

Sex Differences in the Prevalence and Clinical Correlates of Suicidal Ideation in Adolescent Patients with Depression in a Large Sample of Chinese

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Abstract

Background

Sex differences in depression have been well recognized. However, sex differences in suicidal ideation (SI) in adolescents have rarely been systematically studied. This large-scale sample explored the sex differences in the prevalence and related risk factors of SI in adolescent patients with depression.

Methods

1635 patients with depression were recruited. Demographic and clinical characteristics were collected. Suicidal ideation was assessed by an interview. Children's Depression Inventory (CDI) and Adolescent Self-Rating Life Events Check List (ASLEC) were used to evaluate depression and stressful life events.

Results

The prevalence of suicidal ideation in female patients (383/887, 43.18%) was significantly higher than in male patients (242/748, 32.35%). There were sex differences in CDI, ASLEC, and all subscales of ASLEC in patients with and without SI. Correlation analysis showed that family depression history and less sleeping time were significantly associated with suicidal ideation in female patients, while the severity of depression and stressful life events were associated in both genders. Further logistic regression analysis indicated that the severity of depression and relationship problems were independent risk factors of suicidal ideation in both sexes; family depression and inadequate sleeping time were significantly associated with suicidal ideation in female patients.

Conclusions

Our findings show that there are significant sex differences in the risk and clinical correlations of suicidal ideation in adolescent depression patients. Suicidal ideation is more frequent in female patients and is associated with multiple factors in both genders.

Introduction

Suicide is a significant public health problem [1], more than 700,000 people die from suicide every year worldwide [2], statistics suggest an increase in suicide among adolescents [3]. Suicide is the second-leading cause of death among adolescents. With increases in social media use, depression, anxiety, and self-inflicted injuries, adolescent suicides are of particular concern [4, 5]. Adolescence is a high-risk period for suicidal behavior [6], and the best period for intervention and treatment of suicide attempt. By understanding how and why suicide risk emerges during adolescence, we can offer opportunities to intervene on this trajectory earlier in life.

Around 3–5% of adolescents worldwide are affected by depression. Compared with the adult with depression, adolescents with depression have more severe impairments in social and educational function and have a higher risk of smoking, substance abuse, obesity, and suicide [7]. The optimal treatment for depression in adolescents is unclear [3]. Besides, delays in obtaining professional treatment are a significant problem. Many children and adolescents receive help only a few years after the onset of the mental health conditions, and considerably much later than adults. Depression can have a devastating effect on young people's academic and social development and can adversely affect family relationships, mostly if these issues are misunderstood.

Gender difference in suicidal rates is called the "Gender Paradox". Among adolescents and young adults, males' suicide rate is 2 to 4 times higher than females', but females' attempt suicide is 3 to 9 times more common than males'. In developed countries, young males' suicide death rate is estimated to be 2 to 3 times higher than females'. The female suicide attempt rates increase with age, reaching a peak in the middle of adolescence. The male suicide rate continues to rise into early adulthood. Previous suicide attempts are among the strongest predictors of suicide death, especially among females. Gender differences in suicidal behavior can be explained by differences in emotional and behavioral problems. The higher suicide mortality rate among young males may be related to the higher prevalence of external disorders (such as to substance abuse disorder, and deviant behavior) and the preference for

highly lethal methods. In contrast, females are more likely to show inherent disorders (e.g., anxiety, mood disorders). These disorders may mediate links with suicidal thoughts and behaviors.

Data show that suicidal ideation is the most important predictor of suicide death and the most risk factor leading to suicidal behavior. However, the mechanism of the occurrence and development of suicidal ideation in adolescent depression is still unclear, bringing great difficulties in preventing suicidal behavior. Exploring the influencing factors of suicide ideation is of great significance for suicide prevention and effective intervention [8].

Adolescent suicide has become a severe public health problem [9]. The high incidence of suicide among adolescents is believed to be caused by young people's numerous social stressors [10, 11]. To illustrate: the following variables are related to suicide among adolescents: mood disorders; depression; abuse of drugs; decreased self-esteem; medical illnesses [12, 13], and other demographic factors associated with suicidal ideation in adolescents including female, low school grades, older age, only-child family and lower socioeconomic status of parents [14–16]. Several studies from different populations have shown that sleep problems are related to suicidal ideation [17, 18]. Stressful life events are associated with increased suicidal ideation in adolescents [19, 20].

