Social Science & Medicine 72 (2011) 884–889

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Short report

Do local landmark bridges increase the suicide rate? An alternative test of the likely effect of means restriction at suicide-jumping sites

Garrett Glasgow*

Department of Political Science, University of California, 9420 Political Science, UCSB, Santa Barbara, CA 93106-9420, United States

ARTICLE INFO

Article history:
Available online 1 February 2011

Keywords:
USA
Suicide
Means restriction
Jumping
Bridges
Volunteered geographic information

ABSTRACT

A number of recent studies have examined the effect of installing physical barriers or otherwise restricting access to public sites that are frequently used for suicides by jumping. While these studies demonstrate that barriers lead to a reduction in the number of suicides by jumping at the site where they are installed, thus far no study has found a statistically significant reduction in the local suicide rate attributable to a barrier. All previous studies are case studies of particular sites, and thus have limited statistical power and ability to control for confounding factors, which may obscure the true relationship between barriers and the suicide rate. This study addresses these concerns by examining the relationship between large, well-known bridges ("local landmark" bridges) of the type that are often used as suicide-jumping sites and the local suicide rate, an approach that yields many more cases for analysis. If barriers at suicide-jumping sites decrease the local suicide rate, then this implies that the presence of an unsecured suicide-jumping site will lead to a higher local suicide rate in comparison to areas without such a site. The relationship between suicides and local landmark bridges is examined across 3116 US counties or county equivalents with negative binomial regression models. I found that while exposure to local landmark bridges was associated with an increased number of suicides by jumping, no positive relationship between these bridges and the overall number of suicides was detected. It may be impossible to conclusively determine if barriers at suicide-jumping sites reduce the local suicide rate with currently available data. However, the method introduced in this paper offers the possibility that better data, or an improved understanding of which potential jumping sites attract suicidal individuals, may eventually allow researchers to determine if means restriction at suicide-jumping sites reduces total suicides.

Introduction

A growing body of literature has examined the effectiveness of limiting access to the means of suicide as a method of suicide prevention (Clarke & Lester, 1989; Daigle, 2005; Florentine & Crane, 2010; Hawton, 2007). Interviews with suicide attempt survivors have shown that in many cases suicide attempts are impulsive, with only minutes passing between the first thought of suicide and the suicide attempt (Diesenhammer et al., 2009; Simon et al., 2001; Williams, Davidson, & Montgomery, 1980). This suggests that some suicidal individuals may be saved by restricting access to particular lethal agents, allowing time for a suicidal crisis to pass before a substitute suicide method is found (Clarke & Lester, 1989; Daigle, 2005). Changes in the rates of suicide and self-poisoning following the detoxification of domestic gas (Kreitman, 1976) and restrictions on the pack sizes of dangerous drugs such as paracetamol (Hawton et al., 2001) are frequently cited as examples of the beneficial effects of means restriction (although some of this evidence has recently been challenged (Bateman, 2009)).

Would means restriction be an effective method of suicide prevention at public sites that are frequently used for suicide by jumping, such as large bridges and other structures? Past work on the effectiveness of means restriction on other methods of suicide has led some researchers to conclude that means restriction measures at suicide-jumping sites, such as installing physical barriers or fences, may also be effective (Gunnell, Nowers, & Bennewith, 2005).

However, there are also reasons to doubt that means restriction will be an effective suicide prevention method at public suicide-jumping sites. Means restriction is most likely to be effective with household suicide methods that are quickly accessible, such as firearms, dangerous medications, and toxic substances (Hawton, 2001). The additional effort and time required to travel to a jumping site in comparison to household suicide methods may indicate

* Tel.: +1 805 893 3432.
E-mail address: glasgow@polsci.ucsb.edu.

0277-9536/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.socscimed.2011.01.001

that suicides in these locations are less impulsive, and thus less likely to be prevented through means restriction. Further, individuals who commit suicide by jumping from bridges and other high public places appear to be more likely to suffer from severe psychiatric illnesses than most other people who commit suicide (Beautrais, 2007; Cantor, Hill, & McLachlan, 1989; De Moore & Robertson, 1999; Reisch, Schuster, & Michel, 2008), making it unclear how comparable the populations in previous means restriction studies are to the population of concern in this case.

