

# The Ten-year Trend in Suicide Methods

## Evidence from an Asian Population

Kuo-Hsuan Chung, MD<sup>1,2</sup>  
Hsin-Chien Lee, MD, MPH<sup>1,2</sup>  
Shu-Fen Chen, MA<sup>3</sup>  
Herng-Ching Lin, PhD<sup>3</sup>

### ABSTRACT

**Objective:** Despite the wealth of studies investigating methods of committing suicide, very few studies have been undertaken in which the focus has been placed on the long-term trend in suicide methods. The aim of this study is therefore to examine the changes in suicide methods in Taiwan.

**Methods:** Our study uses 1995-2004 'cause of death' data, obtained from the Department of Health in Taiwan, to explore the trend in suicide methods among different age and gender groups. The autoregressive integrated moving average model is applied to examine the change in suicide methods among 25,062 suicide deaths during the ten-year study period.

**Results:** Dramatic rises were identified in the proportions of suicides committed by poisoning by means of gases and vapors (both  $p < 0.001$ ) in the <34 and 35-64 years age groups between 1995 and 2004, as compared to steady declines in the proportions of suicides committed by hanging, strangulation or suffocation, and poisoning by solid or liquid substances (all  $p < 0.001$ ). However, for the >64 years age group, the proportions remained steady throughout the study period for all suicide methods, with the one exception of jumping from heights.

**Conclusions:** Poisoning by gases and vapors is identified as being an increasingly popular method of committing suicide in Taiwan among both genders under the age of 65 years.

**Key words:** Suicide; suicide methods; suicide trend

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1. Taipei Medical University Hospital, Department of Psychiatry, Taipei, Taiwan

2. Taipei Medical University, School of Medicine, Department of Psychiatry, Taipei, Taiwan

3. Taipei Medical University, School of Health Care Administration, Taipei, Taiwan

**Correspondence:** Herng-Ching Lin, School of Health Care Administration, Taipei Medical University, 250 Wu-Hsing St., Taipei 110, Taiwan, Tel: 886-2-2736-1661, ext. 3613, Fax: 886-2-2378-9788, E-mail: henry11111@tmu.edu.tw

As an important contributor to global patterns of mortality, seeking out effective methods of prevention of suicide has become a major priority for health care service providers throughout the world,<sup>1</sup> with one approach to the reduction of suicide cases lying in the restriction of access to specific methods of committing suicide.<sup>2</sup>

A number of prior studies have observed suicide patterns in most countries and regions throughout the world, among both men and women, with the leading methods of committing suicide being hanging, strangulation and suffocation, or poisoning by means of solid or liquid substances; these are followed by various other methods, including jumping from heights, or the use of firearms, although such methods differ greatly across countries.<sup>3-5</sup> Some studies have even revealed that the novel and increasingly contagious use of charcoal burning has become a growing means of committing suicide within Asia.<sup>6,7</sup>

Despite the wealth of studies investigating methods of committing suicide, there have been few studies in which any focus has been placed on the long-term trend in suicide methods. There appears to be only one recent study, undertaken in Lithuania, in which an alarming rise was identified in cases of suicide by poisoning by means of solvents, gases, pesticides and vapors,<sup>8</sup> and indeed, to the best of our knowledge, no study has ever explored the trend in suicide methods within the Asian region. Given this rising trend, the current lack of knowledge with regard to the methods used to commit suicide prevents policy-makers from developing strategies to effectively bring about a reduction in overall suicide rates.

