

Victims of Criminal Homicide in Sweden: A Matched Case-Control Study of Health and Social Risk Factors Among All 1,739 Cases During 1978–1994

Christer Allgulander, M.D., and Bo Nilsson, M.Sc.

Objective: The psychiatric and medical characteristics of victims of homicide have not been systematically studied and are often confounded by race. This study was undertaken to determine health and social factors contributing to the risk of being murdered in the Swedish, predominantly Caucasian population. **Method:** All 1,739 homicides between 1978 and 1994 in Sweden were studied in terms of variables in national case registers regarding health, crimes, immigration, and marital status. The same data were extracted for matched comparison persons in the general population, with controls for time of exposure. The data were analyzed by conditional logistic regression on matched pairs. **Results:** Traumatic brain injury, physical abuse, alcohol dependence, and criminal recidivism conferred risk of being murdered. **Conclusions:** To the authors' knowledge, this is the first report of traumatic brain injury, in both men and women, as a risk factor for being murdered. Brain injury may mark risk-taking behavior in general or may cause provocative behavior.

(*Am J Psychiatry* 2000; 157:244–247)

This study was undertaken to identify factors contributing to the risk of being murdered in Sweden. The demographic characteristics of the Nordic populations may yield factors other than those true for the United States. There are national health insurance and comprehensive social support systems, immigration is regulated, and the populations were until recently almost entirely Caucasian. Cocaine is hardly available, and handguns are not as common as in the United States. The motives for homicide are similar to those in other cultures: anger during a drunken altercation, jealousy, and revenge (1, 2). Most victims are killed by their spouses or acquaintances, and usually both the victim and perpetrator are inebriated. Homicide followed by suicide of the perpetrator seems more common than in the United States, perhaps because of the higher proportion of mentally deranged perpetrators in Sweden (3).

The annual homicide rates per 100,000 adults in 1994 were 4.1 in Finland, 2.2 in Denmark, 1.6 in Nor-

way, and 2.7 in Sweden, compared to 9.4 in the United States (4). Wikström (5) reported that the higher homicide rate in Philadelphia than in Stockholm during the 1950s was due to intraracial black homicides (6). Twelve times as many homicides were committed with a weapon in Philadelphia as in Stockholm. Homicides provoked by the victim's behavior occurred in 26% of the Philadelphia cases, compared to 11% in Stockholm (6). In a matched case-control study of all 820 cases of firearm injuries in Stockholm over 20 years, murder or attempted murder was the motive in 21% (7). The homicide rate in Sweden after 1955 has been correlated with the consumption of spirits at home; the attributable fraction has been estimated to be 50% (8).

The typical risk factors for being murdered in U.S. metropolitan areas are male sex, youth, black or Hispanic ethnicity, household crowding, homelessness, inebriation, drug dealing, handguns, and just living in an environment with these elements (9–17).

Our study was undertaken to identify health and social characteristics conferring risk of being murdered in Sweden. There are about 120 criminal homicides per year in a population of 8.6 million, i.e., 1.0 per 100,000 men and 0.5 per 100,000 women. All consecutive adult cases over 16 years were included. We hypothesized that substance abuse, criminality, and immigrant status would be independent risk factors for being murdered in Sweden.

Received Feb. 9, 1999; revision received May 4, 1999; accepted July 23, 1999. From Neurotec, Division for Psychiatry, and the Division of Cancer Epidemiology at Radiumhemmet, Karolinska Institutet, Stockholm. Address reprint requests to Dr. Allgulander, M57 Huddinge Hospital, S-141 86 Huddinge, Sweden; Christer.Allgulander@neurotec.ki.se (e-mail).

Supported by research grants from the Karolinska Institutet and the Söderström-Königska Foundation. The data file was compiled by the Center for Epidemiology at the Swedish National Board of Health and Welfare and by Statistics Sweden.