A number of recent studies have examined the effect of installing physical barriers or otherwise restricting access to suicide-jumping sites (Beautrais, 2001; Beautrais, Gibb, Fergusson, Horwood, & Larkin, 2009; Bennewith, Nowers, & Gunnell, 2007; Berman, O'Carroll, & Silverman, 1994; Pelletier, 2007; Reisch & Michel, 2005; Sinyor & Levitt, 2010; Skegg & Herbison, 2009). While these studies demonstrate that barriers lead to a reduction in the number of suicides by jumping at the site where they are installed, thus far no study has found a statistically significant reduction in the local suicide rate attributable to a barrier. Thus, it remains unknown whether restricting access to suicide-jumping sites prevents suicides, or leads suicidal individuals to substitute another suicide location or method.

Previous studies of the effectiveness of means restriction at suicide-jumping sites have been case studies of particular sites that test for a decrease in the local suicide rate after access to the jumping site is restricted. This approach has two weaknesses that may obscure the true relationship between barriers and the suicide rate. First, since suicide by jumping is relatively rare, a case study of a single site will most likely never have the statistical power to determine if a barrier has led to a reduction in the suicide rate, a point openly acknowledged in previous work (Beautrais, 2007; Sinyor & Levitt, 2010; Skegg & Herbison, 2009). Second, a case study of a single site is unable to control for confounding factors (such as national level trends) that may obscure the effect of a barrier on the local suicide rate. Studying a large number of cases simultaneously could address these problems, but this is not a viable approach because barriers at suicide-jumping sites are rare.

An alternative approach to analysis is to examine the effect of suicide-jumping sites without barriers on the local suicide rate. Comparing the suicide rate in areas with unsecured suicide-jumping sites to the rate in areas that do not have such sites may reveal whether exposure to these sites increases the suicide rate, and thus whether restricting access to this means of suicide though barriers would be expected to reduce the suicide rate. A similar approach has uncovered a statistically significant relationship between local suicide rates and access to other means of suicide, such as firearms (Miller, Lippmann, Azrael, & Hemenway, 2007), suggesting that restricting access to these means might reduce the suicide rate. Some studies suggest that increased access to a means to commit suicide by jumping (high-rise residences) leads to an increase in the suicide rate (Lester, 1994; Marzuk et al., 1992), but these studies focus on a single community, and do not control for possible confounding factors.

This study examines the relationship between suicides and exposure to large, notable bridges ("local landmark" bridges) of the type that are often used as suicide-jumping sites. By comparing areas with and without these sites over a large region the number of cases to examine is greatly increased, addressing concerns with statistical power and allowing for controls for confounding factors. This study is a cross-sectional ecological design in which the units of analysis are 3116 US counties (or the equivalent in each US state, including independent cities and Census Areas) observed from 1990 through 2006. The hypothesis tested is whether the presence of a large, notable bridge (a potential suicide-jumping site) in a county increases the number of suicides in that county.

Data and methods

Suicide-jumping sites

The primary difficulty in this study was in identifying those bridges most likely to be local suicide-jumping sites. There are no official statistics on suicides from individual bridges in the US, and media reporting of such suicides is not systematic. Instead, this study examines "local landmark" bridges that share the characteristics of those bridges known to be suicide-jumping sites though a measure that captures both the size and the aesthetic and symbolic qualities of the bridge.

Not all large bridges become frequent targets for suicide attempts. Interviews with survivors of suicide attempts from bridges reveal that accessibility plays a role in the choice of a bridge used for a suicide attempt (Blaustein & Fleming, 2009; Rosen, 1975).

Perceptions of aesthetic and symbolic qualities also appear to play a role in the choice of bridge used for a suicide attempt (Daigle, 2005). Survivors of suicide attempts from bridges have described their choice of suicide location as "romantic," "majestic," "scenic," and possessing "a certain grace and beauty" (Blaustein & Fleming, 2009; Rosen, 1975). A study of individuals who jumped from either the Golden Gate or San Francisco-Oakland Bay Bridges found numerous instances of individuals crossing the Bay Bridge to jump from the equally high but more famous Golden Gate Bridge, but no instances of travel in the reverse direction (Seiden & Spence, 1983), although this finding may be partially explained by the relatively low population north of the Golden Gate Bridge (the starting point for a trip across the Golden Gate Bridge to the Bay Bridge) and the fact that the Golden Gate Bridge is the only major bridge in the San Francisco Bay Area with pedestrian access. Other studies have shown that in many cases suicidal individuals prefer to jump into open water rather than onto land or ice (Cantor & Hill, 1990; Lindqvist, Jonsson, Eriksson, Hedelin, & Björnstig, 2004). This preference may be driven by a symbolic meaning attached to a bridge over water, or a widely-held belief that suicide by leaping into water is painless (Rosen, 1975; Seiden, 1978).

