

Test anxiety and emotion regulation among undergraduate medical students in China: the mediating role of psychological resilience

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2 **China: the mediating role of psychological resilience**

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46 **Abstract**

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48 **Background:** Medical students experience a considerable amount of anxiety due to exams.

49 Emotion regulation and psychological resilience are established protective factors of individual

50 mental health, however, the investigations for the effects of anxiety were limited. The goal of the

51 present study was to examine the relationship of psychological resilience and emotion regulation

52 with test anxiety and the associated factors of them among medical students.

53 **Methods:** In this cross-sectional survey, a simple random sampling methods was used to select the

54 participants. Information from a sample of 1266 medical students was collected by self-reporting

55 questionnaires. Logistic regression was applied to test the associations between test anxiety and

56 emotion regulation, resilience. Bootstrap were conducted to explore the mediating role of

57 resilience.

58 **Results:** Our important results were that the prevalence of problematic test anxiety among

59 medical students to be 71.4%, 33.7% was high test anxiety. Gender and academic performance

60 correlated significantly with test anxiety, emotion regulation, and psychological resilience. There

61 were correlations between test anxiety and various dimensions of emotion regulation and

62 psychological resilience ($P < 0.01$). Emotion regulation and psychological resilience predicted

63 emerging test anxiety. The mediating role of psychological resilience was identified for the effects of

64 emotion regulation on test anxiety.

65 **Conclusions:** Findings suggest that emotion regulation affected test anxiety through psychological

66 resilience, which may provide insights for clinical psychologists, raise their awareness of the

67 importance of cultivating and improving medical students' psychological resilience, and prompt

68 them to offer psychological support to students with test anxiety as early as possible. The

69 combination of curing and self-healing can solve the root cause of the problem and truly apply
70 psychological research to improving the mental health of the general public.

71 **Keywords:** Psychological resilience, Test anxiety, Emotion regulation, Medical student

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74 **Background**

75 Test anxiety is considered as a set of psychological responses (such as worry, stress, emotionality)
76 that individual experience negative consequences or failure of an exam or similar evaluation
77 situation [1]. It can occur at any phase of exam. According to educational psychologists and
78 experts in education, an average level of anxiety is useful as an effective motivational factor can
79 enhance one's performance for more effort [2]. While for some, taking high-stakes exams has a
80 significant influence on the emotional and physiological well-being of exam-takers, it may arouse
81 feelings of fear, incompetence or even anger in others [3-4]. From 2001 to 2011, the proportion of
82 students with test anxiety in China increased from 21.8% to 27.52%. Interestingly, students
83 majoring in medicine generally have higher level of test anxiety than students of other majors.
84 This is mainly attributed to the fact that medical students are demanding to master a large amount
85 of knowledge, clinical practice skill and professional quality tests. Therefore, it is practical
86 significance to study the prevalence of test anxiety in medical students.

87 Emotion regulation is defined as “the process by which we influence which emotions we
88 have, when we have them, and how we experience and express them” [8]. Among the emotion
89 regulation strategies researched in the field, cognitive reappraisal and expressive suppression
90 emerged as two widely-investigated strategies associated with physical health, mental health, and
91 social well-being [9-11]. Cognitive reappraisal refers to the process involving a reinterpretation of
92 the meaning of an emotional stimulus and subsequently, leading to a change of the initial

93 trajectory of an emotional response [8]. In contrast, expressive suppression is a response- focused
94 emotion regulation strategy whereby people adjust their emotional experience by suppressing the
95 expression of that emotional state [10]. Previous studies suggested that cognitive reappraisal was
96 view as an adaptive emotion regulation strategy [10,12-13]. For example, cognitive reappraisal
97 was found to reduce negative emotions and heighten positive ones, thereby enhancing mental
98 health and interpersonal functioning. Compared to cognitive reappraisal, expressive suppression
99 potentially prevents the suppressors from experiencing positive emotions, increases experiences of
100 negative emotions, and creates a sense of inauthenticity, which are detrimental to mental and
101 physical health [14-15].

