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In the line of fire: firearm violence in Europe

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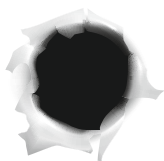
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Chapter 6



A Typology of Lethal and Non-Lethal Firearm Violence

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Missing the Mark? A Typology of Lethal and Non-Lethal Firearm Violence
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Abstract

Firearm violence in Europe is a complex phenomenon; it manifests itself in various contexts and circumstances, involving different types of victims and perpetrators. Yet, previous research does not account for this complexity and focuses mainly on lethal firearm violence alone. In this study, we use 243 cases of lethal shootings (2015-2021) and 807 cases of non-lethal shootings in the Netherlands (2018-2021) to build typologies of firearm violence using agglomerative hierarchical clustering. The analysis results show five distinct types: urban lethal shootings, urban injurious shootings, and urban non-injurious shootings, as well as suburban and rural shootings. Those categories differ mainly in the lethality, urbanity, context and location of the shootings. We conclude that the inclusion of non-lethal firearm violence is necessary in understanding and act upon this multifaceted problem.

Introduction

Firearms are considered the most lethal type of weapon commonly used in interpersonal violent encounters. Recent years have witnessed a substantial growth in empirical studies on firearm violence in Europe. These studies have explored the temporal and geographical trends of firearm homicides for particular populations (Frei et al., 2006; Sturup et al., 2019), the differences between firearm homicides compared to non-firearm homicides (Krüsselmann et al., 2023) and the links between firearms trafficking and firearm homicides (Duquet & Vanden Auweele, 2021; Florquin, 2021). What these studies also underline is the heterogeneous nature of firearm homicides, cross-nationally and compared to other weapons (Killias & Markwalder, 2012; Krüsselmann et al., 2023).

One aspect largely neglected in European studies on firearm violence is non-lethal firearm violence (Khoshnood et al., 2023; Sturup et al., 2018; Sturup et al., 2019). This lack of inclusion of non-lethal firearm violence data is problematic, for conceptual, empirical as well as practical reasons. On a conceptual level, it has been argued that (firearm) homicides may be used as an indicator for underlying non-lethal (firearm) violence (Liem, 2022; van Breen et al., 2023). Yet, the underlying assumption that homicides – and firearm homicides specifically – are homogeneous in nature to non-lethal shootings remains untested. Empirically, a focus on firearm homicides is problematic as it ignores the majority of firearm violence (Krüsselmann, 2023). Yet, there is a relative scarcity of publicly accessible statistics on non-lethal firearm violence, both on the national as well as regional level in Europe (Duquet & Vanden Auweele, 2021) and elsewhere (Hipple, 2022). The little accessible data is further diffused across various sources, including police files, medical data, or courts (Duquet & Vanden Auweele, 2021; Hipple, 2022; Kaufman & Delgado, 2022; Naik-Mathuria et al., 2021), making the process of obtaining relevant data complex and long. Finally, for practical reasons, the inclusion of non-lethal firearm violence data could help to inform and evaluate the effectiveness of prevention efforts against firearm-related violence. Currently, policy-briefings, reports and studies on the prevention of or interventions against firearm violence tend to use firearm homicides to describe the prevalence and importance of the issue or to evaluate certain countermeasures (European Commission Directorate-General for Enterprise and Industry, 2014; European Commission Directorate-General for Migration and Home Affairs, 2020; König et al., 2018). But if the majority of firearm violence is neglected, to what extent can we move forward in the quest for effective prevention and intervention efforts to reduce firearm violence?

The Heterogeneous Nature of Firearm Homicide

Firearm violence is a complex phenomenon. Both national and cross-national accounts show the various facets and characteristics of firearm homicides in Europe. These largely descriptive studies show how profiles of victims and offenders, context and motivations, situational factors of firearm homicides and the role of firearm availability vary (Duquet & Vanden Auweele, 2021; Khoshnood et al., 2023; Killias & Markwalder, 2012). For example,

in countries such as Finland and Switzerland, firearms are predominantly used in domestic homicides, whereas in countries such as Sweden and the Netherlands, firearm homicides are linked mostly to activities by organized crime groups or drug-related conflicts (Krüsselmann et al., 2023). In addition to cross-national variations, studies report various manifestations of firearm violence and profiles of victims or perpetrators within a country (Dressler, 2021; Khoshnood et al., 2023). Overall, this observed heterogeneity of firearm violence is not only observed in Europe, but other geographical regions as well (Dare et al., 2019).

In describing various types of firearm homicides, researchers tend to categorize firearm homicides based on the pre-established categories of the context in which they occur, for example domestic firearm homicides compared to robbery homicides, or drugs-related shootings (Cook et al., 2019; Krüsselmann et al., 2023; Pelletier & Pizarro, 2019). Yet, to the best of our knowledge, no study thus far has classified firearm homicides into data-driven types that fully account for the varieties of characteristics of firearm homicides even within a specific context.

