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主題論文

臺灣自殺率與自殺關聯關鍵字搜尋之初探研究

Suicide Rate and Suicide Related Keywords Search with Google Trends in Taiwan: An Exploratory Study

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中文摘要

背景：

過去 Google Trends 已經展現出具有監控及預測流行性感冒疫情爆發之能力。然而，對於網路關鍵字搜尋與自殺發生事件之間是否具關聯性目前仍然未知，因此本研究試圖探討自殺關鍵字搜尋是否能預測臺灣自殺率之變化情況。

目的：

本研究在探討運用 Google Trends 搜尋引擎，搜尋自殺關鍵字趨勢與臺灣逐年自殺率變化之相關性研究。

方法：

運用 2005 年至 2014 年之 Google Trends 搜尋引擎與政府開放死因統計資料，計算臺灣逐年自殺率之變化趨勢，且分析自殺關鍵字搜尋量、自殺關聯關鍵字和自殺率之相關性。並進一步運用簡單線性迴歸評估自殺關鍵字搜尋對自殺率之預測能力。

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結果：

2005 年至 2014 年之標準化自殺率有逐年下降的趨勢 (20.9-15.2 每十萬人口)，男性自殺率高於女性且自殺率隨年紀逐年增加。自殺關鍵字搜尋空間分布方面，新北市、高雄市及新竹市之關鍵字搜尋量最高。在與自殺關聯之關鍵字方面，精神疾病、認知與情緒、生活事件和其他四個面向中，與自殺高度相關的關鍵字分別為憂鬱症($r=0.43, p<0.001$)、憂鬱($r=0.41, p<0.001$)、負債($r=0.28, p<0.001$)和張老師($r=0.28, p<0.001$)。迴歸分析結果發現全年度自殺關鍵字搜尋量之中位數，對自殺率有較佳的預測能力 ($\beta=0.39, R^2=0.57, p=0.01$)，尤其在 65 歲以下自殺率之預測能力為最佳 ($\beta=0.41, R^2=0.60, p=0.01$)。

結論：

本研究結果發現運用 Google Trends 搜尋引擎，搜尋自殺關鍵字之趨勢，對臺灣自殺率具有預測能力。因此，Google Trends 搜尋引擎可做為日後自殺防治之潛在預測工具。

關鍵詞：Google Trends, 自殺, 關鍵字搜尋。

Suicide Rate and Suicide Related Keywords Search with Google Trends in Taiwan: An Exploratory Study

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Abstract

Background

Google Trends has demonstrated the capability to monitor and predict influenza outbreaks. However, the association between keyword search for suicide and subsequent suicide incidence remains unknown. Therefore, we tried to investigate whether the Google Trends engine could predict the subsequent suicide incidence in Taiwan.

Objective

To examine the association between keyword search for suicide and subsequent suicide incidence.

Methods

We used Google Trends engine and open source mortality database in Taiwan from 2005 to 2014. The standardized suicide rate was calculated according to age and sex. The standard reference was from the population of Taiwan in 2014 and correlation between suicide and suicide related keywords was estimated by Pearson's correlation coefficient. We then investigated and validated whether the suicide keyword would be the optimal predictors for suicide rate by using simple linear regression.

Results

The secular trend of standardized suicide rates was decreased from 2005 to 2014 (20.9-15.2 per 100,000 population). For age and sex standardized suicide rate, the male suicide rate was higher than female and increased with age. The top three cities for

suicide search were New Taipei City, Kaohsiung City and Hsinchu City. With regard to suicide related keywords, the highest keywords association with suicide were depressive disorder (憂鬱症) ($r=0.43$, $p<0.001$), depression (憂鬱) ($r=0.41$, $p<0.001$), debts (負債) ($r=0.28$, $p<0.001$) and TEACHER CHANG (張老師) ($r=0.28$, $p<0.001$) in mental disorders, cognition and emotion, life events and other groups respectively. For regression model, the median of search volume in year was the optimal predictor for suicide rate ($\beta=0.39$, $R^2=0.57$, $p=0.01$), especially the suicides aged less than 65 years old ($\beta=0.41$, $R^2=0.60$, $p=0.01$).

Conclusions

In this study, we found keyword search for suicide by using Google Trends was optimal predictor for suicide rate. Therefore, Google Trends could be a potential tool for suicide prevention.

