Journal of Affective Disorders 246 (2019) 166–173

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Prevalence and correlates of suicidal ideation among college students: A mental health survey in Jilin Province, China

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ARTICLE INFO

Keywords:
Suicidal ideation
Prevalence
Risk factors
Mental health

ABSTRACT

Background: The prevention of suicidal ideation plays a key role in reducing suicide rates. This study aimed to determine the prevalence of suicidal ideation among college students in Jilin Province, China, and to analyse the risk factors associated with suicidal ideation.

Methods: A total of 6284 valid data collection sheets were collected using the stratified cluster sampling method. The data collected were divided into four sections, namely, socio-demographic information, family and social interactions, daily habits, and mental health self-rating scales.

Results: The prevalence of suicidal ideation in the past 12 months was 9.2%. A multivariate logistic regression analysis showed that being a senior (OR = 1.769, 95%CI:1.225–2.555), general family relationships (OR = 1.641, 95%CI:1.172–2.298), frequent parental quarrels (OR = 1.398, 95%CI:1.027–1.902)/parental separation (OR = 2.497, 95%CI:1.414–4.408), the level of satisfaction with motherly love (OR = 2.261, 95%CI:1.454–3.515), having only one or two friend(s) (OR = 1.530, 95%CI:1.038–2.254), frequent excursions to bars/ karaoke halls/ song and dance halls (OR = 1.673, 95%CI:1.257–2.229) or billiard halls with friends (OR = 1.865, 95%CI:1.270–2.740), smoking (OR = 2.175, 95%CI:1.603–2.951), moderate sleep quality (OR = 1.636, 95%CI:1.115–2.402), and depressive symptoms (OR = 2.078, 95%CI: 1.710–2.525) were risk factors for suicidal ideation. Family factors had the most influence on suicidal ideation, whereas depression symptoms were identified to be a mediating factor between family, social interactions, or daily habits and suicidal ideation, and it only exerted direct effects.

Limitations: This cross-sectional study cannot provide causal interpretations.

Conclusion: Our findings showed the prevalence of suicidal ideation among college students in Jilin province. Among all the risk factors associated with suicidal ideation, family factors should be the main concern in the prevention of suicidal ideation, and interventions that target depression symptoms are key to reducing suicidal ideation.

1. Introduction

Suicide is a major public health issue worldwide. According to the latest statistics provided by the World Health Organization, nearly 800,000 people commit suicide every year (Parekh, 2014), and suicide is the second leading cause of death worldwide in individuals aged 15–29 years (Arensman et al., 2016), an age group that is increasingly composed of college students (Mortier et al., 2017). In fact, suicide is one of the most common causes of unnatural death among college students and thereby causes tremendous trauma to and places a high burden on the families and society (Chen et al., 2012). College students are thus considered a high-risk group (Miletic et al., 2015). In China, 19% of college student deaths are due to suicide (Phillips et al., 2002), and the suicide rate of Chinese college students is approximately 20 per 10,000 individuals, which is 2- to 4-fold higher than that of the general population (Chen et al., 2008). Therefore, it is imperative to strengthen suicide prevention interventions targeted at college students in China.

Suicide is a continuous behaviour that includes suicidal ideation as well as plans, attempts, and the act of suicide itself (Christine Yuodelis-Flores and Ries, 2015). Suicidal ideation, also known as suicidal thoughts, refers to ideas about ending one's life (Bureau et al., 2012). As the first step toward suicide attempts and the actual act of suicide,

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https://doi.org/10.1016/j.jad.2018.12.055
Received 23 June 2018; Received in revised form 9 November 2018; Accepted 17 December 2018
Available online 19 December 2018
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Table 1
Demographic characteristics and suicidal ideation.

