



Combined effects of depression and anxiety on suicide: A case-control psychological autopsy study in rural China

Zhang Jie^{a,b}, Liu Xinxia^c, Fang Le^{d,*}

^a School of Public Health and Center for Suicide Prevention Research, Shandong University, Jinan, China

^b Department of Sociology, State University of New York Buffalo State, Buffalo, USA

^c College of Humanities and Law, Northeast Agricultural University, Haerbin, China

^d Department of Non-communicable Diseases Control and Prevention, Zhejiang Provincial Center for Disease Control and Prevention, Hangzhou, China



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ABSTRACT

Most of the previous researches indicated depression and anxiety were potential risk factors for suicide, and they were also highly correlated. However, few studies have explored their combined effects on suicide and the dimensions which really work. A total of 392 suicide cases aged 15–34 years and 416 community controls of the same age range were investigated. The results showed that after controlling confounding factors, people with low depression and high anxiety, with high depression and low anxiety, with high depression and high anxiety were at 2.46, 26.32, 54.77 times more risk for suicide (all $P < 0.05$), compared with subjects with low depression and low anxiety. Only two of seven dimensions of depression (including cognitive disturbance, helplessness, excluding anxiety dimension) and one of two dimensions of STAI anxiety (anxiety dimension, not depression dimension) were risk factors for suicide (all $OR > 1$). Our main findings was that combined effects of depression and anxiety on suicide were complicated, and the effects of anxiety dimension of depression and depression dimension of anxiety must be cautiously evaluated, avoiding overlapping inclusion.

1. Introduction

Suicide is an important public health issue worldwide which claims more than 800,000 people each year, and World Health Organization (WHO) has declared that reducing suicide-related mortality is a global imperative (World Health Organization, 2014; Turecki and Brent, 2016). Suicide deaths in Chinese population constitute nearly one-fifth of suicides in the world (Dong et al., 2015). Suicide is the leading cause of death among Chinese young adults 15–34 years of age, while globally it is the second leading cause of mortality in 15–29-year-old (McLoughlin et al., 2015; World Health Organization, 2014, 2014; Phillips et al., 2002a). China also has substantially higher rates of suicide in rural area versus urban communities (Phillips et al., 2002a; Sun et al., 2013; Zhang et al., 2014). Hence suicide among rural young people aged 15–34 years in China needs more attention.

Most previous studies indicated that being unmarried, poor education, unemployment, low income, poor health condition, family history of suicide attempt, no religious relief, negative life event, lack of social support, mental disorder, depression and anxiety were risk factors for suicide (Lawrence et al., 2016; Li et al., 2012; Phillips et al., 2002b; Turecki and Brent, 2016; Zhang et al., 2004, 2011). Among these

potential risk factors, depressive and anxiety symptoms (or disorders) are very prevalent and frequently coexist (Cyranowski et al., 2012; Oude Voshaar et al., 2016; Placidi et al., 2000; Sobowale et al., 2014; Zhang et al., 2013).

Depression usually refers to depressive mood or disorder. Depression is a persistent feeling of sadness and loss of interest in things, which can affect individual's thoughts, behavior, feelings and sense of well-being, and it may occur temporarily in almost every person in his/her whole lifetime. However, depressive disorder is usually much severer than depressive mood which may not meet criteria of depressive disorder, and usually has more than two weeks' depressive symptom and meet other specific clinical diagnosis criteria. Similarly, anxiety may also be interpreted as mood or disorder, and anxiety disorder is much more severe than anxiety mood. Depressive disorder has 30 times increased risk of suicide (Li et al., 2012), and comorbidity of anxiety disorder may illustrate a summative effect on suicide risk. Meanwhile, depression and anxiety are high correlated: depression may include anxiety symptom, and anxiety also has some symptoms of depression. Current researches seldom take the overlap symptoms of depression and anxiety into account when investigating the effects of depression and anxiety on suicide, and they mainly focus

* Corresponding author.

E-mail address: lef@cdc.zj.cn (L. Fang).

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on the depression and anxiety disorders. In this study, the authors try to explore the combined effects of depression and anxiety symptoms on suicide and give full consideration of their symptom overlap.

2. Methods

2.1. Participants

A total of 392 suicide cases aged 15–34 years were consecutively sampled, and 416 community living controls were recruited during October 2005 through June 2008. Samples were selected from sixteen rural counties in three provinces in China (6 from Liaoning, 5 from Hunan, and 5 from Shandong). We used the 2005 census database of the 16 counties to randomly select a living control in the same age range (i.e., 15–34 years) and county of residence for each suicide case. Liaoning is an industrial province in Northeast China, Hunan is an agricultural province located in the Central South China, and Shandong is a province with economic prosperity in both industry and agriculture which is located on the east coast of China.

