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Adverse childhood experiences and fertility intention among college students in China: moderated mediation effects of resilience and attachment

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Abstract

Background The declining fertility rates and aging are becoming major demographic and public health challenges. According to the life course theory, an individual's current fertility intention is shaped by past experiences, with adverse childhood experiences (ACEs) known to have long-term effects on adult physiology, psychology, and society. Existing literature indicates that attachment styles and resilience are important factors in shaping psychological responses to ACEs and may play a role in influencing fertility intentions over time. We aim to investigate how ACEs influences fertility intentions and to identify mechanisms that could inform early intervention strategies.

Methods We draw a large-scale design at a comprehensive university in eastern China between September 2022 and October 2023. Validated questionnaires assess ACEs, attachment, resilience, and fertility intentions. Latent class analysis identified three distinct ACEs profiles and logistic regression explored the relationship between ACEs and fertility intention. Mediation and moderation models were then tested using the PROCESS in SPSS, with attachment being a mediator and resilience playing a moderating role in the relationship between ACEs and fertility intention.

Results A total of valid 15,969 samples were included, among which 36.5% of adult students intended to have children. Latent class analysis divided ACEs into Severe Adversity (3.53%), Predominant Neglect (3.39%), and Minimal Adversity (93.07%). Logistic analysis indicates that, compared with Minimal Adversity, Severe Adversity ($\beta = -0.45$, $P < 0.01$) and Predominant Neglect ($\beta = -0.29$, $P = 0.02$) significantly lower fertility intentions. Mediation analysis found that ACEs influence fertility intentions through attachment anxiety and avoidance, with different mediation effects depending on adversity patterns. "Severe Adversity" showed full mediation, while "Predominant Neglect" exhibited partial mediation. Higher ACE exposure was linked to greater attachment insecurity, which in turn lowered fertility intentions. Additionally, resilience moderated these pathways, buffering the negative impact of ACEs on attachment.

Conclusions This study highlights the impact of ACEs on fertility intentions, with attachment and resilience playing key roles. While resilience buffers ACEs' effects on attachment, it does not directly influence fertility intention,

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suggesting that strengthening interpersonal relationships is better than resilience alone. Interventions should focus on fostering secure attachment patterns to support positive reproductive decision-making.

Clinical trial Not applicable.

Keywords Adverse childhood experiences (ACEs), Fertility intention, Attachment, Resilience, Chinese college students

Introduction

Background

In recent decades, the declining fertility rates have significantly impacted healthcare infrastructure and services [1], social determinants of health [2], health policy [3]. This global trend of reduced birth rates presents tremendous socio-economic challenges [4] and exacerbates global health inequities [5]. As a result, extensive research has focused on understanding the factors influencing fertility intentions, which are the strongest predictors of future reproductive behaviors [6]. These intentions are influenced by a range of factors [7–9] including culture, socioeconomic status, marital status, relationship duration, education level, and religion. Among them, life course theory offers a valuable framework for analyzing how past experiences and current behaviors interact to shape future reproductive choices [10], providing insight into the multifaceted nature of fertility intentions and their implications for public health.

One significant aspect of past experiences that may influence fertility intentions is Adverse Childhood Experiences (ACEs), which refers to physical and emotional abuse or neglect suffered during childhood [11]. Childhood is a critical period for psychological [12, 13], physiological [14], and social [15] development, and ACEs have been found to be associated with a variety of diseases and adverse health behaviors in multiple areas. Childbearing decision of couples/individuals are influenced by their social and family factors, childbearing affordability and resources [16]. ACEs can increase stress, impair brain and organ development, and significantly affect physical and mental health [17], and these negative effects could last a lifetime, even persist into old age [18, 19] and next generation [20], prompting negative assessments of family social environment and resource access and leading to pessimistic reproductive decisions. Although ACEs significantly impact individuals' long-term development, relatively few studies have explored how ACEs relate to fertility intentions and the mechanisms that mediate or moderate this relationship.

Literature review and development of hypotheses

Fertility intention and adverse childhood experiences

Previous public health studies have linked ACEs to a range of physical and mental problems [21–25]: such as depression, cardiovascular and cerebrovascular diseases,

diabetes, and malignant tumors. The effects of ACEs can persist throughout life and are a key factor in healthy aging [18]. Furthermore, evidence suggests that maternal ACEs can negatively impact their children's health, well-being, and academic performance [20].

The negative effects of ACEs in terms of psychological, physical, and social support challenge fertility intention. Adults with ACEs may experience impaired social functions [26], hindering the ability to support childbearing. ACEs are associated with poor health behaviors and outcomes [27], impairing reproductive health reserves. They also undermine psychological resources, including self-esteem [28], well-being [29], and interpersonal relationships [30, 31], potentially lowering fertility intentions [32], delaying reproductive plans, and reducing family size [33]. Additionally, ACEs can perpetuate intergenerational trauma [34], with parents who suffered abuse more likely to have children facing similar issues [35]. Daily stressors linked to ACEs further affect perceptions and intentions of fertility [36].

However, research exploring this relationship directly remains limited [37]. Understanding how ACEs affect fertility intentions could provide valuable insights into the intersection of mental health, psychological development, and reproductive decisions.

Attachment as a mediator

One of the potential mechanisms between ACEs and fertility intention is relationships and internal working models. As a key subfield in the area of parenting and parent-child relationships research [38, 39], attachment was also found to be closely related to early experience [40, 41]. It is widely recognized within the social sciences that an individual's family upbringing experiences (e.g. ACE) significantly impacts their fertility decision [42]. Attachment theory, initially introduced by John Bowlby, underscores the pivotal role that early interpersonal relationships play in future development [43]. These early-formed attachment styles can subsequently influence coping mechanisms and relationship conduct.

Early research classified adult attachment styles into distinct categories like secure, avoidant, or anxious-ambivalent [44]. However, by the late 1990s, researchers shifted towards a dimensional framework, influenced by taximetrics research indicating that attachment security varies continuously. Attachment avoidance involves

minimizing the importance of close relationships and maintaining emotional distance, while attachment anxiety is marked by fear of rejection and preoccupation with relationships [45]. The dimensional approach offers a more nuanced understanding of attachment [46], capturing variability more effectively and offering stronger statistical power and predictive validity in research [47].

Attachment style promotes individual's support for family [48] and ability to stress regulation [49]. Modern shifts in marriage and family structures highlight the role of relationships and family values in supporting fertility [50]. Secure attachments buffer the pain of social rejection and help manage adaptive stress [51], indicating that strong interpersonal relationships positively impact reproductive intention. Avoidant attachment, contrasting with secure and anxious types, often leads individuals to prioritize work over relationships, potentially reducing their fertility motivation [52]. Furthermore, secure attachment promotes positive attitudes towards children, enhancing the perceived value of parenting [53, 54]. Based on the above studies, we speculated that attachment might be a mediator of the relationship between ACEs and fertility intention.

Resilience as a moderator

While ACEs, as immutable past events, comes with a host of adverse effects, fortunately, resilience may mitigate these effects which refers to the process and result of effectively adapting to strenuous or challenging life circumstances [55], play a key role in overcoming hardships [56]. The meta-analysis pointed out that the presence of resilience is positively associated with secure attachment [57]. Cognitive-behavioral therapy highlights that the effects of events are shaped by personal beliefs, not just the events themselves [58].

Resilience affects the way individuals process ACEs [59], influencing attachment development and social functions [60]. Resilient individuals better handle negative early experiences, showing higher school engagement [61] and reduced mental health issues [62]. They also mitigate the link between ACEs and depression, with high resilience lessening this connection [63]. Thus, resilience not only buffers adverse effects but also supports overall health and adaptive development [55, 64]. Thus, it is hypothesized that resilience may moderate the direct and indirect link between ACEs and attachment.