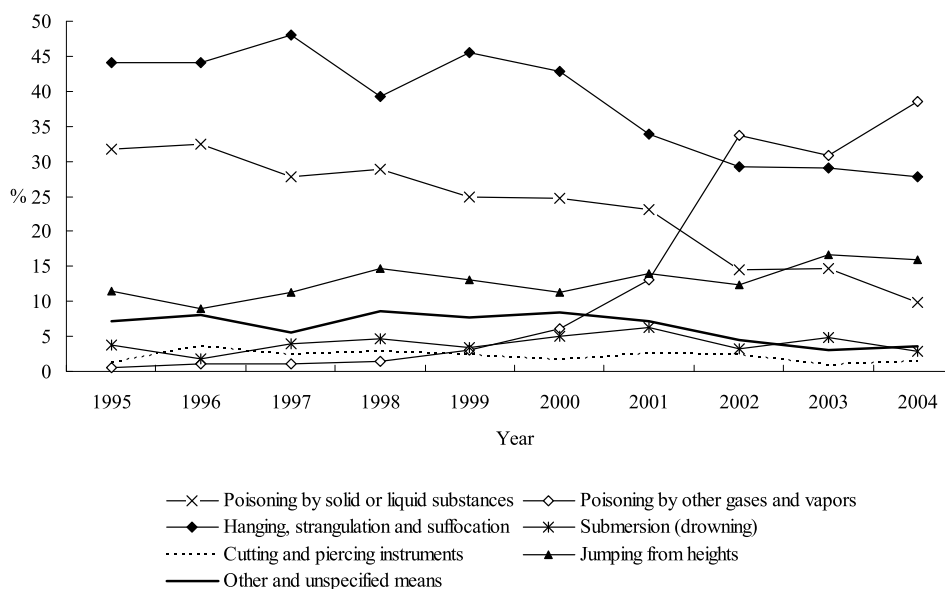
Using ten-year nationwide population-based data on Taiwan covering the period from 1995 to 2004, this study sets out to examine the changing trend, over time, in the methods used to commit suicide. The suicide mortality rates in Taiwan from the early 1950s through to the early 1990s exhibited a tri-phasic trend with binomial distribution,<sup>9</sup> followed by an upward trend since the early 1990s. Such an upward surge has led to suicide having been ranked ninth among the ten leading causes of death in Taiwan since 1999. In this study, we are particularly interested to determine whether conspicuous frequencies of certain methods of committing sui-

TABLE I

## Demographic and Suicide Characteristics in Taiwan, 1995-2004

Variables	Total No.	%
Suicide Method		
Poisoning by solid or liquid substances	6623	26.4
Poisoning by other gases and vapors	2360	9.4
Hanging, strangulation and suffocation	10,899	43.5
Submersion (drowning)	1108	4.4
Cutting and piercing instruments	598	2.4
Jumping from heights	2353	9.4
Other and unspecified means	1121	4.5
Age Group (Years)		
<35	6323	25.2
35-64	12,496	49.9
>64	6243	24.9
Gender		
Male	16,889	67.4
Female	8173	32.6
Geographical Location		
Northern	10,691	42.7
Central	4625	18.5
Southern	8745	34.9
Eastern	1001	4.0

Note: Total sample number = 25,062.



**Figure 1.** Suicide deaths in Taiwan among <35 years age group, by suicide method, 1995-2004

cide could be identified, which might then become possible targets for specific intervention strategies.

## METHODS

### Dataset

Our study uses 1995-2004 'cause of death' data obtained from the Department of Health (DOH) in Taiwan to investigate the trend in suicide methods among different age and gender groups. The cause of death data file provides information on the date of birth and death, place of residence, place of death, type of death, the underlying cause of death, employment status and marital status.

### Study sample

A total of 25,062 deaths by suicide (ICD-9-CM codes E950-E958) were recorded in Taiwan between 1 January 1995 and 31 December 2004, all of which are included in this study.

### Statistical analysis

All suicide cases were identified by different methods of suicide, including: 'poisoning by solid or liquid substances', 'poisoning by other gases and vapors', 'hanging, strangulation and suffocation', 'submersion', 'cutting and piercing instruments', 'jumping from heights' and 'other and unspecified means'. The total annual occurrences of all types of suicide deaths,

as well as the percentages, were calculated across the ten-year study period for male and female groups and for 0-34, 35-64, and ≥65 years age groups, both separately and collectively.

Descriptive analyses, including frequencies, proportions, or means and standard deviations, were performed on all of the identified variables. The Auto-Regressive Integrated Moving Average (ARIMA) regression method was also employed to evaluate the statistical significance level of the time trend. In this study, any p-values of <0.05 were considered to be statistically significant.