Lethal and Non-Lethal Firearm Violence

Mostly omitted from the criminological literature on firearm violence in Europe are accounts of non-lethal firearm violence. This is problematic for the understanding of the broader phenomenon of firearm violence, that includes both lethal and non-lethal types of violence. In addition, research based on US-data found that lethal and non-lethal firearm violence incidents differ on victim characteristics, situational context of the shootings, types of firearms and medical factors (Alzheimer et al., 2019; Grommon & Rydberg, 2015; Hipple & Magee, 2017). For example, scholars seem to agree that the context of a shooting matters for the outcome, with shootings related to drug-crimes being associated with a higher likelihood for lethal outcomes (Alzheimer et al., 2019; Hipple & Magee, 2017). In one of the US-based studies, the shooting being drug-related increased the odds for a lethal outcome by 23 times, even when controlling for injury severity and victim characteristics (Hipple & Magee, 2017). On the other hand, shootings in the context of domestic violence increased the odds of the victim's death by almost ten and seven times, respectively.

More attention for and empirical data on non-lethal firearm violence can be found in public health studies, where data is commonly sourced from registers of injuries from emergency departments (Moore et al., 2013; Naik-Mathuria et al., 2021). From these sources, a number of health variables have been found relevant for the outcome of shootings, such as the number of gunshot wounds, the location of the gunshot wound, as well as medical response time (Crandall et al., 2013; Hipple & Magee, 2017). The location of the gunshot injury is considered one of the strongest predictor of a lethal outcome, with shots to vital parts of the body such as the head or chest increasing the odds of the victim's death by up to 130 times (Alzheimer et al., 2019; Cripps et al., 2009; Hipple & Magee, 2017). Although the relevance of the public health perspective to the study of firearm violence is recognized amongst (mainly US) criminologists, only few studies to date have empirically combined relevant factors to firearm lethality.

In the European context, studies comparing lethal to non-lethal firearm violence from either discipline are scarce at best. The few existing findings are mostly in line with findings from the context of the US, in that the context of firearm violence matters. Lethal firearm violence seems more common in the context of drug-related violence and domestic conflict, whereas robberies and drug-related extortions committed with a firearm commonly do not result in the death of a victim (Dressler, 2021; Liem & Krüsselmann, 2021). Whilst existing work provides valuable insights and hint at potential differences in the characteristics of firearm violence between lethal and non-lethal incidents, studies so far emphasize the scarcity of data on non-lethal firearm violence.

Thus, in conclusion, although empirical studies comparing lethal with non-lethal firearm violence are rare, they have identified several factors associated with either lethal or non-lethal firearm violence. This suggests that the broader phenomenon of firearm violence becomes even more complex when accounting for firearm homicides as well as non-lethal firearm violence incidents. Therefore, in this study, we aim to identify types of firearm violence that are not just based on firearm homicides but extend to non-lethal violent firearm incidents.

Goal of This Study

In this study, our aim is twofold: first, we seek to identify distinct types of shootings based on individual-level data for both lethal and non-lethal shootings. Second, in building a data-driven typology, we aim to address the question whether firearm homicides and non-lethal firearm violence are distinct typologies or whether the assumption that firearm homicides can be used as an indicator for non-lethal firearm violence is supported. The answer to this question has implications for future theoretical and empirical research and the conceptualization of firearm violence in the European context.

Methodology

Data

This study makes use of two related data sources: the Dutch Firearm Violence Monitor and the Dutch Homicide Monitor whose data collection instruments share compatible key features. The Dutch Firearm Violence Monitor contains detailed information on all police-registered shootings in the Netherlands between 2018 and 2021. Initial registrations of shootings from the *Basisvoorziening Handhaving Register* – a registration system of crimes – by the Dutch National Police form the base of the Dutch Firearm Violence Monitor. The registration makes distinctions between the following types of shootings relevant for this study: (1) lethal shootings, (2) shootings resulting in physical injuries, and (3) shootings at individuals that do not result in physical injuries. Threats with firearms in which no shot is fired are not included. To fill gaps of information from the police registrations, additional information from public court decisions, media articles and ballistic information from the Dutch Forensic Institute

have been manually matched to incidents (based on location and date of the incident), and then incorporated into the Dutch Firearm Violence Monitor where possible.

The second data source for this study is the Dutch Homicide Monitor. The Dutch Homicide Monitor contains all homicides – including firearm homicides – committed between 1992 and 2021 that fall under the legal codes of murder, manslaughter and infanticide. Not included are assaults leading to death or legitimate killings, such as lethal shootings by police officers on duty. Detailed information on the homicide cases, victims and perpetrators is gathered through a number of public sources – news articles, court decisions – and non-publicly accessible sources, such as police and court files, as well as forensic reports. For this study, only firearm homicides from the Dutch Homicide Monitor are extracted and used in the analyses.

