INTRODUCTION

Depression is one of the most common causes of disability around the world. As reported by World Health Organization, it is estimated that more than 350 million people suffer from it. For college students, depression is also one of the most common mental disorders, which is also prevalent in China. Depression in college students may influence their academic attainments and interpersonal relationship, and worse, may lead to suicide. Therefore, given the high prevalence and serious consequences of depression, it is necessary to identify its influential factors among college students.

In college students, previous studies have validated that childhood trauma is correlated with the risk of depression, and that childhood trauma could predict depression. For the mechanism of this effect, some studies found that individuals who experienced trauma were more sensitive to future adversity or negative events. Thus, minor adverse events may also trigger their depressive reactions. In other words, childhood trauma, a distal stressor, would increase individuals' sensitivity to stress, which would then lower their threshold to suffer from depression. These findings above were consistent with the diathesis-stress theory, which suggested that the stress may activate a vulnerability to trigger depres-
sive symptoms. Thus, the stress may play a vital role in the relationship between childhood trauma and depressive level.

College students are usually under varying kinds of pressure, such as continuing study pressure, family pressure, or employment pressure.31-34 But high levels of stress also could affect students’ interest in learning, general health, physical function, and even increase their depressive levels.35-37 Consistent with the theory of diathesis-stress mentioned above, many studies have suggested that individuals who have adversity experiences in childhood may have higher perceived stress levels, which might increase the risk of depression. Further, some studies have validated the mediation role of stress between different types of childhood trauma and depressive level in various populations. However, few studies focused on the mediation role of perceived stress between childhood trauma and depressive level among Chinese college students. Perceived stress refers to a subjective evaluation and assessment of the stress level for an objective event that individuals experienced.28 Previous studies suggested that individuals with higher perceived stress levels would report more depressive symptoms than those with lower perceived stress levels when faced with the same stress event, which means that perceived stress may determine the severity and impact of stress.

Nevertheless, some studies discovered that individuals who had childhood traumatic experiences may not report more symptoms of depression. Thus, there may be a moderation factor in the relationship between childhood trauma and depression. Rumination was defined as ‘the process of thinking about one’s negative and distressing feelings and bad consequences repeatedly and passively, rather than actively solving problems.’31 Previous studies have validated that rumination was correlated with childhood trauma and depression, especially the positive correlation between high rumination level and childhood traumatic experiences, as well as between high rumination level and high depressive level.35 Further, previous studies have found that rumination mediated the relationship between childhood trauma and depression, that is, higher childhood traumatic experiences lead to higher depressive levels via increasing their rumination levels. In total, these studies above emphasized the positive correlations between high rumination level with childhood traumatic experience and depression, while the correlations between low rumination level with childhood traumatic experience and depression were not clear. In other words, it remains unknown whether high and low rumination levels can bring different effects of childhood trauma on depression. Thus, it is necessary to investigate the moderation role of rumination in the pathway between childhood trauma and depressive level to compare the roles of high and low rumination level.

Based on the diathesis-stress theory and the above studies, this study aimed to set up a comprehensive model to investigate the possible pathway between childhood trauma and depressive level in non-clinical Chinese college students, focusing on the roles of perceived stress and rumination. Specifically, this study hypothesized that perceived stress played a mediation role in the pathway between childhood trauma and depressive level (hypothesis 1), and rumination played a moderation role in the pathway between childhood trauma and depressive level (hypothesis 2). We illustrated our theoretical model using Figure 1 as a guide.

**METHODS**

**Participants**

The sample size in this questionnaire survey study was determined based on Monte Carlo simulation and the possible rate of invalid answers. Specifically, Monte Carlo simulation suggested that 702 participants were needed to obtain at least 0.80 of the statistical power. Considering the possible rate of 20% for the invalid records, a sample size of 883 participants was recommended. With the help of our collaborators, 1,212 college students without any clinical diagnosis of psychiatric diseases (non-clinical) were recruited from October to December 2021 in Guangzhou, China, via advertisement.

