



## Research paper

# Patterns of adverse childhood experiences and suicidal behaviors in adolescents: A four-province study in China

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## ABSTRACT

**Background:** : Adverse childhood experiences (ACEs) are associated with increased suicidal behaviors in adolescents and most research has been restricted to certain types of or cumulative exposure to ACEs. Few studies have examined the association between patterns of ACEs and suicidal behaviors.

**Objective:** : To identify the contributions of type and pattern of exposure to ACEs to suicidal behaviors and their gender differences among middle school students in China.

**Methods:** : A school-based health survey was conducted in four provinces in China between 2017 and 2018. 14 500 students aged 10–20 years completed standard questionnaires, to record details of ACEs, suicide ideation, suicide plan, and suicide attempt.

**Results:** : Latent class analysis indicated four distinct patterns of ACEs exposure: high ACEs (6.3%), high abuse and neglect (21.4%), high neglect (45.5%), and low ACEs (26.8%). Logistic analyses showed that, compared with low ACEs, the high ACEs were more likely to report suicidal behaviors. No gender differences were found in the independent effects of ACEs type or pattern on suicidal behaviors, except for the emotional neglect associated with suicidal behaviors in girls than boys.

**Limitations:** : The study was cross-sectional and used self-reported questionnaires. Thus, it is difficult to establish a causal relationship between patterns of ACEs and suicidal behaviors.

**Conclusion:** : Our findings addressed the need for a comprehensive consideration of ACEs in preventive healthcare work to identify children exposed to the most problematic ACE patterns. The study provided the evidence of targeted intervention to preempt the emergence of suicide behavior in at-risk students in adolescents.

## 1. Introduction

Adverse childhood experiences (ACEs) refer to some of the most intensive and frequently occurring sources of stress that children may suffer early in life. Such experiences include multiple types of abuse, neglect, violence between parents or caregivers, other kinds of serious household dysfunction such as alcohol and substance abuse, divorce/separation of parents, witnessed domestic violence, and family financial

difficulties (World Health Organization, 2018). There is much evidence that child abuse and neglect increase the risk of suicidal behaviors (Norman et al., 2012). Recently Briere et al. (2016) reported that adults who had made at least one recent suicide attempt had higher rates of childhood sexual and physical abuse in comparison to those without suicide attempt. A systematic review concluded that there was solid evidence that childhood maltreatment is associated with increased odds for suicidal behaviors in adults (Angelakis et al., 2019). Similarly, early

**Abbreviations:** ACEs, Adverse childhood experiences; LMICs, low and middle income countries; CTQ, Child Trauma Questionnaire; SD, standard deviation; LCA, latent class analysis; AIC, Akaike's Information Criteria; BIC, Bayesian Information Criteria; ssaBIC, sample size adjusted BIC; LMRT, Lo-Mendell-Rubin Test; aOR, adjusted odds ratio; CIs, confidence intervals; RORs, ratio of two odds ratios; SPSS, Statistical Product and Service Solutions.

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exposure to interpersonal violence confers a risk of suicide attempts and particularly suicide death in youths and young adults (Castellví et al., 2017).

Previous research on ACEs estimates focused on certain types rather than the combined exposure to various types of ACEs (Khan et al., 2020; Felitti et al., 2019). Several studies have indicated that different types of ACEs lead to various health effects. For example, one study involving 989 college students from two universities in China found that the strongest predictor of suicide ideation in adulthood was peer isolation/rejection, followed by emotional neglect, and low socioeconomic status (Wang et al., 2019). However, when children experienced ACEs, most encountered several types of ACEs, not just one. ACEs are a mixture of many different types of exposure, so the estimate of a single ACE form cannot reflect the actual exposure in daily life completely. In other words, ACEs are complex and multifaceted, and advanced statistical techniques are required to improve their assessment. Emerging research using a person-centered, pattern-based approach demonstrated discernible patterns of ACEs co-occurrence that are associated with different risk profiles for poorer outcomes (Barra et al., 2018; Shin et al., 2018). The findings of these studies are largely restricted to western contexts, and there is lack of data from low and middle income countries (LMICs).

Furthermore, there are uncertainties in gender differences in the association of ACEs with suicidal behaviors in adolescents. Some studies (Pournaghash-Tehrani et al., 2019) reported a stronger association between ACEs and suicide ideation in girls than boys, while other studies found that suicidal ideation was more common among boys exposed to emotional neglect than girls (Wan et al., 2019). In this paper, we examined data of a large middle school cross-sectional survey in China to assess the contribution of ACEs patterns to suicide behaviors using the person-centered approaches and identify gender differences in the exposure pattern of ACEs in Chinese middle school students.

