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## ORIGINAL ARTICLE

# Risk factors of suicide mortality among multiple attempters: A national registry study in Taiwan

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suicide method

**Background/Purpose:** Little is known about the risk factors of suicide mortality among multiple attempters. This study aims to investigate the predictors of suicidal mortality in a prospective cohort of attempters in Taiwan, focusing on the time interval and suicide method change between the last two nonfatal attempts.

**Methods:** The representative data retrieved from the National Suicide Surveillance System (NSSS) was linked with National Mortality Database to identify the causes of death in multiple attempters during 2006–2008. Cox-proportional hazard models were applied to calculate the hazard ratios for the predictors of suicide.

**Results:** Among the 55,560 attempters, 6485 (11.7%) had survived attempts ranging from one to 11 times; 861 (1.5%) eventually died by suicide. Multiple attempters were characterized by female (OR = 1.56,  $p < 0.0001$ ), nonrecipient of national aftercare service (OR = 1.62,  $p < 0.0001$ ), and current contact with mental health services (OR = 3.17,  $p < 0.0001$ ). Most multiple attempters who survived from hanging (68.1%) and gas poisoning (61.9%) chose the same method in the following fatal episode. Predictors of suicidal death were identified as male, older age ( $\geq 45$  years), shorter interval and not maintaining methods of low lethality

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

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in the last two nonfatal attempts. Receipt of nationwide aftercare was associated with lower risk of suicide but the effect was insignificant.

*Conclusion:* The time interval of the last two nonfatal attempts and alteration in the lethality of suicide method were significant factors for completed suicide. Risk assessment involving these two factors may be necessary for multiple attempters in different clinical settings. Effective strategies for suicide prevention emphasizing this high risk population should be developed in the future.

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## Introduction

Suicide attempt is a major public health threat that may lead to fatal consequences. Researchers had elucidated a repetitive and self-propagating nature of suicidal behaviors.<sup>1,2</sup> Multiple attempters, defined as people with two or more survived suicide attempts, were found to have more severe psychopathology, stronger suicidal ideation, more perceived problem solving difficulties, and higher risk of further attempts compared with single attempters.<sup>3–5</sup> However, current evidence for the risk factors of mortality in this high-risk group for suicide is scarce; findings derived from large cohort studies were also limited.

Recent studies have identified some important predictors of repetition of self-harm acts, including female gender, the young or middle-aged, self-cutting or drug-poisoning, and psychiatric service recipients.<sup>6–9</sup> Poverty and chronic illness additionally increased the risk of hospitalization due to repeated suicide attempts.<sup>7</sup> Yet these investigations mostly contribute to our knowledge about the risk factors of repetition of self-harm rather than on suicidal mortality, and researchers gathered regional data or suicidal inpatients while some suicidal attempts did not lead to subsequent admissions.<sup>6–9</sup> Nationwide research on the characteristics and suicidal mortality of multiple attempters are still lacking.

Moreover, nonfatal attempts of high lethality was an important predictor of later suicide,<sup>10,11</sup> and multiple self-harm acts alone increased subsequent suicide risks.<sup>11</sup> Although lower lethality of methods was found to associate with more repeated suicidal behaviors, this association requires further investigation.<sup>8,11</sup> The impact of frequency of attempts and level of lethality on suicide mortality has never been concurrently examined and remains unclear. As a correlation between suicide method and mortality, the continuity of methods of different lethality and its consequence of death should be considered as well. So far only one study indicated their nonsignificant association with limited representativeness due to its sampling from three centers, the authors suggested that the timing of repetition and its duration might determine the correlation between suicide method and mortality.<sup>12</sup> Besides, recent psychiatric care and aftercare service were reported to be associated with suicide mortality.<sup>13–15</sup>

Therefore, the aim of this study is to elucidate factors of suicide mortality among multiple attempters from a national prospective sample: (1) we hypothesized that

distinct demographic characteristics, contacts of mental health services, and utilization of aftercare service exist between multiple and single attempters in the National Suicide Surveillance System (NSSS) registry; (2) we hypothesized that the time interval and suicide method alteration between the last two nonfatal attempts were associated with suicide mortality among multiple attempters in a large cohort of hospital registers after adjusting for demographics and service utilization.