Within the context of gender differences in adolescent suicide research, researchers tried to assess the association between gender and suicide attempt and determine the gender-specific risk/protective factors in adolescents [21]. They found that females presented a higher risk of suicide attempts and males for suicide death. In China, there are few studies on sex differences in suicidal ideation in adolescent depressive disorder. A recent study found like suicidal behavior, non-suicidal self-injurious behavior is prevalent among Chinese people and has gender difference among adolescents.

The purpose of this study was to determine: (1) whether adolescent patients with the depression had sex differences with or without suicidal ideation; (2) whether suicidal ideation in depression showed sex differences; and (3) whether suicidal ideation differences correlated with symptoms of depression, clinical symptoms and stressful life events.

Methods

Subjects

One thousand six hundred thirty-five patients were recruited from two hospitals, The First Affiliated Hospital of Harbin Medical University and The First Specialist Hospital of Harbin, from 2016 to 2020. The inclusion criteria were: (1) aged 12–18 years, Chinese; (2) met the diagnosis of depression according to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) criteria, which was confirmed by two trained clinical psychiatrists; (3) could understand the meaning of each scale item and question and be able to participate in clinical evaluation; (4) Patient who agrees to participant need to sign an official consent form by themselves and their parents. The exclusion criteria were: (1) significant medical abnormalities, including central nervous system diseases, or medical illnesses; (2) with physical disorders or cerebral pathologies; (3) with alcohol or drug abuse or dependence. We had initially recruited 1813 patients from two hospitals. After screening, 98 patients were excluded for being unable to complete the CDI scale, 32 patients unable to complete the ASLEC scale, 48 patients were excluded due to the inability to comprehend consent procedures.

Research psychiatrists obtained social-demographic data and clinical characteristics using the questionnaires. Moreover, we collected complete information for each subject, including age, gender, education, residence, family history, sleeping, school information, and so on. More information was gathered from available medical records and collateral resources. All information is collected from medical records and related resources. If the data is lost or ambiguous, the researcher will conduct another visit with the family or the patient's clinical team to complete the medical history. The protocol was approved by the Institutional Review Board of The First Affiliated Hospital of Harbin Medical University and The First Specialist Hospital of Harbin. Each participant who agreed to join in the study were given fully explained and provided an official consent form by the adolescents and their parents.

Clinical Measures

Two psychiatrists, who had simultaneously attended a training session in clinical measures before the study began, assessed the patient's psychopathology. Each subject came into the testing room on a particular day to have a research member introduce the research center, know the assessments and the process. In the beginning, there is an interview to assess suicidal thoughts. The subject

was asked the same question, "have you planned or considered suicide in the past two weeks?" If their answer is "yes", the subject is defined as having suicidal ideation, and then asked more information about the frequency and method of occurrence. We define Suicidal Ideation (SI) as any life-ending thoughts and plans that may refer to subjects [22]. For the treatment intervention of the participants is necessary. We had told the guardian to escort 24 hours to stay them away from suicide tools or places. And had told them hospitalization should be taken if necessary.

Adolescent depression was evaluated using the Children's Depression Inventory (CDI) [23]. The CDI is comprised of 27 subtests that are used to calculate three age-adjusted index scores and a total score. A score of 19 was defined as depressive symptoms, with a higher score indicative of severe depression. Test indices are sadness, self-deprecation, loneliness, reduced social interest, anhedonia, self-hate, self-blame, sleep disturbance, fatigue, somatic concerns, and decreased appetite. CDI has five dimensions: anhedonia, negative mood, negative self-esteem, ineffectiveness, and interpersonal problems. To prevent spurious correlations with the other constructs in this study, i.e., suicidality, we left out CDI items 9 (suicidal ideation). In this study, Cronbach's alpha coefficient of the scale was 0.851.

