Coping Styles Mediates the Effect of Resilience on Medical Students' Depression in the Context of Online Classes during the COVID-19 Pandemic

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Abstract

Background: Due to the strict nationwide COVID-19 comprehensive protective measures, which included home quarantine, all Chinese medical students began taking online classes beginning in the spring semester of 2020. Home quarantine, online classes, and the stress surrounding the COVID-19 pandemic may have triggered increased mental health problems of medical students. Although there has been an increasing literature on depression among medical students, studies focusing on positive psychological resources such as resilience during the COVID-19 pandemic still need to be expanded.

Objective: The present study aims at assessing depression of medical students taking online classes during the COVID-19 pandemic and investigating the role of coping styles as a mediator between resilience and depression.

Methods: A cross-sectional study of 666 medical students with stratified sampling in Shenyang, Liaoning Province in China was completed between March 20th, 2020 and April 10th, 2020. The participants responded to a self-administered smartphone-based questionnaire which included Patient Health Questionnaire (PHQ-9), Simplified Coping Style Questionnaire (SCSQ), and Ego-Resilience scale (ER-89). Hierarchical linear regression and structural equation modeling (SEM) were used in this study.

Results: The prevalence of depression in the participants was 9.6% in this study. Regression analysis revealed that grade (the year in which the medical student was in their training), how well they adapted to online classes, their levels of resilience, and their coping styles were independent predictors for depression. Resilience and positive coping style were negatively related to depression and negative coping style was positively related to depression. SEM showed that the effect of resilience on depression was partially mediated by coping styles.

Conclusions: It was found in the present study the prevalence of depression was slightly low and coping styles mediated the association between resilience and depression among medical students during COVID-19, which was of significant implications for further study. Future studies and interventions are supposed to be aimed at improving resilience and promoting positive coping style.

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Conclusions: It was found in the present study the prevalence of depression was slightly low and coping styles mediated the association between resilience and depression among medical students during COVID-19, which was of significant implications for further study. Future studies and interventions are supposed to be aimed at improving resilience and promoting positive coping style.

Keywords: Resilience, Coping Styles, Depression, Medical Students, COVID-19

Introduction

The COVID-19 pandemic has deeply affected peoples' lives all over the world since its emergence in 2019. Not only isolation, but also economic pressure, has had a profound impact on the psychosocial environment in each affected country. The pandemic has also increased the public's vulnerability to detrimental psychological consequences [1]. According to a Chinese study, more than half the study population reported moderate or severe psychological impacts due to COVID-19 [2]. Quarantine-associated mental health issues involve depression, anxiety, and irritability [3].

School lockdowns were implemented in many countries [4]. In order to better prevent and control the further spread of COVID-19, many universities in China began online classes in

February, 2020. With the unprecedented number of online classes, the home-quarantined medical students' psychological status is an important area of investigation. Medical students have been reported to have high rate of anxiety and depression [5], and COVID-19 pandemic might bring about further risks to their mental health in that medical courses usually need practices and experiments, while online classes can't provide such opportunities, which may add to medical students' worries about their academic achievement and lead to high mental stress. Students have been reported to prefer to study in the classroom rather than have online classes for the feeling of being together in classroom learning and sharing perspectives [6], so lack of peer contact and face-to-face communication with teachers in the context of online classes may increase the development of worry, anxiety, or even depression in medical students.

Depression, a mood disorder defined by sadness, inactivity, loss of appetite or overeating, and difficulty concentrating, can result in reduced ability to perform daily activities among some people. Depression is one of the most often spotted health issues in college undergraduates [7, 8] and especially common among medical undergraduates [9, 10]. Previous studies found that approximately 30% of medical undergraduates in Europe experienced anxiety or depression [11, 12]. Mental health disorders among home-quarantined university students have also been found in a previous study, which reported that depression was as high as 9% among university students about a month after COVID-19 outbreak in China [13]. A large cross-sectional study including 44,447 Chinese college students reported an overall prevalence of depression symptom of 12.2% during the COVID-19 pandemic [14]. Increased depression was also observed in the winter 2020 academic semester in a US study [15].

