



Intentional child and adolescent homicides in Milan (Italy): A 30-year interdisciplinary study

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ARTICLE INFO

Keywords:

Child homicide
Infanticide
Adolescent homicide
Filicide-suicide
Child abuse
Firearm deaths

ABSTRACT

This study aims to discuss the forensic and criminological implications of child homicides in the territory of Milan, Italy. The authors present a retrospective study on all the cases of child and adolescent homicides, that were observed at the Institute of Legal Medicine of Milan (Italy) in the last 30 years (from January 1991 to December 2020). A total of 46 child homicides were collected, focusing on the sociological features, by highlighting peculiar cases, risk factors, potential changing social trends, and comparing our cases with the current literature. The analysis revealed a statistically significant relationship ($p < 0.05$) for male adolescents and indicated that adolescent homicides were more frequently perpetrated in extrafamilial contexts. In contrast, neonaticides and infanticides were mainly committed at home. Furthermore, the Fisher's Exact test revealed that child murders were mainly committed by immigrants in the Milan district after 2005 ($p < 0.05$). The two main causes of death were due to sharp and firearm injuries. While the relationship between homicide clusters and homicides committed by sharp objects was not significant, adolescent homicides were mainly committed using firearms ($p < 0.05$). The present study may help to identify risk factors for homicides against child and adolescent. Consequently, policies that identify, prevent, and minimize this extreme violence should be designed to interrupt the vicious circle of such dreadful murderous events. Child and adolescent homicides deserve additional focus and better education for healthcare professionals and further research should be carried out to develop therapeutic and caring strategies.

1. Introduction

Child homicide is one of the most dramatic manifestations of interpersonal violence, which has serious effects on families and the community. The Global Study on Homicide by the United Nations Office on Drugs and Crime reported that an estimated total of 205,153 children aged 0 to 14 years lost their lives worldwide as a result of intentional homicide during the 10-year period 2008–2017. Over the same period, an estimated total of 1,691,869 adolescents and young adults between the ages of 15 and 29 were intentionally killed [1–2]. Specifically, the risk of homicide is higher for boys, who account for 70 % of all child murders [3]. Furthermore, 90 % of child homicide victims are

characterized by poor socio-economic conditions in low- and middle-income countries, with the highest child homicide rates found in Latin America [4–5].

Although legal definitions vary among different countries, according to Goodway et al. [6], homicides against minors can be conventionally classified by chronological age into 4 clusters that reflect specific features: neonaticides (0–28 days of life); infanticides (1–11 months old); pedicides or young child homicides (1–11 years old); and adolescent homicides (12–18 years old) [7]. They often represent the fatal endpoint of a long story of violence against children, which include physical abuse, neglect, or more rarely, sexual violence [2]. Young child murders are typically perpetrated by family members, who may show mental

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<https://doi.org/10.1016/j.legalmed.2024.102433>

Received 28 October 2023; Received in revised form 6 February 2024; Accepted 5 March 2024

Available online 6 March 2024

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disorders or religious/intrafamilial stigma [4–5,7]. On the other hand, intentional homicides of adolescents are more frequently committed outside the family unit, with specific gender-related differences. Thus, young males are often killed by criminal organizations (e.g., mafia, baby-gangs), whereas young women may experience extreme intimate partner violence, resulting in homicide [8–9].

In this paper, the authors present a retrospective study on all the cases of child and adolescent homicides that were observed at the Institute of Legal Medicine of Milan (Italy) in the last 30 years, providing a forensic-based classification. Personal information about the victims and their relationships, circumstances surrounding the death scene, and the reasons for the murders were reported. Therefore, the study aims to discuss the forensic and criminological implications of child and adolescent homicides as well as their sociological features in the last 30 years in the district area of Milan, by highlighting peculiar cases, risk factors, potential changing socio-economic trends, and comparing our forensic cases with the available literature.

2. Material and methods

In the present research, 28,302 autopsy reports assessed at the Institute of Legal Medicine of Milan (Italy) from January 1991 to December 2020 were retrospectively documented. Only intentional homicides against ≤ 18-year-old victims were included. The internal digital database compiled the list of cases, which were further checked by reviewing all the papers from daily agendas regarding the autopsy activity. However, cases of suspected homicides without strong forensic and investigative evidence were ruled out. For each case, a close analysis of the interviews with family members and acquaintances was performed. These latter data were collected by interviewing the victims' relatives before the autopsy examination; furthermore, the clinical documentation available was analyzed. Complementary information such as the homicide rate in Italy (available from 1991 up to 2019), the child and adolescent homicide rate in Italy (available from 2007 up to 2019), the number of homicides per year in the district area of Milan and the general population were collected using the external database provided by ISTAT (Italian National Institute of Statistics – <https://www.istat.it>) in order to better contextualize the number of child homicides in

Milan.

All statistical analyses were performed using R. Since variables of interest are categorical (i.e., gender, groups of age, ethnicity, relationship with the perpetrator, place of crime scene, injury patterns, and year of homicides in Milan), the Fisher Exact test for independence with approximate p-value has been computed.

3. Results

The number of the general population in the Milan district area increased by 3,75 million from 1990 to 4,11 million in 2019. In Italy, the estimated homicide rate per 100,000 general population decreased by 3.38 deaths from 1991 to 1.04 in 2005, and 0.53 deaths in 2019, as shown in Fig. 1 (Fig. 1). Furthermore, a total number of 370 child and adolescent homicides were registered in Italy from 2007 up to 2019, with the highest number in 2017 (n. 42), and the lowest in 2018 (n. 17). Likewise, the total number of homicides in the Milan district gradually decreased over the years, as shown in detail in Fig. 2 (Fig. 2). Specifically, the highest number was registered in 1991 (n. 83), while the lowest in 2016 (n. 11), with a mean value of 34.46 cases per year. The estimated homicide rate per 100,000 Milan population fell, therefore, by 2.21 deaths in 1991 to 0.31 deaths in 2019 (mean value: 1.24 murders per year). A total number of 46 child and adolescent homicides were collected in the last 30 years, representing 0.16 % among all the autopsies, and 3.32 % among all the homicides that underwent postmortem examination. Specifically, there were 7 cases of neonaticides, 3 cases of infanticides, 14 cases of pedicides, and 22 cases of adolescent homicides. The main findings of the 4 clusters of the victims are described in the following subsections. All features are listed in Table 1 (Table 1). A forensic-based classification of child and adolescent homicides is presented in Fig. 3 (Fig. 3).