It is interesting to note that, rather than describing their choice of suicide location as a "landscape of despair," survivors of suicide attempts from bridges describe their choice of bridge in much the same language that is used to describe "therapeutic landscapes," or environments thought to promote physical, mental, or spiritual well-being (Gesler, 1992). Therapeutic landscapes are often described as possessing beautiful or dramatic scenery (Gesler, 1992, 1996, 1998; Palka, 1999; Tonnellier & Curtis, 2005). The presence of water is also an important component of many therapeutic landscapes (Gesler, 1992, 1996, 1998). The contradiction inherent in selecting a suicide location that has therapeutic qualities may be explained by the fact that ambivalence about suicide is common among suicidal individuals, as revealed in a study of suicidal individuals who used hotline telephones installed on bridges (Glatt, 1987). This suggests that some individuals may view the bridge not only as a place for suicide, but also a place to seek solace or help. However, it should be noted that much of the research on the relationship between suicide and the aesthetic and symbolic qualities of a bridge has focused on the Golden Gate Bridge (a world-famous cultural icon), raising the possibility that these factors may be less important at other suicide-jumping sites (Sinyor & Levitt, 2010).

Identification of those bridges that were most likely to be local suicide-jumping sites began with an examination of the 2009 National Bridge Inventory (NBI), maintained by the US Federal Highway Administration (United States Federal Highway Administration, 2009). The NBI contains information on the location and structural properties of the nearly 600,000 US bridges located on public roads. As shorter bridges are unlikely to have

sufficient vertical distance from the bridge deck to the ground to make them targets for a suicide attempt, only the approximately 1200 bridges with a maximum span over 100 m were selected for further consideration (information on the actual vertical distance from the bridge deck to the ground is not available in the NBI).

Then, the local notability and perceptions of the aesthetic and symbolic qualities of each of these selected bridges was captured through the use of volunteered geographic information (VGI), a useful way to identify local landmarks or places of interest that are not systematically recorded by the media or official organizations (Goodchild, 2007). From the NBI the latitude and longitude of each bridge with a maximum span over 100 m was obtained and plotted in Google Earth (Google, 2009). Each location was then examined for VGI content related to the bridge submitted by Google Earth users, such as photographs or Wikipedia pages. Most of this VGI was focused on the aesthetic qualities of these bridges. Only bridges with at least two pieces of VGI from at least two different people were regarded as local landmark bridges in the subsequent analysis. Bridges known to have suicide barriers for the entire study period and other bridges obviously not suitable for a suicide attempt (such as floating bridges and other bridges with insufficient vertical distance from the bridge deck to the surface below for a suicide attempt) were eliminated from consideration, leaving 312 local landmark bridges in the analysis.

Exposure to one or more local landmark bridges was coded with a simple indicator variable for each county. This exposure measure was adjusted to the appropriate fraction in those cases where a bridge or a suicide barrier on a bridge was constructed after 1990. In cases where a bridge connected two counties both counties were coded as exposed to the bridge. This procedure resulted in 312 counties coded as containing at least one local landmark bridge. The geographic distribution of these counties is unsurprising, with most clustered in coastal urban areas and along major river valleys (Fig. 1)

Suicides and other data

Information on the total number of suicide deaths from 1990 through 2006 by all methods (ICD-9, 1990–1998 (E950–E959); ICD-10, 1999–2006 (X60–X84, Y87.0)) and by jumping from a high place (ICD-9, 1990–1998 (E957); ICD-10, 1999–2006 (X80)) in each county was obtained from the national mortality files maintained by the National Center for Health Statistics (Centers for Disease Control and Prevention, 2003, 2009). These numbers were tabulated separately for males and females in each of three age groups (15–24, 25–64, and 65+). Although the International Classification of Diseases (ICD) codes for cause of death were revised during the study timeframe, this revision did not introduce any significant discontinuities into the coding of suicide mortality (Anderson, Miniño, Hoyert, & Rosenberg, 2001). A total of 516,884 suicide deaths by all methods and 11,345 suicide deaths by jumping from a high place were included in the analysis. Information on which of the suicides by jumping from a high place took place from bridges was not available.

Several variables were included in the analysis to control for confounding factors. Urban counties tend to have lower suicide rates than rural counties (Singh & Siahpush, 2002) and were also more likely to contain a local landmark bridge. Urban counties are also more likely to contain high-rise residential buildings, where many suicides by jumping take place (Fischer, Comstock, Monk, & Sencer, 1993; Marzuk et al., 1992). The urbanization of each county was measured by a 10-category rural-urban continuum variable developed by the U.S. Department of Agriculture (United States Department of Agriculture, 1993, 2003) that is based on characteristics such as population, commuting patterns, and proximity to a metropolitan area. The average of the measures from 1993 and 2003 was used in the analysis, with the two categories for urban counties with a population of over 1 million collapsed into a single category for the 1993 measure in order to make it compatible with the 2003 measure.