Variables	N	Cr	Suicidal ideation		OR	95%CI	*p*
			n	Pr			
Gender						0.664–0.939	
Male	3310	52.7%	334	10.1%	1.000		
Female	2974	47.3%	242	8.1%	0.789		0.007
School category							0.038
Directly under the Ministry of Education	2842	45.2%	280	9.9%	1.000		
Provincial key	2113	33.6%	166	7.9%	0.780	0.638–0.954	0.015
Provincial general	1329	21.1%	130	9.8%	0.992	0.797–1.235	0.943
Age group						1.105–1.594	0.003
≤20 years old	4550	72.4%	386	8.5%	1.000		
>20 years old	1734	27.6%	190	11.0%	1.327		
Ethnicity						0.982–1.718	0.067
Han	5737	91.3%	514	9.0%	1.000		
Minority	547	8.7%	62	11.3%	1.299		
Year							<0.001
Freshman	2586	41.2%	193	7.5%	1.000		
Sophomore	1966	31.3%	189	9.6%	1.319	1.069–1.627	0.010
Junior	1072	17.1%	106	9.9%	1.361	1.061–1.744	0.015
Seniors and above	660	10.5%	88	13.3%	1.908	1.459–2.494	<0.001
Monthly family income per capita							0.212
Less than ¥3000	2909	46.3%	267	9.2%	1.000		
¥3000–¥4999	1916	30.5%	158	8.2%	0.889	0.724–1.093	0.264
¥5000-¥6999	842	13.4%	89	10.6%	1.170	0.908–1.507	0.225
¥7000 and above	617	9.8%	62	10.0%	1.102	0.826–1.479	0.500
Monthly living expenses							<0.001
Less than ¥1000	2036	32.4%	171	8.4%	1.000		
¥1000-¥2000	3646	58.0%	324	8.9%	1.064	0.876–1.291	0.532
¥2001-¥3000	467	7.4%	56	12.0%	1.486	1.079–2.047	0.015
More than ¥3000	135	2.1%	25	18.5%	2.479	1.562–3.933	<0.001

Note: Cr, Constituent ratio; Pr, Prevalence rate.

suicidal ideation is considered a significant predictor of both suicide attempts and an act of suicide (Chamberlain et al., 2009). The Ukraine World Mental Health survey showed that one-third and one-fifth of suicide ideators had a suicide plan and undertook a suicide attempt (Bromet et al., 2007). Lamis et al. (2010) noted that an estimated 34.7% of lifetime suicide ideators eventually made a suicide attempt. Thus, an investigation into suicidal ideation and its correlates might aid the early detection of suicidal ideation and thus the design of strategies for suicide prevention and intervention. Related studies have shown that 10.72% of college students in China experience suicidal ideation (Li et al., 2014). A cross-sectional survey of 1390 first-year college students sampled from 10 universities in mainland China revealed that the lifetime prevalence of suicidal ideation was equal to 45.1% (Zhao et al., 2012). A survey of Shanxi Province college students conducted by Gao et al. (2003) showed that the prevalence of suicidal ideation in the past year reached 35.5%. Therefore, controlling the development of suicidal ideation in Chinese college students has become increasingly important.

The prevention of suicidal ideation might reduce future suicide plans and attempts (Wilcox et al., 2010), and preventing suicidal ideation requires a study of its influencing factors. Many studies have shown that suicidal ideation among college students is associated with different factors, which include socio-demographic characteristics, family factors, some daily habits, sleep problems, and depression or other mental illnesses (Rodríguezcintas et al., 2017; Menezes et al., 2012). However, the previous studies investigated focused on different factors, and few studies have performed a comprehensive analysis of the factors influencing suicidal ideation among Chinese college students. Therefore, this study aimed to determine the prevalence of suicidal ideation among college students in Jilin Province in northeastern China and to explore the risk factors and their effect pathways for suicidal ideation from multiple aspects in order to provide guidance for the design of strategies for the prevention of and early intervention in suicidal behaviour.

2. Methods

2.1. Participants

A cross-sectional mental health survey was performed in Jilin Province, China. This survey was initiated in 2016 by Jilin University, a national key comprehensive university directly under the Ministry of Education. Our respondents were 15- to 25-year-old college students studying at one of ten select universities in Jilin Province. There were no exclusion criteria. The respondents were associated with a variety of different departments and included students from all years at the various universities. The study was approved by the Ethics Committee of the School of Public Health, Jilin University.

2.2. Sample

The sample size calculated by considering the reported prevalence of suicidal ideation of 10%, a confidence level of 95% and an allowable error of 0.012 was 7500. The final target sample size was approximately 1% of the total college student population in Jilin province. Our response rate was 95.8%.

A stratified cluster sampling method was used in this study. Jilin province has three types of universities based on their influence and affiliated institutions: universities directly under the Ministry of Education, provincial key universities and provincial general universities. There is no intersection among these types of universities. First, two universities directly under the Ministry of Education, five provincial key universities, and three provincial general universities were selected according to the different types of schools. A number of classes were then successively extracted using years and departments as the stratification factors. The class size ranged from 20 to 40. An entire class was then defined as an observation unit, and all the students in an extracted class were investigated.

