Journal of Youth and Adolescence (2023) 52:2300–2313
https://doi.org/10.1007/s10964-023-01821-7

EMPIRICAL RESEARCH

Profiles, Transitions, and Resilience Factors of Suicide Risk in Early Chinese Adolescents

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Received: 31 May 2023 / Accepted: 6 July 2023 / Published online: 17 July 2023

Abstract

As a severe public health concern directly endangering life safety, adolescent suicide has been extensively investigated in variable-centered studies. However, gaps remain in the knowledge of heterogeneous suicide risk patterns and their developmental nature. Additionally, little is known about protective factors associated with suicide risk patterns and changes. This study applied person-centered approaches to explore suicide risk profiles and transitions over time in early Chinese adolescents, along with their protective factors. A total of 1518 junior high school students (49.6% girls, $M_{age} = 13.57$, $SD = 0.75$) participated in two surveys within a 12-month interval. Latent Profile Analysis and Latent Transition Analysis were used to model the profiles and transitions of suicide risk. Three risk profiles were identified at both time points: *low risk* profile (73.9, 78.3%), *medium risk-high threat* profile (16.2, 10.2%), and *high risk* profile (9.9, 10.2%). *Low risk* profile was stable, while *medium risk-high threat* and *high risk* profiles showed great transitions over 12 months. Sense of control, meaning in life, and regulatory emotional self-efficacy served as protective factors against suicide risk profiles and transitions. Findings underscore the importance of comprehensively illustrating suicide risk states from multiple aspects, as well as understanding the fluid nature of transitions between different risk states. Prevention and intervention strategies aimed at enhancing resilience, such as increasing sense of control, perceived meaningfulness, and belief in emotional regulation, may contribute to reducing the risk of suicide among adolescents.

Keywords Adolescents · Suicide risk · Profiles · Transitions · Resilience factors

Introduction

During adolescence, a range of stressors, including mental and physical distress, poor academic performance, and challenging interpersonal relationships, can emerge (Blakemore 2019), potentially heightening vulnerability to suicidality (Scott et al. 2010; Wilkinson 2011). World Health Organization (2022) data reported that suicide ranked second in the leading death causes among youth aged 10–19 worldwide. In China, suicide issues frequently arise among adolescents, with suicide ideation prevalence ranging from 17.6 to 23.5% and suicide attempt prevalence ranging from 2.9 to 3.8% (Liu et al. 2019). According to another large-sample survey conducted in China, 41.5% of adolescents were classified as having suicide risk (Xu et al. 2018). Suicide-related behaviors co-exist (Jiang et al. 2010) and undergo changes throughout early stages (Oppenheimer et al. 2022), which highlights the potential for negative consequences for vulnerable young individuals. However, most studies have not explored the specific suicide risk patterns and their developmental nature in a sample of Chinese adolescents, as well as the associated protective factors. In-depth research on the risk of adolescent suicide is crucial for addressing the significant public concern surrounding this issue. Therefore, this study employed person-centered approaches to identify diverse profiles and transitions of suicide risk, and further investigate the protective effects of resilience factors.

Latent Patterns of Suicide Risk

Suicide risk is a complex and dynamic state marked by a spectrum of past attempt, current ideation, threat, and willingness associated with self-destructive actions (Osman

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et al. 2001). Suicide ideation and attempt involves thoughts and behaviors about ending one's life (Silverman et al. 2007). Suicide threat refers to the explicit or implicit expression of intent to commit suicide (Jobes 2006). Suicide willingness reflects the acceptance or desire for death. Those indicators provide critical information in determining an individual's risk of follow-up suicidal behaviors (Stefansson et al. 2012) and even long-term mortality (Fagerström et al. 2021; Kapur et al. 2015; Raue et al. 2010). Different aspects of suicidality could co-exist and interact with each other, which may pose a greater risk. As the Three-Step Theory of Suicide posits: suicide ideators with a history of suicide attempt, compared to those without lifetime attempt, are far more likely to engage in suicidal behaviors subsequently because they could acquire practical capacity for suicide from past attempts (Klonsky and May 2015, Ren et al. 2019). Furthermore, high levels of suicide ideation and engagement in suicidal actions are often concomitantly associated with low disclosure of suicide intention, consequently rendering certain at-risk populations imperceptible and precluding them from receiving timely and efficacious intervention (Hallford et al. 2023). The evidence suggest that research should adopt a more holistic perspective to understand the comprehensive characteristics of suicide risk.

Prior studies commonly indicated the degrees of suicide risk via aggregate calculations of pertinent risk components (e.g., Kang et al. 2019; Rey et al. 2019), or ascertained the state of suicidal risk through established threshold delineations of relevant measures (e.g., Pournaghash-Tehrani et al. 2021; Xu et al. 2018). Such variable-centered methodologies or antecedent tactics have overlooked the multifaceted nature of suicidal risk status within a demographic sample and potentially suffer from misclassifications, thereby proving ineffective in the precise identification and characterization of suicide risk status (Nylund et al. 2007). Person-oriented analytic techniques, such as the Latent Profile Analysis (LPA) or Latent Class Analysis (LCA), can help to overcome those limitations. Unlike conventional variable-oriented approaches, which focus on relationships between variables, LPA and LCA gain advantages in discerning meaningful subgroups based on a set of observed indicators and allowing for misclassification errors (Howard and Hoffman 2018).