For this study, data from the Dutch Firearm Violence Monitor and Dutch Homicide Monitor have been merged into one dataset. This is possible due to the overlap in the data collection instruments. For the Dutch Homicide Monitor, detailed data on case-, victim- and perpetrator characteristics is collected following the validated framework of the European Homicide Monitor (Granath et al., 2011). The data collection instrument of the Dutch Firearm Violence Monitor follows the same structure and definitions of the Dutch Homicide Monitor whilst also allowing for aspects of non-lethal violence to be captured.

Although studies indicate that animals or objects could be considered proxies for individuals (Newberry, 2017), the information available to us did not allow for a reliable classification of such shootings as proxies. Therefore, accidental shootings, and suicide(attempts) were excluded in the analysis. Around 50 shootings at individuals for which the non-lethal outcome was unclear were excluded as well. Following this criterium, 126 cases of lethal shootings, 488 injurious shootings and 319 non-injurious shootings at a person between 2018 and 2021 from the Dutch Firearm Violence Monitor are included in the analysis. Due to the relatively small number of annual firearm homicides compared to non-lethal shootings in that period, we expanded the timeframe for firearm homicides to 2015-2021, so that in total the analysis is based on 243 cases of lethal and 807 cases of non-lethal shootings.

Variables

Based on the existing literature, several variables regarding victim characteristics, situational context and injury factors have been selected for inclusion in the analysis.

Victim characteristics: This study includes two variables related to the victim. The victim's gender is a binary variable, indicating the gender as assigned during birth as either male or female. In addition, the relationship between victim and perpetrator is indicated by three categories, commonly used in previous studies (Fox & Allen, 2014; Pizarro et al., 2019): Family or (ex-)partners, acquaintances, and strangers.

Situational context: Four variables indicate the situational context of the shootings. The context of the shootings is identified through three categories: domestic shootings (shootings directed at (ex-)partners, (step)kids, or other family members), shootings related to robberies (of private homes, businesses or street robberies) or criminal milieus

(e.g. rip deals, assassinations) and, finally, other contexts – a category which mainly includes disputes unrelated to the criminal milieu, such as disputes between neighbors, (ex-)business partners etc. These categories are typically used to categorize lethal firearm shootings, but are yet to be tested on non-lethal firearm violence (Krüsselmann et al., 2023; Pelletier & Pizarro, 2019). We further distinguished between urban, suburban and rural areas within the Netherlands, following classifications of the European statistical agency (Eurostat, 2023). In addition, we captured the type of crime scene, differentiating between private locations (homes, hotels or institutions), public recreational locations outside (parks, forests, etc.), public recreational locations inside (bars, restaurants, clubs etc) and streets, roads and public transportation that are not linked to recreational. Finally, suicide attempts and suicides were combined into one category, indicating whether the suspect of the shooting attempted to commit suicide after the shooting.

Injury variables: First, a binary variable indicates whether the shooting resulted in a lethal or non-lethal outcome. In shootings that resulted both in non-lethal as well as lethal injuries to several victims, the shooting was classified as lethal. We differentiate between shootings committed with handguns (pistols, revolvers, converted gas/alarm pistols, unknown types of handguns), long guns (rifles, shotguns, machine guns, unknown types of long guns) and other types of guns (alarm pistol, gas pistol, combination gun, Flaubert, air gun etc). The position of the gunshot wound is divided into three categories: injuries at the head or neck, at the chest, abdomen or back and at other locations, such as the extremities.

Analyses

To meet our first aim, we performed hierarchical cluster analysis. Hierarchical cluster analysis requires distance measures as a unit of analyses. Consequently, the originally categorical dataset had to be transformed through Multiple Correspondence Analysis (further discussed and results presented in Supplementary Material). Multiple Correspondence places each of the variable categories into a two- or higher dimensional space, based on their principal component (Le Roux & Rouanet, 2010). The closer the proximity of categories in this space, the closer their multivariate relationship – in other words, the more often they occur together in individuals, or, in the case of this study, shootings. Multiple Correspondence Analysis thus quantifies variable categories by associating them with coordinates – the distance measure necessary for cluster analysis. For the cluster analysis, we used agglomerative hierarchical clustering following Ward's method which is suitable for the type of our data. In this type of agglomerative clustering, each case – shootings in this study – starts off as its own cluster which are then progressively merged further based on their similarity to each other (Miyamoto, 2022). There are various methods to merge clusters; Ward's linkage method of clusters aims to minimize the variance within each cluster. For the clustering, we used the *HCPC* function of the *FactoMineR* package (Lê et al., 2008).

To meet our second aim, we present descriptive statistics of the included shootings, differentiated by lethal and non-lethal outcome. We ran Chi-Square tests on frequencies, for statistical significance. These analyses provide an overview of the characteristics of

shootings in the Netherlands and a preliminary answer to the question whether lethal and non-lethal shootings differ from one another in those characteristics. Therefore, they are presented first in the following result section. Throughout the results, we present percentages of known cases. Specific frequencies are not displayed in the tables to adhere to ethical agreements made with providers of the data and the authors' affiliated institute.

