

Provided for non-commercial research and education use.  
Not for reproduction, distribution or commercial use.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Contents lists available at ScienceDirect

## Forensic Science International

journal homepage: [www.elsevier.com/locate/forsciint](http://www.elsevier.com/locate/forsciint)

## Homicide–suicide and other violent deaths: An international comparison

Marieke Liem<sup>a,\*</sup>, Catherine Barber<sup>b</sup>, Nora Markwalder<sup>c</sup>, Martin Killias<sup>c</sup>, Paul Nieuwebeerta<sup>a,d</sup><sup>a</sup> Leiden University, The Netherlands<sup>b</sup> Harvard School of Public Health, Boston, MA, United States<sup>c</sup> Institute of Criminology, University of Zurich, Switzerland<sup>d</sup> Utrecht University, The Netherlands

## ARTICLE INFO

## Article history:

Received 27 May 2010

Received in revised form 6 September 2010

Accepted 7 September 2010

Available online 8 October 2010

## Keywords:

Homicide

Suicide

Murder–suicide

Firearms

International aspects

Family violence

## ABSTRACT

Homicides followed by the suicide of the perpetrator constitute a serious form of interpersonal violence. Until now no study has directly compared homicide–suicides to other violent deaths from multiple countries, allowing for a better understanding of the nature of these violent acts. Using country-specific data, this study describes and compares the incidence and patterns of homicide–suicide as well as the relationship between homicide–suicide, homicide, suicide and domestic homicide in the Netherlands, Switzerland and the United States. The results indicate that cross-nationally, homicide–suicides are more likely than other types of lethal violence to involve a female victim, multiple victims, take place in a residential setting and to be committed by a firearm. Although homicide–suicides display many similarities across the different countries, differences exist regarding age and the use of firearms in the offence. This study indicates that homicides followed by suicides differ from both homicides and suicides in similar ways internationally. Cross-national differences in the availability of firearms may explain the international variation of homicide–suicide rates and patterns.

© 2010 Elsevier Ireland Ltd. All rights reserved.

## 1. Introduction

Homicide–suicide refers to an incidence of homicide followed by the suicide of the perpetrator. Homicide–suicide incidents make up a relatively small proportion of homicides overall. However, certain subtypes of homicide are frequently followed by suicide – notably men who kill an intimate partner with a firearm are followed by suicide in over half of all incidents [1–5].

In recent years, the rate of homicide–suicides showed considerable geographic variation. Homicide–suicide rates range from as low as 0.06 per 100,000 persons per year in England and Wales [6] to 0.38 per 100,000 in the Toyama region in Japan [7]. Examining thirteen US states, Bossarte et al. estimated the overall rate to be 0.21 per 100,000 [8]. In Australia and New Zealand, the homicide–suicide rate has ranged from 0.07 [9] to 0.11 [10]. Marzuk et al. (1992) placed the homicide–suicide mortality rate in the United States, based on 1000–1500 deaths per year, on par with diseases, such as tuberculosis (1467 deaths), viral hepatitis (1290 deaths), influenza (1943 deaths) and meningitis (1156 deaths).

## 1.1. Background

Previous studies on homicide–suicide have been limited in at least three aspects [11]. First, given the rarity of the act, previous studies have relied on small samples that were studied in a qualitative manner [12–15]. Second, earlier research has mainly focused on describing the epidemiology of these events in a particular region, ranging from city-level [16–19] to country-level [10,20,21,4] analyses. Third, given the relatively diverse nature of the phenomenon, previous studies have focused on particular subtypes of homicide–suicide, mostly those involving intimate partners [22–26] or children [27–30].

Until now no study has directly compared rates and characteristics across countries adequately and in a detailed manner. International comparisons are limited to meta-analyses and have been hampered by a lack of uniform inclusion criteria, the use of different homicide–suicide classification schemes and incongruity in time periods studied. Some rely on a time span of 24 h [1,10,17,24,31] or several days [23,32], between the homicide and the suicide of the perpetrator; others use a week as an inclusion criterion [33–36] and still others do not use a timeline at all [37–39].

To examine the characteristics of a large number of homicide–suicides and to conduct international comparisons, M.L. and P.N. sought the assistance of authors of recent studies of homicide and

\* Corresponding author. Permanent address: Leiden University, Faculty of Law, Department of Criminology, Steenschuur 25, 2311 ES Leiden, The Netherlands. Tel.: +31 71 5278583; fax: +31 71 5277600.

E-mail address: [m.c.a.liem@law.leidenuniv.nl](mailto:m.c.a.liem@law.leidenuniv.nl) (M. Liem).

homicide–suicide from Switzerland and the United States, who had data about these types of lethal violence.

## 1.2. Objectives

The aims of the present study are to compare the rates and patterns of homicide–suicide in three countries: two European countries (the Netherlands and Switzerland) and the United States, by establishing a cross-nationally comparable dataset. Also, because our dataset includes a uniform classification scheme and a sizeable number of cases, we are able to compare several characteristics of homicide–suicide cases, victims and perpetrators across countries. In addition, we compare the incidence and characteristics of homicide–suicide with other violent death categories: suicide, homicide, and conduct a comparison between domestic homicide–suicide and domestic homicide.