## RESULTS

There was a consistent increase in the annual occurrences of suicide deaths during the ten-year study period, with the total annual suicide deaths being 1,618 in 1995, 1,874 in 1996, 2,172 in 1997, 2,177 in 1998, 2,281 in 1999, 2,470 in 2000, 2,781 in 2001, 3,053 in 2002, 3,195 in 2003 and 3,468 in 2004. The majority of suicide deaths (49.9%) were accounted for by those in the age range of 35 to 64 years, who had selected hanging, strangulation or suffocation (43.5%) as their method of committing suicide (Table I).

The proportions of all suicide deaths between 1995 and 2004 among the <35 years age group, by method of suicide, are illustrated in Figure 1. It is worth noting that the proportion of suicide deaths carried out by self-inflicted poisoning by means of gases and vapors rose dramatically from 0.63% in 1995 to 38.78% in 2004 ( $p < 0.001$ ), representing a 62-fold increase in such suicide deaths during the period of this study; however, the proportion of suicide deaths by self-inflicted hanging, strangulation or suffocation decreased steadily from 1995 to 2004, as did those by self-inflicted poisoning by solid or liquid substances (all  $p < 0.001$ ).

The proportions of all suicide deaths between 1995 and 2004 among the 35-64 years age group, by method of suicide, are illustrated in Figure 2. The trend in suicide methods for this group is similar to the trend in the <35 years age group, although the magnitude of the increase in the proportion of suicide deaths by self-inflicted poisoning by means of gases and vapors (about 57-fold) was not as high in this age group as it was in the <35 years age group.

The proportions of all suicide deaths between 1995 and 2004 among the >64 years age group, by method of suicide, are illustrated in Figure 3. With the single exception of jumping from heights, the proportions of all suicide methods remained steady throughout the period of this study. Interestingly, the proportional share of suicide deaths by jumping from heights increased from 4.90% in 1995, to 12.68% in 2004 ( $p < 0.001$ ).

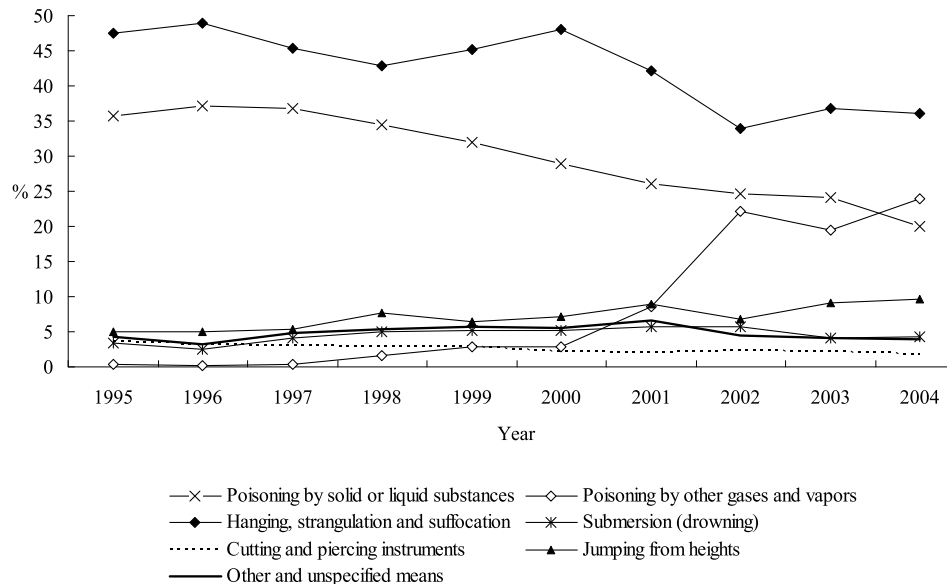
The proportions of all suicide deaths between 1995 and 2004 for the separate gender groups, by method of suicide, are illustrated in Figures 4 and 5. Fairly similar patterns of methods of suicide were apparent for both gender groups, with the proportional shares of all suicide deaths carried out by self-inflicted poisoning by means of gases and vapors showing significant rises during the period of this study, for both gender groups (all  $p < 0.001$ ).