Results

Descriptive Statistics

Focusing on the four most recent years for which a differentiation between lethal, injurious and non-injurious categories was possible, on average 230 shootings at individuals took place annually. Between 35 and 55 percent of these shootings resulted in non-lethal injuries; between twelve and 17 percent in lethal injuries (see Table 6.1). That means that for every lethal shooting, there were 3.8 shootings resulting in non-lethal injuries and 6.3 non-lethal shootings overall.

Table 6.1: Number and distribution of shootings by type of outcome in the Netherlands, 2018-2021 (Dutch Firearm Violence Monitor)

	N total shootings at individuals	Non-injurious	Non-lethal injury^a	Lethal injury
2018	269	111 (41.2%)	120 (44.6%)	33 (12.3%)
2019	247	92 (37.2%)	132 (53.4%)	30 (12.1%)
2020	221	59 (26.7%)	133 (35.4%)	31 (14%)
2021	186	57 (30.6%)	103 (55.4%)	32 (17%)

^a data derived from Dutch National Police

Lethal Compared to Injurious and Non-Injurious Shootings

A first descriptive comparison of the relevant variables for lethal, non-lethal injurious and non-injurious shootings reveals significant differences on all but three of the variables (see Table 6.2). Amongst lethal shootings, shootings in private and recreational locations, and rural areas are more common. Equally, shootings committed with long guns and injuries to vital parts of the body, such as head, neck, abdomen, or chest are most prevalent in this category. In addition, suicide(attempts) by the perpetrator following the shooting are only associated with lethal shootings. Distinct features of non-lethal injurious shootings are the low fraction of shootings in the domestic context and relatively many dispute-related shootings, few shootings in rural locations and no injurious shootings in which the perpetrator attempted to or succeeded in committing suicide. In addition, injuries to non-vital parts of the body and relatively few shootings with long guns set injurious shootings apart from lethal and non-injurious outcomes. Finally, non-injurious shootings are associated with relatively many domestic conflicts and fewer shootings in the criminal

milieu, the use of firearms other than handguns and long guns and no registered (attempts of) suicides by the perpetrator. In addition, there are relatively few non-injurious shootings in urban areas and in private locations, but more so in public streets.

Table 6.2: Descriptive statistics of lethal (2015-2021) and non-lethal injurious and non-injurious shootings (2018-2021) in the Netherlands; % of known cases & chi-square results

	Lethal	Non-lethal injurious	Non-injurious
Victim Gender	$\chi^2=2.0376$, $p=0.361$		
Male	89.2%	93.1%	91.5%
Female	10.8%	6.9%	8.5%
Missing	14	239	226
Victim-Perpetrator Relationship	$\chi^2=6.2513$, $p=0.181$		
(Ex-)Partner & Family	22.5%	10.9%	17.3%
Acquaintances	46.5%	58.4%	50%
Strangers	31%	17.3%	32.7%
Missing	84	354	256
Context Violence	Fisher's exact, $p=0.014$		
Domestic	20.8%	13%	34.5%
Criminal Milieu/ Robbery	74.5%	71.4%	58.6%
Dispute	4.7%	15.6%	6.9%
Missing	77	378	279
Crime Scene	$\chi^2=99.443$, $p=0.000$		
Public – recreational outside	20.1%	4%	5.1%
Public – recreational inside	9.6%	6.5%	4.7%
Public – streets & public transport	44%	74.8%	81.6%
Private	26.3%	14.7%	8.6%
Missing	27	102	52
Type Firearm	$\chi^2=24.273$, $p=0.000$		
Handgun	73.7%	75.8%	64.9%
Long Gun	21.2%	8.3%	11.7%
Other Firearm	5.1%	15.9%	23.4%
Missing	70	323	231
Injury	$\chi^2=522.14$, $p=0.000$		
Head/Neck	55.4%	10.7%	0%
Chest/Abdomen/ Back	43.8%	23.3%	0%
Other bodypart	0.8%	63%	0%
No injury	0%	0%	100%
Missing	105	305	202

Table 6.2: Continued

	Lethal	Non-lethal injurious	Non-injurious
Urbanization	$\chi^2=10.291$, $p=0.036$		
Urban	77.9%	75.8%	70.8%
Suburban	13.7%	19.6%	22.7%
Rural	8.4%	4.6%	6.5%
Missing	0	0	0
Perpetrator Suicide	Fisher's Exact: $p=0.000$		
(Attempted) suicide	8.3%	0%	0%
No (attempted) suicide	91.7%	0%	0%
Missing	57	300	234
Time of Shooting	$\chi^2=4.5191$, $p=0.104$		
Daytime (6am-6pm)	36.7%	29.4%	35.1%
Nighttime (6pm-6am)	63.3%	70.6%	64.9%
Missing	11	10	6
N Total	243	488	319

Typologies of Shootings

All non-injurious (N=319) and injurious (N=488) shootings between 2018 and 2021 and lethal shootings (N=243) committed between 2015 and 2021 were clustered based on their principal components. In total, five clusters – that is typologies of shootings – were identified (see Table 6.3). The lethality, urbanity of the location and type of injury associated with the shootings are the three most important variables differentiating the clusters overall. In the following section, for each cluster, the defining characteristics specific to that cluster, as well as on overall description with percentages of known cases (thus excluding missing cases) are presented.