3.1. Neonaticides

The male to female ratio was 1.33:1 (m = 4, f = 3). 5 newborns were killed shortly after the delivery, whereas the other 2 victims were 3 days-old and 7 days-old, respectively. Regarding the nationality, 3 babies were born to Italian mothers, other 2 to immigrants, and the last 2 to

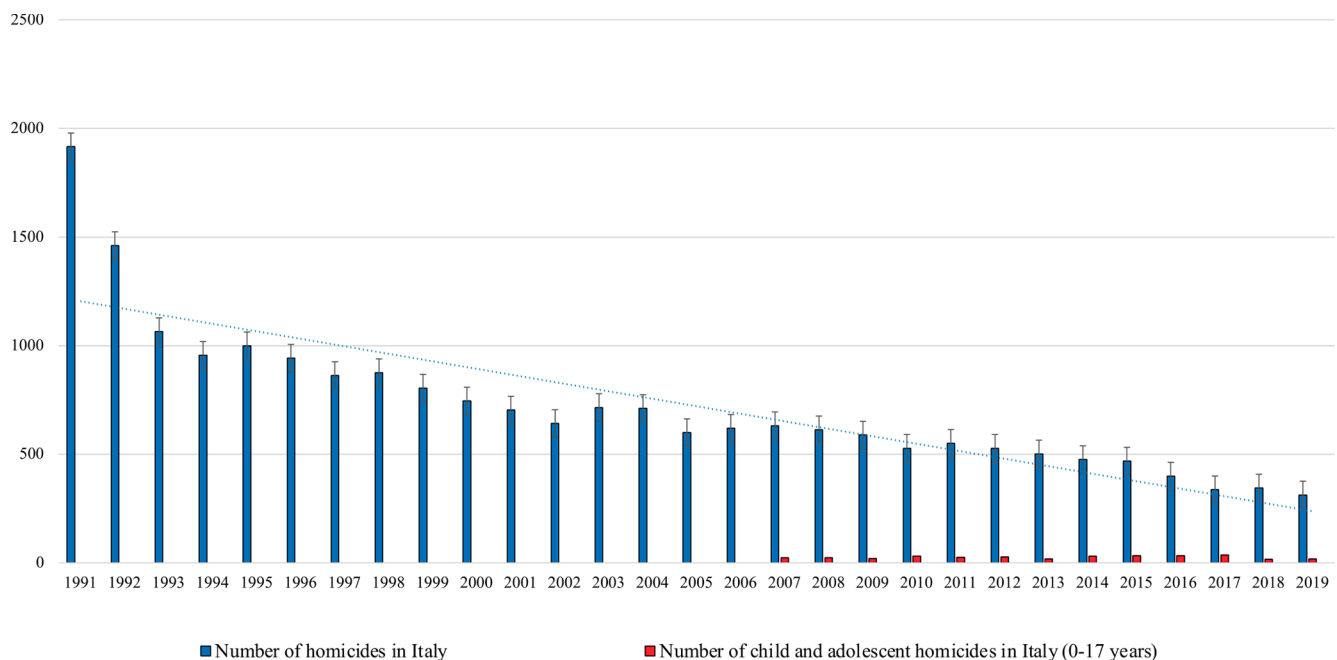


Fig. 1. Temporal trend of homicide rate in Italy in comparison to all the Italian child and adolescent homicides. Note that before 2007, data on Italian child and adolescent homicides is no longer available.

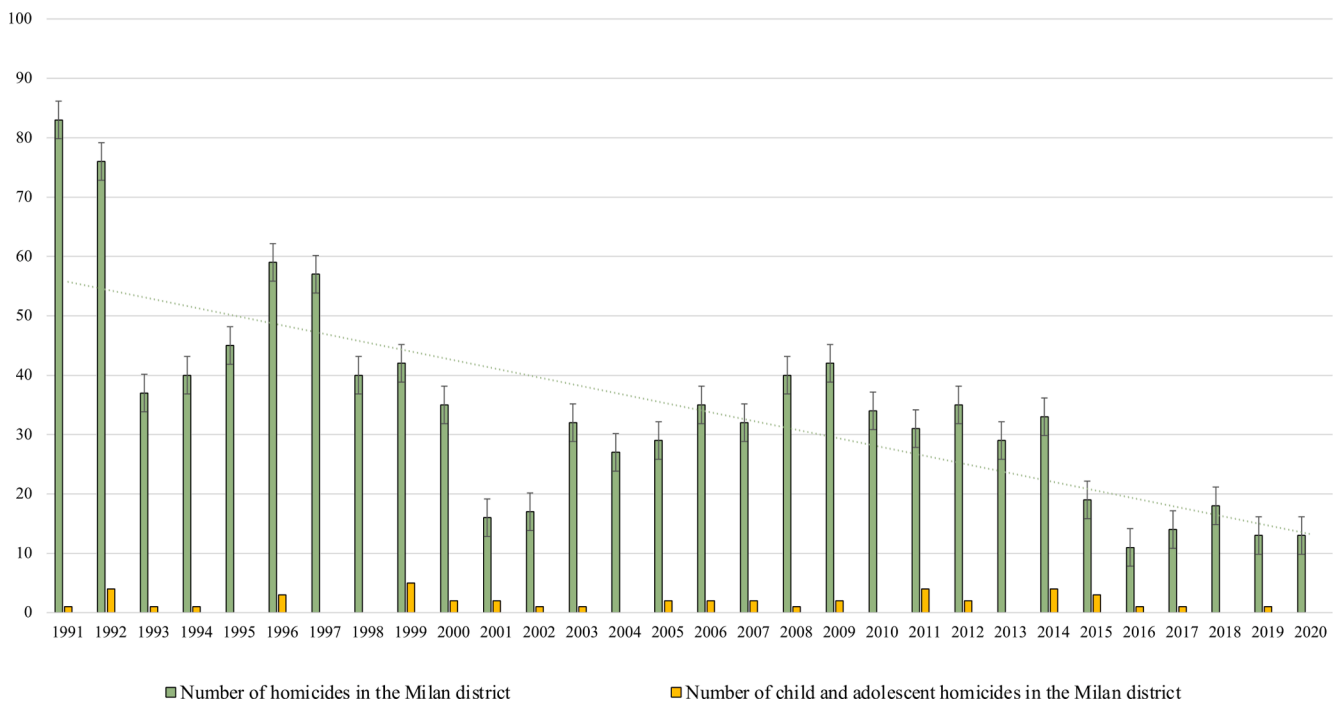


Fig. 2. Temporal trend of homicide rate in Milan in comparison to child and adolescent homicides in the same area.