## 2. Materials and methods

### 2.1. Sample and procedure

A total of 15,486 junior and senior middle school students aged 10 to 20 years old (mean age 14.83, SD = 1.79) were recruited in this study using a health survey of adolescents in junior and senior middle schools (Grades 7–12) in four cities (Zhengzhou in Henan province, Guiyang in Guizhou province, Nanchang in Jiangxi province, and Shenzhen in Guangdong province) in China. Eight schools (four rural and four urban) were selected randomly from each city; all were either general junior or senior middle schools. As three were combined junior and senior schools, 29 schools were finally selected for inclusion in the survey. In each school, a cluster sampling method was used to extract three classes from each grade. The participants were then asked to complete an anonymous questionnaire. The survey was conducted from November 2017 to January 2018. A total of 15,486 questionnaires were distributed, and 14,615 questionnaires were recovered (645 students with refusal to participate; 226 students with absence). The response rate was 94.4%. 115 (0.79%) questionnaires were eliminated (79 questionnaires with missing value >5%; 20 questionnaires with fictitious responses; 16 questionnaires with participants over the age of 20). After screening, 14,500 questionnaires were included in the analysis and the efficiency rate was 99.21%. The design and data collection procedures were approved by the Ethics Committee of Anhui Medical University (20,170,290). Informed consent was obtained from the parents or guardians of the students.

### 2.2. Measures

#### 2.2.1. Adverse childhood experiences

ACEs were defined as experiences during childhood of maltreatment and/or household dysfunction. Child maltreatment was evaluated using

the Chinese version of Childhood Trauma Questionnaire 28 items Short Form (CTQ-SF). CTQ-SF (Bernstein et al., 2003) has been translated and validated in Chinese by Zhao in 2005 (Zhao et al., 2005). The Chinese version of the CTQ-SF, has 28 items including 25 clinical items and 3 validity items assessing five different forms of childhood trauma: physical abuse, sexual abuse, emotional abuse, physical neglect, and emotional neglect. Each form included 5 items and 3 other items was taken as validity evaluation among CTQ. The participants were asked about any abusive childhood experiences that occurred before the age of 12. Response scores ranged from 1 = “never,” 2 = “rarely,” 3 = “sometimes,” 4 = “often,” and 5 = “very often.” Respondents were defined as “exposed to a category” if they responded “very often,” “often,” or “sometimes” to any item in that category. The Cronbach’s  $\alpha$  coefficient for the CTQ was 0.75 in the present study. Cronbach’s  $\alpha$  coefficients of the physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect scale in this study was 0.73, 0.69, 0.76, 0.65, and 0.85, respectively.

Household dysfunction items were derived from Felitti et al., adapted to the actual situation in China (Felitti et al., 1998). Household dysfunction was assessed through endorsement of the following experiences: (1) divorce/separation of parents, (2) witnessed domestic violence, (3) lived with someone with alcohol or gambling problems, and (4) family financial difficulties. Respondents were defined as having been exposed to household dysfunction if they responded “Yes” to any of these items.

#### 2.2.2. Suicidal behaviors

Suicide ideation, suicide plan, and suicide attempt refer to categories in the ‘middle school questionnaire’ of the 2015 Youth Risk Behavior Surveillance System in America (Centers for Disease Control, 2015). Suicide ideation was defined as a “yes” in response to the question “Have you ever seriously thought about killing yourself in the past 12 months?” Suicide plan was defined as a “yes” in response to the question, “Have you ever made a plan about how you would kill yourself in the past 12 months?” Suicide attempt was defined as a “yes” in response to the question “Have you ever tried to kill yourself in the past 12 months?”

### 2.3. Covariates

Demographic data for each participant were recorded, including age, gender (boys or girls), regional area (Shenzhen, Nanchang, Zhengzhou, and Guiyang), urban/rural residency, parents’ education level (less than junior middle school, junior middle school, senior middle school, college or higher), self-perceived economic status of the family (poor, moderate, or good), only child (yes or no), and resident student (yes or no).

### 2.4. Statistical analysis

Continuous variables were described using mean and standard deviation (SD), while categorical variables were described using frequency and percentage. Gender differences were assessed using the  $\chi^2$  test for categorical variables and one-way analysis of variance for continuous variables. In order to identify clusters of ACEs, latent class analysis (LCA) was used to identify homogeneous, mutually exclusive “patterns” of 9 ACEs using Mplus 7.4. The 1-class solution was tested first and then the number of classes was incrementally increased until the best fitting model was identified. The ACEs classes were determined based on model fit indices (Table DS 1): Akaike’s Information Criteria (AIC) (Akaike, 1974), Bayesian Information Criteria (BIC) (Schwarz, 1978) and sample size adjusted BIC (ssaBIC) (Sclove, 1987), entropy, and  $p$ -value for Lo-Mendell-Rubin Test (LMRT) (Lo, 2001). And multiple sets of random starting values would be specified for each LCA model tested. Individuals are assigned to latent classes based on their largest posterior class membership probabilities that can be obtained from their observed responses and the estimated parameters of the LCA model in Mplus. The best model was identified based on substantive interpretation and