Several recent studies have used LPA or LCA to evaluate the latent structure of youth suicide risk. For instance, an analysis identified five profiles of adolescents based on a range of factors relevant to suicide risk, including suicidal thoughts and actions, depression, aggression, drug misuse, and physical and sexual abuse (King et al. 2020). The study found the subgroups displayed varying levels of mental health service use. The other research revealed three distinct risk classes among firearm suicide decedents: "low problems", (characterized by a low probability of all risk factors, 50.3% of the sample), "high mental health problems and suicidality" (34.69%), and "high problems at school" (15.1%), moreover, it was found that Black adolescents had decreased odds of being in the "high mental health and suicidality" class compared to being in the "low problems" class than their White counterparts (Osborne et al. 2021). Despite the efforts, existing literature has commonly focused on western samples. A study has illustrated different profiles of non-suicidal self-injury among Chinese youth (Gao et al. 2021), while those risk patterns were represented by certain risk antecedents of suicidality (e.g., self-injurious behaviors, parental hostility, negative emotions, and relationship disturbance), which are insufficient to capture finer-grained details on suicidal states. Therefore, questions remain regarding the specific risk profiles based on multiple robust suicide indicators among Chinese adolescents.

Changes of Suicide Risk Patterns

The developmental psychopathology framework suggests that suicidality manifests differently and evolves throughout life, particularly in the early stages (Oppenheimer et al. 2022). Therefore, incorporating a developmental perspective into youth suicide research is also crucial for identifying the areas where suicide prevention efforts should be focused. Indeed, longitudinal studies have revealed specific developmental courses of adolescent suicidality. A study have found that the development of suicide ideation from adolescence to mid-adulthood followed three trajectories: being initially low and keeping sustained, being initially high and keeping sustained, and initially increasing and then decreasing. Moreover, the changes of suicide attempt followed two trajectories: being initially high and then decreasing, and being initially low and keeping sustained (Erausquin et al. 2019). Other findings on youth suicidality developmental paths were also observed (Geoffroy et al. 2021; Kim et al. 2019). Nevertheless, these studies mostly focused on the broad variations in suicide risk trends, failing to represent the varied patterns and illustrate how they change over time. Generally speaking, quantitative changes cause qualitative changes, thus the variation of suicdiality levels may reflect the transition of suicide risk patterns.

The Latent Transition Analysis (LTA), as a longitudinal extension of LPA/LCA, is helpful in revealing the transitions among the latent profiles across time (Howard and Hoffman 2018). Only two studies applying LTA investigated the dynamic nature of suicide profiles. Specifically, One divided 10424 adolescents into three suicide risk classes (i.e., Low risk, Medium risk, High risk) based on factors including suicide ideation, suicide history of family and friend, depression, and hopelessness (Thompson et al.

2009). The research further revealed the extent to which subgroups remained stable or shifted after 1 year and 7 years: throughout both periods, 92–95% low risk students staying in the same group, 64–88% medium risk students stayed in the same group; 34–82% high risk students moved to Low risk and Medium risk groups. Similarly, the other discovered three subgroups of suicide ideation among young adults and found that individuals in higher-risk groups tended to transit into lower-risk groups, whereas those in lower-risk groups tended to stick with their current groupings more frequently (Fong et al. 2022). Moreover, psychological distress was identified as a transdiagnostic risk factor worsening suicidal ideation over time. Identifying the specific subgroups of the population that remain in a high-risk state or transition between different risk states over time is crucial as it may reinforce the importance of not only addressing immediate risk but also monitoring and responding to changes in risk over time. Given that person-oriented literature addressing teen transitional patterns of suicide is sparse and the only research still limited in without considering multiple suicide dimensions simultaneously, the developmental nature of the comprehensive risk profiles needs to be further explored.

Influencing Factors Associated with Suicide Risk Patterns and Changes

The Buffering Hypothesis of suicide postulates that some personal beliefs or perceptions might bestow resilience toward suicidality (Johnson et al. 2011). To put it another way, these psychological constructs could mitigate the risk of succumbing to a suicidal crisis when individuals encounter stress or any risk factors. Sense of control, an individual's subjective interpretation of their ability to influence their behaviors and internal states (Lachman et al. 2011), is given prominence. Longitudinal data implies that heightened perceived control forecasts a reduction in depressive symptoms and offers protection against mortality risk (Infurna and Okun 2015). The concept of meaning in life encompasses the perceived essence and values of one's existence (Steger et al. 2006). It is a crucial element of psychological health from early adolescence to advanced adulthood, endowing individuals with life purpose, evaluative standards, and positive self-assessment (King and Hicks 2021; Steger et al. 2009). Regulatory emotional self-efficacy assumes a significant role in self-regulation processes when managing emotions (Bandura et al. 2003; Caprara et al. 2008). Possessing a robust conviction in controlling affective states, young individuals in stressful situations are reported to exhibit decreased maladjustment (Caprara et al. 2010) and heightened well-being levels (Pauletto et al. 2021). In conjunction with their positive association with mental health, research has shown that sense of control (Crandall et al. 2018), meaning in life (Aviad-Wilchek and Ne'eman-Haviv 2018), and regulatory emotional self-efficacy (Valois et al. 2015) confer protective effects against adolescent suicidality. The investigation of resilience factors is significant because it lays the groundwork for suicide preventive measures and intervention endeavors (Sher 2019). However, existing literature has given minimal attention to the roles of the resilience constructs in suicide profiles and transitions, which limits the understanding of individual difference of their potential protection against risk classifications and persistence of resilience between risk shifts.

Some demographic factors play important roles in adolescent suicide risk. With respect to age, for instance, studies have indicated an upward trend in suicide risk as adolescents grow older (Nock et al. 2013). Gender is another critical variable. Research has revealed that girls tend to report higher levels of suicide ideation and attempt than boys (Miranda-Mendizabal et al. 2019). Lastly, the place of residence also affects suicide risk in adolescents. For example, individuals living in rural areas, particularly those with limited access to mental health services, might be at a higher risk compared to their urban counterparts (Fontanella et al. 2015). Nonetheless, further exploration is still necessary to understand how these demographic variables, such as age, gender, and place of residence, explain differences in the suicide risk profiles and transitions.