unknown mothers. Newborns' mothers were identified as the perpetrators in 4 cases: specifically, 2 victims were delivered in toilet bowls and then drowned, whereas the other 2 victims were killed by multiple sharp injuries and then concealed in the house (one baby inside a bag and the other one inside a storage closet). None of the mothers had suicidal ideation. In one case the perpetrator was a family friend of the mother who released the baby into her temporary custody. The woman threw the baby from the window of the flat in a fit of jealousy/vengeance, causing severe traumatic brain injuries. In the last 2 cases, the perpetrators were never found, although their mothers were *probably* involved. In fact, one baby was found in a local river and died from drowning, and the other was left inside a dumpster, dying from starvation and hypothermia. In both cases, their unknown mothers were suspected of the crimes, however there is no proof about the participation of others.

3.2. Infanticides

The male to female ratio was 2:1 ($m = 2$, $f = 1$). The youngest infant was an Italian 45 day-old who died in hospital after he was found unconscious by his parents. At autopsy, there were subdural hemorrhages with signs of hypoxic encephalopathy, cerebral thrombosis, and retinal hemorrhages. Therefore, a diagnosis of shaken baby syndrome was identified as the cause of death. Likewise, a Chinese 3-month-old infant was found dead lying in his cradle; the autopsy examination revealed subdural and subarachnoid hemorrhages as evidence of shaken baby syndrome. Lastly, an Italian 9-month-old infant was found dead in her bedroom with postmortem lividity and *rigor mortis*; furthermore, the infant showed very poor hygiene conditions, and she had suffered from hyperpyrexia over the days before. At autopsy, the body revealed signs of severe malnutrition (length: 69 cm; weight: 4.5 kg), dehydration, and septicemic pneumonia, as well as evidence of fatal parental neglect.

3.3. Pediticides or young child homicides

The male to female ratio was 1.33 ($m = 8$; $f = 6$). The youngest child was 1 year old, while the oldest was 10 years old; however, the mean age of the victims was 4.14 years old. 9 of the children were Italian, whereas

the others were immigrants. Specifically, 2 children came from East Europe, 2 children from North Africa, and 1 child from South America.

Almost all the cases (13 out of 14) were intrafamilial child homicides; the only extrafamilial murder took place accidentally in the outskirts of Milan during a shooting among people belonging to criminal organizations. The young girl was killed by a firearm injury of the neck. Among the intrafamilial homicides, there were 7 cases of *pure* filicide: specifically, 3 children were all asphyxiated by their mothers (i.e., ligature strangulation or external suffocation), a couple of siblings were killed by the father with several sharp injuries (the oldest sibling had also been shaken years before), 1 child was suffocated with a pillow by his father, and the last child was physically abused by his father with blunt force injuries, bites, and burns. In such cases, 2 mothers suffered from severe depression, while 1 father showed mystical delirium and hallucinations.

Other 5 cases were victims of typical filicide-suicides. In particular, 3 children were all killed by their fathers by falling from a height together. In one case the cause of death of the child was carbon monoxide poisoning inside the car with subsequent hanging of the father. Lastly there was a filicide-suicide caused by sharp injuries on the thorax of the child and the parent died of a single head gunshot. Interestingly, this latter case took place inside a social service office during a visiting program since there was an important parental conflict. As a consequence of this, the social workers were investigated for negligent homicide. On the other hand, 2 children were killed by their mothers by drowning together in a local river, and by acute overdose due to methadone intoxication. Only 2 offenders were drug abusers and showed known psychiatric problems.

Lastly, a case showed borderline features among intra- and extrafamilial murders since it involved a man who committed a revenge double-homicide of his girlfriend and her child by sharp injuries to their necks inside their home. The police reported that the man was in love with the mother, but she had decided to break up with him.

3.4. Adolescent homicides

The male to female ratio was 6.33 ($m = 19$; $f = 3$). The youngest child was 13 years old, while the oldest adolescent was 18 years-old; however,

Table 1
child and adolescent homicides 1991 – 2020.

