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“Anger beyond depression”? The effect of trait anger on depression—A moderated mediating effect

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Research Article

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Abstract

Previous studies have shown that there is a positive correlation between anger and depression, which are usually in the form of "comorbid". However, the complex relationship mechanism of the interaction between anger and depression is rarely involved. Inspired by the traditional Chinese medicine theory of "anger beyond depression", this paper explores the formation mechanism of endogenous factors of trait anger and reactive factors of life events on depression and the influence of anger expression on the mechanism of depression. In this study, 89 normal healthy subjects were randomly selected as the reference group, and 115 outpatients with depression were selected as the control group. Through the analysis of the above variables by statistical software SPSS and PROCESS, it is concluded that trait anger has a significant complete mediating effect on depression with life events as mediators for the control group. The conclusions of this study are as follows: (1) There is a significant and complete mediating effect of trait anger on depression with life events as mediating variables in the control group. (2) In the control group, anger expression has a significant moderating effect on the mediating effect model (the path of life events to depression).

These results supports the moderated mediation model with anger expression as the moderating variable, which provides a new approach and thought for the clinical treatment of depression.

2 Introduction

Major depression disorder (MDD) is also called depression. It is a mental disorder with a variety of clinical manifestations, such as persistent depression. The core symptoms are depression, lack of interest and pleasure, and loss of will and behavior, also known as the 'three low' symptoms (Delgado, 2004).

It has been shown that during family interactions, teenagers with depression express more anger than nondepressed teenagers (Nadja et al., 2018). Grant et al. (2018) suggested that anger is related to depression, and both tend to occur at the same time. Another study showed a moderate relativity between anger and depression (Christine & Wendy, 2018). Mohammad et al. (2013) found that there is a positive correlation between anger and depression in patients with clinical depression through a questionnaire survey of patients with depression.

Previous studies have shown a positive correlation between anger and depression (Liliana et al., 2019). However, depression is heterogeneous, so there may be multiple variables affecting it (Besharat M. A., Nia M. E. & Farahani H., 2013). It is speculated that the components of anger may have a direct or indirect effect on depression through other variables. Some studies have shown that anger is related to more sources of mental stress. (Amanda et al., 2015).

Beck & Alford (2021) categorized depression into two types: endogenous, which is mainly caused by internal psychological factors, and reactive, resulting from external stress. Stepanichev M. Y. et al. (2016) considered that severe acute stress events or mild chronic stress factors may induce depression. In animal experiments, male Wistar rats were exposed to two different chronic stress modes. The levels of cortisol and passive floating behavior in brain tissue and blood were measured, which further aggravated the depressive symptoms. Reactive life stress events are the direct factors leading to depression.

Exploring the different effects of variables such as trait anger and life event stress on depression and the role of moderators of anger expression is particularly important for the pathogenesis of depression, the choice of treatment path and the secondary prevention strategy of the disease.

2.1 The mediating effect of trait anger on depression with life events as mediating variables.

Anger is a negative emotional state with changing intensity and persistence that is usually associated with emotional arousal and perception of the outside world (Kassinove & Sukhodolsky, 1995). Spielberger (1988) showed that state trait anger theory divides anger into state anger, trait anger and anger expression. Trait anger is defined as a stable, personality-based tendency to experience anger across various situations, characterized by its frequency, duration, and intensity. Individuals with higher levels of trait anger are more likely to feel enraged in a variety of situations, so they are more likely to experience state anger. Trait anger plays a certain role in the clinical manifestation of depression (Wenze, Gunthert & Forand 2009).

Consequently, trait anger is inferred to be an endogenous factor in depression.