Current Study

Although informative findings regarding youth suicide have been obtained, a paucity of evidence exists for the comprehensive risk state and related developmental nature of Chinese adolescent suicidality. How resilience factors function in the risk classification and changes also remains largely unknown. The current study put forward three research goals to address the gaps. First, this study aimed to applying LPA to explore the heterogeneous risk profiles based on four suicide indicators (ideation, attempt, threat, and willingness). Drawing on most previous findings, it was hypothesized that three profiles would be identified, which showed low, medium, and high degree of suicidality (Hypothesis 1). The second goal is to applying LTA to investigate the developmental nature (including stability and transition) of suicide risk profiles, using a two-wave longitudinal design with a 12-month interval. Consistent with prior studies, it was hypothesized that lower risk profiles would exhibit greater stability, and higher risk profiles would exhibit greater transition (Hypothesis 2). The third goal is to examine the effects of sense of control, meaning in life, and regulatory emotional self-efficacy on risk profiles and their changes. Given that the resilience factors can

mitigate suicide risk, it was hypothesized that adolescents with high or increased resilience were less likely to be assigned or transit to higher risk profiles (Hypothesis 3).

Methods

Participants and Procedure

Participants from a junior high school in Luoyang, Henan Provence, were recruited by convenient sampling. Two surveys were conducted within a 12-month interval, in May 2021 (T1) and May 2022 (T2), respectively. A total of 1651 students in 7–8th grades completed questionnaires regarding demographic information and all study variables at T1. At T2 data collection, 132 students dropped out due to being absent from school or choosing not to participate and the rest rated on suicide risk items. The final sample consisted of 1518 junior high school students (91.9% participation rate) between the ages of 11 and 15 ($M = 13.57$, $SD = 0.75$, 49.6% girls) in the current analysis. The number of students from urban and rural areas was 438 (28.9%) and 1080 (71.1%).

Ethical approval was granted by the Ethics Committee of the first author's institution. After receiving authorization from relevant school boards, students' and their parents' informed consent was obtained. Participants were assured that they were voluntarily to join in, free to drop out of the surveys and that their privacy would be kept confidential. Under the instructions of well-trained graduate assistants, students spent 20–30 min filling out the paper-and-pencil questionnaires during school time in their classrooms. All collected data were directly encrypted and saved by the first author.

Measures

Suicide risk

Adolescents' suicide risk was evaluated by the Suicidal Behaviors Questionnaire-Revised (SBQ-R, Osman et al. 2001), which showed great internal consistency in Chinese adolescents (Kang et al. 2019; Xu et al. 2018). The SBQ-R contains four aspects of suicidality. Item 1 assesses lifetime suicide attempt (Have you ever considered or attempted suicide as long as you can remember? rated from 1 to 4). Item 2 assesses the frequency of suicidal ideation within 12 months (How many times have you seriously considered ending your life in the past year? rated from 1 to 5). Item 3 assesses the threat (or disclosure) of suicide (Have you ever told others that you intend to or might commit suicide? rated from 1 to 3). Item 4 assesses the willingness of future suicide attempt (How likely is it that you will attempt suicide in the future? rated from 0 to 6). In this study, Cronbach's alpha values were 0.79 at T1 and 0.81 at T2.

Sense of control

Adolescents' sense of control was evaluated by the Chinese version of Sense of Control Scale (Li 2012). The scale has two dimensions: personal mastery (four items) and perceived constraints (eight items). Each item was rated on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree), with high total scores indicating high levels of perceived control. Cronbach's alpha values for the scale was were 0.72 at T1 and 0.82 at T2.

Meaning in life

The Chinese version of the Meaning in Life Questionnaire (Steger et al. 2006; Wang et al. 2016) contains two subscales: Presence of Meaning (MLQ-P) and Search for Meaning (MLQ-S). In this study, the 5-item MLQ-P was used to assess adolescents' meaning in life. Each item was rated on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree), with high total scores reflecting high levels of perceived meaningfulness. Cronbach's alpha values were 0.85 at T1 and 0.83 at T2.

Regulatory emotional self-efficacy

Adolescents' regulatory emotional self-efficacy was assessed by the Chinese version of the Regulatory Emotional Self-efficacy Scale (Caprara et al. 2008, Wen et al. 2009). Self-efficacy in expressing positive affect (four items), self-efficacy in managing despondency/distress (five items), and self-efficacy in regulating anger/irritation (seven items) are the three components of the scale (three items). Each item was rated on a 7-point Likert scale from 1 (absolutely disagree) to 5 (absolutely agree), with high total scores indicating high levels of belief in managing emotions. Cronbach's alpha alues were 0.85 at T1 and 0.94 at T2.

Demographic variables

The effects of demographic factors on suicide risk profiles and transitions were also examined. Age, gender (coded as 1 = female, 0 = male), and place of residence (coded as 1 = rural area, 0 = urban area) were measured at T1.

Data Analysis

First, preliminary analyses of all study variables were performed, including correlation analysis and descriptive statistics. Second, LPA was used to investigate latent profiles of suicide risk based on four SBQ-R indicators. According

to Collins and Lanza (2010), the best-fitting model was determined using the following criteria: (1) lower Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and adjusted BIC (ABIC), (2) higher Entropy (>0.8), and (3) significant Bootstrapped likelihood ratio test (BLRT) and Lo-Mendell-Rubin test (LMRT). Thirdly, unconditional LTA was conducted to illustrate the stability and transition between suicide risk profiles over 12 months. To ensure latent profiles representing the same constructs over time and thus permit a straightforward interpretation of transition possibilities, the assumption of longitudinal measurement invariance was tested in advance by comparing a restricted model to an unrestricted one, with lower values of AIC, BIC, and ABIC indicating better fitness (Collins and Lanza 2010). Finally, multinomial logistic regression analysis was used to examine how baseline levels (T1 scores) of sense of control, meaning in life, and regulatory emotional self-efficacy influence T1 profiles and how increased levels (T2 scores minus T1 scores) of resilience factors influence profile transitions. The demographic factors were also investigated. To ensure that the measurement of latent profile parameters was independent from added covariates' effects, this step were calculated through the manual method (Asparouhov and Muthen 2014). For better description and explanation, scores of protective factors were standardized in the logistic regression analyses.