## 1.3. Cross-national differences

The three countries in our study are similar in many aspects, but also differ substantially in others. All are highly developed, stable democracies and have fairly similar demographics. Data for the year 2008 [40] indicate quite comparable population structure with respect to age: between 18 and 20 per cent of the population under age 14, and approximately 68 per cent between the ages 15 and 64 in all three countries. Also, life expectancy at birth (Netherlands = 79 years; Switzerland = 80 years; United States = 75 years), literacy (99 per cent of the total population in all three countries) and unemployment rate (Netherlands = 5 per cent; Switzerland = 3 per cent; United States = 7 per cent) are fairly similar. Lifetime prevalence of mental disorder in the Netherlands is approximately 41 per cent, of which alcohol dependence accounts for 6 per cent and drug dependence for 2 per cent [41]. In Switzerland the lifetime prevalence of mental disorders is approximately 49 per cent [42], of which 18 per cent is alcohol and 8 per cent drug-related.<sup>1</sup> In the United States, lifetime prevalence of mental disorder is roughly 46 per cent, of which 5 per cent constitutes alcohol dependence and 3 per cent drug dependence.

One especially relevant aspect for this study in which these countries differ is the availability of firearms. In the Netherlands, firearm legislation is restricted and hence, firearm possession relatively low (around 5 per cent of all households) [43]. Switzerland, however, with its militia system engaging every male Swiss citizen to serve in the military, legally held army ordnance weapons are kept at home. This contributes to a high prevalence of households owning at least one firearm (approximately 28 per cent).<sup>2</sup> In the United States, many people keep firearms in the home for personal protection [45]. Overall, it is estimated that 33 per cent of all households in the United States possess a firearm [46].

It is expected that the differences in the availability of firearms and the accompanied lethal impact of violent behavior will be reflected in differences in rates of lethal violence between the three countries. Given the many similarities between the countries, however, we expect the nature of homicide–suicide in the three countries to be similar and to differ from other types of lethal violence in similar ways. Based on the existing literature, this

translates specifically in the expectations that the majority of homicide–suicides will involve women who are killed by their (estranged) male partner.

## 2. Materials and methods

### 2.1. Data sources

Due to the various forms of lethal violence and due to the multi-centre nature of this study, various data sources were used. In all three countries, uniform definitions were applied to extract information on homicide–suicide, homicide and suicide for overlapping periods. We defined a homicide–suicide as an incident involving one or more homicides followed by the suicide of the suspected perpetrator within 24 h, a definition used in previous studies [1,10,17,23,32].

#### 2.1.1. The Netherlands

In the Netherlands, homicide data (articles 287–291 Code of Dutch Criminal Law) were retrieved from the National Dutch Homicide Monitor 1992–2006 [47]. Not covered in these articles are physician-assisted deaths, assistance to suicide, and abortion, since in the Netherlands, these are considered crimes only in exceptional circumstances [48]. From the Dutch Homicide Monitor, all homicide–suicides were extracted and included in a new database entitled Homicide–Suicide 1992–2006 [49]. Additional information on individual homicide–suicide cases was collected from print media in order to supplement the data with background information that was not included in the database [50]. Suicide data were collected from the dataset Causes of Death Statistics from the Dutch Central Bureau of Statistics, Statistics Netherlands [51]. Data on suicide ranged from the period 1996 to 2006. Cases were classified as suicides based on the cause of death given by the medical examiner (ICD-10 codes X60–X84).

#### 2.1.2. Switzerland

Homicide (articles 111–116 of the Swiss Criminal Code) as well as suicide (ICD-10 codes X60–X84) data from Switzerland were retrieved from the National Swiss Homicide and Suicide Database [52]. This database includes all homicides and a randomly selected 10 per cent of all suicides<sup>3</sup> that occurred in Switzerland. Homicide–suicide cases were imported into a new database. It should be noted that only homicide cases where an autopsy had been ordered could be considered. In obvious cases of homicide followed by suicide of the offender (e.g. the homicide–suicide takes place in a locked apartment), an autopsy is not always ordered. Therefore, the rates presented for Switzerland may suffer from some undercounts.<sup>4</sup> In order to adjust the time line to the data available in the Netherlands, cases that took place between 1992 and 2004 were included in the analysis. As the Swiss suicide sample consists of a random selection of 10 per cent of suicides in Switzerland, mean annual suicide rates were taken from the Causes of Death Statistics from the Swiss Federal Bureau of Statistics [53].

#### 2.1.3. United States

Data from the US are from the National Violent Death Reporting System (NVDRS), an incident-based surveillance system of all incidents involving suicide, homicide, and combined homicide–suicide events, in addition to selected other death types, that occur within participating states [54,55]. For our study we used data on deaths for the years 2004 through 2006 reported by the thirteen US states that participated in NVDRS throughout that period (Alaska, Colorado, Georgia, Maryland, Massachusetts, New Jersey, North Carolina, Oklahoma, Oregon, Rhode Island, South Carolina, Virginia and Wisconsin). Data abstractors follow a detailed NVDRS coding manual to ensure consistency. To improve uniformity in coding, CDC staff review 10 per cent of the narratives and provide feedback to the reporting sites when coding is not supported by the narrative. Homicide, suicide and homicide–suicide incident rates (based on abstractor's assigned type of death) were calculated using the CDC's Web-based Injury Statistics Query and Reporting System's (WISQARS) NVDRS module [56]. Population estimates in WISQARS are based on the US Census Bureau. Data on decedent and incident characteristics are from the NVDRS Restricted Access Database which was released by the CDC in January 2009.