Participants were administered a comprehensive scale of life events by the Chinese version of the Adolescent Self-Rating Life Events Check List (ASCLE) [24]. ASCLE is a self-evaluation scale reflecting the psychological characteristics and social roles of adolescents. ASCLE has six domains: relationship, learn pressure, punishment, deprived, health, and others, which are used to assess the frequency and impact the intensity of adverse life events of adolescents in the past year. The scoring is based on the 27 items, rated on a 6-point scale, ranging from 1 (no impact) to 6 (severe impact). In this study, Cronbach's alpha coefficient of the ASCLE scale was 0.849.

Data analysis

Demographic and clinical data were analyzed using t-tests for the continuous variables and chi-squared tests for the categorical variables. The term "Suicidal Ideation" refers to the subject with suicide ideation versus without suicide ideation, and "Sex" refers to male versus female adolescent patients with depression. Further, a one-way analysis of covariance was used with demographic and clinical parameters as covariates for group comparisons after adjusting for these. Cross-comparisons were performed to calculate the prevalence of suicidal ideation by sex groups, as well as suicidal ideation-by-sex interactions on each item. Pearson or Spearman tests were examined correlations among demographic and clinical variables. We found that there was a very high collinearity of ASLEC total scores with the other ASLEC subscores, so we manually deleted this item in logistic regression analysis. Finally, stepwise multiple regression analyses were used to investigate the relationships between suicidal ideation and other variables in male and female groups. Covariates in these stepwise included those with significant differences shown in the univariate analyses. The statistical software package for statistical calculations was the Statistical Program for Social Sciences (SPSS, version 24.0). The statistical test was considered with a two-tailed test, and the significance was set at 0.05 level.

Results

Sample characteristics in adolescent depression patients with or without suicidal ideation by sex

Table 1 shows the demographic data and clinical data of all subjects by gender. A total of 1635 patients (748 males/ 887 females) with adolescent depression were enrolled in this study, including 625 (38.23%) with suicidal ideation, and the female was significantly higher than the male (43.18% vs. 32.35%, $P<0.001$).

Table 1

Comparison of demographic and clinical variables in adolescent depression patients with or without suicidal ideation (between sex)

	Without SI		With SI		SI F	Sex F	SI×Sex F
	Male(n = 506)	Female(n = 504)	Male(n = 242)	Female(n = 383)	(P-value)	(P-value)	(P-value)
Age (years)	14.56 ± 1.71**	14.88 ± 2.02	14.85 ± 1.87 ⁺	15.02 ± 1.83	8.563(0.210)	10.740(0.189)	0.579(0.447)
Education (years)	7.81 ± 1.57**	8.24 ± 1.79	8.04 ± 1.60	8.29 ± 1.67	2.460(0.361)	14.300(0.165)	1.084(0.298)
Residence, City	391/77.3%	354/70.2%	186/76.9%	282/73.6%	0.613(0.577)	7.280(0.226)	0.708(0.400)
Onlychild, Yes	415/82.0%	354/70.2%	187/77.3%*	268/70.0%	1.250(0.465)	18.141(0.147)	1.009(0.315)
Family depression history, Yes	11/2.2%	6/1.2%	7/2.9%	18/4.7% ⁺⁺	2.295(0.371)	0.087(0.817)	2.920(0.088)
Key school, Yes	186/36.8%	179/35.5%	73/30.2%	128/33.4%	3.732(0.304)	0.200(0.732)	0.835(0.361)
Leader, Yes	157/31.0%	233/46.2%	81/33.5%	143/37.3% ⁺⁺	0.324(0.671)	2.829(0.341)	5.194(0.023)
Sleep less than 8 hours	264/52.2%	251/49.8%	137/56.6%*	251/65.5% ⁺⁺	3.189(0.325)	0.336(0.665)	4.883(0.027)
CDI Total Score	26.01 ± 2.69	26.08 ± 2.60	26.86 ± 3.18 ⁺⁺	27.02 ± 3.22 ⁺⁺	54.855(0.085)	2.322(0.370)	0.797(0.372)
ASLEC Total Score	57.94 ± 21.07	56.01 ± 21.81	72.14 ± 23.77 ⁺⁺	70.90 ± 23.79 ⁺⁺	1762.063(0.015)	20.953(0.137)	0.090(0.765)
ASLEC Relationship Score	12.86 ± 4.73	12.66 ± 4.96	15.84 ± 5.54 ⁺⁺	16.37 ± 5.67 ⁺⁺	84.626(0.069)	0.205(0.729)	1.855(0.173)
ASLEC Learn pressure Score	11.99 ± 4.30	11.77 ± 4.18	14.53 ± 4.86 ⁺⁺	14.19 ± 4.85 ⁺⁺	1584.920(0.016)	19.999(0.140)	0.072(0.788)
ASLEC Punishment Score	14.40 ± 6.67*	13.37 ± 6.96	18.23 ± 7.62 ⁺⁺	17.24 ± 8.11 ⁺⁺	51986.589(0.003)	3610.233(0.011)	0.002(0.964)
ASLEC Deprived Score	6.51 ± 4.14	6.51 ± 4.23	7.92 ± 4.70 ⁺⁺	7.94 ± 4.59 ⁺⁺	25491.249(0.004)	0.611(0.578)	0.002(0.969)
ASLEC Health Score	6.65 ± 3.14	6.60 ± 3.00	7.93 ± 3.64 ⁺⁺	7.97 ± 3.45 ⁺⁺	913.840(0.021)	0.028(0.894)	0.067(0.795)
ASLEC Others Score	7.71 ± 3.61**	6.87 ± 3.45	10.52 ± 3.97 ^{****}	9.50 ± 4.33 ⁺⁺	937.801(0.021)	109.721(0.061)	0.204(0.652)

