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Negative life events as triggers on suicide attempt in rural China: a case-crossover study

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ABSTRACT

This study aims to investigate the potential triggering of negative life events (NLEs) on suicide attempt in rural China. A case-crossover design was used to study 1200 suicide attempters aged 15–70 years. NLEs were assessed by a modification of Paykel's Interview for Recent Life Events. NLEs had significant triggering effects on the day of and month of suicide attempt. Marriage/love, family/home, and friend/relationship were the types of NLEs found to trigger suicide attempt when occurring on the day and month of suicide attempt. Specifically, increased risk of suicide attempt was associated with quarreling with a partner or family member on the day and month of suicide attempt. Being disappointed in a love affair, fighting with a partner, family poverty and loss of face during the month of attempts were linked to increase odds of suicide attempt. Further, when month of suicide attempt was assigned as the case period, the impact of NLEs on suicide attempt was greater among those who were younger and without mental disorders. These findings provide knowledge of the triggering of NLEs on suicide attempt, especially among the young and those without mental disorders. Further, family conflicts should be a greater focus of attention in suicide prevention.

1. Introduction

Each suicide is a personal tragedy and has a lasting effect on families, friends, and communities (World Health Organization, 2014). Although the suicide rate in China (9.8/100,000, 2009–2011) is lower than that worldwide (11.4/100,000) (Wang et al., 2014; World Health Organization, 2014), the rate in rural areas (8.58/100,000, 2012) is considerably higher than in urban areas (4.82/100,000, 2012) (China MOH, 2013). In China, suicide is the 10th leading cause of death in term of potential years of life lost (PYLL) and accounts for 3.06% of all PYLL, although the impact of suicide on PYLL in rural areas is approximately two-fold higher than in urban areas (Sun and Zhang, 2015). Understanding the potential predictors of suicide is complicated as a number of social, psychological, cultural, and other personal factors (such as sleep problems (Liu, 2004; Pompili et al., 2013)) can interact to lead a person to suicidal behavior (World Health Organization, 2014). However, a great deal of evidence has shown that previous suicide attempt is the single greatest risk factor for suicidal

behavior (Phillips et al., 2002; Spirito and Esposito-Smythers, 2006; World Health Organization, 2014). As such, identifying factors that elevate the risk of suicide attempt should be a necessary component in suicide prevention efforts.

A number of personal and situational factors have been previously linked with suicide attempt and suicide behaviors. For example, previous research has found lower rates of mental disorders among Chinese suicides (Phillips et al., 2002; Zhang et al., 2010) and suicide attempters (Liu et al., 2018b; Tong et al., 2016). Similarly, negative life events (NLEs) may also play a non-negligible role in suicidal behavior in China. The NLEs that have been linked with suicide in studies worldwide include death of relatives (Mogensen et al., 2016; Qin and Mortensen, 2003), interpersonal conflict with intimate partners, relatives or friends (Cooper et al., 2002; Foster, 2011; Phillips et al., 2002), health problems (Li et al., 2008; Zhang and Ma, 2012), poverty (Li et al., 2008), forensic events (being charged/arrested) (Cooper et al., 2002), and marital problems (Fjeldsted et al., 2017; Zhang and Ma, 2012). Accordingly, using national suicide data from China, Phillips

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et al. verified that chronic and acute stress were indeed significant risk factors of suicidal behavior (Phillips et al., 2002). In a similar respect, interpersonal conflict (Bagge et al., 2013a; Conner et al., 2012; Li et al., 2008; Liu and Zhang, 2018; Wang et al., 2015; Weyrauch et al., 2001; Zhang et al., 2015), poverty (Wang et al., 2015; Zhang et al., 2015), health problems (Li et al., 2008; Zhang et al., 2015), marital problems (Yen et al., 2005), crime (Yen et al., 2005) and loss of face (Liu and Zhang, 2018) represent NLEs linked with suicide attempt. In fact, some studies have demonstrated the sufficiency of NLEs alone in predicting suicide attempt (Kar, 2010; Liu et al., 2018a; Zhang et al., 2015). For example, a study in rural China found a strong dose-response relationship between suicide attempt and NLEs, with a 7 fold increase among those with 1 or 2 NLEs and an 11 fold increase among those with 3 or more NLEs compared to controls (Zhang et al., 2015). This line of research supports the importance of further evaluating the impact of NLEs on suicide attempt.

