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Suicides by Fall from Height in Geneva, Switzerland, from 1991 to 2000*

ABSTRACT: Suicides due to fall from height in Geneva from 1991 to 2000 were reviewed. Scene investigations, autopsy findings, psychiatric histories, and toxicology results were examined. There were 197 of these suicides, an incidence of five cases per 100 000 inhabitants per year or one fourth of all suicides in Geneva per year. Autopsies were performed on 33%, the rest had external examinations. Of the victims, 56% were female and 44% were male. The age distribution peaked at 20–29 years in men and 60–69 years in women. Most of the victims jumped from their home, the range of 2 to 7 stories being the most frequent height. Major injury sites, in decreasing frequency, were the thorax, abdomen, skull, vertebrae, pelvis and limbs. Psychiatric illness was reported in 38% of the cases. Toxicological analysis was performed in 25% of the cases and showed that the main drugs present were benzodiazepines, cannabis and antidepressant.

KEYWORDS: forensic science, forensic pathology, falls and descent from height, suicide, suicide by jumping, jump from height, blunt injury

Geneva is a relatively small state in Switzerland with an area of 282 km² and a current population of approximately four hundred thousand. It is an urban center with a mix of native Swiss and a large number of foreign nationals. In Geneva, the suicide rate increased through the 1970s and remained level through the 1990s. The number of suicides is now approximately 80 cases per year and, of these suicides, the modality of fall from height is the first choice for women and the third for men. During the last five years, it has become the leading cause of suicide in Geneva (1,2).

During the 1990s, Geneva experienced an increase of unemployment due to its worst economic crisis since the beginning of the century. Unemployment has been shown to be an important risk factor for suicide (3), but according to another study (5), mental illness is a more significant risk factor. Our previous study described a decreased rate of suicide from 1991 to 1995 in Geneva (4) but did not look for the possible temporal delay in the onset of suicides with economic downturns and the role of mental illness.

Methods

We reviewed retrospectively all cases of suicides due to fall from heights from January 1, 1991 to December 31, 2000 in Geneva. Although the Geneva Department of Forensic Medicine conducts forensic examinations of all nonnatural deaths, police investigators decide if an autopsy with or without toxicological analysis or an external exam of the body will be performed. This decision is based on the scene, on the circumstances of the death and the wish of the family. This is a limitation for the study, as from the 197 suicides by fall, only 65 autopsies and 48 toxicological testing were performed.

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A brief clinical summary was available for most of the charts. Information was collected from the family doctor, family of the victim and police investigators. Only summary statements of psychiatric history were available and we were not able to determine if a psychiatric illness was present in 62% of the cases because of the lack of information. Data abstracted included the victim's age and gender, height of the fall, date and place of the suicide, past psychiatric history, types of injuries sustained and toxicological analysis. To calculate the height of falls, we assigned the value to each floor of a building from 2.8 to 3 meters.

Results

Epidemiology

During the ten-year period 1991–2000, a total of 197 suicides by falls from heights were reported in Geneva. The rate per 100 000 per year has remained stable over that period, at 4 to 6, which represents 24% of the overall suicide rate per 100 000 per year (see Fig. 1).

Fifty-six percent of the victims were female and 44% were male. This proportion is in contrast with the sex distribution in the overall suicide rate for the same period, which was 39% female and 61% male.

The mean age was 52 years with a range from 13 to 95 years old. The age distribution shows that suicide by falls peaks at the age of 20–29 year in men and at the age of 60–69 years in women (see Fig. 2).

March and December were the months with the highest number of suicides, which represents 25% of the total number (see Fig. 3). Most of the bodies were found between 6 a.m. and 6 p.m. Most of the victims jumped from their home (62%), 14% from a building they were not living in, 13% from bridges and 10% from hospitals. Half of the suicides from bridges occurred from the same bridge, the highest one in Geneva, which has a height of 48 m above a river. The mean height of the six bridges where suicides occurred in the Geneva area is 35 m (range = 5.5 m–48 m). For suicides from buildings, the height of fall was known for 66% of the vic-