## Methods

### National Suicide Surveillance System (NSSS)

The NSSS was launched in 2006 with the aim of delivering aftercare for suicide attempters upon hospital reports of people with suicide attempts in Taiwan. All emergency departments were mandated to report inflictors of suicidal behavior to the national suicide prevention center via web-based system or by facsimile. Initial assessment and online registration should be done within 24 hours of any people presenting to the hospitals with self-harm or suicidal attempts. Meanwhile the local government provides aftercare services within 72 hours after receiving the case reports according to standardized procedures regulated by the National Suicide Prevention Center. The aftercare services included mental health screening by the five-item Brief Symptom Rating Scale and at least one visit by telephone or via face-to-face interview upon consent by trained personnel of social work, volunteer work, or nursing backgrounds.<sup>16</sup> Information regarding attempters that were gathered by first-line health care providers included gender, age, current utilization of mental health services (positive, negative, or uninformative upon query), date of attempt, adopted methods, and receipt of aftercare services.

### Study design and individuals

We collected 55,560 suicide attempters who registered in the NSSS between January 1, 2006 to December 31, 2008. There were 6485 multiple attempters who had two or more nonfatal records of attempts and 45,274 single attempters each with a nonfatal attempt during the study period. We adopted the principle in our previous study to deal with delayed deaths arising from the index attempt.<sup>15</sup> As deaths

may not occur on the same day of a suicide attempt, death was regarded as the same suicide event if the date of death in the National Mortality Database was within 7 days of the attempt reported in the NSSS. We excluded individuals who had two reports but the death occurred within 7 days of a nonfatal attempt and individuals with all reported attempts within 7 days of their index attempts.<sup>15</sup> Individuals were linked with National Mortality Database for the identification of the causes of death during the same period. All protocols were approved by the Ethics Committee of the National Taiwan University Hospital, Taipei, Taiwan (reference number 200711030R).

### Definition of suicide attempt, interval, and method

Suicide attempt was defined in this study as any self-harmful act resulting in emergency service engagement. The last nonfatal suicidal attempt was defined as the survived suicidal attempt occurring just before completing suicide. Time intervals between the last and penultimate attempts were calculated. Patients were grouped into four quartiles according to lengths of the interval for multivariate Cox proportional hazards regression analysis. We examined the effect of changing methods between the last two consecutive events on suicide mortality.

Methods of suicidal attempt were categorized by ICD-9-CM code E950–E958, include: (E950) solid or liquid substances, (E951) gases in domestic use, (E952) other gas poisoning (mostly carbon monoxide poisoning by charcoal burning), (E953) hanging/strangulation/suffocation, (E954) submersion/drowning, (E955) firearms/air guns/explosives, (E956) cutting and piercing instrument, (E957) jumping from high place, (E958) other and unspecified means. Additionally, (E951) gases in domestic use, (E954) submersion/drowning, and (E955) firearms/air guns/explosives were coded into “other” due to their rare incidences in Taiwan. As a single method was conducted in the majority of suicide events (92.4%), only the single most lethal and rare method was included for analysis if two or more methods were reported.<sup>8,9</sup> The process of identification was based on the following hierarchy of rarity and lethality: E955, E954, E951, E957, E953, E958, E952, E956, and E950. According to the change of the lethality of method in the last two survived attempts, multiple attempters were classified into three groups: individuals who maintained methods of low/high lethality, and who switched between methods of different levels of lethality. Adopted from previous literature, overdose (E950) and cutting (E956) were regarded as low lethality, while others methods were assigned to high lethality.<sup>8,17</sup>

### Statistical analysis

We categorized individuals into single and multiple attempters according to individual number of nonfatal attempts observed during 2006–2008, then compared the differences of demographic characteristics, self-reported contact with psychiatric services, and utilization of after-care service among each group with odds ratios and  $\chi^2$  test statistics. In addition to descriptive analysis, we used Cox proportional hazard models to estimate hazard ratio (HR) of

suicidal death for the predictors. Outcomes were determined by suicide deaths (ICD-9-CM code E950–959). The observation was censored for survivors at the endpoint or nonsuicide deaths during the observational period. Independent variables included gender, age groups (< 25 years, 25–44 years, 45–64 years,  $\geq$  65 years), contact with psychiatric services, method and time interval between the last two survived attempts, and receipt of aftercare program. Analyses were carried out using SAS version 9.2 (SAS, Inc., Cary, NC, USA).