The time period between NLEs and subsequent suicide attempt is also a crucial element in understanding the nature of their relationship. While many studies have shown a link between NLEs and increased risk of suicidal behavior, the time period has ranged from one day to one year (Bagge et al., 2013a; Cooper et al., 2002; Yen et al., 2005; Zhang and Ma, 2012; Zhang et al., 2015), with most focusing their evaluation over a one year time period prior to suicide or suicide attempt (Liu et al., 2016; Phillips et al., 2002; Zhang et al., 2010). However, some researchers have argued that greater emphasis should be placed on more proximal NLEs, such as the most recent month, week, or day (Bagge et al., 2013a; Yen et al., 2005), to the extent that these may be most prominent, memorable, and current. For example, when focusing on the death of close relatives, the highest odds ratio (OR) of suicide was found within the first week (Mogensen et al., 2016). Similarly, Cooper et al. reported that suicide was associated with NLEs in the previous three months, especially the first week (Cooper et al., 2002), while others have found increased risk of suicide attempt among those experiencing NLEs within the previous month (Yen et al., 2005; Zhang et al., 2015) and the previous 1–6 month time frame (Pompili et al., 2011; Srivastava et al., 2004). In this respect, greater research is needed to explore more immediate time periods between different types of NLEs and suicide attempt, and as such we have chosen to focus on one day and one month from the suicide attempt.

To our knowledge, there are few studies to explore the potential triggering of NLEs on suicide attempt. Using data from suicide attempters in rural China, the main aims of this study are to: (1) explore the triggering of NLEs on suicide attempt; (2) investigate the risk of suicide attempt associated with various types and items of NLEs experienced on the day of and month of attempt; and (3) determine if sex, age, mental disorder, suicide intent, and history of suicide attempt impact the link between suicide attempt and NLEs. We hypothesize that NLEs do act as a trigger on suicide attempt. Other relationships of the key variables are exploratory in nature.

2. Method

2.1. Case-crossover design

The case-crossover design was proposed by Maclure (1991) to study transient effects on the risk of acute health events (Maclure, 1991). Different from the traditional case-control design, the cases and the controls of case-crossover design come from the same individual. Using a with-subjects technique, the case-crossover design controls many of the confounding between-subject factors, such as gender, age, mental disorders etc. The case-crossover design employs "case period" and "control period" as the case and control respectively. A case period represents the time period right before the disease or event onset while a control period includes any specified time interval other than the case period. This approach has been successfully employed in previous research to study the effect of air pollution (Bakian et al., 2015; Casas

et al., 2017), ambient temperature (Kim et al., 2016), cancer (Lu et al., 2013; Wang et al., 2017), alcohol abuse (Bagge and Borges, 2017; Bagge et al., 2013b; Borges et al., 2017; Ghanbari et al., 2015), and death of relatives (Mogensen et al., 2016) on suicidal behaviors.

In this study, we used the case-crossover design to explore the triggering of negative life events (NLEs) on suicide attempt. In consideration of different experiential periods of unique types or categories of NLEs and based on the research mentioned in the introduction regarding NLE timing, we adopted the day and month of the suicide attempt as case periods and the day and month prior to the suicide, respectively, as the control periods. The day of the suicide attempt was regarded as the first day (case) and the day before the attempt was thus considered as the second day (control). Similarly, the month of the suicide attempt included 30 days from the 1st to 30th day from the attempt (case) while the month before the suicide attempt was counted as the next 30 days from the 31st to 60th day prior to the attempt (control).

2.2. Procedure: recruitment and data collection

Three databases were used in total for the present study and were all collected from samples in rural Shandong Province, China. Shandong is the second largest province by population (97 million people), with more than half (54 million people) living in rural areas. The earliest data set was supported by the Natural Science Foundation of China (NSFC) and included data collected in six rural counties (Junan, Lijin, Ningyang, Penglai, Tengzhou, Zoucheng). In total, information from 409 suicide attempters aged 15–70 years was consecutively collected from October 2009 to March 2011 in this data set. The second data set was supported by the US National Institute of Mental Health and included data from eight rural counties (Longkou, Chengwu, Dongming, Dong'e, Gaotang, Juancheng, Junan, Shenxian, Zoucheng). Here, data from 659 suicide attempters aged 15–50 years was consecutively collected from January 2012 to June 2013. The latest data set was supported by the Natural Science Foundation of China (NSFC) and the Shandong Scientific Development Plan and was carried out in five rural counties (Junan, Zhangqiu, Xintai, Zoucheng, Yishui). In total, data from 132 suicide attempters aged 15–50 years was consecutively collected from January 2014 to June 2015 in this data set. The populations used in this study, which only included suicide attempters, were also used as case groups of previous case-control studies to explore the associations between negative life events and suicide attempt (Liu and Zhang, 2018; Zhang et al., 2015).