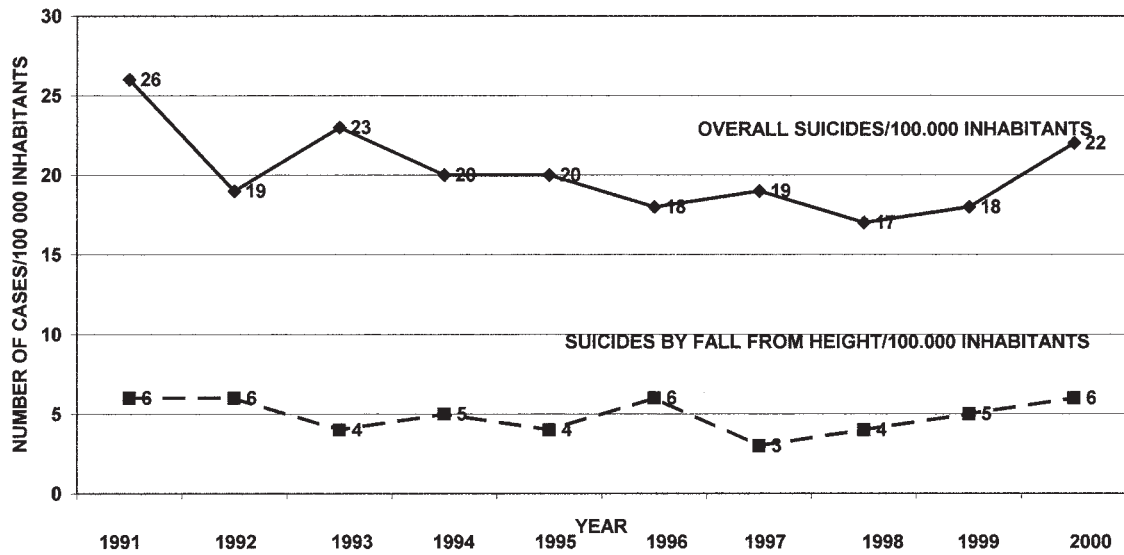


FIG. 1—Overall annual suicide rate each year compared with the annual rate of suicides by fall from height (number of cases/100 000 inhabitants) from 1991 to 2000 in Geneva (N = 197).

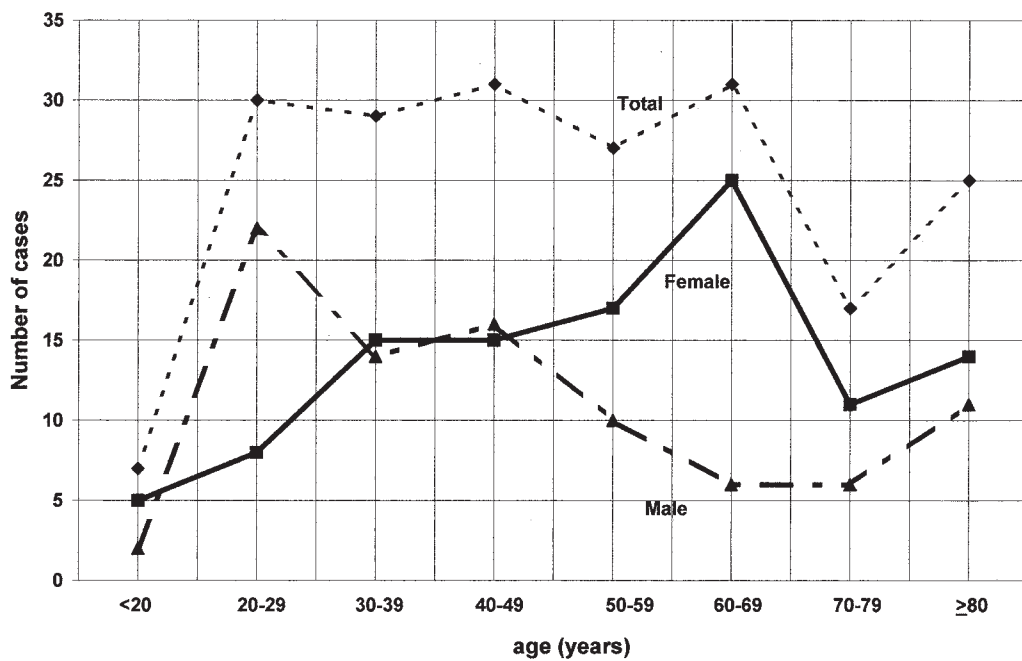


FIG. 2—Distribution of suicides by fall from height according to their age and sex in Geneva from 1991 to 2000 (N = 197).