TABLE 1. Univariate Conditional Logistic Regression Modeling of Risk Factors for Homicide in Swedish Men

Risk Factor	Male Homicide Victims (N=1,145)		Comparison Subjects (N=6,870)		Relative Risk of Homicide		Analysis		
	N	%	N	%	Relative Risk	95% CI	χ^2	df	p
Hospital diagnoses									
Brain concussion/contusion	40	3.5	2	0.0	120.0	29.0–496.7	43.7	1	<0.001
Physical abuse	132	11.5	32	0.5	27.0	18.1–40.3	257.8	1	<0.001
Drug dependence	27	2.4	10	0.1	16.2	7.8–33.5	56.6	1	<0.001
Alcohol dependence	124	10.8	44	0.6	22.1	14.9–32.6	242.2	1	<0.001
Psychosis excluding schizophrenia	6	0.5	4	0.1	9.0	2.5–31.9	11.6	1	<0.001
Suicide attempt	21	1.8	18	0.3	7.3	3.8–13.8	36.8	1	<0.001
Personality disorder	6	0.5	6	0.1	6.0	1.9–18.6	9.6	1	0.002
Neurotic disorder	4	0.3	5	0.1	4.8	1.3–17.9	5.5	1	0.02
Schizophrenia	5	0.4	11	0.2	2.7	0.9–7.8	3.5	1	0.06
Affective disorder	2	0.2	5	0.1	2.4	0.5–12.4	1.1	1	0.30
Country of birth									
Sweden	846	73.9	6,325	92.1	1.0 ^a		337.0	3	<0.001
Denmark, Iceland, Norway	15	1.3	87	1.3	1.3	0.8–2.3	0.9	1	0.34
Non-Nordic origin	120	10.5	256	3.7	3.7	2.9–4.7	122.4	1	<0.001
Finland	164	14.3	202	2.9	6.4	5.1–8.0	261.6	1	<0.001
Crime rate^b									
No criminal record	499	43.6	5,921	86.2	1.0 ^a		869.5	3	<0.001
0.1 to 1.2	99	8.6	426	6.2	3.7	2.9–4.9	93.6	1	<0.001
1.3 to 2.9	157	13.7	333	4.8	7.9	6.2–10.1	278.8	1	<0.001
3.0 or more	390	34.1	190	2.8	38.1	29.6–49.0	795.1	1	<0.001
Marital status^c									
Married	219	21.1	2,992	43.6	1.0 ^a		327.8	4	<0.001
Unmarried	437	42.0	2,115	30.8	3.9	3.2–4.8	179.2	1	<0.001
Widowed	15	1.4	65	0.9	2.8	1.5–5.2	10.5	1	<0.001
Divorced	182	17.5	344	5.0	7.0	5.5–8.8	263.9	1	<0.001
Unclassified	187	18.0	1,354	19.7	0.8	0.2–3.0	0.1	1	0.25

^a Reference value.^b Number of court sentences per 10 person-years.^c For the homicide victims, N=1,040.

METHOD

All 1,739 persons 18 years and older who resided in Sweden in 1978 and were murdered through 1994 were identified (criminal homicides: ICD E960–E969 as recorded in the national Cause-of-Death Register).

On the basis of sex, year, and month of birth, 1,024 strata were formed within the total Swedish population on Dec. 31, 1977, to find six comparison persons for each homicide victim. Random selection within the strata was performed by means of SAS software (SAS Institute, Cary, N.C.), resulting in a data file with 12,173 persons. Their personal identification numbers were used to retrieve data from a national crime register, from the immigration register, and from the national inpatient register (Statistics Sweden and the National Board of Health and Welfare). The means of personal identification were then removed from the file.

The variables used were sex, year and month of birth and homicide, marital status in December 1977, country of birth, number of criminal court sentences, and inpatient diagnoses between January 1978 and December 1994. The ICD diagnoses from a total of 30,855 hospital admissions were divided into 10 categories reflecting substance abuse, suicide attempts, other psychiatric disorders, brain injuries, and physical abuse.

To permit adjustment for time of exposure, i.e., time to homicide, the comparison persons had to remain alive at least as long as the homicide victims. Univariate and multivariate analyses were performed with conditional logistic regression on the matched pairs (18).