## DISCUSSION

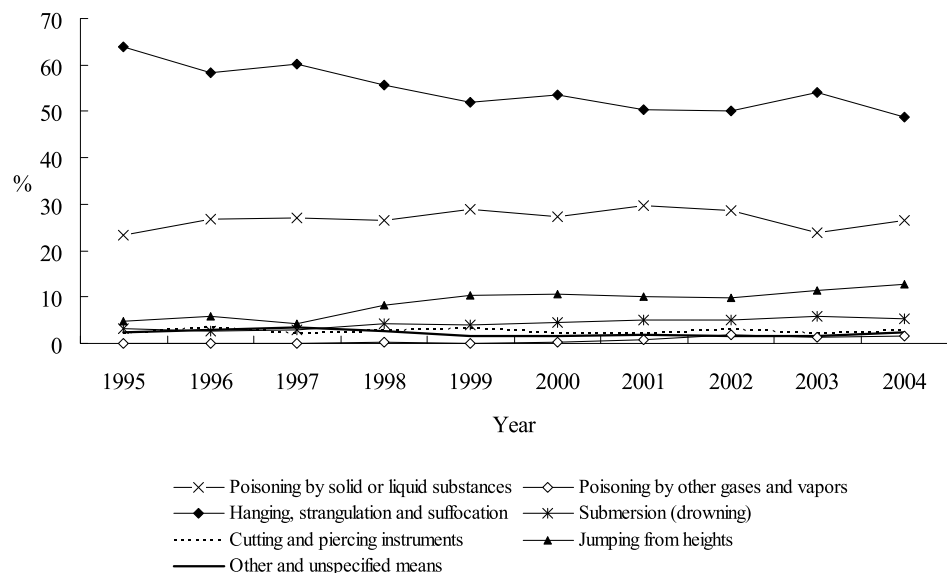
The major finding in this study is that, with regard to the time trend in suicide methods between 1995 and 2004, with the single exception of the >64 years age group, among all other age groups there was a rapid and marked upward surge, from around 1998 onwards, in suicides committed by self-inflicted poisoning by means of other gases and vapors.

It is again worth noting that, with the exception of the marked rise in this particular method of suicide, the ranking of all other suicide methods remained almost the same throughout the entire study period. It is also particularly important to note that in those cases of suicide in which the victim was below the age of 35 years, the use of self-inflicted poisoning by means of other gases and vapors stands out as the primary method of committing suicide. Conversely, the trend in suicide methods among those people over the age of 64 years has remained quite stable.

This study finds that self-inflicted poisoning by means of other gases and vapors has become a rapidly rising method of committing suicide in Taiwan. Among this particular group of suicide deaths, the majority were found to have used charcoal burning as the method of suicide. Interestingly, this finding is in line with a number of prior



**Figure 2.** Suicide deaths in Taiwan among 35-64 years age group, by suicide method, 1995-2004



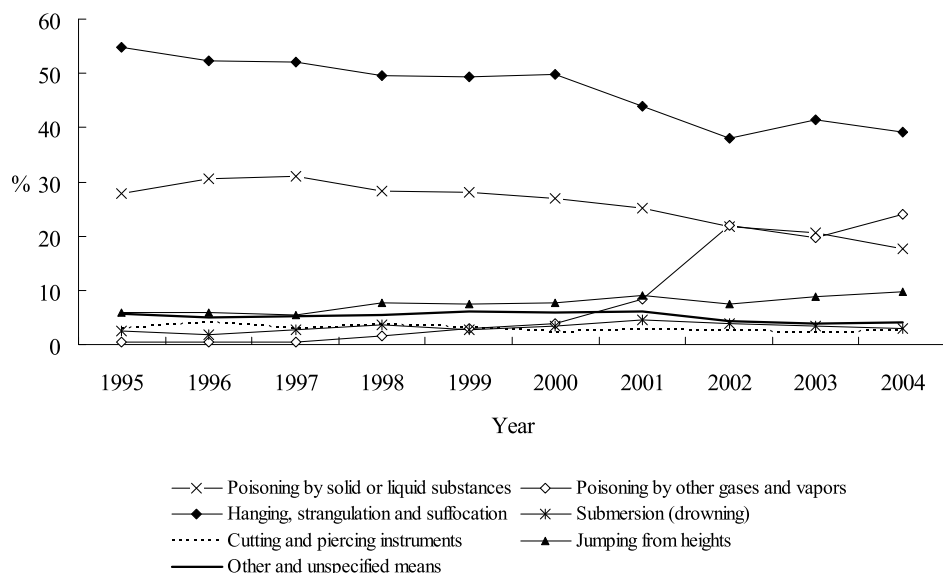
**Figure 3.** Suicide deaths in Taiwan among >64 years age group, by suicide method, 1995-2004