Table 2
Univariate logistic regression analyses of family and social interactions with suicidal ideation.

Variables	N	Cr	Suicidal ideation		OR	95%CI	p
			n	Pr			
Family relationship							< 0.001
Very harmonious	3884	61.80%	282	7.30%	1.000		
Harmonious	1822	29.00%	173	9.50%	1.340	1.099–1.634	0.004
Neutral	442	7.00%	88	19.90%	3.175	2.441–4.131	< 0.001
Disharmonious	69	1.10%	13	18.80%	2.965	1.602–5.487	0.001
Highly disharmonious	67	1.10%	20	29.90%	5.435	3.177–9.300	< 0.001
Parental marital status							< 0.001
Harmony	5402	86.00%	419	7.80%	1.000		
Frequent quarrel	494	7.90%	90	18.20%	2.649	2.065–3.399	< 0.001
Separation	79	1.30%	26	32.90%	5.834	3.611–9.426	< 0.001
Divorce	309	4.90%	41	13.30%	1.819	1.291–2.565	0.001
Communication with parents							< 0.001
Substantial	1567	24.90%	112	7.10%	1.000		
Often	2290	36.40%	167	7.30%	1.022	0.797–1.310	0.864
Neutral	1857	29.60%	181	9.70%	1.403	1.097–1.794	0.007
Rarely	398	6.30%	76	19.10%	3.066	2.237–4.203	< 0.001
Never	172	2.70%	40	23.30%	3.937	2.632–5.888	< 0.001
Satisfaction with paternal love							< 0.001
Very satisfied	3091	49.20%	202	6.50%	1.000		
Satisfied	2019	32.10%	158	7.80%	1.214	0.978–1.507	0.078
Neutral	786	12.50%	120	15.30%	2.577	2.025–3.280	< 0.001
Dissatisfied	174	2.80%	52	29.90%	6.096	4.276–8.690	< 0.001
Very dissatisfied	214	3.40%	44	20.60%	3.702	2.580–5.311	< 0.001
Satisfaction with maternal love							< 0.001
Very satisfied	3750	59.70%	259	6.90%	1.000		
Satisfied	1855	29.50%	159	8.60%	1.264	1.029–1.552	0.026
Neutral	397	6.30%	81	20.40%	3.455	2.625–4.548	< 0.001
Dissatisfied	113	1.80%	40	35.40%	7.386	4.923–11.081	< 0.001
Very dissatisfied	169	2.70%	37	21.90%	3.778	2.569–5.557	< 0.001
Relationship with classmates							< 0.001
Very good	1791	28.50%	145	8.10%	1.000		
Better	3164	50.40%	240	7.60%	0.932	0.752–1.155	0.519
Neutral	1157	18.40%	145	12.50%	1.626	1.275–2.074	< 0.001
Poor	80	1.30%	27	33.80%	5.783	3.530–9.473	< 0.001
Very poor	92	1.50%	19	20.70%	2.955	1.735–5.033	< 0.001
Number of good friends							< 0.001
Three and above	5078	80.80%	387	7.60%	1.000		
Two	826	13.10%	114	13.80%	1.941	1.552–2.426	< 0.001
One	233	3.70%	46	19.70%	2.982	2.1525–4.184	< 0.001
None	147	2.30%	29	19.70%	2.979	1.959–4.530	< 0.001
Places often going with friends							< 0.001
Gymnasium	1662	26.40%	120	7.20%	1.000		
Bar/karaoke hall/song and dance hall	809	12.90%	133	16.40%	2.528	1.944–3.288	< 0.001
Billiard hall	301	4.80%	51	16.90%	2.621	1.840–3.734	< 0.001
Internet cafes	630	10.00%	48	7.60%	1.060	0.748–1.501	0.744
Other	2882	45.90%	224	7.80%	1.083	0.860–1.364	0.498

Note: Cr, Constituent ratio; Pr, Prevalence rate.

2.3. Data collection

The survey was conducted by the School of Public Health of Jilin University. Permission to conduct the survey at all included universities was obtained from the university's administration. The respondents were verbally informed of the study by faculty advisors and told that participation was optional, and all the respondents provided informed consent before participating in the study. The survey was anonymous and did not reveal personal information of any of the respondents. The survey was conducted using a self-report questionnaire that included four sections: socio-demographic characteristics, family and social interactions, daily habits, and mental health self-rating scales. The data collection form was centrally distributed and collected, and specific personnel at the scenes checked the questionnaires.

