

Patterns of suicidal behaviour in a metro subway system

A study of 306 cases injured by the Munich subway, 1980–1999

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Background: As a basis for preventive strategies to reduce subway suicides, an investigation was undertaken to determine if there was a distinct pattern of subway suicidal behaviour. **Methods:** Data were taken from the Municipal Munich Subway System case registry (southern Germany) for all suicidal incidents on the track: purposely inflicted; date, time and location of incident, sex of victim, outcome. The analysis covered a 20 year observation period between 1980 and 1999, for which the Munich Municipal Office for Statistics also provided data of all deaths due to suicides within the city area of Munich. Suicide mortality was classified by the International Classification of Diseases, Ninth revision (codes E950–E959). **Results:** A total of 306 incidents were documented with an annual mean of 16.5 cases. Case fatality was 66% (n=202). It was highest in winter and in higher aged groups. No significant time trend for incidences was observed. Median age of suicide attempters was 38 years. Most incidences (24.2%) were recorded for persons aged 20–29 years. The male: female ratio was 1.15 : 1. The peak time of day for incidences in women was during the late morning hours while significantly more men committed subway suicides during evening hours (p=0.001). No consistent seasonal variation was observed. **Conclusions:** In comparison to average suicide attempters, subjects committing subway suicides are markedly younger and they follow to a lesser extent established seasonal or circadian time patterns. More women are involved in subway suicides than would be expected. However, similarities to reports on behavioural patterns of subway suicides in other communities are striking.

Keywords: behavioural patterns, gender differences, subway suicides

Subway suicides are perceived as a serious public health issue in metropolitan cities around the world.^{1–5} Although absolute figures of subway suicide attempts may not be particularly high, a suicide event in a metropolitan subway system represents a 'public death' which is likely to distress and traumatize the train driver⁶ and may also severely affect an uncounted number of bystanders who witness the mutilated body. Attempts to promote strategies which may prevent suicides by this method are urgently warranted.^{7,8} Thus, one challenge to implement preventive strategies is to identify specific patterns of suicidal behaviour on a metro subway system. However, the characteristic features of subway suicides have not been assessed sufficiently in recent years. It is also unclear whether results on suicide patterns obtained in a particular metropolitan environment like London or Vienna can be transferred and applied as a preventive tool elsewhere.

We, therefore, analysed a complete data set of all cases of suicide attempts in the Munich subway system covering a 20 year period. We studied the time trend over the 20 year period and examined whether a particular behavioural pattern could be defined between sexes, between survivors and non-survivors and in terms of time of the day, weekly and seasonal distribution.

METHODS

The target area for this study was the city of Munich in southern Germany, which had a residential population of 1,315,000 inhabitants in the year 1999. In 1999, there were a total of 12,469

deaths, or 930 deaths per 100,000 individuals per year from all causes. Suicides were responsible for 2.0% of these deaths.

The Municipal Munich subway system (MVG) at present comprises eight lines and 89 stations over a system length of 137.6 km. The subway opens daily for 22 hours. About one million passengers ride the subway daily. In 1990, the MVG comprised six lines and 63 stations. At that time, the system length was 83.6 km, it opened 21 hours daily, and about 650,000 passengers rode the subway daily.

The major source of data for the present study is the MVG case registry for all incidents concerning 'persons under trains' which satisfy the operational definition of an act of suicidal behaviour: purposely inflicted; date, time and location of incident, sex of victim, outcome. Misclassification and incomplete records are unlikely as the local police and the local coroner investigate every unnatural death on the track by law. The data were analysed for all incidents which occurred between 1980 and 1999.

The Munich Municipal Office for Statistics provided data of all deaths due to suicides within the city area of Munich for the period 1980 to 1999. Suicide mortality was classified by the International Classification of Diseases, Ninth revision (ICD-9 of WHO, codes E950–E959).

Statistical analysis was carried out with the χ^2 test for equal proportions to test for differences in time pattern variables and the χ^2 test for association between categorical variables to test for group differences (e.g. between sexes; survivors and non-survivors). In the case of continuous variables, group differences were determined using the Mann–Whitney U test. A *p* value less than 0.05 was considered to be statistically significant. Operations were performed with the statistical software package SAS (Version 6.12, SAS-Institute Inc., Cary, NC, USA).