Among these data sets, the sixteen distinct rural counties were randomly selected from various disease surveillance points (DSPs). The information regarding suicide attempt was recorded by the emergency departments from local county-level hospitals and collected by county-level Centers for Disease Prevention and Controls (CDCs). Suicide attempt is defined as a self-inflicted, potentially injurious behavior with a nonfatal outcome for which there is evidence (either explicit or implicit) of intent to die (Silverman et al., 2007). The interviews were conducted usually one month after the suicide attempt at local village clinics or in the homes of the suicide attempters themselves. If the targeted suicide attempters were not available, close proxy informants were interviewed, which has been found in previous research to represent a good alternative to information from the attempter themselves (Zhang et al., 2003). Totally, 78.6% (943/1200) of the interviews were self-reported, 14.7% (176/1200) by close relatives, and 6.7% (81/1200) by other sources (such as friends, neighbors and doctors of clinics). In addition, important information for every case (including suicidal behavior, reasons for suicide attempt) was also solicited from doctors of clinics in the respective villages to get better quality of data.

For each subject, a structured questionnaire was used to carry out the interview. All interview data was collected by trained medical postgraduates from School of Public Health and each interview lasted 1.5 h on average. These interviewers received systematic training in

interviewing skills and data collection (Zhang et al., 2015). Prior to each interview, informed consent was obtained without any incentive, force, or coercion. This study was approved by the Ethics Committee of the Shandong University School of Public Health and the institutional review board of the American institution where the principal researcher is affiliated.

2.3. Instruments

2.3.1. Demographic information and characteristics of suicide attempt behaviors

Demographic information in this study included gender and age of suicide attempters. We separated age into three groups: youth (15–24 years old), young adults (25–50 years old), and older adults (51–70 years old). These groupings were chosen because they represented a basic yet common set of age categories, where individuals in each group would share common life experiences. We also collected information regarding history of suicide attempt (yes or no) and suicide intent. The Chinese version of the shortened Suicide Intent Scale (Zhang and Jia, 2011, 2007), developed from Beck's Suicide Intent Scale (SIS) (Beck et al., 1974), was used to assess the suicide intent in Chinese culture. This version has been previously proven to have relatively good validity and reliability in Chinese suicide research (Zhang and Jia, 2011; Zhang and Jia, 2007). The Chinese version of the shorten suicide intent scale included the first 8 items of the larger scale, which were each scored on a 3-point scales (0, 1, 2). The total score of this version of the SIS ranged from 0 to 16, while a median split was used to distinguish attempters as either high intent and low intent (Liu et al., 2017). For this study, the split occurred at a score of 4 (i.e. high suicide intent: SIS > 4, low suicide intent: SIS ≤ 4).

2.3.2. Diagnosis of mental disorders

The Structured Clinical Interview for the DSM-IV Axis I Disorders (First et al., 2002) was used to assess mental disorders which mainly included mood disorders, psychotic disorders, substance use disorders, and anxiety disorders in this study. The Chinese SCID has shown satisfactory psychometric properties and is widely used in suicide research in China (Liu et al., 2018b; Phillips et al., 2002; Zhang et al., 2010). The data of SCID were collected by the interviewers. A senior psychiatrist who works at the mental health center reviewed the data and helped with diagnosing the disorders when we finished the interview of every county.

2.3.3. Negative life events (NLEs)

The Life Event Questionnaire was developed from Paykel's Interview for Recent Life Events (IRLE) (Paykel et al., 1971). For the present study, 19 items were added while slight modifications were made to other items in consideration of Chinese cultural concerns. The final 64 items were categorized into 6 types: (1) Marriage/Love [14 items], (2) Family/Home [18 items], (3) Work/Business [10 items], (4) Health/Hospital [13 items], (5) Law/Legal [4 items], and (6) Friend/Relationship [5 items]. There were six common questions for each life event item that were focused over the past year prior to the suicide attempt: (1) occurrence (yes or no), (2) time of occurrence prior to the suicide attempt (recording the specific time interval by day), (3) frequency, (4) nature (good or bad life event), (5) degree of influence on mental status (from no impact to very severe impact), and (6) the duration of the event. For interpretation, any positive life event, items with no impact on mental status, and events occurring beyond the month of the attempt were excluded. Finally, subjects with more than one life event in any one type, were counted only once for that category. Previous studies have shown this approach to measuring NLEs to have high reliability and validity in Chinese samples (Zhang et al., 2003) and thus has been widely used in Chinese research (Liu et al., 2016; Liu and Zhang, 2018; Zhang et al., 2015).

2.4. Statistical analysis

STATA version 13.1 (Stata Corporation, College Station, TX, USA) was used for statistical analyses and creation of figures. Quantitative data was described including mean ± SD, and categorical data included sample size and proportions. Univariate conditional logistic regression models were used to examine the associations between any NLEs and suicide attempt. Multivariate conditional logistic regression models were used to examine the associations between types/items of NLEs and suicide attempt. Stratified conditional logistic regression models were used to assess the triggering of NLEs on risk of suicide attempt among variables of interest. Furthermore, full conditional logistic regression models and interaction analyses were used to test the differences in the impact of age, gender, mental disorders, suicide intent, and history of suicide attempt on the link between NLEs and suicide attempt. All reported probabilities (*P*-value) were two-sided, and *P* < 0.05 was considered statistically significant.