This study was approved by the ethical committee of the School of Public Administration in Guangdong University of Foreign Studies (file number: 20230605). Written informed consent was obtained from each participant, and all participants were asked to fulfill four questionnaires according to their real situation and were paid for their participation. One participant would be excluded from this study if they met one of these following criteria: 1) the answer time was below the average time (4 min), 2) the answers to the items conflicted with each other obviously, 3) the answers to the polygraph questions were completely inconsistent (the polygraph question was set up to repeat an item at a certain interval of time to test whether the participants’ choice was consistent). Eventually, 995 participants (306 males and 689 females) were included in this study and participants were between 19 and 26 years old (mean=19.89; standard deviation [SD]=1.99). The flow diagram of the participant inclusion process in this study was displayed in Supplementary Figure 1 (in the online-only

![Figure 1. The theoretical model used in this study.](www.psychiatryinvestigation.org)
Measures

Childhood trauma
The Childhood Trauma Questionnaire-Short Form (CTQ-SF) was used to evaluate traumatic experiences before 16 years old. The scale was a 28-item (including 25 clinical items and 3 validity items) self-report scale which contained five subscales: emotional neglect, physical neglect, sexual abuse, emotional abuse, and physical abuse. Each item was presented in a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always). The total score of this scale ranged from 25 to 125, with higher score indicating greater level of abuse or neglect experienced by the participant. The Chinese version of CTQ-SF has been proven to have high internal reliability and test–retest reliability. The Cronbach's alpha of the CTQ-SF in this study was 0.87.

Perceived stress
The Perceived Stress Scale (PSS) was used to assess the college students' perceived stress in the last month. It was a self-report scale including 14 items and adopted a 5-point Likert scale, ranging from 0 (almost never) to 4 (almost always). The total score of this score ranged from 0 to 56, with higher score indicating greater level of perceived stress of the participant. The Chinese version of PSS has been validated to be a reliable and valid measurement in rating stress among college students. Its Cronbach's alpha coefficient in this study was 0.86.

Rumination
The 22-item Ruminative Responses Scale (RRS-22), a self-report rumination measure, was mainly used to measure how often one participant think or do each item when they are feeling down, sad, or depressed (e.g., “Think why do I have problems other people do not have?”). The scale consisted of 22 items, which was rated on a 4-point Likert scaling from 1 (almost never) to 4 (almost always), with higher score indicating higher frequency of ruminative tendencies. Previous studies have shown that the Chinese version of the RRS-22 has excellent convergent validity and internal consistency. Its Cronbach's alpha in this study was 0.93.

Depressive level
The Beck Depression Inventory-II (BDI-II), a widely used measurement of depressive symptoms, was primarily used to rate participants' depressive symptoms and their severity in the past seven days. The scale consisted of 21 items with a 4-point response scale ranging from 0 (almost never) to 3 (almost always). The total score of this scale ranged from 0 to 63 with higher score indicating higher severity of depression. Previous studies have demonstrated that the Chinese version of the BDI-II has excellent reliability and validity. The Cronbach's alpha of BDI-II in this study was 0.88.

Statistical analysis
Data analyses were conducted with Mplus 8.3 (Muthén & Muthén, Los Angeles, CA, USA) with the following steps. First of all, descriptive analyses and correlation analyses were used to reveal the relationship among all variables. Then, moderated mediation analyses were conducted to test the mediation effect of perceived stress on the relationship between childhood trauma and depressive level, and the moderation effect of rumination on the relationship between childhood trauma and perceived stress as well as between childhood trauma and depressive level. Considering that sex and age were common influential factors for depression and were always regarded as covariates in analyses, Sex (0=female, 1=male) and age were also controlled for their effects on depressive level in this study. In addition, childhood trauma and rumination were grand-mean centered before creating the interactive term. The maximum likelihood estimator with robust standard error was utilized to take into account the possible influence of non-normal data distribution on the parameter estimation. Besides, 95% bias-corrected confidence interval (CI) with 10,000 resampling were obtained for all of the parameter estimates. Pseudo R² were reported for perceived stress and depressive level.

Supplementary analyses
In order to test whether the theoretical model in this study can be applied in different subtypes of childhood trauma, we also conducted the above analyses based on each subtype of childhood trauma, respectively.

