy killing

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## Introduction

Homicide-suicide (HS) is a form of violence that is rarer compared to homicides or suicides alone but has nonetheless grave repercussions on surviving family members and the community at large, mainly due to its emotional impact and the impossibility to prosecute the perpetrator.

The incidence of HS has been stable over time at less than 0.001% (Eliason, 2009), but there is considerable national variation (Knoll & Hatters-Friedman, 2015; Milroy, 1995). Indeed, in Europe rates range from as low as 0.02/100.000 inhabitants in Greece and Southwestern Croatia (Alexandri et al., 2022; Cengija et al., 2012), 0.04–0.05 in England and Wales (Flynn et al., 2009, 2016), 0.05 in the Netherlands (Liem et al., 2011) to 0.09 in Switzerland (*ibidem*) and 0.11 in Romania (Balica & Stöckl, 2016). In other continents, the rate has been reported to be as high as 0.38 in the United States (Hannah et al., 1998) and 0.89 in South Africa (Roberts et al., 2010).

Despite the difference in rates, the international literature reported some frequently encountered characteristics of HS. A recent systematic review (Rouchy et al., 2020) delineated some of the most consistent elements associated with this phenomenon: this type of violent behavior is primarily intrafamilial, takes place at home and involves a male perpetrator, married or recently separated and often depressed, who murders with a firearm a younger female victim (Banks et al., 2008; Galta et al., 2010; Merzagora et al., 2011; Roma et al., 2012a; Salari & Sillito, 2016; Verzeletti et al., 2014). Findings related to other sociodemographic characteristics are less consistent, indicating, for instance, the presence of both high (e.g., Kivivuori & Lehti, 2003) and low (e.g., Shiferaw et al., 2010) socioeconomic status.

Net of phenomenological constants, HS is a complex and polymorphic phenomenon, with some of its defining criteria sparking debate among experts, which could in part explain the national variation observed: for instance, some authors (Barber et al., 2008; Logan et al., 2008) argued that, for it to be considered HS, the suicide needs to occur within twenty-four hours from the homicide; others (Comstock et al., 2005; Felthous & Hempel, 1995; Hata et al., 2001), instead, proposed that the suicide can occur from days to an unspecified amount of time after the murder. Regardless of the temporal variable, it is of paramount importance that a clear criminogenic link between the homicide and the suicide exists (Roma et al., 2011).

To add to the complexity of this phenomenon, theoretical perspectives and psychological interpretations of HS are not concordant (Zeppegno et al., 2019): it could be considered a homicide in which the murderer, overwhelmed by remorse, takes their own life; conversely, it could be akin to a suicide extended to the perpetrator's significant ones; finally, some Authors advocated that HS is a separate phenomenon, distinct from both homicide and suicide taken alone (e.g., Santos-Hermoso et al., 2022).

Lastly, the motivational aspects of HS are heterogenous as well: pathological jealousy or extreme possessiveness directed towards the current or former partner are the most frequently encountered motives (e.g., Roma et al., 2011). However, in other cases, this phenomenon takes the form of mercy killing, for which in older couples the man kills his spouse for her declining health; alternatively, HS can take the form of filicide, involving mothers with post-partum depression or maternal salvation fantasies (Marzuk et al., 1992).

## Objective

In Italy, a national registry of HS has yet to be compiled by a governmental source, making it difficult to examine the sociodemographic, motivational, and criminological factors associated with HS. As a result, most of the studies investigating this phenomenon in the

Italian peninsula either cover specific districts (Merzagora et al., 2011; Roncallo et al., 2021; Verzeletti et al., 2014) or rely on media sources. For example, a newspaper study considering the period between 1985-2008 (Roma et al., 2012b) reported a 0.04 rate of HS in Italy and outlined results aligned with the international literature: perpetrators were mostly males (84.6%), while the majority of victims were females (68.4%); firearms were the most commonly used method for both murders (56.5%) and suicides (55.8%); romantic jealousy (24%) and financial or social stressors (17%) were the most frequently encountered motives.

This study aims to document the epidemiology of HS incidents in a ten-years window (2009-2018) in Italy and compare it to national and international data. Furthermore, a forecasting model was fitted on the available data regarding HS considering a 34-year period (between 1985-2018) to predict the trend of homicide-suicide cases in Italy in the future years (up to 2025).

## Methods

HS incidents that occurred in the period between 1<sup>st</sup> January 2009 and 31<sup>st</sup> December 2018 were collected from major national news sources: two press agencies' sites (Adnkronos and ANSA) and four major Italian newspapers (Il Corriere della Sera, La Repubblica, La Stampa, and Il Messaggero). Since not all the selected newspapers' websites had adequate search engines, national and local editions were examined in their entirety, looking for articles covering homicide-suicide cases that happened in the specified period. This methodology has been employed in previous studies, both in Italy (e.g., Roma et al., 2012b) and in other countries (e.g., Liem & Koenraadt, 2007).