3. Results

3.1. Demographic information, psychiatric and suicidal characteristics of suicide attempters

In total this study included response data from 1200 suicide attempters (430 males and 770 females). The distribution of age was 15.6% youth (15–24 years), 73.4% young adults (25–50 years), and 11.0% older adults (51–70 years). 60.7% (*n* = 728) of suicide attempters reported low suicide intent and 9.1% (*n* = 109) had a previous history of suicide attempt. According to the SCID, 25.8% (*n* = 309) of suicide attempters met the criteria for at least one type of mental disorders, including 18.2% with mood disorders, 6.0% with substance abuse disorders, 4.7% with psychotic disorders, and 3.5% with anxiety disorders. More details can be found in Table 1.

3.2. Triggering of NLEs on the day of suicide attempt

Across the total data set, the rate of any NLE happening on the day of suicide attempt was 25.9%. The proportions experiencing various categories of different NLEs were: marriage/love (15.8%), family/home (9.3%), friend/relationship (1.9%), and work/business (0.3%). In specific, the most commonly experienced single NLEs on the day of the suicide attempt included quarreling with a partner (14.2%), quarreling

Table 1
Demographic, psychological, and suicidal characteristics of suicide attempters (*n* = 1200).

Variables	<i>n</i>	%
Gender		
male	430	35.8
female	770	64.2
Age		
15–24 years old	187	15.6
25–50 years old	881	73.4
51–70 years old	132	11.0
Mental disorders (MD)^a	309	25.8
Mood disorders	218	18.2
Psychotic disorders	56	4.7
Substance use disorders	72	6.0
Anxiety disorders	42	3.5
Suicide intent (SI)		
Low SI	728	60.7
High SI	472	39.3
History of suicide attempt (HSA)		
Yes	109	9.1
No	1091	90.9

^a The number of suicide attempters was less than the sum of all kinds of mental disorders because of comorbid diseases existed in this database.

Table 2
Triggering of negative life events (NLEs) on suicide attempt: univariate conditional logistic regression.

NLEs	Day		cOR (95%CI) ^b	Month		cOR (95%CI) ^b
	1st day N (%)	2nd day N (%)		1st month N (%)	2nd month N (%)	
Any NLE	311 (25.9)	62 (5.9)	5.02 (3.82–6.59)***	563 (46.9)	75 (6.3)	9.87 (7.48–13.03)***
Types of NLEs						
Marriage/Love	189 (15.8)	46 (3.8)	4.11 (2.98–5.67)***	344 (28.7)	23 (1.9)	21.06 (12.76–34.78)***
Family/home	111 (9.3)	19 (1.6)	5.84 (3.59–9.50)***	185 (15.4)	20 (1.7)	9.68 (6.04–15.53)***
Work/business	3 (0.3)	0	–	19 (1.6)	8 (0.7)	2.38 (1.04–5.43)*
Health/hospital	0	0	–	40 (3.3)	26 (2.2)	1.56 (0.94–2.58)
Law/legal	0	0	–	2 (0.2)	1 (0.1)	2.00 (0.18–22.06)
Friend/relationship	23 (1.9)	1 (0.1)	23.00 (3.11–170.31)**	49 (4.1)	8 (0.7)	6.13 (2.90–12.93)***
Items of NLEs^a						
3.Disappointed in love affair	3 (0.3)	1 (0.1)	3.00 (0.31–28.84)	12 (1.0)	1 (0.1)	12.00 (1.56–92.29)*
11.Quarreling with partner	170 (14.2)	41 (3.4)	4.15 (2.95–5.83)***	298 (24.8)	12 (1.0)	24.83 (13.95–44.22)***
12.Fighting with partner	28 (2.3)	5 (0.4)	5.60 (2.16–14.50)***	48 (4.0)	4 (0.3)	12.00 (4.33–33.28)***
13.Physically abused	13 (1.1)	0	–	16 (1.3)	1 (0.1)	16.00 (2.12–120.65)**
18.Quarreling with family members	96 (8.0)	18 (1.5)	5.33 (3.22–8.82)***	144 (12.0)	10 (0.8)	14.40 (7.59–27.34)***
19.Fighting with family members	15 (1.3)	1 (0.1)	15.00 (1.98–113.56)**	22 (0.9)	0	–
21.Family poverty	0	0	–	9 (0.8)	1 (0.1)	9.00 (1.14–71.04)*
23.In discord with spouse's mother	7 (0.6)	3 (0.3)	2.33 (0.60–9.02)	13 (1.1)	1 (0.1)	13.00 (1.70–99.38)*
47.Life-threatening illness parents/spouse/children	0	0	–	11 (0.9)	2 (0.2)	5.50 (1.22–24.81)*
61.Face loss	13 (1.1)	0	–	26 (2.2)	3 (0.3)	8.67 (2.62–28.63)***

Note: Marriage/love: item 1–14, family/home: item 15–32, work/business: item 33–42, health/hospital: item 43–55, law/legal: item 56–59, friend/relationship: item 60–64.