### 2.2. Variables

Homicide–suicides were classified according to Marzuk et al.'s widely used classification system based on the relationship between victim and offender. This includes intimate partners (current or former spouse, girlfriend or boyfriend),

<sup>1</sup> It should be noted that Swiss data has not been collected according to the WHO-CIDI format and is based on a rather small sample.

<sup>2</sup> Among the Swiss households with at least one firearm, 63 per cent own an ordnance weapon only, whereas private weapons are kept in 26 per cent among households owning firearms. Private and military firearms are being kept in the remaining 10 per cent of households [44]. In 2007, the Swiss army has stopped distributing ammunition to soldiers and has started to withdraw ammunition already in possession of members of the military. Nevertheless, the military firearms remain in possession of soldiers, as long as they serve in the army, and often beyond.

<sup>3</sup> In a first step, we created lists containing all cases of suicides known to official authorities. Suicides where an autopsy had been performed were collected in the legal medicine institutes, those not involving any autopsy were collected from police, court or other criminal justice authorities. In a second step, in order to ensure a randomized sampling, every tenth case was chosen from these lists. Considering this proceeding as well as the relatively high number of selected cases, it can be assumed that the sample is representative of all suicides in Switzerland.

<sup>4</sup> Checks with alternative sources revealed that undercounts may be in the order of 16 percent.

**Table 1**  
Mean annual homicide–suicide, homicide and suicide incident rates per 100,000 per country (95 per cent C.I.).

	Netherlands (1992–2006)	Switzerland (1992–2004)	United States (2004–2006)
Homicide rate	1.38 (1.25–1.51)	0.87 (0.80–0.94)	5.06 (4.70–5.43)
Suicide rate	9.71 (9.50–9.92)	19.35 (18.58–20.12)	10.76 (9.86–11.65)
Homicide–suicide rate	0.05 (0.04–0.06)	0.09 (0.07–0.12)	0.22 (0.20–0.25)

children (biological, step-, adoptive or foster child), combined intimate partner and child homicides (also known as familicides), and extrafamilial homicide–suicides (friends, acquaintances, or strangers) [36]. We supplemented Marzuk et al.'s classification by adding a fifth category of other family members (parents, stepparents, siblings, in-laws, and other family members). When an incident involved more than one category, the closest relationship between victim and offender was coded according to the following hierarchy: familicide, intimate partner homicide, child homicide, other family homicide and finally the category 'other'.

The location of the event was considered to be residential if the event took place inside the home or adjacent premises. Homicides and homicide–suicides were considered as domestic if the victim included a (former) spouse, (former) girlfriend or boyfriend, a (biological, step or foster) child, parent, stepparent, sibling or another family member.

2.3. Statistical methods

Homicide–suicide incidence, event, victim and offender characteristics were compared by calculating frequency distributions and population-based incidence rates. The homicide rates in all three countries were calculated based on homicide incidents and hence do not include homicide–suicide incidents. Due to the nature of

the suicide data, we were not able to filter out homicide–suicide incidents from the suicide rate and hence, the suicide rates in all three countries are crude rates. The reported incidence rates are based on 95 per cent Confidence Intervals.

Perpetrators of homicide–suicide incidents were compared with individuals who committed homicide only and those who committed suicide only. A subgroup of domestic homicide–suicide was compared to domestic homicides. T-Tests, ANOVA's and Yates' chi-square tests were conducted to assess significance of differences in offender, victim and event characteristics. Analyses used SPSS v.17.0 software.

3. Results

3.1. Incidence

In the time period studied, in the Netherlands approximately 9 people per year died in a homicide–suicide, constituting 4 per cent of all homicides. In Switzerland, annually 9 people were victimized in a homicide–suicide, making up 11 per cent of all homicides. In the US states included in this study, a total average of 176 victims died annually in homicide–suicides, making up 4 per cent of all homicides. Both the homicide rate as well as the homicide–suicide incident rate was highest in the United States (Table 1); suicide rates, however, were highest in Switzerland (Fig. 1).

3.2. Event characteristics

In all countries, homicide–suicide incidents involving intimate partners were most prevalent (Table 2). In contradiction to the other two countries, a relatively high proportion of events in the Netherlands constituted a child homicide–suicide. Homicide–suicides in the Netherlands and Switzerland were more likely to involve multiple victims than homicide–suicides in the United States.