Study aims and underlying hypothesis

This study aims to verify that ACEs negatively affect fertility intentions, hypothesizing that attachment styles (e.g., anxiety and avoidance) mediate this relationship while resilience moderates the negative impact of ACEs on fertility intention through three pathways. Given that ACEs are categorized into empirically derived latent

classes, we expect the strength of these effects to vary depending on the severity of ACEs. The decline of fertility rates in China is increasingly severe. According to the data from the seventh national census, the total fertility rate in China has dropped to its lowest level in the past 15 years, with an average of 1.3 children per couple [65]. College students, a key fertility group facing choices between education, career, and family, are particularly relevant, as their fertility intentions will shape future population trends [66, 67]. Thus, the study aims to identify factors influencing their fertility intentions and suggest interventions for this demographic in China. Also, we account for cultural factors and socioeconomic status to isolate the effects of these psychological variables on fertility intentions. The hypothetical model of this study is shown in Fig. 1, specifically:

Hypothesis (H1) ACEs negatively affect the adult students' fertility intention.

Hypothesis (H2) Adult attachment mediates the relationship between ACEs and fertility intention.

Hypothesis (H3) Resilience may moderate the direct and indirect link between ACEs and attachment that (a) Resilience has a positive direct effect on fertility intentions, with higher resilience being associated with stronger intentions to have children. (b) Resilience moderates the relationship between ACEs and attachment styles, such that the effect of ACEs on attachment anxiety and attachment avoidance increases as resilience decreases. (c) Resilience will moderate the indirect relationship between ACEs and fertility intentions via attachment styles, such that the negative association between ACEs and fertility intention weakens as resilience increases. (d) Resilience will moderate the negative effect of attachment anxiety and attachment avoidance on fertility intentions, such that the adverse impact of insecure attachment on fertility intention is stronger among individuals with lower resilience. Given the complexity of moderated mediation models and the novelty of examining resilience as a moderator in the context of ACEs and fertility intentions, we expect the effect sizes to be within a moderate range, in line with findings from similar studies [68–71].

Methods

Data and sample

We conducted a cross-sectional study from a comprehensive university in eastern China from September 2022 to October 2023, targeting adult non-graduates. Fertility intention is a complex and evolving construct [72], especially among young adults still in the education stage, thus we included groups that formed a clear desire to have children. To ensure data quality, we implemented multiple control measures. The study utilized a university survey platform with built-in monitoring features to prevent duplicate and incomplete responses. Attention

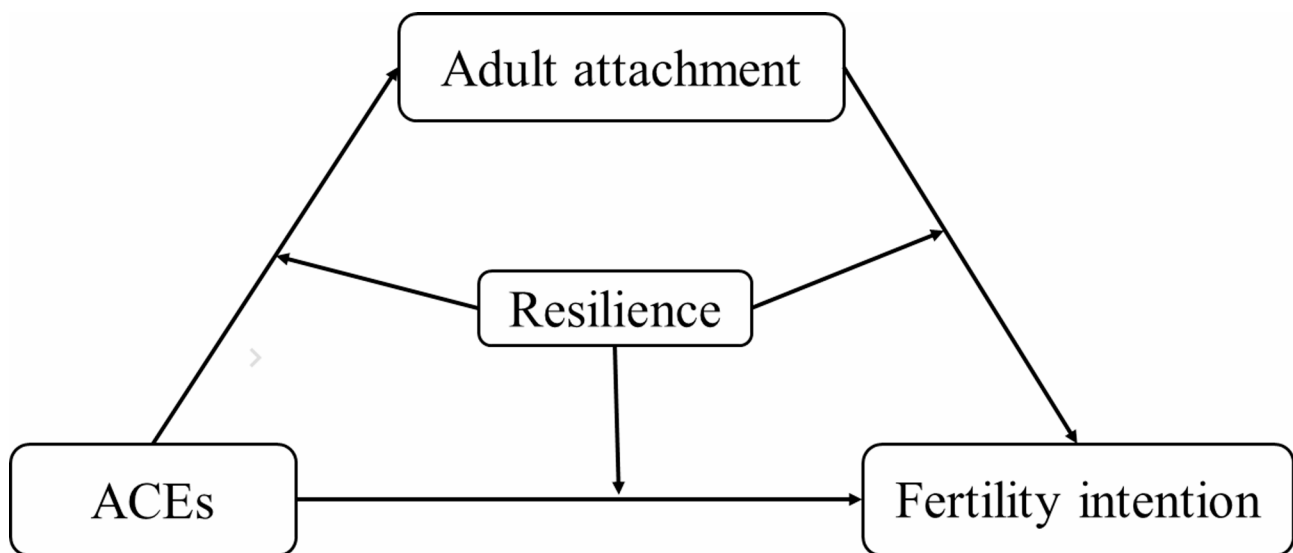


Fig. 1 A conceptual diagram of hypothesized relations in a moderated mediation model

checks were embedded within the questionnaire, and responses failing these checks were excluded. Additionally, we eliminated questionnaires with response times shorter than the minimum threshold established through pilot testing. Cognitive interviews further validated the questionnaires clarity and relevance. These measures collectively ensured data reliability and validity while maintaining methodological rigor.

Ethics approval for the study was obtained from the Academic Ethics Committee of the Academic Ethics Committee of Jing Hengyi School of Education Hang Zhou Normal University (Approval Number: 2022026). The research was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. All participants provided informed consent prior to participation. Participation was entirely voluntary, and respondents were informed of their right to withdraw at any time without penalty.

Key measures

Fertility intention

The question “Do you plan to have children?” was adopted to assess fertility intentions, which was adapted from the fertility intention scale developed by Lampic in 2006 [66], which evaluates people’s attitudes towards fertility intention and parenting. It has been widely used in the research of university students in Sweden [66], the United States [73] and Hong Kong [74]. To ensure linguistic and cultural accuracy, we applied a rigorous forward- and back-translation process. Prior to the formal study, cognitive interviews were conducted, leading to refinements in response options to enhance clarity and relevance. The final response options included: a. “I do

not plan to have children”, b. “uncertain”, c. “I plan to have children”, d. “I have children”.

For analysis, we focused on individuals with clear fertility intentions and excluded respondents who selected (b) “uncertain” or (d) “I have children”. Fertility uncertainty is fluid, shaped by life course factors, and often reflects transitional states rather than stable goals [75, 76]. Including this group could introduce ambiguity, whereas restricting the sample to clear intentions ensures clearer interpretation of findings [76, 77]. Responses were dichotomized for group comparisons and logistic regression analysis, with (a) coded as 0 (*no intention to have children*) and (c) coded as 1 (*intends to have children*).

Adverse childhood experiences (ACEs)

ACEs were assessed using the CDC-Kaiser ACE Scale, derived from the ACEs study conducted by Felitti [11]. The 10-question questionnaire measures 10 adverse family experiences exposure before the age of 18, including abuse (e.g. verbal violence and physical violence), neglect (e.g. emotional neglect and material neglect) and other trauma. Respondents were defined as exposed to ACEs category if they responded “yes” to the questions. Because the scale measures different types of adversities, the relationship between adversities is not parallel and comparable. A higher score can only indicate that an individual has experienced more types of adversities instead of severity of adversities from the perspective of validity. Similarly, those with the same score could not show the same severity of adversity. Thus, this study did not carry out validity analysis on them.