For this study, HS cases were included when the perpetrator killed one or more persons and then committed suicide, without applying restrictions to the time elapsed between the homicide and the suicide as long as there was a motivational and criminogenic connection between the two facts. Cases in which the murderer survived or that had no victims were, instead, excluded.

The final dataset comprised 368 cases and included the following variables: (a) murderers' and victims' sociodemographic characteristics (sex, age, nationality, marital status, occupation); (b) the relationship between the murderer and victim; (c) methods used to commit homicides and suicides; (d) the apparent motivation or reason that might explain the HS.

## Statistical Analysis

Statistical analyses were carried out using Statistical Package for Social Sciences SPSS v.26.0 (IBM SPSS Statistics, New York, NY, USA). To examine the characteristics of perpetrators and victims, their relationships, the methods of homicides and suicides, and their motives, descriptive statistics were computed. Furthermore, a time series analysis was carried out employing Autoregressive Integrated Moving Average (ARIMA), which was fitted to the time series data from 1985 to 2018 to model the year's effect on yearly HS cases. For this analysis, the data between 1985-2008 were retrieved from a previous epidemiological work on HS cases in Italy (Roma et al., 2012b), which employed the same methodology as the present study. Briefly, the univariate

ARIMA model has the general structure of  $(p, d, q)$  where  $p$  is the order of the autoregressive model,  $d$  is the degree of differencing, and  $q$  is the order of the moving-average model.

### Model Estimation Procedure

Estimating the adequate ARIMA model is an iterative process that involves a series of steps to understand which forecasting model is better suited with the available data.

First, the time series plot (Fig. 1) was inspected, suggesting the presence of an increasing trend. Correspondingly, the Dickey-Fuller unit root test accepted (lags = 0;  $Z(t) = -2.54$ ;  $p = .106$ ) the null hypothesis that the time series had some time-dependent structure and lacked constant variance over time, confirming the time series' non-stationarity.

Therefore, the raw series was transformed into a new set of observations (Fig. 2) to remove the trend (via differencing) and have a constant variance (via natural logarithmic transformation). The Dickey-Fuller unit root test on the transformed time series rejected (lags = 1;  $Z(t) = -5.06$ ;  $p = .010$ ) the null hypothesis confirming its stationarity.

At this point, it was possible to analyze the sample autocorrelation function (ACF) and partial autocorrelation function (PACF) plots (Fig. 3). The plots indicated that only the first lag of both ACF and PACF lay outside the 95% confidence limits, rendering it the only significant lag. Thus, an ARIMA (0, 1, 1) model was determined to be appropriate with the available data. This conclusion was in line with SPSS forecasting model's automatic selection.

### Model Diagnostic Checking

A series of indicators were considered to examine the adequacy of the fitted model. First, the ACF and PACF of the model residuals showed that all lags were within the 95% confidence bands, suggesting the absence of a correlation structure in the model residuals and, thus, the adequacy of the fitted ARIMA model. Moreover, the Ljung-Box test accepted ( $Q_{17} = 7.19$ ;  $p = .981$ )