102 Studies have shown that cognitive reappraisal and expressive suppression are closely
103 associated with anxiety. Cognitive reappraisal can regulate individual anxiety to promote his/her
104 mental flexibility and emotional well-being [16], while negative emotion regulation is closely
105 associated with individual negative emotions, especially anxiety. The anxiety level of adolescents
106 depends on the use of cognitive reappraisal strategy, with less use of cognitive reappraisal
107 associated with higher anxiety level [17]. Therefore, cognitive reappraisal is an important but
108 difficult strategy for anxious individuals.

109 Psychological resilience refers to the ability of an individual to effectively adapt to and cope
110 with frustrations, difficulties, or adversities, and maintain mental health [18]. Studies have found
111 that psychological resilience can alleviate the impact of stress on anxiety [19], and individuals
112 with high psychological resilience have faster cardiovascular recovery from negative emotional
113 arousal and higher levels of positive emotions [20]. A large number of longitudinal studies have
114 shown a significant correlation between positive emotions and psychological resilience [21-23].

115 Meanwhile, psychological resilience, as a positive psychological quality, may be an important
116 regulating variable in the face of stress. Studies have shown that psychological resilience can be
117 used to predict anxiety [24].

118 Studies have found that cognitive reappraisal strategy is associated with high anxiety level
119 while expressive suppression strategy is associated with low anxiety level [25-26]. However, most
120 of these studies did not involve other variables, making it impossible to determine whether the
121 above relationship between emotion regulation strategies and anxiety would change with the
122 addition of other variables. Emotion regulation and psychological resilience are protective factors
123 of individual mental health; they are closely related [21-23] and may have a joint effect on anxiety.
124 Based on literature analysis and current research gaps, we aimed to analyze the relationship of
125 psychological resilience and emotion regulation with test anxiety among a large sample of medical
126 students in China, and hypothesized as follows: psychological resilience and emotion regulation
127 are associated with test anxiety and accurately predict it, and psychological resilience may play a
128 mediating role in the effect of emotion regulation on test anxiety.

129

130 **Methods**

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132 **Study population and procedure**

133 Totally 1300 undergraduate students at a Chinese medical university in Guangdong were selected
134 with simple random sampling methods. Of these students were eligible to participate and written
135 consent was obtained before the study began. This was an cross-sectional survey performed from
136 June to December, 2019. The study was approved by the Ethics Committee of the Guangdong
137 Medical University (ref. YJYS2019027). Face-to-face interview was applied to inform notes then
138 participants completed surveys online for scales. On average participants took 15-20 min to

139 provide responses on the questionnaires. Concerning acute anxiety evoked during period of stress
140 was shown to be worse than usual, we decided on the exam period at the end of the first and
141 second semesters during this year for the present study [27].

142

143 **Measures**

144 ***Test anxiety***

145 For measuring the students' test anxiety, the Chinese adaptation of Sarason's Test Anxiety Scale
146 (TAS) was used [1, 28]. TAS consists of 37 items to which respondents are asked to report how
147 often they experience anxiety symptoms before, during, and after taking tests. The responses are
148 included "Yes" and "No". The "yes" responses are added one point up and "no" 0 point, except
149 six items are reversed (e.g., the 3rd, 15th, 26th, 27th, 29th, 33th). Respondents were classified as
150 three different levels of test anxiety according to TAS score. Scores falling at or below 12 were
151 indicative of low-test anxiety, scores falling above 12 and below 20 were indicative of a normal
152 level of anxiety, score falling at or above 20 were indicative of high level of test anxiety. The
153 Cronbach's alpha was alpha of .77, split-half reliability of .60 in a Chinese sample [28]. The
154 Cronbach's α of TAS in this sample was 0.884, indicates an acceptable level of internal
155 consistency.