Keywords: Google Trends, Suicide, keyword search

Introduction

Google Trends is a device of Google Labs that enables users to know the frequency of the search for a specific word in the Googles browser (Fond, Gaman, Brunel, Haffen, & Llorca, 2015). Years ago, there was a project named Google Flu Trends has been launched that Google Inc. used their search engine to analyze the large number of Google search queries gathered by monitoring millions of users' health tracking behaviors online to reveal if there is the presence of flu-like illness in a population for its corresponding region. In the 2009 flu pandemic, Google Flu Trends made a success to show influenza cases spiking in the mid-Atlantic region of the United States two weeks earlier than the CDC's report. Thus, Google Trends has the capability to monitor and predict influenza outbreaks (Carneiro & Mylonakis, 2009).

Suicide has negative effect on individuals, families, communities and society and make a serious public health problem. In the US, suicide is one of the leading causes of death among young people. It is the third leading cause of death among 15-24 year olds and the second leading cause of death among 25-34 year olds (Eaton et al., 2011). Suicide risk was considered in relation to the joint effect of factors regarding family structure (single marital status), socioeconomics (unemployment), demographics (lower social class), mental illness (psychiatric disorders), and family history of suicide (both a family suicide history and a family psychiatric history) and physical illness. Potential risk factors include male gender, being an adolescent or young adult, drug or alcohol abuse, and past history of self-harm (Haw, Hawton, Niedzwiedz, & Platt, 2013; P. Qin, E. Agerbo, & P. B. Mortensen, 2003).

Cheng et al (2014) have reported a systematical review about definition of contagion in suicide-related research. Their results showed 'suicide contagion' as a descriptive metaphor, to say that the apparent spread of suicidal behaviors among persons or populations, its use has illustrative and frightening power. Suicide contagion spread through the media, including newspapers, television and internet. For example, celebrities committed suicide effect that suicide rates have increased than average in the past. In addition, internet search trends could also be a potential indication of suicide

contagion (Cheng, Li, Silenzio, & Caine, 2014)

Therefore, we aimed to investigate association between suicide keyword search and suicide rate in Taiwan. To evaluate whether Google Trends can be a potential tool for suicide prevention.

Methods

We conducted a retrospective study between 2005 and 2014. The data source were obtained from Google Trends search engine and mortality database from Open Data platform of Taiwan (DATA.GOV.TW). For mortality database, the cause of suicide mortality according to the International Classification of Disease 9th or 10th Clinical Modification (ICD-9 CM for 2005-2007 and ICD-10 CM for 2008-2014). The suicide rate was calculated as the number of suicides divided by the total number of population alive on June 31st. The standardized suicide rate was calculated according to age and sex. The standard reference was from the population of Taiwan in 2014.

We used Google Trends search engine with following search terms: suicide (自殺), depressive disorder (憂鬱症), schizophrenia (精神分裂), bipolar disorder (躁鬱症), anxiety disorder (焦慮症), depression (憂鬱), stress (壓力), grieved (傷心), sad (難過), debts (負債), retirement (退休), unemployment (失業), affair (外遇), TEACHER CHANG (張老師), Lifeline (生命線), charcoal-burning (燒炭) and hanged (上吊). These search terms were based on literature review which was related suicide, such as psychiatric illness, cognition, emotions and stress-life events (Caldwell & Gottesman, 1992; Kposowa, 2001; McLean, Maxwell, Platt, Harris, & Jepson, 2008; Marta Miret, José Luis Ayuso-Mateos, Jose Sanchez-Moreno, & Eduard Vieta, 2013; Ping Qin, Esben Agerbo, & Preben Bo Mortensen, 2003; 廖士程, 李明濱, 龍佛衛, 張家銘, & 吳佳儀, 2015; 蘇宗偉, 邱震寰, 郭千哲, 陳喬琪, & 李明濱, 2005). Whole search was restricted in Taiwan site and the number of search volume was normalized and presented on a scale from 0 to 100. The correlation between those keywords and suicide was estimated by Pearson's correlation coefficient. We also calculated the mean, median, minimum and maximum of suicide search volume in year and mid-year

respectively and used these values as independent variables to predict suicide rate of Taiwan by using simple linear regression. All significance levels were two-sided, $P < 0.05$. We performed all statistical analyses using SAS (version 9.3 for Windows; SAS Institute Inc., Cary, NC, USA).