Table 6.3: Cluster descriptions; % of known cases & chi-square test results; ordered by contribution to creation of typologies.

	CLUSTER 1 Lethal urban shootings	CLUSTER 2 Injurious urban shootings	CLUSTER 3 Non- injurious urban shootings	CLUSTER 4 Suburban shootings	CLUSTER 5 Rural shootings
Lethality	$\chi^2=1540.5$, $p=0.000$				
Lethal	98.5%	0%	0%	8.6%	31.7%
Non-lethal injurious	1.5%	100%	0%	51.1%	35%
Non-injurious	0%	0%	100%	40.2%	33.3%
Missing	0	0	0	0	0

Table 6.3: Continued

	CLUSTER 1 Lethal urban shootings	CLUSTER 2 Injurious urban shootings	CLUSTER 3 Non- injurious urban shootings	CLUSTER 4 Suburban shootings	CLUSTER 5 Rural shootings
Urbanization	Fisher's Exact p=0.000				
Urban	91.8%	100%	100%	0%	0%
Suburban	8.2%	0%	0%	100%	0%
Rural	0%	0%	0%	0%	100%
Missing	0	2	0	0	0
Injury	Fisher's Exact p=0.000				
Head/Neck	57.9%	13.4%	0%	0%	31.6%
Chest/Abdomen/Back	39.3%	19.6%	0%	29.8%	36.8%
Other bodypart	1.9%	64.3%	0%	29.8%	21.1%
No injury	0.9%	2.7%	100%	40.4%	10.5%
Missing	88	240	136	118	42
Context Violence	Fisher's Exact p=0.042				
Domestic	20.8%	8.3%	31.8%	25.8%	29.4%
Criminal Milieu/ Robbery	74.4%	75%	63.6%	64.5%	64.7%
Disputes/Other	4.8%	16.7%	4.6%	9.7%	5.9%
Missing	70	292	196	144	44
Victim Gender	Fisher's Exact p=0.046				
Male	89.6%	91.9%	89.2%	98.6%	82.1%
Female	10.4%	8.1%	10.8%	1.4%	17.9%
Missing	13	180	153	106	33
Perpetrator Suicide	Fisher's Exact p=0.000				
Suicide(attempt)	7.7%	0%	0%	0%	13%
No suicide(attempt)	92.3%	100%	100%	100%	87%
Missing	53	236	162	114	38
Type Firearm	Fisher's Exact p=0.011				
Handgun	72.5%	73.7%	67.2%	75.9%	75%
Long Gun	21.7%	8.4%	13.8%	7.4%	15%
Other firearm	5.8%	17.9%	19%	16.7%	10%
Missing	57	257	160	121	41
Crime Scene	Fisher's Exact p=0.000				
Public – recreational outside	19.9%	2.2%	5.2%	4.5%	26.2%

Table 6.3: Continued

	CLUSTER 1 Lethal urban shootings	CLUSTER 2 Injurious urban shootings	CLUSTER 3 Non- injurious urban shootings	CLUSTER 4 Suburban shootings	CLUSTER 5 Rural shootings
Public – recreational inside	9.9%	6.7%	3.6%	5.3%	11.9%
Public – streets & public transport	44.8%	77%	82.8%	72.2%	50%
Private	25.4%	14.1%	8.3%	18%	11.9%
Missing	14	82	26	42	19
Victim-Perpetrator Relationship	Fisher's Exact p=0.103				
(Ex-)Partner/ Family	21.7%	8.3%	17.9%	14.6%	37.5%
Acquaintances	44.2%	59.7%	51.3%	56.2%	50%
Strangers	34.1%	32%	30.8%	29.2%	12.5%
Missing	75	280	179	127	45
Time of shooting	$\chi^2=4.9031$, p=0.297				
Daytime (6am-6pm)	35.5%	28.3%	35.2%	35.3%	35.1%
Nighttime (6pm-6am)	64.5%	71.7%	64.8%	64.7%	64.9%
Missing	5	16	5	5	4
N Total	195	368	232	193	62

Type I – *Urban lethal shootings* – includes 195 shootings. Most shootings in this category have a lethal outcome (98.5%, v-test=27.4), are committed against male victims (89.6%, v-test=11.74) and result in injuries to the head or neck (57.9%, v-test=11.51). Overall, there are relatively few missings in this type of shooting.