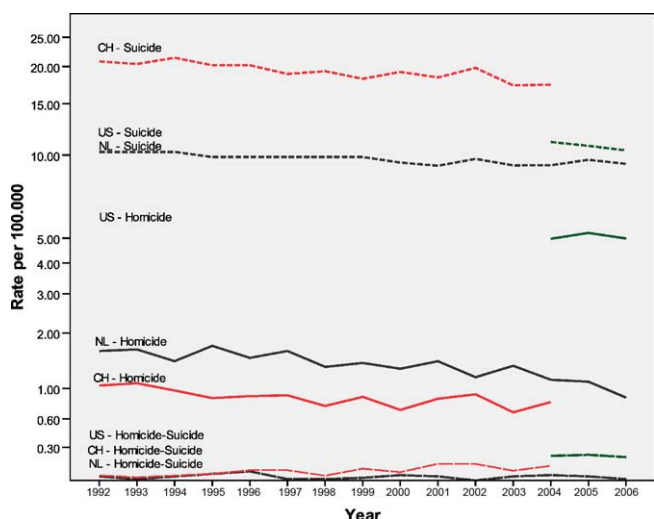
3.3. Victims

In all three countries, the large majority of the homicide–suicide victims were female (Table 3, top). Homicide–suicide victims in the Switzerland and the United States were found to be significantly older than victims in the Netherlands. Homicide–suicides in Switzerland and the United States were more likely to be perpetrated with a firearm compared to the Netherlands. In Switzerland, privately owned firearms were involved in 64 per cent of the firearm-perpetrated homicides-suicides, followed by military weapons (18 per cent) and illegal firearms (12 per cent).<sup>5</sup>

3.4. Perpetrators

In all countries, homicide–suicide perpetrators were mostly male, aged between 25 and 64 (Table 3, bottom). Similar to victims' age, offenders in Switzerland and the United States were overall older than those in the Netherlands. The results further showed a significant difference between countries regarding offenders' marital status. In Switzerland, the degree of married perpetrators was higher than in the other two countries.

<sup>5</sup> The category of private firearms and military firearms is difficult to distinguish, due to the fact that military weapons merge into private possession of the soldier once he has finished his active duty.



**Fig. 1.** Population-based incident rates of homicide–suicide, homicide and suicide over time in the Netherlands (1992–2006), Switzerland (1992–2004) and the United States (2004–2006).

**Table 2**  
Homicide–suicide event characteristics per country.

	Netherlands		Switzerland		United States		P value
	N	Per cent	N	Per cent	N	Per cent	
Type							.000
Intimate partner and child	9	9	7	8	8	2	
Intimate partner	52	50	60	69	321	70	
Child	19	18	7	8	43	9	
Other family	3	3	2	2	34	7	
Extra-familial	13	13	11	13	42	9	
Unknown	7	7	0	0	13	3	
Number of homicide victims							.054
1	82	80	71	82	407	88	
2≥	21	20	16	18	54	12	
	103	100	87	100	461	100	

**Table 3**  
Homicide–suicide victim and offender characteristics, per country.

	Victim characteristics						P value
	Netherlands		Switzerland		United States		
	N	Per cent	N	Per cent	N	Per cent	
Gender							
Male	43	32	41	34	131	25	.000
Female	92	68	79	66	397	75	
Age							.000
≤17	49	36	18	15	64	12	
18–24	9	7	10	8	62	12	
25–39	43	32	31	26	150	29	
40–64	26	19	45	38	180	34	
≥65	8	6	14	12	68	13	
Mean	28.2 (±20.5)		39.3 (±19.9)		39.2 (±20.1)		.000
Homicide characteristics							
Firearm homicide	48	36	100	83	456	86	.000
Residential location <sup>a</sup>	108	80	88	73	425	81	
	135	100	120	100	528	100	
	Offender characteristics						
Gender							
Male	93	90	80	92	424	92	NS
Female	10	10	7	8	37	8	
Age							.096
≤17	1	1	0	0	2	0	
18–24	8	8	5	6	36	8	
25–39	46	46	22	25	145	32	
40–64	41	41	38	44	216	47	
≥65	4	4	15	17	61	13	
Mean	40.9 (± 13.5)		49.1 (±17.2)		45.1 (±16.2)		.002
Marital status							.000
Single	27	26	12	14	99	22	
Married	33	32	54	62	153	33	
Divorced	19	18	15	17	88	19	
Other <sup>b</sup> and unknown <sup>c</sup>	24	23	6	7	121	26	
	103	100	87	100	461	100	

<sup>a</sup> The offence location is reflected by the location of death of the victim.

<sup>b</sup> The high prevalence of widowed offenders in the United States might be a result of a discrepancy in coding. Closer analyses revealed that 104 out of 111 widowed offenders killed their intimate partner prior to their suicide. Although strictly speaking, these men were widowed at the time of their suicide, the analysis suggests they were married and/or divorced at the time of the homicide.

<sup>c</sup> In the Dutch sample, information on details of the relationship between victim and offender was often missing. This was particularly true for marital status.

3.5. Homicide–suicides compared with other homicides and other suicides

Following, homicide–suicide characteristics were compared to homicide-only and suicide-only characteristics (Table 4). In all countries, the three types of lethal violence were predominantly committed by males (but for suicide to a lesser degree), and

homicide–suicides were more likely than homicide-only incidents to involve female victims. Further, a higher proportion of victims were children in homicide–suicide incidents than in homicide incidents, significantly so in the Netherlands and the United States. All countries had in common the finding that homicide–suicides were more likely than other homicides to involve multiple victims and more likely than both homicide-only and suicide-only events

**Table 4**  
Homicide–suicide characteristics compared to other homicides and other suicides per country.

	Netherlands			Switzerland			United States		
	Percentage of all incidents								
	Homicide–suicides (N=103)	Other homicides (N=4074)	Other suicides (N=17,751)	Homicide–suicides (N=87)	Other homicides (N=723)	Other suicides (N=872)	Homicide–suicides (N=461)	Other homicides (N=11,480)	Other suicides (N=22,569)
Offender characteristics									
Offender male	90	90	68	92	79	70*	92	90	78*
Offender age	40.9 years	30.9* years	47.8* years	49.1 years	33.3 years*	51.0 years	45.1 years	28.2 years*	45.3 years
Victim characteristics									
Victim female	68	29*	–	66	39*	–	75	20*	–
Victim child	33	4*	–	10	6	–	9	5*	–
Multiple victims	21	5*	–	18	6*	–	12	4*	–
Event characteristics									
Residential location	80	47*	54*	73	54*	57*	81	49*	75
Firearm incident	36	35	3*	83	43*	28*	87	66*	51*

\* p < .01.