studies undertaken in Hong Kong,<sup>6,7,10</sup> This novel method of committing suicide has demonstrated a rapidly rising trend in Taiwan, among both men and women, particularly those below the age of 64 years.

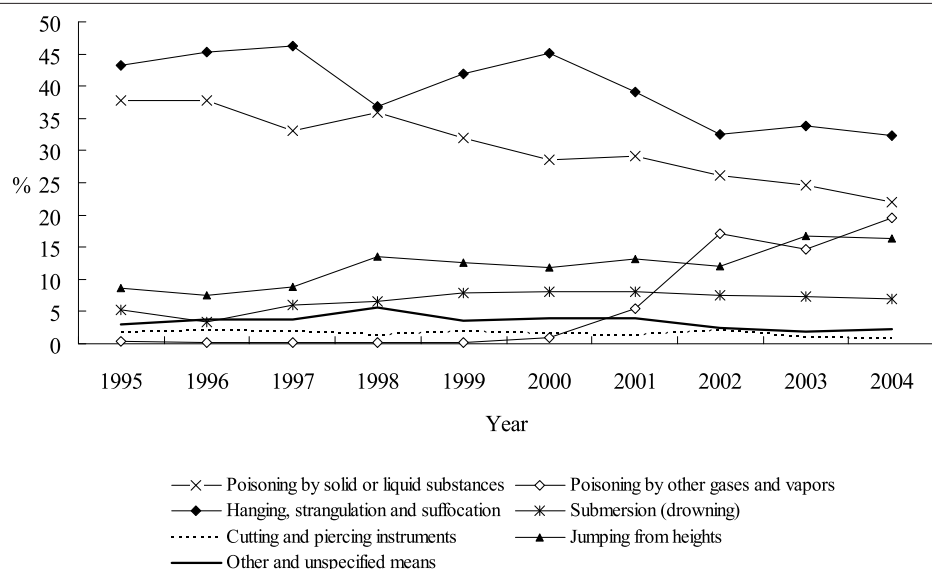
Throughout the period of this study, alongside the growing trend in cases of suicide carried out by charcoal burning, there has also been a discernible downward trend in suicides carried out by hanging, strangulation and suffocation, and by solid or liquid substances. It is, however, unlikely that the choice of suicide method is a random

event, since it is likely to be influenced by a complex combination of social, cultural, psychological, environmental, physical and biological factors.<sup>11,12</sup>

In recent years, some focus has also been placed on the impact of the media and of 'cyber suicide pacts',<sup>7,13</sup> with such phenomena possibly leading to popular patterns of suicide among younger men and women, particularly as such methods of interface are more available to younger people.<sup>14</sup> As such, any comprehensive suicide prevention strategies should comprise multi-dimensional approaches.



**Figure 4.** Suicide deaths among males in Taiwan, by suicide method, 1995-2004



**Figure 5.** Suicide deaths among females in Taiwan, by suicide method, 1995-2004

The prevention of suicide raises more complex issues than does the prevention of unintentional injury since suicide is a purposive act. The purposive nature of suicide would clearly suggest that any restriction of access by the population to any particular method of suicide may simply lead to substitution by other methods,<sup>2</sup> which may partially explain the diverse trends in suicide methods. However, while efforts focusing on suicide prevention have yielded some promising findings, the strongest evidence for successful prevention methods is derived from reducing access to the necessary means.<sup>15</sup> Thus, any future studies will need to be directed towards addressing the characteristics of the different suicide

methods, particularly with regard to charcoal burning in Asian countries.

