

Trends in weapon-related injuries from violence in Odense Municipality, Denmark 1991-2009

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ABSTRACT

INTRODUCTION: The aim of this study was to examine the development in incidence rates and the severity of weapon-related physical interpersonal violence in Odense Municipality, Denmark from 1991 to 2009.

METHODS: All victims of physical interpersonal violence with weapon-related injuries treated at the Emergency Department in the 1991-2009 period at Odense University Hospital, Denmark, and/or subjected to medico-legal autopsy at the Institute of Forensic Medicine in the 1991-2009 period at the University of Southern Denmark were included. Incidence rates were estimated following stratification by gender and age. The development in the incident rates was examined.

RESULTS: Overall, 2,957 victims were included. The overall incidence rate was 8.5 per 10,000 population/years (14.6 and 2.7 for males and females, respectively). The rates did not change significantly in the study period. Most victims were injured with bottles/glass and blunt weapons (44.8% versus 28.2%), whereas 24% were injured with sharp weapons and 3% with firearms. Most lesions were sustained to the head/neck (56.1%) and to the upper limbs (26.2%). A total of 182 (6.1%) victims had lesions that were considered severe. The mortality rate was 4.8 per 1,000 victims in males and 29.1 per 1,000 victims in females. More than half (57%) of the homicides were caused by lesions due to sharp weapons.

CONCLUSION: Weapon-related injuries are rare in the Odense Municipality. The incidence rate of weapon-related violence did not increase in the study period. Additionally, no evidence of an increased proportion of severe injuries was found. Women had a seven-fold higher mortality than males.

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Frequently, the media claims that weapon-related violence is a growing problem. The news media mostly rely on crime statistics. Studies advocate that the use of hospital data gives a more accurate estimate [1-4].

Few Danish studies have described the development in weapon-related injuries. Skov et al found an increased proportion of incidents involving objects [5]. Faergemann et al found no significant change in cases involving knives

or firearms in the 1991-2002 period [6]. Brink concluded that the frequency of penetrating violence and the use of weapons remained unchanged by comparing 1993-1994 with 1981-1982 and 1987-1988 [3].

Boström et al found an increased frequency of admitted Swedish patients caused by stab wounds in the 1985-1993 period [7].

No previous long-term Scandinavian studies have described the development in incidence rates and the severity of weapon-related injuries. Although this subject is not well investigated in Scandinavia, there has been an increasing public and political focus on weapons. Special attention has been paid to carrying of knives in public. The present study is conducted on the background of the apparently misleading information in the news media, the lack of relevant studies and the increased focus on weapons.

The aim of this study was to examine the development in incidence rates and the severity of weapon-related physical interpersonal violence in Odense Municipality in the 1991-2009 period.

METHODS

Included were all victims of violence with use of weapons treated at the emergency department (ED), Odense University Hospital, Denmark, and/or victims subjected to medico-legal autopsy at the Institute of Forensic Medicine (IFM), University of Southern Denmark in the 1991-2009 period. Only inhabitants of Odense Municipality were included. The victims had to declare that the incident had been caused by assault, and only those caused by physical interpersonal violence, as defined by the World Health Organization, were included [8]. Information from the patient registration system and autopsy reports was registered prospectively.

Before 1994, the victims were diagnosed by the ICD-8 codes, and from 1994 and onwards the ICD-10 codes were used. Physicians registered the diagnosis. All victims who died were subjected to medico-legal autopsy at the IFM. The ED situated in the city centre is open 24 hours a day, seven days a week.

The municipality has a population of 188,000, corresponding to 3.4% of the population of Denmark. There is only one ED and IFM in the municipality.

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TABLE 1

The number of victims, the population at risk, the incidence rates per 10,000 individuals/year (IR), and the 95% confidence intervals (CI) stratified by gender and age groups.

Age group, yrs	Males			Females			All		
	n	population	IR (95% CI)	n	population	IR (95% CI)	N	population	IR (95% CI)
0-14	107	301,277	3.6 (2.9-4.3)	44	289,579	1.5 (1.1-2.0)	151	590,856	2.6 (2.2-3.0)
15-24	1,057	251,121	42.1 (39.6-44.7)	166	258,618	6.4 (5.4-7.5)	1,223	509,840	24.0 (22.7-25.4)
25-39	894	424,018	21.1 (19.7-22.5)	151	404,059	3.7 (3.2-4.4)	1,045	828,077	12.6 (11.9-13.4)
40-59	383	438,587	8.7 (7.9-9.6)	101	444,486	2.3 (1.0-2.8)	484	883,073	5.5 (5.0-6.0)
≥ 60	40	285,471	1.4 (1.0-1.9)	14	395,485	0.4 (0.2-0.6)	54	680,956	0.8 (0.6-1.0)
All	2,481	1,700,474	14.6 (14.0-15.2)	476	1,792,227	2.7 (2.4-2.9)	2,957	3,492,701	8.5 (8.2-8.8)

TABLE 2

The gender-specific rate ratios between the incidence rates in the different time periods.