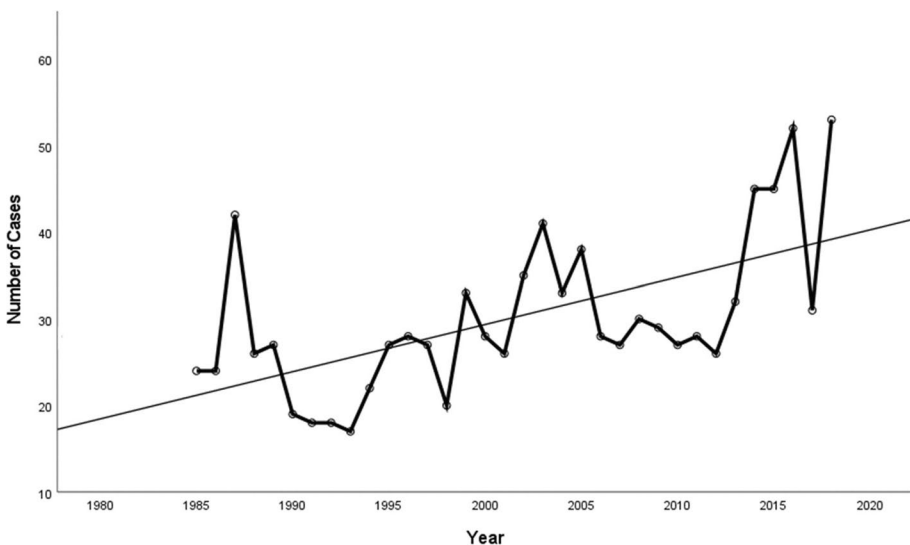


Fig. 1 Time Series Plot of the Original Data

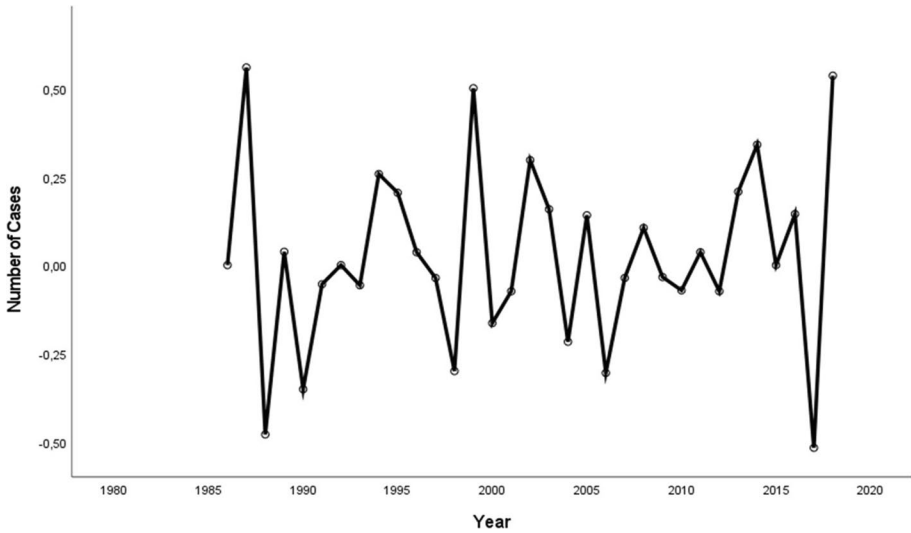


Fig. 2 The Smoothed Time Series Following Differencing and Natural Logarithm Transformation

the null hypothesis that the model residuals were distributed as white noise. Furthermore, the Shapiro-Wilk test ( $W_{33} = 0.983; p = .865$ ) indicated that the model residuals were distributed normally. Lastly, the ARCH-LM test accepted ( $\chi^2_1 = 3.27; p = .070$ ) the null hypothesis of no auto-regressive conditional heteroskedasticity effect. Thus, the fitted model's adequacy was established.

## Results

### Sample Size and Rates

Between 2009 and 2018, 368 HS incidents occurred in Italy (Table 1). The frequencies of cases each year ranged from 26 to 53 ( $M = 36.8; SD = 10.8$ ). The average rate was 0.06 cases per 100,000 per year (range 0.04-0.09). The total number of deceased (murderers + victims) was 808, of which 440 were passive victims, with an average of 44 ( $SD = 13.8$ ) deceased every year.

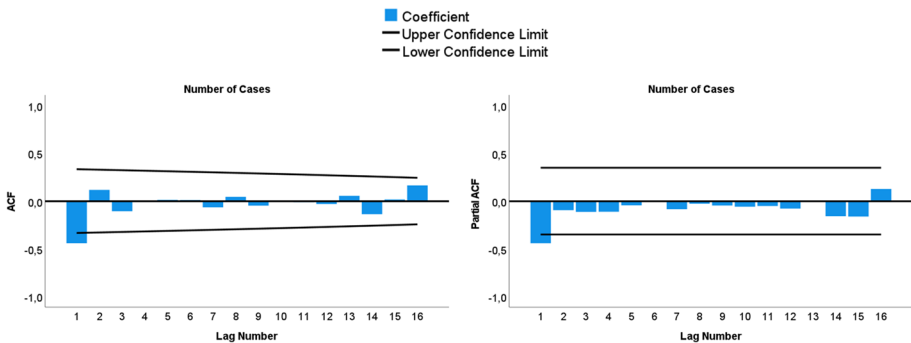


Fig. 3 ACF and PACF Plots of the Smoothed Time Series

## Characteristics of the Murderers

The murderer was male in 331 cases (89.9%) and female in 37 cases (10.1%). Forty-seven murderers were non-Italians, but 27.4% of data regarding nationality were missing. Non-Italian perpetrators' most frequently encountered nationalities among the observed cases were Moroccans (12.77%), Moldovans (10.64%), Romanians (8.51%), and Brazilians (6.38%). The most represented age class was over 64 years old (26.4%), followed by 45-54 (20.9%) and 35-44 (20.4%). Most of the perpetrators were married (56.5%) and either employed (42.9%) or retired (23.2%). The sociodemographic characteristics of perpetrators, divided by gender, are presented in Table 2.