**Table 5**  
Domestic homicide–suicides compared to other domestic homicides.

	Netherlands		Switzerland		United States	
	Percentage of all incidents					
	Domestic homicide–suicides (N = 78)	Other domestic homicides (N = 1056)	Domestic homicide–suicides (N = 76)	Other domestic homicides (N = 263)	Domestic homicide–suicides (N = 406)	Other domestic homicides (N = 1457)
Offender characteristics						
Offender male	90	81	91	79 <sup>†</sup>	91	73
Victim characteristics						
Victim female	72	63	77	71	82	53 <sup>*</sup>
Victim child	41	13 <sup>*</sup>	13	15	9	22 <sup>*</sup>
Multiple victims	24	5 <sup>*</sup>	16	7 <sup>†</sup>	20	14 <sup>†</sup>
Event characteristics						
Residential location	46	75 <sup>*</sup>	85	79	86	88
Firearm homicide	37	25 <sup>†</sup>	82	31 <sup>*</sup>	84	37 <sup>*</sup>

<sup>\*</sup>  $p < .01$ .

<sup>†</sup>  $p < .05$ .

to take place at home. In both Switzerland and the United States homicide–suicides were more frequently committed by a firearm compared to other homicides. In all three countries homicide–suicides were more likely to involve a firearm as a suicide method compared to other suicides.

### 3.6. Domestic homicide–suicides compared to other domestic homicides

In Switzerland and the United States, domestic homicide–suicides were found to be more likely than other domestic homicides to be committed by men (Table 5). Other findings replicate the results from the overall comparison between homicide–suicide and homicide, domestic homicide–suicides in all countries being more likely than other domestic homicides to involve multiple victims and to involve a firearm.

## 4. Discussion

We set out to directly compare homicide–suicide, suicide incidence, rates and characteristics to other types of violent death in three developed nations using national data. This approach has some limitations: as noted before, due to the fact that the Swiss dataset is based on autopsy reports, figures presented here are likely undercounts. Furthermore, the US data includes homicide–suicides from a nonrandom sample of states; findings may not be valid for homicide–suicides nationally. In addition, due to the use of nationwide statistics, detailed information on homicide–suicide, homicide and suicide events, their victims and offenders were mostly unavailable. Although every case was subject to extensive data quality reviews, the accuracy of the data is limited by the quality of the information collected by the primary sources [57]. Finally, the reported data might present an underreporting of homicide–suicide cases, as there may be instances in which an undetected perpetrator attempted or completed suicide away from the scene of the homicide incident and thus was not counted as a case [1]. However, the combined sources constitute the largest collection of homicide–suicide cases to date, the studying of which allows for an increased understanding of the nature of these violent acts.

We expected that the differences in the availability of firearms would be reflected in differences in rates of lethal violence between the three countries. Based on the many similarities between the countries, we also expected the characteristics of homicide–suicide to be similar and to differ from other types of lethal violence in similar ways. These expectations were partially

met; substantial cross-national differences were found, however, regarding the type of relationship between victim and perpetrator and the method used in the offence.

Addressing the first expectation, homicide–suicide rates were found to be highest in Switzerland and the United States. This finding is in line with a recent systematic review of population-based homicide–suicide studies by Large et al. which showed that in areas with a high prevalence of private firearm possession the rates of homicide–suicide appeared to be positively associated with the rate of homicides by firearms [58].

Regarding the second expectation, significant differences between countries were found regarding the relationship between victim and offender. In the Netherlands a relative overrepresentation of child homicide–suicides was found, which is also reflected in an overall lower age of homicide–suicide victims and perpetrators. Conversely, homicide–suicides in both Switzerland and selected states in the United States present a high prevalence of older offenders and victims. Homicide–suicides involving elderly offenders are thought to differ from those committed by younger perpetrators by being centered on themes of decline in health, pain and suffering [22,36]. The low prevalence of elderly homicide–suicide in the Netherlands compared to Switzerland does not seem to be associated with physician-assisted dying<sup>6</sup> in the Netherlands, as assisted suicide is legally permitted and widely practiced in Switzerland as well [59]. Rather, this finding could be attributed to an overall lower proportion of homicide–suicides in the Netherlands being committed with a firearm. Arguably, it is more difficult to kill both another adult in addition to take one's own life with other means than a firearm. Lacking physical strength, this might apply especially to elderly perpetrators. The relatively high frequency of homicide–suicide among the elderly in Switzerland could be explained by the fact that many Swiss men continue keeping their army equipment after being released from military service [60].