Since ACEs tend to co-occur rather than occur in isolation [78, 79], to avoid fragmented results from treating ACEs as separate variables and to create meaningful

predictors for subsequent hypothesis testing, we conducted a latent class analysis (LCA) to identify meaningful patterns of ACE exposure. This approach allowed us to group participants based on their ACE profiles rather than analyzing each ACE separately, which could lead to fragmented and inconsistent results. We then used these latent classes as independent variables in subsequent analyses to examine their effects on attachment and fertility intentions. LCA models with 1 to 7 classes were compared using Log-likelihood, AIC, BIC, Entropy, and significance tests (LMR, BLRT) to determine the best-fitting solution [80].

Resilience

The 14-Item Resilience Scale (RS-14), developed by Wagnild and Collins in 2009 [81], assesses an individual's resilience or ability to maintain or recover mental health in adversity. Because it is relatively short and covers multiple aspects of mental toughness, it is widely used, and the Chinese-version scale has been proven to have high reliability and validity [82]. The Cronbach's α coefficient of the scale in this study is 0.931. Subjects were asked to rate how strongly they agreed with each item in the previous four weeks on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree) and averaged it, the mean score ranges from 1 to 7, with higher mean scores indicating more resilience among participants.

Adult attachment

Adult attachment is measured using the Adult attachment scale (AAS), which was developed by Collins and Read in 1990 [83] to assess adult attachment style. It consists of two dimensions, attachment avoidance (consisting of the reverse scoring of the *close* and the *depend* subscales) and attachment anxiety, and contains 18 items. The Chinese-style scale has also been proved to have good reliability and validity [84]. Subjects rated the extent to which each statement described their feelings on a scale ranging from *strongly disagree* (1) to *strongly agree* (5). The mean score is distributed between 1 and 5. The higher the mean score, the higher the corresponding attachment anxiety or attachment avoidance. The overall Cronbach's α coefficient of this scale in this study was 0.852. Attachment anxiety and attachment avoidance, Cronbach's α was 0.842 and 0.781.

Other covariates

Based on previous research, we controlled for marital and family values as well as individual and family socioeconomic status that might influence the relationship between ACEs and fertility intention. As the important cultural variable of fertility intention, the "Marriage and Family Values Scale" developed by the Korean Women's Policy Institute to assess the two aspects of individual

marriage and family values, the scale has high reliability and validity. This study selected nine items from them and integrated them into 4 categories, namely, marriage and childbearing concepts, openness to marriage, marriage achievement antagonism, independence and autonomy; A 5-level score is performed from 1 (strongly disagree) to 5 (strongly agree), with some entries being scored in reverse.

The demographic variables measured in this study included gender and grade. Previous studies have shown that socioeconomic status is an essential factor affecting fertility intention [85, 86], so we focused on different subjective and objective socioeconomic status levels. Because the actual socioeconomic level of the student group is closely related to the socioeconomic level of the family, the study also analyzed the family's residence (urban and rural), the parent's education and occupational level.

Analytical strategies

SPSS 27.0 was used for analysis. First, the scale's reliability was tested, followed by descriptive analysis to examine the distribution of key variables. LCA using Mplus 7.11 [80] identified distinct ACE exposure patterns, allowing us to examine their impact on psychological outcomes and fertility intention. Logistic regression tested Hypothesis 1, where fertility intention as independent variable, assessing the association between ACEs, ACE patterns, and fertility intention. Mediation analysis tested Hypothesis 2, examining whether adult attachment (anxiety or avoidance) mediates this relationship. Hypothesis 3 tested the moderating role of resilience in three pathways (Fig. 2). Bootstrap analysis (1,000 resamples) and PROCESS v4.1 in SPSS 27.0 were used to analyze moderated mediation effects, focusing on interaction significance rather than all conditional effects to enhance clarity. This sequential approach ensured that each analysis directly tested our hypotheses. Fertility intention was modeled as a binary outcome, while attachment was treated as a continuous variable with its mean score assumed to follow a normal distribution. Accordingly, paths b and b' (fertility intention) were analyzed using logistic regression, while paths a and a' (attachment) were modeled using linear regression (sees Fig. 2). The significance level of this study was $P < 0.05$.

Results

Sociodemographic information

A total of 25,642 participants completed the survey. After data cleaning, which involved removing responses are non-adult ($n = 902$), invalid response time and failed attention check ($n = 1665$), and those who had already had children ($n = 165$), uncertain fertility intention ($n = 6,941$), the size was 15,969, which remained consistent

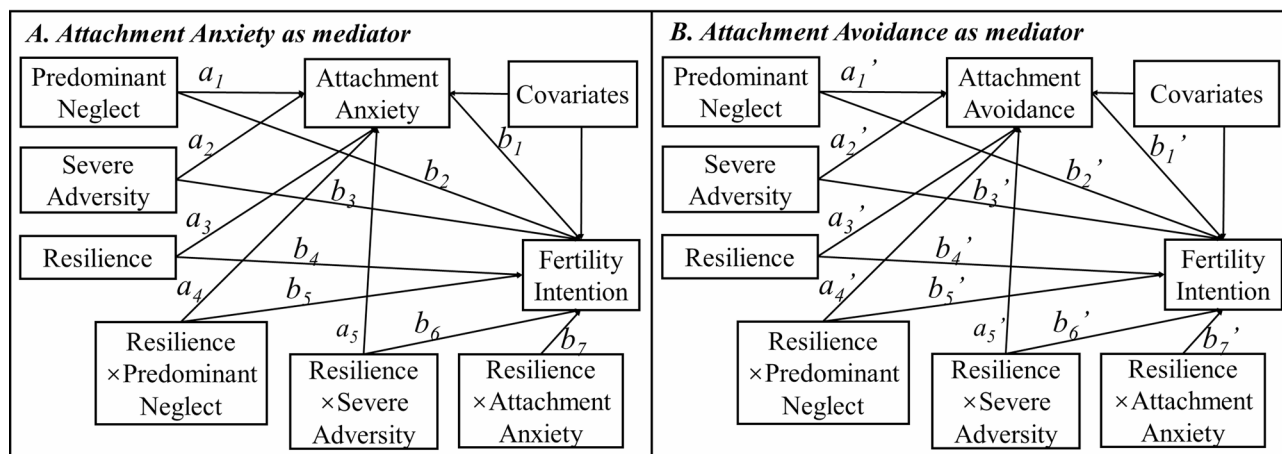


Fig. 2 Path analysis of the moderated mediation model

across all analyses. Among them, 35.1% ($n=5,598$) were male. The rest of the general demographics of the subjects are detailed in Table 1. 63.5% ($n=10,136$) of the participants said, “I intend to have children,” while 36.5% ($n=5,833$) said, “I do not intend to have children.”

Analysis of patterns of aces

Because ACEs often co-occur, we conducted LCA to identify subgroups of individuals with distinct ACE exposure patterns. Models with 1 to 7 latent classes were fitted, and the 3-class solution was selected based on the high entropy (>0.7), and significant LMR and BLRT tests ($p<0.05$) and sample distribution more balanced. The three identified classes were: (1) a “Severe Adversity” group (3.30%), characterized by a high probability of verbal and physical violence, emotional neglect, parental separation or divorce, and family mental illness; (2) a “Predominant Neglect” group (3.39%), which had elevated probabilities of emotional neglect, parental separation or divorce, and family mental illness; and (3) a “Minimal Adversity” group (93.07%), with low probabilities for all ACE categories (see Table 2; Fig. 3). In the subsequent analysis, we use the “Minimal Adversity” group as the reference category, justified by its significantly lower exposure to all ACE categories, making it the most stable baseline for comparison.