SA = suicide attempt, NLEs = negative life events, OR = odds ratio, CI = confidence interval, cOR = crude OR.

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

^a Only significant items of negative life events statistically were listed in the table.

^b Crude ORs could not be calculated because of inclusion of a zero cell.

with family members (8.0%), and fighting with a partner (2.3%).

Based on the univariate conditional logistic regression, it was found that on the day of suicide attempt, NLEs were an important trigger on suicide attempt with a crude odds ratio (OR) of 5.02 (95% CI: 3.82–6.59). Further, after adjusting for mutual types, three categories of NLEs were found to be significant using multiple conditional regression models: marriage/love (Adjusted OR, 95% CI: 3.87, 2.80–5.35), family/home (Adjusted OR, 95% CI: 5.06, 3.10–8.28), and friend/relationship (Adjusted OR, 95% CI: 17.05, 2.34–130.90). Finally, four specific NLE items were also found to be significant. After adjusting for mutual items, quarreling with a partner (Adjusted OR, 95% CI: 3.75, 2.66–5.30), fighting with a partner (Adjusted OR, 95% CI: 2.59, 0.96–7.04), quarreling with family (Adjusted OR, 95% CI: 4.45, 2.67–7.42), and fighting with family (Adjusted OR, 95% CI: 7.48, 0.95–58.83) were related to suicide attempt. More details are presented in Table 2 and Fig. 1.

3.3. Triggering of NLEs on the month of suicide attempt

The rate of any NLE happening on the month of suicide attempt was 46.9%. The rates of different types of NLEs on the month of suicide attempt were: marriage/love (28.7%), family/home (15.4%), friend/relationship (4.1%), health/hospital (3.3%), work/business (1.6%), law/legal (0.2%). The three most frequent individual NLE items on the month of suicide attempt were quarreling with a partner (24.8%), quarreling with family (12.0%), and fighting with a partner (4.0%).

On the month of suicide attempt, univariate conditional logistic regression showed that NLEs were found to be a significant trigger on suicide attempt with a crude OR of 9.87 (95% CI: 7.48–13.03). Four categories of NLEs were found to be significant in the model after adjusting for mutual types: marriage/love (Adjusted OR, 95% CI: 20.11, 12.13–33.36), family/home (Adjusted OR, 95% CI: 8.46, 5.18–13.82), work/business (Adjusted OR, 95% CI: 1.51, 0.57–4.00), and friend/relationship (Adjusted OR, 95% CI: 5.63, 2.47–12.85). Further, after adjusting for mutual items, nine individual NLEs experienced during

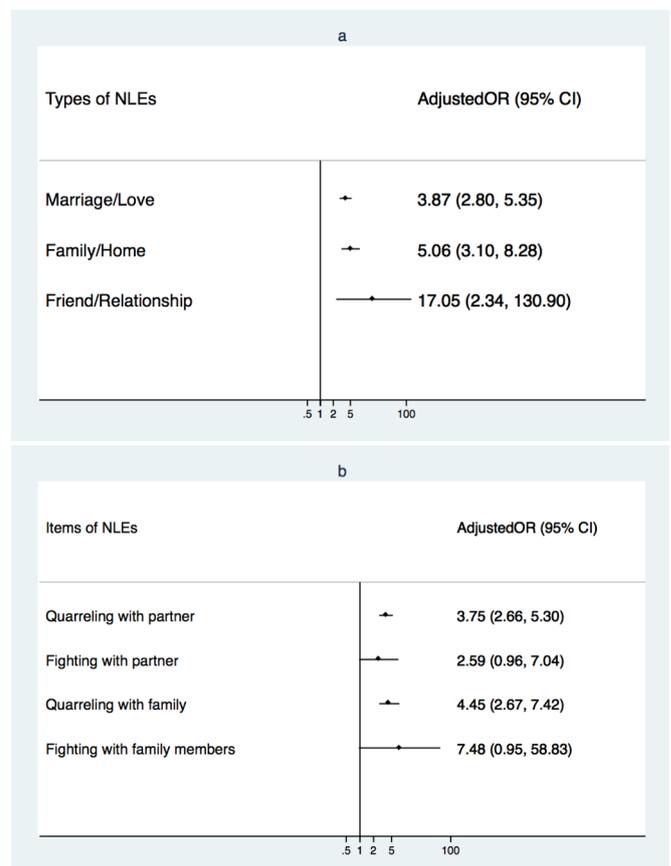


Fig. 1. Adjusted ORs and their 95% CIs of suicide attempt associated with NLEs on the day of suicide attempt. a, types of NLEs; b, items of NLEs. Mutual adjustment of NLEs was used to assess the associations between types/items of NLEs and suicide attempt.