multiple fit statistics. After determining the best fitting model, the association between a set of demographic covariates and class membership was assessed using the modified three-step Mplus procedures (R3STEP auxiliary command) recommended by Vermunt (Vermunt, 2010) to ensure that the effects of the covariates on the classes were minimally biased. This approach takes into account measurement error associated with the most likely class membership, while preserving the stability of class formation. Multivariable logistic regressions were conducted to evaluate the relationships between ACEs and suicidal behaviors, presented as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). In the multivariable logistic regressions, adjustment was made for gender (only in Table 2), age, regional areas, school, urban/rurality, parents' education level, economic status of family, only child and resident student. We also examined whether the associations vary by gender via two odds ratios (ratio of two odds ratios, RORs) (Altman and Bland, 2003). All analyses were conducted using SPSS software, Windows version 23.0.

### 3. Results

#### 3.1. Characteristics of participants

As shown in Table 1, of the 14 500 participants, the mean age was 14.83 years (SD = 1.79), and 50.7% were boys. 52.9% of the participants had experienced emotional abuse, 25.3% had experienced physical abuse, 13.8% had experienced sexual abuse, 68.1% had experienced emotional neglect, 57.2% had experienced physical neglect, 5.3% had family members with alcohol or gambling problems, 12.6% had experienced parental divorce or separation, 13.6% had witnessed domestic violence, and 8.7% had experienced family financial difficulties. In total, 24.6% of the sample had suicidal ideation, 12.0% had a suicide plan, and 4.9% had attempted suicide in the past 12 months.

Boys had significantly increased exposure to emotional, physical, and sexual abuse, emotional and physical neglect, family members with alcohol or gambling problems, and family financial difficulties than girls ( $P < 0.001$ ). Compared to boys, girls had significantly greater exposure to divorce/separation of parents ( $P = 0.002$ ), suicide ideation ( $P = 0.002$ ), and suicide plan ( $P < 0.001$ ).

#### 3.2. Patterns of ACEs

Models with one to seven classes were tested in the LCA (Table DS 1). The 4-class model was selected based on the lower BIC, ssaBIC and higher entropy (0.748), and the average posterior class membership probability scores were acceptable among groups (0.749–0.898; Table DS 2).

Fig. 1 shows the 4-class model of ACEs and item-response probabilities for the 9 ACEs for each class. Class 1 is characterized by a high probability of exposure to each of the 9 ACEs; thus, we labeled this latent class “high ACEs” (6.3%); Class 2 is comprised of individuals who have high probabilities of endorsing exposure to physical abuse, emotional abuse, physical neglect, and emotional neglect, which was labeled as “high abuse and neglect” (21.4%). Class 3 consists of individuals likely to report physical neglect and emotional neglect, which was labeled as “high neglect” (45.5%). Class 4 characterized by a low probability of exposure to each of the 9 ACEs was labeled as “low ACEs” (26.8%). Each pattern was approximately equally represented in both sexes (Figure DS 1, 2).

#### 3.3. Types and patterns of ACEs with suicidal behaviors

As shown in Table 2, associations between ACEs and suicidal behaviors are presented in Table 2. All types and patterns of ACEs had a statistically significant association with suicidal behaviors. Regarding suicide ideation (aOR: 3.20, 95% CI: 2.94–3.48) and suicide plan (aOR: 3.37, 95% CI: 2.99–3.80), the adjusted OR displayed the highest for

**Table 1**

Characteristics of participants by gender, data shown as n(%).