Missing data in the item responses accounted for 0.3–3.1%. Missing Completely at Random (MCAR) test showed a χ^2/df of 1.11, which indicated a random missing pattern (Schlomer et al. 2010). Full information maximum likelihood (FIML) was used to handle missing data. The model parameters were estimated using the Maximum Likelihood Robust (MLR) estimator. Data analyses were conducted by SPSS 26.0 and Mplus 8.3.

Results

Descriptive Results

The means, standard deviations, and bivariate correlations of study variables were presented in Table 1. Scores of lifetime suicide attempt, recent suicide ideation, suicide threat, and suicide willingness at both T1 and T2 were positively correlated with other ($r = 0.25$–0.70, $p < 0.001$). Scores of sense of control, meaning in life, and regulatory emotional self-efficacy at both T1 and T2 were positively correlated with other ($r = 0.24$–0.54, $p < 0.001$). Scores of lifetime suicide attempt, recent suicide ideation, suicide threat, and suicide willingness at both time points and scores of resilience factors at at both time points were negatively correlated with other ($r = -0.35$–-0.09, $p < 0.001$).

Latent Profile Analysis

LPA models was performed at T1 and T2 to identify suicide risk patterns. Table 2 presented the fit indices of LPA models with an increasing number from 1 to 4. At T1, the 3-profile solution provided the lowest AIB, BIC, and aBIC values, as well as the highest entropy. The LMRT and BLRT were significant for the 3-profile model, but not for the 4-profile solution. A similar result was obtained at T2. These suggested that the 3-profile models at each time point fit best.

Figure 1 and Table 3 illustrated the profile proportions, profile-specific mean scores, and the difference on the SBQ-R indicators among 3 profiles (T1). Profile 1 included 1122 participants (73.9%), reflecting a *low risk* group with the lowest levels of lifetime suicide attempt, frequency of recent suicide ideation, suicide threat, and willingness of future suicide attempt. Profile 2 included 246 participants (16.2%), referring to a *medium risk-high threat* group with relatively high levels of lifetime suicide attempt, recent suicide ideation, suicide willingness and the highest level of suicide threat. Profile 3 included 150 participants (9.9%), referring to a *high risk* group with the highest levels of lifetime suicide attempt, frequency of recent suicide ideation, future suicide willingness, and the lowest level of suicide threat. The similar profile results were found at T2, with the prevalence rates of *low-risk*, *medium risk-high threat*, and *high risk* were 78.3, 10.2, and 11.5%, respectively.

Effects of Predictors on Suicide Risk Profiles

Multinomial logistic regressions were conducted to investigate the effects of T1 sense of control, T1 meaning in life, T1 regulatory emotional self-efficacy, and demographic factors on T1 latent profiles. As shown in Table 4, all variables, except for age, significantly predicted T1 profiles. Higher levels of sense of control, meaning in life, and regulatory emotional self-efficacy were associated with lower odds of being classified as *medium risk-high threat* (OR = 0.67, 0.76, 0.74) rather than *low risk*. Higher levels of meaning in life and regulatory emotional self-efficacy were associated with lower odds of being classified in *high risk* (OR = 0.61, 0.54) rather than *low risk*. Compared with boys, girls were more likely to be assigned to *medium risk-high threat* (OR = 2.00) and *high risk* (OR = 1.59) rather than *low risk*. Adolescents from rural areas were more likely to be assigned to *medium risk-high threat* (OR = 1.41) rather than *low risk*, relative to those from rural areas.

Latent Transition Analysis

Two 3-3 profile LTA models (baseline and invariant) were estimated to examine the longitudinal measurement

Table 1 Basic descriptive information and correlations of study variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. T1 lifetime suicide attempt	1.00													
2. T1 recent suicide ideation	0.64***	1.00												
3. T1 suicide threat	0.47***	0.43***	1.00											
4. T1 suicide willingness	0.65***	0.63***	0.42***	1.00										
5. T2 lifetime suicide attempt	0.49***	0.44***	0.38***	0.44***	1.00									
6. T2 recent suicide ideation	0.40***	0.42***	0.33***	0.42***	0.70***	1.00								
7. T2 suicide threat	0.28***	0.26***	0.38***	0.25***	0.48***	0.45***	1.00							
8. T2 suicide willingness	0.41***	0.39***	0.30***	0.46***	0.66***	0.68***	0.42***	1.00						
9. T1 sence of control	−0.29***	−0.27***	−0.21***	−0.34***	−0.23***	−0.21***	−0.14***	−0.22***	1.00					
10. T1 meaning in life	−0.34***	−0.32***	−0.18***	−0.36***	−0.23***	−0.21***	−0.13***	−0.28***	0.41***	1.00				
11. T1 regulatory emotional self-efficacy	−0.32***	−0.31***	−0.16***	−0.35***	−0.21***	−0.17***	−0.09***	−0.22***	0.40***	0.44***	1.00			
12. T2 sence of control	−0.29***	−0.27***	−0.18***	−0.31***	−0.33***	−0.30***	−0.24***	−0.33***	0.48***	0.36***	0.36***	1.000		
13. T2 meaning in life	−0.23***	−0.23***	−0.13***	−0.26***	−0.28***	−0.28***	−0.19***	−0.32***	0.31***	0.41***	0.29***	0.54***	1.00	
14. T2 regulatory emotional self-efficacy	−0.24***	−0.23***	−0.19***	−0.27***	−0.28***	−0.25***	−0.16***	−0.31***	0.24***	0.28***	0.39***	0.45***	0.51***	1.00
M	1.61	1.72	1.19	0.85	1.49	1.41	1.12	0.60	55.19	26.69	41.79	55.68	24.42	43.92
SD	0.80	1.09	0.45	1.34	0.77	0.84	0.37	1.18	9.02	6.13	7.81	9.78	6.08	9.26