## Characteristics of the Victims

The victims comprised 440 persons, 76.6% (337) were females and 23.4% (103) males. In 17.93% of HS incidents (66 vs. 302) the number of victims was more than 1, ranging from 1 to 3 (Table 1). The most represented age class was over 64 years old (27.7%), followed by 45-54 (16.8%) and 7-24 (13.9%). Most victims were married (41.1%) and, even though information regarding victims' occupations was largely missing (40.5%), the available data indicated they were mostly pre-school children (18.8%) or retired (12.8%). The sociodemographic characteristics of victims, divided by gender, are presented in Table 2.

## Relationship Between Victims and Murderers

In general, the most common relationship was current or former partner (55.5%), followed by offspring (24.5%) and parents (8.6%). A detailed overview of the victims' relationship with the murderer, divided by gender, is presented in Table 3.

**Table 1** HS Rates in Italy From 2009 to 2018

Year	Cases	Population	Rate	Total Number of Victims	Number of Victims		
					1	2	3
2009	29	60,045,068	0.05	31	27	2	0
2010	27	60,340,328	0.05	31	23	4	0
2011	28	60,626,442	0.05	32	24	4	0
2012	26	59,394,207	0.04	31	21	5	0
2013	32	59,685,227	0.05	40	26	4	2
2014	45	60,782,668	0.07	59	33	10	2
2015	45	60,795,612	0.07	52	38	7	0
2016	52	60,656,000	0.09	61	43	9	0
2017	31	60,589,445	0.05	35	27	4	0
2018	53	60,483,973	0.09	68	40	11	2
Total	368			440	302	60	6
<i>M</i>	36.8		0.06	44.0	30.2	6	0.6
<i>SD</i>	10.8		0.02	13.8	7.4	2.9	0.9

**Table 2** Sociodemographic Characteristics of Murderers and Victims of HS in Italy, Divided by Gender

Variable	Murderers			Victims		
	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)
<b>Age</b>						
<7	-	-	-	27 (26.3)	16 (4.8)	43 (9.7)
7-24	6 (1.8)	1 (2.7)	7 (1.8)	23 (22.3)	38 (11.3)	61 (13.9)
25-34	43 (13)	8 (21.6)	51 (13.9)	7 (6.8)	54 (16)	61 (13.9)
35-44	60 (18.1)	15 (40.6)	75 (20.4)	10 (9.7)	40 (11.9)	50 (11.4)
45-54	71 (21.5)	6 (16.2)	77 (20.9)	16 (15.5)	58 (17.2)	74 (16.8)
55-64	56 (16.9)	5 (13.5)	61 (16.6)	6 (5.8)	23 (6.8)	29 (6.6)
>64	95 (28.7)	2 (5.4)	97 (26.4)	14 (13.6)	108 (32)	122 (27.7)
<b>Marital Status</b>						
Single	60 (18.1)	3 (8.2)	63 (17.2)	57 (55.3)	90 (26.7)	147 (33.5)
Married	191 (57.7)	17 (45.9)	208 (56.5)	13 (12.7)	168 (49.9)	181 (41.1)
Divorced/Separated	35 (10.6)	6 (16.2)	41 (11.1)	3 (2.9)	20 (5.9)	23 (5.2)
Widowed	4 (1.2)	2 (5.4)	6 (1.6)	4 (3.9)	26 (7.7)	30 (6.8)
Unspecified	41 (12.4)	9 (24.3)	50 (13.6)	26 (25.2)	33 (9.8)	59 (13.4)
<b>Occupation</b>						
Unemployed	28 (8.5)	4 (10.8)	32 (8.7)	4 (3.9)	9 (2.7)	13 (2.9)
Student/pre-school	1 (0.3)	1 (2.7)	2 (0.5)	45 (43.7)	38 (11.3)	83 (18.8)
Homemaker	0 (0)	2 (5.4)	2 (0.5)	0 (0)	17 (5.0)	17 (3.9)
Freelancer	50 (15.1)	6 (16.3)	56 (15.2)	5 (4.9)	22 (6.5)	27 (6.1)
Worker	51 (15.4)	1 (2.7)	52 (14.1)	6 (5.8)	16 (4.7)	22 (5.0)
Employee	15 (4.5)	2 (5.4)	17 (4.6)	1 (0.9)	36 (10.7)	37 (8.4)
Military/police	33 (10.0)	0 (0)	33 (9.0)	5 (4.9)	2 (0.6)	7 (1.6)
Retired	84 (25.4)	1 (2.7)	85 (23.2)	10 (9.7)	46 (13.7)	56 (12.8)
Unspecified	69 (20.8)	20 (54)	89 (24.2)	27 (26.2)	151 (44.8)	178 (40.5)

## Characteristics of the Crime

The most used method for both murder and suicide was a firearm (46.5% and 49.2%, respectively), followed by cold weapons (26.1% and 13.3%, respectively). Characteristics of the methods employed, divided by gender, are presented in Table 4.

