

# Suicide and media reporting: a longitudinal and spatial analysis

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## Abstract

**Purpose** The impact of media reporting on copycat suicides has been well established in various cases of celebrity suicide. However, knowledge is limited about the spatial and temporal relationship between suicide death and media reporting over a long period of time. This study investigated the association of suicide deaths with suicide news in longitudinal and spatial dimensions.

**Methods** All suicides during 2003–2010 ( $n = 31,364$ ) were included. Suicide news in the study period was retrieved from Google News, and included all available news media in Taiwan. Empirical mode decomposition was used to identify the main intrinsic oscillation, reflecting both major and minor suicide events, and time-dependent intrinsic correlation was used to quantify the temporal correlation between suicide deaths and suicide news.

**Results** The media reporting of suicide was synchronized with increased suicide deaths during major suicide events such as celebrity death, and slightly lagged behind the suicide deaths for 1 month in other periods without notable celebrity deaths. The means of suicide reported in the media diversely affected the suicide models. Reports of charcoal burning suicide exhibited an exclusive copycat effect on actual charcoal burning deaths, whereas media reports of jumping had a wide association with various suicide models. Media reports of suicide had a higher association with suicide deaths in urban than in rural areas.

**Conclusions** This report suggested that a delayed effect of copycat suicide may exist in media reports of minor suicide events. The competitive reporting of minor suicide events must be avoided and addressed by media professionals.

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## Introduction

Suicidal behavior that is triggered by the media reporting of suicide, known as copycat suicide or the Werther effect, has been recognized for a long period of time [19, 22].

Media reporting as a risk of suicide has been effectively established in systemic reviews [24, 30, 31]. To prevent copycat suicide, the World Health Organization (WHO) suggested a guideline in which media reporting of suicide must be conducted in an appropriate, accurate, and potentially helpful manner to prevent people from imitating a major suicidal event [32].

However, the number of media and the intensity of news broadcasting have increased markedly in recent years, ranging from print newspapers and televised reports to online news Web sites. Consequently, the intensity and frequency of media reporting of suicide have also increased markedly. Based on counting data provided by Google News (news.google.com.tw), the media reporting of suicide in Taiwan has increased from an average of 46 news reports per month in 2003 to 361 news reports per month in 2010. Such an increase in suicide news intensity may be attributed to the emergence of new news media and competitive reporting of suicide news among various media [4].

Despite the evidence regarding copycat suicides, the knowledge about suicide and the media is limited. First, although numerous studies have demonstrated the effect of a single suicide event (such as a celebrity suicide) on the transient increase in suicide deaths [5–7, 26, 37], knowledge is limited regarding the temporal relationship between suicide news and suicide deaths in the long observation period. Second, only few studies have analyzed the content of suicide news and the effect of the content on suicide cases [21]. Third, the clustering of copycat suicides may be influenced by the complexity of social networks, and knowledge is limited regarding the effect of suicide news on suicide deaths in urban or rural areas.

Therefore, this study tested the following three hypotheses: (1) copycat effect of suicide may be observed not only in major suicide events such as celebrity suicides [14, 27], but also in common reports of non-celebrity suicide events [29]; (2) the suicide means that are reported in the media may be associated differently with certain suicide populations and the choice of suicide method [9, 13, 15]; and (3) suicide news may have a more notable copycat effect on suicide deaths in urban rather than in rural areas [2]. To test these hypotheses in a longitudinal and spatial manner, we performed a time series analysis of monthly suicide deaths and the intensity of media reporting of suicide in Taiwan during the period 2003–2010.

## Methods

### Suicide data

The nationwide data on all suicide deaths in Taiwan from 1 January 2003 to 31 December 2010 was approved and

provided anonymously by the Collaboration Center of Health Information Application, Department of Health, Executive Yuan, Taiwan. This period was selected to match the available online news that was archived at the Google Web site. A total of 31,364 suicide cases were included in this study (68.5 % male, mean age  $48.9 \pm 17.4$  years, range 7–108). The demographic variables in this data included gender, age, year and month of death, and means of suicide by the International Classification of Disease (ICD-9-CM). All data were provided anonymously in electronic format, and specific date of death was not released due to privacy regulations. Therefore, the study chose monthly counts of suicide as the time series by using an ecological study design. The suicide time series was further stratified by age, gender, and suicide means to generate various suicide models. To study the effect of suicide news on suicide deaths in rural and urban areas, we stratified the suicide time series in all of the 359 Taiwan townships, which were classified as urban or rural according to a previously calculated urbanization index [17].