***$p < 0.001$

Table 2 Model fit indices for LPA at two assessment time points

	Model	AIC	BIC	ABIC	Entropy	LMRT(*p*)	BLRT(*p*)
T1	1-profile	15322.86	15365.46	15340.04	–	–	–
	2-profile	12668.89	12738.12	12696.82	0.96	<0.001	<0.001
	3-profile	**11426.59**	**11522.45**	**11465.26**	**0.96**	**<0.001**	**<0.001**
	4-profile	11436.59	11559.07	11486.01	0.88	0.512	1.000
T2	1-profile	13363.51	13406.11	13380.70	–	–	–
	2-profile	9852.04	9921.27	9879.97	1.00	0.049	<0.001
	3-profile	**8468.83**	**8564.68**	**8507.50**	**0.97**	**<0.001**	**<0.001**
	4-profile	8259.67	8382.15	8309.08	0.95	0.179	<0.001

Bolded rows indicate preferred models with the best fitness

AIC Akaike Information Criterion, *BIC* Bayesian Information criteria, *ABIC* adjusted BIC, *LMRT* Lo-Mendell-Rubin likelihood test, *BLRT* bootstrapped likelihood ratio test

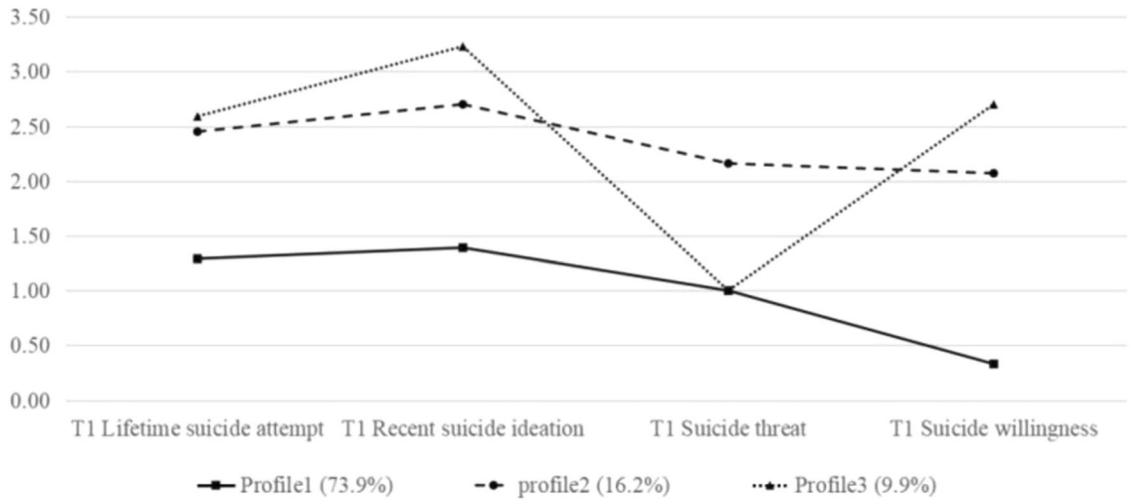

Fig. 1 Latent profiles of suicide risk at Time 1

Table 3 The difference in the mean values among three profiles

Indicators	Profiles	Mean	SD	*F*	*p*	LSD test
Lifetime suicide attempt	1	1.29	0.47	652.72	<0.001	Profile3 >Profile2 >profile1
	2	2.45	0.86			
	3	2.64	0.80			
Recent suicide ideation	1	1.30	0.65	568.22	<0.001	Profile3 >Profile2 >profile1
	2	2.70	1.26			
	3	3.22	1.07			
Suicide threat	1	1.00	0.00	6300.90	<0.001	Profile2 >profile1, Profile2 >Profile3
	2	2.16	0.37			
	3	1.00	0.00			
Suicide willingness	1	0.32	0.68	655.45	<0.001	Profile3 >Profile2 >profile1
	2	2.07	1.72			
	3	2.83	1.21			

LSD Least Significant Difference. The difference is significant at $p < 0.01$

invariance. The invariant model, which constrained the same item responses for latent profiles at each time point, exhibited lower values of BIC (19841.13) than the that (20746.33) in the freely estimated model, which supported the measurement invariance over time. Therefore, unconditional LTA with measurement invariance was conducted to investigate the changes and stability of suicide risk profiles over 12 months.

Results of the transition probability matrix (shown in Table 5) demonstrated that 91.3% of the membership in *low-risk* group at T1 remained in this group after 12 months, and 4.7, 4.0% transited into *medium risk-high threat* and *high risk* groups, respectively. M*edium risk-high threat* had a stability of 34.1%, with 48.2% moving to *low risk* and 17.7% moving to *high risk* at T2. H*igh risk* group had a stability of 38.0%, with 51.6% of membership moving to *low risk* and 10.4% moving to *medium risk-high threat* at T2.

Table 4 Multinomial logistic regression of predictors on T1 profiles

Predictors	Medium risk-high threat				High risk			
	B	SE	OR	95%*CI*	*B*	SE	OR	95%*CI*
T1 SOC	**−0.39*** **	**0.09**	**0.67**	**[0.57, 0.80]**	−0.19	0.11	0.83	[0.69, 1.02]
T1 MIL	**−0.30*** **	**0.08**	**0.76**	**[0.64, 0.89]**	**−0.48*** **	**0.10**	**0.61**	**[0.51, 0.75]**
T1 RES	**−0.29*** **	**0.09**	**0.74**	**[0.62, 0.88]**	**−0.62*** **	**0.11**	**0.54**	**[0.44, 0.67]**
Age	−0.05	0.10	0.96	[0.79, 1.16]	−0.18	0.12	0.83	[0.66, 1.06]
Gender (girl)	**0.70*** **	**0.15**	**2.00**	**[1.49, 2.70]**	**0.46***	**0.19**	**1.59**	**[1.01, 2.28]**
POR (rural)	**0.34***	**0.16**	**1.41**	**[1.03, 1.92]**	0.01	0.20	1.00	[0.68, 1.51]