2.4. Measurements

Suicidal ideation was measured with the question “Did you think about suicide in the past 12 months?”. Smoking was measured with the question “Do you smoke (at least one day per week and not less than one cigarette a day)”. Drinking behaviour was measured with the question “Have you ever drunk a glass of an alcoholic drink? (one glass equals half a bottle/a can of beer, a shot of Chinese hard liquor, and a glass of wine or rice wine)”. The answers to the three previous questions were limited to yes or no, and the last two measures were adapted from the European School Survey Project on Alcohol and Other Drugs and an American national survey on drug use and health (Hibell et al., 2012; SAMHSA, 2009). Participation in recreational activities such as gambling with money, tokens, or other items as the bet was referred to as gambling. Exercise referred to at least one day of exercise (running, basketball, swimming, etc.) lasting for more than 30 min in the past 7 days. The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate sleep quality (Buysse et al., 1989), and after each respondent answered all the sleep-related questions, a global score was calculated and used to classify sleep quality as follows: scores between 0 and 5, “very good” sleep quality; scores between 6 and 10, “good” sleep quality; scores of 11–15, “moderate” sleep quality; and scores of 16–21, “poor” sleep quality. The Chinese version of the PSQI was previously validated and proven to be a good tool for measuring sleep quality in Chinese populations (Liu and Tang, 1996). The Centre for Epidemiologic Studies

Table 3
Univariate logistic regression analyses of daily habits and depressive symptoms with suicidal ideation.

Variables	N	Cr	Suicidal ideation n	Pr	*OR*	*95%CI*	*p*
Smoking							
No	5930	94.40%	499	8.40%	1.000		
Yes	354	5.60%	77	21.80%	3.025	2.313–3.958	< 0.001
Drinking							
No	1890	30.10%	192	10.20%	1.000		
Yes	4394	69.90%	384	8.70%	0.847	0.706–1.016	0.074
Study pressure and burden							< 0.001
Very low	887	14.10%	91	10.30%	1.000		
Low	903	14.40%	103	11.40%	0.126	0.836–1.518	0.435
Average	2611	41.50%	180	6.90%	0.648	0.497–0.844	0.001
High	1488	23.70%	144	9.70%	0.937	0.711–1.236	0.646
Great	395	6.30%	58	14.70%	1.505	1.508–2.143	0.023
Gambling							
No	5147	81.90%	461	9.00%	1.000		
Yes	1137	18.10%	115	10.10%	1.144	0.922–1.418	0.221
Exercise							
Yes	4758	75.70%	421	8.80%	1.000		
No	1526	24.30%	4337	10.20%	1.165	0.959–1.414	0.123
Sleep quality					< 0.001		
Very good	4177	66.50%	329	7.90%	1.000		
Good	1857	29.60%	196	10.60%	1.380	1.146–1.662	0.001
Moderate	235	3.70%	45	19.10%	2.770	1.964–3.907	< 0.001
Poor	15	0.20%	6	40.00%	7.797	2.758–22.041	< 0.001
Depressive symptoms							
No	4689	74.60%	319	6.80%	1.000		
Yes	1595	25.40%	257	16.10%	2.631	2.208–3.136	< 0.001

Note: Cr, Constituent ratio; Pr, Prevalence rate.

Depression Scale (CES-D) was used to assess whether the respondents suffered from depressive symptoms (Radloff, 1977). This scale includes 20 questions, and scores of at least 16 were considered to indicate the presence of depressive symptoms. The Chinese version of the CES-D has been proven to be applicable to different age groups and a good tool for measuring depressive symptoms in China (Zhang et al., 2010).

2.5. Data analysis

Epidata software (Version 3.1, Odense, Denmark) was used for data entry, and SPSS software (Version 24.0, IBM SPSS, IBM Corp, Armonk, NY, USA) was used for the statistical analyses. First, univariate logistic analyses were performed to examine the correlations of the various variables (socio-demographic characteristics, family and social interactions, daily habits and depression) with suicidal ideation. Second, the variables that were found to be significant were included into forward stepwise multivariate logistic regressions after adjusting for gender, age and ethnicity to examine the risk factors related to suicidal ideation. Statistical significance was set to $p < 0.05$ (two-tailed). Third, the risk factors identified in the previous analysis were further tested using structural equation modelling (SEM) to explore their relationship with suicidal ideation.