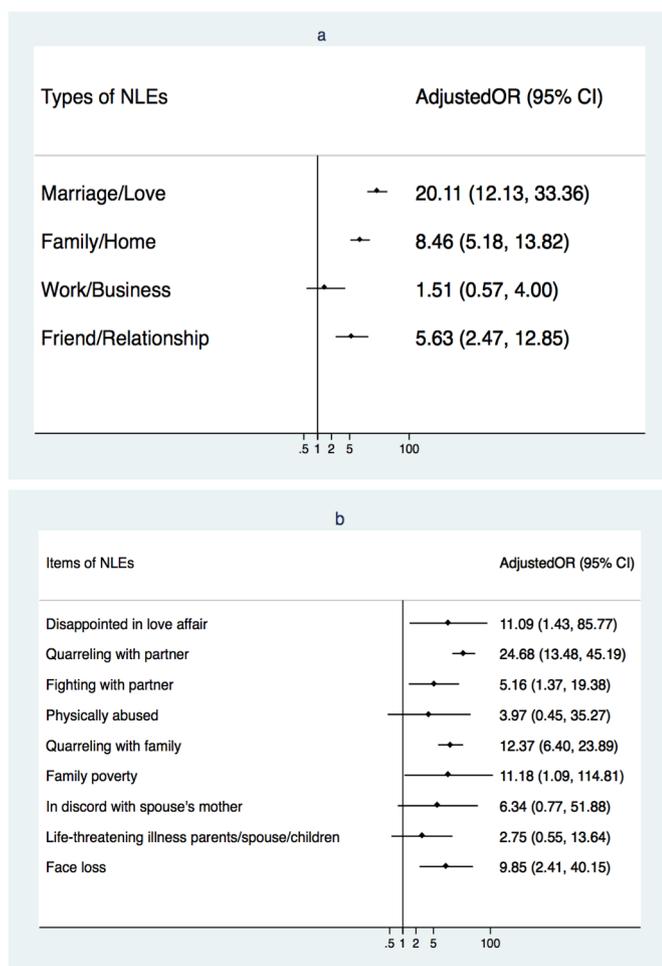


Fig. 2. Adjusted ORs and 95% CIs of suicide attempt associated with NLEs on the month of suicide attempt. a, types of NLEs; b, items of NLEs. Mutual adjustment of NLEs was used to assess the associations between types/items of NLEs and suicide attempt.

the month were linked to suicide attempt: disappointment in a love affair (Adjusted OR, 95% CI: 11.09, 1.43–85.77), quarreling with a partner (Adjusted OR, 95% CI: 24.68, 13.48–45.19), fighting with a partner (Adjusted OR, 95% CI: 5.16, 1.37–19.38), quarreling with family members (Adjusted OR, 95% CI: 12.37, 6.40–23.89), discord with spouse's mother (Adjusted OR, 95% CI: 6.34, 0.77–51.88), family poverty (Adjusted OR, 95% CI: 11.18, 1.09–114.81), life threatening illness to parent/spouse/children (Adjusted OR, 95% CI: 2.75, 0.55–13.64), being physically abused (Adjusted OR, 95% CI: 3.97, 0.45–35.27), and loss of face (Adjusted OR, 95% CI: 9.85, 2.41–40.15). Greater details are presented in Table 2 and Fig. 2.

3.4. Comparison of NLEs impact on suicide attempt across demographic and psychological factors and history of suicide attempt

Using a full conditional logistic regression approach, a further evaluation was conducted to examine the potential influence of demographic, psychological, and history factors on the links between NLEs and suicide attempt. As can be seen in Table 3, while NLEs increased the risk of suicide attempt in every subgroup, when the day of suicide attempt was assigned as the case period, no significant differences in this relationship were found across the target demographic, psychological, or history variables. However, when month of the suicide attempt was assigned as the case period, the ORs for the youth and young adults, as well as those without mental disorders were greater

compared to the older adults and those with mental disorders respectively.

4. Discussion

To our knowledge, this is the largest study on suicide attempters to date in rural China. Using a case-crossover design, this study had several major findings: (1) On the day and month of suicide attempt, NLEs were an important trigger on suicide attempt; (2) Marriage/love, family/home and friend/relationship were the types of NLEs found to trigger suicide attempt both on the day and month of the attempt. In terms of specific NLEs, family conflict was a significant trigger both on the day and month of the attempt, while family poverty and loss of face were also triggers on the month of the attempt; (3) Elevated triggering effects of NLEs were found among younger suicide attempters and those without mental disorders when the month of the attempt was assigned as the case period.