156 ***Emotion Regulation***

157 Cognitive reappraisal and expressive suppression frequency during a student's daily life was
158 measured by Emotion Regulation Questionnaire (ERQ), which developed by Gross and John [29].
159 It includes 14 items that describe five universal emotions (including disgust, anger, sadness, fear
160 and joy) that involve regulating expression, and it can be divided into 2 dimensions: cognitive
161 reappraisal scale includes 6 items, and the expressive suppression scale includes 4 items. Items are
162 assessed on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The

163 total score range from 14 to 98; with higher scores indicate a higher frequency in using a
164 particular emotion regulation strategy. Previous studies demonstrated ERQ as a reliable tool with
165 Cronbach's alpha coefficient of .83 for cognitive reappraisal, and 0.77 for expressive suppression.
166 Current research yielded that the Chinese version of this scale has adequate reliability and validity
167 [30]. The Cronbach's α of ERQ in our study was 0.903.

168 ***Resilience***

169 For the assessment of students' psychological resilience, the Chinese adaptation of
170 Connor-Davidson Resilience Scale (CDRS) was used [31, 32]. The CDRS, developed by Connor
171 and Davidson [33], measures the capability to deal with adversity and stress. Based on exploratory
172 factor analysis of the designer, the 25 items of CDRS can be grouped into 3 dimensions: strength,
173 optimism, resilience. The respondents were expected to answer items based on their own situation.
174 Each statement is rated on a 5-point scale ranging from 0 (not true at all) to 4 (true nearly all the
175 time). The combined score of CDRS ranges from 0 to 100, with a higher sum indicates a greater
176 resilience. The scale was found to be internally consistent and reliable as indicated by the alpha
177 coefficient value 0.89 [34]. Evidence suggests that the CDRS is a very reliable scale which was
178 used by researchers to find out level of psychological resilience among Chinese college students
179 [31-32]. In our sample, the internal consistency of CDRS was very high (Cronbach's alpha =
180 0.955).

181

182 **Statistical analysis**

183 All statistical data were imported to SPSS version 21.0 (SPSS Inc., USA) for analysis. The
184 categorical variables were presented with frequencies and proportions while the continuous
185 variables were described by means and standard deviations (SDs). Associated factors of test
186 anxiety, resilience and emotion regulation were examined by using *t*-tests and ANOVA,

187 respectively. Comparisons the correlation between emotion regulation, resilience and test anxiety
188 were performed via correlation analyses and the predictor of test anxiety were analyzed by
189 regression analyses. Bootstrapping was conducted in testing mediation effects. A *p* -value was less
190 than 0.05 was considered statistically significant.

191

192 **Results**

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194 **General characteristics of participants**

195 The final sample consisted of 1266 participants for further analysis, because of missing
196 information in critical items. The valid response rate was 96.6%. Major characteristics of study
197 subjects were listed in Table 1. Of these participants, females hold the predominant majority
198 (*N*=820, 64.8%). There were 991 participants (78.3%) that took 5 to 7 exams, as the predominant
199 majority. Students reported engaged in part-time jobs or member account for 26.5%, 83.9%,
200 respectively. More than half of the participants 781 (61.7%) came from town and most of the
201 respondents were not single-child family 971(76.7%) and regarding education level of the
202 respondent's majority of the participant were 1rd year 605(47.8%) followed by 3nd year
203 312(24.6%).

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211 **Table 1** Socio demographic characteristics of medical students

Variable	Category	Frequency	Percentage
Gender	Male	446	35.2
	Female	820	64.8
Grade	First year	605	47.8
	Second year	264	20.9
	Third year	312	24.6
	Fourth year	64	5.1
	Fifth year	21	1.7
Colleague	Public health	280	22.1
	Humanities and management	14	1.1
	Clinical medicine	100	7.9
	Medical technology	234	18.5
Part-time jobs	Pharmacy	638	50.4
	Yes	335	26.5
Members of the club	No	931	73.5
	Yes	1062	83.9
Academic evaluation	No	204	16.1
	Excellent	351	27.7
	Moderate	490	38.7
	Lower-moderate	241	19.0
Examination number	Poor	184	14.5
	Below 5	82	6.5
	5 to 7	991	78.3
	8 to 9	144	11.4
Birthplace	Above 9	49	3.9
	City	485	38.3
Single-child family	Country	781	61.7
	Yes	295	23.3
	No	971	76.7

212

213 **Levels and associated factors of test anxiety, resilience and emotion regulation**

214 As seen in Table 2, more than half (71.4%) of medical students had problematic test anxiety, 33.7%
 215 was high test anxiety. The average scores of the three specific dimensions of psychological
 216 resilience varied, ranging from 9.07 ± 2.70 (optimism) to 29.68 ± 8.557 (resilience). Regarding
 217 emotion regulation, cognitive reappraisal (34.30 ± 6.824) adopted by students was higher than
 218 expressive suppression (30.26 ± 7.046).