RESULTS

Of the 1,739 homicide victims, 1,145 were men and 594 women. The most frequent diagnoses in both sexes were physical abuse and alcohol dependence. Finland was the most common country of origin after

TABLE 2. Multivariate Conditional Logistic Regression (Forward Stepwise) Modeling of Risk Factors for Homicide in Swedish Men^a

Risk Factor	Relative Risk of Homicide (multiple risk)		Analysis		
	Relative Risk	95% CI	χ^2	df	p
Hospital diagnoses					
Brain concussion/contusion	112.8	18.7–682.2	26.5	1	<0.001
Physical abuse	18.2	10.8–30.6	120.3	1	<0.001
Alcohol dependence	5.7	3.4–9.8	40.4	1	<0.001
Country of birth					
Sweden	1.0 ^b		71.3	3	<0.001
Denmark, Iceland, Norway	1.0	0.5–2.0	0.0	1	0.97
Non-Nordic origin	2.1	1.4–3.0	13.6	1	0.002
Finland	3.9	2.8–5.5	63.4	1	<0.001
Crime rate^c					
No criminal record	1.0 ^b		504.5	3	<0.001
0.1 to 1.2	3.1	2.2–4.4	44.5	1	<0.001
1.3 to 2.9	6.2	4.6–8.4	142.2	1	<0.001
3.0 or more	34.8	25.2–48.0	468.0	1	<0.001
Marital status					
Married	1.0 ^b		138.0	4	<0.001
Unmarried	3.4	2.6–4.3	88.2	1	<0.001
Widowed	2.4	1.2–4.8	6.4	1	<0.012
Divorced	4.5	3.5–6.4	97.1	1	<0.001
Unclassified	2.1	0.3–12.6	0.6	1	0.43

^a Significance level for inclusion, $p < 0.001$. Competitive and non-competitive factors shown in univariate analysis in table 1.^b Reference value.^c Number of court sentences per 10 person-years.

TABLE 3. Univariate Conditional Logistic Regression Modeling of Risk Factors for Homicide in Swedish Women

Risk Factor	Female Homicide Victims (N=594)		Comparison Subjects (N=3,564)		Relative Risk of Homicide		Analysis		
	N	%	N	%	Relative Risk	95% CI	χ^2	df	p
Hospital diagnoses									
Brain concussion/contusion	8	1.3	2	0.1	24.0	5.1–113.1	16.2	1	<0.001
Physical abuse	39	6.6	2	0.1	117.0	28.3–484.4	43.1	1	<0.001
Drug dependence	5	0.8	2	0.1	26.8	3.1–231.4	8.9	1	0.003
Alcohol dependence	25	4.2	2	0.1	75.0	17.8–316.7	34.5	1	<0.001
Psychosis excluding schizophrenia	3	0.5	3	0.1	6.0	1.2–29.8	4.8	1	0.03
Suicide attempt	22	3.7	13	0.4	10.8	5.3–21.8	43.7	1	<0.001
Personality disorder	3	0.5	2	0.1	9.0	1.5–53.9	5.8	1	0.02
Neurotic disorder	8	1.3	6	0.2	8.0	2.8–23.0	14.8	1	<0.001
Schizophrenia	2	0.3	3	0.1	4.0	0.7–23.9	2.3	1	0.13
Affective disorder	2	0.3	2	0.1	6.0	0.9–42.6	3.2	1	0.07
Country of birth									
Sweden	426	71.7	3,270	91.7	1.0 ^a		186.7	3	<0.001
Denmark, Iceland, Norway	13	2.2	50	1.4	2.0	1.1–3.7	4.7	1	0.03
Non-Nordic origin	72	12.1	110	3.1	5.0	3.7–6.9	101.8	1	<0.001
Finland	83	14.0	134	3.8	5.0	3.7–6.8	110.2	1	<0.001
Crime rate ^b									
No criminal record	482	81.1	3,442	96.5	1.0 ^a		186.7	3	<0.001
0.1 to 1.2	26	4.4	75	2.1	2.7	1.7–4.3	16.6	1	<0.001
1.3 to 2.9	46	7.7	31	0.9	11.5	7.0–18.8	94.4	1	<0.001
3.0 or more	40	6.7	16	0.4	21.8	11.3–43.1	85.0	1	<0.001
Marital status ^c									
Married	190	35.4	1,649	46.2	1.0 ^a		79.6	4	<0.001
Unmarried	128	23.8	787	22.1	1.6	1.2–2.2	10.0	1	0.002
Widowed	36	6.7	167	4.7	1.9	1.2–2.9	7.7	1	0.007
Divorced	77	14.3	169	4.7	3.9	2.9–5.3	72.4	1	<0.001
Unclassified	106	19.7	792	22.2	0.3	0.1–1.7	1.8	1	0.18