Main results

Distribution of key variables

To preliminarily examine the effects of ACEs, attachment, and resilience on fertility intention, we compared these variables between individuals who intend to have children and those who do not. ACE exposure was assessed by counting the number of adversities experienced, and a chi-square test was used to compare ACE prevalence across fertility intention groups. For individual ACE categories, participants who did not intend to

have children reported significantly higher exposure to all forms of adversity compared to those who intended to have children. The largest discrepancies were found in parental separation or divorce ($P<0.01$) and emotional neglect ($P<0.01$), with 17.7% and 7.6% of non-intending participants experiencing these adversities, respectively, compared to 10.0% and 3.1% of those intending to have children. Similarly, exposure to physical violence ($P<0.01$) and family mental illness ($P<0.01$) was significantly more prevalent among individuals without fertility intentions (6.2% and 5.0%, respectively) than among those who intended to have children (2.9% and 2.1%). Regarding ACE patterns, those in the Severe Adversity (5.6%) and Predominant Neglect (5.4%) groups were over twice as likely to lack fertility intentions compared to those experiencing Minimal Adversity (2.4% and 2.2%, $P<0.01$). (see Table 3)

An independent samples t-test revealed significant differences in attachment and resilience between fertility intention groups ($P<0.05$). LSD post-hoc tests indicated that individuals who intend to have children reported higher resilience compared to those who do not ($P<0.05$). Additionally, those who do not intend to have children exhibited significantly higher attachment anxiety and attachment avoidance than those who do ($P<0.05$, see Table 4).

Hypothesis 1

To further test the association between ACE exposure and fertility intention, we conducted logistic regression analyses. Model 1 examined the effects of each ACE on fertility intention, revealing that emotional neglect ($\beta=-0.30$, $p=0.01$), parental separation or divorce ($\beta=-0.29$, $p<0.01$), and family mental illness ($\beta=-0.33$, $p=0.01$) were each associated with lower fertility intention. Model 2 incorporated the LCA-derived ACE patterns, showing that compared to the “Minimal Adversity” group, both

Table 1 Sociodemographic information of participants

Variables	Category	Number	%
Gender	Male	5598	35.1
	Female	10,371	64.9
Student category	Undergraduate	12,416	77.8
	Master	3553	22.2
Grade	1	11,832	74.1
	2	2898	18.1
	3	1239	7.8
Residence	Urban	10,296	64.5
	Rural	5673	35.5
Paternal occupation	Semi-unemployed or unemployed	997	6.2
	Manual laborers	4523	28.3
	Individual and commercial server	5878	36.8
	Professional technical and clerks	2595	16.3
	Power dominance layer	1976	12.4
Maternal occupation	Semi-unemployed or unemployed	2522	15.8
	Manual laborers	3684	23.1
	Individual and commercial server	5994	37.5
	Professional technical and clerks	2422	15.2
	Power dominance layer	1347	8.4
Paternal education level	Primary and below	1929	12.1
	Junior high school	5776	36.2
	High school or technical secondary school	4550	28.5
	Junior college	1590	10.0
	Undergraduate	1884	11.8
Maternal education level	Master degree or above	240	1.5
	Primary and below	2850	17.8
	Junior high school	5647	35.4
	High school or technical secondary school	4197	26.3
	Junior college	1480	9.3
Regular monthly expenditure	Undergraduate	1635	10.2
	Master degree or above	160	1.0
	< 1000 yuan	856	5.4
	1000 ~ 1500(excluding)yuan	5385	33.7
	1500 ~ 2000 yuan	6387	40.0
Subjective family economic level	> 2000 yuan	3341	20.9
	Very good	200	1.3
	Above average	3988	25.0
	Normal	9171	57.4
	Below the average	2262	14.2
	Very bad	348	2.2

Table 2 Model fitting statistical results for latent class analysis

Model	Log likelihood	AIC	BIC	aBIC	Entropy	LMR(p)	BLRT(p)
1	-31929.643	63879.286	63959.68	63927.90			
2	-31929.640	58892.652	59061.48	58994.74	0.87	<0.01	<0.01
3	-29425.326	58570.186	58827.44	58725.75	0.83	<0.01	<0.01
4	-29253.093	58414.066	58759.76	58623.10	0.81	<0.01	<0.01
5	-29164.033	58315.146	58749.27	58577.66	0.84	0.06	<0.01
6	-29103.573	58283.434	58805.99	58599.42	0.84	<0.01	<0.01
7	-29076.717	58271.623	58882.61	58641.08	0.85	0.16	<0.01

Note. ACEs Adverse childhood experiences, AIC Akaike Information Criterion, BIC Bayesian information criterion, aBIC adjusted Bayesian information criterion, LMR Lo-Mendell-Rubin Test, BLRT Bootstrap Likelihood Ratio Test

the “Severe Adversity” ($\beta = -0.45$, $p < 0.01$) and “Predominant Neglect” ($\beta = -0.29$, $p = 0.02$) groups had significantly lower fertility intention (sees Table 5).

Hypothesis 2

For the second hypothesis, we expected that attachment anxiety or attachment avoidance would mediate the relationship between ACE patterns (a categorical variable, with *Minimal Adversity* as the reference group) and fertility intention (a binary variable, with *not intending to have a child* as the reference category). The results of the mediating analysis indicate that attachment anxiety and attachment avoidance mediate the relationship between ACEs patterns and fertility intention. As shown in Table 6, for severe adversity, full mediation was observed, as the direct effect was non-significant (the 95% bias-corrected bootstrap CI contained 0) while the indirect effect was significant (the 95% bias-corrected bootstrap CI did not include 0). In contrast, for predominant neglect, partial mediation was found, as both the direct and indirect effects were significant (the 95% bias-corrected bootstrap CI did not include 0 for either).

Specifically, in the mediation model where the attachment anxiety was mediator, compared to the experience of “Minimal Adversity”, “Predominant Neglect” ($\beta = 0.35$, $P < 0.01$) and “Severe Adversity” ($\beta = 0.52$, $P < 0.01$) had a positive effect on attachment anxiety, while attachment anxiety ($\beta = -0.18$, $P < 0.01$) had a negative effect on fertility intention, as shown in Table 7. The proportion of the total effect mediated by attachment anxiety was 14.2% for predominant neglect (Sees Table 6). Similar results were also found in the mediation model 2 where the attachment avoidance was mediator. Compared to “Minimal Adversity”, “Predominant Neglect” ($\beta = 0.20$, $P < 0.01$) and “Severe Adversity” ($\beta = 0.28$, $P < 0.01$) had a positive effect on attachment avoidance, and attachment avoidance ($\beta = -0.44$, $P < 0.01$) had a negative effect on fertility intention (Sees Table 7). The proportion of the total effect mediated by attachment avoidance was 18.8% for predominant neglect (Sees Table 6).