### News data

The media reporting of suicide was retrieved from the Chinese version of Google News, which is a keyword-driven service that provides archives of digitized news from all available televised reports, print newspapers, and online media in Taiwan. To improve the accuracy of the search results that were relevant to actual suicide events, the keyword *suicide*, with exclusion of words *terrorism*, *bomb*, and *explosion*, was used to retrieve the record of suicide news. A timeline feature was used to count the monthly number of suicide news during the study period to evaluate the reporting intensity of suicide news. Furthermore, to study the effect of suicide content on actual suicide cases, we classified and refined the search results of suicide news by specifying keywords that refer to suicide means such as drug intoxication, charcoal burning, pesticide, hanging, and jumping. We subsequently recounted the monthly occurrence of specific suicide news according to the refined search results.

### Empirical mode decomposition (EMD)

The EMD was developed to de-trend and identify the intrinsic oscillations that were embedded in a time series [12]. The decomposition was based on the assumption that any data consist of a finite number of intrinsic components of oscillations. Each oscillation component, termed intrinsic mode function (IMF), was sequentially decomposed from the original time series by a sifting process.

The details of the EMD method [12] and its application to epidemiological time series has been previously

described [10, 34–36]. In brief, the sifting process comprised the following steps: (1) connecting the local maxima or minima of a targeted signal to form the upper and lower envelopes by natural cubic spline lines; (2) extracting the first prototype IMF by estimating the difference between the targeted signal and the mean of the upper and lower envelopes; and (3) repeating these procedures to produce a set of IMFs that are represented by a certain frequency–amplitude modulation at a characteristic timescale. The decomposition process is complete when no more IMFs can be extracted, and the residual component is treated as the overall trend of the raw data.

The EMD method removes oscillations that are irrelevant to the temporal suicide events. Furthermore, IMF has a zero-mean distribution, thereby reducing type I statistical error in the subsequent regression analysis. This study used a publicly available EMD algorithm based on Matlab software (version 2007; The Mathworks, Natick, Massachusetts) (<http://rcada.ncu.edu.tw/research1.htm>).

#### Time-dependent intrinsic correlation (TDIC)

Conventionally, cross-correlation analysis was used to determine the temporal relationship between two time series. The correlation analysis, however, is a global property and assumes the stationarity on the examined data. Recently, the TDIC algorithm was proposed based on the EMD method [3]. In addition to using a sliding window to compute the local or regional correlation, the proposed TDIC computes the correlation based on the IMF components of comparable timescales. This approach includes both auto and cross-correlation analysis that is specifically designed to analyze, capture, and track the local correlations between nonstationary time series pairs [3] and may be used to identify the local and transient synchronization of increased suicide events that occurred during the massive reporting of suicide news.

#### Statistical analysis

Because the impact of news on suicide may be local and transient, we used the EMD method to de-trend the time series into a set of IMFs [12, 33]. Each IMF has a characteristic timescale, which allowed us to identify the main IMF that was relevant to the transient increase in media reporting of suicide and to remove the unwanted and non-stationary oscillations (for example, secular or seasonal trend). Specifically, we used the multiple regressions with stepwise variable selection method to identify the single most significant IMF that can predict the original time series, and used this identified IMF as the representative time series for subsequent analyses [10, 35].

The time series analyses presented in this study can be further divided into two parts. The first part of the analysis is to assess the temporal and spatial correlation between suicide news and suicide deaths. To this end, we applied the TDIC method to quantify the temporal correlation between the identified IMFs of suicide deaths and suicide news at nationwide level, and generalized the TDIC analysis to each township in Taiwan. Pearson's correlation was used in the TDIC method to calculate the temporal correlation between the decomposed IMFs of suicide cases and suicide news. For the spatial analysis of the effect of suicide news on suicide deaths, partial correlation controlling for local population density was used to determine the correlation between suicide news and local suicide deaths. The Mann–Whitney *U* non-parametric statistics was used to test the difference in the suicide and news correlation in rural and urban areas. The ArcGIS Version 10.1 was used to produce the quantile map. A two-tailed *P* value of less than 0.05 was required for statistical significance in the Mann–Whitney *U* non-parametric analysis.