Regarding the apparent motivation for the crime, romantic jealousy was the main motive (44.3%), followed by family, financial and social stressors (23.6%), and mercy killing (17.9%). Motives, divided by gender, are presented in Table 5.

## Forecasting Model

The ARIMA (0, 1, 1) model found the constant to be non-significant ( $p = .431$ ), therefore it could be removed from the forecasting model. The parameter  $q = 1$  was, instead, found to be significant ( $p = .006$ ) with an estimate of .479. The predictions of HS cases in Italy up to 2025 and their corresponding 95% prediction intervals based on the ARIMA (0, 1, 1) model are presented in Table 6.

**Table 3** Relationship Between Murderers and Victims of HS in Italy, Divided by Gender

Relationship	Male (%)	Female (%)	Total (%)
Partner	4 (3.9)	240 (71.2)	244 (55.5)
Parents	7 (6.8)	31 (9.2)	38 (8.6)
Offspring	65 (63.1)	43 (12.8)	108 (24.5)
Siblings	5 (4.9)	5 (1.5)	10 (2.3)
Other relatives	2 (1.9)	10 (3)	12 (2.7)
Colleagues	7 (6.8)	1 (0.3)	8 (1.8)
Strangers	1 (1)	0 (0)	1 (0.2)
Other	12 (11.7)	7 (2.1)	19 (4.3)
Total	103 (23.4)	337 (76.6)	440 (100)

## Discussion

The main purpose of the present study was to document and update the epidemiology of HS in Italy, focusing on sociodemographic factors, the relationship between perpetrators and their victims, murder and suicide methodology and, lastly, the apparent motive that sparked the criminal act.

HS rate for the decade between 2009-2018 was 0.06, which is higher than the rate observed between 1985-2008 (0.04), and indicates that, in general, this phenomenon occurred more frequently in the time frame considered. In general, however, HS can be considered a rare event and the present findings highlighted that the higher the number of victims, the rarer the event: indeed, most cases (82.07%) only involved one victim, becoming progressively rarer when involving two (16.30%) or more (1.63%) victims. Despite the observed increase in time, the HS rate in Italy is not considerably higher or

**Table 4** Method for Committing the Homicide and the Suicide, Divided by Gender

Method	Homicide			Suicide		
	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)
Firearm	164 (49.5)	7 (18.9)	171 (46.5)	174 (52.6)	7 (18.9)	181 (49.2)
Cold weapon <sup>a</sup>	88 (26.6)	8 (21.6)	96 (26.1)	45 (13.6)	4 (10.8)	49 (13.3)
Asphyxiation <sup>b</sup>	27 (8.1)	4 (10.8)	31 (8.4)	41 (12.4)	6 (16.3)	47 (12.8)
Poison	3 (1)	1 (2.7)	4 (1.1)	4 (1.2)	0 (0)	5 (1.5)
Mixed means	8 (2.5)	3 (8.1)	11 (2.9)	0 (0)	0 (0)	0 (0)
Drowning	4 (1.2)	5 (13.5)	9 (2.4)	5 (1.5)	4 (10.8)	9 (2.4)
Defenestration	5 (1.5)	2 (5.5)	7 (1.9)	33 (10.0)	7 (18.9)	40 (10.9)
Fire	6 (1.8)	1 (2.7)	7 (1.9)	9 (2.7)	3 (8.1)	12 (3.3)
CO <sup>c</sup>	0 (0)	1 (2.7)	1 (0.3)	2 (0.6)	1 (2.7)	3 (0.9)
Drugs	2 (0.6)	4 (10.8)	6 (1.6)	7 (2.1)	4 (10.8)	10 (2.7)
Other	4 (1.2)	0 (0)	4 (1.1)	8 (2.4)	1 (2.7)	8 (2.4)
Unspecified	20 (6)	1 (2.7)	21 (5.7)	3 (0.9)	0 (0)	2 (0.6)
Total	331 (100)	37 (100)	368 (100)	331 (100)	37 (100)	368 (100)

<sup>a</sup>includes cutting, stabbing, and blunt instruments

<sup>b</sup>includes throttling, strangulation, and hanging

<sup>c</sup>Carbon monoxide



**Table 5** The Apparent Motivation for Murders, Divided by Gender

Apparent motivation	Male (%)	Female (%)	Total (%)
Romantic Jealousy	157 (47.5)	6 (16.2)	163 (44.3)
Mercy killing	64 (19.3)	2 (5.4)	66 (17.9)
Altruistic or extended suicides	20 (6.1)	3 (8.1)	23 (6.3)
Family, financial, or social stressors	62 (18.7)	25 (67.6)	87 (23.6)
Retaliation	7 (2.1)	0 (0)	7 (1.9)
Other	3 (0.9)	1 (2.7)	4 (1.1)
Unspecified	18 (5.4)	0 (0)	18 (4.9)

lower than in other European countries but rather lies in a middle position: for instance, it is lower than Switzerland (0.09, Liem et al., 2011) and Romania (0.11, Balica & Stöckl, 2016), but higher than Greece (0.02, Alexandri et al., 2022), Croatia (0.02, Cengija et al., 2012) and United Kingdom (0.04, Flynn et al., 2009).