In spite of these differences, the findings showed that cross-nationally, the majority of the homicide–suicides involved males killing their (estranged) intimate female partner. Previous explanations for this gender difference have focused on male pathological possessiveness that deals with power and control. From this perspective, a woman's estrangement constitutes an affront to male status and feeling of entitlement over her [24]. The countries also had in common the finding that, when compared to other types of lethal violence, homicide–suicide perpetrators were

<sup>6</sup> Physician-assisted dying includes both physician-assisted suicide and euthanasia at the explicit request of the individual.

older than homicide perpetrators. Homicides committed by younger offenders are typically crime-related rather than family-related and are less likely to involve the perpetrator's suicide. It has also been argued that an older age of homicide–suicide perpetrators may be a function of mental disorders as well as relationship problems increasing with age [32]. In addition, in line with our expectations, homicide–suicides were found to be more likely than other types of lethal violence to involve a female victim, multiple victims and to take place in a residential setting. The higher likelihood of a homicide to end in a suicide when there is a female victim involved can be ascribed to the majority of non-domestic homicides involving a male victim and a male offender. These homicides include criminal homicides and homicides arising from arguments and generally do not result in a homicide–suicide. The finding that, compared to homicide, homicide–suicide is cross-nationally more likely to involve multiple victims can on one hand be explained by the lethality of firearm violence compared to other methods—both among homicide–suicides overall and domestic homicide–suicides in particular. Other explanations focus on the association of the killing of multiple victims and severe forms of psychopathology in the perpetrator, who accordingly is more likely to commit suicide following the multiple victim homicide [29]. The finding that homicide–suicides were more likely than other homicides to take place within the home can be ascribed to the involvement of family members in homicide–suicide, the primary location of congregation being the home. Stack (1997) has previously shown that homicide–suicide is more likely to occur when the relational distance between offender and victim is closer—the prime example of such a close relationship being the intimate partner and family members. This finding can also be ascribed to the home as being the primary location where guns are kept. In relation to this, one possible policy implication of our findings is that, given the relatively high prevalence of firearms in these acts, reducing firearm availability could be one step into the direction of decreasing the number of tragedies such as homicide–suicides as well as homicides and suicides alone.

## 5. Conclusions

The aim of this study was to compare the nature and incidence of homicide–suicide in the Netherlands to homicide–suicides in the United States and Switzerland. The results indicated that there are considerable similarities in the characteristics of homicide–suicide between the three countries: most homicide–suicides being committed by men who kill their intimate partner before committing suicide. Differences between the three countries include the incidence of homicide–suicide. The homicide–suicide rates in Switzerland and the United States were found to be substantially higher than in the Netherlands. One possible explanation for these differences can be found in the availability of firearms in the home. Altercations between intimate partners and family members are likely to take place in the home. A firearm might not only lower the threshold for acting out violently, but also increases the lethality of such assaults [61]. Homicide–suicides in the Netherlands further differed from both Switzerland and the United States in a relative underrepresentation of elderly homicide–suicides. This difference could be attributed to an overall lower proportion of homicide–suicides in the Netherlands being committed with a firearm. It can be argued that it is more difficult to kill both another adult in addition to take one's own life with other means than a firearm, particularly for elderly perpetrators. In line with the findings from other studies, the availability of firearms seems a genuine preventive issue regarding impulsive acts [15]. One could argue that restricting firearm legislation could be one step into the direction of decreasing the number of tragedies such as homicide–suicides.