Results

Secular trends in suicide rates

The study was consist of 39,085 suicides in Taiwan from 2005-2014. Among these suicides, 26,543 were male and 12,542 were female. The mean age (standard deviation) of male was 49.5 (17.2) and female was 49.7 (18.0). The secular trend of standardized suicide rates was gradually decreased from 2005 to 2014 (20.9-15.2 per 100,000 population). The male standardized suicide rate was higher than female for each year (male: 28.7-20.2 per 100,000 population; female: 13.1-10.1 per 100,000 population) and the rates were increased with age (Figure 1A, B).

Evaluation of research on the word suicide and suicide related keywords between 2005 and 2014

All of the keywords were categorized in four groups: (1) mental disorders, (2) cognition and emotion, (3) life events and (4) other groups. In mental disorders, the highest keyword association with suicide was depressive disorder (憂鬱症) ($r=0.43$, $p<0.001$) and the rank of the other keywords were schizophrenia (精神分裂) ($r=0.35$, $p<0.001$), bipolar disorder (躁鬱症) ($r=0.25$, $p<0.001$) and anxiety disorder (焦慮症) ($r=0.14$, p: 0.0011) (Figure 3A). In cognition and emotion, the highest keyword association with suicide was depression (憂鬱) ($r=0.41$, $p<0.001$) and the rank of the other keywords were stress (壓力) ($r=0.37$, $p<0.001$), grieved (傷心) ($r=0.11$, $p=0.011$) and sad (難過) ($r=-0.07$, $p=0.1126$) (Figure 3B). In life events, the highest keyword association with suicide was debts (負債) ($r=0.28$, $p<0.001$) and the rank of the other keywords were retirement (退休) ($r=0.26$, $p<0.001$), unemployment (失業) ($r=0.13$, $p=0.004$) and affair (外遇) ($r=-0.02$, $p=0.597$) (Figure 3C). In other groups, the highest

keyword association with suicide was TEACHER CHANG (張老師) (r=0.28, p<0.001) and the rank of other keywords were Lifeline (生命線) (r=0.27, p<0.001), charcoal-burning (燒炭) (r=0.10, p=0.028), hanged (上吊) (r=0.22, p<0.001). (Figure 3D)

Comparative spatial distribution between "suicide" keyword search with Google Trends and suicide rate

Comparative spatial distribution between suicide keyword search with Google Trends and suicide rate in 2014. The top three cities for suicide keyword search were New Taipei City, Kaohsiung City and Hsinchu City (Figure 2A) and the top three cities for suicide rate were Keelung City, Chiayi County and Yunlin County (Figure 2B) and those cities suicide rate were higher than the suicide rate of Taiwan (Figure 2C). The spatial distribution of suicide keyword search was inconsistent with suicide rate. The top three cities for suicide rate were not changed much by years (Supplementary Figure 2).

Association between suicide rate and suicide keyword search with google trends

The mean, median, minimum and maximum of suicide search volume in year and mid-year was calculated respectively. The regression coefficients of those search volume were estimated by simple linear regression. The median of search volume in year was the optimal predictor for suicide rate (β=0.39, R2=0.57, p=0.01). We further divided the suicide into two groups: above 65 years old and less than 65 year old groups. Among less than 65 years old group, the median of search volume in year was also optimal predictor for suicide rate (β=0.41, R2=0.60, p=0.01) but not in above 65 years old group (β=0.61, R2=0.44, p=0.04).

Discussion

In this study, we used the Google Trends for suicide keyword search and estimated the association between suicide search and suicide rate of Taiwan. We found the trend of suicide search was associated with suicide rate of Taiwan, especially the suicides aged less than 65 year old. However, the spatial distribution of suicide search and

suicide rate were not consistent. This inconsistent could be resulted from the place of suicide recorded in open source mortality database was registered residence not current residence. Thus, there was no correlation of spatial distribution between suicide search and suicide rate.