219 Moreover, we found gender and academic performance were significantly associated with
 220 among test anxiety, psychological resilience and emotion regulation. In other words, the odds of
 221 having positive test anxiety, psychological resilience and emotion regulation for those who have

222 excellent academic evaluation is higher than those who have poor academic evaluation.

223 Additionally, female reported more difficulties in above-mentioned three aspects compared to

224 male.

225 **Table 2** Means, standard deviations, and correlations

Variable		Psychological resilience	Resilience	Strength	Optimism	Emotion regulation	Cognitive reappraisal	Expressive suppression	Test anxiety
Total		58.89±15.28	29.68±8.56	20.14±5.01	9.07±2.70	64.56±11.92	34.30±6.82	30.26±6.82	16.75±7.62
Gender	Male	60.96±17.58	30.99±9.85	20.64±5.71	9.33±2.97	65.52±13.93	33.97±7.72	31.55±7.63	15.77±7.74
	Female	57.77±13.76	28.97±7.68	19.86±4.56	8.93±2.53	64.03±10.63	33.48±6.28	29.55±7.61	17.27±7.51
	<i>T</i>	3.33**	3.75***	2.49*	2.39*	1.97*	-1.184	4.66***	-3.36**
Grade	First year	59.87±15.31	30.19±8.61	20.45±4.97	9.22±2.69	64.42±11.99	34.22±6.88	30.20±7.25	16.61±7.61
	Second- year	59.59±16.70	30.36±9.09	20.10±5.47	9.13±2.92	64.91±12.54	34.26±6.88	30.65±7.17	16.74±7.74
	Third year	56.26±13.83	28.10±7.83	19.43±4.69	8.73±2.52	64.54±11.45	34.35±6.69	30.19±6.61	17.02±7.74
	<i>F</i>	3.17*	3.80**	2.38*	1.18	0.26	0.14	0.81	0.17
Academic evaluation	Excellent	61.89±13.41	31.22±7.59	21.26±4.48	9.40±2.46	65.89±11.08	35.28±6.21	30.61±6.81	15.49±6.67
	Moderate	60.22±14.41	30.37±8.14	20.56±4.61	9.29±2.67	64.76±11.46	34.55±6.57	30.21±7.00	16.51±7.61
	Lower-moderate	56.40±14.73	28.37±8.23	19.27±4.90	8.77±2.58	63.46±11.67	33.55±6.96	29.91±6.61	16.85±7.94
	Poor	52.92±19.11	26.64±10.62	18.00±6.17	8.28±3.15	62.92±14.47	32.75±8.01	30.17±8.12	19.64±8.22
	<i>F</i>	17.93***	15.01***	21.73***	9.22***	3.37*	6.86***	0.51	12.48***
Single-child family	Yes	59.37±16.45	29.94±9.14	20.19±5.35	9.24±2.85	64.01±12.75	33.49±7.16	30.52±7.41	17.12±7.88
	No	58.75±14.92	29.61±8.37	20.12±4.90	9.02±2.65	64.73±11.65	34.54±6.70	30.18±6.93	16.63±7.54
	<i>T</i>	0.58	0.58	0.21	1.21	-0.90	-2.32*	0.72	0.95
Part-time jobs	Yes	60.71±15.44	30.84±8.72	20.52±5.02	9.35±2.75	66.00±12.75	34.90±6.97	31.10±7.30	16.37±7.97
	No	58.24±15.18	29.26±8.46	20.00±5.00	8.98±2.68	64.04±11.56	34.08±6.76	29.95±6.93	16.88±7.49
	<i>T</i>	2.54*	2.91**	1.62	2.18*	2.59*	1.88	2.56*	-1.05
Members of the club	Yes	59.26±14.79	29.86±8.26	20.27±4.88	9.12±2.65	64.68±11.59	34.46±6.67	30.22±6.94	16.86±7.55
	No	57.00±17.53	28.74±9.91	19.42±5.60	8.84±2.93	63.92±13.49	33.47±7.53	30.45±7.59	16.17±7.97
	<i>T</i>	1.73	1.53	2.03*	1.34	0.83	1.90	-0.43	1.18
Birthplace	City	59.32±15.94	29.86±8.84	20.17±5.23	9.29±2.82	64.74±12.27	34.09±6.78	30.66±7.34	17.41±7.87
	Country	58.63±14.87	29.57±8.38	20.12±4.87	8.94±2.62	64.44±11.70	34.43±6.85	30.01±6.85	16.33±7.44
	<i>T</i>	0.78	0.57	0.18	2.23*	0.44	-0.87	1.58	2.46*