3. Results

3.1. Prevalence of suicidal ideation

A total of 7500 questionnaires were distributed, and 7187 were returned. The number of valid data collection sheets was 6284, and the effective response rate was 87.4%. Table 1 presents the demographic characteristics of the sampled respondents. Of the respondents, 576 college students reported instances of suicidal ideation within the past 12 months. Thus, the prevalence of suicidal ideation among the respondents was 9.2% (576/6248), and the prevalence of suicidal ideation among males and females was 10.1% (334/3310) and 8.1% (242/2974), respectively (see Table 1).

3.2. Demographic characteristics associated with suicidal ideation

The prevalence of suicidal ideation with respect to each demographic characteristic is shown in Table 1. In addition to those among ethnicity and monthly family income per capita, the differences in the distribution of suicidal ideation among other demographic characteristics were also significant ($p < 0.05$). In addition, older students were found to have a higher prevalence of suicidal ideation than younger ones ($p < 0.05$), and increases in the year of study were associated with an increase in the prevalence rate ($p < 0.05$). An increasing trend in the prevalence of suicidal ideation was also observed with increases in monthly living expenses ($p < 0.05$).

3.3. Family and social interaction factors associated with suicidal ideation

Univariate logistic regression analyses showed that all family and social interactions surveyed were associated with suicidal ideation ($p < 0.05$). In terms of family interactions, poor family relationships, poor parental marital status, a lack of communication with parents, and dissatisfaction with parental love all increased the risk of suicidal ideations ($p < 0.05$). The analysis of social interactions revealed that poor relationships with classmates, having only a few good friends, and frequent outings to bars/karaoke halls/song and dance halls/billiard halls with friends were also significantly associated with an increased risk of suicidal ideations among college students ($p < 0.05$) (Table 2).

3.4. Daily habits and depressive symptoms associated with suicidal ideation

The results of the univariate logistic regression analyses of various daily habit-related variables and depressive symptoms found that smoking, increased study pressure and burden, poorer sleep quality and depressive symptoms were all associated with a higher risk of suicidal ideation among college students ($p < 0.05$; see Table 3).

3.5. Risk factors associated with suicidal ideation

Table 4 shows the results of the multivariate logistic regression

Table 4
Multivariate logistic regression analysis of risk factors with suicidal ideation.

Variables	β	SE	χ2	P	OR	95%CI
Year						
Freshman					1.000	
Sophomore	0.256	0.114	5.020	0.025	1.292	1.033–1.616
Junior	0.406	0.160	6.417	0.011	1.501	1.096–2.055
Seniors and above	0.570	0.188	9.239	0.002	1.769	1.225–2.555
Family relationship						
Very harmonious					1.000	
Harmonious	0.037	0.118	0.099	0.753	1.038	0.824–1.307
Neutral	0.495	0.172	8.313	0.004	1.641	1.172–2.298
Disharmonious	0.026	0.364	0.005	0.942	1.027	0.503–2.097
Highly disharmonious	0.524	0.337	2.418	0.120	1.688	0.872–3.267
Parental marital status						
Harmony					1.000	
Frequent quarrel	0.335	0.157	4.543	0.033	1.398	1.027–1.902
Separation	0.915	0.290	9.950	0.002	2.497	1.414–4.408
Divorce	0.137	0.201	0.460	0.497	1.146	0.773–1.700
Satisfaction with maternal love						
Very satisfied					1.000	
Satisfied	0.047	0.116	0.166	0.684	1.048	0.835–1.316
Neutral	0.533	0.167	10.177	0.001	1.704	1.228–2.364
Dissatisfied	0.940	0.249	14.196	<0.001	2.560	1.570–4.173
Very dissatisfied	0.816	0.225	13.105	<0.001	2.261	1.454–3.515
Number of good friends						
Three and above					1.000	
Two	0.319	0.124	6.569	0.010	1.376	1.078–1.756
One	0.425	0.198	4.625	0.032	1.530	1.038–2.254
None	0.292	0.247	1.402	0.236	1.339	0.826–2.171
Places often go with friends						
Gymnasium					1.000	
Bar/ karaoke hall /song and dance hall	0.515	0.146	12.407	<0.001	1.673	1.257–2.229
Billiard hall	0.623	0.196	10.094	0.001	1.865	1.270–2.740
Internet cafes	0.200	0.186	1.154	0.283	0.819	0.569–1.179
Other	0.124	0.129	0.919	0.338	1.132	0.879–1.458
Smoking						
No					1.000	
Yes	0.777	0.156	24.876	<0.001	2.175	1.603–2.951
Sleep quality						
Very good					1.000	
Good	0.113	0.104	1.194	0.274	1.120	0.914–1.372
Moderate	0.493	0.196	6.322	0.012	1.636	1.115–2.402
Poor	0.944	0.617	2.344	0.126	2.571	0.768–8.608
Depressive symptoms						
No					1.000	
Yes	0.731	0.099	54.065	<0.001	2.078	1.710–2.525