Most studies have been indicated people dying by suicide, approximately nine out of every ten individuals had a psychiatric disorder at the time of their death. Previous studies have shown that depression is the most common of these disorders, occurring in half to two thirds of cases (Hawton, Casanas, Haw, & Saunders, 2013). Major depression have the highest risk of committing suicide with around 15–20% of depressive patients ending their lives by suicide (M. Miret, J. L. Ayuso-Mateos, J. Sanchez-Moreno, & E. Vieta, 2013). The cause of major depressive disorder is likely to be multi-factorial etiology (Belmaker & Agam 2008). The diagnosis of major depressive disorder requires a distinct change of mood, characterized by sadness or irritability and accompanied by at least several psychophysiological changes, such as disturbances in sleep, appetite, or sexual desire; constipation; loss of the ability to experience pleasure in work or with friends; crying; suicidal thoughts; and slowing of speech and action (Belmaker & Agam 2008). Therefore, detection of individuals at risk of suicide, while clearly extremely important, could be difficult for public health prevention (Hawton et al., 2013). It is important for policy making to develop a useful tool to monitor and predict suicide incidence. In this exploratory study, we found Google trend could be a potential tool for this purpose. We found the trend of suicide search was associated with suicide rate of Taiwan, especially the suicides aged less than 65 year old. This finding was also consistent with previous published review articles (Daine et al., 2013; Mok, Jorm, & Pirkis, 2015). This association between the suicide keyword search and suicide rate seemed to implicate the change of internet users could be influenced by suicide event through the effect of suicide contagion.

There are some limitation of this study should be noted. First, there was no demographic information about the Google Trends users for suicide keyword search. Thus, we cannot control the effect of user's characteristics (such as age, sex or

socioeconomic status…etc.) on suicide rate. Therefore, these factors were not considered in this study. Second, the mortality database was obtained from Open Data platform of Taiwan and the database was de-identification and aggregated by year, sex, age, township and cause of death. Therefore, we did not calculate the daily suicide rate and evaluate the association between real-time suicide keyword search and suicide incidence. Third, there were probably other keywords highly associated with suicide rate of Taiwan but we did not consider those keywords in this study. We used a direct and intuitional keyword (suicide) as a predictor for suicide rate. Fourth, we did not address the mechanism or causal relationship on suicide rate in this study.

In conclusion, we found suicide keyword search with Google Trends is a predictor for suicide rate. The median of suicide keyword search volume in year was the optimal predictor for suicide rate, especially the suicides aged less than 65 year old. Therefore, in our opinion, Google trends could be a potential tool for suicide prevention and which is also similar with a previous study suggestions (Song, Song, An, Hayman, & Woo, 2014). However, whether Google trends could be a real-time supervision system and reporting suicide epidemic peaks required further studies in the future.