RESULTS

Common method bias
All variables in this study were collected by self-report questionnaires which may pose the risk of common method bias. Therefore, Harman's single factor test was used to conduct exploratory factor analyses on all variables. The results extracted 22 factors with the eigenvalue greater than 1. The maximum factor variance explained 21.52%, which was far less than 40%. Thus, the influence of common method bias on the results of this study was not significant.

Descriptive analyses
As shown in Table 1, significant correlations were found among childhood trauma, perceived stress, rumination, and
depressive level. Specifically, childhood trauma was positively correlated with depressive level \((r=0.05, p<0.01)\), perceived stress \((r=0.05, p<0.01)\), and rumination \((r=0.11, p<0.01)\). Meanwhile, depressive level was positively correlated with perceived stress \((r=0.15, p<0.01)\), and rumination \((r=0.16, p<0.01)\). Perceived stress was also positively correlated with rumination \((r=0.04, p<0.01)\). Other correlations could be found in Table 1.

Hypothesis testing

As shown in Table 2, childhood trauma significantly impacted perceived stress \(\text{estimate}=0.15, \text{SE}=0.04, t=4.03, 95\% \text{ CI}=0.06–0.22\), whereas perceived stress significantly affected depressive level \(\text{estimate}=0.32, \text{SE}=0.02, t=18.95, 95\% \text{ CI}=0.29–0.36\). Perceived stress positively mediated the relationship between childhood trauma and depressive level \(\text{estimate}=0.09, \text{SE}=0.02, t=5.93, 95\% \text{ CI}=0.06–0.12\), and the direct influence of perceived stress on depressive level remained significant \(\text{estimate}=0.13, \text{SE}=0.02, t=5.54, 95\% \text{ CI}=0.09–0.18\).

Rumination negatively moderated the relationship between childhood trauma and perceived stress \(\text{estimate}=-0.17, \text{SE}=0.06, t=-2.86, 95\% \text{ CI}=-0.28–-0.05\)). Further simple analysis suggested that, the relationship between childhood trauma and perceived stress \(\text{estimate}=0.05, \text{SE}=0.05, t=1.15, 95\% \text{ CI}=-0.04–0.14\) and the mediation effect of perceived stress between childhood trauma and depressive level \(\text{estimate}=0.02, \text{SE}=0.02, t=1.16, 95\% \text{ CI}=-0.01–0.05\) were not significant when rumination was one standard deviation above its mean. However, these two relationships were significant when rumination was one standard deviation below its mean. Specifically, the relationship between childhood trauma and perceived stress \(\text{estimate}=0.24, \text{SE}=0.05, t=4.66, 95\% \text{ CI}=0.14–0.34\) and the mediation effect of perceived stress between childhood trauma and depressive level \(\text{estimate}=0.08, \text{SE}=0.02, t=4.50, 95\% \text{ CI}=0.04–0.11\) were significant and stronger when rumination was one standard deviation below its mean. The results of simple analyses were shown in Figure 2.

With the direct influence of trauma on depressive level, nonetheless, the moderating effect of rumination was positive \(\text{estimate}=0.10, \text{SE}=0.04, t=2.74, 95\% \text{ CI}=0.03–0.16\), in which the relationship was stronger \(\text{estimate}=0.16, \text{SE}=0.03, t=5.26, 95\% \text{ CI}=0.10–0.22\) when rumination was one standard deviation above its mean, and weaker \(\text{estimate}=0.06, \text{SE}=0.03, t=2.18, 95\% \text{ CI}=0.01–0.10\) when rumination was one standard deviation below its mean.

Supplementary results

The results based on each subtype of childhood trauma were displayed in Supplementary Tables 1-4 and Supplementary Figure 1 (in the online-only Data Supplement). Results revealed that the theoretical model in this study was especially

Table 1. Means, SD, and correlations of all variables in this study (N=995)

<table>
<thead>
<tr>
<th></th>
<th>Mean±SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sex</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2. Age (yr)</td>
<td>19.89±1.99</td>
<td>-0.29**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Childhood trauma</td>
<td>1.71±0.47</td>
<td>0.02</td>
<td>-0.05</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4. Depressive level</td>
<td>1.44±0.38</td>
<td>0.01</td>
<td>0.02</td>
<td>0.05**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5. Perceived stress</td>
<td>2.66±0.59</td>
<td>0.03</td>
<td>0.02</td>
<td>0.05**</td>
<td>0.15**</td>
<td>-</td>
</tr>
<tr>
<td>6. Rumination</td>
<td>2.24±0.56</td>
<td>0.06**</td>
<td>-0.01</td>
<td>0.04**</td>
<td>0.11**</td>
<td>0.16**</td>
</tr>
</tbody>
</table>