Note: adjusted for gender, age and ethnicity.

analysis. The significant factors identified from the univariate analyses were incorporated into the model, and gender, age and ethnicity were included as adjusted variables. The results showed that students in later years of study had an increased risk of suicidal ideation ($p < 0.05$). Specifically, seniors and above had the highest risk compared with that of freshman (OR = 1.769, 95% CI: 1.225–2.555). There was also a correlation between general family relationships and suicidal ideation (OR = 1.641, 95% CI: 1.172–2.298), and parental marital status was significantly associated with suicidal ideation in college students ($p < 0.05$). In comparison with harmonious family relationships, frequent parental quarrels (OR = 1.398, *95%* CI: 1.027–1.902) and parental separation (OR = 2.497, 95% CI: 1.414–4.408) increased the risk of suicidal ideation among college students. Feelings of dissatisfaction with maternal love and having only one or two friends ($p < 0.05$) were also risk factors ($p < 0.05$). Students who often went to bars, karaoke halls or song and dance halls had a higher risk of suicidal ideation than those who went to gymnasiums (OR = 1.673, *95%* CI: 1.257–2.229). A high risk was also found for students who went to billiard halls (OR = 1.865, *95%* CI: 1.270–2.740). Smoking (OR = 2.175, *95% CI*: 1.603–2.951) and depressive symptoms (OR = 2.078, *95%* CI: 1.710–2.525) were also shown to be risk factors ($p < 0.05$). After a comparison with high-quality sleep, an association between moderate sleep quality (OR = 1.636, *95%* CI: 1.115–2.402) and suicidal ideation was not found (see Table 4).

3.6. Further investigation of risk factors by SEM

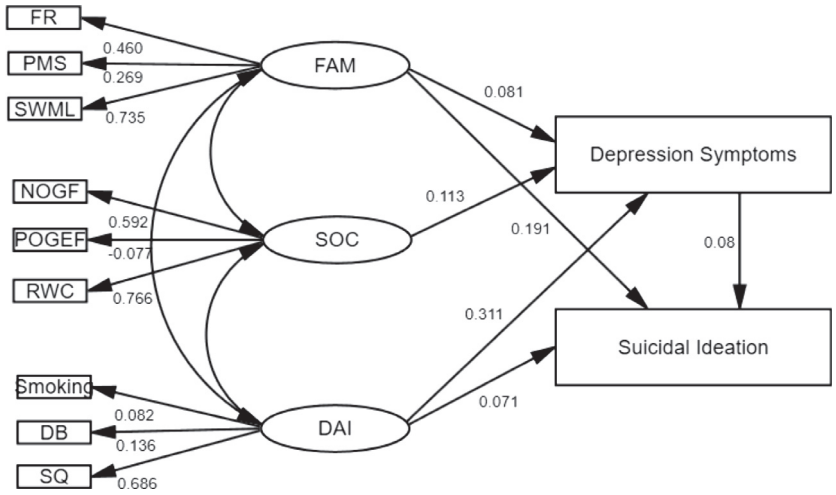
Based on the results of the multiple logistic regression analysis, Fig. 1 shows a structural equation model for the interaction of risk factors associated with suicidal ideation. The model fit was satisfactory ($\chi^2 = 519.539$, RMSEA = 0.052, GFI = 0.985, RMR = 0.021, NFI = 0.919, CFI = 0.923). The standardized path coefficients are presented on each arrow, and all the paths in the final structural were significant ($p < 0.05$). Table 5 summarizes the direct, indirect and total effects on suicidal ideation.