226

227 **Correlation between study variables**

228 To that extent we performed spearman rank correlation analyses between test anxiety, resilience

229 and emotion regulation. This correlation was shown in Table 3. As expected, test anxiety has a
 230 significant negative correlation with resilience ($r = -0.382, p < 0.01$) and emotion regulation ($r =$
 231 $-0.158, p < 0.01$). A low level of test anxiety is linked with a high degree of resilience as well as
 232 emotion regulation in medical students. Interesting, more than emotion regulation and resilience,
 233 all the dimensions of that were significantly negative correlations with test anxiety respectively.

234 **Table 3** The correlation coefficients for the test anxiety, emotion regulation and resilience (N = 231)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)Test anxiety	-							
(2)Emotion regulation	-0.158**	-						
(3)Cognitive reappraisal	-0.191**	0.854**	-					
(4)Expressive suppression	-0.082**	0.864**	0.476**	-				
(5)Resilience	-0.382**	0.507**	0.559**	0.316**	-			
(6)Resilience	-0.374**	0.500**	0.537**	0.326**	0.972**	-		
(7)Strength	-0.364**	0.492**	0.562**	0.288**	0.946**	0.867**	-	
(8)Optimism	-0.304**	0.371**	0.420**	0.221**	0.827**	0.723**	0.723**	-

235 * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

236

237 **Testing the mediating role of resilience**

238 We finally set out to investigate whether resilience was a mediator. Multiple regression analysis
 239 showed that cognitive reappraisal negatively predicted test anxiety ($\beta = -0.191, p < 0.01$). Similarly,
 240 resilience and strength negatively predicted test anxiety ($\beta = -0.235, p < 0.01$; $\beta = -0.160, p < 0.01$,
 241 respectively). Table 4 indicates the unstandardized parameter estimates and standard errors in the
 242 model. It can be assumed that practical work aimed at developing the cognitive reappraisal and
 243 resilience could effectively ensure less test anxiety.

244 Furthermore, regression analyses found that dimensions of resilience possible be taken as
 245 mediating role. Total effects model was conducted by taking cognitive reappraisal as independent
 246 variable X, resilience and strength as mediating variables M1 and M2, and test anxiety as
 247 dependent variables Y to examine the mediating role of resilience. Bootstrapping was conducted

248 to test the mediating effects, as it can yield more accurate estimates of the indirect effect standard
 249 errors than alternative approaches to testing mediation [35]. We adopt Bootstrapping to test
 250 mediation effects and the 95% confidence interval (CI) based on 5000 bootstrap samples with
 251 replacement. When the indirect effects as represented here by confidence intervals, did not include
 252 zeros, we can infer that mediation occurred. The results presented that, *ab* was statistically
 253 significant. Therefore, there was a mediation occurred of resilience and strength on emotion
 254 regulation and test anxiety. In other words, the path model going from emotion regulation to
 255 resilience to test anxiety was significant. As shown in Table 5, the indirect effects of resilience and
 256 strength on emotion regulation and test anxiety did not include a zero (95% CI: -0.189, -0.091; 95%
 257 CI: -0.162, -0.048, respectively), thereby indicating resilience and strength as a mediator.
 258 Moreover, controlling for mediating variables, the direct effects of cognitive reappraisal on test
 259 anxiety include a 0 (95% CI: -0.027, 0.112). It indicated that resilience and strength performed
 260 a completely mediating role in the relation between emotion regulation and test anxiety.