The cognitive-behavioral model of health anxiety [16] suggests that some individuals have “maladaptive” assumptions about their health and consequently tend to overconsume health information which could lead to high levels of anxiety [17]. Based on this model, individuals who have high levels of anxiety tend to be more anxious during a pandemic [18, 19]. The transactional stress model theory [20] states that the response of individuals who are faced with stress are affected by the coping process during a stressful experience [21] and that situation appraisal and coping could be influenced by positive personal resources.

There are many positive psychology [22, 23] studies focusing on depression at present and resilience is a widely concerned positive capability [24, 25]. Resilience refers to the capability to adjust to challenges and adverse events [26, 27] such as trauma, threats, or other major stresses and resilience may prevent depression [28-30]. People who are less resilient are more susceptible to pathological reactions to adversities, while people who are more resilient are more likely to be protected against adversities [31].

According to the transactional stress model theory, the process of coping plays a significant role in individuals’ response to stress [21]. Coping presents strategies of cognition and behavior for individuals to master, decrease, or stand up to inward or outward demands of stressful situations [32]. Dynamic reactions to adversities aid individuals to keep themselves from psychological impairments. Coping styles generally consist of two categories: positive coping and negative coping. Positive coping involves managing problems, adjusting quickly to stressors and allaying pressure, while negative coping includes avoidance, social withdrawal, and pitying oneself, which all exacerbate anxiety. Studies have shown the significant correlation between negative coping style and depression [33, 34]. Positive coping style helps individuals cope with adversities actively, which may involve seeking others’ advice and finding out solutions to problems, which is beneficial for mental well-being. Previous studies have indicated that coping styles play a mediating role in the relationship between perfectionism and depression among undergraduate students [35] and mediate the association between depression and eating disorders among Chinese female undergraduates [36]. Thus, it is

speculated that coping styles would mediate the relationship between resilience and depression.

This study assessed the prevalence of depression among medical students and explored whether coping styles play a mediating role in the relationship between resilience and depression among medical students during the COVID-19 pandemic. This study examined three hypotheses: (1) Higher levels of resilience predict lower depression scores; (2) coping exerts a positive effect on relieving depression; (3) coping styles mediate the relationship between resilience and depression.

Methods

Study Design and Participants

A cross-sectional study with stratified sampling was carried out online using a self-administered questionnaire conducted on Wenjuanxing, a smartphone-based online questionnaire platform, between March 20th, 2020 and April 10th, 2020. Wenjuanxing is a widely used open online questionnaire platform, which was developed by Changsha Ranxing Information and Technology Limited Company. Free and self-design version was used in this study. The validity and reliability of the questionnaire designed and used by us in this study have been examined.

Medical students who were home-quarantined in their first, second, or third year at China Medical University were eligible for the study. Eight classes from each grade in which the medical students were in their training were randomly selected. The medical students from 24 classes in their first, second, or third year at China Medical University were selected as the participants and finished the questionnaire. A total of 720 medical students were recruited in this study, among which 666 participants responded completely to the questionnaire contributing to a valid response rate of 92.5% (666/720).

Ethics Statement

All participants were fully informed of the study protocol with informed consent prior to the online questionnaire. Participation was voluntary and anonymous. The study protocol was approved by the Ethics Committee of China Medical University.

Demographic Characteristics of Participants

Demographic information consisting of grade (the year in which the medical student was in their training) (freshman, sophomore and junior), gender, age (<20, ≥20), father's education (junior middle school and below, specialized secondary school and above), mother's education (junior middle school and below, specialized secondary school and above), monthly income (≤5000 RMB, >5000 RMB), major (clinical medicine, others) and adapting to online classes (yes, no) was collected.

Measurement of Depression

Depression was measured with the Patient Health Questionnaire (PHQ-9), which is commonly used for the measurement of depression based on DSM-IV criteria and is comparably sensitive and specific including nine items [37]. A score of ≥10 for PHQ-9 was taken as the indicator for the existence of depression. PHQ-9 is widely used in previous studies among Chinese population [38]. Most previous studies have confirmed that PHQ-9 has good reliability ranging from 0.749 to 0.92 [39-42], and the Cronbach's alpha coefficient of the PHQ-9 was 0.927 in this study.

Measurement of Coping Styles

Coping styles were assessed with the Simplified Coping Style Questionnaire (SCSQ), which included 20 items using a Likert scale of 0 (never) to 3 (frequently). In the present study, the Cronbach's alpha coefficient of the SCSQ was 0.862.