N°	Year	Sex	Age	Ethnicity	Place of death	Relationship with the child/adolescent	Cause of death
1	1991	M	18	North African	Public park	Unknown	Sharp force injuries
2	1992	M	18	Italian	Street	Criminal organization	Firearm injuries
3	1992	F	1	Italian	Home	Mother	External suffocation
4	1992	M	17	Italian	Street	Unknown	Firearm injuries
5	1992	M	17	Italian	River	Criminal organization	Firearm injuries + concealment
6	1993	M	16	Italian	Street	Police	Firearm injuries
7	1994	M	16	North African	Street	Unknown	Firearm injuries
8	1996	M	1	Italian	Street	Father (filicide-suicide)	Falling from the height
9	1996	M	16	Est Europe	Billiard room	Unknown	Firearm injuries
10	1996	F	5	Italian	Car	Father (filicide-suicide)	CO poisoning
11	1999	M	14	Italian	Home	Father	Immolation with gasoline
12	1999	F	10	Est Europe	Home	Mother (filicide-suicide)	Acute intoxication (methadone)
13	1999	M	0	Unknown	Dumpster	Mother <i>probably</i>	Starvation and hypothermia
14	1999	F	0	Italian	Home	Mother	Drowning (toilet bowl)
15	1999	M	0	Unknown	River	Mother <i>probably</i>	Drowning
16	2000	F	0	Italian	Home	Mother	Sharp force injuries + concealment
17	2000	M	18	Est Europe	Street	Unknown	Firearm injuries
18	2001	F	16	Italian	School	Ex-boyfriend	Sharp force injuries
19	2001	F	6	Italian	Home	Mother	Ligature strangulation
20	2002	M	6	Italian	Home	Father	External suffocation
21	2003	F	2	Italian	Street	Criminal organization	Firearm injuries
22	2005	M	0	Italian	Home	Mother	Drowning (toilet bowl)
23	2005	M	18	Asiatic	Street	Acquaintance	Sharp force injuries
24	2006	M	17	North African	Home	Acquaintance	Sharp force injuries
25	2006	F	0	Italian	Home	Mother	Sharp force injuries + concealment
26	2007	M	18	South America	Street	Criminal organization (gang)	Sharp force injuries
27	2007	M	17	Romany	Open field	Grandfather	Firearm injuries
28	2008	M	0	Asiatic	Street	Mother's friend	Falling from a height
29	2009	M	8	North African	Public office	Father (filicide-suicide)	Firearm and sharp force injuries
30	2009	M	4	Italian	Home	Mother	Ligature strangulation
31	2011	M	0	Asiatic	Home	Parents	Shaken baby syndrome
32	2011	F	13	Italian	Open field	Acquaintance	Sharp force injuries + hypothermia + concealment
33	2011	M	0	Asiatic	Home	Parents	Shaken baby syndrome
34	2011	M	18	Italian	Open field	Acquaintance	Sharp force injuries
35	2012	M	1	North African	River	Mother (filicide-suicide)	Drowning
36	2012	F	18	Asiatic	Home	Boyfriend	Ligature strangulation
37	2014	M	1	Italian	Home	Father	Sharp force injuries
38	2014	F	8	Italian	Home	Father	Sharp force injuries
39	2014	M	3	South America	Home	Father	Sharp force injuries
40	2014	F	0	Italian	Home	Parents	Starvation
41	2015	M	16	South America	Home	Father (filicide-suicide)	Sharp force injuries
42	2015	M	18	South America	Street	Acquaintance	Sharp force injuries
43	2015	M	18	Est Europe	Railway	Criminal organization	Firearm injuries
44	2016	M	18	Est Europe	Street	Criminal organization (gang)	Sharp force injuries
45	2017	M	18	North African	Street	Acquaintance	Sharp force injuries
46	2019	M	2	Est Europe	Home	Father	Blunt force injuries

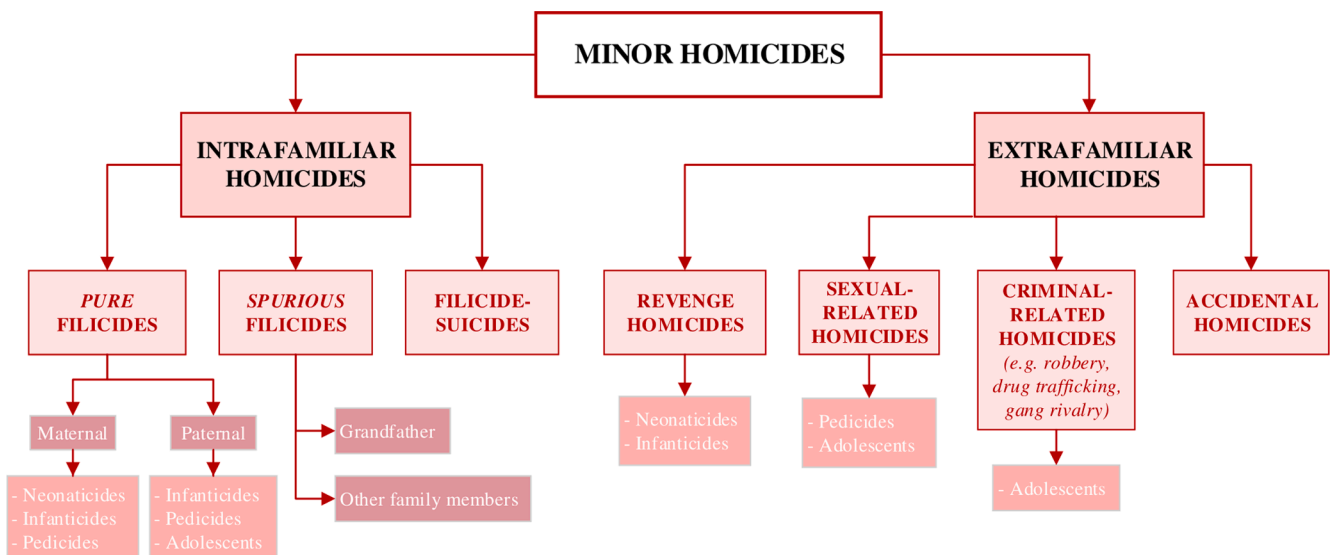


Fig. 3. A forensic-based classification of child and adolescent homicides.

the mean age of the victims was 16.9 years old. 8 victims were Italian, whereas the others were immigrants. Specifically, 4 adolescents came from East Europe, 4 from North Africa, 3 from South America, 2 from Asia, and 1 victim was a Romani. Interestingly, homicides against South American adolescents were documented only from 2007, without observing any further intentional homicides against Italian adolescents since 2012.

The majority of cases (12 out of 22) were extrafamilial homicides, which included: drug trade with criminal organizations, gang rivalry, fighting, robberies, and one case of sexual violence. Regarding the causes of death, sharp-force injuries were more frequently documented (8 cases), followed by firearm injuries (4 cases). In 2 cases, the victims' bodies were also concealed, including the young girl that was sexually abused. Almost all the victims were killed outside. However, 5 out of 22 adolescents were murdered by unknown people (*probably* by criminal organizations); specifically, these victims were all males, > 15 years-old, almost all immigrants (4 out of 5), and killed in the 1990 s by firearm injuries or sharp force injuries.

Among the intrafamilial homicides (5 out 22), 2 victims were murdered for jealousy motivations by their boyfriend or ex-boyfriend without any signs of sexual aggression. In these cases, the cause of death was identified as ligature strangulation and sharp force injuries, respectively. In the other 3 cases, the homicides were perpetrated by fathers and a grandfather. Specifically, there was only one case of filicide-suicide caused by sharp force injuries, followed by a *pure* filicide by immolation with gasoline, and, lastly, a *spurious* filicide (grandfather) by firearm injuries. In all of these cases, the parents suffered from psychiatric disorders, which included severe depression or dementia.

3.5. Statistical analysis

The Fisher's Exact test of independence with approximative p-value was used for the present research. This test checks whether two variables are likely to be related or not. The test provides a way to decide if the

hypothesis is plausible or not. All results are shown in detail in Table 2 (Table 2).