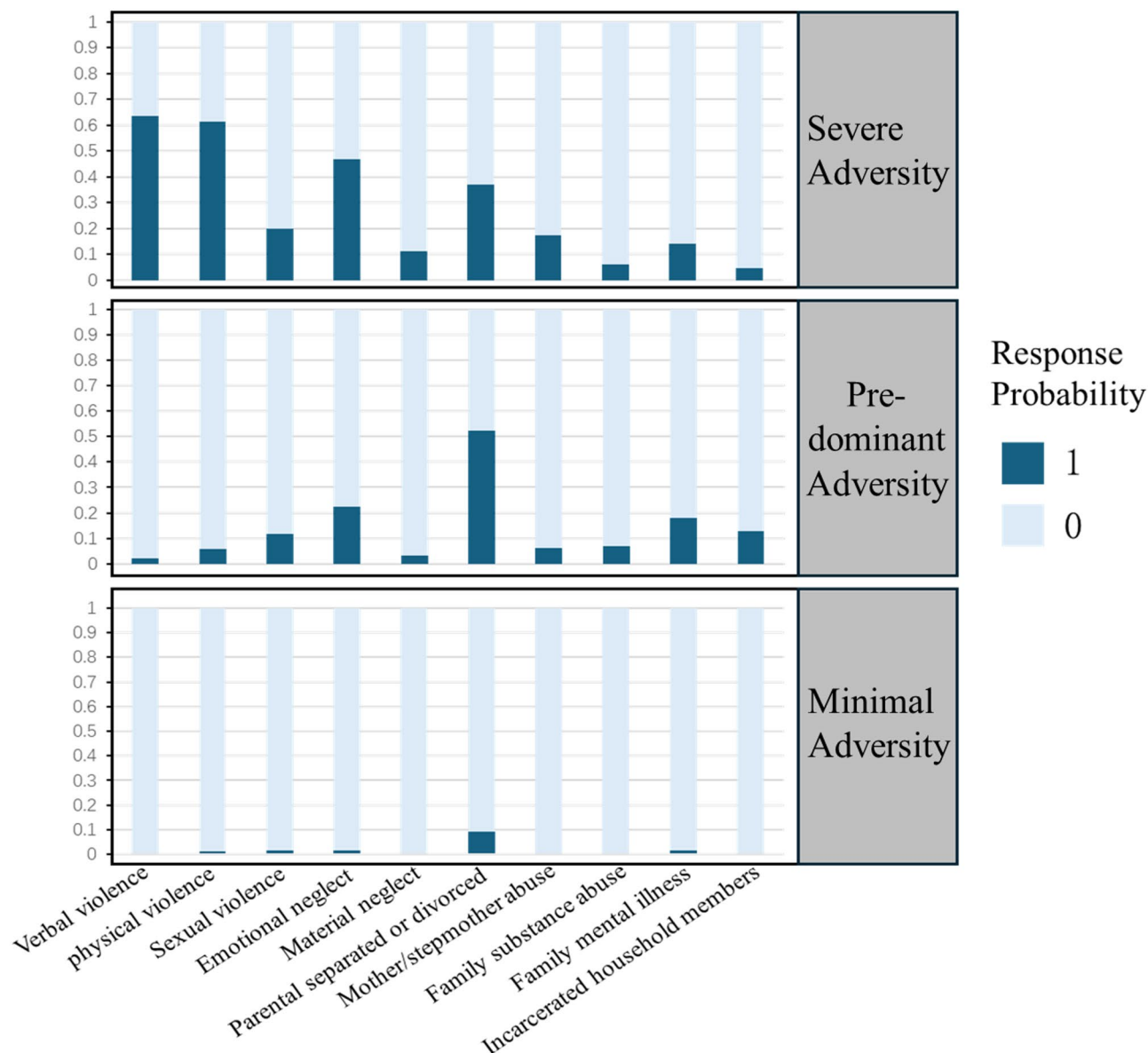


Fig. 3 Responses to 10 items for three latent class of ACEs

Hypothesis 3

Based on testing hypothesis 2, we examined whether resilience moderates the direct and indirect effects of ACEs patterns on fertility intention through attachment anxiety and attachment avoidance. We tested moderated mediation models incorporating resilience as a moderator. In this analysis, ACEs, fertility intention, attachment anxiety, attachment avoidance, and resilience were used as the independent, dependent, mediating, and moderating variables, respectively. Since ACEs is a categorical variable, the model analysis compared “Predominant Neglect” and “Severe Adversity” with “Minimal Adversity” as the reference group to assess the moderating role of resilience in these pathways.

The results showed that in the model where attachment anxiety was the mediating variable, resilience significantly moderated the pathways between Predominant Neglect and attachment anxiety ($\beta = 0.12$, $P < 0.01$) and Severe Adversity and attachment anxiety ($\beta = 0.17$, $P < 0.01$).

Similarly, in the model where attachment avoidance was the mediating variable, resilience significantly moderated the effect of Severe Adversity on attachment avoidance ($\beta = 0.12$, $P < 0.01$). (see Table 8).

To further examine the nature of these moderating effects, simple slope analysis was conducted. In the model with attachment anxiety as a mediating variable, results indicate that the effect of Predominant Neglect

Table 3 Distribution of aces among participants with different fertility intentions

ACE Categories	Intend to have children		Not intend to have children		χ^2
	n	%	n	%	
Verbal violence	219	2.2	275	4.7	80.556**
Physical violence	290	2.9	365	6.2	108.579**
Sexual abuse	222	2.2	274	4.7	77.332**
Emotional neglect	316	3.1	450	7.6	171.337**
Material neglect	59	0.6	72	1.2	19.361**
Parental separated or divorced	1017	10.0	1031	17.7	193.385**
Mother/stepmother abuse	118	1.2	110	1.9	13.700**
Family substance abuse	56	0.6	77	1.3	26.412**
Family mental illness	214	2.1	294	5.0	103.127**
Incarcerated household members	141	1.4	105	1.8	4.084*
ACEs patterns	n	%	n	%	
Minimal Adversity	9669	95.4	5194	89.0	231.426**
Severe Adversity	239	2.4	325	5.6	
Predominant Neglect	228	2.2	314	5.4	

Note. ACEs Adverse childhood experiences * $P < 0.05$ ** $P < 0.01$; The model controlled for student category, grade, gender, parents' education level, parents' work level, subjective socioeconomic status, regular monthly expenditure, marriage and family values

Table 4 Comparison of resilience and adult attachment in groups with different fertility intentions

Variable	Intend to have children	N	Mean	SD	95%CI	t
Resilience	YES	5833	3.603	0.669	[3.586, 3.620]	-28.426**
	NO	10,136	3.906	0.613	[3.894, 3.918]	
Attachment anxiety	YES	5833	2.953	0.813	[2.932, 2.974]	21.110**
	NO	10,136	2.669	0.827	[2.653, 2.685]	
Attachment avoidance	YES	5833	2.562	0.579	[2.547, 2.576]	28.383**
	NO	10,136	2.311	0.510	[2.302, 2.321]	

Note. * $P < 0.05$ ** $P < 0.01$

Table 5 Logistics regression analysis of the impact of aces models on adult student groups

Model	Independent variable	β	Exp(β)	EXP(β) 95% CI	Wald	P
Model 1- Each ACE	Verbal violence	-0.060	0.941	[0.693, 1.279]	0.149	0.699
	Physical violence	-0.162	0.850	[0.657, 1.100]	1.527	0.217
	Sexual abuse	0.054	1.056	[0.818, 1.362]	0.172	0.678
	Emotional neglect	-0.295	0.744	[0.594, 0.933]	6.582	0.010
	Material neglect	-0.545	0.580	[0.336, 1.001]	3.828	0.050
	Parental separated or divorced	-0.286	0.751	[0.655, 0.862]	16.618	<0.001
	Mother/stepmother abuse	0.410	1.507	[0.995, 2.280]	3.758	0.053
	Family substance abuse	-0.267	0.766	[0.455, 1.288]	1.014	0.314
	Family mental illness	-0.322	0.724	[0.562, 0.934]	6.159	0.013
	Incarcerated household members	0.162	1.176	[0.801, 1.726]	0.684	0.408
	χ^2	9445.595				
	P	<0.001				
Model 2- ACEs pattern	Minimal Adversity	reference			17.520	<0.001
	Severe Adversity	-0.450	0.638	[0.499, 0.815]	12.930	<0.001
	Predominant Neglect	-0.286	0.751	[0.589, 0.957]	5.366	0.021
	χ^2	9410.972				
	P	<0.001				