Gender	Time period	Rate ratio (95% CI)	p-value ^a
All	1991-1993 vs. 1999-2001	0.83 (0.74-0.94)	0.003↑
	1999-2001 vs. 2007-2009	1.28 (1.14-1.45)	< 0.001↓
	1991-1993 vs. 2007-2009	1.07 (0.94-1.22)	0.938
Males	1991-1993 vs. 1999-2001	0.82 (0.71-0.92)	0.003↑
	1999-2001 vs. 2007-2009	1.33 (1.16-1.52)	< 0.001↓
	1991-1993 vs. 2007-2009	1.08 (0.94-1.22)	0.280
Females	1991-1993 vs. 1999-2001	0.91 (0.68-1.32)	0.545
	1999-2001 vs. 2007-2009	1.13 (0.84-1.52)	0.404
	1991-1993 vs. 2007-2009	1.01 (0.75-1.37)	0.938

CI = confidence interval.

↓) A significant ($p < 0.05$) decrease in the incidence rate.

↑) A significant ($p < 0.05$) increase in the incidence rate.

a) χ^2 -test.

TABLE 3

The gender-specific rate ratios between incidence rates in the different time periods in the age groups 15-24 and 25-39 years.

Age group, yrs	Gender	Time period	Rate ratio (95% CI)	p-value ^a
15-24	All	1991-1993 vs. 1999-2001	0.73 (0.60-0.88)	0.001↑
		1999-2001 vs. 2007-2009	1.09 (0.90-1.32)	0.389
		1991-1993 vs. 2007-2009	0.79 (0.65-0.96)	0.019↑
	Males	1991-1993 vs. 1999-2001	0.77 (0.63-0.95)	0.016↑
		1999-2001 vs. 2007-2009	1.09 (0.88-1.34)	0.429
		1991-1993 vs. 2007-2009	0.84 (0.68-1.04)	0.106
	Females	1991-1993 vs. 1999-2001	0.47 (0.27-0.81)	0.005↑
		1999-2001 vs. 2007-2009	1.06 (0.67-1.67)	0.798
		1991-1993 vs. 2007-2009	0.50 (0.29-0.86)	0.010↑
25-39	All	1991-1993 vs. 1999-2001	1.46 (1.23-1.74)	< 0.001↓
		1999-2001 vs. 2007-2009	1.63 (1.30-2.03)	< 0.001↓
		1991-1993 vs. 2007-2009	1.63 (1.30-2.03)	< 0.001↓
	Males	1991-1993 vs. 1999-2001	0.73 (0.59-0.92)	0.006↑
		1999-2001 vs. 2007-2009	1.64 (1.29-2.08)	< 0.001↓
		1991-1993 vs. 2007-2009	1.20 (0.93-1.56)	0.167
	Females	1991-1993 vs. 1999-2001	1.41 (0.88-2.27)	0.150
		1999-2001 vs. 2007-2009	1.52 (0.85-2.73)	0.155
		1991-1993 vs. 2007-2009	2.15 (1.23-3.75)	0.006↓

CI = confidence interval.

↓) A significant ($p < 0.05$) decrease in the incidence rate.

↑) A significant ($p < 0.05$) increase in the incidence rate.

a) χ^2 -test.

A severe lesion was defined as amputation of a body part, crushing or as injury to a blood vessel, internal organ, tendon, muscle or nerve. The development in severe lesions was examined in order to describe a time trend for severity. Information on weapons was collected from the patient registration. If more than one weapon was used in the incident, all weapons were registered.

We defined the following groups of weapons: firearms, sharp weapons (knife, axe, scissors), blunt weapons (bats, clubs, etc.) and bottles/glasses.

By splitting the study period into three parts: initial three years (1991-1994), mid three years (1999-2001) and final three years (2007-2009), the test for trend in incidence rates was carried out by calculating the rate ratio between two periods at a time, 95% confidence intervals (CIs), and p-value (two-tailed) using OpenEpi.com. When we compared the time periods, the first period served as the reference, and hence a rate ratio > 0 indicates a decrease and vice versa. OpenEpi and Stata were also used in calculating 95% CIs and Two-by-Two tables for the chi-squared test.

Trial registration: not relevant.