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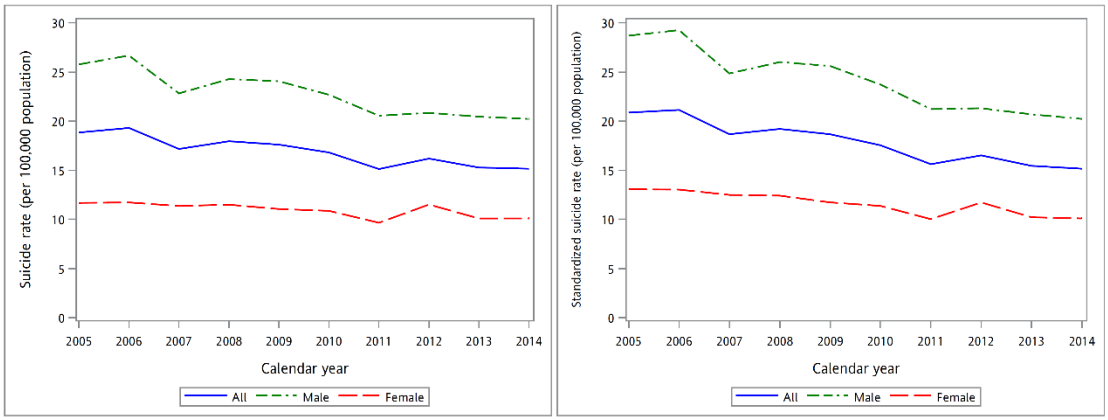
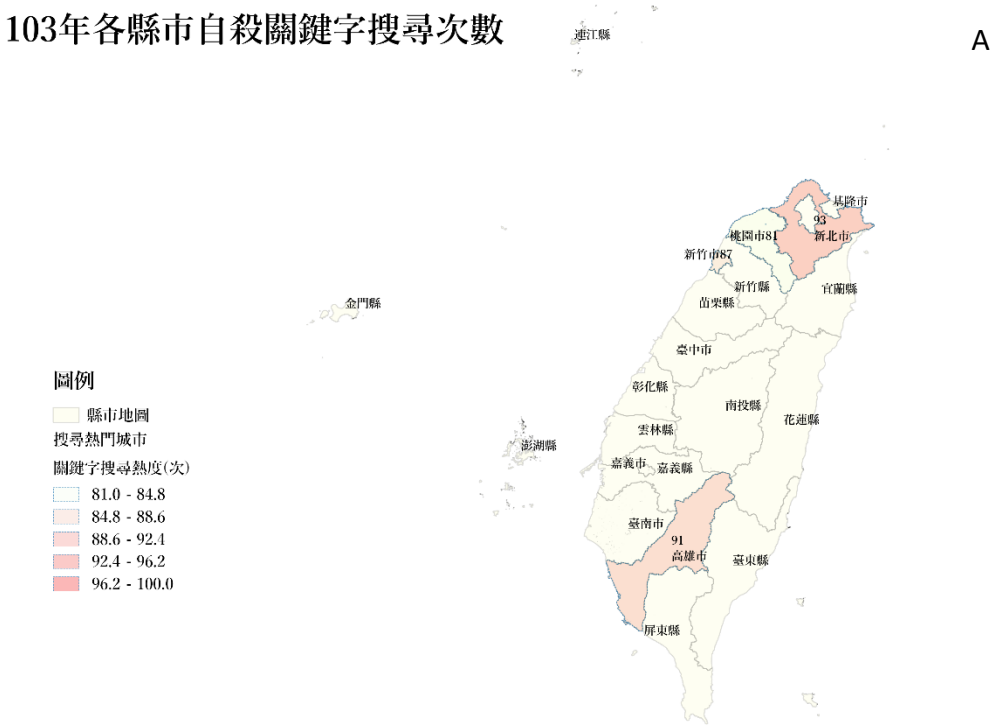
Figure 1. The secular trend of suicide rate and standardized suicide rate from 2005 to 2014.



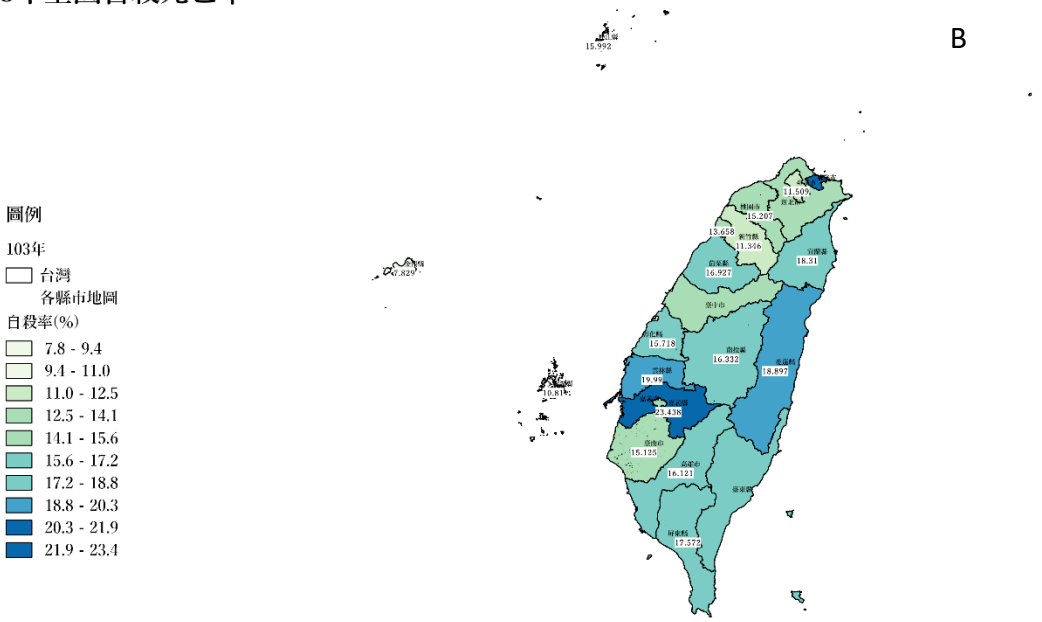
A B

Figure 2. The spatial distribution between suicide keyword search with Google Trends and suicide rate.