The analysis revealed a statistically significant relationship ($p < 0.05$) for the gender and the age among adolescent murders. Specifically, male adolescents were more commonly involved in homicides (Fig. 4A). The statistical analysis indicated that adolescent homicides were more frequently perpetrated in extrafamilial contexts (Fig. 4B). The Fisher's Exact test revealed that child murders were mainly committed by immigrants in the Milan district after 2005 ($p < 0.05$) (Fig. 4C). The relationship between homicide clusters and the place of death was significant ($p < 0.05$) as neonaticides and infanticides were mainly committed at home (Fig. 4D). The two main causes of death were due to sharp and firearm injuries. While the relationship between homicide clusters and homicides committed by sharp objects was not significant, adolescent homicides were mainly committed using firearms ($p < 0.05$) (Fig. 4E-F).

4. Discussion

The following discussion focuses on the forensic, criminological, and sociological implications concerning child and adolescent homicides in the district area of Milan from 1991 up to 2020, highlighting peculiar cases, risk factors, potential changing socio-economic trends, and comparing our forensic cases with the current literature.

Infanticide identifies the term by which an infant less than 1 year of age is a victim of homicide. Neonaticide is a sub-group of infanticide, which characterizes a homicide against a child that is 1 month of age or less [1,5]. In the U.S., almost one infant is killed every day, and at least 5 % of infanticides are neonaticides, accounting for 8.5 cases of infant homicide per 100,000 infants [10]. A recent review discovered that 20–25 % of infanticide victims were under a day old in Britain [5]; on the other hand, Vanamo et al. reported that in Finland between 1970 and 1994, neonaticides comprised 19 % of all child homicides, and almost 50 % of infant homicides [11].

Table 2
Fisher's Exact test of independence on categorial variables.

	Sex	Homicide cluster	Ethnicity	Relationship	Place of death	y>2005	Sharp	Firearm
Sex								
Homicide cluster								
Ethnicity								
Relationship								
Place of death				α				
y>2005			β					
Sharp								
Firearm		γ		δ	ϵ			

*Green cells represent significant relationships between variables ($p < 0.05$).
 **Red cells represent non-significant relationships between variables ($p > 0.05$).
 α Neonaticides and infanticides have been mainly committed at home.
 β Child and adolescent homicides have been mainly committed by immigrants after 2005.
 γ Adolescent homicides have been mainly committed by using firearms.
 δ Firearm has been mainly used by non-family members (extrafamilial).
 ϵ Firearm has never been used at home.

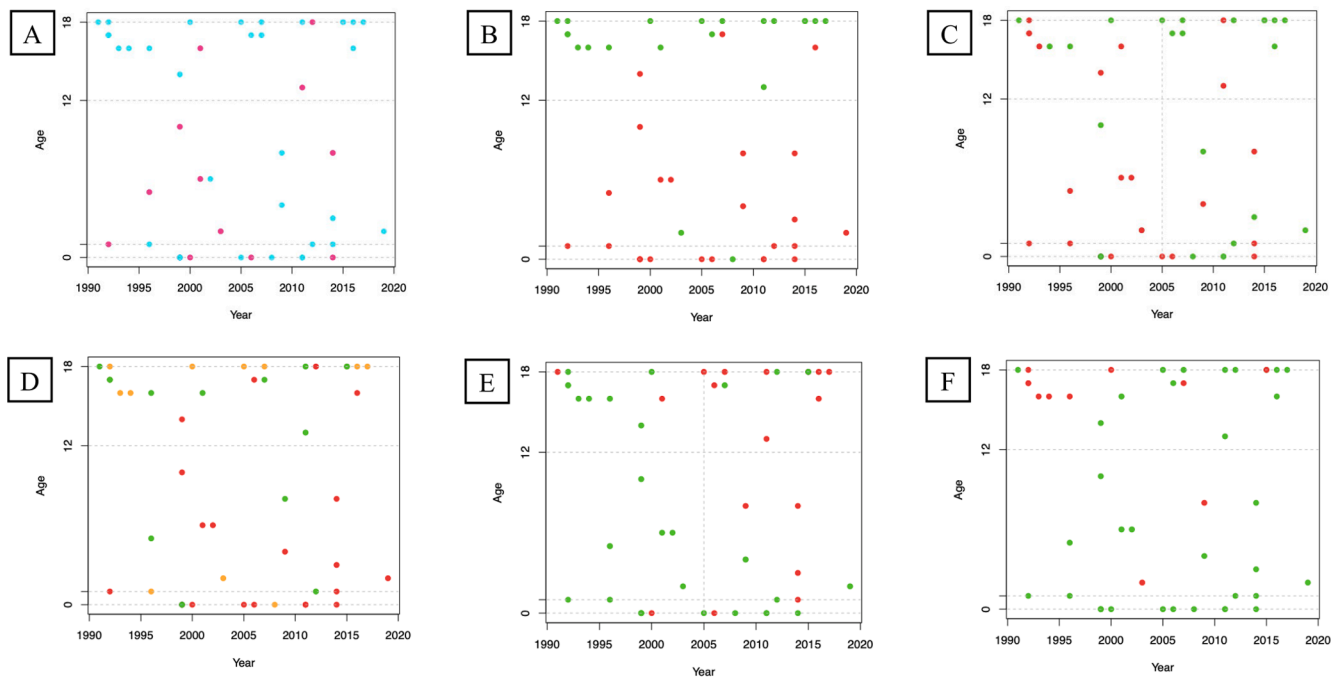


Fig. 4. Scatter graphs showing the distributions of variables for a set of data. Distribution of genders in A (male = blue, female = pink); relationship with the perpetrator in B (extrafamilial = green; intrafamilial = red); ethnicity in C (Immigrants = green; Italian = red); place of death in D (street = green; home = red; other places = orange); injury pattern in E (sharp force injury = green; other causes = red); injury pattern in F (firearms = green; other causes = red).