Shootings of this type occur almost exclusively in urban centres of the Netherlands and are more likely to take in private spaces (25.4%) and outside recreational spaces (19.9%), whereas shootings in the streets are less common (45%) compared to other types. Around two thirds of the shootings take place at night (64.5%). Here, most shootings occur in the context of the criminal milieu (74.4%) or in domestic conflicts (20.8%). The share of stranger homicides (34.1%) in this category is comparatively high. Further, although handguns are still used in most of these shootings, the relatively high frequency of long guns (21.7%), such as automatic rifles, stands out. Finally, a small yet distinguishing fraction of the shootings were followed by the suicide(attempt) of the perpetrator (7.7%).

Type II – *Urban injurious shootings*– includes 368 shootings and is as such the type with the largest fraction of shootings. All resulted in non-lethal injuries (100%, v-test=26.18) and all took place in an urban environment (100%; v-test=15.45). Compared to all shootings

taken together, relatively much information regarding the victims and situational context of the shootings in this type remains unknown.

Shootings in this category mostly occur at night (71.7%) and in the streets (77%). Similar to other typologies, the largest fraction of urban injurious shootings are related to organized crime groups or robberies, yet the relatively low fraction of domestic conflicts (8.3%) and high fraction of dispute-related shootings (16.7%) differentiates this type of shooting from the others. More than 90 percent of these injurious shootings occur amongst acquaintances (59.7%) or strangers (32%). Victims are mostly male (91.9%) and wounded in non-vital body parts (64.3%), such as their limbs. The use of non-traditional firearms (17.9%), such as converted alarm- or gas-pistols, is setting this type apart from others. Finally, no suicides or attempts thereof are registered for any of the urban injurious shootings.

Type III – *Urban non-injurious shootings* – (N=218) is the second biggest category. None of the shootings of this type resulted in any physical injury (lethality: 100%, v-test=25.87; injury: 100%, v-test=12.50), and all took place in urban areas (100%, v-test=11.90).

Based on available data, the share of shootings taking place in streets outside of recreational places is high (82.8%) compared to the other types, whilst shootings in private homes are relatively rare (8.3%). The majority of shootings (63.6%) in this category is associated with the criminal milieu or robberies, and about half (51.3%) of involve acquaintances. About 90 percent of victims are male, and none of the perpetrators identified in this category is known to have committed or attempted suicide.

Type IV – *Suburban shootings* – includes 193 shootings and is characterized almost exclusively by taking place in smaller cities or towns that do not qualify as either urban nor rural (100%, v-test=28.43).

Within these suburban locations, most shootings take place on the streets (72%), although a comparatively high percentage occurs in private locations (18%). Similar to the other types, around two thirds of suburban shootings take place between 6pm-6am and the majority of these shootings can be linked to organized crime activities or robberies (64.5%). Around a quarter of the shootings are the result of domestic disputes (25.8%). With half of the shootings involving acquaintances and about 30 percent strangers, the victim-perpetrator relationship is not significantly different from the other typologies. What sets this type apart are victim- and firearm-characteristics, with significantly more male victims (98.6%) and fewer long guns (7.4%) involved. A little over half of the shootings resulted in nonlethal injuries, and less than ten percent (8.6%) in lethal injuries. There are no known cases of injuries to the head, but around thirty percent to the chest, abdomen or back and equally thirty percent to non-vital body parts.

Finally, 62 shootings constitute the base of the fifth type, *Rural shootings*. As the label of the type already indicates, these shootings exclusively take place in rural areas (100%; v-test=21.14). In this category a relatively large fraction takes place in recreational spaces (recreational outside, 26.2%; recreational inside, 11.9%). The majority of shootings (64.7%) in rural areas is connected to organized crime activities or robberies; about 30 percent to domestic conflicts. The fraction of shootings involving acquaintances (50%) is similar to the other typologies, but the share of (ex)partners or family members is higher (37.5%), and

shootings amongst strangers lower (12.5%). Victim- and firearm-related characteristics also differ from other categories, with rural shootings involving comparably fewer male victims (82.1%) and a relatively high share of long guns (15%). Finally, the outcome of these shootings was proportionally divided into lethal (32%), injurious (35%) and non-injurious (33%), in spite of the fact that about two thirds of the shootings were to vital parts of the body (31.6% head/neck; 36.8% chest/abdomen/back). With thirteen percent, rural shootings have the highest share of (attempted) suicides by the perpetrator.

Discussion

This study had two aims: First, we aimed to develop types of lethal and non-lethal shootings through hierarchical cluster analysis using detailed information regarding victims, situational contexts, and medical factors. In light of our first aim, our results indicate the existence of five distinct types of firearm violence in the Netherlands, which are most significantly differentiated by the outcome and space: *urban lethal shootings*, *urban injurious shootings*, *urban non-injurious shootings*, *suburban shootings* and *rural shootings*.