Psychological autopsy was used to collect the information of suicide cases and community living controls. For each suicide or control, two informants were interviewed, with the first one being a family member and the second one a friend or neighbor. Informants were first reached by local village doctor or cadre by a personal visit. Upon their agreement, the interview time was scheduled between two and six months after the suicide death. Interviews with informants regarding controls were scheduled as soon as the control targets and their informants were identified. Each informant was interviewed separately by one trained investigator, in a private room of the health agency or the informant's home. The average time for each interview was about 2.5 h.

The study protocol was approved by Research Ethical Committees of State University of New York Buffalo State in United States and collaborating universities in the three provinces in China where the data were collected. Informed consent was obtained from each of the proxy information interviewees, as well as the controls themselves.

2.2. Measurements

The case–control status was the dependent variable, with suicide coded as 1 and control as 0. Besides depression and anxiety, predicting variables included gender, age, marital status, education, employment, religious belief, average annual income per head, physical health, family suicide history, social support and negative life events. Both age and education were measured by the number of years. Average annual per head income was measured with Chinese Renminbi (RMB) with Yuan as its unit, and the exchange rate at the time of data collection was \$1.00–7.00 RMB Yuan. Marital status was dichotomized as '0 = single, divorced or widowed' and '1 = Married or cohabitated'. Employment, religious belief and family suicide history were dichotomized as '0 = no' and '1 = yes'. Physical health was measured at five levels: very poor, poor, common, good, very good, and combined into three groups during data analysis because of limited case number.

Depression was measured by 24-item Hamilton Depression Rating Scale, and could be divided by seven dimensions: anxiety/somatization, weight loss, cognitive disturbance, diurnal variation, retardation, sleep disorder, helplessness (Hamilton, 1967). Anxiety was estimated by the Spielberger's Trait-Anxiety Inventory (STAI) scale which has 20 items and each of them was assessed by 4 choices from 1 (never) to 4 (always), and was composed by anxiety and depression dimensions (Bieling et al., 1998; Spielberger, 1983). The Chinese version of STAI has been tested and demonstrated a good validation in general Chinese populations (Zhang et al., 2012). The cut-off point for depression is 8 (Hamilton, 1967), while the cut-off score for anxiety is 42 which was the median score of the Trait-Anxiety Inventory among the control group in this study. For those subjects lower than cut-off score of depression or anxiety, they were defined as low depression or anxiety,

otherwise they were defined as high depression or anxiety.

Social support was measured by the Duke Social Support Index (DSSI) and the Chinese version of the scale had been validated in the earlier study (Landerman et al., 1989; Zhang et al., 2012). The life event questionnaire was developed on the Paykel's Interview for Recent Life Events with some modifications and additions by the current research team in an earlier study with the data in Liaoning Province of China. There were 44 items in Paykel's Interview for Recent Life Events. We added 19 items in consideration of the physical, psychological characteristics of 15–34 years old people in rural China. The results of pilot study showed that the modified life event questionnaire had high reliability and validity scores (Paykel et al., 1971; Zhang and Norvilitis, 2002). The occurrence of recent life events during the last one year preceding suicide was ascertained through a list of 64 structured questions on different aspects of adult life.

2.3. Statistical analyses

Chi-square test, Mann–Whitney *U* test and *t*-test were used to compare demographic variables, depression, anxiety and other confounding factors between suicide cases and community living controls. Unconditional logistic regression models were employed to explore the effect of depression and anxiety on suicide. For the adjusted OR analyses, confounding variables including education, marital status, family suicide history, social support and negative life events were controlled, and their interactions were also analyzed.

3. Results

For gender, employment and religious belief, there were no differences between suicide and control groups. Average age of suicide cases was 26.86 years old, elder than community controls. The proportion of single, divorced and widowed among suicide cases was 44.9%, higher than its proportion (35.6%) in controls. Suicide cases had less education (7.38 vs 9.14 years), less annual per head income (3892 vs 5486 RMB), more suicide history (22.1% vs 3.6%), poor health proportion (22.4% vs 4.6%), less social support (29.79 vs 37.04), and more negative life events (3.38 vs 1.10), compared to controls. See Table 1.

As Table 2 shown, scores of depression (15.53 vs 0.36) and anxiety (49.75 vs 42.05) among suicide cases were higher than community controls', as well as their dimensions (All $P < 0.001$). Compared with subjects with low depression and low anxiety, people with low depression and high anxiety, with high depression and low anxiety, with high depression and high anxiety were at 2.69, 82.16, 152.59 times more risk for suicide (All $P < 0.001$), see Table 3.