Variables	Total	Girls	Boys	P-value
Age (mean, std)	14.83 (1.79)	14.69 (1.760)	14.96 (1.804)	<0.001
Regional areas				
Shenzhen	3465 (23.9%)	1554 (21.7%)	1911 (26.0%)	<0.001
Nanchang	3697 (25.5%)	1734 (24.2%)	1963 (36.7%)	
Zhengzhou	3678 (25.4%)	1833 (25.6%)	1845 (25.1%)	
Guiyang	3660 (25.2%)	2032 (28.4%)	1628 (22.2%)	
Urban/Rurality				
Urban	3890 (26.8%)	2016 (25.5%)	1874 (28.2%)	<0.001
Rurality	10,610 (73.2%)	5137 (74.5%)	5473 (71.8%)	
Father's education level				
College or more	3479 (24.0%)	1647 (11.4%)	1832 (24.9%)	<0.001
Senior middle school	4120 (28.4%)	1974 (27.6%)	2146 (29.2%)	
Junior middle school	4706 (32.5%)	2373 (33.2%)	2333 (31.8%)	
Less than junior middle school	2195 (15.1%)	1159 (16.2%)	1036 (14.1%)	
Mother's education level				
College or more	2735 (18.9%)	1274 (17.8%)	1461 (19.9%)	<0.001
Senior middle school	3786 (26.1%)	1806 (25.2%)	1980 (26.9%)	
Junior middle school	4664 (32.2%)	2398 (33.5%)	2266 (30.8%)	
Less than junior middle school	3315 (22.9%)	1675 (23.4%)	1640 (22.3%)	
Economic status of family				
Good	2451 (16.9%)	1091 (15.3%)	1360 (18.5%)	<0.001
Moderate	10,010 (69.0%)	5189 (72.5%)	4821 (65.6%)	
Poor	2039 (14.1%)	873 (12.2%)	1166 (15.9%)	
Only child	4669 (32.2%)	1902 (26.6%)	2767 (37.7%)	<0.001
Resident student	6830 (47.1%)	3324 (46.5%)	3506 (47.7%)	<0.001
Type of ACEs				
Emotional abuse	7669 (52.9%)	3987 (50.1%)	3682 (55.7%)	<0.001
Physical abuse	3662 (25.3%)	1595 (22.3%)	2067 (28.1%)	<0.001
Sexual abuse	1998 (13.8%)	756 (10.6%)	1242 (16.9%)	<0.001
Emotional neglect	9873 (68.1%)	4778 (66.8%)	5095 (69.3%)	<0.001
Physical neglect	8295 (57.2%)	3896 (54.5%)	4399 (59.9%)	<0.001
Lived with someone with alcohol or gambling problems	772 (5.3%)	309 (4.3%)	463 (6.3%)	<0.001
Parental divorce or separation	1821 (12.6%)	960 (13.4%)	861 (11.7%)	0.002
Witnessed domestic violence	1976 (13.6%)	944 (13.2%)	1032 (14.0%)	0.136
Family financial difficulties	1265 (8.7%)	563 (7.9%)	702 (9.6%)	<0.001
Number of ACEs type				
0	1942 (13.4%)	1003 (14.0%)	939 (12.8%)	<0.001
1	2192 (15.1%)	1179 (16.5%)	1013 (13.8%)	
2	3361 (23.2%)	1638 (22.9%)	1723 (23.5%)	
3	2916 (20.1%)	1446 (20.2%)	1470 (20.0%)	
4+				

(continued on next page)

**Table 1** (continued)

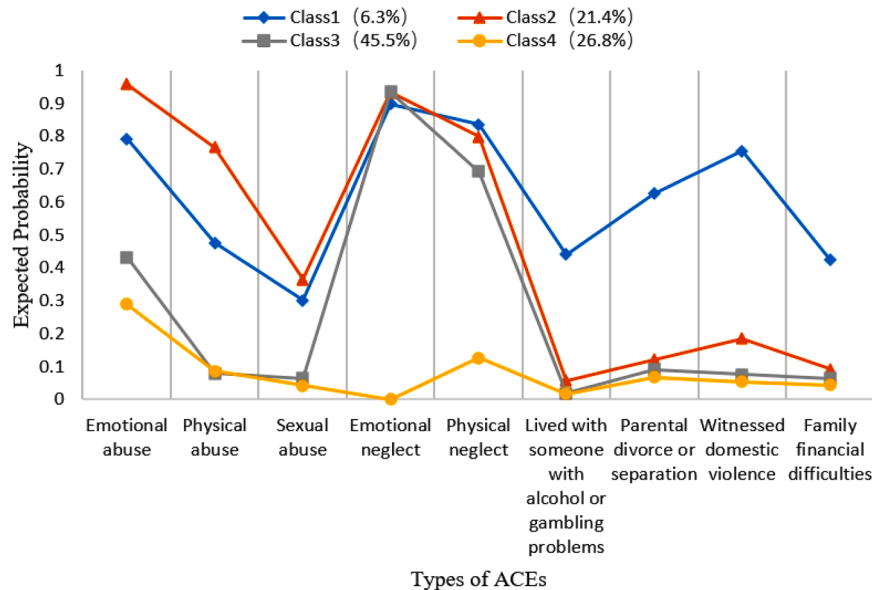
	4089 (28.2%)	1887 (26.4%)	2202 (30.0%)	
Suicide ideation	3562 (24.6%)	1907 (26.7%)	1655 (22.5%)	0.002
Suicide plan	1738 (12.0%)	903 (12.6%)	835 (11.4%)	<0.001
Suicide attempt	717 (4.9%)	374 (5.2%)	343 (4.7%)	0.120

ACEs = adverse childhood experiences.

emotional abuse. Regarding suicide attempt, the adjusted OR displayed the highest for sexual abuse (aOR: 3.81, 95% CI: 3.23–4.49). Compared with the “low ACEs” pattern, adolescents assigned to other classes of ACEs exposure had a higher risk of reporting suicide ideation, suicide plan and suicide attempt. The strongest association with suicidal behavior was observed in “high ACEs” patterns ( $P < 0.001$ ).