^a Reference value.^b Number of court sentences per 10 person-years.^c For the homicide victims, N=537.**TABLE 4. Multivariate Conditional Logistic Regression (Forward Stepwise) Modeling of Risk Factors for Homicide in Swedish Women^a**

Risk Factor	Relative Risk of Homicide (multiple risk)		Analysis		
	Relative Risk	95% CI	χ^2	df	p
Hospital diagnoses					
Brain concussion/contusion	27.7	4.3–176.0	12.4	1	<0.001
Physical abuse	108.1	2.7–806.7	20.8	1	<0.001
Alcohol dependence	51.6	6.6–404.0	14.0	1	<0.001
Suicide attempt	7.0	2.6–19.0	14.7	1	<0.001
Country of birth					
Sweden	1.0 ^b		37.7	3	<0.001
Denmark, Iceland, Norway	1.6	0.8–3.4	1.5	1	0.22
Non-Nordic origin	2.6	1.7–4.0	20.0	1	<0.001
Finland	2.5	1.7–3.7	20.7	1	<0.001
Crime rate ^c					
No criminal record	1.0 ^b		81.8	3	<0.001
0.1 to 1.2	2.3	1.3–4.1	8.1	1	0.004
1.3 to 2.9	6.5	3.4–12.3	32.9	1	<0.001
3.0 or more	14.4	6.8–30.8	47.7	1	<0.001
Marital status					
Married	1.0 ^b		43.7	4	<0.001
Unmarried	1.6	1.1–2.2	7.2	1	0.008
Widowed	1.5	0.9–2.3	2.4	1	0.12
Divorced	3.1	1.4–5.0	38.4	1	<0.001
Unclassified	0.4	0.1–1.9	1.4	1	0.23

^a Significance level for inclusion, $p < 0.001$. Competitive and non-competitive factors shown in univariate analysis in table 3.^b Reference value.^c Number of court sentences per 10 person-years.

Sweden. Only 21.1% of the men and 35.4% of the women were married when they were killed. A criminal record was found for 56.4% of the men and 18.9% of the women, as compared to 13.8% for the comparison men and 3.4% of the comparison women.

In the univariate model for male homicide victims, the highest relative risks were admission for traumatic brain injury, a high crime rate, and diagnoses of physical abuse, alcohol dependence, and drug dependence (table 1). All of these except drug dependence remained statistically significant in the multivariate model (table 2).

In the univariate model for female homicide victims, the highest risks were physical abuse, alcohol dependence, drug dependence, brain injury, and a high crime rate (table 3). As for the men, all of these except drug dependence remained significant in the multivariate model (table 4).

DISCUSSION

The study identified traumatic brain injury as a risk factor for being murdered. This is the first such report, to our knowledge. The study also identified other expected risks, such as crime recidivism, physical abuse, and substance abuse.

The results were not confounded by race. All homicide cases during 16 years were included, and the risks were estimated by comparing the victims with

matched persons and controlling for length of exposure. Errors due to mistaken identities, missing records, or faulty entries in the registries are negligible. The diagnoses were made routinely in public inpatient settings. The diagnoses of brain injury and physical abuse were based on physical examinations, X-rays, and witness accounts in cases of such severity that inpatient care was warranted. One limitation of the study is the absence of police reports including forensic examinations.

We have no knowledge of the behavior of the victims at the time of killing. Evolutionary psychologists view homicide as an extreme manifestation of interpersonal conflict or character contest, especially within the family (19, 20). Criminologists find conflicting results in classifying victim-offender relationships (21). Tiihonen et al. (22) proposed that the seasonal variation of the homicide rate in Finland parallels that of variations in CNS serotonin transmission, an impetus for neurophysiological studies of the matter.

Why are brain injuries conducive to homicide? According to one estimate (23), 1.5 million U.S. residents, mostly young males, sustained nonfatal brain injuries in 1991. A traumatic brain injury may cause long-term irritability, agitation, belligerence, anger, episodic dyscontrol, and inappropriate social responses (24). Retrospective and prospective studies suggest that traumatic brain injury may be associated with criminal and violent behavior (25), but to our knowledge, no prior study has elucidated an association with homicide. It seems plausible that aggressive and persevering behavior, compounded by alcohol inebriation, may provoke homicidal acts for trivial reasons in an environment characterized by crime, substance abuse, and poverty.