Together, this new data-driven typology of shootings provides a unique, in-depth picture of firearm violence in the Netherlands. Some of these types match with profiles of shootings sketched in previous studies or reports (Dressler, 2021; Hipple & Magee, 2017; Weaver et al., 2004). For example, *urban lethal shootings* fit the profile of targeted assassinations, which are instigated by organized crime groups to retaliate or 'solve' a conflict outside of the legal system. On average 20 to 30 of such contract killings take place each year in the Netherlands; they are typically committed by a hired hand who does not have a relation with the victim, with fully automatic firearms that can fire multiple shots in a short amount of time (Van Gestel & Kouwenberg, 2021). In addition, shootings included align with studies on domestic homicide, which usually include a high share of female victims (Chopra et al., 2022; Stöckl et al., 2013), take place in private spaces (Cussen & Bryant, 2015), and are strongly associated with (attempted) suicide by the perpetrator (Liem & Koenraadt, 2018).

Our findings are also in line with previous studies on the nature of firearm violence. For example, we find across the types of shootings that domestic conflicts and conflicts between (ex-) partners or other family members rarely lead to injuries, but either lethal or non-injurious outcomes, a finding in line with studies on firearm use and the lethality of domestic assaults (Dressler, 2021; Hipple & Magee, 2017; Weaver et al., 2004). In another example, our findings emphasize the importance of health-related factors and their association with lethality of shootings: 98 percent of lethal shootings recording injuries to vital areas of the body, such as head, neck, chest, abdomen or back. In contrast, in only around 33 percent of injurious shootings, gunshots to these areas were registered, which is in line with previous studies on health-related predictors of lethal shootings (Alzheimer et al., 2019; Hipple & Magee, 2017). The two most distinguishing factors of all types – urbanization and lethality – deserve further examination. As our findings show, the vast majority of shootings in the Netherlands take place in urban centres, such as Amsterdam, Rotterdam and The Hague. Such a concentration of gun violence is mirrored in both

European countries (Gerell et al., 2021; Krüsselmann et al., 2023), and in the United States (Branas et al., 2004). Studies suggest that such a concentration occurs across degrees of urbanity and on a local level within urban centres, associated with illegal activities, such as drug-related crimes (Contreras & Hipp, 2020; Gerell et al., 2021; Silveira Neto et al., 2023). Our findings are in line with this observation, given that most shootings overall are also related to activities by organized crime groups or robberies. In the Netherlands, violence associated with these activities is commonly linked to cocaine-trafficking through the port of Rotterdam and subsequent trafficking within the country and across borders (Liem & Krüsselmann, 2021). Suburban and rural areas may experience less of such systemic drug-related firearm violence.

The strongest contributing factor to the establishment of the clusters, however, was the lethality of the shootings. As our findings show, lethal, injurious, and non-injurious shootings differ across their context, the urbanity, type of crime scene, and other factors. In other words, firearm homicides in the Netherlands are structurally different from non-lethal firearm shootings. This finding contradicts previous US-studies arguing that “[...] fatal and nonfatal [shootings], are statistically indistinguishable with respect to circumstances, with the sole exception of whether the shooting was indoors or outdoors” (Cook et al., 2019, p. 526). The characteristics of lethal shootings in the US come closest to the characteristics of in the cluster of *urban lethal shootings*, such as the (disproportionate) use of long guns with high caliber bullets (Braga & Cook, 2018; Zimring, 1972), or gunshot wounds to the head, chest, abdomen or back (Alzheimer et al., 2019; Hipple & Magee, 2017).

Coming back to our second aim, we need to address the assumption that firearm homicides may be used as an indicator for underlying non-lethal firearm violence. At least for the Dutch context, this assumption is not supported, as victim- and contextual characteristics differed across the outcome of shootings and lethality was a defining factor for the creation of the different typologies.

This conclusion implies that we should take a critical look at current theoretical approaches to firearm violence and empirical research, which mostly fail to address such heterogeneity. As most existing theoretical approaches to firearm violence focus on lethal cases alone (Heide, 1993; Krüsselmann et al., forthcoming (Chapter 5); Rennison et al., 2011), one may question to what extent these approaches are applicable to and hold explanatory power over non-lethal firearm violence. Future research on theoretical approaches to firearms need to address this gap, by accounting for non-lethal firearm violence, as well as lethal violence. Our findings have similar implications for future empirical work seeking to inform policymaking related to firearm violence, such as evaluations of prevention and intervention methods. When such methods are designed to tackle firearm violence overall – thus including non-lethal shootings – an evaluation solely based on firearm homicide data, as is currently the norm in the European context (Gjertsen et al., 2014; Hurka & Knill, 2020), is insufficient. Should future prevention strategies only be based on and informed by research on firearm homicide, their effectiveness may be limited only to the small fraction of lethal shootings, instead of addressing the majority of non-lethal firearm violence. Thus, systematic registration of non-lethal firearm violence by

law enforcement and inclusion in criminological research is necessary not just to improve the criminological understanding of firearm violence in Europe and elsewhere, but also to enhance policymaking tackling firearm violence.