Note. The model controlled for student category, grade, gender, parents' education level, parents' work level, subjective socioeconomic status, regular monthly expenditure, marriage and family values

and Severe Adversity on attachment anxiety is weaker among individuals with higher resilience. As shown in Fig. 4, higher resilience buffers the negative impact of ACEs on attachment anxiety. In contrast, individuals

with lower resilience exhibit a steeper increase in attachment anxiety as ACE exposure intensifies. Similarly, in the model with attachment avoidance as the mediating variable, resilience moderated the effect of Severe

Table 6 Mediating effect and ratio of adult attachment in aces patterns and fertility intention

Model		Effect size	BootLLCI	BootULCI
Mediation model 1: ACEs pattern → attachment anxiety → fertility intention				
Indirect effect	Minimal Adversity	reference		
	Predominant Neglect	-0.064	-0.090	-0.040
	Severe Adversity	-0.094	-0.130	-0.062
Direct effect	Minimal Adversity	reference		
	Predominant Neglect	-0.388	-0.634	-0.142
	Severe Adversity	-0.193	-0.437	0.051
Mediation model 2: ACEs pattern → attachment avoidance → fertility intention				
Indirect effect	Minimal Adversity	reference		
	Predominant Neglect	-0.087	-0.118	-0.061
	Severe Adversity	-0.123	-0.159	-0.092
Direct effect	Minimal Adversity	reference		
	Predominant Neglect	-0.375	-0.622	-0.128
	Severe Adversity	-0.165	-0.410	0.081

Note. The model controlled for student category, grade, gender, parents' education level, parents' work level, subjective socioeconomic status, regular monthly expenditure, marriage and family values

Adversity on attachment avoidance. As shown in Fig. 5, this effect increases more gradually among individuals with higher resilience, indicating a protective role in mitigating attachment avoidance following ACEs. These findings partially support Hypothesis 3, confirming that

resilience buffers the negative impact of ACEs on attachment-related outcomes.

Discussion

This study investigated the relationship between ACEs and fertility intentions among adult university students in China, highlighting the mediating role of attachment and the moderating role of resilience. Our findings reveal three primary insights. First, we identified the types and patterns of ACEs that significantly negatively affected fertility intention. Second, attachment anxiety and avoidance partial mediate this relationship, indicating that early adversity influences fertility decisions through interpersonal patterns. Third, resilience buffers the impact of ACEs on attachment but does not moderate the direct pathways from ACEs or attachment to fertility intention, underscoring the need for interventions focused on fostering secure interpersonal relationships.

In our sample, 36.5% of respondents reported no intention to have children, a striking figure given China's demographic concerns. The study highlighting those specific ACEs (such as emotional neglect, parental separation or divorce, and family mental illness) and patterns of ACEs (such as Severe Adversity and Predominant Neglect) are linked to lower fertility intentions. According to life course theory, the quality of parenting during childhood predicts parenting behaviors in adulthood [87]. The impact of ACEs extends beyond romantic and marital relationships previously studied to affect actual fertility intentions even before the reproductive stage [36, 88, 89]. This finding bridges the gap between public health research on ACEs and fertility research.

Table 7 Mediating effects of adult attachment on aces patterns and fertility intention

Variable		β_1	t_1	P		β_2	t_2	P
Mediation model 1: ACEs model → attachment anxiety → fertility intention								
		Equation 1 Dependent variable: fertility intention				Equation 2 Dependent variable: attachment anxiety		
Attachment anxiety	b_1	-0.180	-5.871	<0.001				
Minimal Adversity		reference				reference		
Predominant Neglect	b_2	-0.388	-3.089	0.002	a_1	0.354	10.337	<0.001
Severe Adversity	b_3	-0.193	-1.549	0.121	a_2	0.522	15.549	<0.001
df / F		17.000				156.716		
P		<0.001				<0.001		
Mediation model 2: ACEs model → attachment avoidance → fertility intention								
		Equation 1 Dependent variable: fertility intention				Equation 2 Dependent variable: attachment avoidance		
Attachment avoidance	b_1'	-0.441	-9.475	<0.001				
Minimal Adversity		reference				reference		
Predominant Neglect	b_2'	-0.375	-2.977	0.003	a_1'	0.197	8.813	<0.001
Severe Adversity	b_3'	-0.165	-1.315	0.188	a_2'	0.278	12.676	<0.001
df / F		17.000				178.868		
P		<0.001				<0.001		

Note. The model controlled for student category, grade, gender, parents' education level, parents' work level, subjective socioeconomic status, regular monthly expenditure, marriage and family values

Table 8 Analysis of moderated mediating effects of resilience and adult attachment on aces pattern and reproductive intention

Variable		β_1	t_1	P		β_2	t_2	P
Model 1	Eq. 1 dependent variable: fertility intention				Eq. 2 dependent variable: attachment anxiety			
Attachment anxiety	b_1	-0.332	-1.992	0.046				
Minimal Adversity		reference				reference		
Predominant Neglect	b_2	-0.345	-0.501	0.616	a_1	-0.193	-1.236	0.216
Severe Adversity	b_3	-0.168	-0.269	0.788	a_2	-0.214	-1.426	0.154
Resilience	b_4	0.279	2.174	0.030	a_3	-0.420	-41.414	<0.001
Minimal Adversity×Resilience		reference				reference		
Predominant Neglect×Resilience	b_5	0.016	0.082	0.935	a_4	0.122	2.740	0.006
Severe Adversity×Resilience	b_6	0.028	0.158	0.874	a_5	0.174	3.995	<0.001
Attachment anxiety×Resilience	b_7	0.070	1.653	0.098				
F						240.342		
R^2						0.2226		
$df1$		21.000				19.000		
$df2$						15949.000		
P		<0.001				<0.001		
Model 2	Eq. 1 dependent variable: fertility intention				Eq. 2 dependent variable: attachment avoidance			
Attachment avoidance	b_1'	-0.714	-2.789	0.005				
Minimal Adversity		reference				reference		
Predominant Neglect	b_2'	-0.357	-0.520	0.603	a_1'	0.120	1.184	0.237
Severe Adversity	b_3'	-0.261	-0.413	0.680	a_2'	-0.222	-2.272	0.023
Resilience	b_4'	0.151	0.903	0.367	a_3'	-0.282	-42.850	<0.001
Minimal Adversity ×Resilience		reference				reference		
Predominant Neglect×Resilience	b_5'	0.022	0.115	0.909	a_4'	-0.003	-0.108	0.914
Severe Adversity×Resilience	b_6'	0.062	0.342	0.733	a_5'	0.118	4.185	<0.001
Attachment anxiety×Resilience	b_7'	0.113	1.715	0.086				
F		21.000				271.781		
R^2								
$df1$								
$df2$								
P		<0.001				<0.001		

Note. The model controlled for student category, grade, gender, parents' education level, parents' work level, subjective socioeconomic status, regular monthly expenditure, marriage and family values

One mechanism through which this occurs may be individuals' perceived fertility support, such as family support environment [50] and labor of market [90]. ACEs may reduce the perceived fertility support by accompanying experiences like negative parent-child relationships [91] and less intergenerational exchange of support [87]. ACEs also adversely affects academic performance [92, 93], potentially influencing individuals' expectations regarding their competitiveness in the labor market and future socioeconomic supports.