## Results

### Sample profiles and differences between multiple and single attempters

A total of 55,560 individuals had registered in the NSSS, among which 51,759 had at least one nonfatal attempt during the study period. Among these attempting individuals, 4136 (7.89%) eventually died by suicide and 2007 (3.83%) died of nonsuicide causes. The following characteristics were distinctly identified among the 6485 multiple attempters: females (4866, 75.03%), aged 25–44 years (3962, 61.09%), having current contact with mental health services (2674, 41.23%), and lethal attempts ( $n = 861$ , 13.28%).

Compared with single attempters, multiple attempters were found to have a significantly higher proportion of females (OR = 1.56,  $p < 0.0001$ ) and fewer proportion of people in the age groups of < 25 years, 45–64 years, and  $\geq$  65 years (OR = 0.87, OR = 0.63, and OR = 0.31, respectively; all  $p < 0.0001$ ). Those with repeated suicidal behaviors were also more likely to be currently in contact with mental health services (OR = 3.17,  $p < 0.0001$ ). Significantly greater portions of multiple attempters had never utilized/received the nationwide aftercare service (OR = 1.62,  $p < 0.0001$ ; Table 1).

### Characteristics of multiple attempters who completed suicide

Among the 861 decedents who repeated suicide attempts, 80.95% had two nonfatal attempts ( $n = 697$ ); 13.94% ( $n = 120$ ) had three attempts, and the rest of them had a range from four to 11 times of repetition. Gas poisoning (excluding domestic gas), hanging/suffocation, and solid or liquid intoxication were the most common causes of death, accounting for 77.47% ( $n = 667$ ) of total deaths. People < 25 years-old committed suicide by diverse means including strangulation (or suffocation), gas poisoning, jumping from a height, and self-poisoning, while elder individuals had an increasing propensity to die by strangulation and intoxication.

### Methods comparison between the last two attempts among repeaters deceased by suicide

Table 2 shows the distribution of the relationships between the last survived attempt and the fatal method among deceased multiple attempters ( $n = 861$ ). Over 60% multiple attempters who survived from hanging (68.1%) and gas poisoning (61.9%) chose the same method in the following

**Table 1** Profiles of single and multiple attempters registered in the National Suicide Surveillance System between 2006 and 2008 ( $n = 51,759$ ).

Characteristics	No. of nonfatal attempts, $n$ (%)		Multiple vs. single attempters			
	Single	Multiple ( $\geq 2$ )	OR	95% CI	$\chi^2$	$p$
Sex						
Female	29804 (65.83)	4866 (75.03)	1.56	(1.47–1.66)	217.30	< 0.0001
Male	15470 (34.17)	1619 (24.97)	1.00	—	—	—
Age <sup>a</sup> (y)						
< 25	8477 (18.72)	1256 (19.37)	0.87	(0.81–0.93)	16.14	< 0.0001
25–44	23255 (51.37)	3962 (61.09)	1.00	—	—	—
45–64	9977 (22.04)	1076 (16.59)	0.63	(0.59–0.68)	159.90	< 0.0001
$\geq 65$	3565 (7.87)	191 (2.95)	0.31	(0.27–0.37)	255.04	< 0.0001
Current contact with mental health services <sup>b</sup>						
Negative	14879 (32.86)	1207 (18.61)	1.00	—	—	—
Positive	10412 (23.00)	2674 (41.23)	3.17	(2.94–3.40)	1046.05	< 0.0001
Uninformative	19983 (44.14)	2604 (40.15)	1.61	(1.50–1.73)	171.37	< 0.0001
Receipt of aftercare service						
Yes	39847 (88.01)	5313 (81.93)	1.00	—	—	—
No	5427 (11.99)	1172 (18.07)	1.62	(1.51–1.74)	188.84	< 0.0001
Total No.	45274	6485				

CI = confidence interval; OR = odds ratio; SD = standard deviation.

<sup>a</sup> The age of individuals with one nonfatal attempt (mean = 38.45, SD = 15.61), with two nonfatal attempts (mean = 35.88, SD = 12.91), and with three or more attempts (mean = 33.78, SD = 10.39).

<sup>b</sup> Classified by individual responses to query at index episodes.

fatal episode. By contrast, people who attempted to jump from high places in their last nonfatal attempts were more likely to die by other methods as well (i.e., poisoning or hanging).