Multiple logistic regression model showed that OR values (95%CI) for depression and anxiety were 24.82 (10.04–61.38), 2.39 (1.38–4.13), see Table 4. The results also showed that family suicide history and negative life events were risk factors with OR values at 4.89 and 1.45 respectively. Better education and marital status of married (or cohabitated) were demonstrated as protective factors, and their OR values were 0.78 and 0.51. After controlling the effects of education, marital status, family suicide history, social support and negative life events, people with low depression and high anxiety, with high depression and low anxiety, with high depression and high anxiety were at 2.46, 26.32, 54.77 times more risk for suicide, compared with subjects with low depression and low anxiety. For seven dimensions of depression and two dimensions of anxiety, there were only three dimensions including cognitive disturbance, helplessness and STAI-anxiety dimension remained the model when the above five confounding factors were entered.

4. Discussion

Our study adds the understanding about the combined effects of depression and anxiety symptoms on suicide. People with high

Table 1
Characteristics comparison between suicide and control groups.

	Suicide (n = 392)	Control (n = 416)	t / χ^2	df	P
Gender^a			2.94	1	0.086
Male	214 (54.6)	202 (48.6)			
Female	178 (45.4)	214 (51.4)			
Age	26.86 (6.32)	25.69 (6.16)	2.66	806	0.008
Education	7.38 (2.77)	9.14 (2.40)	-9.65	801	<0.001
Marital status^a			7.30	1	0.007
Single, divorced or widowed	176 (44.9)	148 (35.6)			
Married or cohabitated	216 (55.1)	268 (64.4)			
Employment status^a			0.36	1	0.549
Employed	257 (66.1)	275 (38.1)			
Unemployed	132 (33.9)	129 (31.9)			
Average annual per head income	3892(5005)	5486 (6764)	-3.69	754	<0.001
Religious belief^a	31 (7.9)	24 (5.8)	1.44	1	0.231
Physical health^a			59.40	2	<0.001
Poor	88 (22.4)	19 (4.6)			
Average	78 (19.9)	79 (19.0)			
Good	226 (57.7)	318 (76.4)			
Family suicide history^a	86 (22.1)	15 (3.6)	62.48	1	<0.001
Social support	29.79 (6.04)	37.04 (4.41)	-17.94	696	<0.001
Negative life events	3.38 (2.41)	1.10 (1.45)	16.67	806	<0.001

^a Data were presented in the form of 'n (%)', while others expressed as 'mean (SD)'.

Table 2
Depression and anxiety comparison between suicide and control groups.

	Suicide (n = 392)	Control (n = 416)	Z ^a	P
Depression	15.53(14.37)	0.36(1.51)	21.85	<0.001
Anxiety/Somatization	1.98(2.88)	0.07(0.37)	14.91	<0.001
Weight loss	0.43(0.81)	0.01(0.12)	10.50	<0.001
Cognitive disturbance	3.88(3.26)	0.05(0.36)	21.27	<0.001
Diurnal variation	0.21(0.58)	0.01(0.05)	7.26	<0.001
Retardation	3.58(3.55)	0.12(0.66)	18.46	<0.001
Sleep disorder	1.13(1.93)	0.04(0.30)	11.79	<0.001
Helplessness	4.17(4.04)	0.06(0.37)	18.12	<0.001
STAI-anxiety	49.75(7.45)	42.05(4.45)	15.07	<0.001
Anxiety dimension	17.04(4.36)	12.96(2.70)	13.96	<0.001
Depression dimension	32.73(3.84)	20.09(2.59)	13.68	<0.001

^a Because of non-normal distributions, Mann-Whitney U test was used.

depression and high anxiety was 54.77 times more risk for suicide, much higher the suicide risk of people with either high anxiety (2.46) or high depression (26.32). The combined effects of depression and anxiety showed higher risk than their addition risk (2.46 + 26.32 = 28.78), but lower than their multiple effects (2.46 × 26.32 = 64.75). It indicated there might be overlap effect of depression and anxiety. From the dimensions and items of depression

Table 3
Combined effects of depression and anxiety on suicide.