## References

- [1] C.W. Barber, D. Azrael, D. Hemenway, L.M. Olson, C. Nie, J. Schaechter, S. Walsh, Suicides and suicide attempts following homicide, *Homicide Studies* 12 (2008) 285–297.
- [2] L.E. Lund, S. Smorodinsky, Violent death among intimate partners: a comparison of homicide and homicide followed by suicide in California, *Suicide and Life-Threatening Behaviour* 31 (2001) 451–459.
- [3] S. Walsh, D. Hemenway, Intimate partner violence: homicides followed by suicides in Kentucky, *Journal of the Kentucky Medical Association* 103 (2005) 10–13.
- [4] M. Liem, M. Postular, P. Nieuwebeerta, Homicide–suicide in the Netherlands: an epidemiology, *Homicide Studies* 13 (2009) 99–123.
- [5] P.W. Easta, Killing the Beloved, Australian Institute of Criminology, Canberra, 1993.
- [6] P.J. Taylor, J. Gunn, Homicides by people with mental illness: myth and reality, *British Journal of Psychiatry* 174 (1999) 9–14.
- [7] N. Hata, Y. Komanito, I. Shimada, H. Takizawa, T. Fujikura, M. Morita, M. Funayama, N. Yoshioka, K. Touda, K. Gonmori, et al., Regional differences in homicide patterns in five areas of Japan, *Legal Medicine* 3 (2001) 44–55.
- [8] R.M. Bossarte, T.R. Simon, L. Barker, Characteristics of homicide followed by suicide incidents in multiple states, 2003–04, *Injury Prevention* 12 (2006) 33–38.
- [9] A. Moskowitz, A.I.F. Simpson, B. McKenna, J. Skipworth, J. Barry-Walsh, The role of mental illness in homicide–suicide in New Zealand, 1991–2001, *The Journal of Forensic Psychiatry and Psychology* 17 (2006) 417–430.
- [10] C. Carcach, P.N. Grabosky, Murder–suicide in Australia, Australian Institute of Criminology Trends and Issues in Crime and Criminal Justice, 1998.
- [11] M. Liem, Homicide followed by suicide: a review, *Aggression and Violent Behavior* 15 (2010) 153–161.
- [12] R.D. Goldney, Family murder followed by suicide, *Forensic Science International* 3 (1977) 219–228.
- [13] M. Rosenbaum, The role of depression in couples involved in murder–suicide and homicide, *American Journal of Psychiatry* (1990) 147.
- [14] P. Saint-Martin, M. Bouyssy, P. O'Byrne, Homicide–suicide in tours, France (2000–2005) - description of 10 cases and a review of the literature, *Journal of Forensic and Legal Medicine* 15 (2007) 104–109.
- [15] O. Saleva, H. Putkonen, O. Kiviruusu, J. Lönnqvist, Homicide–suicide - an event hard to prevent and separate from homicide or suicide, *Forensic Science International* 166 (2007) 204–208.
- [16] R. Gartner, B. McCarthy, Twentieth-century trends in homicide followed by suicide in four North American cities, in: J. Weaver, D. Wright (Eds.), *Histories of Suicide: International Perspectives on Self-destruction in the Modern World*, University of Toronto Press, Toronto, 2008.
- [17] D.W. Harper, L. Voigt, Homicide followed by suicide. An integrated theoretical perspective, *Homicide Studies* 11 (2007) 295–318.
- [18] D. Lecomte, P. Fornes, Homicide followed by suicide: Paris and its suburbs, 1991–1996, *Journal of Forensic Sciences* 43 (1998) 760–764.
- [19] S. Stack, Homicide followed by suicide: an analysis of Chicago data, *Criminology* 35 (1997) 435–454.
- [20] B.M. Barraclough, E. Clare Harris, Suicide preceded by murder: the epidemiology of homicide–suicide in England and Wales 1988–92, *Psychological Medicine* 32 (2002) 577–584.
- [21] J. Kivivouri, Homicide–Suicide in Finland, 2002–2006, European Society of Criminology, Bologna, 2007.
- [22] D. Bourget, P. Gagne, J. Moamai, Spousal homicide and suicide in Quebec, *Journal of the American Academy for Psychiatry and Law* (2000) 179–182.
- [23] D. Cohen, M. Llorente, C. Eisdorfer, Homicide–suicide in older persons, *American Journal of Psychiatry* 155 (1998) 390–396.
- [24] M. Dawson, Intimate femicide followed by suicide: examining the role of premeditation, *Suicide and Life-Threatening Behavior* 35 (2005) 76–90.
- [25] J. Koziol-McLain, D. Webster, J. McFarlane, C.R. Block, Y. Ulrich, N. Glass, J.C. Campbell, Risk factors for femicide–suicide in abusive relationships: results from a multisite study, *Violence and Victims* 21 (2006) 3–21.
- [26] M. Liem, D. Roberts, Intimate partner homicide by presence or absence of a self-destructive act, *Homicide Studies* 13 (2009) 339–354.
- [27] R. Byard, D. Knight, R.A. James, J. Gilbert, Murder–suicides involving children: a 29-year study, *American Journal of Forensic Medicine and Pathology* 20 (1999) 232–237.
- [28] S. Hatters Friedman, C.E. Holden, D.R. Hrouda, P.J. Resnick, Maternal filicide and its intersection with suicide, *Brief Treatment and Crisis Intervention* (2008) 1–9.
- [29] M.K. Krischer, M.H. Stone, K. Sevecke, E.M. Steinmeyer, Motives for maternal filicide: results from a study with female forensic patients, *International Journal of Law and Psychiatry* 30 (2007) 191–200.
- [30] T.K. Shackelford, V.A. Weekes-Shackelford, S.L. Beasley, An explanatory analysis of the contexts and circumstances of filicide–suicide in Chicago, 1965–1994, *Aggressive Behavior* 31 (2005) 399–406.
- [31] J. Logan, H.A. Hill, M. Lynberg Black, A. Crosby, D.L. Karcg, J.D. Barnes, K.M. Lubell, Characteristics of perpetrators in homicide–followed-by–suicide incidents: national violent death reporting system—17 US States, 2003–2005, *American Journal of Epidemiology* 168 (2008) 1056–1064.
- [32] A.R. Felthous, A.G. Hempel, Combined homicide–suicides: a review, *Journal of Forensic Sciences* 40 (1995) 846–857.
- [33] G. Campanelli, T. Gilson, Murder–suicide in New Hampshire, 1995–2000, *American Journal of Forensic Medicine and Pathology* 23 (2002) 248–251.
- [34] C.Y. Chan, S.L. Beh, R.G. Broadhurst, Homicide–suicide in Hong Kong 1989–1998, *Forensic Science International* 137 (2003) 165–171.