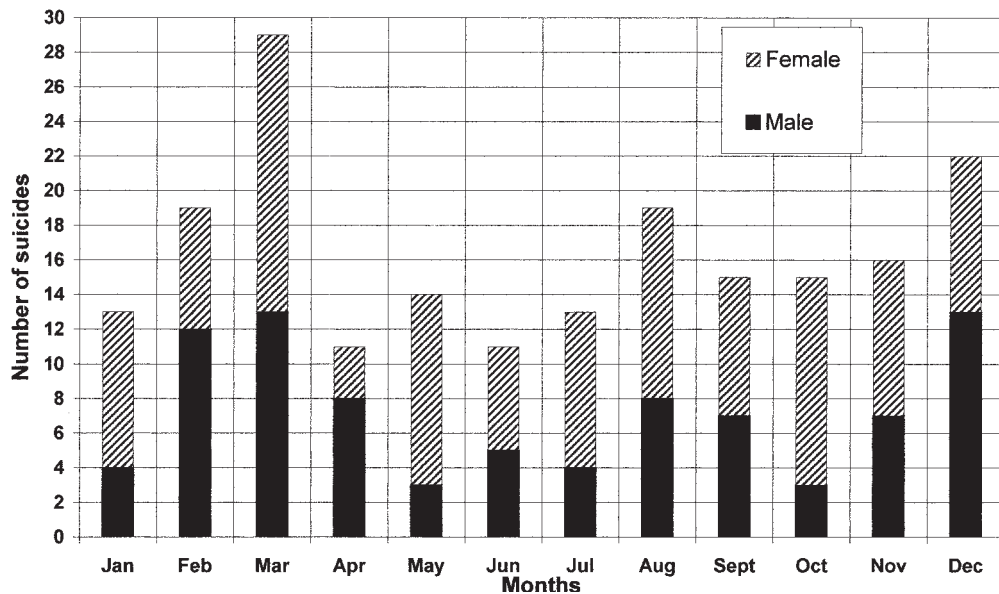


FIG. 3—Months in which suicides by falls from heights occurred in Geneva from 1991 to 2000 (N = 197).

tims. The height ranged from 1 to 28 stories (range = 3 m–84 m), with 2 to 7 stories being the most frequent (73%).

Sixty-seven percent of the victims died at the scene, 28% in the emergency room and only 5% survived a few days.

Injuries

From those on which an autopsy was performed major injuries, in decreasing frequency, were to the thorax, abdomen, skull, vertebrae, pelvis, lower extremities and upper extremities. In the thorax, rib fractures and lung contusions were the predominant injury. Heart and aortic lacerations were frequent. Right atrium laceration alone was present in 22% of all heart lacerations, which was found in 42% of the autopsies. In the abdomen, liver, and spleen, lacerations had the highest frequency. In the skull, fracture and subarachnoid hemorrhage were predominant. Vertebral fractures were found in 58% of the autopsies, most often in the thorax (see Table 1).

Thorax, abdomen, pelvis, and upper and lower extremity injuries increased in frequency with the height of the floors (see Table 2). In 64% of the bodies autopsied there was a combination of skull, thoracic and abdominal injuries and in 12% a combination of skull and neck injuries.

Only four autopsies were performed on the 24 victims who jumped from a bridge. Three jumped from a bridge with a height of 48 m above a river and one from a bridge with a height of 25 m above a river. All of them showed rib fracture and lung contusion. One had a laceration of the left ventricle and the aorta, one of the right atrium. Both of them had vertebral fracture. Two had liver and spleen laceration.

Psychiatric Illness

Psychiatric illness was reported in 38% of all deaths (N = 197) and unknown in the remaining 62% of the cases because of lack of information. Among the victims with known psychiatric history, 64% had the diagnosis of depressive illness and 6% had the diagnosis of psychosis at the time of suicide. Nine percent were known for chronic alcoholism and 12% for drug and alcohol dependence. At least one prior suicide attempt was known in 16% of the cases.

Psychiatric illness was present in 47% of the victims who jumped from their worksite or a building which was not their home, in 44% of the victims who jumped from a hospital, in 36% of the victims who jumped from their home, and in 31% of the victims who jumped from bridges.