### Risk factors of suicide mortality among multiple attempters

In the Cox proportional hazard models (Table 3), the results revealed that multiple attempters ( $n = 6485$ ) of male gender (adjusted HR = 1.41, 95% CI 1.01–1.96) and older age (aHR for age 45–64 years = 1.56, 95% CI 1.08–2.24; aHR for age  $\geq 65$  years was 3.06, and 95% CI 1.68–5.57, vs. age 25–44 years) had significantly higher risks for

completed suicide. Ongoing contact with mental health services was associated with higher risk but was not statistically significant. Furthermore, no significant association was found between receipt of aftercare and suicide. After adjustment of the above-mentioned determinants, the time interval between the last two nonfatal attempts (aHR = 3.21 for 1–33 days, 95% CI 1.96–5.28; aHR = 3.00 for 34–132 days, 95% CI 1.82–4.96; aHR = 2.30 for 133–322 days, and 95% CI 1.38–3.82, vs. 323–1082 days) as well as continuation or alteration of lethality of method (aHR = 2.62 for continuing high level of lethality, 95% CI = 1.66–4.15; aHR = 2.05 for switching between low and high lethality, 95% CI = 1.44–2.92, vs. continuing low level of lethality) showed significant associations with suicide mortality. The model indicated that, as a whole, age > 45

**Table 2** Distribution of methods used between the last survived attempt and the fatal one among the multiple attempters completing suicide ( $n = 861$ ).

ICD-9 codes of methods of survived suicidal attempt	ICD-9 codes of external cause of death							Total (%)
	E950	E952	E953	E956	E957	E958	Others (E951, E954, E955) (%)	
E950 Solid or liquid substances	174 (36.3)	115 (24.0)	100 (20.9)	5 (1.0)	53 (11.1)	7 (1.5)	25 (5.2)	479 (100.0)
E952 Other gases and vapors	4 (3.5)	70 (61.9)	22 (19.5)	0 (0)	7 (6.2)	2 (1.8)	8 (7.1)	113 (100.0)
E953 Hanging	1 (2.1)	4 (8.5)	32 (68.1)	0 (0)	4 (8.5)	2 (4.3)	4 (8.5)	47 (100.0)
E956 Cutting	14 (11.7)	23 (19.2)	34 (28.3)	7 (5.8)	26 (21.7)	5 (4.2)	11 (9.2)	120 (100.0)
E957 Jumping	3 (18.8)	1 (6.3)	5 (31.3)	0 (0)	7 (43.8)	0 (0)	0 (0.0)	16 (100.0)
E958 Unspecified means	11 (21.6)	17 (33.3)	9 (17.6)	3 (5.9)	4 (7.8)	5 (9.8)	2 (3.9)	51 (100.0)
Others (E951, E954, E955)	0 (0)	10 (28.6)	18 (51.4)	1 (2.9)	1 (2.9)	2 (5.7)	3 (8.6)	35 (100.0)
Total	207	240	220	16	102	23	53	861

Data are presented as  $n$  (%).