RESULTS

Overall incidence and time trend

In the 20 year period between 1980 and 1999, a total of 306 suicide attempts were recorded in the Munich subway system. Of those, 104 (34%) subjects survived the event. Table 1 compares

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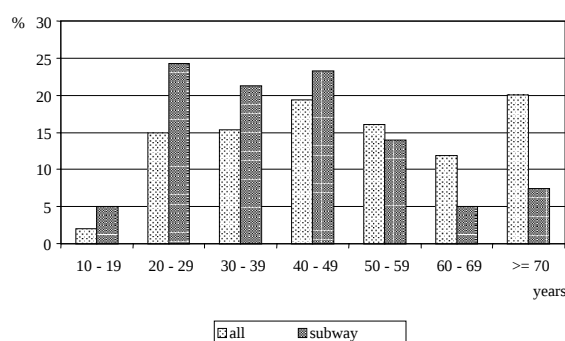


Figure 1 Age distribution of all suicides (n=5,282) and subway suicides (n=202) in the city of Munich from 1980 to 1999 ($p=0.001$)

the incidence of completed subway suicides with the incidence of all suicides committed in the city district of Munich. The table displays a marked variation ranging from 1.7% in the year 1986 to a maximum of 7.5% in 1990. Overall suicide rates in the city of Munich decreased while subway suicides slightly increased. However, time trends were not statistically significant. The mean time interval between events on the subway track was 23.8 days (ranging from 0–183 days; median 16 days).

The mean age of all 306 suicide attempters was 40.1 years (SD 15.9; range from 15–85 years, median 38 years). Most incidences were recorded for persons aged 20–29 years ($n=74$; 24.2%).

Figure 1 displays the age distribution (in seven age groups) of all subjects who committed suicides in the city of Munich in comparison to those who committed suicide in the subway. The proportion of subway suicides in the age groups up to 49 years

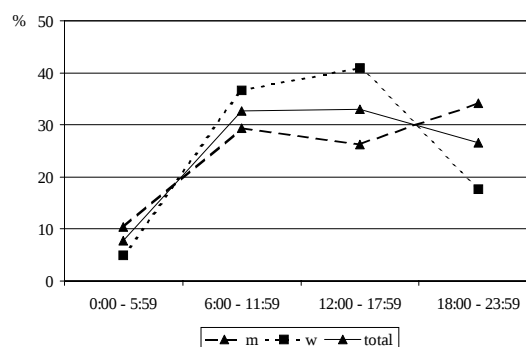


Figure 2 Distribution by time of day of suicide attempts (n=306) in the city of Munich from 1980 to 1999, stratified by gender ($p=0.001$)

is higher for subway suicides while other methods are more prevalent in older subjects.

Time patterns

The day was divided into 6 h periods, beginning at 00:01. Figure 2 shows the distribution of subway suicides through the 24 h course (closed line for the total sample). Incidents occurred most often in the late morning and early afternoon hours. As can be seen, the incidence peaks for the total sample between 09:00 and 12:00. No distinct high risk day in the course of the week could be detected for the total sample (χ^2 test for equal proportions, $p=0.17$). However, incidences were lowest on Sundays and more subway suicides occurred at the beginning of the week. The analysis of seasonality did not reveal a consistent seasonal pattern for the total sample.

Table 1 All suicides (n=5,282) and completed subway suicides (n=202) in the city of Munich from 1980 to 1999 with incidences per 100,000 inhabitants and year

Year	All suicides	Subway suicides ^a	Percentage of all suicides	Incidence of all suicides	Incidence of subway suicides
1980	276	8	2.9	21.2	0.6
1981	315	6	1.9	24.4	0.5
1982	322	9	2.8	25.0	0.7
1983	303	10	3.3	23.6	0.8
1984	274	11	4.0	21.5	0.9
1985	248	5	2.0	19.4	0.4
1986	300	5	1.7	23.2	0.4
1987	298	13	4.4	23.8	1.0
1988	260	5	1.9	20.6	0.4
1989	244	12	4.9	19.2	0.9
1990	240	18	7.5	18.8	1.4
1991	249	11	4.4	19.1	0.8
1992	247	15	6.1	18.7	1.1
1993	229	9	3.9	17.3	0.7
1994	279	12	4.3	21.1	0.9
1995	272	12	4.4	20.5	0.9
1996	239	13	5.4	18.1	1.0
1997	205	9	4.4	15.7	0.7
1998	237	9	3.8	18.3	0.7
1999	245	10	4.1	18.6	0.8
Total	5,282	202	—	—	—

a: Survivors of subway suicide attempts were excluded.

Sex differences

The overall sex difference in suicides was relatively small: 164 (53.6%) were male and 142 (46.4%) were female. Thus, the male : female ratio for the absolute number of subway suicides was 1.15 : 1. The sex distribution of the subway suicides was significantly different from that of all Munich suicides (χ^2 test for association, $p=0.007$).