Notably, while childhood neglect has been identified as a critical predictor of long-term well-being [85, 86], our findings suggest a distinction between material and emotional neglect in shaping fertility intentions. Contrary to expectations, material neglect (e.g., insufficient food, clothing, and protection) was not significantly associated with fertility intentions. This suggests that psychological adversities have a more enduring influence on reproductive decision-making than economic hardships

experienced in childhood. Despite the perceived socioeconomic mobility that higher education offers, the emotional scars of ACEs persist, influencing expectations about parenthood and family formation [94]. As a serious problem in China [95] and around the world [96], which is developing and more "hidden" compared to abuse [97], neglect has a more detrimental effect on fertility intentions. Fertility policies and interventions should thus consider not only economic factors but also the long-term emotional consequences of childhood adversity.

Our findings also confirm that attachment mediates the relationship between ACEs and fertility intention, aligning with attachment theory's emphasis on the development of affectional bonds [98]. Compared to "Minimal Adversity," both "Predominant Neglect" and "Severe Adversity" increased attachment anxiety and avoidance, which in turn negatively impacted fertility intentions. A critical distinction in our mediation analysis is that the effects of "Predominant Neglect" and "Severe Adversity"

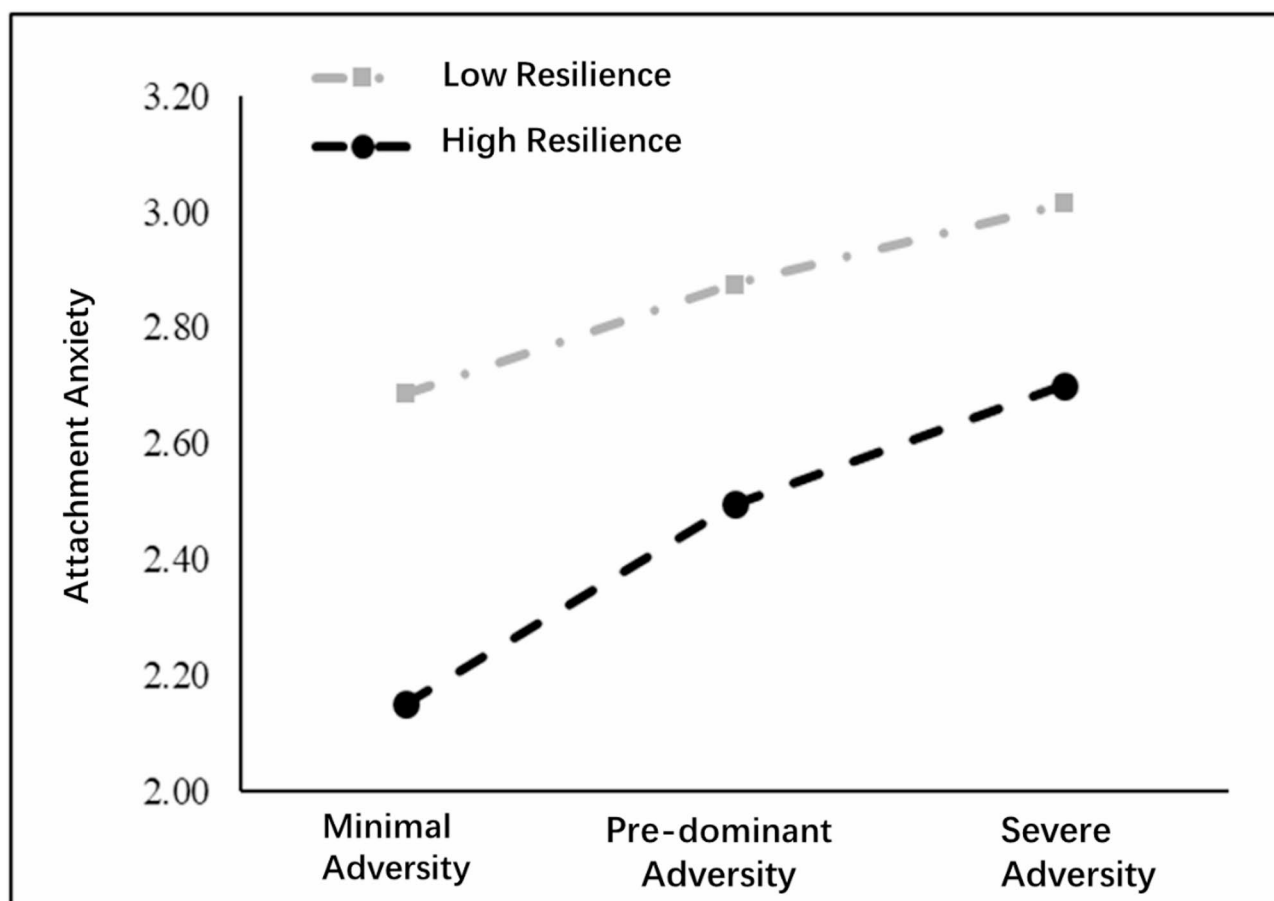


Fig. 4 The moderating effect of resilience in the “ACEs model-attachment anxiety-fertility intention” mediating model

on fertility intention differed. For “Predominant Neglect,” attachment partially mediated the relationship, as the direct effect of ACEs on fertility intention remained significant. This suggests that individuals experiencing neglect-related ACEs may develop negative fertility attitudes beyond attachment-related mechanisms. In contrast, for “Severe Adversity,” attachment fully mediated the relationship, meaning that the impact of ACEs on fertility intention was entirely explained through attachment-related processes. Additionally, comparisons of effect sizes suggest that “Severe Adversity” has a stronger influence on attachment anxiety, whereas “Predominant Neglect” has a stronger direct impact on fertility intention. Previous research hinted that ACEs have lasting effects on emotional development [99] and attachment patterns [100], influencing attitudes towards parenting [101, 102]. Our study extends this understanding by demonstrating that ACEs influence not only expectations of parenting but also the fundamental decision to have children.

The differences in mediation pathways may be explained by the nature of attachment styles. Individuals with high attachment avoidance tend to minimize

reliance on others and maintain negative appraisals of interpersonal support [103]. As a result, those with “Predominant Neglect” may resist social connections despite experiencing direct adversity, leading to persistently low fertility intentions. Conversely, individuals with “Severe Adversity” who develop high attachment anxiety may still seek connection but experience heightened fears of inadequacy, which could fully explain their lower fertility intentions. However, attachment styles can evolve with increased social interactions in adulthood [104, 105]. For college students, exposure to diverse social relationships may facilitate changes in attachment security. Support from peers, mentors, and organizations may offer compensatory experiences that promote positive attachment patterns [106, 107]. Research suggests that social groups provide a secure base, fostering resilience and adaptive interpersonal relationships [108, 109]. Thus, promoting attachment security in educational and workplace settings could help mitigate the negative effects of ACEs on fertility intentions.