Low risk profile is the reference group. Bolded rows emphasize the significant effects of corresponding predictors

SOC sense of control, *MIL* meaning in life, *RES* regulatory emotional self-efficacy, *POR* place of residence

*$p < 0.05$, ***$p < 0.001$

Table 5 Latent transition probabilities from T1 to T2

Profiles	Low risk	Medium risk-high threat	High risk
Low risk	91.3%	4.7%	4.0%
Medium risk-high threat	48.2%	34.1%	17.7%
High risk	51.6%	10.4%	38.0%

Rows for T1 profiles, columns for T2 profiles

Effects of Predictors on Suicide Risk Transitions

Multinomial logistic regressions were conducted to investigate the odds ratios of increased resilience and demographic variables on profiles transitions. As shown in Table 6, the growth of sense of control, meaning in life, and regulatory emotional self-efficacy significantly predicted profile transitions. Specifically, among adolescents in *low risk* at T1, higher levels of increased meaning in life were associated with lower odds of moving to *medium risk-high threat* (OR = 0.66) than staying in the same profile at T2. Higher levels of increased regulatory emotional self-efficacy were associated with lower odds of moving to *high risk* (OR = 0.68) rather than staying in the same profile at T2. Among adolescents in *medium risk-high threat* at T1, higher levels of increased sense of control were associated with higher odds of moving to *low risk* (OR = 1.65) and and lower odds of moving to *high risk* (OR = 0.54) rather than staying in the same profile at T2. Higher levels of increased regulatory emotional self-efficacy were associated with higher odds of moving to *low risk* (OR = 1.45) rather than staying in the same profile at T2.

With regard to demographic variables, among adolescents in *medium risk-high threat* at T1, higher age was associated with lower odds of moving to *low risk* (OR = 0.65) and *high risk* (OR = 0.58) rather than staying in the same profile at T2. Girls in *low risk* at T1 were more likely than boys to transition to *high risk* (OR = 2.12) rather than stay in the same profile at T2.

Table 6 Multinomial logistic regression of predictors on profile transitions

Predictors	Profile	LR	MRHT	HR
Increased SOC	LR	REF	0.88	0.95
	MRHT	**1.65****	REF	**0.54****
	HR	1.31	0.74	REF
Increased MIL	LR	REF	**0.66***	0.71
	MRHT	1.22	REF	1.22
	HR	0.76	1.05	REF
Increased RES	LR	REF	0.80	**0.68***
	MRHT	**1.45***	REF	1.11
	HR	1.26	1.19	REF
Age	LR	REF	1.27	0.87
	MRHT	**0.65***	REF	**0.58***
	HR	0.89	1.13	REF
Gender (girl)	LR	REF	1.70	**2.12***
	MRHT	0.53	REF	0.90
	HR	0.72	1.58	REF
POR (rural)	LR	REF	0.89	1.05
	MRHT	1.36	REF	1.32
	HR	0.66	0.82	REF

REF represents the reference group. Bolded OR values emphasize the significant effects of corresponding predictors

LR low risk, *MRHT* medium risk-high threat, *HR* high risk, rows for T1 profiles, columns for T2 profiles

*$p < 0.05$, **$p < 0.01$

Discussion

Suicide poses a significant and serious challenge in the realm of youth health and development. Research on suicide has often been addressed through variable-centered approaches. The concrete suicide risk states and their developmental nature, particularly in Chinese adolescents, is unclear. Furthermore, the roles of resilience factors, such as sense of control, meaning in life, and regulatory emotional self efficacy associated with

risk patterns and changes, remain largely unexplored. This study used person-centered approaches with a two-wave longitudinal design to identify the distinct risk profiles and their stability and transitions over time. The effects of resilience factors in this context were also examined.

Profiles of Suicide Risk in Adolescents

This study used LPA to explore adolescents' suicide risk heterogeneity based on the SBQ-R indicators. In line with the hypothesis 1, results identified three meaningful subgroups of early adolescents at T1 and T2: *low risk*, *medium risk-high threat*, and *high risk*. It is aligned with previous studies demonstrating three district classes of suicidality (Fong et al. 2022; Osborne et al. 2021; Thompson et al. 2009). At both time points, 73.9–78.3% of adolescents belonged to *low risk* group, which showed the lowest levels of lifetime suicide attempt, recent suicide ideation, suicidal threat, and willingness of future suicide attempt. Moreover, 10.2–16.2% of adolescents were classified in *medium risk-high threat* group, which showed medium levels of lifetime suicide attempt, recent suicide ideation, suicide willingness, and the highest level of suicide threat. Results also reported 9.9–11.5% of adolescents were in *high risk*, reporting highest levels of lifetime suicide attempt, recent suicide ideation, suicide willingness but lowest levels of suicide threat.

These findings suggested that despite the majority of adolescents residing in a safe state, a substantial proportion confronted diverse risks. Two risk groups possessed distinct characteristics, with the most significant divergence being their respective suicide threat. In fact, suicide threat, expressions of intent to commit suicide, also represents a kind of help-seeking signal (Ammerman et al. 2022). Thus, adolescents in *medium risk-high threat* group are more likely to be identified in suicide screening, then receiving real-time support. However, adolescents in *high risk* group, having not only experienced the most frequent suicidal ideation and attempts but also possessing an alarmingly the highest potential for future suicide willingness, warrant particular attention. Most notably, those individuals exhibited the least propensity to reveal their suicidal intentions. This might shed light on why, despite years of dedicated effort toward suicide prevention, the progression in suicide intervention has not been significantly improved (Franklin et al. 2017). That is, individuals in the moderate suicide risk are likely to disclose their suicidal intentions, potentially leading to a high false-positive rate, while those at high risk may not exhibit their suicidal intentions externally, potentially leading to a lower true detection rate of suicide risk (Nock et al. 2010). Hence, future efforts in suicide prevention necessitate focus on employing multi-indicator risk assessment and prioritizing those high-risk individuals for targeted intervention and support.