Rick et al. (2007) highlight possible ways in which anger leads to stress directly, with increasing anger and hostility leading to problematic interpersonal interactions. Anger can activate the autonomic nervous system to increase psychological stress sensitivities and activate the adrenal cortex to secrete cortisol through the hypothalamus-pituitary-adrenal axis (HPA) (Mustafa A. U. Stephan B. & William R. L. 2020). The increase in cortisol reduces the recognition of anger in patients with depression and produces more anger than normal people in the field of endocrine research, in which corticosteroids are used as marker variables for the effects of mental stress on depression (Katie &Richard 2012). Higher anger is accompanied by an increase in cortisol with increased stress, and it is speculated that there is a positive correlation between the increase in mental stress and anger in depressed subjects. However, Amanda et al. (2015) found different results in that greater anger was associated with less cortisol output when they investigated the relationship between daily cortisol and anger in depression. Ellen et al. (2019) further found that the slowing of the daytime cortisol slope may have a protective effect on some forms of internalized psychopathology and relieve depressive symptoms in highly irritable cases, in which the effects of circadian rhythms of cortisol diurnal patterns on irritability lead to internalization and externalization symptoms in children 9 years later. Joana S. C. P. et al. (2020) explained that participants with trait anger showed the highest level of HPA activation in stressors, which activates hypothalamic paraventricular nucleus neurons (PVN) to secrete arginine vasopressin (AVP) and corticotropin releasing factor (CRF), which in turn promotes the production and secretion of adrenocorticotropin (ACTH) in the anterior pituitary. Therefore, ACTH induces the production and secretion of corticosteroids and glucocorticoids (corticosterone). Cortisol enters the bloodstream from the adrenal cortex. Therefore, high levels of cortisol inhibit the further release of ACTH and CRF through a negative feedback mechanism with the binding of cortisol to glucocorticoid receptors (GRs) in the pituitary, hypothalamic paraventricular nucleus and hippocampus. This results in a return to the physiological state after acute activation of the system. In the case of depression, the negative feedback loop of the HPA axis is damaged, leading to a long-term increase in glucocorticoids (Joana S. C. P. et al.,2020). It is precisely because the negative feedback mechanism of cortisol is impaired in patients with depression when they feel angry and the level of cortisol in the blood cannot return to a low level that life stress events lead to maladjustment. Maladjustment of stress can lead to disorders of the HPA axis and the immune system. Furthermore, it leads to cognitive and emotional disorders, thereby increasing the risk of depression (Joana S.C.P. et al. 2020).

Rick et al. (2007) considered that anger tends to increase sensitivity to life events, which is the core feature of depression. Sensitization is also a necessary condition for depressive disorder (Scott B. P. 2008).

There was a significant positive correlation between stressful life experience and depression (Rannveig, Bryndis, Sarah & Inga 2017). Therefore, mental stress is regarded as a major factor leading to depression (Maheen, R. S., Preet Mehroze 2019). Beck's model suggests that depression follows when stressful life events activate negative schemata, including dysfunctional attitudes (Beck A. T. 1987). Kai G. R. et al. (2022) showed that there was a negative correlation between stressful life events (SLEs) and gray matter volume (GMV) in the left medial prefrontal cortex, in

which the relationship was determined between inquiring about the life event questionnaire and changes in GMV for 2 years. That said, SLEs in adulthood are risk factors for diseases such as depression, and part of this risk is regulated by ways that change the physiology and structure of the brain. Davey et al. (2016) tried to clarify the relationship between stress and depression by studying twin experiments.

The etiology of depression is related to stress and HPA(Joana S.C.P. et al.2020). Trait anger affects depression by activating the HPA axis and sensitizing life stress events. Therefore, it is speculated that trait anger affects depression, as life stress events play a mediating role.

2.2 A moderating mediating effect of anger expression as a moderating variable

Kendler et al. (2001) found an interesting phenomenon. There is an increasing relationship between life stress events and the number of depressive episodes in the early stage, but the relationship between life stress events and recurrent depression is decreasing. It is inferred that there should be a certain variable between life stress events and depression that moderates the relationship between life events and depression. Jutta J. & Colin H. S. (2016) believe that difficulties in emotional self-regulation may lead to depression after experiencing negative life events. Atefe A. et al. (2011) believed that suppressing anger leads to depression and has a negative impact on mental health. There is a close relationship between anger and depression. Different theorists assume that anger, especially repressed anger, plays a role in the dynamics of depression. Psychoanalytic theorists conceptualize depression as anger turning inward or directed against themselves. It was believed that those who vent their anger inward tend to deny thoughts and reactions associated with irritating situations, and feelings of anger itself are denied. Feelings of anger are suppressed and replaced by feelings of guilt, anxiety and depression (Marialuisa R. et al., 2019). When anger is repressed or anger cannot be expressed, it will aggravate depression. There is a strong positive correlation between anger expression and life events. Through further study of the bivariate quantitative genetic model, we found the common genetic factor of these two characteristics (Xiao Lin Wang, R. Trivedi, F. Treiber &H. Snieder 2005). Alissa J.E., Giulia S., David J.M. & Sandra K.L. (2019) in the reward response EEG paradigm (REWP) experiment, it was found that the dull nerve response to reward was related to susceptibility to depression. The results showed that a longer REWP latency was associated with depressive symptoms only when the avoidance motivation score was included. The results suggested that treatment aimed at withdrawal may reduce the susceptibility to depression. Compared with anger, inward expression of anger is associated with a higher level of withdrawal motivation, which confirms the current view that inward expression of anger is a withdrawal strategy to deal with anger. In addition, anger was associated with lower levels of positive emotion (Jennifer L. S., Rebecca L.L., Sarah M. S., Wendy H. &Gregory A.M. 2008). The outward expression of anger was associated with a lower heart rate and the response of catecholamines to stress. Paul J. M., Robert H. S. & Joel E. D. (1993) show that anger plays a leading role in promoting the heart rate stress response. Anger is associated with more related stressors (Amanda et al., 2015).