**Table 3** Cox proportional hazard model of time to suicidal death among the multiple attempters ( $n = 6485$ ).

Demographic and clinical variables	Total $n$ (%)	Suicidal death after index attempt ( $n$ )	Incident rate of suicidal death (no. of suicidal death/person-y; %)	Hazard ratio (HR) of suicidal death estimated by Cox proportional hazard model	
				Crude HR (95% C.I.)	Adjusted HR (95% C.I.)
<b>Sex</b>					
Female	4866 (75.03)	105	1.22	1.00	1.00
Male	1619 (24.97)	59	2.16	1.78 (1.30–2.45)**	1.41 (1.01–1.96)*
<b>Age (y)</b>					
<25	1256 (19.37)	14	0.62	0.45 (0.26–0.80)**	0.47 (0.27–0.83)**
25–44	3962 (61.09)	95	1.36	1.00	1.00
45–64	1076 (16.59)	42	2.33	1.71 (1.19–2.46)**	1.56 (1.08–2.24)*
≥65	191 (2.95)	13	4.36	3.18 (1.78–5.68)***	3.06 (1.68–5.57)**
<b>Current contact with mental health services<sup>a</sup></b>					
Negative	1207 (18.61)	17	0.85	1.00	1.00
Positive	2674 (41.23)	73	1.62	1.48 (0.92–2.38)	1.60 (0.98–2.60)
Uninformative	2604 (40.15)	25	0.52	1.30 (0.81–2.11)	1.51 (0.92–2.46)
<b>Receipt of aftercare service</b>					
Yes	5313 (81.93)	132	1.52	1.00	1.00
No	1172 (18.07)	32	1.18	1.25 (0.85–1.85)	1.19 (0.80–1.78)
<b>Interval between the last two nonfatal attempts</b>					
Q1 (1–33 d)	1638 (25.26)	51	2.15	3.33 (2.03–5.46)***	3.21 (1.96–5.28)***
Q2 (34–132 d)	1614 (24.89)	47	1.85	2.88 (1.74–4.74)***	3.00 (1.82–4.96)***
Q3 (133–322 d)	1615 (24.90)	43	1.51	2.35 (1.42–3.91)**	2.30 (1.38–3.82)**
Q4 (323–1082 d)	1618 (24.95)	23	0.64	1.00	1.00
<b>Change of method lethality<sup>b</sup></b>					
High– high	402 (6.20)	24	3.51	3.32 (2.12–5.20)***	2.62 (1.66–4.15)***
Switch between low and high	1168 (18.01)	48	2.36	2.21 (1.56–3.13)***	2.05 (1.44–2.92)***
Low– low	4915 (75.79)	92	1.06	1.00	1.00

\* $p < 0.05$ .\*\* $p < 0.01$ .\*\*\* $p < 0.001$ .

CI = confidence interval.

<sup>a</sup> Classified by individual responses at index episodes.<sup>b</sup> Defined by method lethality in the last two survived attempts. E950 and E956 were regarded as methods of low lethality, while others were assigned to high lethality.

years, male gender, shorter time interval, and not maintaining the methods of low lethality in the last two survived attempts were major risks for multiple attempters deceased by suicide.

## Discussion

Despite increased attention to multiple suicide attempters in clinical services and research, little evidence have focused on this high-risk group for completed suicide. In this population-based study with representative data retrieved from the nationwide surveillance and aftercare system in Taiwan, the profile of multiple attempters was characterized as females, 25–44 years of age, being in contact with mental health services, and receiving fewer aftercare services compared with individuals with a single attempt. Moreover, important predictors of suicide in nonfatal multiple attempters were identified as males, > 45 years, not maintaining methods of low lethality and shorter time intervals (3-fold risk for those < 1 month

between the last two survived attempts before completing suicide.

## Implications of lethal methods repetition

There was a tendency of adopting the same methods of the last survived event in final death for attempts by hanging and gas poisoning mainly of charcoal burning, while this phenomenon was less marked for attempters who survived from jumping, overdose, and cutting. Our study population represented registered attempters, who have received medical attention and national aftercare immediately after their index episode. The aftercare program was designed to mobilize medical and social resources to meet individuals' needs but its effectiveness in preventing these attempters from tragic endings seems slight. Some explanations might be considered: (1) regular aftercare intervention may be less helpful for individuals attempted hanging and charcoal burning suicide. Previous study indicated that acute life stress rather than mental illness precipitate suicide by



charcoal burning in Taiwan, and the victims were less likely to utilize health care resources<sup>18</sup> and (2) suicide attempters might prefer hanging and charcoal burning to other lethal methods. For instance, the prevalence of charcoal burning among Taiwanese was attributed to the culture of preserving one's intact body, wide availability of charcoal in this country, and suicide report on the mass media.<sup>19</sup> In addition, substitution effect might also play a role when suicide by drug overdose or cutting was prevented after nonfatal attempts. We suggest that service providers utilize this knowledge and take necessary precautions against suicide including means restriction after a nonfatal attempt by hanging and charcoal burning.

### Risk factors determining lethal attempts prior to death

The underlying study examined several risk factors for suicide mortality among multiple attempters. We did not find significant association between recent contact of psychiatric services and suicide mortality. Recent findings in Western countries, however, indicated that psychiatric illness and treatment contribute to suicide mortality.<sup>13–15,20,21</sup> As the proportion of our individuals being in contact with psychiatric services was 25.3%, comparable to a survey of patients with deliberate self-harm presented to emergency department in a hospital of Hong Kong,<sup>22</sup> the insignificance in our study could not merely be explained by report bias. In addition to the psychiatric service, we found that the proportions of study individuals receiving the nationwide aftercare service were high (i.e., 81.9% for multiple attempters and 88.0% for single attempters). Moreover, all individuals agreed to be registered at hospital entry by the health care system, indicating that stigma might not be a main barrier for psychiatric and mental health services. Rather, the active aftercare outreach by mental health providers may serve the gatekeepers role and mitigate suicide risks. However, the influence of stigma-related issues and the long-term effects of aftercare service towards suicide mortality remained unclear and should be further studied.