RESULTS

In the study period, 22,549 victims of violence from Odense Municipality were treated at the ED and/or subjected to medico-legal autopsy at the IFM. Overall, 2,957 (13.3%) had weapon-related injuries of whom 0.4% had injuries from a firearm, 3.2% from a sharp weapon, 3.7% from a blunt weapon and 6.0% from bottles/glasses. Overall, 2,931 were treated at the ED, 15 were subjected to medico-legal autopsy at the IFM only, and 11 were registered at both places.

In total, 2,481 (84%) victims were males. The median age was 25 years (range: 3-89 years) for males and 27 years (range: 1-83 years) for females (Kruskal-Wallis test, $p = 0.599$).

Table 1 shows the number of victims, the population at risk and the incidence rates. **Table 2** summarises

the gender-specific rate-ratios between the incidence rates in different time periods. The overall incidence rate in the study period was 8.5 (95% CI: 8.2-8.8) per 10,000 population/year and did not change significantly from the first to the last time periods. However, a significant increase ($p = 0.003$) and a significant decrease ($p < 0.000$) between the first and second, and the second and third time period was observed. Among males, the overall incidence rate was 14.6 (95% CI: 14.0-15.2) per 10,000 population/year and the same time trend was observed. The overall incidence rate for females was 2.7 (95% CI: 2.4-2.9) per 10,000 population/years, and this did not change significantly when comparing any of the periods.

Table 3 summarises the gender-specific rate-ratios between incidence rates in the different time periods in the age groups 15-24 years and 25-39 years. The overall incidence rate for the 15-24-year-old victims was 24.0 (95% CI: 22.7-25.4) per 10,000 population/years. The incidence rate for the 15-24-year-old males was 42.1 (95% CI: 39.6-44.7) per 10,000 population/years, and the rate increased significantly ($p = 0.016$) when comparing 1991-1993 with 1999-2001. Among the 15-24-year-old females, the annual incidence rate was 6.4 (95% CI: 5.4-7.5) per 10,000 population/years, and the rate increased significantly ($p = 0.010$) when comparing the beginning and the end of the study period. The overall incidence rate for the 25-39-year-old victims was 12.6 (95% CI: 11.9-13.4) per 10,000 population/years, and the rate decreased significantly ($p < 0.001$) when comparing all three periods.

Table 4 shows the number and the proportion of victims by type of weapon. A total of 40 victims (1.4%) had injuries from more than one type of weapon. The proportion of victims with injuries from sharp weapons decreased significantly in the study period among males (trend test, $p = 0.004$) and in the overall group (trend test, $p = 0.008$).

In the study, period a total of 4,715 lesions were registered, corresponding to 1.6 lesions per victim for both genders. The lesions were most frequently located to the head, (56.1%) and the upper limbs (26.2%). Inversely, lesions in the lower limbs (7.3%), the thorax (6.7%), and the abdomen (3.8%) were less frequent.

A total of 182 (6.1%) victims had severe lesions. No significant difference ($p = 0.08$) was found in the proportion of severe lesions between males and females. No change in the proportion of victims with severe lesions was observed in the study period (trend test, $p = 0.56$). The victims who were assaulted by firearms had the highest proportion of severe lesions (14.4%). The proportion of victims with severe lesions was 7.3%, 2.7%, and 2.4% when assaulted by sharp weapons, bottles/glasses, and blunt weapons, respectively.

TABLE 4

The number (and the proportion) of victims of assault by different types of weapon stratified by gender.

	Males		Females		All	
	n (%)	p-value ^a	n (%)	p-value ^a	N (%)	p-value ^a
Fire arms	73 (2.9)	0.960	18 (3.7)	0.985	91 (3.0)	0.312
Sharp weapons	605 (24.1)	0.004↓	115 (23.9)	0.577	720 (24.0)	0.008↓
Bottles/glasses	1,156 (45.9)	0.185	186 (38.7)	0.316	1,342 (44.8)	0.109
Blunt weapons	682 (27.1)	0.153	162 (33.7)	0.092	844 (28.2)	0.348
All	2,516 (100.0)	–	481 (100.0)	–	2,997 (100.0)	–

↓) A significant ($p < 0.05$) decrease in the proportion.

a) Non-parametric trend test for changes in the proportion of victims assaulted by different types of weapon.

In the study period, 26 victims died from their lesions (8.7 per 1,000 victims), 12 males (4.8 per 1,000 victims) and 14 females (29.1 per 1,000 victims). The overall mortality rate was 7.4 per 1,000,000 population/years. The mortality rate for males and females were 7.1 and 7.8 per 1,000,000 population/years, respectively. A total of 13 (57%) of the homicides were caused by sharp weapons (0.4 per 100,000 population/years), nine (39%) by firearm (0.3 per 100,000 population/years), and one (4%) by blunt weapons (0.03 per 100,000 population/years). The median age was 38 years (range: 9-51 years) and 34 years (range: 1-59 years) for the deceased male and female victims, respectively.