### 3.4. Gender difference between ACEs and suicidal behaviors

As shown in Fig. 2, 3 and 4, all types and patterns of ACEs were

**Fig. 1.** Plot of 4 latent classes of adverse childhood experiences.**Table 2**

Number, percents and odds ratio of suicide ideation by ACEs types and patterns: adverse childhood experiences.

ACEs Patterns	Suicide ideation n (%)	aOR (95%CI)	P	Suicide plan n (%)	aOR (95%CI)	P	Suicide attempt n (%)	aOR (95%CI)	P
Low ACEs	613 (14.2%)	1.0		237(5.5%)	1.0		90(2.1%)	1.0	
High ACEs <sup>a</sup>	364 (45.6%)	5.08 (4.29–6.01)	<0.001	230 (28.8%)	6.71 (5.45–9.25)	<0.001	118 (14.8%)	7.03 (5.24–9.44)	<0.001
High neglect and abuse <sup>a</sup>	1200 (40.8%)	4.15 (3.70–4.66)	<0.001	667 (22.7%)	4.82 (4.11–5.65)	<0.001	304 (10.3%)	5.05 (3.96–6.45)	<0.001
High neglect <sup>a</sup>	1385 (21.5%)	1.63 (1.46–1.81)	<0.001	604(9.4%)	1.72 (1.47–2.01)	<0.001	205(3.2%)	1.47 (1.14–1.90)	<0.001
Type									
Emotional abuse <sup>a</sup>	2627 (34.3%)	3.20 (2.94–3.48)	<0.001	1349 (17.6%)	3.37 (2.99–3.80)	<0.001	546(7.1%)	2.78 (2.33–3.32)	<0.001
Physical abuse <sup>a</sup>	1409 (38.5%)	2.53 (2.32–2.75)	<0.001	780 (21.3%)	2.69 (2.42–2.99)	<0.001	374 (10.2%)	3.38 (2.89–3.94)	<0.001
Sexual abuse <sup>a</sup>	768 (38.4%)	2.25 (2.03–2.49)	<0.001	463 (23.2%)	2.70 (2.39–3.05)	<0.001	257 (12.9%)	3.81 (3.23–4.49)	<0.001
Emotional neglect <sup>a</sup>	2847 (28.8%)	2.12 (1.94–2.33)	<0.001	1449 (14.7%)	2.41 (2.11–2.76)	<0.001	596(6.0%)	2.18 (1.78–2.66)	<0.001
Physical neglect <sup>a</sup>	2475 (29.8%)	1.99 (1.83–2.16)	<0.001	1261 (15.2%)	2.07 (1.86–2.33)	<0.001	569(6.9%)	2.80 (2.32–3.37)	<0.001
Lived with someone with alcohol or gambling problems <sup>a</sup>	330 (42.7%)	2.39 (2.049–2.78)	<0.001	214 (27.7%)	2.98 (2.51–3.54)	<0.001	117 (15.2%)	3.63 (2.91–4.53)	<0.001
Parental divorce or separation <sup>a</sup>	637 (35.0%)	1.76 (1.58–1.96)	<0.001	353 (19.4%)	1.87 (1.63–2.13)	<0.001	170(9.3%)	2.08 (1.73–2.50)	<0.001
Witnessed domestic violence <sup>a</sup>	726 (36.7%)	1.96 (1.76–2.17)	<0.001	391 (19.8%)	1.98 (1.74–2.25)	<0.001	175(8.9%)	1.95 (1.63–2.34)	<0.001
Family financial difficulties <sup>a</sup>	402 (31.8%)	1.45 (1.27–1.67)	<0.001	255 (20.2%)	1.98 (1.68–2.34)	<0.001	147 (11.6%)	2.66 (1.14–3.30)	<0.001

ACEs = adverse childhood experiences;

aOR = adjusted odds ratio;

a = Adjusted for gender, age, regional areas, school, urban/rurality, parents' education level, economic status of family, only child and resident student.