Measurement of Resilience

Resilience was measured with the Ego-Resilience scale (ER-89), which has good internal reliability [43] as well as superior construct validity [44]. Participants completed the 14-item four-point scale by indicating the degree to which they approve of each statement with scores ranging from 1 to 4 indicating "does not apply at all", "applies slightly, if at all", "applies somewhat" and "applies quite strongly" respectively. In the present study, the Cronbach's alpha coefficient of the ER-89 was 0.935.

Measurement of Statistical Analysis

SPSS 17.0 and AMOS 24.0 were used for statistical analyses in the present study. The comparison of differences among classified groups was conducted with T-tests and one-way analysis of variance (ANOVA) with a two-tailed *P*-value of less than 0.05 considered statistically significant.

In order to examine the incremental variance of any given set of independent variables and to assess the mediating role of coping styles on the association between resilience and depression, hierarchical linear regression analysis was adopted. Depression was utilized as the dependent variable. Resilience and coping styles were employed as the independent variables. The variables were entered step by step as follows: Step 1: the demographic characteristics of the medical students; Step 2: resilience; and Step 3: coping styles. Criteria to establish the mediating effects according to Baron and Kenny in their approach of analyzing mediation are supposed to be met as follows [45]: (1) the independent variable (resilience) is significantly related to both the dependent variable (depression) and the mediator (coping styles); (2) the mediator (coping styles) is significantly related to the dependent variable (depression); (3) the adding of the mediator (coping styles) in the model significantly lessens or clears away the independent variable's (resilience's) impact on the dependent variable (depression).

To prove the mediating role of coping styles on the relationship between resilience and depression, structural equation modeling (SEM) was used. Bootstrapping strategies were utilized to examine the mediating role (a * b product) of coping styles on the relationship between resilience and depression. The bootstrap estimate was based on 5000 bootstrap samples and a bias-corrected and accelerated 95% CI (BCa 95% CI) for each a * b product was examined with a BCa 95% CI. Goodness of fit was determined by: $\chi^2/df < 5$, GFI > 0.90, CFI > 0.90, RMSEA < 0.08, and TLI > 0.90.

Results

Demographic Characteristics and Depression Distribution of the Participants

The demographic characteristics and their respective mean depression scores are shown in Table 1. Approximately 41.7% (278/666) of study participants were freshmen. The average age of the participants was 20 years old. Approximately 39.3% (262/666) of the participants were males (n=262). The students' father's education and mother's education reported as junior middle school or below accounted for 55.4% (369/666) and 59.9% (399/666), respectively. About 49.2% (328/666) of the participants reported their family

monthly income as more than 5000 RMB. Most students were studying clinical medicine (460 out of 666, 69.1%). With respect to gender, depression scores of the male students were significantly higher than those of the female students ($P < .05$). Up to 88.9% (592/666) of the participants were adapting to online classes, while 11.1% (74/666) of them were not. The depression scores among the students who were not adapting to online classes were significantly higher than those among the students who were adapting to online classes ($P < .01$).

Table 1. Demographic characteristics and the distributions of depression among students (N=666)

Variables	N (%)	Depression (Mean ± SD)
Grade		
Freshman	278 (41.7)	4.31±4.83
Sophomore and junior	388 (58.3)	3.67±4.20
Gender		
Male	262 (39.3)	4.37±5.12[a]
Female	404 (60.7)	3.66±3.98
Age (years)		
<20	315 (47.3)	3.84±4.48
≥20	351 (52.7)	4.02±4.48
Father's education		
Junior middle school and below	369 (55.4)	4.02± 4.69
Specialized secondary school and above	297 (44.6)	3.84±4.21
Mother's education		
Junior middle school and below	399 (59.9)	3.99±4.47
Specialized secondary school and above	267 (40.1)	3.86±4.50
Monthly income (RMB)		
≤5000	338 (50.8)	3.84±4.16
>5000	328 (49.2)	4.04±4.79
Major		
Clinical medicine	460 (69.1)	3.91±4.54
Others	206 (30.9)	4.00±4.35
Adapting to online classes		
Yes	592 (88.9)	3.44±4.07
No	74 (11.1)	7.88±5.54[b]

[a] Significant at the 0.05 level (two-tailed).

[b] Significant at the 0.01 level (two-tailed).