DISCUSSION

This study does not support an increasing incidence rate of weapon-related injuries from violence in Odense Municipality in the 1991-2009 period. Furthermore, the study did not find an increased proportion of severe injuries.

The overall incidence rate was 8.5 per 10,000 population/years, and the rate for males was five-fold greater than the rate recorded for females. The overall incidence rate did not change from the beginning to the end



of the study period. Previous studies on violence based on hospital data have shown that the incidence rates for assaulted victims have either decreased or remained unchanged in Denmark [5, 6, 9]. In Odense, the incidence rate decreased in the periods of 1988-1996 and 1991-2002 [5, 6]. In Aarhus, the incidence rate decreased when the 1999-2000 period was compared with the three previous studies from the eighties and nineties [9].

The highest incidence rate was found among the 15-24-year-old male victims. The rate increased significantly when comparing the first and mid three years, but stagnated onwards. The incidence rate for the 15-24-year-old females increased significantly when comparing the first three years and the last three years. Similar trends were found in other Danish studies [2, 6].

Overall, 6.1% of the victims had severe injuries and this proportion remained constant. The definition of severe injuries used in this study is not optimal, and no other study has used this approach. However, no optimal tool for rating changes in severity of injuries from violence is available. Previous studies have used the Abbreviated Injury Scale (AIS). Even though the AIS is the best tool we have for rating severity of injuries, the scale has been criticised for rating changes in severity of injuries from violence over time [2, 6, 10, 11]. The AIS has a low sensitivity for measuring changes over time.

The distribution of the weapon types in our study are similar to those reported by other Scandinavian studies based on data from EDs [2, 12-15]. In these studies, 4-10% of all ED-registered victims were assaulted with a bottle and/or glass, 2-11% with a blunt object, 1-8% with a knife and 0.2-0.8% with firearms [2, 12-15]. The proportion of victims with injuries from sharp weapons decreased significantly in the study period among males and in the overall group. In a previous study from Odense University Hospital, the proportion of injuries caused by objects increased from 9% to 18% in 1988-1996 [5]. The overall mortality rate was 7.4 per million population/years, which corresponds to the rate of violence-related deaths in other Western countries, excluding the United States [16]. The mortality rate per victim for females was seven times greater than the rate recorded for males. This indicates that the females were exposed to more serious violence than the male victims. The homicide rate for firearms was 0.3 per 100,000 population/years, which corresponds to the Danish national homicide rate [17]. The rate in Finland is 0.4 and, in contrast, the rate is 3.0 per 100,000 population/years in the US [17]. The incidence rates were not based on mid-year population and the victims were not subtracted from the population. However, the population does not change significantly every six months and the number of victims is low. Therefore, the incidence rates are considered to be valid for the included victims.

This study only included victims of violence registered at the hospital or in the forensic system. We believe that most victims with weapon-related lesions are treated in the hospital. A local study has shown that only 2% of all victims in Odense Municipality seek medical attention in other hospitals [18]. According to a Norwegian study, 15% seek medical treatment at their own general practitioner after an assault [19].

Sampling bias may have occurred. Firstly, the victim had to describe that a weapon had been used and if they did not, they were excluded leading to an underestimation. Secondly, the weapon had to be classified correctly. Thirdly, it is complicated to distinguish the way the weapon inflicted the injury; e.g. it was not known whether a glass was thrown or if the victim was pushed into a cabinet containing glass, etc.

Our study did not include violence registered solely by the police. We have only limited information of victims solely recorded by the Police. In a previous study, 13% of all registered victims in Odense Municipality were registered by the police only [20]. We believe that most victims with severe injuries are treated in the ED.

We have only compared the results with Scandinavian studies from the same time period. Papers have shown that the epidemiology of violence in the Scandinavian countries is comparable.

It could be argued that the proportion of weapon-related violence is a matter of interest in itself. This would call for subgroup identification, such as source of weapon, environment (e.g. related to gang crime) or cultural acceptance of weapon use. The depth of information attainable here does not allow for such detailed analyses.

CONCLUSION

The present study does not support an increasing incidence rate of weapon-related injuries from violence, and no evidence of an increasing proportion of severe injuries was found. The study indicates that females have a seven-fold higher risk of dying from weapon-related violence than males. Future studies should include a more detailed analysis of the higher risk of dying from weapon-related violence among women.

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