The characteristics of HS perpetrators and victims aligned with the typical profile highlighted by international findings: the murderer was typically a married male, over 45 years old, employed and motivated by romantic jealousy, that killed with a firearm a married female, usually the current or former partner.

In detail, murderers were mostly males (89.9%), while the victim was mainly female (76.7%). This finding suggests that HS is a crime in which the gender of victims and perpetrators do not coincide but rather are opposed. This result is consistent with the international literature (Panczak et al., 2013a; Rouchy et al., 2020) and matches what was observed in the Italian epidemiological study between 1985-2008, which indicated that the majority of perpetrators were males (84.6%), while most victims were females (68.4%).

Another finding indicated that more than half of the perpetrators were older than 45 years old (63.9%). On this matter, Rouchy et al. (2020) indicated being a male in middle to late adulthood as a risk factor for HS. This result is in line with the existing literature, however, when taking into account gender, it deviates from the previous epidemiological data: male perpetrators were younger in the past decades (35.4% over 55 years old between 1985-2008 vs. 45.6% over 55 years old between 2009-2018), whereas there was no observable difference for female murderers, most frequently represented by younger age classes (i.e., under 45 years old). Regarding HS victims, the most represented age range was over

**Table 6** The Predicted Values of HS Cases in Italy and Related 95% Prediction Intervals Based on the ARIMA (0, 1, 1) Model

Year	Prediction value	95% prediction intervals	
		Lower prediction limit	Upper prediction limit
2019	46.98	25.97	78.89
2020	47.39	24.43	83.85
2021	47.80	23.12	88.64
2022	48.21	21.96	93.30
2023	48.63	20.94	97.87
2024	49.05	20.01	102.37
2025	49.47	19.18	106.84

64 years old (27.5%), but once again gender differences seemed to emerge: women victims tended to be older (32% over 64 years old), whereas men victims tended to be very young (48.6% under 24 years old). This finding could indicate that victimization for men often comes in the form of filicide, which is in line with the existing literature (Panczak et al., 2013a). Furthermore, victims in the past decades were not as old (10.6% over 64 years old between 1985-2008 vs. 27.5% over 64 years old between 2009-2018); this could indicate that, in the last decade, a second peak of victimization, observable for the elderly, emerged. This finding could be related to the fact that mercy killings, which typically involve older individuals (Panczak et al., 2013a), have nearly doubled (17.9% between 2009-2018 vs 10.8% between 1985-2008) in the last decade.

Regarding marital status, both perpetrators and victims were mostly married (56.5% and 41.4%). An interesting difference seemed to emerge when considering the gender of victims: married females represented 49.9% of cases whereas married men made up only 12.7% of cases. A possible explanation for this finding takes again into account gender differences in victims' age: in fact, a large amount (26.3%) of men victims were under seven years old, suggesting that when men are victimized, they are often children.

Regarding the relationship between victims and perpetrators, in more than half of cases (55.5%), the victim was the current or former partner of the murderer. A worrisome gender difference emerged: women victims had a romantic relationship with their murderer in 71.2% of cases, whereas men were killed by their partners in only 3.9% of cases. A factor that might play a role in this disparity is that men are more often victimized when very young as evidenced by the finding that they were often killed in the context of filicides (63.1%). Instances in which the victim was an acquaintance (4.3%), a colleague (1.8%) or a stranger (0.2%) were increasingly rarer and the victims were typically males with an 8:1 ratio compared to women.