Stability and Transitions of Suicide Risk in Adolescents

The prevalence rates of distinct risk groups fluctuated over time. To illustrate, 73.9% of adolescents were classified as *low risk* at the initial time, escalating to 78.3% after 12 months. The proportion within the *medium risk-high threat* group diminished from 16.2 to 10.2%. Conversely, the *high risk* group slightly increased from 9.9 to 11.5%. Furthermore, the transition patterns varied among the three groups. As anticipated, the LTA results indicated that *low risk* group remained consistent, while substantial transitions were observed within *medium risk-high threat* and *high risk* groups, consistent with Thompson et al.'s (2009) research findings. Post the 12-month period, a majority of adolescents (91.3%) in *low risk* sustained their initial classification, whereas a minimal fraction transitioned to *medium risk-high threat* (4.7%) and *high risk* (4.4%) groups. Regarding *medium risk-high threat* group, 34.1% remained within their initial category, with 48.2% transitioning to the *low risk* and 17.7% to the *high risk* groups. Within *high risk* group, 38.0% of adolescents sustained their status, while 51.6% transitioned to *low risk* and 10.4% moved to the *medium risk-high threa*t groups. Nonetheless, the transitional proportions of *medium risk-high threat* (65.9%) and *high risk* (62.0%) groups greatly exceeded those of corresponding groups (12 and 34%) in Thompson et al.'s (2009) study. This could be attributed to the difference of observed indicators. Profiles in the present investigation were established incorporating historical, contemporary, and prospective elements (e.g., lifetime suicide attempts, recent suicidal ideations, and future predisposition toward suicide attempts), resonating more accurately with the dynamics of progression and alteration. These indicators may epitomize heightened dynamism, capturing a more vibrant nature than those implemented in Thompson et al.'s study. The derived outcomes suggest that expressions of suicidality in early adolescence exhibit diverse developmental patterns, supporting the perspective of developmental psychopathology (Oppenheimer et al. 2022).

In summary, the majority of adolescents present a low propensity for suicide, which remains relatively constant over 12 months, presenting an optimistic prognosis. To some degree, this discovery reflected the overarching decline in suicide rates among Chinese youth (Sha et al. 2017). As a result of advancements in health surveillance systems and psychological assistance services in recent years, adolescents might be less prone to confront suicide-related issues (Zhang 2019). However, a substantial proportion of adolescents consistently stayed either a medium or high suicide risk status, or shifted between both, emphasizing the urgent necessity and significance of suicide intervention. Additionally, a rising trend is observed in *high*

risk group. Owing to the low level of suicide disclosure within this group, they are prone to being overlooked in suicide prevention efforts, necessitating particular attention from educators and crisis intervention workers. For individuals persistently inhabiting risk status, immediate and effective interventions are essential to facilitate their transition toward a lower-risk condition.

Effects of Resilience Factors on Suicide Risk Profiles and Transitions

This study discovered that the hypothesized resilience factors played protective roles in risk profiles and related transitions. First, adolescents with a strong sense of control were less likely to be assigned to *medium risk-high threat*. This can be explained by the Theory of Planned Behavior, according to which high perceived control is associated with solid decision-making capacity, contributing to the engagement of adolescents' suicide prevention behaviors (Totura et al. 2019). Moreover, adolescents with high meaning in life were less likely to be assigned to *medium risk-high threat* and *high risk* than *low risk*. The Three-Step Theory of Suicide suggests that meaningfulness represents a kind of connectedness to one's life. People connected with the external world will have a positive attitude and look forward to the future (Klonsky and May 2015). Thus, a strong sense of meaningfulness may reduce the likelihood of falling into a suicide crisis, even when individuals facing suicide-related distress (Johnson et al. 2011). Third, adolescents high in regulatory emotional self-efficacy were less likely to be assigned to *medium risk-high threat* and *high risk* than *low risk*. Self-efficacy in emotional regulation may reduce suicide risk by improving adolescents' emotional adjustment. For instance, belief in regulating negative emotions could help individuals effectively deal with suicide-related emotional problems, such as depression, hopelessness, and psychache (Troister and Holden 2010). On the other hand, confidence in expressing positive emotions enhances adolescents' positive experiences, which could broaden scopes of cognition and attention and increase perceived social support and purpose in life (Fredrickson and Branigan 2005).

In *low risk* group, adolescents with higher levels of increased meaning in life were less likely to transition into *medium risk-high threat* group rather than remaining in the same group after 12 months. Adolescents with higher levels of increased regulatory emotional self-efficacy were less likely to transition into *high risk* group. These results emphasized that protective effects of the two resilience constructs were stable over time. Besides, increased sense of control and regulatory emotional self-efficacy predicted favorable transitions from *medium risk-high threat* group to *low risk* group, which indicated the two constructs might buffer the potential impact of the risk profile (Johnson et al. 2011). Significant influence was also found in the transitions between risk profiles. Specifically, for *medium risk-high threat* adolescents, high levels of increased sense of control could reduce their likelihood of moving to *high risk* group. However, all increased resilience did not facilitate any favorable transitions for individuals from high suicide risk groups to medium or low risk groups. This may be attributed to the complex and multifaceted nature of the *high risk* group and the severity of the underlying factors contributing to *high risk* profile. Individuals in high suicide risk may experience persistent feelings of hopelessness (Mitchell et al. 2023) and a combination of other risk factors such as a history of self-harm, substance abuse, and social isolation (Jacobson et al. 2023; Steele et al. 2018). These factors likely pose substantial challenges to the potential protective effects of resilience constructs alone. It is warranted to seek other protective factors that may be sufficient to counteract the strong risk factors.