The trend in suicide methods in Taiwan from the early 1950s through to the early 1990s indicated that the most common method was self-inflicted poisoning by solid or liquid substances, which accounted for about 90% of all cases.<sup>9</sup> Other methods, such as suffocation by gases, self-inflicted injury by cutting or slashing of the body, jumping from heights and drowning, were all less common. This general trend was also found to be consistent throughout those four decades.<sup>9</sup> However, in this study, a dramatic change has been noted in suicide method trends over the past decade. It is therefore suggested that

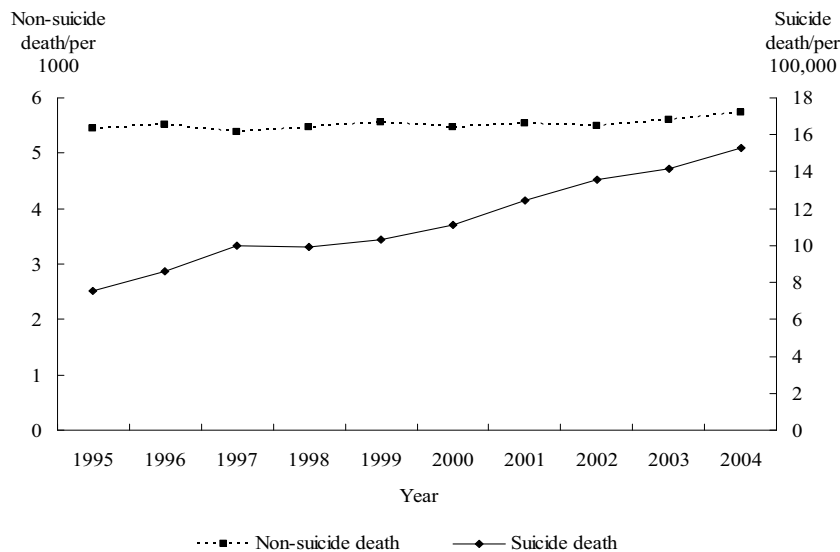
researchers and policy-makers need to adopt a completely different perspective to those previously adopted in dealing with this issue.

There are some limitations to our study which should be pointed out. First, misclassification of the cause of death and the under-reporting of cases of suicide within the registry system may serve to confound the results of this study, despite the fact that in Taiwan, the vital event statistics are as accurate and comprehensive as possible. Second, mixed methods of suicide do exist, such as a self-inflicted overdose of sedatives prior to charcoal burning, hanging or jumping from heights. However, in Taiwan, once again, the major cause of death is similarly identified and recorded as accurately and comprehensively as possible. Finally, when interpreting differences in trends in suicide and non-suicide deaths, the possibility of changes in coding practices on death certificates should be considered. In spite of the fluctuation of suicide deaths by various methods, there has been a steady trend in non-suicide deaths, which may reflect no obvious attitudinal changes in coding practices on death certificates over the study period (Figure 6).

In conclusion, self-inflicted poisoning by means of other gases and vapors – more specifically, charcoal burning – is identified as having become increasingly popular in Taiwan among both men and women over the past decade, as compared to previous decades, particularly among the younger population. Future studies should therefore ensure the inclusion of all potential contributory factors, particularly with regard to charcoal burning, and address the relative importance of these factors and their contribution to the goal of developing predictive models and enhancing preventive suicide efforts.

## REFERENCES

1. Levi F, La Vecchia C, Lucchini F, Negri E, Saxena S, Maulik PK, et al. Trends in mortality from suicide, 1965-99. *Acta Psychiatr Scand* 2003;108(5):341-49.
2. Beautrais AL. Methods of youth suicide in New Zealand: Trends and implications for prevention. *Aust N Z J Psychiatry* 2000;34(3):413-19.
3. McClure GM. Changes in suicide in England and Wales, 1960-1997. *Br J Psychiatry* 2000;176:64-67.
4. Lin JJ, Lu TH. Association between the accessibility to lethal methods and method-specific suicide rates: An ecological study in Taiwan. *J Clin Psychiatry* 2006;67(7):1074-79.