Note: * indicates the comparison between males and females with or without SI: *P<0.05, **P<0.01.

+ indicates the comparison between SI and without SI group in males or females : *P<0.05, **P<0.01.

CDI score: delete the 9 item from the CDI total score

SI: Suicidal ideation; ASLEC: Adolescent self-rating life event checklist; CDI: Children's Depression Inventory

In the group with suicidal ideation, female patients had less sleeping, more male patients in the family with only-child, and male patients had higher others of ASLEC than female patients. In the group without suicidal ideation, male patients had younger age, lower education, a higher score on punishment score of ASLEC than female patients (all $P < 0.05$).

For genders, as can be seen in the males' group with and without suicidal ideation, male patients with suicidal ideation had older age, more CDI total score, more ASLEC total score, and all six indexes score. For female patients, except for higher CDI total score and ASLEC total and all subindex scores as males, female patients with suicidal ideation had more positive family depression history, less be the school leader, and less sleeping.

Moreover, there were no significant diagnosis differences (depression patients with suicidal ideation vs. without suicidal ideation) in the demographic characteristics. ASLEC total and subscore except relationship score had significant differences in the group with or without suicidal ideation (all $P < 0.05$). There was a significant gender difference in the punishment score of ASLEC ($P = 0.011$). Furthermore, there was significant interaction in the leader ($P = 0.023$) and less sleeping ($P = 0.027$) between suicidal ideation and sex.

Sex Differences In The Associations Between Suicidal Ideation And Clinical Variables In Adolescent Patients Groups

For all patients, suicidal ideation was correlated with age ($r = 0.061$, $df = 1635$, $P = 0.013$), education ($r = 0.049$, $df = 1635$, $P = 0.047$), family depression history ($r = -0.071$, $df = 1635$, $P = 0.004$), less sleeping ($r = 0.108$, $df = 1635$, $P = 0.000$), CDI total score ($r = 0.170$, $df = 1635$, $P = 0.000$), ASLEC total score ($r = 0.299$, $df = 1635$, $P = 0.000$), Relationship score ($r = 0.305$, $df = 1635$, $P = 0.000$), Learn pressure score ($r = 0.256$, $df = 1635$, $P = 0.000$), Punishment score ($r = 0.242$, $df = 1635$, $P = 0.000$), Deprived score ($r = 0.157$, $df = 1635$, $P = 0.000$), Health score ($r = 0.194$, $df = 1635$, $P = 0.000$), Others ($r = 0.314$, $df = 1635$, $P = 0.000$).