Correlations of Depression and Continuous Variables

The correlations of depression and the continuous variables are shown in Table 2. Depression among medical students was significantly and negatively associated with both resilience ($P<.01$) and positive coping style ($P<.01$), while depression was significantly and positively associated with negative coping style among medical students ($P<.01$).

Table 2. The correlations of depression and continuous variables

	M±SD	1	2	3	4
1.Depression	3.94±4.48	1			
2.Resilience	43.88±7.77	-0.288[b]	1		
3.Positive coping style	38.80±6.76	-0.332[b]	0.558[b]	1	
4.Negative coping style	17.79±4.83	0.356[b]	-0.089[a]	0.078[a]	1

[a] Significant at the 0.05 level (two-tailed).

[b] Significant at the 0.01 level (two-tailed).

The linear regression models of depression among medical students are presented in Table 3. The final regression model (Model 3) explained the 31.0% of the total variance of depression. Resilience and coping styles explained 7.0% and 13.5% of total variance of depression, respectively. Grade, resilience, positive coping style, as well as negative coping style were significant predictors for depression. Grade, resilience, and positive coping style were negatively associated with depression, while negative coping style was positively associated with depression.

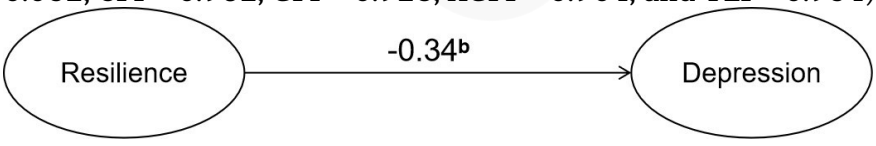
Table 3. The hierarchical linear regression analysis of depression

	Depression (Standardized β)		
	Model 1	**Model 2**	**Model 3**
Block 1 Demographic Characteristics			
Grade (Freshman VS. Sophomore and junior)	-0.088	-0.112 [a]	-0.103 [a]
Gender (Male VS. Female)	-0.029	-0.040	0.000
Age (<20 VS. ≥20)	0.051	0.073	0.079
Father's education (Junior middle school and below VS. Specialized secondary school and above)	-0.019	0.018	0.022
Mother's Education (Junior middle school and below VS. Specialized secondary school and above)	-0.019	-0.022	-0.019
Monthly income (≤5000 RMB VS. >5000 RMB)	0.043	0.049	0.041
Major(Clinical medicine VS. Others)	-0.019	-0.037	-0.053
Adapting to online classes (Yes VS. No)	0.303	0.270 [a]	0.197
Block 2 Resilience		-0.270 [b]	-0.087 [a]
Block 3 Coping styles			
Positive coping style			-0.287 [b]
Negative coping style			0.335 [b]
R^2	0.105	0.175	0.310
ΔR^2	0.105	0.070	0.135

[a] Significant at the 0.05 level (two-tailed).
[b] Significant at the 0.01 level (two-tailed).

The Mediating Role of Coping Styles between Resilience and Depression

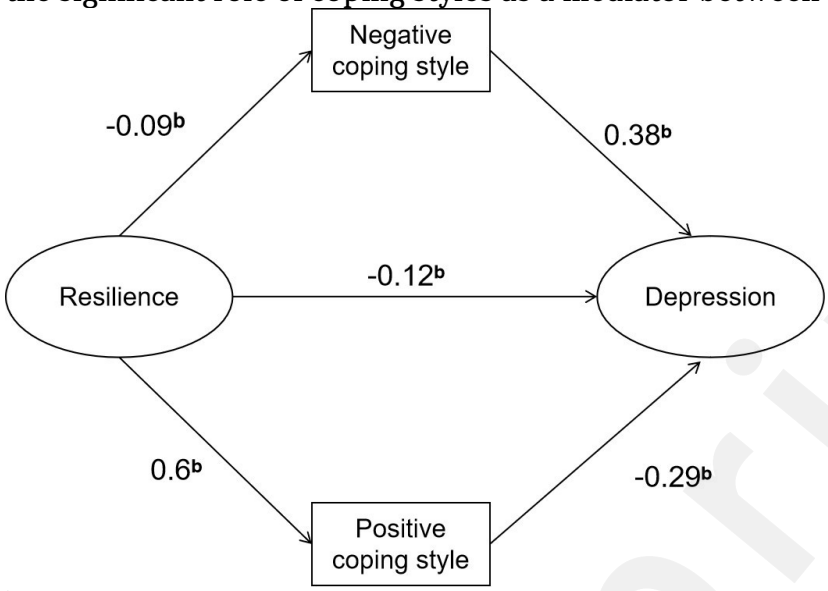
Figure 1 presents the direct effect of resilience on depression (c=0.34, *P*<.01) before coping styles were entered as a mediator. The model reveals that resilience has a significant negative effect on depression, and this model has good model fit indices (x^2/df < 5, RMSEA = 0.052, CFI = 0.962, GFI = 0.928, AGFI = 0.904, and TLI = 0.954) (Figure 1).



