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Suicide by Jumping and Accessibility of Bridges: Results from a National Survey in Switzerland

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Rates of suicide by jumping show large regional differences. Barriers on bridges may prevent suicides but also may lead to a substitution of jumping site or method. The aim of our study was to compare suicide data from regions with and without suicide bridges and to estimate the effects on method and site substitution if bridges were to be secured. In a national survey, suicide data for the years 1990 to 2003 were collected. Regions with high rates of bridge suicides were identified and compared with regions with low rates, and the analysis revealed that only about one third of the individuals would be expected to jump from buildings or other structures if no bridge was available. The results suggest no method substitution for women. For men, a trend of a substituting jumping by overdosing in regions without suicide bridges was found. We conclude that restricted access to suicide bridges will not automatically lead suicidal individuals to choose another jumping site or suicide method. The results support the notion that securing bridges may save lives.

The risk of suicide is related to the availability of means (Gunnell & Lewis, 2005; Azrael, Hemenway, Miller, Barber, & Schackner, 2004), and restriction of means may prevent suicides (Gunnell & Frankel, 1994; Hawton et al., 1998; Leenaars et al., 2000). Preventive effects have been demonstrated for changes in firearm legislation (Leenaars, Moksony, Lester, & Wenckstern, 2003; Miller et al., 2006), reducing packet size of analgesics (Hawton, et al., 2001); and building barriers on jumping sites (e.g., Beautrais, 2001; Reisch & Michel, 2005).

The question of whether restricting the availability of a specific method will reduce the overall frequency of suicide is controversial (Cantor & Baume, 1998; O'Carroll & Silverman, 1994). For instance, a general decrease in suicide rates was found after detoxification of coal gas (Lester, 1990). Marzuk et al. (1992) reported that differences in suicide rates between the five counties of New York City were, in large, due to differences in the accessibility of high rise buildings. Some individuals, however, will choose another method when a certain method is not available. Rich, Young, Fowler, Wagner, and Black (1990) found a substitution effect for shooting by leaping after the introduction of gun control legislation. De Leo, Dwyer,

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Firman, and Neulinger (2003) demonstrated a correlation between a decrease of suicides by firearms and an increase in hanging. Ho (1996) reported that an increase in jumping was accompanied by a decrease of other methods. Overall, it appears that some people will be likely to substitute suicide methods but not all (Marzuk et al., 1992).

In the case of suicide by jumping from height, method substitution has to be differentiated from site substitution. Site substitution describes the possibility that a person who is deterred from jumping from bridge A will instead jump from bridge B or from building C. Reisch and Michel (2005) as well as O'Carroll and Silvermann (1994) did not find a substitution of a jumping hot spot for a nearby bridge after the installation of safety barriers, whereas site substitution was found for two bridges in New Zealand (Beautrais, 2001). Cantor and Hill (1990) concluded that persons prevented from jumping by barriers "will not automatically jump from another bridge although a minority will do so" (p. 377).

Leaping from height is the fourth most frequent suicide method in Switzerland, with a proportion of 10.7% of all suicides (average 1990–2003, Swiss Federal Statistical Office [Bundesamt für Statistik, BFS], 2006). From an international perspective, only Germany, Austria, and Japan have similar percentages of suicides by jumping; however, it is not so much the national but the regional view that seems to be important. The numbers of suicides by jumping show marked regional differences, mostly dependent on accessibility of structures to jump from (Ross & Lester, 1991). High numbers of suicides by jumping have been reported from Brussels, Belgium, (Moens, Loysch, & van de Voorde, 1988); New York, USA (Fischer, Comstock, Monk, & Sencer, 1993); Singapore (Peng & Choo, 1992); and Bern, Switzerland (Reisch & Michel, 2005). The phenomenon is explained in part by the fact that persons who kill themselves by jumping tend to go to sites close to their place of residence (Ross & Lester, 1991; Wohner & Schmidtke, 2005).

Switzerland has 26 regions defined by cantonal borders. There are high bridges in some cantons but not in all. In some cantons, certain bridges are known to be suicide hot spots. Therefore, the cantonal suicide data, which include the distribution of methods, can be correlated with the accessibility of suicide bridges. This, we felt, would allow an estimation of the proportion of individuals that might be expected to substitute some other method for jumping if no easily accessible jumping sites were available. The results may yield important information in view of preventive measures such as barriers on bridges.