Table 2 showed separately sex differences in clinical characteristics associated with suicidal ideation. In male subjects, suicidal ideation was positive related to the following characteristics: CDI total score ($r = 0.126$, $df = 748$, $P = 0.001$), ASLEC total score ($r = 0.297$, $df = 748$, $P = 0.000$), Relationship score ($r = 0.251$, $df = 748$, $P = 0.000$), Learn pressure score ($r = 0.260$, $df = 748$, $P = 0.000$), Punishment score ($r = 0.251$, $df = 748$, $P = 0.000$), Deprived score ($r = 0.159$, $df = 748$, $P = 0.000$), Health score ($r = 0.206$, $df = 748$, $P = 0.000$), Others ($r = 0.345$, $df = 748$, $P = 0.000$). Further logistic regression analyses indicated that suicidal ideation was significantly associated with CDI total score (beta = 1.127, $t = 0.029$, $P = 0.000$), Relationship score (beta = 1.044, $t = 0.020$, $P = 0.032$), Others (beta = 1.171, $t = 0.027$, $P = 0.000$), as independent contributors to suicidal ideation in adolescent patients, which together accounted for 18.3% of the variance in suicidal ideation, see in Table 3.

Table 2
Correlation between suicidal ideation and clinical variables in male and female adolescent patients with depression

	Male	Female
Age (years)	0.069(0.057)	0.037(0.272)
Education (years)	0.071(0.053)	0.026(0.440)
Family Depression history	-0.022(0.549)	-0.107(0.001)
Key school	0.065(0.076)	0.022(0.516)
Leader	0.025(0.503)	-0.089(0.008)
Sleep less than 8 hours	0.042(0.255)	0.157(0.000)
CDI Total Score	0.126(0.001)	0.190(0.000)
ASLEC Total Score	0.297(0.000)	0.339(0.000)
ASLEC Relationship Score	0.251(0.000)	0.323(0.000)
ASLEC Learn pressure Score	0.260(0.000)	0.253(0.000)
ASLEC Punishment Score	0.251(0.000)	0.269(0.000)
ASLEC Deprived Score	0.159(0.000)	0.178(0.000)
ASLEC Health Score	0.206(0.000)	0.231(0.000)
ASLEC Others Score	0.345(0.000)	0.351(0.000)
Note: CDI score:delete the 9 item from the CDI total score		
ASLEC: Adolescent self-rating life event checklist; CDI: Children's Depression Inventory		

Table 3
Logistic regression analyses in suicidal ideation among male adolescent patients with depression

	Coefficients B	Std.error	Wald	P-value	95% confidence interval for EXP(B)		
					Exp(B)	Lower	Upper
(constant)	-5.927	0.835	50.412	0.000	0.003	1.064	1.193
CDI Total Score	0.119	0.029	16.718	0.000	1.127		
ASLEC Relationship Score	0.043	0.020	4.578	0.032	1.044	1.004	1.087
ASLEC Others Score	0.158	0.027	34.893	0.000	1.171	1.111	1.234
Note: CDI score:delete the 9 item from the CDI total score							
ASLEC: Adolescent self-rating life event checklist; CDI: Children's Depression Inventory							

In female subjects, suicidal ideation was positive related to the following characteristics: less sleeping ($r = 0.157$, $df = 887$, $P = 0.000$), CDI total score ($r = 0.190$, $df = 887$, $P = 0.001$), ASLEC total score ($r = 0.339$, $df = 887$, $P = 0.000$), Relationship score ($r = 0.323$, $df = 887$, $P = 0.000$), Learn pressure score ($r = 0.253$, $df = 887$, $P = 0.000$), Punishment score ($r = 0.269$, $df = 887$, $P = 0.000$), Deprived score ($r = 0.178$, $df = 887$, $P = 0.000$), Health score ($r = 0.231$, $df = 887$, $P = 0.000$), Others ($r = 0.351$, $df = 887$, $P = 0.000$). Family depression history ($r = -0.107$, $df = 887$, $P = 0.001$) and Leader ($r = -0.089$, $df = 887$, $P = 0.008$) were negative related to the suicidal ideation, see in Table 2. As shown in Table 4 in female patients, family depression history ($\beta = 0.328$, $t = 0.502$, $P = 0.027$), less sleeping ($\beta = 1.614$, $t = 0.152$, $P = 0.002$), CDI total score ($\beta = 1.146$, $t = 0.027$, $P = 0.000$), Relationship score ($\beta = 1.079$, $t = 0.017$, $P = 0.000$), Others ($\beta = 1.112$, $t = 0.024$, $P = 0.000$) were found to be independent contributors to suicidal ideation, which accounted for 22.8% of the variance in suicidal ideation.

