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Urbanicity and Methods of Suicide: A Nationwide Population-based Study

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ABSTRACT *Despite urban–rural disparities in suicide rates having been reported in prior studies, there is scant information on the impact of urbanicity on suicide methods. This study investigates violent and nonviolent suicide methods in Taiwan and their association with urbanicity. We use a Taiwanese nationwide mortality database covering the period January 1997 to December 2003. A multilevel logistic regression analysis was performed to examine the relationship between urbanicity and violent/nonviolent suicide methods after adjusting for the age, gender, marital status and employment status of the victims, and the seasons during which the deaths occurred to account for possible dependence within cities/towns. Of the total of 17,849 suicide deaths examined, those residing in more urbanized areas tended to commit suicide by violent methods, an association that remains after controlling for the age, gender, marital and employment status of the victims, and the season during which the deaths occurred. We concluded that a significant association is noted between urbanicity and suicide methods. Thus, effective strategies for suicide prevention should also consider urbanicity.*

KEYWORDS *Suicide, Urbanicity, Violent/Non-violent Methods*

INTRODUCTION

In Taiwan, suicide mortality rates have been steadily rising during the past decade. In 2006, there were over 4,000 suicide deaths, making suicide ninth among the leading causes of death.[1] In responding to this public health threat, greater insight into the complexity of suicidal behavior would facilitate the development of effective prevention efforts.

Given that the degree of violence involved varies considerably among different methods of suicide, suicide victims should not be considered a homogeneous group. Violent methods of suicide tend to be employed by males, suicide completers with psychosis or a lifetime history of aggression.[2–4] Seasonality has been noted as a factor in violent, but not in nonviolent, suicides.[5,6] These findings may suggest a different etiology between violent and nonviolent suicide that should be taken into consideration for suicide prevention as part of clinical work. Actually, suicidal behavior has consistently been viewed from diverse perspectives as a multifaceted clinical phenomenon shaped by many factors.[7]

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Urban–rural variations in suicide rates have been reported in prior studies.[8–13] In general, people residing in rural communities are at increased risk for suicide compared to those residing in urban areas, although the magnitude of difference varies among countries.[14] Nevertheless, there is scant information beyond suicide rates regarding urban–rural disparities in suicide. The pattern of suicide, in terms of methods, may be unevenly distributed across areas with different levels of urbanicity. With the pace of urbanization continuing to accelerate on a global scale, there is a growing need for firm understanding of the association between suicide methods and urbanicity. It will be helpful for researchers and policymakers concerned with suicide prevention to know about urban–rural disparities in suicidal behaviors.

Therefore, this study uses a 7-year nationwide population-based dataset to assess the association between urbanicity and violent/nonviolent methods of suicide in Taiwan, to further understanding about the effect of urbanicity on suicidal behavior.

METHODS

Dataset

The dataset adopted for this study was taken from the "cause of death" data file, provided by the Taiwanese Department of Health (DOH), covering the years 1997–2003. As it is mandatory for all deaths throughout Taiwan to be registered with the DOH, this register provides comprehensive information on the gender, age, marital and employment status of all suicide victims, along with the municipality of the residence, the date and place of death, and the diagnoses referring to the cause of death based on the International Classification of Diseases, Ninth Revision (ICD-9-CM) codes.

Study Sample

There were a total of 18,130 suicide deaths from 359 cities/towns in Taiwan between 1 January 1997 and 31 December 2003. After deleting those suicide deaths for which there were missing data (n=281), we were ultimately left with a sample of 17,849 eligible suicide deaths, which had occurred during the period under examination. We categorized the sampled suicide victims into two groups by suicide methods, as the violent group (ICD-9-CM codes E953-E958 including hanging, drowning, firearms, air guns and explosives, cutting and piercing instruments, jumping from high places, and other and unspecified means) and the nonviolent group (ICD-9-CM codes E950-E952 including poisoning by solid or liquid substances, poisoning by gas used domestically, and poisoning by other gases and vapors). This classification method has been widely adopted by prior studies.[15–17] The violent group accounted for a total of 11,450 suicide deaths, whereas 6,399 deaths were accounted for by the nonviolent group.

Key Variables of Interest

The primary study outcome was to determine whether or not a suicide victim had used violent methods to commit suicide. The key independent variable of interest was the urbanicity of the community in which the suicide victim had resided. All 359 cities/towns in Taiwan were stratified into seven groups according to the standards published by the Taiwanese National Health Research Institute, with 1 referring to "most urbanized" and 7 referring to "least urbanized."[18] The Taiwanese National Health Research Institute used cluster analysis to study the urbanicity and the results showed seven clusters were identified based on 2000 Taiwan census data. These

standards include the population density (people/km^2), the proportion of people with college educational levels or above (in percentage terms), the proportion of elderly people over 65 years of age population (in percentage terms), the proportion of agricultural workers of the population (in percentage terms), and the number of physicians per 100,000 of the population. This urbanicity method has been adopted as the reference of the sampling design of the 2005 National Health Interview Survey (NHIS) in Taiwan. The detailed descriptions of each level of urbanicity are presented in the Appendix.