Geographic variation of the role of psychiatric disorder in suicide has been revealed.<sup>22,23</sup> Self-reported adverse life problems were an influential risk factor of reattempt.<sup>22</sup> A study in India suggested psychosocial stress rather than mental illness contribute to suicide,<sup>24</sup> while psychological autopsy in China also revealed that many suicides are impulsive attempts following interpersonal crises.<sup>25</sup> A study in Taiwan showed that many suicide attempters were referred to a psychiatric clinic due to interpersonal problems after discharge from emergency departments, which suggest that interpersonal issue and psychiatric illness are both important to understand suicidal behaviors of attempters in Taiwan.<sup>26</sup> It is possible that interpersonal problems may be one of the factors that contribute to the limited effect of psychiatric care on suicide mortality in our analysis.

Furthermore, a psychological autopsy study collected consecutive cases with completed suicide in eastern Taiwan and examined combined effects of psychiatric and psychosocial risk factors of suicides.<sup>27</sup> The researchers found

that depression followed by stressful life events contribute the most to suicide.<sup>27</sup> By contrast, our individuals representing nationwide suicide attempters who were sent to hospitals after suicide attempts did not reveal such impact of mental illness. It is possible that different characteristics of the study population between the two studies exist, that suicide decedents in previous studies might suffer from more devastating mental illnesses than registered attempters in the NSSS.

In terms of suicide behaviors, short intervals between episodes and method alteration in the last two nonfatal attempts significantly increase suicide risk. To our best knowledge, no previous study discussed the relationship of interepisode time length and mortality. Frequent and intensive suicide attempts are related to complicated psychopathology, life problems, and personality disorder,<sup>22,28,29</sup> and trigger subsequent lethal attempt by kindling effect.<sup>30</sup>

In our findings, alteration in the lethality of methods in the last two nonfatal attempts as well as maintenance of highly lethal methods hastened lethal consequences. People who maintained a relatively low lethal method for serial attempts might have more chance of survival; however the mortality rate was doubled in one-fourth of our study sample who chose suicide method of higher lethality, indicating the close link between lethality of method and mortality. Previous literature has linked the association of lethality of method with suicidal intent.<sup>31</sup> Although our study lacked personal information of intention, it is possible that the trajectory of changing lethality in consecutive nonfatal attempts reflected the attempters' persistent will of death, and that they progressively adopted more dangerous ways to end their lives after unsuccessful attempts.

It is noted that a significant association between method alteration and suicide risk in our study was inconsistent with a recent multicenter study in the UK.<sup>12</sup> In addition to cultural and ethnic differences, a possible explanation may be that the present study utilized a nationwide registry of all suicide attempts, thus would not be confounded by regional or hospital-level features. Another reason may be related to shorter follow-up duration in our study. However, it is unclear whether the significance would diminish with prolonged time.

Multiple attempters have distinct profiles compared to individuals with single attempts, including a tendency of being female, in early adulthood, more utilization of mental health services, but fewer receipt of aftercare. The time interval of the last two nonfatal attempts and alteration in the lethality of suicide method were significant factors for completed suicide among multiple attempters. Our findings indicate that repeated attempters who survived from consecutive suicidal attempts in a short period, and who switched between methods from low to high lethality or maintaining highly lethal methods should all receive detailed risk assessment for consequent suicide. More effective interventions for suicide prevention in this high risk population should be developed in the future.