The present findings are consistent with other researches which have demonstrated a significant relationship between interpersonal conflicts and suicide attempt in different cultures (Bagge et al., 2013a; Conner et al., 2012; Li et al., 2008; Liu and Zhang, 2018; Wang et al., 2015; Weyrauch et al., 2001; Zhang et al., 2015). However, different findings related to cultures are that these conflicts were found predominantly within the family in this study and friends (especially romantic partner) in the western study (Bagge et al., 2013a). In fact, the most prominent individual NLE items involved fighting/quarreling with partners and family members in this study. Besides, it is important to note that the odds ratio linking family conflicts with suicide attempt was much greater when occurring on the day, compared to month, of the attempt. In this respect, family conflict appeared to be the most important trigger on suicide attempt in rural China. This would make sense in this context given the importance of family as central to the concept of self in China.

In addition, the present study showed that on the month of the suicide attempt, there were also social and financial triggers of note. Specifically, the risk of suicide attempt increased significantly when there was a loss of face and issues related to family poverty, which is consistent with other researches (Liu and Zhang, 2018; Wang et al., 2015; Zhang et al., 2015). However, we are not sure we can extend these social and financial factors to western culture because of culturally specific. In many cultures, self-esteem is linked to the perceptions that others value the individual and their contribution to society, and that is certainly true in China. Loss of face in this instance could signal that the individual is not valued or respected which may heighten thoughts of suicide as an escape. Similarly, the acute realization of the inability to meet basic financial demands on any specific day may threaten an individual's sense of personal value and suicide may seem a rational means of avoiding current and future burdens linked to their poverty.

It is also noteworthy that the present study showed that the impact of NLEs during the month of suicide attempt was compounded among the younger subjects (particularly youth) and among those without mental disorders. With respect to age, previous research has linked NLEs over the past year to elevate suicide risk to the elderly (Liu et al., 2018a) which suggests that perhaps more distal concerns (e.g. health issues) may be an impact for the elderly in linking NLEs to suicide attempt. But in this study, it was younger subjects who were at greater risk for NLEs to trigger suicide attempt. This suggests that some of the more proximal NLEs are of greater concern for suicide risk at younger ages. Given that family conflicts during both the day and month of a suicide attempt were so prominent in the present study, rural Chinese youth and young adults appear to be most significantly impacted by these types of family issues and may see few alternatives other than suicide. Perhaps effort should be directed towards working with younger individuals on how to deal with such acute life stressors, and on working with families to more effectively deal with conflict at earlier

Table 3

Comparison of the triggering of NLEs across gender, age, mental disorders, suicide intent, and history of suicide attempt.

Variables	1st day/2nd day cOR (95%CI)	Relative effect (OR) ^a	P ^b	1st month/2nd month cOR (95%CI)	Relative effect (OR) ^a	P ^b
Subgroup: gender						
Male	6.75 (3.99–11.41)***	1.53	0.171	8.23 (5.29–12.81)***	0.75	0.321
Female	4.39 (3.19–6.05)***	Ref.		10.97 (7.68–15.67)***	Ref.	
Subgroup: age						
15–24 years old	8.14 (3.71–17.85)***	0.31	0.289	13.00 (6.03–28.04)***	2.93	0.046
25–50 years old	4.20 (3.12–5.66)***	0.16	0.077	10.56 (7.61–14.67)***	2.38	0.033
51–70 years old	26.00 (3.53–191.60)**	Ref.		4.44 (2.16–9.16)***	Ref.	
Subgroup: MD						
Without MD	4.66 (3.46–6.27)***	0.67	0.293	11.60 (8.29–16.22)***	1.83	0.048
With MD	7.00 (3.48–14.07)***	Ref.		6.33 (3.85–10.41)***	Ref.	
Subgroup: SI						
Low SI	4.45 (3.24–6.10)***	0.66	0.195	11.13 (7.75–15.97)***	1.37	0.276
High SI	6.73 (3.92–11.58)***	Ref.		8.13 (5.27–12.54)***	Ref.	
Subgroup: HSA						
Yes	8.50 (1.96–36.79)**	1.74	0.466	5.29 (2.36–11.86)***	0.50	0.116
No	4.88 (3.70–6.45)***	Ref.		10.54 (7.84–14.17)***	Ref.	

Note: MD = mental disorders, SI = suicide intent, HSA = history of suicide attempt, NLE = negative life event, OR = odds ratio, CI = confidence interval, cOR = crude OR.

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

^a Relative effects were calculated by male vs. female, 15–24 years old/25–50 years old vs. 51–70 years old, without MD vs. with MD, low SI vs. high SI, and history of SA vs. no history of SA.

^b P was estimated by the interaction test (age, gender, MD, SI, and HSA*any NLE) in the full model of conditional logistic regression.

stages in relationships – particularly focusing on how to incorporate younger family members in this process.