Geographic areas suffering from social and socioeconomic disruption tend to have higher suicide rates (Durkheim, 1951; Kubrin, Wadsworth, & DiPietro, 2006). To control for this association the mean unemployment rate for 1990 through 2006 for each county was obtained from the Bureau of Labor Statistics and included as a control variable (United States Department of Labor, 1990–2006). The mean unemployment rate for 1990–2004 was

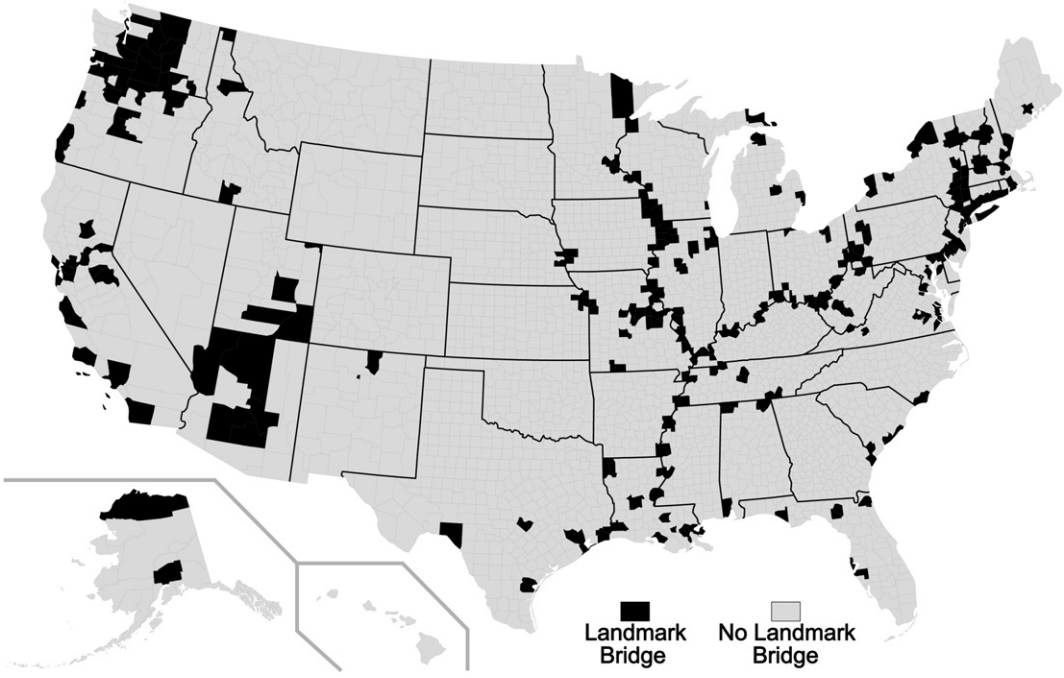

Fig. 1. Distribution of local landmark bridges across US counties and county equivalents.

used for six Louisiana parishes where some data were unavailable due to the effects of Hurricane Katrina.

Non-Hispanic Whites and American Indians have substantially higher suicide rates than other ethnic groups in the United States (Centers for Disease Control and Prevention 2003, 2009). The mean ethnic composition of each county during the study period was calculated using US Census Bureau population estimates (United States Department of Health and Human Services, 2008), and the population percentages of Non-Hispanic Whites and American Indians/Alaskan Natives were included as control variables.

Counties that experienced changes in their geographic boundaries during the study time frame were excluded from the analysis, leaving a total of 3116 counties or county equivalents for analysis.

Analysis

Separate negative binomial regression models using the total number of suicides in each county as the dependent variable were estimated for each age-sex group, both for suicide by jumping from a high place and for suicide by any method. All independent variables described above were included in the regression models. The log of each county's population during the study period was included as an offset term with a coefficient of 1.

Areas with high suicide rates tend to cluster geographically, and this clustering cannot always be explained by observed predictors of suicide (Baller & Richardson, 2002). To control for spatial autocorrelation, a spatial lag variable for each county was also included. This spatial lag was created through a weighted sum of the number of deaths due to suicide in all contiguous counties, with the weight of each contiguous county's suicide total given by the inverse distance between the reference county's centroid and the contiguous county's centroid (Anselin, 1988). Heteroskedasticity-robust standard errors were calculated for all analyses. All analyses were conducted with Stata 10.1 (StataCorp, 2007).