Neonaticide is a murder that is typically committed by the mother. There are several risk factors associated with neonaticides: in fact, women who murder newborns tend to be younger than 25 years old, emotionally immature, unmarried, often living with their parents, unemployed/attending school, and not suffering from psychosis or depression [12–13]. They do not seek prenatal care and are often no longer involved with the baby's father. Furthermore, the majority of newborns are born outside of a healthcare setting, usually at the woman's home in solitude, although there are recorded cases of neonaticides in birthing units [14–15]. The most common reason is the aim to eliminate an unwanted child, followed by the shame of unwed motherhood and the poor economic situation [16]. Consistent with these motivations, neonaticide mothers do not usually show suicidal ideation after the murder. In Resnick's seminal work, there was the first differentiation of the killing methods of a newborn into active and passive ones [17]. Active methods include direct violence against the infant such as beating, shaking, drowning, or suffocation, all of which could be associated with the concealment of the body [14,18]. On the other hand, passive methods are characterized by an evidently negligent conduct that is adopted by the parents (especially the mother), including starvation, hypothermia, and depriving the baby of adequate care [13,19–20]. However, contrary to expectation, most mothers kill their newborns by an aggressive act, rather than by passive negligence, suggesting the desperate will to eliminate the baby.

Conversely, women who commit infanticide are significantly different from women who murder newborns. In fact, the former group is older than 25, often married, well educated, and tends to be more frequently affected by mental illness [17]. Therefore, an important difference between neonaticide and infanticide is characterized by the evidence of an extreme hormonal fluctuation of the mother within the post-partum state [12]. This condition may also be worsened by a state of material and moral abandonment, providing exceptional circumstances that lead the mother to commit homicide. However, in Italy and in many other countries, taking into consideration the above peculiar features, women who kill the newborn shortly after the delivery may be charged with a misdemeanor [21].

From a forensic point of view, autopsy examination is strictly

necessary in the event of a neonaticide and infanticide. Thus, post-mortem CT scans may reveal previous rib or long bone fractures as a sign of physical abuse, and it could provide useful information on the age estimation of unknown children [22–24]. An autopsy is fundamental for the identification of the vitality of the child at birth and for the cause of death: in fact, it could document evidence of physical abuse and negligence, which include burns, bite marks, broken fingers, and traumatic brain injuries (i.e., subdural and retinal hemorrhages, diffuse axonal injury, skull base fractures). In addition, the evidence of human myiasis is a condition which could indicate fatal neglect. Thus, pathologists should carefully collect maggots from the dead body, especially in the presence of markedly colonized wounds, so that to demonstrate the *ante-mortem* infestation [25–26].

In our study, neonaticides and infanticides can be considered very rare occurrences that are more frequently committed by the mother inside home ($p < 0.05$), and using active methods rather than passive ones, confirming other previous studies. None of the known mothers had suicidal ideation. However, there are two cases (nos. 25 and 28) worthy of peculiar medicolegal issues. In case no. 25, the mother first tortured her newborn by stapling the mouth with two paper clips, then killed her from multiple sharp force injuries, and finally tried to conceal the baby inside a bag. This manner of killing is quite unusual, and rarely reported since it shows an intentionally inflicted extreme physical abuse with sadistic features on the newborn. Hence, such behavior cannot be considered a consequence of the hormonal fluctuation of the mother in the post-partum period, whereas an aggressive action should be charged with first-degree homicide aggravated by torture. This behavior may also raise questions concerning the presence of psychiatric disorders, which should be further investigated. Case no. 28, in contrast, represents an atypical form of spouse revenge neonaticide. Specifically, the perpetrator was a family friend of the mother who released the baby into her temporary custody. However, the woman threw the baby from the window of the flat for jealousy/vengeance. This phenomenon is uncommon but known since ancient times and consists of women who killed their offspring in a deliberate attempt to make their husbands suffer (e.g., after discovery of the husband's infidelity). For instance, in the *Medea* of Euripides, Jason deserted Medea for the daughter of King Creon of

Corinth; hence, in revenge, Medea brutally murdered her two sons she had by Jason as well as Creon and his daughter.

The prevention of infanticide is a must. Hence, there are several prevention strategies and recommendations that could be adopted by countries. The American Academy of Pediatrics recommends regularly screening for post-partum depression, as well as other social stressors at pediatric healthcare visits. Pediatricians need to take the time to discuss and screen for family and community stressors [27–28]. Furthermore, sex education, easy access to contraception, and a safe environment in which to discuss sexual issues could potentially help to decrease unwanted pregnancies [29]. Finally, Safe Haven laws have spread in the U. S. since the last years of the 90 s, which decriminalize the leaving of unharmed infants in statutorily designed places such as police stations, hospitals, and fire stations [30]. These laws may encourage parents to safely surrender infants, providing an alternative to abortion, neonaticide, or child abandonment. Similar laws are effective in many other countries in order to safeguard both children and their mothers, which include the possibility of giving anonymous birth in hospitals and giving up unwanted infants under safe conditions [31]. However, opponents allege that Safe Haven and similar laws could potentially encourage women to conceal their pregnancies, deprive fathers of their rights, give birth unsafely, and actually favor abandonment [32].

Pedicides or young child homicides are typical intrafamilial crimes; however, they show several important differences as compared with neonaticides and infanticides. These filicides may be divided into two classes: the former is represented by *pure* filicides, whereas the latter is represented by filicide-suicides. Babies killed in the first days of life are almost always killed by mothers with equal numbers of males and females among the victims [33–35]. For children killed after the first year, slightly more of the perpetrators are male than female [27,36]. Resnick categorized the maternal filicides occurring after the first 24 h on a classification based on apparent motives, which included, in order of frequency: 1) altruistic filicide (i.e., murders committed out of love to protect the child from real or imagined suffering); 2) acutely psychotic filicide; 3) unwanted child; 4) accidental or fatal battered child syndrome; 5) spouse revenge with a clear attempt to make the spouse suffer [37–38]. In several studies, filicidal mothers tend to be married and to report high levels of stress, including unemployment/financial problems, social isolation, ongoing abusive adult relationships, conflict with family members, and limited social support [39–40]. Depression or psychotic disorders are common in filicidal mothers; furthermore, psychotic women are also more likely to have a history of substance abuse, psychiatric hospitalization, ongoing psychiatric treatment, and suicide attempts [41–43]. Marital violence and parental separation represent potential risk factors for fatal child abuse. Notably, women use less violent methods such as suffocation, drowning, and jumping from heights [14,44]. These conditions justify still today the observations of Resnick on filicide mothers, for which altruistic and acutely psychotic pedicides represent the most prevalent motivations.