Eleven victims who jumped from their worksite or a building which was not their home had depression, two were known to consume heroin and cannabis, one cocaine and alcohol and one had alcoholism. Only one was known for a prior suicide attempt.

From the victims who jumped from a hospital, four suffered from depression, one from alcoholism and two had an unknown psychiatric diagnosis. Only one victim was known for a prior suicide attempt.

From the victims who jumped from their home, 29 were known to have depression and, among them, one used heroin and one had alcoholism. Three had psychosis, one known for alcoholism and one for heroin use, two had alcoholism and two consumed heroin and cocaine. Three victims were known for a prior suicide attempt. Eight victims had past psychiatric history but the diagnosis was not found.

Three victims who jumped from bridges were known to have depression, one suffered from psychosis and used heroin and cocaine and four of them had unknown psychiatric diagnosis. Two were known for a prior suicide attempt.

Toxicology

Toxicological and alcohol testing were performed on only 24% of all deaths. Blood tested positive for the presence of drugs in 69% of these cases, for alcohol in 35% and for drugs plus alcohol in 25%. The main drugs found were benzodiazepines, cannabis and antidepressant (see Table 3).

Blood-alcohol concentration alone was analyzed in another 11% of all deaths. Among all victims tested for blood alcohol, 78% had a concentration below 0.5 g/L, 4% between 0.5 and 1 g/L, 15% between 1.1 and 2 g/L, and 3% with more than 2 g/L.

Discussion

Epidemiology

We have found no decrease in the rate of suicides due to falls from height in Geneva from 1991 to 2000. The number of cases per

TABLE 3—Summary of the drugs and alcohol findings among victims who had toxicological and blood alcohol testing (N = 48).

Drugs	Number of Cases With or Without Drugs (Total of Deaths with Toxicological Testing)	Percent of Cases Positive or Negative for the Drugs	Number of Cases Positive for Alcohol	Mean Blood Alcohol Concentration in Percent
None	15 (48)	31%	5	0.66
Benzodiazepines	11 (48)	23%	4	1.9
Cannabis	5 (48)	10%	2	0.62
Benzodiazepines + Antidepressants	3 (48)	6%	2	1.54
Antidepressants	3 (48)	6%	0	
Cocaine + Benzodiazepines	2 (48)	4%	1	0.24
Morphine	2 (48)	4%	0	
Benzodiazepines + Cannabis	1 (48)	2%	1	0.11
Methadone + Antidepressants	1 (48)	2%	1	1.49
Antipsychotics + Benzodiazepines	1 (48)	2%	0	
Lidocain	1 (48)	2%	1	0.5
Benzodiazepines + Opioids	1 (48)	2%	0	
Morphine + Cocaine	1 (48)	2%	0	
Methadone + Benzodiazepines	1 (48)	2%	0	

ity of the injuries, but may also be due to the time elapsed between the fall and the discovery of the body.

There is an increase in frequency of thorax, abdomen (excepted kidneys), pelvis, upper and lower extremity injuries with the increasing height of the fall. Lung contusion and rib fractures were present in more than 80% of the victims who jumped from the 4th floor and above. From the 7th floor and above, more than 50% of the victims had lacerations of the thoracic aorta. Among these victims, heart laceration and brain hemorrhage was universal. As in previous studies (8,15), we found that thoracic injuries had the highest frequency. Head injuries were third most frequent after abdominal injuries, as opposed to the study of Li and Smialek (16), where head injury had the highest frequency. Note that head lesions (skull fracture and brain hemorrhage in our study) were more frequent in falls below the 4th floor than in falls between the 4th and 6th floor. This observation is similar to the study of Li and Smialek (16) which shows a higher proportion of head lesions at autopsy after a fall from between 8 to 30 ft than after a fall higher than 30 ft. It is also in concordance with the study of Goonetilleke (17) which showed that the severity of brain damage was not directly proportional to the height of the falls.

We could hypothesize that victims without head injuries are more prone to survive in falls below the 4th floor (average height of 11 m) and therefore not seen by us. In fact, head injuries were found in only 14% of the victims who survived a fall from an average height of 6 m (18); below the 4th floor, 50–65% of the victims may survive after the fall (12,19). The possibility of variable orientations of the body when it strikes the ground is probably not a significant factor in the conclusions drawn from our observations because according to Isbister and Roberts (12), it is more common for a jumper from a lower floor to strike the ground feet-first and from above the 13th floor to strike the ground head-first. Autopsies from victims who jumped from a bridge above water did not show external injuries but marked internal injuries, as has been previously described (10,15).