As shown, family and daily habits had both direct and indirect impacts on suicidal ideation, whereas depression symptoms had only direct effects, and social interaction exerted only indirect effects. Family, social interaction and daily habits were all mediated by depression symptoms. Among all the standardized total effects, the highest absolute value was obtained for family (0.197), followed by daily habits (0.096), depression symptoms (0.080) and social interaction (0.009). In terms of risk factors, satisfaction with motherly love exerted the greatest influence on family (0.735), whereas sleep quality had the greatest effects on daily habits (0.686), and the number of good friends had the highest influence on social interaction (0.592).

4. Discussion

The main findings of this study were as follows: the prevalence of suicidal ideation among college students in Jilin Province was 9.2%; the prevalence of suicidal ideation was associated with gender, year of study and monthly living expenses; risk factors for suicidal ideation, including multiple aspects of family, social interaction, daily habits and mental health, were found; family factors had both direct and indirect effects on suicidal ideation and were the most influential risk factors; and depression symptoms were a mediating factor between family, social interaction or daily habits and suicidal ideation and exerted direct effects on suicidal ideation.

The prevalence of self-reported suicidal ideation varies among different studies due to many factors, including cultural diversity (Weissman et al., 1999), economic diversity (McKinnon et al., 2016) or regional differences (Crosby et al., 2011). A comparison with other studies that investigated similar age groups revealed that our prevalence (9.2%) was lower than that reported in the United States (9.5%) (Kisch et al., 2005), Poland (30.8%) (Gmitrowicz et al., 2003) and Italy (29.2%) (Miotto et al., 2003). Furthermore, our reported prevalence was lower than that found in a meta-analysis of Chinese college students (10.72%) (Li et al., 2014) but higher than that found in Wuhan (7.3%), a large, central city in central China, and in Mexico (7.8%) (Tang et al., 2018; Lara et al., 2018). Differences in sampling methods, measurements, and demographic features might contribute to the discrepancies in the findings of different studies. For example, measuring suicidal ideation over the previous 7 days (Lara et al., 2018) might yield a lower prevalence than that obtained by measuring suicidal ideation over the previous 12 months. In addition, previous studies have shown that male students are more likely to experience suicidal ideation (Lee and Choi, 2015; Culbreth et al., 2018). Therefore, differences in the compositions of males and females in the samples might also lead to different prevalences. In contrast, the prevalence obtained in Jilin province was consistent with that found in Harbin (9.2%), a provincial capital city in northeast China (Zhai et al., 2015). Although most of the abovementioned prevalence rates differed from that measured in this study, the similarity with the prevalence in Harbin might be due to geographical proximity. Although our reported prevalence was lower than the national level, the results still indicated that the emergence of suicidal ideation must be controlled.



Note: FAM = Family factors; SOC = Social interactions; DAI = Daily habits FR = Family relationship; PMS = Parental marital status; SWML = Satisfaction with maternal love; NOGF = Number of good friends; POGEF = Places often go with friends; RWC = Relationship with classmates; DB = Drinking behavior; SQ = Sleep quality.

Fig. 1. Pathway analysis of risk factors for suicidal ideation from SEM analysis.
Note: FAM = Family factors; SOC = Social interactions; DAI = Daily habits. FR = Family relationship; PMS = Parental marital status; SWML = Satisfaction with maternal love; NOGF = Number of good friends; POGEF = Places often go with friends; RWC = Relationship with classmates; DB = Drinking behavior; SQ = Sleep quality.

Table 5
Standardized effects on suicidal ideation from SEM analysis.

Factors	Total effect	Direct effect	Indirect effect
Family	0.197	0.091	0.006
Social	0.009	0.000	0.009
Daily habits	0.090	0.071	0.025
Depression symptoms	0.080	0.080	0.000