Although not statistically significant, median age of female suicide victims was higher than that of their male counterparts (females: median 41 years; IQR 27–53 years; males: median 36 years; IQR 27.5–46 years; Mann–Whitney U test, $p=0.078$). There was no sex difference in the median time interval between events (16 days for both genders). However, stratification by sex revealed differences in peak time: as is further shown in figure 2, significantly more women committed suicide during late morning and early afternoon hours (09:00 – <12:00; 12:00 – <18:00) while more men choose the evening hours (18:00 – <24:00) as time for suicide on a subway track ($p=0.008$). To a certain degree, the sex stratification also contoured the weekly distribution: peak day for women was Monday ($n=28$; 19.7%) and Tuesday for men ($n=29$; 17.7%).

Figure 3 displays the sex-specific time trend of all suicide attempts over 5 year periods. The figure shows that for men the incidences steadily increased while for women a pronounced decrease occurred in the latest time period.

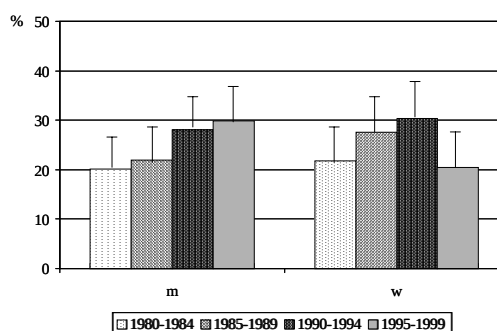


Figure 3 Distribution over 5 year time periods of suicide attempts ($n=306$) in the city of Munich from 1980 to 1999, stratified by gender ($p=$ not significant)

of the sources may be questioned, the results of their analysis are in many respects close to the data presented in the present paper. Sonneck *et al.*⁴ reported data on the Viennese subway covering the time period 1980–1992. The authors did not statistically analyse their data, probably because of the small size of their

Outcome of the suicidal act

During the 20 year observation period, a total of 202 (66%) subjects died and, accordingly, 104 (34%) subjects survived the subway suicide attempt. As expected, case fatality peaked in the very old age group of subjects (80 years and older) with a case fatality rate of 83.3% and was lowest in the youngest age group (15–19 years) with a case fatality rate of 55.6% ($p=0.43$). As can be seen in table 2, case fatality was highest in the afternoon hours; during winter time ($n=54$; 72%); with respect to the day of the week, lethality peaked on Thursdays (78%) and in respect to long time periods, peaked significantly from 1990 to 1995 ($p=0.05$). Accordingly, survival was more likely in the late night hours; on Saturdays; in the summer time and in the time period between 1985 and 1989. However, there were no sex differences in fatality.

DISCUSSION

The present study of subway suicides in Munich over the period from 1980–1999 is part of an international effort to map this kind of suicidal behaviour. In 1992, O'Donnell and Farmer¹ published an analysis of subway suicides with data gathered from 23 metro systems around the world. Although validity of the information from at least some

Table 2 Case fatality and time characteristics (daytime, weekday, season and period) of all subway suicides attempts ($n=306$) in the city of Munich from 1980 to 1999

	Case fatality				p value ^a
	Survived		Deceased		
	n	%	n	%	
Total	104	34.0	202	66.0	
Daytime					
0:00 – 5:59	10	41.7	14	58.3	
6:00 – 11:59	37	37.0	63	63.0	
12:00 – 17:59	29	28.7	72	71.3	
18:00 – 23:59	28	34.6	53	65.4	0.51
Weekday					
Sunday	7	25.0	21	75.0	
Monday	17	34.0	33	66.0	
Tuesday	16	32.7	33	67.3	
Wednesday	14	36.8	24	63.2	
Thursday	11	22.0	39	78.0	
Friday	17	38.6	27	61.4	
Saturday	22	46.8	25	53.2	0.22
Season					
Winter	21	28.0	54	72.0	
Spring	24	30.8	54	69.2	
Summer	34	40.0	51	60.0	
Fall	25	36.8	43	63.2	0.37
Period					
1980–1984	20	31.3	44	68.8	
1985–1989	35	46.7	40	53.3	
1990–1994	24	27.0	65	73.0	
1995–1999	25	32.1	53	67.9	0.05

a: χ^2 test for association of case fatality and time characteristics.

sample (56 suicides and 33 suicide attempts). The most extended data set was presented by O'Donnell and Farmer² who analysed a total of 3,240 cases in the London underground covering an observation period between 1940 and 1990. In general, similarities between results of these studies and the present inquiry are striking.