Limitations

The findings presented in the previous section must be interpreted in the light of their limitations. The most significant limitation may be the low number of shootings overall. With a little over a thousand shootings, this study includes all shootings in the Netherlands which (a) are directed at an individual and (b) for which the outcome is known. However, disaggregating these shootings across their outcomes and several other variables results in relatively small clusters, such as the category of rural shootings which is based only on 61 shootings. A bigger population would ensure a more reliable clustering and, consequently, strengthen the generalizability of our findings. One way to increase the population of shootings would be to include threats against individuals in which no shots are fired, which was not possible in this study due to a lack of uniform registration of such incidents on the national level. A second option would be to consider proxies of individuals, such as objects or animals who are targeted to threaten or intimate a victim (Newberry, 2017). This approach was deemed too unreliable for this study, as the available information did not allow for proxies to be defined, yet should be considered for future studies.

Another shortcoming is the large fraction of missing information, in particular in non-lethal shootings. Some of the missing information may be due to the lack of available and reliable sources to the authors of this study. Yet, another part of the missing data may be non-random, because perpetrator information is not available for unsolved shootings or because victims may not report to the police when involved in criminal activities themselves (Cook et al., 2019; Hipple et al., 2019). However, there are reasons to believe that part of the missing information is linked to shortcomings in the data sources used for this study. Data registration of non-lethal shootings in particular is poor; data received from law enforcement was restricted in detail, forcing the researchers to use public sources, such as court decisions or media articles as substitutes. However, compared to lethal shootings, such public sources on non-lethal shootings contain relatively little and reliable details about victims, perpetrators or specific technical information about the firearm used. As a consequence, the validity of the categories to the extent that they are constructed based on missing data – in particular types II-IV – may be questioned. This study underscores the need for better registration of non-lethal shootings at the level of law enforcements to enable better data quality for future studies.

Another limitation is the geographical context. This study only includes lethal and non-lethal shootings that occurred in the Netherlands. As a recent previous study found, characteristics of firearm homicides differ across European countries (Krüsselmann et al., 2023): firearm homicides in the Netherlands are closely connected to often drug-related activities by organized crime groups and disputes between criminals, whereas firearm homicides in Switzerland or Finland, for example, took place mainly in the context of domestic violence. It can be assumed then that similar exploration of differences between lethal and non-lethal shootings may equally differ across countries. In the US, for example, lethal and non-lethal shootings show

significant overlap (Cook et al., 2019). In addition, trends in firearm violence over time may change the characteristics of typologies presented in this study. Unfortunately, the lack of registration of non-lethal firearm violence and a common framework for collecting such data currently inhibits cross-national comparative and longitudinal research that includes non-lethal violence. To overcome this problem, the adaption of a common detailed data collection instrument, such as the Dutch Firearm Violence Monitor, that allows for cross-national cultural variations, as well as variations in the availability of data sources is needed.

Conclusion and Future Directions

This study explored typologies of lethal and non-lethal shootings in the Netherlands. Results of the hierarchical cluster analysis revealed five different clusters, which differ in lethality, degree of urbanization, type of gunshot injury, context of the shooting and situational characteristics such as location of the crime scene. In spite of its limitations, these clusters add another layer to our understanding of firearm violence: Previous research already indicated the heterogenous nature of (a) firearm homicides compared to homicides committed with other weapons and (b) the characteristics of firearm homicides when compared cross-nationally (Duquet & Vanden Auweele, 2021; Killias & Markwalder, 2012; Krüsselmann et al., 2023). In this study, we show that firearm violence in itself is also heterogenous. The findings further support the necessity for the inclusion of public health factors in future studies on lethality of shootings, which has been noted by previous studies in the United States (Grommon & Rydberg, 2015; Magee et al., 2021). Although the inclusion of injury variables in this study was limited, more factors associated with lethality of assaults should be taken into account in the future, such as medical response time and type of (specialised) trauma intervention (Circo & Wheeler, 2021; Crandall et al., 2013).

Above all, this study calls for further exploration of non-lethal firearm violence. Due to limited data availability and lack of common definitions of non-lethal firearm violence, non-lethal shootings or threats with firearms are rarely included in empirical studies, with the consequence that the majority of knowledge on firearm violence is built on the smallest fraction – lethal firearm violence. This study emphasizes the usefulness to explore non-lethal firearm violence further; for example, geographically, by examining near-repeat patterns of lethal and non-lethal shootings (Sturup et al., 2018) or by assessing whether policies targeted at firearm violence have the same impact on lethal and non-lethal violence. Improved registration of non-lethal firearm violence is essential to this goal. Following examples from the United States, European firearm violence researchers should consider the exploration of public health data to cover the void of existing accessible statistics and gaps in criminal justice data (Kaufman & Delgado, 2022; Naik-Mathuria et al., 2021). Better registration also requires a detailed collection instrument. The Dutch Firearm Violence Monitor is a first attempt of developing such a data collection instrument, with this study serving as a proof-of-concept of its usefulness. Hopefully, the Dutch Firearm Violence Monitor will be used to guide and enable future studies that include much needed non-lethal firearm violence data, thereby improving a better understanding of firearm violence as a whole and reshape future conceptualizations of firearm violence.