Table 4
Logistic regression analyses in suicidal ideation among female adolescent patients with depression

	Coefficients B	Std.error	Wald	P-value	95% confidence interval for EXP(B)		
					Exp(B)	Lower	Upper
(constant)	-3.929	1.248	9.907	0.002	0.020	0.123	0.878
Family depression history	-1.114	0.502	4.923	0.027	0.328	1.197	2.176
Sleep less than 8 hours	0.479	0.152	9.869	0.002	1.614	1.088	1.208
CDI Total Score	0.136	0.027	26.168	0.000	1.146	1.043	1.116
ASLEC Relationship Score	0.076	0.017	19.304	0.000	1.079	1.061	1.167
ASLEC Others Score	0.107	0.024	19.312	0.000	1.112		
Note: CDI score:delete the 9 item from the CDI total score							
ASLEC: Adolescent self-rating life event checklist; CDI: Children's Depression Inventory							

Discussion

To our knowledge, this is the first study to examine sex differences in the prevalence of suicidal ideation and associated factors among adolescents with depression in a large sample. In this study, sex differences were found in suicidal ideation of adolescent depression, showing that female patients had a higher prevalence of suicidal ideation than male patients (female vs. male = 43.18%: 32.35%). The significant clinical correlators of suicidal ideation in female adolescent patients included family depression history, less sleeping time, the severity of depression, and stressful life events. More importantly, whether in females or males, we found that these significant associated factors predictive of suicidal ideation are more severity of depression and relationship problems.

We found that adolescent female patients with depression had a higher rate of suicidal ideation than male patients. The female rate is 43.18%, consistent with previous reports [25, 26]. A recent study reported each year, 22% of adolescent girls had suicidal ideation, the boys about 12% [25]. As in the global picture, girls present higher rates of suicide ideation and attempts. Suicidal ideation increases during adolescent girls, who are at significant risk, due to different reasons, such as biological-social-cognitive characteristics. Furthermore, females are associated with neurobiological sensitivity to hormone change across the menstrual cycle. During menses, girls are often associated with negative affect, deficits in inhibitory control, and disruptive social experiences; these hormone-related symptoms may increase the risk for suicidal thoughts and behaviors [27]. Another reason is that girls often attributed internalizing behavior to a higher risk of suicide or differential socialization that presents suicidality as a feminine way of coping with stressors [28].

Interestingly, we found that suicide ideation was negatively related to family depression in female subjects. A family history of suicide is considered a biological and psychological risk factor for family transmission of suicide behavior[29]; some results exist gender differences [30]. Suicide is highly familial, several studies have shown that family contextual factors and family relationships are identified as risk factors for suicide ideation and attempts[31]. Adolescents at higher risk commonly have a history of depressive disorder, a previous suicide attempt, and a family history of psychiatric disorders. The reasons for this differential outcome may be related to a genetic predisposition to depression and suicide, as well as increased awareness of depression in the family. Adolescent female patients in families with a family history of depression pay more attention to the disease, which helps early identification and early treatment. The role of family history on gender differences in adolescent depression needs to be further studied in the future.

The significant relationship between suicidal ideation and less sleeping in the female group was inconsistent with those previous studies [32, 33]. Several types of research have reported the differences in sleep duration between genders [34, 35]. Gender differences exist in sleep quality, period, the latency of sleep onset, and sleep structure in the general population. In puberty, girls' hormonal and physical changes could affect sleep health during a woman's lifetime. Park et al. have reported sleep duration directly affects suicidal ideation in female adolescents, then further discover that the direct effect of short sleep on suicide was 2.5 times higher for females than for males [36]. The results may have several mechanisms related to sleep physiology. Related hormones in males can help them adapt to various emotional stress situations and sleep deprivation [37]. Recent studies have reported that leptin may be related to

mechanisms of sleep disorders, depression, and suicide [38, 39]. These can explain our findings that less sleeping time has a more significant impact on female adolescent suicide.