Results

Exposure to local landmark bridges was associated with a statistically significant increase in the risk of suicide by jumping from a high place for both men and women across all age groups (Table 1). As exposure to local landmark bridges was coded with a simple indicator variable, these incident rate ratios show that the rate of suicide by jumping is approximately doubled in counties with a local landmark bridge in comparison to counties without such a bridge. Given the low base rate of suicide by jumping, it is possible that a single suicide-jumping site such as a landmark bridge could double the local suicide rate by jumping, although it should be noted that many of these bridges are located in areas with numerous jumping sites by virtue of the local terrain.

Table 1
Incident-rate ratio estimates for exposure to local landmark bridges on suicide by jumping and suicide by all methods, by age and sex.

	Suicide by jumping			Suicide by All methods		
Age-sex group	IRR	95% CI		IRR	95% CI	
Female 15–24	1.86	1.37	2.54	0.98	0.91	1.05
Female 25–64	2.10	1.71	2.58	0.96	0.91	1.01
Female 65+	1.66	1.26	2.19	1.00	0.93	1.07
Male 15–24	1.74	1.45	2.09	0.96	0.92	1.01
Male 25–64	1.99	1.72	2.31	0.96	0.93	0.99
Male 65+	2.05	1.64	2.56	0.94	0.90	0.98

Notes: IRR = Incident-Rate Ratio, CI = Confidence Interval.
Data are 3116 US counties or county equivalents observed from 1990 through 2006. All analyses control for the mean unemployment rate, ethnic composition (percentage Whites and American Indian/Alaskan Native), level of urbanization, and spatial autocorrelation.

As many suicides by jumping occur at high-rise residential structures (Fischer et al., 1993; Marzuk et al., 1992), the relationship between suicide by jumping from non-residential man-made structures (ICD-9, 1990–1998 (E957.1)) and exposure to local landmark bridges was estimated as an additional check of the local landmark bridge measure (this subcategory was not available for the years 1999–2006). The results of this analysis did not substantively differ from those based on all suicides by jumping.

These results correspond with those in other studies that have found that increased exposure to a means of suicide increases the rate of suicide using that means (Beautrais, 2001; Gunnell et al., 2007; Hawton et al., 2001; Kreitman, 1976; Miller et al., 2007). These results also suggest that the measure of bridge exposure developed in this study is capturing those bridges likely to be used in suicide attempts.

The relationship between exposure to local landmark bridges and suicide by all methods was statistically insignificant for all female age groups and for males between 15 and 24 years of age, and associated with a lower suicide rate for males over 24 years of age. The negative relationship between all suicides and local landmark bridges for males over 24 years of age was unexpected. These results generally agree with a previous study that did not find a statistically significant difference in the overall suicide rate between Swiss cantons with high and low rates of suicides by jumping from bridges (Reisch, Schuster, & Michel, 2007). This study did not find any evidence that exposure to local landmark bridges increases the suicide rate.

A possible source of bias in this study is that the procedure used to identify those bridges likely to be suicide-jumping sites might overestimate the number of such bridges, attenuating the relationship between potential suicide-jumping sites and the suicide rate. In the absence of systematic data on suicides from bridges, it is not possible to determine if the measure used in this study is an under- or overestimate of the number of bridges in the US frequently used as suicide-jumping sites. However, there are reasons to believe that the estimated number of suicide-jumping sites is reasonably accurate. On a per capita basis, the number of bridges identified as potential suicide-jumping sites in this study is roughly equal to the number of bridges identified as frequently used suicide-jumping sites in previous studies where data on bridge suicides were available (Lindqvist et al., 2004; Reisch et al., 2007). The strong positive relationship between the bridge exposure variable and both suicide by jumping from a high place and suicide by jumping from non-residential man-made structures also gives some confidence that this measure is capturing local suicide-jumping sites. Limiting the definition of potential suicide-jumping sites to only those bridges accessible to pedestrians (data available in the NBI), or measuring exposure with the total number of local landmark bridges in a county rather than an indicator variable, did not substantively change the results presented above. A better understanding of what leads a bridge to become a site that is frequently used for suicide by jumping could help to more accurately identify bridges likely to be suicide-jumping sites, possibly changing the estimated relationship between exposure to local landmark bridges and suicide.