261 **Table 4** The regression analyses for the test anxiety, emotion regulation and resilience (N = 231)

Independent variable	Equation 1 (dependent variables: test anxiety)				Equation 2 (dependent variables: test anxiety)			
	B*	SE*	β^*	<i>t</i>	B	SE	β	<i>t</i>
Constant	24.046	1.079		22.290***	27.879	0.821		33.941***
Cognitive reappraisal	-0.213	0.031	-0.191	-6.900***				
Resilience					-0.209	0.046	-0.235	-4.506***
Strength					-0.244	0.079	-0.160	-3.078
R ² *				0.036				0.146
F				47.611***				108.230***

262 *B= regression coefficient, SE= standard errors, β = standardized regression coefficient, R²=
 263 coefficient of determination

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 269

270 **Table 5** Mediation model of resilience between emotion regulation and test anxiety

Roadmap	Category	Effect ratio	95% CI (lower, upper)	Relative mediation effect(%)
Cognitive reappraisal→Test anxiety	Total effect	-0.213	-0.273, -0.152	100%
Cognitive reappraisal→Test anxiety	direct effect	0.043	-0.027, 0.112	14.40%
Cognitive reappraisal→Resilience→Test anxiety	indirect effect	-0.146	-0.189, -0.091	48.76%
Cognitive reappraisal→Strength→ Test anxiety		-0.110	-0.162, -0.048	36.84%

271

272 **Discussion**

273

274 **The population characteristics of medical students' test anxiety, emotion regulation, and**
 275 **psychological resilience**

276 Findings from the present study demonstrated that the prevalence of high test anxiety among
 277 medical students to be 33.7%, higher than 32.64% in that of 2015. Literature shows that the
 278 magnitude of high test anxiety for students was 27.52% in 2015 [5], for 21.8% college students in
 279 2001 [28]. Our results thus confirm previous reports showing that the odds of developing test
 280 anxiety was higher among medical students as compared to other majors in China [6-7]. The
 281 possible reasons are described as follows. From the perspective of the knowledge to be mastered,
 282 medical students have to take many abstract and difficult major courses. Meanwhile, they cannot
 283 just make up the number in class since their future careers are related to human life, and medical
 284 schools have very strict requirements for their academic performance. From the perspective of
 285 employment pressure, the employment situation is not optimistic for medical students. Practicing
 286 medicine requires extremely high professional skills, which makes it impossible to find a job in a
 287 highly-ranked hospital without adequate professional skills. At present, the demand from society
 288 for technical personnel has increased dramatically. Compared with the theoretical knowledge
 289 acquired in school, practical skills acquired at work are more important for engineering students.
 290 Moreover, we found that more than half of the medical students (71.4%) had problematic test
 291 anxiety. The result of the current study was higher than the study conducted at USA (55%). This

292 difference may be due to the variations in several factors that have an impact on anxiety, such as
293 curriculum evaluation methods, different requirements about students' physical ability and other
294 factors. Universities in the US adopt flexible teaching and performance assessment methods, with
295 a focus on the improvement of students' self-efficacy. Universities in China generally adopt a
296 single final examination with formatted content for the evaluation of academic performance [36,
297 37].

298 Our study results demonstrate that test anxiety, resilience and emotion regulation are closely
299 associated with both academic performance and genders. As the research data show, female
300 students have higher levels of test anxiety while male students represent a higher level of
301 resilience as well as emotion regulation. With regard to gender differences, most researchers
302 report higher levels of test anxiety in females [38, 39]. This may be attributed to the fact that
303 women are under the pressure from society to develop their own competitiveness. In addition,
304 some scholars have shown that women use negative cognitive emotion regulation strategies more
305 often than men [40]. Parents usually teach boys to control emotions, which makes boys have
306 higher expectations for their ability to control emotions. When encountering emotional problems,
307 men tend to be resilient and finally master the skills to control emotions in silence. In contrast,
308 women are likely to distract their attention owing to their emotional personality traits and
309 psychological characteristics, and tend to adopt immature and negative coping styles when dealing
310 with stressful events, which makes them inferior to men in emotional control and psychological
311 resilience [41]. Students with poor academic performance suffer from more severe test anxiety and
312 less emotion regulation and psychological resilience than those with moderate to excellent
313 academic performance.