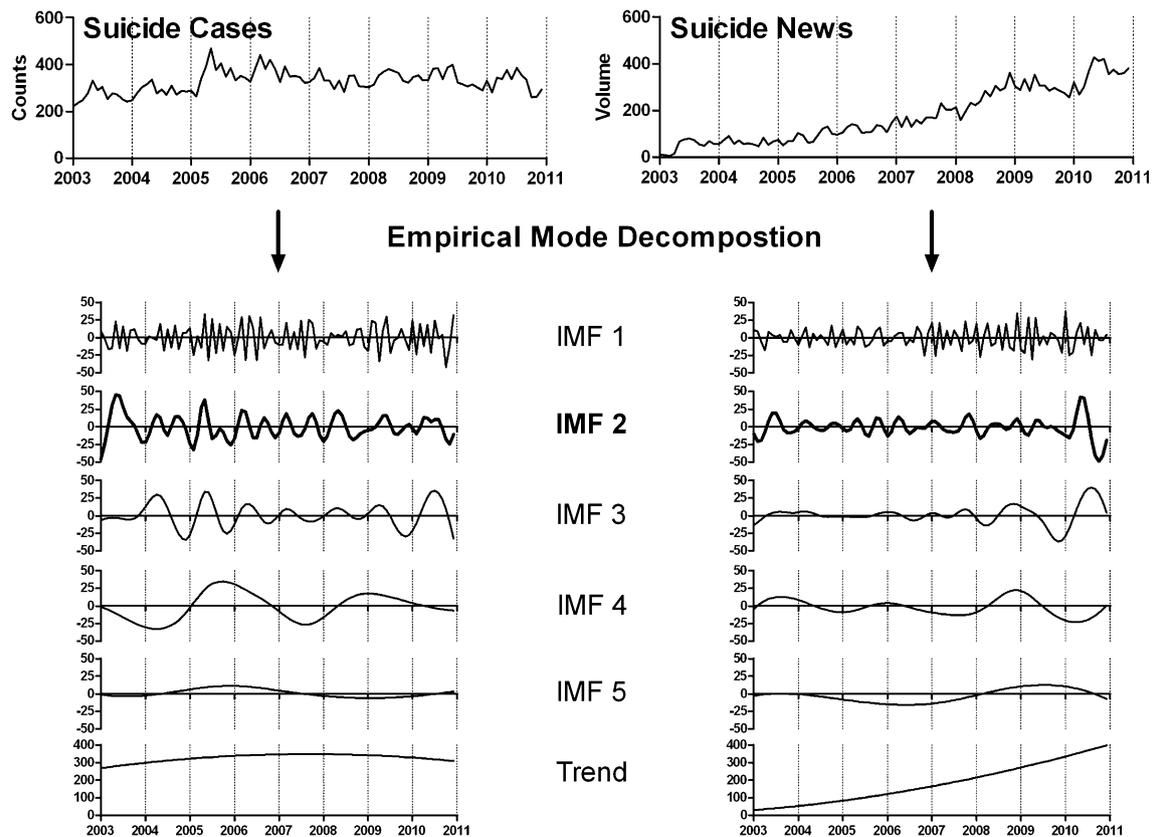
The second part of the analysis assesses the effect of suicide news content on different models of suicide deaths. The time series of suicide counts were stratified by the age or suicide means. Likewise, the time series of suicide news were stratified by the content of suicide. We then tested the direct Pearson's correlation between the identified IMFs of suicide deaths and suicide news according to various pairs of suicide models. Because of the multiple comparison problems, a stricter two-tailed *P* value at a level of less than 0.01 was considered to be significant in all correlation analyses. The SPSS for Windows Version 15.0 (Chicago, IL; SPSS Inc.) software was used for statistical analyses.

## Results

#### Baseline characteristics of suicide and news data

Among the 31,364 persons who committed suicide, 24,629 (78.5 %) were adults (age  $\geq 20$  and age  $\leq 65$ ), 6,270 (20.0 %) were elderly (age  $> 65$ ), and 465 (1.5 %) were adolescents (age  $< 20$ ). A total of 16,281 (51.9 %) deaths occurred by violent means, such as hanging or jumping from heights (ICD-9-CM codes E953-E957), 14,415 (46.0 %) were by non-violent means, such as poisoning (ICD-9-CM codes E950-E952), and 668 (2.1 %) were unclassified. Prior reports suggested that charcoal burning suicide, which is an emerging suicide method in Taiwan [16], may be attributed under ICD code E952/E958, thus 9,652 (30.8 %) of the deaths may be classified under this category.