Another possible source of bias is in the recording of suicides by jumping. Suicides by jumping from a height appear to be more likely to be misclassified as deaths of undetermined intent than other types of suicide such as hanging (Cooper & Milroy, 1995; Ohberg & Lonnqvist, 1998). This could result in a downward bias in the estimated effect of local landmark bridges on overall suicides. Adjusting the number of suicides in each county upwards by the number of deaths due to falling from a high place with an

undetermined intent (ICD-9, 1990–1998 (E987); ICD-10, 1999–2006 (Y30)) did not substantively change the results of the analysis presented above.

Conclusion

This study examined the relationship between exposure to large, locally notable bridges of the type frequently used for suicide by jumping and suicides in 3116 US counties and county equivalents over 17 years. This study found that exposure to these local landmark bridges was associated with an increased number of suicides by jumping in the county where the bridge was located. However, no positive relationship between these bridges and the overall number of all types of suicides was detected.

Given the relatively high cost of physical barriers at suicide-jumping sites in relation to other suicide prevention efforts and public safety projects, more research on the efficacy of such barriers, as well as on alternative measures such as suicide hotline phones (Glatt, 1987), is needed. It may be impossible to conclusively determine if barriers or other measures at suicide-jumping sites reduce the local suicide rate with currently available data. However, by addressing some of the methodological shortcomings of previous work, the approach developed in this study offers the possibility that improved data, or an improved understanding of which potential jumping sites attract suicidal individuals, may eventually allow researchers to determine if means restriction at suicide-jumping sites reduces total suicides.

Acknowledgments

I thank James Hardin, Mike Kruger, Jarad Niemi, David Sherman, and participants in the UCSB Quantitative Methods in the Social Sciences (QMSS) seminar for helpful comments and suggestions on an earlier version of this paper.

References

Anderson, R. N., Miniño, A. M., Hoyert, D. L., & Rosenberg, H. M. (2001). Comparability of cause of death between ICD–9 and ICD–10: preliminary estimates. *National Vital Statistics Reports, 49*, 1–32.

Anselin, L. (1988). *Spatial econometrics: Methods and models*. Boston, MA: Kluwer Academic.

Baller, R. D., & Richardson, K. K. (2002). Social integration, imitation, and the geographic patterning of suicide. *American Sociological Review, 67*, 873–888.

Bateman, D. N. (2009). Limiting paracetamol pack size: has it worked in the UK? *Clinical Toxicology, 47*, 536–541.

Beautrais, A. L. (2001). Effectiveness of barriers at suicide-jumping sites: a case study. *Australian and New Zealand Journal of Psychiatry, 35*, 557–562.

Beautrais, A. L. (2007). Suicide by jumping from heights: a review of research and prevention strategies. *Crisis, 28*(Suppl.), 58–63.

Beautrais, A. L., Gibb, S. J., Fergusson, D. M., Horwood, L. J., & Larkin, G. L. (2009). Removing bridge barriers stimulates suicides: an unfortunate natural experiment. *Australian and New Zealand Journal of Psychiatry, 43*, 495–497.

Bennewith, O., Nowers, M., & Gunnell, D. (2007). Effect of barriers on the Clifton suspension bridge, England, on local patterns of suicide: implications for prevention. *British Journal of Psychiatry, 190*, 266–267.

Berman, A. L., O'Carroll, P. W., & Silverman, M. M. (1994). Community suicide prevention: the effectiveness of bridge barriers. *Suicide and Life-Threatening Behavior, 24*, 89–99.

Blaustein, M., & Fleming, A. (2009). Suicide from the Golden Gate Bridge. *American Journal of Psychiatry, 166*, 1111–1116.

Cantor, C. H., & Hill, M. A. (1990). Suicide from river bridges. *Australian and New Zealand Journal of Psychiatry, 24*, 377–380.

Cantor, C. H., Hill, M. A., & McLachlan, E. K. (1989). Suicide and related behaviour from river bridges: a clinical perspective. *British Journal of Psychiatry, 155*, 829–835.

Centers for Disease Control and Prevention, National Center for Health Statistics. Compressed Mortality File 1979–1998. (2003). CDC WONDER on-line database, compiled from compressed mortality file 1968–1988, Series 20, No. 2A, 2000 and CMF 1989-1998, Series 20, No. 2E [data file]. Retrieved from. http://wonder.cdc.gov/cmf-icd9.html on Dec. 1, 2009.

Centers for Disease Control and Prevention, NationalCenter for Health Statistics. Compressed Mortality File 1999–2006. (2009). CDC WONDER on-line database, compiled from compressed mortality file 1999–2006 Series 20 No. 2L [data file]. Retrieved from. http://wonder.cdc.gov/cmf-icd10.html on Dec. 1, 2009.