Psychiatric Illness and Toxicology

Among the psychiatric illnesses, depression was the most frequent disorder found in our study, which correlates well with previous studies based on autopsy or attempted suicide by fall from height (9,11,12,15,20).

Toxicology results showed that alcohol, cannabis and benzodiazepines were found with the highest frequency. These substances may contribute to suicidal behavior by suppressing fear and inhibition.

Limitations of the Study

This study has a few limitations. Although the total number of victims was 197, only 33% of the bodies were autopsied and the study of the distribution of injuries was limited to these bodies. Only 24% of the cases had toxicological testing performed.

In our medico-legal system an autopsy and toxicological testing are performed only if ordered by the police and solely for purposes of their investigation. This may introduce a bias; for example, the toxicology testing may be requested only for people suspected of abusing alcohol or drugs.

Despite these limitations, we think our findings regarding the pattern of injuries, the psychiatric history and the toxicological results of the victims who committed suicide by a fall from height are significant and in concordance with other studies. A prospective study is needed to confirm these data.

References

1. La Harpe R. Selbsttötungen im Kanton Genf (1971–1990). Arch Kriminol 1995;95:65–74.
2. La Harpe R. Suicide in the state of Geneva (dissertation). Geneva: University of Geneva, 2002.
3. Lewis G, Sloggett A. Suicide, deprivation and unemployment. BMJ 1998;317:1283–6.
4. Mortensen PB, Agerbo E, Erikson T, Qin P, Westergaard-Nielsen N. Psychiatric illness and risk factors for suicide in Denmark. Lancet 2000 Jan;335:9–12.
5. La Harpe R, Dozio A. Wirtschaftskrise und Suizid in Genf: 1991–1995. Arch Kriminol 1998;202:69–74.
6. Haenel T. Die Zunahme der Sturzsuzide in der Schweiz. Crisis 1985;6:36–45.
7. Gunnell D, Nowers M. Suicide by jumping. Acta Psychiatr Scand 1997;96:1–6.
8. Chao T-C, Lau G, Eng-Swee Teo C. Falls from a height: the pathology of trauma from vertical deceleration. In: Mason JK, Purdue BN, editors. The pathology of trauma. 3rd ed. London: Arnold, 2000;313–26.
9. Nowers M, Gunnell D. Suicide from the Clifton Suspension Bridge in England. J Epidemiol Community Health 1996;50:30–2.
10. Cetin G, Günay Y, Fincanci S, Kulusayin R. Suicides by jumping from Bosphorus Bridge in Istanbul. Foren Sci Int 2001;116:157–62.

11. Copeland AR. Suicide by jumping from buildings. *Am J Forensic Med Pathol* 1989;10(4):295–8.
12. Isbister ES, Roberts JA. Autokabalesis: a study of international vertical deceleration injuries. *Injury* 1992;23(2):119–22.
13. Osuna E, Pérez-Carceles MD, Conejero J, Abenza JM, Luna A. Epidemiology of suicide in elderly people in Madrid, Spain (1990–1994). *Forensic Sci Int* 1997;87:73–80.
14. Wehr TA, Rosenthal NE. Seasonality and affective illness. *Am J Psychiatry* 1989 July;146(7):829–39.
15. Gill JR. Fatal descent from height in New York City. *J Forensic Sci* 2001;46(5):1132–37.
16. Li L, Smialek JE. The investigation of fatal falls and jumps from heights in Maryland (1987–1992). *Am J Forensic Med Pathol* 1994;15(4):295–9.
17. Goonetilleke UKD. Injuries caused by falls from heights. *Med Sci Law* 1980;20(4):262–75.
18. Velmahos et al. Patterns of injury in victims of urban free-falls. *World J of Surg* 1997;21:816–21.
19. Risser D, Bönsch A, Schneider B, Bauer G. Risk of dying after a free fall from height. *Forensic Sci Int* 1996;78:187–91.
20. Kontaxakis V, Markidis M, Vaslamatzis G, Ioannidis H, Stefanis C. Attempted suicide by jumping: clinical and social features. *Acta Psychiatr. Scand.* 1988;77:435–7.

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