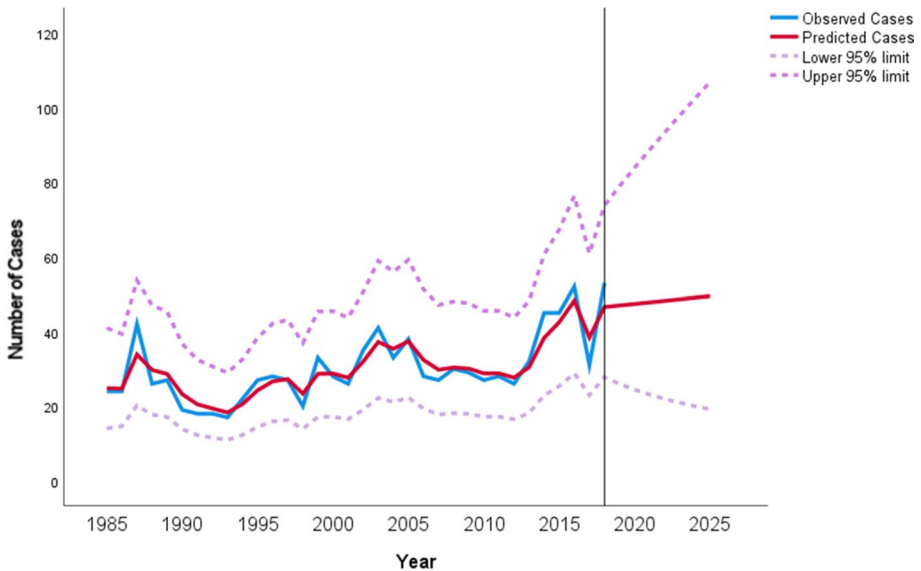
The most frequently encountered motivation for HS was romantic jealousy (44.3%), followed by family, financials, or social stressors (23.6%) and mercy killing (17.9%). Moreover, romantic jealousy seemed to be the main motivation only for male murderers (47.5%), whereas for female perpetrators was family, financials or social stressors (67.6%); this result is in line with what was observed for the period between 1985-2008, in which romantic jealousy was the leading motivation for HS for the whole sample (24%) and for male perpetrators (25.7%) whereas for women the leading motivations were family, financial or social stressors (20.6%) and altruistic or extended suicide (14.8%). Even though motives for HS are heterogeneous, when comparing these findings to those of other European countries, it appears that the two most frequently encountered motivations for HS (i.e., romantic jealousy and family or financial stressors) are consistent: a recent epidemiological study of HS in Greece between 2008-2020 (Alexandri et al., 2022), for instance, reported that 25% and 27.8% of the cases were motivated by amorous jealousy and economic problems, respectively. In general, the present results are in line with the findings of a recent systematic review (Rouchy et al., 2020) which reported that HS is guided by two main motives: jealousy and domestic disputes on one hand, and the psychotic delusion to "save" loved ones, either from financial hardships or terminal illnesses, on the other hand.

The most common method for committing both homicides and suicides was a firearm (46.5% and 49.2%, respectively), followed by cold weapons (26.1% and 13.3%, respectively). This result has been consistently observed in epidemiological studies in different countries and suggests that firearms "substantially precipitate the risk of HS" (Rouchy et al., 2020, p.12). Another interesting consideration, that echoes what had already been highlighted for Italian cases of homicide-suicide (Merzagora et al., 2011), is that when perpetrators used a firearm for the murder, in most cases (98.2%) they used a firearm to kill

themselves as well. Even though such a strong match between the method for the homicide and the suicide seemed to be exclusive to firearms, there appeared to be a predilection for committing suicide, when possible, in the same way in which the murder was executed, reinforcing the idea that the chosen method is not only dictated by practical concerns but also by symbolic ones (Merzagora et al., 2011): when the murder was carried out via asphyxiation, so was the suicide in 67.7% of cases; similar instances were observed for drugs (66.7%) and drowning (55.6%).

Lastly, considering the yearly number of cases between 1985-2018 an oscillatory trend seemed to emerge, with peaks and moments of decline alternating, but, generally, highlighting an increase. The forecasting model predicted a further increase in HS cases in Italy in the coming years, as can be observed in Fig. 4.

Interestingly, when considering homicide and suicide alone, a difference emerges. In fact, a recent study (Ghirini & Vichi, 2020) highlighted a negative trend in a 30-year period (between 1987-2016) for suicides in Italy, revealing a decreasing phenomenon, that could be ascribed to “higher attention being paid to mental health through the development of suicide prevention programs” (Terranova, 2022). Likewise, the homicide rate in Italy in the last 30 years (1980-2014) has been declining (Vichi et al., 2020), in line with Elias’ theory (1982) of a “civilizing process”, which postulated the long-term decline in homicide rates due to two parallel processes: the State’s assumption of the monopoly of the legitimate use of violence and a higher degree of internalized self-restraint in the general population. This decline is consistent with other European countries: indeed, a recent study (Suonpää et al., 2022) conducted with data from the European Homicide Monitor pointed towards the generality of the homicides drop, regardless of the subtype, except Sweden in which male victims of criminal milieu homicides increased in the 2000s. Additionally, in the Italian context, the decrease in homicides can be ascribed to the steep reduction in mafia-related killings, which comprised 37.5% of total homicides in 1991 and plummeted to 9.7% in the period between 2015–2019 (Italian National Institute of Statistics [ISTAT], 2021a). The antithetic increase in the rate of HS, then, could be explained by at least two phenomena: first, even though homicides in Italy are declining, intra-familial ones are on the rise (ISTAT, 2021a), especially in the form of femicide. This observation is in line with the prediction of Verkko (1951), which postulated that the proportion of women victims would increase as the rate of homicides would decrease. In Italy, in the 90s, the male-to-women ratio of murder victimization was 5 to 1, whereas recent data indicate that the current ratio is lower than 2 to 1 (Roma et al., 2023). Paired with the finding that 93.7% of HS cases involved a family member, it could be hypothesized that intra-familial homicides and HS share similar criminogenic elements, distinct from the ones encountered in other forms of homicides. Consistently, the number of HS motivated by romantic jealousy has almost doubled in the last decade (44.3% between 2009-2018 vs 24% between 1985-2008). Some authors (Roma et al., 2011) hypothesized, in this regard, that “passional” HS is consummated in the context of symbiotic relationships based on exclusivity and authoritarianism in which perpetrators kill their partner to attest their absolute possession over their loved ones, and then commit suicide for their inability to live without the object of their love. This explanation echoes Daly and Wilson’s (1988) evolutionary models of social motives for family violence: this theory posits that “male sexual proprietariness is the dominant issue in marital violence” (p.521), frequently illustrated by expressions such as “if I can’t have her, no one else will” which characterizes possessive and jealous men who fear change and losing control of the relationship. Accordingly, Starzomski and Nussbaum (2000) noted that many HS cases are preceded by marital breakdowns and that some men in these relationships “do not appear to have the capacity or willingness to incorporate their