In this study we described an essential profile and key risk factors of repeated attempters who died by suicide, which added to current evidence that help medical professionals making critical appraisals for the mortality of this

high-risk group. However, there are limitations that need to be taken into consideration while making interpretations. (1) Our findings may underestimate the prevalence of multiple attempters since all kinds of suicide registry could be underreported due to socio-cultural stigma of suicide and insurance reimbursement determined by causes of injury. However, the NSSS report is mandatory and had no influence on public or private health insurances, thus minimized the intent to conceal reports of hospital suicide attempts. According to the National Census of Mental Health during 2003–2005 in Taiwan, suicide attempt prevalence was estimated at 0.29%, equivalent to ~47,000 suicide attempters per year.<sup>32</sup> Based on this estimation, the NSSS database had covered at least one-third of total suicide attempters in Taiwan and was nationally representative. Therefore we believe that the study sample had covered a reasonable proportion of the study population nationwide. (2) The cause of death may be misclassified as accidental, resulting in underestimation of actual suicide. Chang et al<sup>33</sup> suggested that there was significant “hidden” suicide among deaths certified as accidental pesticide poisoning and suffocation in Taiwan. However, it is less likely to misclassify accidental death to suicide in our study since these individuals had at least one prior nonfatal attempt. Our findings at least provided a certain level of evidence of suicide mortality and quantify adjusted hazards of multiple attempts to suicide on a national scale, offering important basis for future studies evaluating the issues of misclassification in suicide death. Finally, current contact of psychiatric care was based on a self-report upon query by health care providers in the emergency departments, thus the results might underestimate the utilization of mental health care among study individuals. Accurate psychiatric diagnoses and treatment may have been ascertained through medical chart review or electronic health records.

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## References

- Chapman AL, Gratz KL, Brown MZ. Solving the puzzle of deliberate self-harm: the experiential avoidance model. *Behav Res Ther* 2006;44:371–94.
- Joiner Jr TE, Conwell Y, Fitzpatrick KK, Witte TK, Schmidt NB, Berlim MT, et al. Four studies on how past and current suicidality relate even when “everything but the kitchen sink” is covaried. *J Abnorm Psycho* 2005;114:291–303.
- Rudd MD, Joiner T, Rajab MH. Relationships among suicide ideators, attempters, and multiple attempters in a young-adult sample. *J Abnorm Psychol* 1996;105:541–50.
- Forman EM, Berk MS, Henriques GR, Brown GK, Beck AT. History of multiple suicide attempts as a behavioral marker of severe psychopathology. *Am J Psychiatry* 2004;161:437–43.
- Miranda R, Scott M, Hicks R, Wilcox HC, Harris Munfakh JL, Shaffer D. Suicide attempt characteristics, diagnoses, and future attempts: comparing multiple attempters to single attempters and ideators. *J Am Acad Child Adolesc Psychiatry* 2008;47:32–40.
- Chen VCH, Tan HKL, Cheng ATA, Chen CY, Liao LR, Stewart R, et al. Nonfatal repetition of self-harm: population-based prospective cohort study in Taiwan. *Br J Psychiatry* 2010;196:31–5.
- Chien WC, Lai CH, Chung CH, Pai L, Chang WT. A nation-wide evidence-based data analysis of repeated suicide attempts. *Crisis* 2013;34:22–31.
- Huang YC, Wu YW, Chen CK, Wang LJ. Methods of suicide predict the risks and method-switching of subsequent suicide attempts: a community cohort study in Taiwan. *Neuropsychiatr Dis Treat* 2014;10:711–8.
- Kwok CL, Yip PS, Gunnell D, Kuo CJ, Chen YY. Nonfatal repetition of self-harm in Taipei City, Taiwan: cohort study. *Br J Psychiatry* 2014;204:376–82.
- Chen VCH, Chou JY, Hsieh TC, Chang HJ, Lee CT, Dewey M, et al. Risk and predictors of suicide and nonsuicide mortality following nonfatal self-harm in Northern Taiwan. *Soc Psychiatry Psychiatr Epidemiol* 2013;48:1621–7.
- Zahl DL, Hawton K. Repetition of deliberate self-harm and subsequent suicide risk: long-term follow-up study of 11,583 patients. *Br J Psychiatry* 2004;185:70–5.
- Bergen H, Hawton K, Waters K, Ness J, Cooper J, Steeg S, et al. How do methods of nonfatal self-harm relate to eventual suicide? *J Affect Disord* 2012;136:526–33.
- Finkelstein Y, Macdonald EM, Hollands S, Sivilotti MLA, Hutson JR, Mamdani MM, et al. Risk of suicide following deliberate self-poisoning. *JAMA Psychiatry* 2015;72:570–5.
- Hjorthøj C, Madsen T, Agerbo E, Nordentoft M. Risk of suicide according to level of psychiatric treatment: a nationwide nested case-control study. *Soc Psychiatry Psychiatr Epidemiol* 2014;49:1357–65.
- Pan YJ, Chang WH, Lee MB, Chen CH, Liao SC, Caine ED. Effectiveness of a nationwide aftercare program for suicide attempters. *Psychol Med* 2013;43:1447–54.
- Lee MB, Liao SC, Lee YJ, Wu CH, Tseng MC, Gau SF, et al. Development and verification of validity and reliability of a short screening instrument to identify psychiatric morbidity. *J Formos Med Assoc* 2003;102:687–94.
- Elnour AA, Harrison J. Lethality of suicide methods. *Inj Prev* 2008;14:39–45.
- Chen YY, Liao SC, Lee MB. Healthcare use by victims of charcoal-burning suicide in Taiwan. *Psychiatr Serv* 2009;60:126.
- Pan YJ, Liao SC, Lee MB. Suicide by charcoal burning in Taiwan, 1995–2006. *J Affect Disord* 2010;120:254–7.
- Bergen H, Hawton K, Kapur N, Cooper J, Steeg S, Ness J, et al. Shared characteristics of suicides and other unnatural deaths following nonfatal self-harm? A multicenter study of risk factors. *Psychol Med* 2012;42:727–41.
- Mortensen PB, Agerbo E, Erikson T, Qin P, Westergaard-Nielsen N. Psychiatric illness and risk factors for suicide in Denmark. *Lancet* 2000;355:9–12.
- Yip PS, Hawton K, Liu K, Liu KS, Ng PW, Kam PM, et al. A study of deliberate self-harm and its repetition among patients presenting to an emergency department. *Crisis* 2011;32:217–24.
- Arsenault-Lapierre G, Kim C, Turecki G. Psychiatric diagnoses in 3275 suicides: a meta-analysis. *BMC Psychiatry* 2004;4:37.
- Manoranjitham SD, Rajkumar AP, Thangadurai P, Prasad J, Jayakaran R, Jacob KS. Risk factors for suicide in rural south India. *Br J Psychiatry* 2010;196:26–30.