More specifically, the following questions relating to suicide in Switzerland were formulated: (1) Do cantons with easy access to suicide bridges have a higher total of suicides by jumping compared to cantons with no or few high bridges? (2) If yes, what would the assumed proportion of individuals not committing suicide by jumping be if existing suicide bridges were secured?

METHOD

Data Collection

Our analysis included two different datasets. The first was obtained from the Swiss Federal Statistical Office (BFS). These data were available for 1990 to 2003, and include the numbers of all officially registered suicides specified by time (year), method used, age, gender, and place of residence. The suicide method is listed on the death certificate using *ICD-9* (until 1994) and *ICD-10* criteria (1995–2003).

In *ICD*, "suicide by leaping from height" is not differentiated in subgroups. In order to determine if a person had jumped from a bridge, a second dataset was collected from local authorities. Due to the federal system in Switzerland, data of suicides by jumping are registered according to cantonal rules. Therefore, data had to be obtained from various sources, such as medical-legal institutes, cantonal and district medical authorities, and police records. Permission to use the data were obtained from all suppliers.

Data from one of the 26 cantons (Ticino) could not be included because of legal obstacles. Authorities of three cantons (Berne, Lucerne, Valais) were unable to provide data for the period 1990 to 1995 due to changes of the registration system. The BFS dataset was reduced accordingly for these cantons, yielding a dataset of 475 persons who jumped from 141 bridges.

Twenty-three of these 141 bridges had a frequency of more than 0.4 suicides per year, accounting for 312 (65.7%) of all bridge suicides. The average height of these bridges was 69.5 metres (range: 18–150 metres), the mean distance to the next town 2.8 kilometres (range 0–30 kilometres).

Data Alignment

BFS data and data gathered from local authorities were synchronized. The collated datasets yielded a total of 1,830 suicides by jumping, which were included in the second set of analyses. In order to relate bridge suicides to suicides by leaping from other high places, the data were subdivided into two groups: "bridge" and "other sites"; with "other sites" consisting of buildings and natural sites such as mountain cliffs. However, jumping from cliffs is a rare method in Switzerland and can be neglected here. Therefore, the term "other sites" mainly refers to suicides from high buildings (multistory buildings, towers, etc.).

Data of 475 persons who jumped from bridges were collected from local sources. The data of 146 persons could not be aligned with the BFS data due to several reasons; for example, absence of details in the police records, or persons not resident in Switzerland (persons not living in Switzerland are not listed in the BFS dataset). Of the remaining 329 datasets, 283 subjects (86.0%) could be aligned (data alignment was not possible in 46 cases). Sixty-two persons committed suicide from a bridge in a canton different from their canton of residence. The data of such persons were aligned according to their place of residence. Nonalignment may have lead to an underestimation of the total number of jumps from bridges. Mean values of age and gender distribution of persons who jumped from a bridge did not vary significantly between aligned data and original dataset.

In summary, the aligned dataset finally consisted of 17,482 suicides with 283 bridge suicides and 1,547 suicides by jumping from other sites.

Obviously, for suicide by jumping, the presence of high places is a precondition. There is an association between high population density and the availability of high buildings suitable for suicide by jumping. We therefore included population density as a covariate in the analyses. Socioeconomic characteristics contribute to suicide rates (Taylor, Page, Morrell, Harrison, & Carter, 2005) and were also included as covariates in the analyses. Other variables included as covariates were: religion (rate of catholic citizens, rate of citizens without religious affiliations), unemployment, and language (rate of citizens speaking French). All analyses were carried out for both genders.

Data Analyses

In order to control for different population numbers of the cantons, we calculated the number of suicides by jumping, for those from bridges and for those from other sites respectively, per 100,000 inhabitants per year for all 26 cantons, using the aligned data set. The rates (suicides per 100,000 inhabitants per year) for all other main suicide methods (overdose, hanging, shooting, and other methods) were calculated correspondingly.