The influence of demographic factors on the risk profiles and transitions of adolescent suicide is a notable finding of this study. Firstly, the study discovered that older adolescents were less likely to shift to either *low risk* or *high risk* subgroups from *medium risk-high threat* group. This suggests that age may play a role in the stability of medium risk profile, with older adolescents potentially exhibiting more stable risk patterns. Secondly, the results indicate notable gender differences in suicide risk profiles and transitions. Compared to boys, girls were more likely to be classified into *medium risk-high threat* and *high risk* categories and were also more prone to transition to the *high risk* group from the *low risk* group. This finding corroborates prior research highlighting higher suicidality among adolescent girls compared to boys (Miranda-Mendizabal et al. 2019), potentially due to greater emotional sensitivity and higher rates of depression and anxiety among girls (Sanchis-Sanchis et al. 2020; Uddin et al. 2020). Lastly, the finding that rural students were more likely to become *medium risk-high threat* members than urban students provides important insights into geographical differences in suicide risk. This may be linked to the limited access to mental health services and resources in rural areas compared to urban settings (Fontanella et al. 2015). These results emphasize the importance of demographic factors in understanding and predicting suicide risk patterns and transitions among adolescents, providing valuable guidance for tailoring suicide prevention and intervention efforts to specific demographic groups.

Limitations and Future Directions

Some limitations should be noted. First of all, the longitudinal design in this study only consisted of two assessments with a 12-month interval. It would be better to reveal the developmental nature of suicide risk over longer

periods. In addition, suicidality may fluctuate over short time frames (Kleiman et al. 2017). To capture the turning points of risk transitions of adolescent suicidality, shorter time intervals should be considered. Moreover, although two risk profiles (i.e., *medium risk-high threat* and *high risk*) were discovered in the current study, additional efforts are needed to replicate those findings and investigate potential factors that can distinguish the two profiles and explain the transitions between them. Lastly, as this study only looked at the independent effects of resilience characteristics on risk profiles and transitions, the conclusions on how they shield adolescents from suicide risk were rather hypothetical. Since resilience factors might function as "moderators" that alleviate the impact of risk factors on suicidality (Johnson et al. 2011), future studies may further explore deep mechanisms between resilience factors and suicide risk patterns.

Implications

Despite the drawbacks, the findings have important implications for lowering suicide risk in adolescents. First, *medium risk-high threat* and *high risk* profiles represent the dangerous status in which adolescents report high levels of suicidality (e.g., past suicide attempt and frequent suicide ideation) and have a high possibility of engaging in suicidal actions in the future. Many adolescents would transition out of the risk of suicide over time, but a significant proportion may not. Thus, remedial intervention programs should be applied immediately to adolescents in risk groups. Second, risk groups differ most in suicide threat. Medium-risk adolescents tend to disclosure their suicidal intention, while the high-risk ones are likely to hide. It suggests that risk screening in the practical suicide evaluation works cannot merely rely on adolescents' self-reported information. Observed suicide-related actions from other sources (e.g., parent-reported, peer-reported, and teacher-reported) may be reliable indicators. Different approaches (e.g., implicit measures) can also be adopted in the suicide risk assessment (Moreno et al. 2022). Third, given that resilience factors such as sense of control, meaning in life, and regulatory emotional self-efficacy have concurrent and prospective protective effects on adolescent suicide risk, related programs are necessary to improve those mental qualities. For examples, the Stop Now and Plan (SNAP) training is an effective strategy for promoting self-control among young people (Augimeri et al. 2017). Setting up life education courses in the middle school teaching system may be beneficial for enhancing students' perceived meaningfulness. Designing emotional self-efficacy teaching interventions helps boost students' confidence in managing emotional states (Pool and Qualter 2012).

Conclusion

Suicide issues are notably severe among Chinese adolescents. However, the understanding of suicide risk patterns, their transitional nature, and associated protective factors is limited. This study used LPA to depict the profiles based on four risk indicators of suicidality, and then apply LTA to investigate their transitions and associated resilience factors. Three heterogeneous groups among Chinese adolescents were identified: a low risk group reporting the lowest levels of suicidality and two risk groups respectively demonstrating medium and high degrees of lifetime suicide attempt, recent suicide ideation, and suicide willingness. The medium and high risk groups had different behavioral patterns, with the high risk group manifesting less disclosure of suicide intent. These finding underlines the heightened danger posed by the high risk individuals and highlights the importance of considering multiple aspects when evaluating distinct suicide risk states. Adolescents in low risk group exhibited a highly stable pattern over time, while those in medium and high risk groups displayed a tendency for transition over stability, suggesting that suicidality fluctuates frequently in early stages. The memberships of medium risk group decreased while the high risk increased over 12 months, indicating the situation regarding Chinese adolescent suicide is not optimistic. Sense of control, meaning in life, and regulatory emotional self-efficacy showed varied protection against being and/or transitioning in risk groups. Strategies aimed at amplifying these resilience constructs in adolescents could serve as focal points for suicide risk prevention and intervention programs.

Authors' contributions Z.W. conceived of the study, participated in its design and coordination and drafted the paper; X.W. conceived of the study, participated in its design and coordination and drafted the paper; K.L. helped to draft the paper; J.H. helped to draft the paper; J.Z. helped to draft the paper; Y.P. helped to draft the paper; F.Z. conceived of the study, and participated in its design and coordination and helped to revise the paper. All authors read and approved the final paper.

Funding The authors would like to thank Stage Achievement of Henan Province Philosophy and Social Science Project (Grant No. 2021BJY035), Educational Science Planning Project in Henan Province (Grant No. 2022YB0010), and Research and Practice Project for Education and Teaching Reform of Zhengzhou University (Grant No. 2021ZZUJGLX101).

Data Sharing and Declaration The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval All procedures performed in this study were in accordance with the recommendations of the Research Ethics

Committee of the the first authors' institution and with the 1964 Declaration of Helsinki.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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