In contrast, there are few papers that focus on paternal filicides. However, studies highlighted that fathers who commit such murders are often perpetrators of fatal abuse filicide, which is usually the endpoint of beating [45]. Male perpetrators are likely to have a personal history of abuse in childhood, financial problems, an impending marital breakup, and a fear of separation [35,46]. Alcohol abuse and psychoactive drug consumption are also frequently reported [47]. Paternal pedicides are committed more violently by sharp or blunt force injuries, firearms, and sometimes extreme physical abuse (e.g., burns, bites) [11,39]. Interestingly, Myers et al. reported an international study focusing only on revenge filicides; thus, they pointed out that this phenomenon is very uncommon, accounting for roughly one out of every 800 homicides (0.125 % of all murders) [48]. Furthermore, they found that these perpetrators are about equally likely to be male as female; over half of them have an active mental disorder of any type and a history of domestic violence. The mean age of victims was 6 years, with preschool-age children killed most frequently, without a prevalent method of killing.

The existing literature provides only limited knowledge of the characteristics and associated factors of filicide–suicide. However, Murfree et al. pointed out some important differences between the maternal and paternal risk of suicide after filicide [34]. Specifically, mental health is a contributing factor among approximately two-thirds of female perpetrators, followed by children’s chronic illness, which is a possible source of family financial or social stressors [49–51]. For most, the guilt of providing inadequate care or causing the chronic illness exacerbates underlying mental disorders. In other instances, the mental health issues were connected to their children’s chronic illnesses [34]. Litigations related to custody, financial problems, or retaliation are uncommon among filicidal mothers [52]. A particular form of filicide-suicide is characterized by familial filicide, which refers to the occurrence of more than one such crime by perpetrators of the same family [53]. These acts are often seen during states of important parental fear, panic, psychosis, or severe depression, reasons for which they are generally followed by the perpetrator’s suicide. Therefore, prevention strategies include community access to immediate psychiatric care and prompt intervention at the first report of child abuse. Absolute indications for hospitalization – spontaneous or coercive – include parental fears of harming their children, unrealistic concern about a child’s health, delusions regarding the child suffering, and hostility toward the favorite child of a loathed spouse.

In our study, the mean age of the young victims was 4.14 years-old with a slight prevalence for males. There were 7 cases of *pure* filicides: among these, the offenders were identified as the mothers in 3 cases while the fathers in the others. Specifically, one father committed familial filicide by killing two siblings. Filicidal mothers suffered from severe depression in 2 cases and committed murders by asphyxiation; in contrast, filicidal fathers used more aggressive methods, and only one man suffered from psychotic disorder. Our results were consistent with the available literature. However, it is important to point out that both neonaticides and pedicides have gradually diminished over the last 30 years in the Milan district. This phenomenon may have socio-cultural reasons. In the first place, the Italian Parliament approved the law n. 194 on the voluntary termination of pregnancy in 1978, which guarantees the possibility for the woman to freely stop her pregnancy [54]. Since the 2000 s (DPR 396/2000), the mother can also decide not to recognize the baby and leave him/her in hospital [55]. The law provides that the mother’s name remains secret and to immediately open adoption process. Furthermore, the city of Milan activated in 1996 a dedicated first aid program for the victims of sexual and domestic violence, including minors [56–57]. This service is completely free, available 24/7, and guarantees a multidisciplinary team examination, which also provides a rapid report to the Judicial Authority. In this way, minors can be promptly safeguarded and taken to family house.

Adolescent homicides have never been deeply explored in the literature; nevertheless, they show peculiar characteristics that differentiate them from other minor homicides as well as from adult murders. A recent study by Mathews et al. focused on the features of adolescent homicides in South Africa [58]. They showed that such murders assumed a distinct gender pattern; specifically, adolescent males were more frequently reported and killed by a stab wound in public spaces in an extrafamilial context. In addition, the authors pointed out that persistent structural inequalities continue to limit young men’s opportunities and can lead to their participating in organized crime groupings and violence. Therefore, gang involvement can provide young men with the recognition and respect they do not receive elsewhere [59–60]. Other American studies focused on the epidemiological and socio-criminological characteristics of gun violence as the leading cause of morbidity and mortality in the young. Specifically, the retrospective study of Manley et al. analyzed 171,113 total firearm-related homicides in those of 25 years of age or younger from 1980 to 2016 in the U.S [61]. Among these victims, the majority were male, black, ranged in age from younger than 1 year to 25 years, and included 5,313 infants, 2,332 children, 59,777 adolescents, and 103,691 young adults. Most

adolescents were killed by non-family members for unknown reasons, followed by arguments, and juvenile gangland killings. Walker et al., showed that the adolescent group (ages 15–19) was the most frequently involved in firearm homicides in the city of Chicago from 2005 to 2010 [62]. Furthermore, male firearm homicide rates were nearly 14 times higher relative to females; among males, black firearm homicide rates were 33.5 per 100,000 versus Hispanic and non-Hispanic white firearm homicide rates of 8.5 and 1.2 per 100,000, respectively. Similar results have been documented by Chadha et al. who showed that, 509 adolescents died of firearm homicide in the city of Chicago between 2013 and 2017: among them, 95.1 % were male, and 79.6 % of cases were black or Afro-American [63].

Our results revealed that most adolescent victims were males, killed in an extrafamilial context using firearms ($p < 0.05$). Furthermore, the statistical analysis demonstrated that such murders increased among immigrants after 2005. This evidence may show different explications. In the first place, murders in the 90 s were more frequently related to criminal organizations than nowadays, and firearms were typically used for their executions [64–66]. Usually, these acts of extreme violence were used as a punishment for having betrayed the criminal organization; however, other reasons included drug trade and fencing. In the second place, income inequality may be considered a trigger for firearm violence against male adolescents [67–68]. Low-income individuals lack both social and public resources, which are further pronounced by difficult access [69–70]. Thus, these socioeconomic factors most likely play a role in the division of rates by firearm homicide. Furthermore, future policy direction may best serve allocating resources and creating multipronged approaches to lowering the socioeconomic risk for immigrants residing in high-poverty areas [61,71]. Similarly, the promotion of healthcare and social services among immigrants is necessary to rapidly identify young people at risk.