[b] Indicating the coefficient of the path is significant.
Standardized path coefficients are shown on the unidirectional arrow path.
Figure 1. Standardized solutions for the structural equation model of resilience and depression

Figure 2 represents the SEM of the mediating role of coping styles in the relationship between resilience and depression, and the standardized path coefficients are presented on the unidirectional arrow paths. When coping styles were used as the mediator, the path coefficient

between resilience and depression decreased significantly (from -0.34 in Figure 1 to -0.12 in Figure 2), which confirmed coping styles' partial mediating role in the association between resilience and depression. This model yielded a good model fit (χ^2 /df < 5, RMSEA = 0.051, CFI = 0.957, GFI = 0.923, AGFI = 0.900, and TLI = 0.949). According to the bias-corrected and accelerated bootstrap test, coping styles played a significant mediating role in the association between resilience and depression (a * b= -0.208, BCa 95% CI: -0.324, -0.153), which proved the significant role of coping styles as a mediator between resilience and depression.



[b] Indicating the coefficient of the path is significant.
Standardized path coefficients are shown on the unidirectional arrow paths.
Figure 2. Structural equation modeling of the mediating role of coping styles on the relationship between resilience and depression

Discussion

As far as we know, the present study presents the first attempt to investigate the relationship among resilience, coping styles and depression among Chinese medical students in the context of online classes during the COVID-19 pandemic. In this study, 64 out of 666 (9.6%) participants reported depression, which was slightly higher than the depression prevalence of 9.0% in a study of home-quarantined Chinese college students in the COVID-19 pandemic [13], but lower than most previous studies which indicated high prevalence of depression among college students ranging from 12.2% to 25.3% in the COVID-19 pandemic [14, 46, 47]. Depression is one of the most commonly occurring mental health issues among college students [48-50] and depression is especially high in medical students [10, 51-53]. However, the prevalence of depression among medical students in this study is slightly lower than that of a Swedish study (12.9%) [54] and much lower than that of a study (25%) among US and Canadian medical students [10, 55]. One possible reason this study found lower rates of depression among Chinese medical students may be that staying with family helped ease symptoms of depression which was good for mental health and online classes provided the students more opportunities to use available resources at home for entertainment which might help ease symptoms of depression. Besides, due to their medical knowledge, medical students may be more likely to consider the pandemic objectively, which might prevent depression.

In this study, grade and adapting to online classes had significant impacts on depression. With the national requirement of “Suspending classes without suspension of learning” in China during the COVID-19 pandemic, studying online at home provided the only feasible way to keep

up with the learning schedule. The results in this study showed that the 11.1% (74/666)of the participants who did not adapt to online classes had statistically significant higher depression scores. It may be because the students who failed to adapt to online classes were more accustomed to face-to-face instruction and online classes added to their stress which could lead to increased depression.

It was found that resilience was negatively related to depression in this study. As hypothesized based on the transactional stress model theory [20], findings from this study indicated that higher levels of resilience were predictive of lower depression, which is in accordance with a substantial body of previous studies [56-59]. A prospective, multi-institutional study focusing on US medical students reported that resilient students were less vulnerable to depression [60]. It was clarified in previous studies that resilience played a role in attenuating depression in different populations [57, 58], such as among college students as well as in medical and nursing students [61, 62]. This study indicated that resilience played a protective role for depression in accord with prior studies [63, 64]. Higher levels of resilience were found to be correlated with better subjective health [61], less distress [65] and more optimism among medical students [66]. Previous studies found that resilience among medical students might play a critical role in maintaining mental well-being in the context of the COVID-19 pandemic. Online classes could be viewed as the intervention which played a role in decreasing anxiety associated with the pandemic [67], while there were still some students who might be less resilient and failed to adapt to online classes well. Lower resilience was found to be related to higher incidence of psychological issues [68, 69]. Home-quarantined medical students who transferred from learning in classrooms on campus to online learning at home might have experienced added stress, which might trigger depression. Resilience might help medical students adapt to uncertainty and maintain mental well-being while having online classes at home during the COVID-19 pandemic. Firstly, high resilience could help medical students combat the stressful situations of online classes, thus relieving the symptoms of depression. However, students with lower resilience might be less likely to adapt to online classes well and consequently could be more susceptible to anxiety or even depression. Secondly, students with higher levels of resilience might recover more quickly from adversities and cope with problems more actively, which could help lower their vulnerability to depression in the pandemic. Thirdly, students who had higher levels of resilience could be more likely to have successful experiences of coping with and recovering from adversities including the pandemic.