The control variables included in this study were selected on the basis of a literature review and the information provided in the "cause of death" data file, comprising the gender of the suicide victim, the victim's age (<35, 35–44, 45–54, 55–64, and >74), marital status (never married, married, divorced or widowed), employment status and the season during which the death occurred.

Statistical Analysis

The SAS statistical package (SAS System for Windows, Version 8.2) was used to carry out all of the statistical analyses in this study, with descriptive analyses being performed on all of the identified variables. The Pearson χ^2 tests were performed to assess the associations between the independent variables of interest and the suicide methods. Thereafter, a multilevel logistic regression analysis was performed to determine the relationship between the urbanicity of the residence and the methods of suicide used after adjusting for the age, gender, marital status and employment status of the suicide victim, and the season during which the death occurred to account for possible dependence within cities/towns. In this study, a two-sided p value of ≤ 0.05 was considered to be statistically significant.

RESULTS

Of the 17,849 suicide deaths included in the final sample, 17.5% had resided in the most urbanized communities and 6.1% had resided in the least urbanized communities. The distribution of the sampled suicide victims by sociodemographic characteristics is provided in Table 1. The majority of the victims (43.4%) were found to have committed suicide by hanging, strangulation, or suffocation. The mean age of the victims was 49.4 (±18.3) years and 49.5% were married at the time of their death. A high proportion of the victims (43.1%) had resided in Northern Taiwan, and only 15% were employed at the time of their death.

Table 2 provides the sociodemographic characteristics of the sample suicide victims by suicide method. As compared to those who had used nonviolent methods to commit suicide, those who had used violent methods were more likely to have resided in communities at the highest levels of urbanicity (levels 1 and 2). Furthermore, there was a greater tendency toward the adoption of violent methods to commit suicide among those who were aged over 64 years, never married, unemployed, and residing in Northern Taiwan (all p values less than 0.001).

Details of the adjusted odds ratio estimates of the likelihood of using violent methods to commit suicide are provided in Table 3; these details follow adjustment for the age, gender, marital status and employment status of the suicide victim, and the season during which the deaths occurred.

Table 3 indicates a general decline in the odds of using violent methods to commit suicide for lower levels of urbanicity. More specifically, those residing in the communities at the highest levels of urbanicity were 1.409 times more likely to use

TABLE 1 Methods and sociodemographic characteristics among suicidal deaths in Taiwan from 1997 to 2003 (n=17,849)

Variable	*n* (%)
Suicide method	
Poisoning by solid or liquid substances	4,767 (26.7)
Poisoning by gases in domestic use	81 (0.5)
Poisoning by other gases and vapors	1,551 (8.7)
Hanging, strangulation, and suffocation	7,750 (43.4)
Submersion (drowning)	852 (4.8)
Firearms, air guns, and explosives	50 (0.3)
Cutting and piercing instruments	423 (2.4)
Jumping from high place	1,682 (9.4)
Others and unspecified means	693 (3.9)
Urbanization level	
1 (highest)	3,115 (17.5)
2	4,924 (27.6)
3	3,388 (19.0)
4	3,416 (19.1)
5	610 (3.4)
6	1,306 (7.3)
7 (lowest)	1,090 (6.1)
Gender	
Male	12,040 (67.5)
Female	5,809 (32.6)
Age	
<35	4,417 (24.7)
35–44	3,674 (20.6)
45–54	2,914 (16.3)
55–64	2,411 (13.5)
>65	4,439 (24.9)
Marital status	
Never married	5,029 (28.2)
Married	8,829 (49.5)
Divorced	2,016 (11.3)
Widowed	1,975 (11.1)
Employment status	
Yes	2,681 (15.0)
No	15,168 (85.0)
Suicide area	
Northern	7,400 (41.5)
Central	3,347 (18.8)
Southern	6,427 (36.0)
Eastern	675 (3.8)
Season of death	
Spring	4,735 (26.5)
Summer	4,719 (26.4)
Autumn	4,428 (24.8)
Winter	3,967 (22.2)

TABLE 2 Sociodemographic characteristics among suicidal deaths by suicide methods in Taiwan from 1997 to 2003 (n=17,849)