For suicide news data, a total of 16,795 news reports originating from Taiwan were retrieved from the Google



**Fig. 1** Empirical mode decomposition of suicide cases and suicide news time series. The decomposition yielded five intrinsic mode functions (IMFs) and an overall trend. IMF 2 was identified to be

correlated to major suicide events and associated media reporting. Other IMFs were identified as seasonal (IMF 3) or secular (IMF 4–5) oscillation

News archives from 2003 to 2010. Among these news, 2,136 (12.7 %) were related mainly to drug intoxication, 3,782 (22.5 %) were charcoal burning, 428 (2.5 %) were pesticide suicide, 1,179 (7.0 %) were hanging, 4,082 (24.3 %) were jumping, and 5,188 (30.9 %) were unclassified.

#### Decomposition of suicide and news data

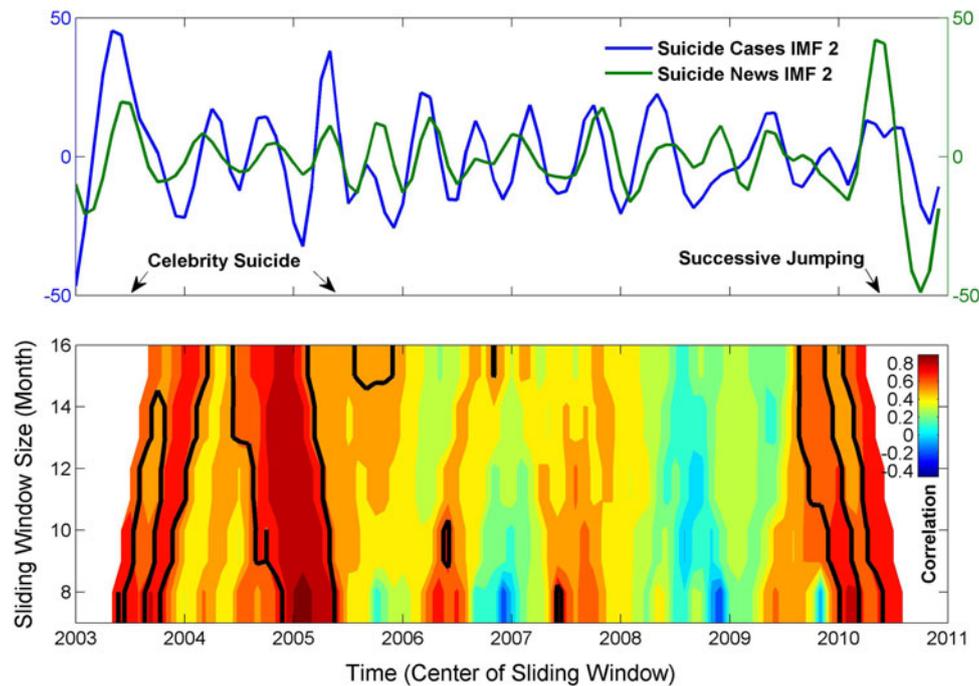
Figure 1 illustrates the raw time series of suicide cases and suicide news, as well as the empirical mode decomposition of both data. The decomposition yielded five IMFs (IMF 1–5) and the overall trend. We identified the IMF 2 that was predicted by the multiple regression model to represent the main oscillations in both the suicide deaths ( $r = 0.558$ ;  $P < 0.001$ ) and the news data ( $r = 0.565$ ;  $P < 0.001$ ) and used this IMF for subsequent analyses. Other IMFs indicated noisy fluctuations (IMF 1), seasonal (IMF 3) or secular oscillations that fluctuated at longer time periods (IMF 4–5). Therefore, the decomposition removed the effect of noise, seasons, and secular trend on the time series data. The trend component of suicide news data exhibits a notable upward trend since 2003, which represents the

increasing number of media companies and coverage in Taiwan in recent years [4].

#### Time-dependent intrinsic correlation between suicide cases and news

Figure 2 illustrates the TDIC plot of suicide deaths and news events by using IMF 2 as the representative mode of suicide cases and news data. Three major suicide events, including two entertainment celebrity suicide deaths (2003, jumping; and 2005, hanging) and a successive jumping in a Taiwan-based industrial company (Foxconn Inc.) in southern China (2010) [8] demonstrated an in-phase correlation (i.e., synchronization) between the peaks of suicide deaths and media reports ( $P < 0.01$ ; black contour line). In periods other than during those events, the peak of suicide news exhibited an out-phase, lagged pattern behind the peak of suicide deaths. The lagged period was estimated to be 1 month.