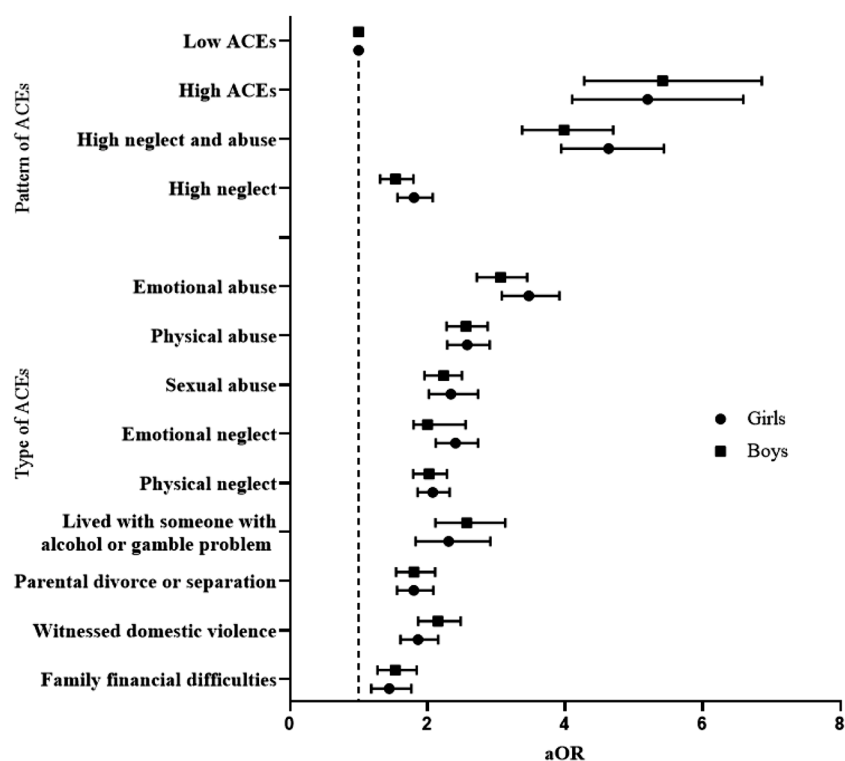


Fig. 2. Logistic regression models of suicide ideation by individual ACEs (Reference: 0 ACEs) and pattern of ACEs (Reference: Low ACEs). Adjusted for age, regional areas, school, urban/rurality, parents' education level, economic status of family, only child and resident student.

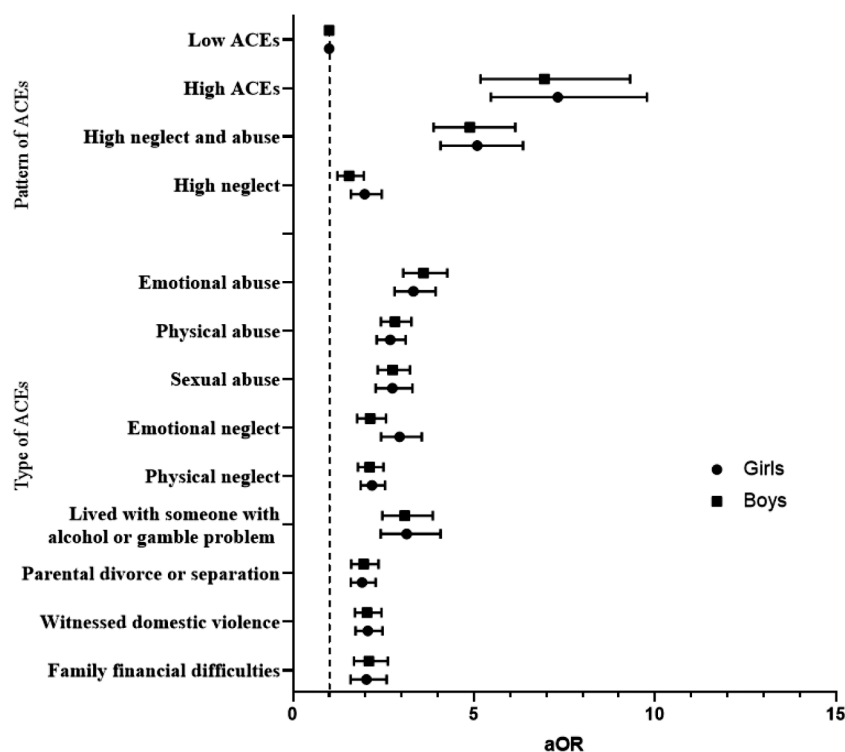
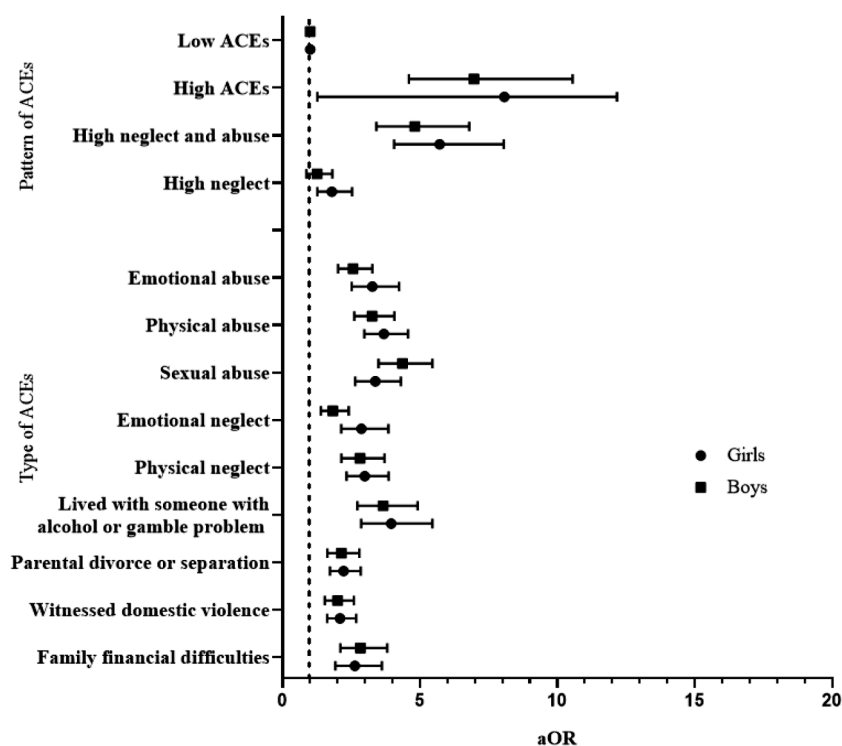