314 This result is consistent with data from student samples in different countries. Researchers
315 reported that students with moderate to excellent academic performance had developed learning
316 abilities and strategies to easily cope with examinations. While some less capable students may
317 experience such expectations due to the unrealistic expectations of parents, peers, or teachers.
318 These expectations may increase their anxiety in exam situations and cause performance problems
319 [42].

320

321 **The relationships between test anxiety, emotion regulation, and psychological resilience**

322 Correlation analyses showed significantly negative correlations of test anxiety with emotion
323 regulation strategies, cognitive reappraisal, and expressive suppression among medical students.
324 This was slightly different from previous studies [10, 43, 44], which had relatively consistent
325 results on cognitive reappraisal that cognitive reappraisal was an adaptive strategy. However, no
326 consistent conclusion was reached in studies on expressive suppression. Some scholars believed
327 that expressive suppression was not adaptive. Nevertheless, whether a strategy is good and
328 adaptive depends on personal experience, scenarios, and personal goals. One-third of the students
329 in this study showed relatively high levels of test anxiety. In high-intensity negative scenarios,
330 individuals were more inclined to choose avoidance-oriented strategies such as expressive
331 suppression, which had better effects in the short term. This was consistent with previous studies
332 [45, 46, 47] that subjects tended to adopt cognitive reappraisal strategy for low or
333 moderate-intensity stimuli, and expressive suppression strategy in high-intensity negative
334 scenarios. A correlation analysis showed that the coefficient of positive correlation between
335 cognitive reappraisal and expressive suppression reached 0.476, which means that medical
336 students who were used to adopting the cognitive reappraisal may frequently adopt the expressive

337 suppression, and the two strategies may coexist instead of contrast each other. However,
338 subsequent regression analysis found that cognitive reappraisal had a direct negative predictive
339 effect on test anxiety (cognitive reappraisal reduced test anxiety, while expressive suppression did
340 not reduce test anxiety), which indicates that the function of cognitive reappraisal generally shows
341 cross-cultural consistency and medical students can effectively reduce the negative stimuli and
342 emotions such as test anxiety by managing their emotions with cognitive reappraisal. Interestingly,
343 in terms of expressive suppression, studies with American, Australian, and Belgian college
344 students as subjects found that [48, 49] the individuals were less likely to adopt expressive
345 suppression to regulate positive emotions, and expressive suppression was associated with reduced
346 positive emotions and psychological adaptation and increased negative emotions. However, in
347 countries with Eastern cultures such as China [50], expressive suppression has a role in social
348 adaptation and not necessarily has a direct negative impact on individual psychological adaptation.
349 In the scenario of academic failure, college students in China would have reputation-based
350 emotions (e.g., shame and embarrassment) and tended to cope with the emotions by themselves
351 [51]. The results of this study exemplify the cross-cultural consistency of cognitive reappraisal
352 adaptiveness and the cultural differences of expressive suppression.

353 According to the regression equation of data, According to the regression equation, cognitive
354 reappraisal, resilience, and strength were negative predictors of test anxiety. This indicates that
355 individuals with high levels of emotion regulation and psychological resilience can quickly
356 recover from severe stress and danger and successfully response to corresponding changes, which
357 were reflected in reduced test anxiety levels in this study. Meanwhile, we also found a
358 significantly positive correlation between psychological resilience and emotion regulation

359 strategies in the sampled medical students. This was consistent with previous studies conducted
360 with a intervention was an effective method, by emotion regulation to enhance the psychological
361 resilience of adolescents [52, 53]. Due to the impact of positive psychology, a large number of
362 studies have focused on the relationship between psychological resilience and positive emotions.
363 Many studies agreed that individuals with high psychological resilience had higher levels of
364 positive emotions than those with low psychological resilience. Individuals with high
365 psychological resilience could use cognitive reappraisal to cultivate their positive emotions and
366 effectively induce others to use positive emotion regulation, thus creating a supportive social
367 environment for themselves. In later studies, researchers also focused on the relationship between
368 negative emotion regulation and psychological resilience.