The findings further refine the role of resilience in the ACEs-fertility intention pathway. While resilience moderated the impact of ACEs on attachment, it did

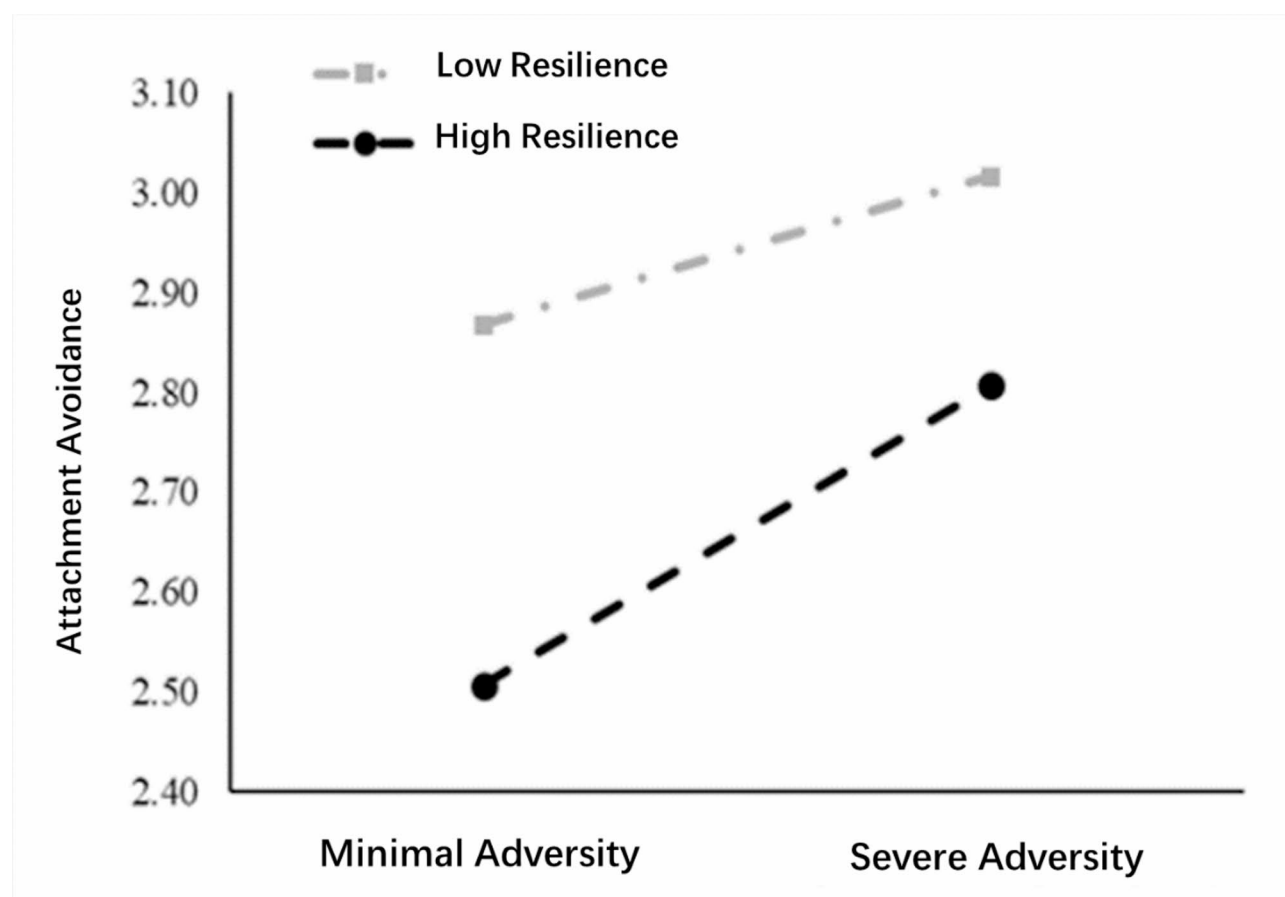


Fig. 5 The moderating effect of resilience in the mediation model of ACEs pattern-attachment avoidance-fertility intention

not significantly alter the direct or indirect relationship between ACEs and fertility intention. This suggests that resilience primarily influences the development of interpersonal patterns rather than fertility decision-making itself. The variation in moderation effects further highlights that interventions should be tailored: individuals with attachment avoidance may require different strategies than those with attachment anxiety.

Our results indicate that resilience buffers the impact of ACEs on attachment, but this effect is not uniform across different adversity patterns. Specifically, resilience moderated the pathway from “Severe Adversity” to attachment anxiety and attachment avoidance, but not the pathway from “Predominant Neglect” to attachment avoidance. This difference may stem from resilience’s emphasis on resource acquisition [55], which is generally less effective for individuals with attachment avoidance, as they tend to reject external support [110]. This suggests that while resilience can mitigate some interpersonal difficulties stemming from ACEs, individuals with high attachment avoidance may require more targeted interventions focused on trust-building and fostering social connections.

Previous research has emphasized resilience’s role in reducing the negative impact of childhood adversity on mental health [111] and behavioral outcomes [112]. While resilience is essential for post-traumatic growth [113], our findings suggest that its influence in shaping fertility-related attitudes is more indirect. The broader social environment—including stable family structures and supportive relationships—remains a critical factor in promoting resilience [114], highlighting the need for policies and interventions that address these contextual factors. Given that resilience does not directly moderate the ACEs-fertility intention link, fertility-promoting interventions should prioritize strengthening interpersonal relationship development over merely enhancing individual resilience.

Given the importance of enhancing fertility intentions for future population trends, early interventions are crucial. Universities and colleges are related institutions should implement ACEs screenings, conduct preventive interventions for at-risk families, and increase awareness among students about early life experiences to promote proactive resource-seeking. Programs fostering positive attachment patterns, reducing attachment avoidance and anxiety, and enhancing resilience are vital for improving

mental health and social adaptation in educational and community settings.

Limitation and future direction

This study offers valuable insights but is subject to several limitations that should be addressed in future research. The use of retrospective self-report questionnaires introduces potential recall bias, which affects the accuracy of the data and limits our ability to track specific fertility behaviors and long-term influencing factors. To mitigate this issue, future studies could consider employing prospective designs or incorporating multiple research methods to ensure more accurate and comprehensive data collection.

Furthermore, the study did not account for the severity of ACEs, such as its frequency and duration, due to the constraints of binary classification measures. This oversight limits our understanding of how varying levels of adversity affect outcomes. Future research should aim to include more detailed assessments of ACEs severity. Additionally, the study's focus on a single comprehensive university in Eastern China may impact the generalizability of the findings. Expanding research to include institutions from diverse regions and educational levels would enhance the external validity and provide a more comprehensive understanding of the phenomena across different contexts.

Conclusion

The research identifies how ACEs negatively impacts fertility intentions through mechanisms like increased attachment avoidance and anxiety. Neglect and abuse-related adversities, in particular, need more focus. Resilience was found to moderate these effects, with lower resilience amplifying the negative impact of ACEs on attachment styles. Therefore, enhancing resilience through targeted interventions could mitigate some of these adverse effects. Future research should delve deeper into the specific roles of neglect and abuse and develop strategies to improve resilience, which could inform more effective fertility-related interventions and policies.

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Author contributions

J Z was responsible for designing the questionnaire, conducting data collection and analysis, drafting the initial outline, writing the Discussion section, and performing comprehensive revisions of the manuscript. WX C contributed by drafting the preliminary versions of the Methods and Results sections. WQ W authored the initial draft of the Background section. M L played a key role in providing the research idea and primary data source, as well as overseeing data collection efforts, with JH M assisting in the data collection process. XZ W provided suggestions in the conceptualization of

idea and the stress-related physiological analysis in this study. XH X, RT Z, DD J, and SS L actively participated by offering critical analysis and constructive feedback during the research process. WN X and PG S provided valuable suggestions for manuscript revision and refinement. QY led the project by overseeing conceptualization, acquiring funding, managing administrative and logistical aspects, revising the manuscript, and providing resources and supervision throughout the study.

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Data availability

The datasets and analytic code used during the current study are not publicly available as our research is still ongoing. However, the data are available from the corresponding author on reasonable request. Additionally, the data that support the findings of this study are available from the psychological survey platform of the university involved in the study. Restrictions apply to the availability of these data, which were used under license for the current study and are therefore not publicly accessible. Data are, however, available upon reasonable request and with permission from the psychological survey platform of the university involved in the study.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethics approval was obtained from the Academic Ethics Committee of Jing Hengyi School of Education Hang Zhou Normal University (Approval Number: 2022026). All participants provided informed consent prior to participation. Participation was entirely voluntary, and respondents were informed of their right to withdraw at any time without penalty.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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