Fig. 3. Logistic regression models of suicide plan by individual ACEs (Reference: 0 ACEs). and pattern of ACEs (Reference: Low ACEs). Adjusted for age, regional areas, school, urban/rurality, parents' education level, economic status of family, only child and resident student.

associated with suicidal ideation, suicide plan, and suicide attempt in both boys and girls. No gender differences were found in the independent effects of ACE type or ACE pattern on suicidal behaviors, with the exception of emotional neglect, which had a stronger effect on suicidal

ideation (ROR: 1.20, 95% CI: 1.00–1.45) ( $P = 0.049$ ), suicide plan (ROR: 1.38, 95% CI: 1.06–1.80) ( $P = 0.018$ ), and suicide attempt (ROR: 1.57, 95% CI: 1.05–2.35) ( $P = 0.018$ ) in girls than in boys.





**Fig. 4.** Logistic regression models of suicide attempt by individual ACEs (Reference: 0 ACEs) and pattern of ACEs (Reference: Low ACEs). Adjusted for age, regional areas, school, urban/rurality, parents' education level, economic status of family, only child and resident student.

#### 4. Discussion

Our study examined the association between patterns of ACEs and suicidal behaviors in adolescence from the large survey of middle school in China. We found that for suicide ideation and suicide plan, the most significant ACEs were emotional abuse, and for suicide attempt, the most significant ACEs were sexual abuse. For all suicide behaviors, the most significant ACEs latent class was high ACEs, followed by high neglect and abuse. In this study, with the exception of emotional neglect, there were no gender differences in other ACEs types and patterns.

##### 4.1. Effect of ace type on suicidal behaviors

Previous studies have shown a relationship between ACEs, suicidal ideation, suicide plan, and suicide attempt, which were consistent with the current study (Cluver et al., 2015; Thompson et al., 2019; Miche et al., 2020). A 10-years longitudinal community study on adolescents and young adults aged 14–24 years at baseline found that different traumatic events have been shown to elevate the risk of suicide attempt in a young community sample, but rape/sexual abuse had the highest hazard ratio (Miche et al., 2020). Thompson et al. found that the odds of suicidal ideation in adulthood increased two-fold to three-fold among those who had experienced sexual abuse, physical abuse, or emotional abuse in childhood (Thompson et al., 2019). A prospective study in youths aged 14–26 showed that physical abuse, emotional abuse, and emotional neglect were associated with subsequent risk of suicidal behaviors (Harford et al., 2014). Similarly, the Brazilian Internet Study on Temperament and Psychopathology with 71,429 participants found a strong association between emotional abuse and suicide behaviors (de Araújo and Lara, 2016). However, a retrospective cohort study of 17,337 adults in San Diego, California suggested that the risk of suicide attempt was increased two-fold to five-fold by any ACEs (Dube et al., 2001). Meta-analysis indicated that all different types of childhood maltreatment including sexual abuse, physical abuse and emotional abuse were associated with two- to three-fold increased risk for suicide attempts and

suicide ideation (Angelakis et al., 2019). Thus although most studies found that different types of ACEs have various influences on suicidal behaviors, some previous studies found that this influence makes no significant difference. In addition, there is controversy regarding which type of ACE affects suicidal behaviors. Likewise, different samples, definitions of ACEs, and control variables should be considered to interpret the results of this study.

##### 4.2. Effect of ACEs exposure patterns on suicidal behaviors

The LCA analysis allowed for new insights into the differentiated risk of specific ACEs patterns for health effects in adolescent. The National Longitudinal Study of Adolescent and Adult Health (Add Health) identified US children with 4 specific patterns of ACE exposure, which were labeled “child maltreatment,” “household dysfunction,” “community violence,” and “low adversity” (Lee et al., 2020). A study on ACE exposure patterns and depressive and externalizing symptoms with four specific patterns of ACE exposure, which were labeled as “low ACEs,” “highly abusive and neglected,” “highly abusive and adverse events,” and “high ACEs” (Zhang et al., 2020). A recent study of data from the Global Early Adolescent Study (GEAS) analyzed the association between ACEs exposure patterns and depressive symptoms, and violence perpetration among early adolescents globally. LCA identified four mutually exclusive, homogeneous subgroups of ACEs: “all ACEs low,” “high abuse, victimization, and instability,” “high abuse and neglect,” and “all ACEs high” (Blum et al., 2019). This is similar to the present study. Since research on specific profiles of ACEs can inform knowledge about how to tailor interventions for the distinctive needs of each individual, prevention and intervention activities can target those in greatest need. In addition to this, efforts to further ascertain the effects of different patterns of ACEs may be necessary empirically and clinically.