To study the effect of suicide news on suicide deaths in rural and urban areas, we calculated the averaged intrinsic correlation (i.e., the average of all correlation values in the



**Fig. 2** Time-dependent intrinsic correlation (TDIC) of main intrinsic mode function (IMF 2) derived from raw suicide cases and suicide news time series. *Upper panel* main IMFs decomposed from suicide and news time series. *Arrows* indicate that the two IMFs were highly correlated during two entertainment celebrity suicide and a successive jumping occurred in a Taiwan-based industrial company in southern

China. *Lower panel* contour plot of TDIC analysis. The TDIC analysis calculated the temporal correlation between suicide news and suicide deaths by using various sliding windows of the time period. *Color bar* indicates the level of correlation, and areas within *black contour line* indicate the significantly temporal correlation between suicide news and suicide death ( $P < 0.01$ )

TDIC plot) across all 359 townships in Taiwan, with an adjustment of local population density. Figure 3 illustrates a higher correlation between suicide news and suicide deaths in the urban area than those in the rural areas (Mann–Whitney  $U$  test;  $P = 0.018$ ).

#### Effect of suicide news content on different models of suicide deaths

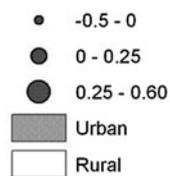
Table 1 summarizes the results of the correlation of IMF 2 between various suicide models and the content of suicide news, which were stratified by means of suicides that were reported in the media. The suicide news was significantly correlated to most types of suicide deaths (all  $P < 0.01$ ), except for young (age  $< 20$ ) suicide cases. Regarding the content of suicide news, those that reported on charcoal burning suicide was significantly correlated to non-violent ( $r = 0.433$ ;  $P < 0.01$ ), male ( $r = 0.300$ ;  $P < 0.01$ ), and exclusively to charcoal burning suicide deaths ( $r = 0.241$ ;  $P = 0.018$ ). The news that reported on pesticides was significantly correlated to violent ( $r = 0.266$ ), female ( $r = 0.359$ ), and elderly ( $r = 0.387$ ) suicide deaths (all  $P < 0.01$ ), whereas the news that reported on jumping was significantly correlated to non-violent ( $r = 0.350$ ), male ( $r = 0.266$ ), female ( $r = 0.368$ ), elderly ( $r = 0.320$ ), and

jumping ( $r = 0.267$ ) suicide deaths (all  $P < 0.01$ ). The news that reported drug intoxication was not associated with suicide deaths, and those that reported on hanging were correlated only to jumping suicide deaths ( $r = 0.272$ ;  $P < 0.01$ ).

#### Discussion

This analysis identified three main findings: (1) synchronization of suicide deaths and media reporting of suicide was observed in major suicide events, which suggested that a copycat effect of suicide occurred during the massive reporting of major suicide events. The synchronization was obscured in other periods without celebrity suicide events, because the peaks of suicide news exhibited a 1-month lagged pattern behind suicide deaths. (2) The means of suicide that were reported in the media diversely affected the suicide models. The reports of charcoal burning suicide may have an exclusive copycat effect on actual charcoal burning deaths. Media reports of jumping had a wide association with various suicide models, indicating a strong psychological impact of such news. (3) Media reports of suicide had a higher association with suicide deaths in urban than in rural areas.

**Fig. 3** Spatial distribution of correlation between suicide cases and suicide news time series



Although the period without celebrity suicide indicated less synchronization between suicide news and suicide deaths, this finding does not exclusively indicate that non-celebrity death has no copycat effect. Instead, a mutual causation between suicide news reporting and actual suicides is possible [4], and copycat suicides may increase simultaneously with the increase in suicide reports of minor figures. Prior studies focused mainly on increased suicide deaths following celebrity suicide, which was also

replicated in our analysis. However, we considered that a delayed effect of copycat suicide may exist following minor suicide events, which may be more crucial than celebrity deaths, because reports of such events comprised the majority of suicide news. Moreover, because the spread of news of celebrity suicide can hardly be avoided, a preventive strategy may focus on reducing the number of news reports of minor suicide events. In Taiwan, reports of minor suicide events may be attributed to competitive