**p<0.01. SD, standard deviations

Table 2. The moderated mediation effect of childhood trauma on depressive level

<table>
<thead>
<tr>
<th></th>
<th>Perceived stress</th>
<th>Depressive level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.67</td>
<td>0.02</td>
</tr>
<tr>
<td>Sex (0=female, 1=male)</td>
<td>-0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Age</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>CT</td>
<td>0.15</td>
<td>0.04</td>
</tr>
<tr>
<td>RU</td>
<td>0.50</td>
<td>0.03</td>
</tr>
<tr>
<td>Perceived stress</td>
<td>-0.17</td>
<td>0.06</td>
</tr>
<tr>
<td>CT×RU</td>
<td>0.24</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Estimate, unstandardized regression coefficient. **p<0.01; SE, standard error; CI, confidence interval; CT, childhood trauma; RU, rumination; t, value of t-distribution
valid in the subtype of emotional neglect.

DISCUSSION

This study constructed a moderated mediation model to analyze the possible pathways between childhood trauma and depressive level in non-clinical Chinese college students with considering the mediation role of perceived stress and the moderation role of rumination. Results first revealed that childhood trauma has a negative effect on depression level, and perceived stress mediated this effect. These results supported the hypothesis 1. Results also indicated that rumination moderated the influence of childhood trauma on perceived stress and on depressive level, which supported the hypothesis 2.

As predicted, firstly, this study validated the negative effect of childhood trauma on depressive level in college students (Tables 1 and 2), which means that those with childhood traumatic experiences were more likely to report high depressive levels. This result in Chinese college students was consistent with prior studies focusing on other populations, such as college students,10,27,56 adolescents,57 adults,58-60 elders,61 and clinical patients.62 The possible reason for this maybe that individuals with traumatic experiences possessed more negative emotions, distorted cognition or personality deficits, which might lead to a social and psychological vulnerability in the future.63 Thus, the childhood trauma may be a stable and significant predictive factor of the prevalence of depression, which required us to pay more attention to the effects of childhood trauma on depression and further take measures to prevent and intervene depression.

Meanwhile, our results revealed that perceived stress mediated the relationship between childhood trauma and depressive level (Table 2), which was also in line with previous studies.77,64 These results indicated that childhood trauma would result in individuals’ depression by enhancing their sensitivity to stress or heightening their perceived stress levels.65,66 The potential reason for this maybe that high sensitivity to stress was functional adaptation to childhood trauma, constituting a potential mechanism by which childhood trauma would induce some mental illness, including anxiety and depression disorders.65,67 These findings could be explained by the theory of diathesis-stress, proposing that psychological or social stress could act on a vulnerability to trigger depressive symptoms.26 In other words, childhood trauma hindered the development of children’s self-structuring and enhanced their psychological susceptibility to future stressors, which would lead to more depressive symptoms.68 In total, our results revealed that childhood trauma affected depression not only directly but also indirectly through perceived stress, which reminded us to pay more attention to the perceived stress when taking measures to alleviate the effects of childhood trauma on depression.

In addition, this study also discovered that rumination not only moderated the link between childhood trauma and perceived stress (Figure 2A and Table 2) but also moderated the association between childhood trauma and depressive level (Figure 2B and Table 2). Rumination was characterized by repetitive negative thinking, and previous studies have revealed its significant correlations with childhood trauma32-34 and depressive level.35,69 In our study, on one hand, we detected the moderation role of rumination between childhood trauma and perceived stress (Figure 2A). Specifically, childhood trauma had significant and strong effect on perceived stress when the rumination level was low, while childhood trauma has no significant effect on perceived stress when the rumination level was high. And, importantly, the perceived stress based on high rumination level were much larger than low rumination level no matter the childhood trauma is high or low. These results indicated that compared with childhood trauma, rumination may have a greater negative impact on perceived stress, which has also been evidenced in previous studies. A study70 found that the adolescents with low levels of rumination would re-