	Suicide (n = 374)	Control (n = 414)	χ^2	df	P	OR	P
Dep⁻Anx⁻	37 (9.9%)	190 (45.9%)	335.4	3	<0.001	Reference	
Dep⁻Anx⁺	113 (30.2%)	216 (52.2%)				2.69	<0.001
Dep⁺Anx⁻	16 (4.3%)	1 (0.2%)				82.16	<0.001
Dep⁺Anx⁺	208 (55.6%)	7 (1.7%)				152.59	<0.001

and anxiety measurements, similar symptoms were also found, such as anxiety/somatization dimension in depression and STAI-anxiety dimension in anxiety, and this might be the reason why overlap effect exists. Just as Clark and Watson argued, depression and anxiety share a significant nonspecific component that encompasses general affective distress and other common symptoms (Pfeiffer et al., 2009). The multiple analyses for the nine dimensions of depression and anxiety showed that only cognitive disturbance and helplessness dimension in depression and STAI-anxiety dimension in anxiety remained effective, and anxiety/somatization dimension in depression and STAI-depression dimension in anxiety were excluded in the model. Although depression and anxiety overlap in some dimension, they could not replace each other, and our results indicated that the combined effects of depression and anxiety might be characterized by three dimensions: cognitive disturbance, helplessness and STAI-anxiety dimension. Above results indicated that combined effects of depression and anxiety should not be ignored during suicide risk assessment. Meanwhile, the effects of anxiety dimension of depression and depression dimension of anxiety must be cautiously evaluated, avoiding overlapping inclusion. So it is critical to develop a measurement to evaluate depression and anxiety simultaneously without symptom overlap.

In this study, depression symptom for suicide was 24.82, lower than the risk of mood disorder (30.54) in Li's meta-analysis (Li et al., 2012). It indicated that depression symptom/mood which may not meet depression disorder criteria had lower suicide risk than depression disorder. Pfeiffer's study showed that generalized anxiety disorder had 1.27 times more risk than others without anxiety among depressed veterans, and its risk was lower than the anxiety effect (2.39) in this study. However, Bentley's meta-analytic review indicated there is no significant contribution of anxiety to death by suicide. This statement remains controversial and needs to be confirmed in larger samples.

We used living residents as controls, other than dead controls due to other reasons. The great advantage was avoiding underestimate the effects of mental disorder and psychical disease for suicide, because prevalence rates of mental disorders (such as substance addiction) or psychical diseases of people died by other reasons were usually higher than living residents (if a control group with higher mental disorders was selected, the effect of mental disorder would be undervalued). However, the existence of living controls might have potential impact on the information providing of their informants, and it would cause reporting bias between the informants of living controls and suicide cases. There were several limitations that should be addressed when interpreting these results. First, the information of the subjects was collected by psychological autopsy, and it may bias the inner feeling of the subjects sometime, although it is unavoidable. Second, the anxiety was measured by trait anxiety, not state anxiety or anxiety symptom, and it was a little different from depression symptom in nature. Despite these limitations, the study helps us to understand the combined effects of depression and anxiety, and implies a better way to evaluate their risk factors. It also told us the most important dimensions of depression for suicide were cognitive disturbance and helplessness, which pointed out the key work for suicide screening, prevention and depression treatment.

Table 4
Multiple logistic regression models assessing the effects of depression and anxiety on suicide.

	OR (95%CI)	Adjusted OR ₁ (95%CI) ^a	Adjusted OR ₂ (95%CI) ^{a,b}
Education	0.78(0.69–0.86)	–	–
Marital status			
Single, divorced or widowed	Reference	–	–
Married or cohabitated	0.51(0.31–0.85)	–	–
Family suicide history	4.89(1.82–13.12)	–	–
Social support	0.88(0.84–0.93)	–	–
Negative life events	1.45(1.26–1.68)	–	–
Depression	24.82(10.04–61.38)	–	–
STAI-anxiety	2.39(1.38–4.13)	–	–
Dep⁻Anx⁻	–	Reference	–
Dep⁻Anx⁺	–	2.46(1.41–4.28)	–
Dep⁺Anx⁻	–	26.32(2.71–254.98)	–
Dep⁺Anx⁺	–	54.77(20.52–146.11)	–
Depression			
Cognitive disturbance	–	–	3.14(2.17–4.53)
Helplessness	–	–	1.62(1.14–2.32)
STAI-anxiety			
Anxiety dimension	–	–	1.12(1.02–1.25)

^a For adjusted OR₁ and OR₂, confounding variables including education, marital status, family suicide history, social support and negative life events were controlled during the multiple logistic regression analyses.

^b Besides adjusted OR₂ modeling, we also conducted another modeling to explore the combined effects of cognitive disturbance, helplessness and anxiety dimension with multiplicative interaction. But these interactions failed to enter the model.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2018.11.010](https://doi.org/10.1016/j.psychres.2018.11.010).

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