In regards to those without mental disorders, the current findings are in line somewhat with Bagge et al. who found that there were no effect differences of NLEs on suicide attempt among those with borderline personality disorder or alcohol issues (Bagge et al., 2013a). The current data, however, showed that there was an effect difference of NLEs on suicide attempt among those without mental disorders (Axis I). It should be noted at this point that the implication here not that there is no link between suicide attempt and mental disorders. In fact, numerous studies have note that categorically they can be a strong predictor of suicide and suicide attempt. What the present study is emphasizing is that these disorders do not appear to magnify the impact of NLEs on suicide risk. One likely explanation for this is that those without disorders may be more inclined to recognize, focus on, or prioritize NLEs whereas those with disorders may be more likely to focus solely on the life impact of their disorder than on other NLEs. As such, this does not minimize the importance of treating mental disorders in general but does point to a greater need to educate that suicide has important triggers even among those without mental illnesses.

There are some limitations that should be noted in this study. One is that the case-crossover design is best used when the risks are intermittent, transient, and their effect is immediate (Maclure, 1991). While most of the NLEs used in the present study meet these criteria, in some way's poverty is generally not intermittent and its effects are not always immediate. More specifically, poverty among this population is an enduring hinderance with long standing issues. A similar argument, although to a lesser extent, could be made of family conflict which at times can become normative in some homes, presenting prolonged issues over time. However, there is precedence for using case-crossover designs even when effects of risks are gradual and when at least some elements or symptoms of the risks are intermittent. The latter would be supported here to the extent that there are many specific intermittent events that result from poverty (e.g. in ability to pay a specific bill or purchase something specific in a given day or month) and family conflict (e.g. a specific argument or conflicting moment) that could trigger suicide attempt.

A second, but related issue is that this design does not necessarily “prove causality”. The word “trigger”, however, is used to identify the most proximal events that are present in each individual on the day or

month of a suicide attempt compared to preceding days or months without attempts (Maclure, 1991). So, it provides an examination of unique life factors or events that are temporally closer to the suicide attempt than other things. When these factors then consistently occur across a larger group of individuals the implication is that the suicide attempt would not have happened if individuals had not been exposed to that risk factor immediately before. This provides evidence that, in this case, certain NLEs were the most probable trigger for the suicide events.

Another consideration is that the present study only focused on shorter time periods (day and month). While in one respect this might help to eliminate issues such as recall bias or memory of events present in longer time periods (e.g. a year), in another respect it might prevent the evaluation of some NLEs which are more sporadic and infrequent which may be identifiable when using a one-year time period. Further, using the shorter time period may falsely increase findings of consistency on the day and month given their relative temporal proximity which might be avoided when using longer time differences such as a year and month.

Finally, there were potential self-selection issues in that subjects who were most negatively impacted by their suicide attempt may have refused to participate. Similarly, some others who had attempted suicide were not included in the data because we were unable to locate them after the event or not at home when approached about the interview. Some attempts were made to include information regarding some of these missing subjects by using a family or close friend as a proxy. Even though this has been considered an appropriate alternative (particularly when used for only a small number of cases), the proxy would not be able to answer some questions as fully or accurately as the subject themselves.

Despite these limitations, there are many strengths of the present study. The case-crossover design, as a within-subject method, allows the advantage of controlling for between groups biases typically found in studies utilizing a traditional control group (e.g. age, gender, family structure). Using face-to-face interviews also contributes to the quality of data. In addition, this is the first study to our knowledge that has used a case-crossover design to explore the associations between NLEs and suicide attempt in China. Finally, the large sample size collected over an extensive rural area in China should help ensure greater generalization of findings.

In conclusion, the present study showed that NLEs did play a triggering role on suicide attempt when experienced the day of and month of the attempt. The most prominent NLEs were related to family conflict and to a lesser extent friendship conflicts, and these were most relevant in triggering suicide attempt when encountered the day of the attempt. These risks were increased even further among younger subjects and those without mental disorders when experienced over the previous month. Suicide prevention measures could benefit from providing education and resources for individuals and families to deal with conflict, particularly those that can serve as “crisis” interventions to deal with more extreme NLEs.

CRedit authorship contribution statement

Bao-Peng Liu: Formal analysis, Writing - original draft, Methodology. **Jie Zhang:** Writing - original draft, Conceptualization, Writing - review & editing. **Jie Chu:** Writing - original draft, Conceptualization, Methodology. **Hui-Min Qiu:** Writing - original draft, Methodology. **Cun-Xian Jia:** Formal analysis, Writing - original draft, Writing - review & editing, Conceptualization, Resources. **Dwight A. Hennessy:** Writing - review & editing.

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Competing interests

The authors have declared that no competing interests exist.

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