In our study, five of the family and social interaction variables were identified to be risk factors for suicidal ideation. Family factors showed the most important direct pathway and had indirect effects on suicidal ideation, and thus, these should be considered more carefully. Students with family problems were 1.688 times more likely to experience suicidal ideation than those from more harmonious families. Similarly, Zhai et al. showed that poor family relationships were a predictor of suicidal ideation (Zhai et al., 2015). Another related study also demonstrated negative relationships between family cohesion and suicidal ideation (Eshun, 2003). A new finding, however, suggests that dissatisfaction with maternal love is most influential family factor. This finding might be due to the fact that an individual perceives motherly love more strongly than fatherly love (Gau et al., 2008). A previous study showed that children experienced stronger emotions from their mothers than from their fathers. Therefore, parents should pay attention to these above-mentioned negative family factors and strive to create as healthy a family atmosphere as possible for their children. The social interaction variables of college students investigated in this study are mainly related to peers or friends, and these were found to only have indirect effects on suicidal ideation in this study. Among all social interaction-related risk factors for suicidal ideation, the number of good friends exhibited the highest contribution to the emergence of suicidal ideation. Having just a few or no friends could make Chinese college students more prone to suicide. This finding is consistent with that of a previous study, which showed that having only a few close friends was strongly associated with suicidal ideation (Tang and Qin, 2015). A poor social network can make students feel lonely and contribute to negative attitudes. Therefore, encouraging students who stay isolated to more actively pursue friendships and join group activities might have a significant beneficial effect on suicide prevention and mental health.

Daily habits were found to form the most important indirect pathway but also had direct effects, and sleep quality exerted the greatest effect on daily habits. Related studies have shown that shorter sleep periods or falling asleep late are both risk factors for suicidal ideation (Gangwisch et al., 2010). Considerable evidence suggests that sleep problems can be early symptoms of mental illness, which was consistent with our finding that depressive symptoms constituted a mediating factor (Cox et al., 2018). Sleep problems can also have a negative impact on cognitive ability (Tao, 2012). Thus, helping students develop good sleep habits could indirectly prevent suicidal ideation. Another factor that was found to be mediated by depression symptoms in the current study was smoking. Nicotine in tobacco can cause depression (Tanskanen et al., 2010), which could indirectly result in suicidal ideation, and this hypothesis is consistent with our results. After college students become addicted to nicotine, their depression could increase. Thus, helping students develop good sleeping habits is important for their learning ability as well as for their physical and mental health.

Moreover, suicide is often accompanied by mental disorders. Data from 2013 have shown that 60% of suicidal individuals with mental disorders were previously diagnosed with depression (Weitz et al., 2014). As the only and most necessary mediating factor in all indirect pathways, depression symptoms were not indirectly connected with suicidal ideation. Other studies revealed similar results, demonstrating that depression was an essential precondition and mediating factor (Hintikka et al., 2009; Gong et al., 2011). In recent years, which can be characterized by economical development and diversification of the environment, depression in college students has exhibited a growing upward trend (Miletic et al., 2015). Therefore, the prevention of depressive symptoms should also be considered as a direct and indirect preventive strategy against suicidal behaviour, particularly in college students. Paying attention to the mental health of college students and strengthening the prevention and treatment of depression should become more important.

Our study has some limitations. First, the study can only provide clues to the possible causes of suicidal ideation rather than clear causal interpretations. Second, the confirmation of suicidal ideation was self-reported, and a standard scale was not adopted. Information bias was also possibility because the participants were asked to recall suicidal ideations over the previous 12 months as part of the survey. Third, due to the limited objective of the study, only one province was included,

and the sample size was not sufficiently large to be representative. Fourth, although we explored many variables from different perspectives, there might exist possible risk factors that were not considered.

In conclusion, the prevalence of suicidal ideation among college students in Jilin province was higher than that reported for some studies and lower than that reported in other studies. According to our results, the factors influencing suicidal ideation in college students are complicated. Family factors exerted the greatest influence on suicidal ideation and should thus be the main concern when designing intervention strategies for suicidal ideation. Although daily habits were found to have mostly indirect effects on suicidal ideation, focusing on improving sleep quality in particular could indirectly help prevent suicidal ideation. Depression symptoms are a necessary mediating factor, and the prevention of depression can directly reduce suicidal ideation. There needs to be a greater awareness of the role on family factors, daily habits especially sleep quality and depressive symptoms in mental health in general and suicide ideation in particular. It is imperative to develop strategies that involve improving mental health awareness and education as well as developing practical programs that target improving the areas of behaviour that influence mental health and suicide ideation.

Conflict of interest

All authors declare that they have no conflicts of interest.

Contributors

MHW, WJL, CGK, and WB designed and performed the study. MHW, CGK, WB and YS analysed the data. MHW and CGK drafted the manuscript. MHW, XYL, WYY, YYL and WQH participated in revising the draft of the manuscript. All authors approved the final version of the paper for submission.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgement

The authors wish to acknowledge all the study participants.

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