The first major result of the present analysis shows an almost stable annual incidence of subway suicides over a 20 year period despite a pronounced decline in total suicide mortality in the German population. Over the period 1980–1995, documented suicide decline was 26.8% in men and 43.1% in women.⁹ We found a decreasing, however, much less pronounced trend for general suicides in the Munich city population. Thus, the suicide rate in the Munich city subway system does not mirror the general suicide rate (nor in the country, nor in the city area). This finding is confirmed by D. Lester¹⁰ who correlated the subway suicide rates of 17 cities around the world with the national suicides of the nations in which the cities were located, using a Spearman rank correlation coefficient, and found that the suicide rates in city subway systems were not associated with suicide rates of the nations containing those cities.

The pronounced expansion of the Munich subway net (with an increase of more than 30% of track length since 1990) may be among factors possibly compensating an expected declining trend effect in subway suicide incidences. The availability of a method has been suggested as a major source of attractiveness of a particular suicide method.¹¹

Elderly people are known to have the highest suicide risk.¹² In contrast to these findings, the majority of victims in the present study were under the age of 40 years and more incidences were recorded for subjects aged 20–29 years than for any other age group. Although in contrast to the typical age pattern of suicidal subjects in western countries, the present study confirms and substantiates earlier reports of the age distribution of subway suicide attempters. Both, O'Donnell and Farmer¹ in their multinational approach and Sonneck *et al.*⁴ in their analysis of the Vienna subway system report that the majority of subway suicides were committed by 20–29 years olds. Moreover, the peak age group in the London study was 25–34 years.²

In the general population, substantially more men than women^{13,14} commit suicides, with a male : female ratio of 3.2 : 1 within European countries.¹⁵ In contrast to these findings, the sex ratio of subway suicide victims in the present study markedly shifted to the female gender. Again, these data fit well with findings based solely on the analysis of subway suicide victims.^{1,2,4} The proportion of 64% male victims in the London study was somewhat higher.

In general, incidences of violent suicide methods follow a clear seasonality, with a peak in spring and a low in late autumn.^{16,17} As for subway suicides, no consistent seasonal pattern could be established. A similar result was found for the weekly distribution: a consistent body of evidence indicates a clear peak in the beginning of the week.¹⁸ This observation has been confirmed for railway suicides as well.¹⁹ However, for subway suicides, both the present analysis as the data from O'Donnell and Farmer,¹ did not support a clear high risk day of the week for subway suicides. It is known that suicide is largely restricted to daytime.^{21,22} As in two studies on railway suicide,^{20,21} such a diurnal pattern was confirmed for women but not for men: male suicides were significantly more prevalent during the evening hours.

A subway suicide is classified as a 'particularly violent' suicide method. In contrast to suicidal methods in which it is possible to solicit help after initiating the suicidal act, no control over the effects of the attempt is available. Thus, the limited scope and helplessness of subway drivers to prevent a lethal outcome once a suicide attempter has jumped on the track, is one major source of their traumatization.⁶ In contrast to this assumption, case

fatality of subway suicides is surprisingly low. In the international comparison study of O'Donnell and Farmer,¹ case fatality rates greater than 60% were rare. Case fatality in London was 55%.² In the present study, the overall case fatality rate was 66%.

We found significant variations of case fatality in 5 year periods (ranging from 53.3% to 73.0%) – currently, we have no firm explanations for this phenomenon. It may be speculated that survival of a subway suicide attempt is accidental in the majority of cases as this method is inappropriate to serve as 'gesture' or 'cry for help'.^{19,23} This assumption is supported by the finding that no gender differences occurred between lethal and non-lethal outcome because women are known to have relatively higher rates of suicide attempts than men.¹⁵ The assumption is further supported by research on subway suicide survivors which clearly revealed that for these subjects the act had been impulsive and was characterized by an extremely high level of suicidal intent.²³

LIMITATIONS

The present analysis relies on data which were routinely assessed by a case fatality registry. The strength of the present analysis is its high reliability and the long-term observation period. However, restrictions of the limited data set are also obvious: e.g. the data do not allow an analysis of the decision-making of suicide attempters to choose the subway as their means of suicide – an inquiry which is urgently warranted as part of a subway suicide prevention strategy.

CONCLUSIONS

The present study confirms that the epidemiological characteristics of those desperate subjects who choose the subway system as a method for self-destruction is markedly distinct from characteristics of subjects in the general population who commit suicide. Subway suicide attempters are significantly younger; there are more women who are prone to commit suicide and they do not follow long established circadian time and seasonal patterns. Efforts to establish preventive strategies have to take into consideration that this particular suicide method is preferred mainly by subjects who act highly impulsively and who benefit from a constant ready access to a means of suicide.

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