![Figure 2. Rumination moderated the effect of childhood trauma (A) on perceived stress and (B) on depressive level. SD, standard deviations.](image-url)
port perceived stress below the average levels. Also, another study found that rumination was still a great risk factor of perceived stress, even after controlling for multiple potential factors, such as sex, age and some physical diseases. Of note, an intervention study on rumination have validated that individuals could alleviate their stress reactivity by reducing their levels of rumination. Overall, this study has showed that rumination has a great impact on the perceived stress levels of college students and can increase the negative indirect effect of childhood trauma on depressive level. On the other hand, we discovered the moderation role of rumination between childhood trauma and depressive level (Figure 2B). Specifically, childhood trauma had significant and strong effect on depressive level when the rumination was high, while the childhood trauma had significant but weak effect on depressive level when the rumination was low. These indicated that higher childhood traumatic experiences would result in more depressive symptoms, and the high rumination level would strengthen this effect. The results were in line with previous studies which showed that childhood trauma could significantly affect depressive symptoms and further increase the likelihood of suffering from depression. Further, the possible reason for the strengthening effect of rumination may be that for individuals with higher childhood traumatic experiences, relatively higher rumination levels will make them more worried about their status quo (e.g., their traumatic experiences and the corresponding consequence), thus increasing the risk and severity of depression. Overall, this study has validated that rumination had a great negative effect on college students’ depressive levels, and can moderate the direct effect of childhood trauma on depressive level. To sum up, these findings indicated the significance of rumination for mental health among college students and further gave us indications that more actions should be taken to alleviate their levels of rumination.

In general, in theory, our study revealed a pathway on how childhood trauma affects the depressive level of college students, by combining a mediation effect of perceived stress and the moderation effect of rumination, based on a moderated mediation model. In practice, our study gave implications to alleviate depressive levels of non-clinical Chinese college students, especially for those with childhood traumatic experience. First, parents or caregivers should try their best to reduce the children’s traumatic experience, such as giving them love and respect, rather than discrimination, abuse or corporal punishment. Second, for those with childhood traumatic experiences, we could prevent and reduce students’ depressive levels by alleviating their perceived stress levels. Specifically, we could take some actions to improve students’ ability to cope with stress (e.g., encouraging them to participate community activity and competitions), which would not only help reduce their perceived stress levels, but also further alleviate their depressive symptoms. Third, we should pay more attention to college students’ level of rumination and take some other interventions to reduce their rumination levels, such as mindfulness, attention control exercises, cognitive reappraisal, and cognitive control training.

Limitations
There were still some limitations in this study. Firstly, because this study is based on a cross-sectional design, it cannot reveal the causal relationship among childhood trauma, rumination, perceived stress, and depressive level. Therefore, a future longitudinal study should be conducted to verify the causal relationship among the above variables. Secondly, this study only recruited non-clinical participants, and it was unclear whether our results can be applied in clinical patients. Future researches should recruit clinical depressive patients to test the replicability of this model in our study. Thirdly, this study only included college students in Guangzhou as participants, which may limit the generalization of our conclusions. In future studies, we should extend the sampling in order to validate our findings. Fourthly, supplementary results indicated that the theoretical model was especially valid in the subtype of emotional neglect, which emphasized the role of perceived stress and rumination in the pathway between emotional neglect and depressive level. Future studies should investigate which factors play more important roles in the pathway between each of other subtypes and depressive level. Lastly, the data in this study were collected in 2021 and the manuscript was submitted in 2023, which indicate the lag of time for this study. Future studies should use the timely data and validate the conclusions in this study.

Conclusion
In general, this study revealed a potential pathway of how childhood trauma affects the depressive level among non-clinical college students. The findings further give us multi-dimensional (perceived stress, and rumination among college students) indications for reducing the negative effects of childhood trauma on depressive level, which will be helpful for improving their mental health.

Supplementary Materials
The online-only Data Supplement is available with this article at https://doi.org/10.30773/pi.2023.0188.

Availability of Data and Material
The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

Conflicts of Interest
The authors have no potential conflicts of interest to disclose.
Pathways Between Childhood Trauma and Depression

Author Contributions


Funding Statement

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