**Table 1** Correlation of intrinsic mode function between different suicide models and suicide news

Suicide models	Suicide news					
	All	Drug intoxication	Charcoal burning	Pesticide	Hanging	Jumping
All	0.454*	0.002	0.167	0.249	0.084	0.224
Violent	0.303*	0.005	-0.069	0.266*	0.147	0.133
Non-violent	0.467*	-0.180	0.433*	0.181	0.064	0.350*
Male	0.483*	-0.070	0.300*	0.250	0.089	0.266*
Female	0.410*	-0.061	-0.025	0.359*	0.085	0.368*
Young	0.145	0.084	-0.032	-0.052	-0.011	-0.059
Adult	0.417*	0.001	0.118	0.182	0.080	0.189
Elderly	0.496*	-0.057	0.246	0.387*	0.113	0.320*
Charcoal burning	0.295*	-0.142	0.241	0.064	0.015	0.200
Hanging	0.327*	-0.079	-0.032	0.297*	0.187	0.176
Jumping	0.348*	0.051	0.030	0.339*	0.272*	0.267*

All correlations were computed using second intrinsic mode function decomposed from each raw time series

\* The significance level was 0.01

reporting of news between media companies, which should be addressed. Future study is warranted to investigate the mechanism of delayed effect of copycat suicide in minor suicide events.

Few studies have investigated the impact of suicide news content on actual suicide death [21, 22, 25]. A patient-based study found that media reports of suicides may contribute to the awareness of suicide methods [1] and subsequently copycat suicides. The results in this study indicated that the reporting of charcoal burning and jumping suicides had a larger effect on particular suicide populations or the copycat choice of suicide methods. The impact of media reports of jumping suicide on actual suicide death may be related to two major jumping suicide events identified in Fig. 2 (i.e., celebrity suicide in 2003 and Foxconn suicides in 2010). However, none of the celebrity suicide identified in Fig. 2 was by charcoal burning, thus our findings of the association of charcoal burning news reports with actual charcoal burning suicides support the hypothesis that reports of non-celebrity suicides could also have copycat effects [29].

Of note, one study demonstrated that certain manners of reporting suicide, such as reporting only individual suicidal ideation or coping strategies without emphasis on suicidal behavior, may have a protective effect, which the study termed the Papageno effect [21]. However, such reports comprised only a minor proportion of all suicide news (8.8 %) in the study [21], and such a reporting strategy may be difficult in the practice of news professionals when reporting an actual suicide death case. The charcoal burning and jumping suicides comprised a large amount of suicide deaths (40.8 %) in Taiwan, and therefore reducing the reports or avoiding details of suicide means regarding

these methods may be a reasonable strategy to reduce related copycat suicides. The Taiwan Suicide Prevention Center introduced a warning message with a supportive source in every suicide news report since 2010, and its effect on suicidal behaviors requires further observation and studies.

The finding of a higher association of suicide news with suicide deaths in urban areas is consistent with the ideas of suicide contagion (or suicide clustering), which may mimic the transmission of infectious disease in a social network [23, 28]. The transmission of such contagion may be easier in urban than in rural areas. Identifying social networks among suicide cases may help to develop meaningful preventive strategies [18, 20]. In addition, suicide may be more prevalent in areas with higher exposure to media news [11, 21], and such a phenomenon may also verify our finding of urban/rural difference in suicide/news association.

The merits of this study include the length of the study period, identification of key oscillation related to suicide events and the removal of irrelevant, non-stationary trends by EMD and TDIC methods, the use of online news archives to include all types of news media, and the stratification of news content by suicide means. The limitations of the study concern its ecological design, which is appropriate for identifying associations, but not for establishing causality. The resolution of ecological design was limited to a monthly count level, because of the privacy policy of the Taiwan government on released suicide data. The content of suicide news was stratified based on keyword search, but not on text analysis. The study also did not consider the prominence, style, or wording of suicide reporting. Information regarding the circulation of media is

limited, thus the estimated exposure to media across Taiwan townships cannot be controlled. Importantly, the study did not consider the confounding effects of certain events on media reporting or suicide death, such as economic crisis or suicide prevention campaigns.

In summary, this study revealed that suicide deaths were associated with media reporting of both major and minor suicide events. The conventional perspective based on celebrity suicide research is not to excessively report celebrity suicide events. The present findings add that competitive reporting of minor suicide events is also inappropriate and should be addressed by media professionals.

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**Conflict of interest** None declared.

**Ethical standard** The study and material was approved and provided anonymously by the Collaboration Center of Health Information Application, Department of Health, Executive Yuan, Taiwan. Application of institution review board approval was not required in released anonymous data from the Department of Health, Taiwan.

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