REFERENCES

1. Gudjónsson GH, Pétursson H: Homicide in the Nordic countries. *Acta Psychiatr Scand* 1990; 82:49–54
2. Lindqvist P: Homicides committed by abusers of alcohol and illicit drugs. *Br J Addiction* 1991; 86:321–326
3. Lindqvist P, Gustafsson L: Homicide followed by the offender's suicide in northern Sweden. *Nord J Psychiatry* 1995; 49:17–24
4. Yearbook of Nordic Statistics 1996. Stockholm, Statistiska Centralbyrån, 1997
5. Wikström P-O: Cross-national comparisons and context-specific trends in criminal homicide. *J Crime Justice* 1991; 14:71–95
6. Wolfgang ME: Victim precipitated criminal homicide. *J Criminal Law, Criminology, and Police Science* 1957; 48:1–11
7. Ponzer S, Bergman B, Brismar B: Morbidity and injury recurrence in victims of firearm injuries. *Public Health* 1996; 110:42–46
8. Norström T: Effects on criminal violence of different beverage types and private and public drinking. *Addiction* 1998; 93:689–699
9. Centerwall BS: Race, socioeconomic status, and domestic homicide, Atlanta, 1971–72. *Am J Public Health* 1984; 74:813–815
10. Goodman RA, Mercy JA, Loya F, Rosenberg ML, Smith JC, Allen NH, Vargas L, Kolts R: Alcohol use and interpersonal violence: alcohol detected in homicide victims. *Am J Public Health* 1986; 76:144–149
11. Kellerman AL, Mercy JA: Men, women, and murder: gender-specific differences in rates of fatal violence and victimization. *J Trauma* 1992; 33:1–5
12. Tardiff K, Marzuk PM, Leon AC, Hirsch CS, Stajic M, Portera L, Hartwell N: Cocaine, opiates, and ethanol in homicides in New York City: 1990 to 1991. *J Forensic Sci* 1995; 40:387–390
13. Kennedy BP, Kawachi I, Prothrow-Stith D: Income distribution and mortality: cross sectional ecological study of the Robin Hood index in the United States. *Br Med J* 1996; 312:1004–1007
14. Rivara FP, Mueller BA, Somes G, Mendoza CT, Rushforth NB, Kellermann AL: Alcohol and illicit drug abuse and the risk of violent death in the home. *JAMA* 1997; 278:569–575
15. Hwang SW, Orav EJ, O'Connell JJ, Lebow JM, Brennan TA: Causes of death in homeless adults in Boston. *Ann Intern Med* 1997; 126:625–628
16. Ikeda RM, Gorwitz R, James SP, Powell KE, Mercy JA: Trends in fatal firearm-related injuries, United States, 1962–1993. *Am J Prev Med* 1997; 13:396–400
17. Bailey JE, Kellerman AL, Somes GW, Banton JG, Rivara FP, Rushforth NP: Risk factors for violent death of women in the home. *Arch Intern Med* 1997; 157:777–782
18. Breslow NE, Day NE: *Statistical Methods in Cancer Research, vol 1: The Analysis of Case-Control Studies*. International Agency for Research on Cancer Scientific Publication 32. Lyons, France, International Agency for Research on Cancer, 1980
19. Daly M, Wilson M: *Homicide*. New York, Aldine de Gruyter, 1988
20. Savitz LD, Kumar KS, Zahn MA: Quantifying Luckenbill. *Deviant Behav* 1991; 12:19–29
21. Decker SH: Exploring victim-offender relationships in homicide: the role of individual and event characteristics. *Justice Quarterly* 1993; 10:585–612
22. Tiihonen J, Rasanen P, Hakko H: Seasonal variation in the occurrence of homicide in Finland. *Am J Psychiatry* 1997; 154:1711–1714
23. Sosin DM, Sniezek JE, Thurman DJ: Incidence of mild and moderate brain injury in the United States, 1991. *Brain Inj* 1996; 10:47–54
24. Prigatano GP: Personality disturbances associated with traumatic brain injury. *J Consult Clin Psychol* 1992; 60:360–368
25. Volavka J: *Neurobiology of Violence*. Washington, DC, American Psychiatric Press, 1995