Findings from this study showed that coping styles had a significant effect on relieving depression, accordant with previous studies [70, 71]. The present study also showed that positive coping was inversely related to depression, while negative coping was positively related to depression among Chinese medical students. A positive coping style could help students cope with problems (e.g. online classes) more rationally and might reduce stress which could prevent depression. This study also indicated that coping styles mediated the effect of resilience on depression. The coefficient of resilience to depression decreased after coping styles were added, which indicated coping styles' partial mediating function in the relationship between resilience and depression. It is possible that individuals who are more resilient might be more likely to adopt a positive coping style, which might increase the possibility for them to perceive stressful situations such as being home-quarantined having online classes in the COVID-19 pandemic surmountable so that they might be less likely to suffer from depression. They are more likely to have a better control of their emotions, be more motivated to figure out the solutions to problems and thus adapt to adverse situations, which could be beneficial for their mental well-being. This result implied that positive coping and resilience training would be beneficial for medical students to confront the COVID-19 pandemic

more positively and adapt to online classes more easily, which might help them fight stress, reduce depression and maintain mental well-being.

A few limitations exist in the present study. Firstly, this study is cross-sectional, which limits its ability to set up causal associations between variables. Secondly, self-report measures may lead to response bias in the present study. Thirdly, the study sample only included some medical students in years 1-3 in one university in northeastern China, which might limit its generalizability to all medical students.

Conclusion

This study found that Chinese medical students suffered from slightly low levels of depression in the context of online classes during the COVID-19 pandemic. Resilience and coping styles were significantly related to depression. A positive coping style could play an essential role in decreasing depression among medical students, while a negative coping style was positively related to depression. It was also found that coping styles mediated the association between resilience and depression. This study indicates that interventions aiming at enabling individuals to develop positive coping style and improving their resilience are of great practical importance to decrease depression among medical students while they are having online classes during the large-scale COVID-19 pandemic.

Acknowledgments

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Conflict of interest

No potential conflict of interest related to the research, authorship or publication of the present article was declared by the authors.

Ethical approval

The study protocol conformed to the ethical standards and was approved by the Ethic Committee of China Medical University. All the participants gave their consent after being informed of the purpose and procedure of the study online. Confidentiality and anonymity of all participants' information collected were ensured.

Informed consent

Informed consent of every participant was acquired before the launch of procedures of this research.