103年全國自殺死亡率

B



C

Figure 3. Evaluation of research on the suicide and suicide related keywords between 2005 and 2014.

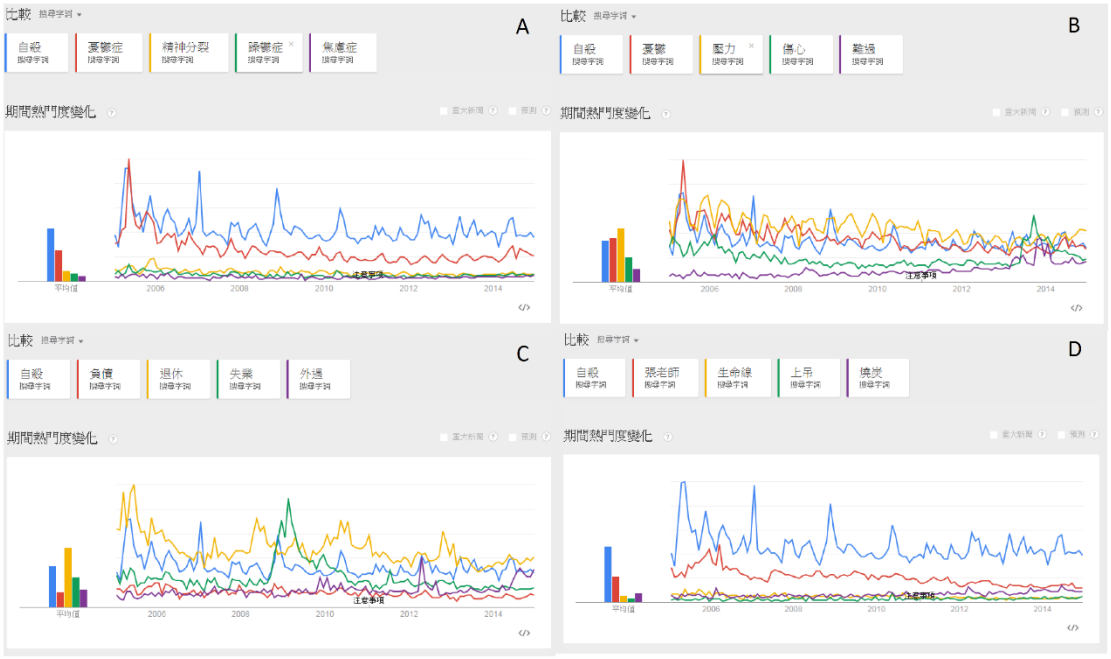
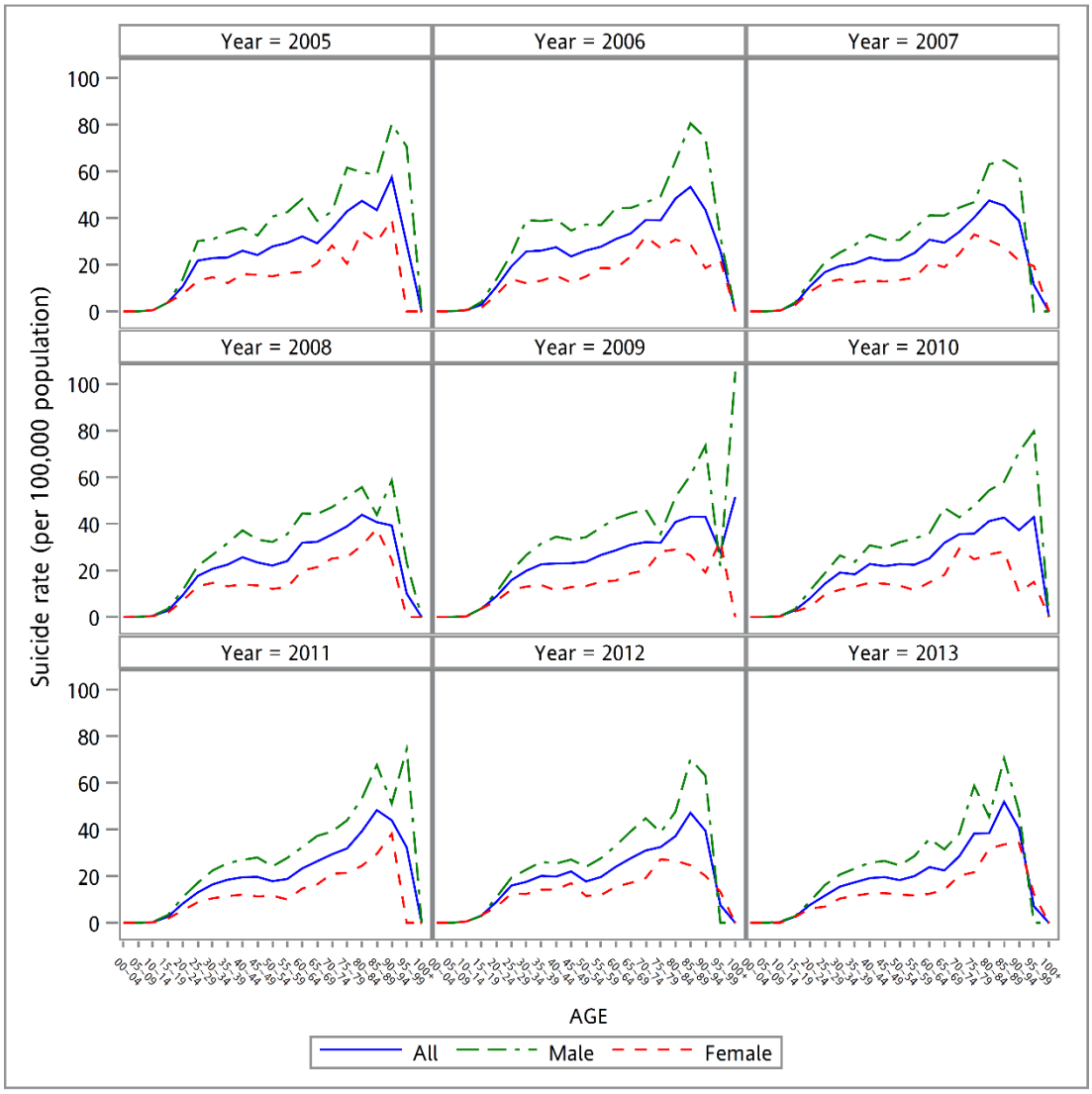
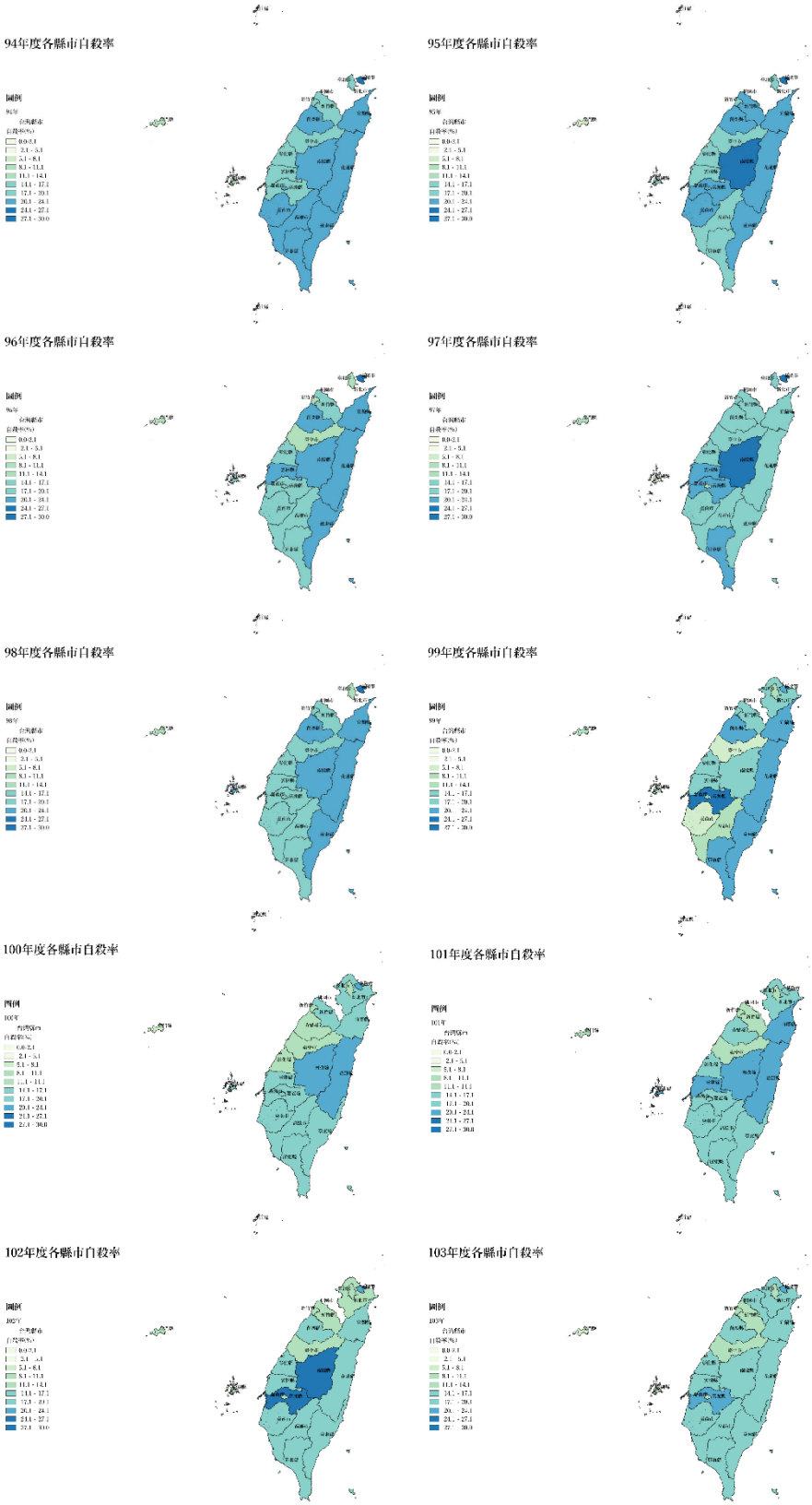