**Figure 6.** Changes in population-based rates for suicide and for non-suicide causes, 1995-2004

- Stark C, Hopkins P, Gibbs D, Rapson T, Belbin A, Hay A. Trends in suicide in Scotland 1981-1999: Age, method and geography. *BMC Public Health* 2004;4:49.
- Lee DT, Chan KP, Lee S, Yip PS. Burning charcoal: A novel and contagious method of suicide in Asia. *Arch Gen Psychiatry* 2002;59(3):293-94.
- Lee DT, Chan KP, Yip PS. Charcoal burning is also popular for suicide pacts made on the internet. *BMJ* 2005;330(7491):602.
- Tamosiunas A, Reklaitiene R, Virviciute D, Sopagiene D. Trends in suicide in a Lithuanian urban population over the period 1984-2003. *BMC Public Health* 2006;6:184.
- Lin T, Tseng EK. Chapter 15: Suicidal Behavior observed in Taiwan: Trends over four decades. Chinese societies and mental health. Taipei, 1995.
- Yip PS, Law YW, Law CK. Suicide in Hong Kong: Epidemiological profile and burden analysis, 1981 to 2001. *Hong Kong Med J* 2003;9(6):419-26.
- Cantor CH, Baume PJ. Access to methods of suicide: What impact? *Aust N Z J Psychiatry* 1998;32(1):8-14.
- Pirkola S, Isometsa E, Lonnqvist J. Do means matter? Differences in characteristics of Finnish suicide completers using different methods. *J Nerv Ment Dis* 2003;191(11):745-50.
- Rajagopal S. Suicide pacts and the internet. *BMJ* 2004;329(7478):1298.
- Ruangkanchanasetr S, Plitponkarnpim A, Hetrakul P, Kongsakon R. Youth risk behavior survey: Bangkok, Thailand. *J Adolesc Health* 2005;36(3):227-35.
- Paris J. Predicting and preventing suicide: Do we know enough to do either? *Harv Rev Psychiatry* 2006;14(5):233-40.

Received: August 24, 2007  
Accepted: April 2, 2008

## RÉSUMÉ

**Objectif :** Il existe une foule d'études sur les méthodes employées pour se suicider, mais très peu portent sur les tendances à long terme dans le choix des méthodes. C'est pourquoi nous avons voulu examiner l'évolution des méthodes de suicide à Taïwan.

**Méthode :** À partir des données du ministère taïwanais de la Santé sur les « causes de décès » de 1995 à 2004, nous avons analysé les tendances relatives aux méthodes de suicide selon l'âge et le sexe. Nous avons appliqué le modèle autorégressif des moyennes mobiles intégrées pour étudier l'évolution des méthodes de suicide pour 25 062 décès par suicide survenus durant la période de référence de 10 ans.

**Résultats :** Nous avons observé des hausses spectaculaires dans la proportion des suicides par inhalation de gaz et de vapeurs ( $p < 0,001$  dans les deux cas) chez les personnes de moins de 34 ans et chez les 35 à 64 ans entre 1995 et 2004, mais des baisses soutenues dans la proportion des suicides par pendaison, strangulation ou suffocation, ainsi que par l'ingestion de poisons à l'état solide ou liquide ( $p < 0,001$  dans tous ces cas). Toutefois, chez les plus de 64 ans, les méthodes de suicide sont restées proportionnellement les mêmes tout au long de la période de référence, à l'exception des sauts dans le vide.

**Conclusion :** Les empoisonnements par inhalation de gaz et de vapeurs sont une méthode de suicide de plus en plus courante à Taïwan chez les hommes et les femmes de moins de 65 ans.

**Mots clés :** suicide; méthodes de suicide; tendances relatives au suicide