	Suicide method		
Variable	Violent	Nonviolent	*P* value
Urbanization level			<0.001
1 (highest)	2,385 (20.8)	730 (11.4)	
2	3,505 (30.6)	1,419 (22.2)	
3	2,171 (19.0)	1,217 (19.0)	
4	1,908 (16.7)	1,508 (23.6)	
5	366 (3.2)	244 (3.8)	
6	576 (5.0)	730 (11.4)	
7 (lowest)	539 (4.7)	551 (8.6)	
Gender			0.779
Male	7,732 (67.5)	4,308 (67.3)	
Female	3,718 (32.5)	2,091 (32.7)	
Age			<0.001
<35	2,784 (24.3)	1,627 (25.4)	
35–44	2,248 (19.6)	1,426 (22.3)	
45–54	1,775 (15.5)	1,139 (17.8)	
55–64	1,463 (12.8)	948 (14.8)	
>64	3,180 (27.8)	1,259 (19.7)	
Marital status			<0.001
Never married	3,372 (29.5)	1,657 (25.9)	
Married	5,547 (48.5)	3,282 (51.3)	
Divorced	1,229 (10.7)	787 (12.3)	
Widowed	1,302 (11.4)	673 (10.5)	
Employment status			<0.001
Yes	1,513 (13.2)	1,168 (18.3)	
No	9,937 (86.8)	5,231 (81.8)	
Suicide area			<0.001
Northern	4,968 (43.4)	2,432 (38.0)	
Central	1,944 (17.0)	1,403 (21.9)	
Southern	4,148 (36.2)	2,279 (35.6)	
Eastern	390 (3.4)	285 (4.5)	
Season of death			0.515
Spring	3,056 (26.7)	1,679 (26.2)	
Summer	3,049 (26.6)	1,670 (26.1)	
Autumn	2,801 (24.5)	1,627 (25.4)	
Winter	2,544 (22.2)	1,423 (22.2)	

violent methods to commit suicide than those residing in communities at the second highest level of urbanicity. Among those who had resided in communities at the lowest levels of urbanicity, the odds of using violent methods to commit suicide were only 0.42 of those of their counterparts who had resided in communities at the second highest urbanicity level.

It is also worth noting that our results indicate that the highest odds of using violent methods to commit suicide were found among those above the age of 64 years. We also found that for those who had never been married, the odds of using violent methods to commit suicide were about 1.263 times of those who had

TABLE 3 Adjusted odds ratio for suicidal death by violent methods (violent methods vs. nonviolent methods) in Taiwan from 1997 to 2003 ($n=17,849$)

Variable	OR	95% CI	*P* value
Urbanicity level			
1	1.409	1.156–1.719	<0.001
2 (reference group)	1.000		
3	0.712	0.602–0.842	<0.001
4	0.521	0.442–0.612	<0.001
5	0.554	0.432–0.710	<0.001
6	0.311	0.255–0.380	<0.001
7	0.414	0.336–0.511	<0.001
Gender			
Male (reference group)	1.000		
Female	1.033	0.963–1.108	0.368
Age			
<35 (reference group)	1.000		
35–44	1.003	0.908–1.109	0.950
45–54	1.002	0.896–1.119	0.975
55–64	1.082	0.960–1.219	0.199
>64	1.767	1.577–1.980	<0.001
Marital status			
Never married	1.263	1.160–1.376	<0.001
Married (reference group)	1.000		
Divorced	0.915	0.823–1.018	0.102
Widowed	0.913	0.812–1.026	0.125
Employment status			
Yes (reference group)	1.000		
No	0.812	0.742–0.888	<0.001
Suicide area			
Northern	0.979	0.847–1.132	0.774
Central (reference group)	1.000		
Southern	1.227	1.070–1.408	0.003
Eastern	1.005	0.755–1.338	0.972
Season of death			
Spring (reference group)	1.000		
Summer	0.986	0.903–1.076	0.746
Autumn	0.916	0.838–1.001	0.053
Winter	0.970	0.885–1.063	0.517
Random effect associated with city (variance ± SE)	0.1043 ± 0.0176		

been married. Surprisingly, the season of death was found to have no impact whatsoever on the methods of suicide used by the suicide victims in our sample. The estimated variance of the city/town effect indicates that there is very little effect across cities/towns.