Furthermore, we found significant positive associations between CDI total score and suicidal ideation both in the female and male adolescents, which was consistent with previous reports. It is more common for adolescents with severe depression to exhibit different problems, such as truancy, running away from home, self-destructive behavior, alcohol abuse, etc. Negative affect also increases in adolescent girls' suicidal ideation and behaviors. Eisenlohr et al. suggesting it is also associated with worsened mood with females depressive disorder [40]. These teenagers may think that their parents or family members have failed or disappointed and think suicide is their only option. Other adolescents may feel that suicide is a better choice than life. Although depression is a strong predictor of suicidal ideation, it cannot predict who will have suicidal ideation. Conversely, mental disorders characterized by anxiety, agitation, and poor behavioral control can indicate the transition from imagination to action.

Our study also had assessing the effect of stressful life events on the relationship between gender and suicidal ideation. We found that ASLEC total score and Relationship score were independent contributors to suicidal ideation in both female and male groups. The current focus on adolescence is characterized by significant changes in social experiences, especially among females, including interpersonal stress and a significant increase in emotional and physiological responses to interpersonal stress. In the past 50 years, almost all theories used to explain suicide have emphasized interpersonal communication and isolation or rejection as the center. Interpersonal stress is a powerful predictor of suicidal ideation and behavior in adolescent girls, and it often encourages self-harm behavior, compared with our results. Consistent with prior work, exposure to traumatic stress has been shown to be associated with an increased risk of suicidal ideation [41]. All indicated that adolescents were at the highest risk for suicide when they experienced higher stress levels, relative to their average stress levels [42]. In another study, interpersonal problems have been reported as a primary trigger for suicidal behavior [43]. Therefore, compared with stressed adults, adolescents have a weakened ability to inhibit and control when they are emotionally high, thereby increasing the possibility of taking action on emotional-related impulses, such as the urge to participate in social conflict and suicide. These results suggest the value of monitoring high-risk youths and intervening during times of risk.

Although our findings provided important insights, this study had some limitations. First, it is only a cross-sectional study. Second, all patients were depressed from two hospitals in China. We did not analyze the patients' treatment, such as the course of the disease, antidepressive drugs, or other medications. Future research will compare the information and relevance of these aspects. Third, suicidal ideation was assessed by interview. Although we also considered the CDI item 9 to assess consistency, this may have been biased during the collection phase. In addition, the contextual understanding of suicidal ideation needs to be further developed, we did not distinguish between thoughts about death without an intent to personally act for killing one-self (for example: "It would be better if I would not exist") and thoughts about being an active author (perpetrator) of the action to take one's life ("Killing myself is the only solution"). Fourth, we utilized CDI for depression degree, ASCLE for life events; these measurements are self-report, despite which can reflect adolescents' actual status but might have information bias. Fifth, it is well known that suicide is associated with many behavioral and environmental factors. Like other types, such as non-suicidal self-injury and suicide attempts. Sixth, we did not have a sex-matched and age-matched healthy control group in this study, which has made it difficult to make a firm conclusion regarding the sex differences with suicidal ideation in adolescents.

Conclusions

In conclusion, this research showed that sex difference existed in suicidal ideation of adolescent depression patients. Female patients had a higher prevalence of suicidal ideation than male patients. Moreover, we observed significant positive associations between suicidal ideation and clinical symptoms. More importantly, these significant associations were primarily driven by female patients. These sexually differential associations between suicidal ideation and clinical symptoms may be related to depressive symptoms, and stressful life events. These findings highlight the importance of considering sex differences in the interpretation of suicidal ideation which contribute to the treatment and prognosis of depression. A longitudinal study in first-episode patients with adolescent depression would further clarify the interrelationship between genders, suicidal ideation, and clinical symptoms.

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of The First Affiliated Hospital of Harbin Medical University and The First Specialist Hospital of Harbin. Each participant who agreed to join in the study were given fully explained and provided an official consent form by the adolescents and their parents.

Consent for publication

Authors have obtained consent to publish from the participant to report patient data.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Jinbo Wu, Xiaohong Wang, Yue Zheng, Na Zhao were responsible for study design, statistical analysis, and manuscript preparation. Chuanyi Kang, Jiacheng Liu, Jingjing Shi, Liying Yang, Sitong Liu, Wanqiu Yang, and Tiefeng Guan were responsible for recruiting the patients, performing the clinical rating and collecting the samples. All authors have contributed to and have approved the final manuscript.

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