369 However, studies on the negative emotion levels of individuals with different levels of
370 psychological resilience showed inconsistent results. Some scholars believed that there were no
371 significant differences in negative emotion regulation between individuals with high and low
372 psychological resilience [21], and other suggested that individuals with higher psychological
373 resilience had lower levels of depression [54]. Ong [55] emphasized that individuals with high
374 psychological resilience evoked positive emotions while experiencing negative emotions, but
375 those with low psychological resilience only regulated negative emotion in adversity or
376 emergencies. It can be seen that researchers' conclusions were divided on the relationship between
377 psychological resilience and the level of negative emotions, which may be attributed to the
378 different subject populations selected by researchers or the fact that there are numerous
379 psychosociology factors that affect negative emotions. In our study, we found that individuals with
380 higher psychological resilience had higher levels of emotion regulation, including cognitive

381 reappraisal and expressive suppression, which was in agreement with several previous studies.

382

383 **The mediating role of psychological resilience**

384 One of the key findings of this study was that emotion regulation indirectly affected test anxiety

385 through the mediating effect of psychological resilience. When medical students felt lower

386 stability of emotion regulation, they would alleviate the impact of emotion regulation on test

387 anxiety through the resilience and strength of psychological resilience. This reflected that the close

388 relationship between emotion regulation and psychological resilience, and supported previous

389 results that psychological resilience can buffer the crisis. Hence, psychological resilience as a

390 positive psychological quality may be an important regulating variable in the face of stress.

391 Bandura [56] pointed out that enhancing individual abilities through experience was the most

392 reliable way to develop strong and resilient self-efficacy. College students with high psychological

393 resilience were not defeated by negative emotions, making them more confident that they can

394 effectively regulate their emotions. Therefore, compared with interfering with emotion regulation,

395 strengthening frustration education and cultivating their psychological qualities such as resilience

396 and strength to resist stress are more effective ways to reduce test anxiety and help medical

397 students to adapt to campus and society in the long run.

398

399 **Conclusions**

400 Our empirical research suggests that gender and academic performance significantly affected

401 medical students' test anxiety, emotion regulation, and psychological resilience. The test anxiety

402 experienced by medical students would be reduced when their psychological resilience and

403 emotion regulation increased, especially when their control of cognitive reappraisal, resilience,

404 and strength was improved. Emotion regulation indirectly affected test anxiety through the

405 mediating effect of psychological resilience. This may provide insight for clinical psychologists
406 and raise awareness of the importance of cultivating and improving the psychological resilience of
407 medical students. Investigation of the continuous psychological development of subjects was
408 limited due to the cross-sectional study design. A deeper understanding of the background of the
409 subject population and exclusion of irrelevant variables that may impair data reliability, such as
410 environmental factors, are needed to improve the reliability of data in future research.

411

412 **List of abbreviations**

413 TAS: Test Anxiety Scale; ERQ: Emotion Regulation Questionnaire; CDRS: Connor-Davidson
414 Resilience Scale; CI: confidence interval; SPSS: Statistical Software for Social Science

415

416 **Ethics approval and consent to participate**

417 The study was approved by the Ethics Committee of the Guangdong Medical University (ref.
418 YJYS2019027). Written informed consent was obtained from all participants prior to the survey
419 administration.

420

421 **Consent for publication**

422 Not applicable.

423

424 **Availability of data and materials**

425 The datasets analyzed during the current study are available from the corresponding author on
426 reasonable request.

427

428 **Competing interests**

429 Authors declare no conflict of interests for this article.

430

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438

439 **Authors' contributions**

440 LYG conceived and designed the study, wrote the paper. WXJ, RJW and ZXS performed the
441 investigation and carried out data collection. YRH and PHY contributed to analyze the data. LYG
442 and PCC drafted and edited the manuscript. PHY reviewed the manuscript. All authors read and
443 agreed to the published version of the manuscript.

444

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447

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