25. Yang GH, Phillips MR, Zhou MG, Wang LJ, Zhang YP, Xu D. Understanding the unique characteristics of suicide in China: national psychological autopsy study. *Biomed Environ Sci* 2005; **18**:379–89.
26. Lin CJ, Lu HC, Sun FJ, Fang CK, Wu SI, Liu SI. The characteristics, management, and aftercare of patients with suicide attempts who attended the emergency department of a general hospital in northern Taiwan. *J Chin Med Assoc* 2014; **77**: 317–24.
27. Cheng ATA, Chen THH, Chen CC, Jenkins R. Psychosocial and psychiatric risk factors for suicide: case-control psychological autopsy study. *Br J Psychiatry* 2000; **177**:360–5.
28. Beghi M, Rosenbaum JF. Risk factors for fatal and nonfatal repetition of suicide attempt: a critical appraisal. *Curr Opin Psychiatry* 2010; **23**:349–55.
29. Monnin J, Thiemard E, Vandell P, Nicolier M, Tio G, Courtet P, et al. Sociodemographic and psychopathological risk factors in repeated suicide attempts: gender differences in a prospective study. *J Affect Disord* 2012; **136**:35–43.
30. Skegg K. Self-harm. *Lancet* 2005; **366**:1471–83.
31. Haw C, Hawton K, Houston K, Townsend E. Correlates of relative lethality and suicidal intent among deliberate self-harm patients. *Suicide Life Threat Behav* 2003; **33**:353–64.
32. Liao SC, Lee MB, Chen WJ, Yang MJ, Lu RB, Chen CC. Prevalence and correlates of suicide ideation, plan, and attempt in Taiwan communities: preliminary report from National Psychiatric Morbidity Survey. In: *12th Pacific Rim College of Psychiatrist Scientific Meetings Taipei, Taiwan*; 2006.
33. Chang SS, Sterne JA, Lu TH, Gunnell D. 'Hidden' suicides amongst deaths certified as undetermined intent, accident by pesticide poisoning, and accident by suffocation in Taiwan. *Soc Psychiatry Psychiatr Epidemiol* 2010; **45**:143–52.