- [35] R.D. Comstock, S. Mallonnee, E. Kruger, K. Rayno, A. Vance, F. Jordan, Epidemiology of homicide–suicide events: Oklahoma, 1994–2001, *American Journal of Forensic Medicine and Pathology* 26 (2005) 229–235.
- [36] P.M. Marzuk, K. Tardiff, C.S. Hirsch, The epidemiology of murder–suicide, *Journal of the American Medical Association* 267 (1992) 3179–3183.
- [37] A.L. Berman, Dyadic death: homicide–suicide, *Suicide and Life-Threatening Behavior* (1979) 15–23.
- [38] A. Dettling, L. Althaus, H.T. Haffner, Criteria for homicide and suicide on victims of extended suicide due to sharp force injury, *Forensic Science International* 134 (2003) 142–146.
- [39] N. Hata, Y. Komanito, I. Shimada, H. Takizawa, T. Fujikura, M.M.F. Morita, N. Yoshioka, K. Touda, K. Gonmori, et al., Regional differences in homicide patterns in five areas of Japan, *Legal Medicine* 3 (2001) 44–55.
- [40] CIA, *The 2008 World Factbook*, 2008.
- [41] R.V. Bijl, A. Ravelli, V.G. Zessen, Prevalence of psychiatric disorder in the general population: results of the Netherlands mental health survey and incidence study (NEMESIS), *Social Psychiatry and Psychiatric Epidemiology* 33 (1998) 587–595.
- [42] J. Angst, A. Gamma, M. Neuenschwander, V. Ajdacic-Gross, D. Eich, W. Rossler, K.R. Merikangas, Prevalence of mental disorders in the Zurich Cohort study: a twenty year prospective study, *Epidemiologia e Psichiatria sociale* 14 (2005) 68–76.
- [43] J. Van Dijk, J. Van Kesteren, P. Smit, V. Ajdacic-Gross, D. Eich, W. Rossler, K.R. Merikangas, Criminal Victimization in International Perspective. Key Findings from the 2004–2005 ICVS and EU ICS, WODC, The Hague, 2007.
- [44] M. Killias, S. Haymoz, P. Lamon, Swiss Crime Survey. Die Kriminalität in der Schweiz im Lichte der Opferbefragungen von 1984 bis 2005, Stämpfli, Bern, 2007.
- [45] A.L. Kellerman, et al., Gun ownership as a risk factor for homicide in the home, *The New England Journal of Medicine* 329 (1993) 1084–1091.
- [46] C.A. Okoro, D.E. Nelson, J.A. Mercy, L.S. Balluz, A.E. Crosby, A.H. Mokdad, Prevalence of household firearms and firearm-storage practices in the 50 states and the district of Columbia: findings from the behavioral risk factor surveillance system, 2002, *Pediatrics* 116 (2005) 370–376.
- [47] P. Nieuwebeerta, G. Leistra, *Lethal Violence. Homicide in the Netherlands 1992–2006*, Prometheus, Amsterdam, 2007.
- [48] C. Bijleveld, P. Smit, Homicide in the Netherlands: on the structuring of homicide typologies, *Homicide Studies* 10 (2006) 195–219.
- [49] M. Postular, P. Nieuwebeerta, *Homicide–suicide 1992–2006*, in: *Codebook and Documentation*, NSCR, Leiden, 2007.
- [50] M. Liem, F. Koenraadt, Homicide–suicide in the Netherlands: a study of newspaper reports, 1992–2005, *The Journal of Forensic Psychiatry and Psychology* 18 (2007) 482–493.
- [51] CBS, *Causes of Death Statistics*, Statistics Netherlands, Voorburg, 2007.
- [52] M. Killias, N. Markwalder, S. Walser, C. Dilitz, Homicide and suicide in Switzerland over twenty years (1980–2004): a study based on forensic medicine, police and court files, Report to the Swiss National Science Foundation no-101312-104167/1 (2009).
- [53] BFS, *Causes of Death Statistics Neuchâtel: Bundesamt für Statistik*, 2009.
- [54] CDC, *Coding Manual: National Violent Death Reporting System, NVDRS, Version 2*, Centers for Disease Control and Prevention, Atlanta, 2004.
- [55] L.J. Paulozzi, J. Mercy, L. Frazier, J.L. Annest, CDC's national violent death reporting system: background and methodology, *Injury Prevention* 10 (2004) 47–52.
- [56] CDC, National center for injury prevention and control, in: *Web-based Injury Statistics Query and Reporting System (WISQARS)*, Centers for Disease Control and Prevention, 2008.
- [57] ICPSR, *Codebook National Violent Death Reporting System, 2005*, Inter-university Consortium for Political and Social Research, Ann Arbor, MI, 2007.
- [58] M. Large, G. Smith, O. Nielsens, The epidemiology of homicide followed by suicide: a systematic and quantitative review, *Suicide and Life-Threatening Behavior* 39 (2009) 294–306.
- [59] B.E. Chabot, A. Goedhart, A survey of self-inflicted dying attended by proxies in the Dutch population, *Social Science and Medicine* 68 (2009) 1745–1751.
- [60] DDPS., 2008. *Schlussbericht der Arbeitsgruppe Ordonnanzwaffen (Final Report of the ordnance weapons working group)*. In Bern, Eidgenössisches Departement für Verteidigung, Bevölkerungsschutz und Sport VBS (Federal Department of Defence, Civil Protection and Sport (DDPS)).
- [61] E.D. Shenassa, S.N. Catlin, S.L. Buka, Lethality of firearms relative to other suicide methods: a population based study, *Journal of Epidemiology and Community Health* 57 (2003) 120–124.