DISCUSSION

This study finds that suicide methods have a significant association with urbanicity. Those committing suicide who had previously resided in areas at higher levels of urbanicity were found to have a greater tendency to adopt violent means. This

association persists even after controlling for the age, gender, marital and employment status of the victims, and the season during which the deaths occurred. In partial accord with the findings of Chuang and Huang, people living in cities were more likely to use violent methods to commit suicide, such as jumping from high places, as opposed to nonviolent methods, such as poisoning, when compared to rural dwellers.[19]

Compositional, contextual, and collective factors have been hypothesized to influence the urban–rural disparities in suicide rates.[20] The results of this study demonstrate that the association between urbanicity and violent/nonviolent suicide remains after controlling for compositional factors including gender, age, marital and employment status. Contextual and collective factors, including access to psychiatric treatment, public attitudes toward suicide, and the availability of lethal means, can all likewise influence the occurrence of suicides.[7,20]

Prior studies have tended to focus on the association between the accessibility of lethal means and method-specific suicide rates.[21] People living near a high suspension bridge were more likely to commit suicide by jumping.[22] A recent study in Taiwan also found that the higher the proportion of households living on the sixth floor or above, the higher the rate of suicide by jumping.[23] Thus, in highly urbanized areas with an abundance of tall buildings, more suicides were committed by jumping from high places.[23–25] However, accessibility to other violent methods of suicide, including hanging, cutting, or using firearms, was not found to be associated with urbanicity levels.[26] Thus, urban–rural differences in suicide methods cannot be explained solely by the availability of methods.

Area-level socioeconomic factors and geographic inequality may play important roles in the relationship between urbanicity and suicide methods.[27,28] A study in Scotland found a large and significant rise of young suicide completers, who tended to use violent suicide methods, in deprived areas.[29] In those areas, social fragmentation, rather than poverty, may be more strongly associated with the occurrence of suicide.[30]

A strong correlation has also been reported between violent suicides and severe mental illness, such as schizophrenia and major affective disorders.[31] There may well be some selective migration of mentally ill people toward more urbanized areas, either as a result of the stigma attached to psychiatric disorders within conservative rural communities, or as a means of gaining easier access to the better medical services available in cities. As for lethality, because of greater availability and accessibility of health services in more urban areas,[20] suicide attempters using less lethal methods may be saved, which could result in more reliance on violent methods in urbanized areas by those who are truly committed to carrying out the task.

In nonviolent suicides, psychosocial factors may play a more important role than biological factors. In the more conservative rural Chinese communities, which are more affected by traditional ideals, people might have a tendency to choose nondisfiguring methods, because Confucian thinking regards a person's body as belonging to one's parents, so to disfigure it is to disrespect one's parents. At the same time, those who believe in reincarnation may also believe their bodies must be buried or cremated intact to be reborn in another life. This may result in fewer violent suicides in rural areas. Furthermore, one particular study indicated higher rates of minor depression among young rural women in Taiwan, highlighting an association between adverse rural environments and related psychosocial stress.[32] It may well be that frequent social activities and contact provide supportive resources for residents in more urbanized areas. Whereas stress from work, marriage, child

rearing, security, and the effort to sustain shelter may pose more complex challenges in urban areas, the pernicious or salutary consequences on mental health arising from urbanicity remain controversial and could be even more complex than previously thought.[33]

Before summarizing our conclusions, we must draw attention to three limitations inherent within this study. First of all, despite the vital event statistics being as accurate and comprehensive as possible in Taiwan, misclassification of the cause of death and underreporting of suicides within the registry system may serve to confound the results. Secondly, mental disorders were not included in our analysis in this study; however, given that this study was based on a large-scale population in Taiwan, it may be seen as representing a broadened view of this issue of nationwide public concern. Finally, this was a descriptive study covering a period of 7 years. Within the mental healthcare literature on the association with urbanicity, the major social trend receiving most attention in developing countries is internal rural–urban migration. Thus, further studies may be required with a particular focus on such dynamic changes.

Policy Implications

In conclusion, this study finds a strong association between urbanicity and methods of suicide, with those residing in the more urbanized areas being more likely to use violent methods to commit suicide. As it is clear that different focus is required for the prevention of violent and nonviolent suicides, approaches to suicide prevention should be adjusted according to urbanicity. The results of this study should alert clinicians to the potential impacts of urbanicity on the methods of suicide, and the requirement for careful evaluation so as to propose appropriate, targeted management protocols.

APPENDIX

TABLE 4 Description and criteria of the seven levels of urbanicity in Taiwan

Criteria					
Level	Population density (people/km^2)	Proportion of people with college educational levels or above (%)	Proportion of people over age 65 (%)	Proportion of agricultural workers (%)	Number of physicians per 100,000 people
1 (most urbanized)	1	1	5	7	1
2	2	2	6	6	2
3	3	3	7	5	4
4	4	4	3	4	3
5	6	5	1	2	7
6	7	7	2	1	5
7 (least urbanized)	5	6	4	3	6

This table was modified from a study by Liu et al.[18] For each category, 1 represents the greatest and 7 represents the least.

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