Clarke, R. V., & Lester, D. (1989). *Suicide: Closing the exits*. New York, NY: Springer Verlag.

Cooper, P. N., & Milroy, C. M. (1995). The coroner's system and under-reporting of suicide. *Medicine, Science and the Law, 35*, 319–326.

Daigle, M. S. (2005). Suicide prevention through means restriction: assessing the risk of substitution. A critical review and synthesis. *Accident Analysis and Prevention, 37*, 625–632.

De Moore, G. M., & Robertson, A. R. (1999). Suicide attempts by firearms and by leaping from heights: a comparative study of survivors. *American Journal of Psychiatry, 156*, 1425–1431.

Diesenhammer, E. A., Ing, C. M., Strauss, R., Kemmler, G., Hinterhuber, H., & Weiss, E. M. (2009). The duration of the suicidal process: how much time is left for intervention between consideration and accomplishment of a suicide attempt? *Journal of Clinical Psychiatry, 70*, 19–24.

Durkheim, E. (1951). *Suicide: A study in sociology*. Glencoe, IL: Free Press. Original work published 1897.

Fischer, E. P., Comstock, G. W., Monk, M. A., & Sencer, D. J. (1993). Characteristics of completed suicides: implications of differences across methods. *Suicide and Life-Threatening Behavior, 23*, 91–100.

Florentine, J. B., & Crane, C. (2010). Suicide prevention by limiting access to methods: a review of theory and practice. *Social Science & Medicine, 70*, 1626–1632.

Gesler, W. (1992). Therapeutic landscapes: medical geographic research in light of the new cultural geography. *Social Science & Medicine, 34*, 735–746.

Gesler, W. (1996). Lourdes: healing in a place of pilgrimage. *Health and Place, 2*, 95–105.

Gesler, W. (1998). Bath's reputation as a healing place. In R. Kearns, & W. Gesler (Eds.), *Putting health into place: landscape, identity, and well-being* (pp. 17–35). Syracuse, NY: Syracuse University Press.

Glatt, K. M. (1987). Helpline: suicide prevention at a suicide site. *Suicide and Life-Threatening Behavior, 17*, 299–309.

Goodchild, M. F. (2007). Citizens as sensors: the world of volunteered geography. *GeoJournal, 69*, 211–221.

Google. (2009). *Google Earth 5.1*. Mountain View, CA: Google, Inc.. Accessed on Nov. 21-22, 2009.

Gunnell, D., Nowers, M., & Bennewith, O. (2005). Suicide by jumping: is prevention possible? *Suicidologi, 10*, 15–17.

Gunnell, D., Fernando, R., Hewagama, M., Priyangika, W. D. D., Konradsen, F., & Eddleston, M. (2007). The impact of pesticide regulations on suicide in Sri Lanka. *International Journal of Epidemiology, 36*, 1235–1242.

Hawton, K. (2001). Studying survivors of nearly lethal suicide attempts: an important strategy in suicide research. *Suicide and Life-Threatening Behavior, 32* (Suppl.), 76–84.

Hawton, K. (2007). Restricting access to methods of suicide: rationale and evaluation of this approach to suicide prevention. *Crisis, 28*, 4–9.

Hawton, K., Townsend, E., Deeks, J., Appleby, L., Gunnell, D., Bennewith, O., & Cooper, J. (2001). Effects of legislation restricting pack sizes of paracetamol and salicytate on self-poisoning in the United Kingdom: before and after study. *British Medical Journal, 322*, 1203–1207.

Kreitman, N. (1976). The coal gas story: UK suicide rates, 1960–1971. *British Journal of Preventative and Social Medicine, 30*, 86–93.

Kubrin, C. E., Wadsworth, T., & DiPietro, S. (2006). Deindustrialization, disadvantage and suicide among young black males. *Social Forces, 84*, 1559–1579.

Lester, D. (1994). Suicide by jumping in Singapore as a function of high-rise apartment availability. *Perceptual and Motor Skills, 79*, 74.

Lindqvist, P., Jonsson, A., Eriksson, A., Hedelin, A., & Björnstig, U. (2004). Are suicides by jumping off bridges preventable? An analysis of 50 cases from Sweden. *Accident Analysis and Prevention, 36*, 691–694.

Marzuk, P. M., Leon, A. C., Tardiff, K., Morgan, E. B., Stajic, M., & Mann, J. J. (1992). The effect of access to lethal methods of injury on suicide rates. *Archives of General Psychiatry, 49*, 451–458.