In the next step, we calculated the proportion of suicides from bridges in view of all suicides by jumping in order to identify cantons with high rates of bridge suicides. The cantons were divided into "bridge cantons," with above average rates of bridge jumps, and "non-bridge cantons," with a below average rate of bridge jumps. We then tested whether population density, religion, language, and unemployment correlated with cantonal suicide data. Variables that were statistically significant were included as covariates in the analyses. ANCOVAs were carried

out to compare bridge and non-bridge cantons in terms of rates of different suicide methods.

In a further step, we calculated an estimate of the proportion of persons in non-bridge cantons substituting some other jumping site for the non-available bridge. This was done by comparing suicides of bridge cantons with those of non-bridge cantons, assuming the accessibility of high buildings in both to be similar since there was no significant difference in population density between the two groups. The site substitution rate was then calculated using the following formula:

$$\text{Site substitution in \%} = 100 \times \frac{X80_{other}CNB - X80_{other}CB}{X80_{bridge}CB - X80_{bridge}CNB}$$

where $X80_{other}$ = suicides by jumping from heights other than bridges, $X80_{bridge}$ = suicides by jumping from bridges, X80 = stands for suicide by jumping (*ICD-10*); CB = bridge cantons, and CNB = non-bridge cantons. All analyses were calculated using SPSS 11.5.

RESULTS

During the period 1990 to 2003, a total of 429 (23.4%) persons jumped from bridges and 1,401 (76.6%) from other sites. The percentage of bridge suicides compared to all suicides by jumping differed widely between the Swiss cantons, ranging from 0 to 100.

Comparison of Cantons

The group of bridge cantons included 11 cantons. Percentages of bridge suicides in relation to all suicides by jumping were between 14.3 and 100 (mean 51.1%, *SD* 25.6). The non-bridge cantons included 14 cantons with percentages of bridge suicides between 0 and 7.4 (mean 2.9%, *SD* 3.6). Population density correlated significantly with jumps from other sites but not with jumps from bridges, indicating that jumping from other sites was strongly related to urban regions. Other significant correlations were found for unemployment, proportion of citizens of German language, and religion. Consequently, five of the six variables were included as covariates in the ANCOVAs. For *r* values and statistical values see Table 1.

In the bridge cantons the suicide rate for all jumps was higher than in the non-bridge cantons. This was statistically significant for the entire sample as well as for women (statistical trend) and men separately (see Table 2). We found a higher number of jumps from other sites in the non-bridge group for the entire sample but not in gender specific analyses.

The suicide rates (per 100,000 citizens), however, did not differ between bridge cantons and non-bridge cantons (bridge cantons, 18.95; non-bridge cantons, 18.77) (see Table 2). Although the rate of overdoses was higher in the non-bridge cantons, this result did not reach statistical significance. A statistical trend for a higher rate of overdoses by men was found. No statistically significant difference between bridge and non-bridge cantons was observed for other suicide methods (see Table 2).

Estimation of Site Substitution

The assumed site substitution was calculated according to the formula described in the method section, using adjusted means (see Table 2). According to this computation, 37.9% of persons (women: 39.6%; men: 37.1%) would be expected to jump from another site if there was no suicide bridge in their region.

DISCUSSION

Cantons with a high rate of bridge suicides had a higher rate of suicide by jumping, a finding that suggests that the availability of bridges in a region attracts suicidal individuals to use this method. Non-bridge cantons

TABLE 1
Correlations of Sociocultural Factors with Suicide Rates

	All methods		All jumps		Bridge jumps		Other jumps	
	r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
Population density	0.35	n.s.	0.43	.03	–0.09	n.s.	0.54	.005
Unemployment	0.10	n.s.	0.50	.01	–0.07	n.s.	0.58	.002
Language (German)	–0.01	n.s.	–0.40	.05	–0.04	n.s.	–0.37	n.s.
Language (French)	0.01	n.s.	0.35	n.s.	0.03	n.s.	0.33	n.s.
Religion (catholic)	–0.40	.05	–0.06	n.s.	0.16	n.s.	–0.23	n.s.
Religion (none)	0.30	n.s.	0.59	.001	–0.13	n.s.	0.75	<.001

Note. $N = 25$ cantons, Pearson correlation.

had a higher rate of suicides by jumping from other high places—suggesting that substitution of jumping sites may occur if no bridge is available. We estimate that in cantons without a suicide bridge, 62% of individuals do not choose another place to jump from. This percentage may reflect the long-term preventive effect of bridge barriers which stop individuals from jumping. In our view, our data therefore support the claims that securing bridges with barriers may have a considerable preventive effect. They also support the conclusions of Daigle (2005) that individuals have a preference for a specific method and are not very likely to replace it. Consistent with this, several evaluations of bridges that were secured with barriers have shown that, first, a suicide bridge was not simply replaced by another bridge and, second, that securing bridges may result in a general reduction of suicides with this method (Reisch & Michel, 2005).