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Supplementary Files

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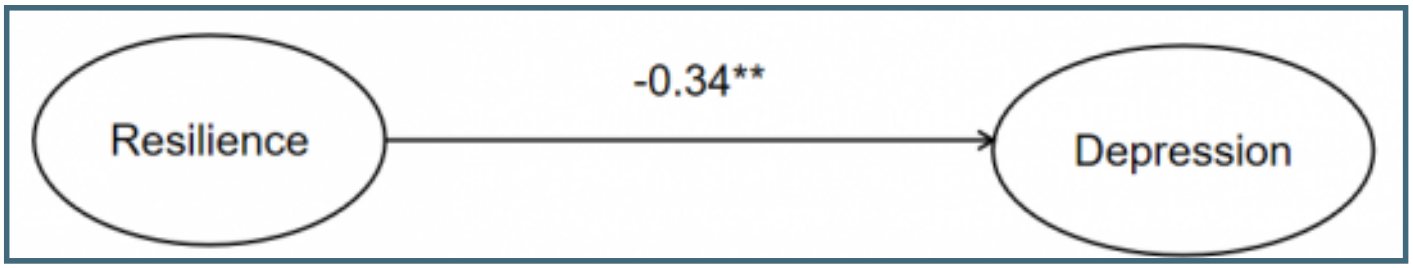
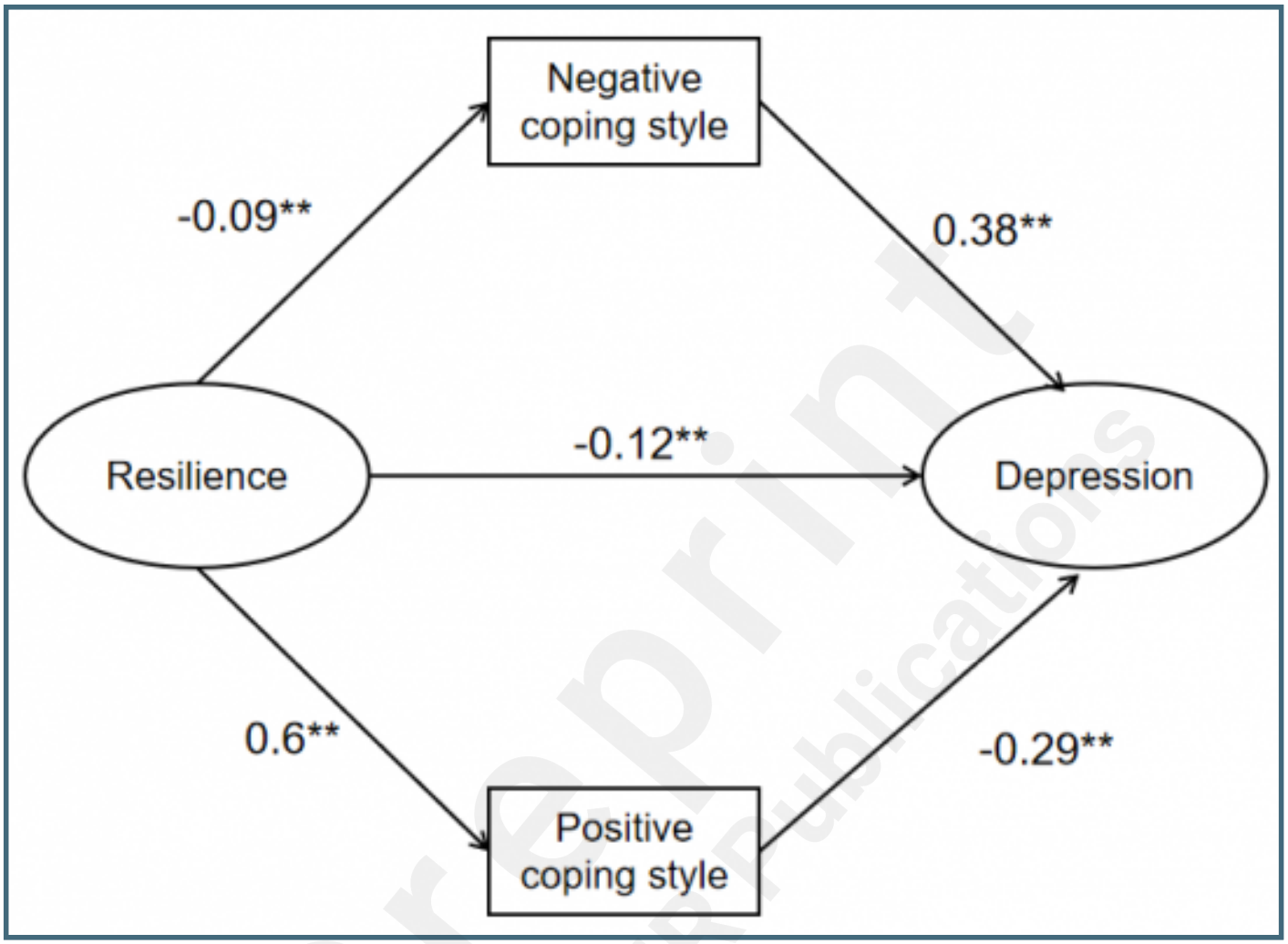
Figures

Standardized solutions for the structural equation model of resilience and depression.



Structural equation modeling of the mediating role of coping styles on the relationship between resilience and depression.



Multimedia Appendixes

Untitled.
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