**Fig. 4** Observed HS Cases Between 1985-2018 in Italy and Predicted HS Cases up to 2025

partner's change into a revised concept of the relationship" (p. 475). This might explain the increase in HS cases when paired with the observation that, following the introduction of two laws (Law No. 162 of November 2014 and Law No. 55 of May 2015) that simplified and expedited divorce procedures, divorces in Italy registered a sharp surge (+57.5% in 2015; ISTAT, 2021b).

Second, the Italian population is among the oldest, both in Europe and worldwide (United Nations Population Division, 2019), and keeps getting older as evidenced by a steady increase in the population's mean age (ISTAT, 2022); as already mentioned, it has been suggested that as age increases, so does the risk for HS (Rouchy et al., 2020); thus, the emerging of a second peak of victimization for the elderly and the increase in mercy killings observed in the last decade could account for the contrary trend of HS compared to homicides alone.

These observations reinforce the notion that HS might indeed be a different phenomenon, distinct from both homicide and suicide taken alone. This hypothesis is further supported by the results of the time series analysis carried out to predict the trend of HS cases in Italy up to 2025; in fact, the ARIMA model forecasted a worrisome scenario: despite the observed cases showed alternating peaks and slumps, the model predicted a steady increase in the number of HS cases. This finding seems to back up the possibility that HS is indeed a distinct entity: not only it has peculiar criminodynamic characteristics when compared to homicides (e.g., Panczak et al., 2013b) but it also has an inverse trend, increasing instead of declining, compared to both homicides and suicides. This underlines the need to tailor preventive interventions toward the specific risk factors and peculiarities of HS.

Furthermore, the results of the present research highlight some critical issues: on one hand, the need to improve senior citizens' quality of life from a preventive and protective perspective; on the other hand, the necessity to refine the institutional efforts to reduce gender violence, by complementing them with psychological and cultural interventions aimed at changing the paranoid and egotistical beliefs that sustain the maladaptive conception of one's partner as an object to be possessed.

## Conclusions

Despite the low incidence rates, HS is a phenomenon with deep repercussions on different levels, from the individual to society in general, and represents a major public health issue, especially considering that it is more frequently directed toward women and children. The current study provides an update on the epidemiology of HS in Italy, highlighting an alarming increase in its rate. Furthermore, the forecasting model predicted an increase in HS cases in the Italian peninsula.

One important limitation of this study is that the methodology used to collect data has distinctive sampling errors: first, the information in the newspapers largely depends on editorial policies and focuses more on media interest, hence some types of HS might be more frequently reported (e.g., those involving children victims) compared to others who might be underreported (e.g., mercy killings); second, homicides might be reported in more detail than suicides; third, the information is often incomplete and speculative, especially regarding the motives of the murderer. Despite these limitations, this methodology is, to date, the only viable for nationwide epidemiological studies in Italy, as data from medico-legal institutions or prosecutors' offices are limited to very specific geographical areas. It is, therefore, of paramount importance that governmental agencies in Italy start collecting in a systematic and organized way data regarding HS, gathering data from all the available sources to provide information that could be useful both for clinicians' work and research; uniforming the definition of HS at a national level would also allow for more detailed and comprehensive comparisons with other violent events. Future studies could, then, evaluate whether HS and homicides and HS and suicides share the same motives, psychological characteristics, and criminogenic and criminodynamic elements.

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**Data Availability** The datasets generated and/or analyzed for the present study are available from the corresponding author upon reasonable request.

## Declarations

**Competing Interests** The authors have no relevant financial or non-financial interests to disclose.

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