Miller, M., Lippmann, S. J., Azrael, D., & Hemenway, D. (2007). Household firearm ownership and rates of suicide across the 50 United States. *Trauma, 62*, 1029–1035.

Ohberg, A., & Lonnqvist, J. (1998). Suicides hidden among undetermined deaths. *Acta Psychiatrica Scandinavica, 98*, 214–218.

Palka, E. (1999). Accessible wilderness as a therapeutic landscape: experiencing the nature of Denali National Park, Alaska. In A. Williams (Ed.), *Therapeutic landscapes: The dynamic between place and wellness* (pp. 29–52). New York, NY: University Press of America.

Pelletier, A. R. (2007). Preventing suicide by jumping: the effect of a bridge safety fence. *Injury Prevention, 13*, 57–59.

Reisch, T., & Michel, K. (2005). Securing a suicide hot spot: effects of a safety net at the Bern Muenster Terrace. *Suicide and Life-Threatening Behavior, 35*, 460–467.

Reisch, T., Schuster, U., & Michel, K. (2007). Suicide by jumping and accessibility of bridges: results from a national survey in Switzerland. *Suicide and Life-Threatening Behavior, 37*, 681–687.

Reisch, T., Schuster, U., & Michel, K. (2008). Suicide by jumping from bridges and other heights: social and diagnostic factors. *Psychiatry Research, 167*, 97–104.

Rosen, D. H. (1975). Suicide survivors: a follow-up study of persons who survived jumping from the Golden Gate and San Francisco-Oakland Bay Bridges. *The Western Journal of Medicine, 122*, 289–294.

Seiden, R. H. (1978). Where are they now? A follow-up study of suicide attempters from the Golden Gate Bridge. *Suicide and Life-Threatening Behavior, 8*, 203–216.

Seiden, R. H., & Spence, M. (1983). A tale of two bridges: comparative suicide incidence on the Golden Gate and San Francisco-Oakland Bay bridges. *Omega, 14*, 201–209.

Simon, T. R., Swann, A. C., Powell, K. E., Potter, L. B., Kresnow, M., & O'Carroll, P. W. (2001). Characteristics of impulsive suicide attempts and attempters. *Suicide and Life-Threatening Behavior, 32*(Suppl.), 49–59.

Singh, G. K., & Siahpush, M. (2002). Increasing rural-urban gradients in US suicide mortality, 1970–1997. *American Journal of Public Health, 92*, 1161–1167.

Sinyor, M., & Levitt, A. J. (2010). Effect of a barrier at Bloor Street Viaduct on suicide rates in Toronto: natural experiment. *British Medical Journal, 341*, c2884. doi:10.1136/bmj.c2884.

Skegg, K., & Herbison, P. (2009). Effect of restricting access to a suicide-jumping site. *Australian and New Zealand Journal of Psychiatry, 43*, 498–502.

StataCorp. (2007). *Stata statistical software: Release 10*. College Station, TX: StataCorp LP.

Tonnellier, F., & Curtis, S. (2005). Medicine, landscapes, symbols: "*The country Doctor*" by Honoré de Balzac. *Health and Place, 11*, 313–321.

United States Department of Agriculture, Economic Research Service. (1993). 1993 Rural-urban continuum codes [data file]. Retrieved from. http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/ on Oct. 2, 2009.

United States Department of Agriculture, Economic Research Service. (2003). 2003 Rural-urban continuum codes [data file]. Retrieved from. http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/ on Oct. 2, 2009.

United States Department of LaborBureau of Labor Statistics (1990–2006). Local area unemployment statistics, county data [data files]. Retrieved. http://www.bls.gov/lau/ fromon Oct 2, 2009.

United States Department of Health and Human ServicesCenters for Disease Control and PreventionNational Center for Health Statistics (2008). CDC WONDER online database, compiled from 1990–1999 bridged-race intercensal population estimates and 2000–2008 (Vintage 2008) bridged-race postcensal population estimates [data file]. Retrieved from. http://wonder.cdc.gov/bridged-race-v2008.html on Nov. 11, 2009.

United States Federal Highway Administration. (2009). 2009 National bridge inventory [data file]. Retrieved. http://www.fhwa.dot.gov/Bridge/nbi/ascii.cfm?year=2009 fromon Sept. 29, 2009.

Williams, C., Davidson, J., & Montgomery, I. (1980). Impulsive suicidal behavior. *Journal of Clinical Psychology, 36*, 90–94.