Table 1. Regression coefficient for suicide rate with search volume of suicide keyword in google trend in Taiwan, 2005-2014.

	Suicide rate for all age					Suicide rate for above 65 years old					Suicide rate for less than 65 years old				
Independent variable	Regression coefficient	SE	t-value	p-value	R-squared	Regression coefficient	SE	t-value	p-value	R-squared	Regression coefficient	SE	t-value	p-value	R-squared
Search volume in year															
Mean	0.35	0.12	2.92	0.02	0.52	0.58	0.23	2.55	0.03	0.45	0.36	0.12	3.00	0.02	0.53
Median	0.39	0.12	3.29	0.01	0.57	0.61	0.24	2.48	0.04	0.44	0.41	0.12	3.45	0.01	0.60
Minimum	-0.30	0.22	-1.32	0.22	0.18	-0.40	0.41	-0.98	0.36	0.11	-0.31	0.22	-1.38	0.21	0.19
Maximum	0.02	0.02	1.01	0.34	0.11	0.05	0.03	1.53	0.16	0.23	0.02	0.02	0.95	0.37	0.10
Search volume in mid-year															
Mean	0.32	0.10	3.09	0.01	0.54	0.53	0.20	2.69	0.03	0.48	0.33	0.10	3.18	0.01	0.56
Median	0.33	0.11	3.12	0.01	0.55	0.50	0.21	2.34	0.05	0.41	0.34	0.10	3.28	0.01	0.57
Minimum	-0.14	0.20	-0.71	0.50	0.06	-0.04	0.37	-0.1	0.92	0.00	-0.17	0.20	-0.83	0.43	0.08
Maximum	0.02	0.02	0.71	0.50	0.06	0.05	0.04	1.21	0.26	0.16	0.02	0.02	0.67	0.52	0.05

Supplementary Figure 1. The age, sex and year stratified suicide rate between 2005 and 2013.



Supplementary Figure 2. The spatial distribution of suicide rate in Taiwan from 2005-2013.