We also reported 5 adolescent cases (between 1991 and 2000) where the offender has never been arrested. Thus, possible reasons include poorly resourced homicide divisions within local police departments, where certain circumstance categories make it hard to obtain witnesses or case information (e.g., members of criminal organization may be less inclined to give known information about a death), or a genuine lack of evidence. Noteworthy, firearm homicide rates in the Milan district and in Italy are less common than in other countries [67]. In terms of tertiary prevention strategies, social factors such as restrictions and strong firearm legislation on the ownership of firearms can decrease extrafamilial child and adolescent homicides. Therefore, several studies limiting the accessibility of firearms in other countries have demonstrated successful results [72–76]. In comparison, in the U.S., from 2010 to 2012, 86 % of all adolescent homicide involved firearms, and 97.5 % of total adolescent homicide occurred in Philadelphia, U.S. [77].

Interestingly, school shootings have never been documented in Italy. The absence of this phenomenon is probably due to the low prevalence of weapons on Italian territory among adults, and consequently, minors do not come into contact with such weapons. Except for the sport of shooting, individuals under the age of 18 are not permitted to possess weapons in Italy. According to the Small Arms Survey [78], there were 8.6 million registered weapons in Italy (all law enforcement and army weapons excluded) in 2018, placing our country among the developed countries where the number of weapons is lowest, fewer than two for every ten people. However, the number of guns in a country is not a good indicator of how many citizens are armed, because enthusiasts usually own more than one gun each. Therefore, a more accurate figure is the number of licenses to possess or carry guns/rifles. The issue of these licenses is highly regulated and needs two medical certificates and a final evaluation from the Prefecture. According to data from the Ministry of the Interior [79], as of 2018, 1,315,700 licenses had been issued in Italy, up 4 % from 2015. The bulk of this growth is the increase in licenses issued for sporting use, while those for hunting use decreased between 2015 and 2018. Therefore, if the increase in the number of licenses is reflected in a greater increase in the number of weapons, then

it is conceivable that there may be such a spread of weapons on Italian territory even among adolescents in the not-too-distant future.

In contrast, adolescent female homicides are significantly less common than male homicides, and they are more likely to occur in the home, with the perpetrator -typically an adult man- being someone close to the female adolescent [80]. Data from the National Violent Death Reporting System from 2003 to 2016 showed that for persons aged 11 to 18 years, there were 2188 homicides; of these, 6.9 % ($n = 150$) were classified as intimate partner homicide (IPH) [81–82]. Among them, 135 (90.0 %) were girls and 63 (42.0 %) were white; the mean age was 16.8. A total of 94 perpetrators (62.7 %) were current intimate partners of the victim, 40 (26.7 %) were former intimate partners, and relationship status at the time of death was unspecified for the remaining 10.7 % ($n = 16$). Firearms were the most common weapon used in adolescent IPHs, which aligns closely with prior literature on adolescent and adult homicide and the greater lethality of firearms [80]. Our results documented 3 females out of 22 cases of adolescent homicide. All the victims were killed by male perpetrators with a known relationship with the young girls. Sharp force injuries killed two people and ligature strangulation killed one.

Female adolescent murders can be classified into 4 categories: specifically, the 2 most common categories of homicides were broken/desired relationships, or jealousy and altercation, followed by reckless firearm behavior and pregnancy related [80]. Our 3 cases were all related to broken/desired relationships or jealousy. Therefore, along with the literature evidence, intimate adolescent femicides may be the consequence of social norms that somehow promote men's dominance and control over women, allowing for the tolerance of violence against women and young girls.

As a legal intervention, civil protection orders have been shown to be effective in reducing subsequent intimate partner violence (IPV) for women [83–84]. However, adolescents in some countries cannot apply for a civil protection order given statutory age or relationship restrictions (i.e., those involving marriage, cohabitation, or children in common). Additionally, some countries require that adolescents obtain parental consent or a parent/guardian file on their behalf. Indeed, stronger laws regarding adolescent IPV, specifically civil protection orders, have been found to impact state-level IPV rates.

Finally, literature is reporting an increasing number of papers dealing with femicides as murders perpetrated because of a failure to recognize the victim's right to self-determination [85]. This phenomenon has been discussed poorly and not homogeneously yet, but it is interesting herein to correlate risk factors related to femicides with the ones established by this study. Authors reported that immigration patterns with ongoing difficulties due to new environments and low socioeconomic status may trigger violence against women [86–88]. Additionally, alcohol abuse contributes to precipitate such aggressive behavior. Noteworthy, these risk factors have been statistically correlated to child murders committed by immigrants in the Milan district after 2005, suggesting a connection between femicides and child homicides. Furthermore, the forensic literature indicates a prevalence use of sharp objects and firearms for femicides which are mainly indoors [89–90], whereas statistical significance was noted only for male adolescent murders by firearms and for neonaticides and infanticides committed indoors. Therefore, femicides share some risk factors with child and adolescent murders which might reflect deeply rooted social issues concerning extreme acts of violence on vulnerable subjects.

5. Conclusion

The case series analyzed presented features in agreement with known literature evidence, confirming how neonaticides, infanticides, and young child homicides are mostly committed in the domestic setting and by family members, affecting the sexes without substantial differences. With increasing age, however, murders occur more frequently outside the home, predominantly affect males and involve of non-family members. Nevertheless, when adolescent females are involved, the

perpetrator is typically a known person. In general, the death is most frequently due to sharp and firearm injuries, and even when the victim was a neonate or an infant, active methods were privileged.

The present study may help to identify risk factors for homicides against children and adolescents, considering that the current literature provides poor evidence on such dramatic phenomenon. Consequently, policies that identify, prevent, and minimize this extreme violence should be designed to interrupt the vicious circle of such dreadful murderous events. Child and adolescent homicides deserve additional focus and better education for healthcare professionals and further research should be carried out to develop preventing, therapeutic and caring strategies.

Ethics approval

All data have been discussed anonymously.

Funding

This research did not receive any specific grant for funding agencies in the public, commercial, or not-for-profit sectors.

CRedit authorship contribution statement

Nicola Galante: Writing – Original draft, Writing – review and editing, Conceptualization, Investigation, Methodology, Data curation. **Alberto Bladino:** Writing – Original draft, Data curation. **Marta Disegna:** Methodology – statistical analysis. **Lorenzo Franceschetti:** Writing – Original draft, Data curation. **Michelangelo Bruno Casali:** Supervision.

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.

Acknowledgments

The authors would like to thank Dr. Benassi and Dr. Cuomo for supporting the realization of the study.

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