Data from the national survey revealed that jumping from buildings was significantly correlated with population density. This result was expected because the frequency of suicide with a specific method is moderated by its accessibility. Cities by nature have a high population density with more easily accessible multistory buildings. Our finding is consistent with other studies demonstrating a higher number of suicides in metropolitan areas (Fischer et al., 1993; Marzuk et al., 1992; Peng & Choo, 1992). Although it may be expected that more bridges are found in urban areas, suicide by jumping from bridges did not significantly correlate with population density.

We observed no clear tendency in non-bridge cantons for people to turn to other suicide methods such as hanging or shooting. Only in men, fatal overdosing in non-bridge cantons was higher (statistical trend)—a finding which was somewhat unexpected.

Our study has several limitations. First, comparing bridge cantons with non-bridge cantons only indirectly allows estimating the phenomena of method and site shift. The applied methodology does not allow the detection of shifts over time, an effect which would be of interest in longitudinal studies on the effects of bridge barriers. Second, the data related to suicide from bridges were gathered from different local authorities and may differ in terms of completeness in contrast to the BFS data which can be considered complete for Swiss citizens. Such a bias, however, would lead to an underestimation of the proportion of jumps from bridges. Finally, several covariates were included in the analyses accounting for the multifactorial nature of suicide; we cannot exclude that some factors have been missed.

TABLE 2
Suicide Victims in Bridge Cantons and non-Bridge Cantons

Method	Corrected mean* (suicides per 100,000 citizens per year) (*SD*)	Corrected mean* (suicides per 100,000 citizens per year) (*SD*)	*F*	*p*
Bridge jump	1.28 (0.87)	0.02 (0.11)	21.74	<.001
Other jump	1.10 (0.40)	1.57 (0.80)	5.92	.023
All jumps	2.37 (0.57)	1.59 (0.88)	13.74	.001
Overdose	5.28 (1.98)	6.05 (1.78)	1.37	ns
Shooting	3.62 (1.12)	3.38 (0.86)	0.41	ns
Hanging	4.73 (1.70)	4.99 (2.03)	0.10	ns
Other method	2.95 (1.07)	2.77 (0.40)	0.28	ns
All methods	18.95 (2.84)	18.77 (3.22)	0.02	ns
Female Suicide Victims				
Bridge jump	0.43 (0.32)	0.00 (0.05)	18.84	<.001
Other jump	0.54 (0.13)	0.71 (0.46)	2.64	ns
All jumps	0.97 (0.27)	0.71 (0.50)	4.18	.056
Overdose	2.07 (0.81)	2.06 (1.00)	0.00	ns
Shooting	0.17 (0.08)	0.15 (0.11)	0.27	ns
Hanging	1.10 (0.40)	1.00 (0.31)	0.52	ns
Other method	1.18 (0.40)	1.09 (0.35)	0.27	ns
All methods	5.49 (1.01)	5.01 (1.42)	2.51	ns
Male Suicide Victims				
Bridge jump	0.85 (0.66)	0.02 (0.07)	16.18	.001
Other jump	0.56 (0.38)	0.87 (0.47)	2.94	ns
All jumps	1.34 (0.35)	0.88 (0.51)	11.23	.004
Overdose	3.21 (1.26)	3.99 (0.92)	3.40	.082
Shooting	3.45 (1.10)	3.22 (0.80)	0.38	ns
Hanging	3.63 (1.50)	3.99 (2.00)	0.21	ns
Other method	1.77 (0.80)	1.68 (0.28)	0.13	ns
All methods	13.46 (2.44)	13.76 (2.70)	0.07	ns

Note. Bridge cantons, $N = 11$; Non-bridge cantons, $N = 14$.
*Mean corrected for population density, religion, unemployment, and language spoken.
ns = nonsignificant

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