Using LCA, we identified 4 patterns of ACE exposure in our sample and found differences in the risk of suicidal behavior for different patterns. The association between the risk of suicidal behavior and the “high ACEs” pattern was significantly higher compared to the “high

neglect” and “high abuse and neglect” patterns. A study of data from the 2016 Minnesota Student Survey identified three subgroups of co-occurring familial adversities: “low or no family based adversity,” “parental dysfunction but low maltreatment,” and “parental dysfunction plus maltreatment,” and found that although membership in the “parental dysfunction plus maltreatment” class was associated with the highest odds of suicidal ideation and suicide attempt, membership in either class of familial adversity elevated risk for these behaviors compared to membership in the “low or no adversity” class (Forster et al., 2020). Similarly, an analysis of data collection started with 801 respondents participating in Amazon’s Mechanical Turk (MTurk) in Spring 2015 showed that the “Poly-victimization” pattern had a higher association with suicidal behaviors in contrast to the association with the “Predominantly crime and sibling/peer victimization” pattern (Charak et al., 2016). These results are very similar to those found in our study in that the risk of suicidal behaviors increased with an increase in ACEs exposure.

#### 4.3. Gender differences in ACEs and suicidal behaviors

Our study has demonstrated this phenomenon by demonstrating gender-difference effects in the relationships, and by addressing the limitation of the lack of equivalent research within Chinese middle school students. It was found that emotional neglect had a stronger impact on suicidal behaviors in girls than in boys, which was consistent with other studies. A cross-sectional retrospective study with 524 undergraduate students from an Iranian University found that ACEs in women had a stronger impact on suicide outcomes (Pournaghsh-Tehrani et al., 2019). A cross-sectional general health questionnaire with young adults (ages 18–29 years) showed that ACEs-exposed females reported worse mental health status than ACEs-exposed males, while males reported more substance use than females, but most outcomes did not vary significantly by sex (Grigsby et al., 2020). However, the current study found no gender differences in the independent effects of ACE patterns on suicidal behaviors. The risk of suicide behaviors showed an increasing trend as the degree of ACEs exposure increased in both genders. At the same time, LCA was performed separately for boys and girls, but showed similar results thus the effects of exposure to ACE patterns on suicidal behaviors were similar for boys and girls.

#### 4.4. Strengths and limitations

We used the person-centered approaches to identify distinct patterns of ACEs, which are in a more concise way than prior methods of representing ACEs subtypes. It is the first study in LMICs to identify the contributions of type and pattern of exposure to ACEs to suicidal behaviors and their gender differences among middle school students in China. The sample is large and then we could perform multivariate adjustment analysis, including gender differences.

Our study has several limitations. First, the study was cross-sectional, therefore, it is difficult to establish a causal relationship. Nonetheless, our findings about the association between ACEs and suicidal behaviors were similar to those in previous cohort studies (Zhang et al., 2020; Hadland et al., 2015). Second, the study only included nine types of ACEs, therefore, this study was not comprehensive and future research should consider more types such as bullying and community violence. Third, because of the use of self-reported questionnaires for data collection purposes, it is possible that recall bias may exist. Finally, this study only analyzed the patterns of ACE types and did not consider the mixed influence of other forms such as timing, frequency, and perpetrators.

## 5. Conclusion

ACEs exposure have the existence of latent individual heterogeneity in this population of adolescents. The current study has furthered our

understanding of the relationship between patterns and special types of ACEs and suicidal behaviors. Thus, the study findings have addressed the need for a comprehensive consideration of ACEs exposure associated with the risk of suicidal behaviors in young adulthood through identifying children exposed to the most problematic ACEs patterns. Our data have afforded an opportunity to identify children that would benefit from targeted early interventions.

## Ethical considerations

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

## Submission declaration

This article has not been published previously, not under consideration for publication elsewhere, its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

## Authors’ contributions

Shuqin Li was involved in data entry, statistical analysis and interpretation, and writing of the manuscript. Shanshan Wang, Xin Gao, Zhicheng Jiang assisted in data entry, statistical analysis and revising the manuscript. Huiqiong Xu, Shichen Zhang and Ying Sun assisted in the development of the study methodology and revising the manuscript. Fangbiao Tao, Ruoling Chen and Yuhui Wan were involved in developing the research question and study methodology, providing assistance and guidance in the interpretation of the study data, and revising the manuscript. All authors approved the final version of the submitted manuscript.

## Declaration of competing interest

None.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2021.02.045.

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