Mustafa A. U., Stephan B. &William R. L. (2020) believed that anger avoids expressing anger because of fear of negative social consequences and are thought to have experienced higher pain and higher levels of autonomic activation. Anger is associated with a higher level of withdrawal motivation, which confirmed the current view that anger expression is a withdrawal strategy to deal with anger (J. L. Stewart, R. L. Levin, S. M. Sassfield &W. Heller G. A. 2008).

2.3 The present study

According to the literature, with the relationship among trait anger, depression, life events and anger expression, the following questions are proposed: as endogenous factors, how do trait anger and reactive life events affect

depression? and what's its mechanism? Is this mechanism universal for people with depression or for people including healthy people? How to make use of the influence mechanism of trait anger and life events on depression to develop a targeted intervention and regulation program will provide a basis for the prevention and treatment of depression. In view of the above problems, this paper proposes the following three hypotheses: Hypothesis 1 in the control group, trait anger mediates depression with life events as mediating variables. Hypothesis 2 In the control group with depressive patients as subjects and the reference group with healthy people as subjects, there should be differences in the comparison of the mediating effect models between the two groups. Hypothesis 3 anger expression as a moderating variable interacts with life events in the control group, moderates the mediating effect on depression, and establishes a moderated mediating model.

3 Method

3.1 Participants

In the study, the control group and the reference group were set up, and the principles and conditions for the selection were as follows: in this study, 89 normal healthy people aged 16–80 years from April to September 2022 were randomly selected as the reference group. and conducted a questionnaire interview required clear consciousness, independent personality, no mental illness, alcoholism, chemical abuse, etc. In addition, they could finish the questionnaire adjustment voluntarily and independently. A total of 115 depression outpatients aged 16–80 years from April to September 2022 were randomly selected as the control group, and a questionnaire interview was conducted (the patients came from the depression clinic of two Grade III psychiatric hospitals of Beijing An Ding Hospital and Shenzhen Kang Ning Hospital). The patients were selected according to the following criteria: (1) patients with depressive and affective disorders met the criteria of the Diagnostic and Statistical Manual of Psychiatric Disorders (DSM-V). (2) The subjects did not take any depression drugs or mood stabilizers in the past 2 weeks; they did not take benzodiazepines for sleep in the last 3 days; they did not take fluoxetine in the last 1 month; and (3) they had no other mental disorders in the past, such as alcohol, drug dependence and clearly diagnosed cognitive impairment. (4) Patients without serious physical disorders, such as respiratory system, blood system, immune system, endocrine system, infectious diseases and tumors. In the reference group, 89 normal healthy people were randomly selected as subjects. The age, gender and distribution are shown in Table 1. The average age of the subjects was 39.37, and the SD was 14.96. There were 34 males, accounting for 38.20%, and 55 females, accounting for 61.8%. A total of 115 outpatients with depression were randomly selected as subjects in the control group. The average age of the subjects was 31.03, and the standard deviation was 9.84; there were 38 males, accounting for 33.04%, and 77 females, accounting for 66.96%.

Table 1
Descriptive statistics and correlation analysis of variables between the control group and the reference group.

Group	Variable	Mean	SD	Trait anger	Depression	Life events	Anger express
Reference(n = 89)	Trait anger	17.76	3.98	1			
	Depression	4.97	2.98	0.18	1		
	Life events	57.26	9.67	0.23*	0.22*	1	
	Anger express	69.7	10.03	0.24*	0.06	0.15	1
Control(n = 115)	Trait anger	23.46	11.34	1			
	Depression	27.35	24.5	0.84***	1		
	Life events	67.87	19.71	0.33***	0.36***	1	
	Anger express	75.93	11.09	-0.27**	-0.27**	0.03	1

Note: * p < 0.05;** p < 0.01 *** p < 0.001, following table is the same as it.

3.2 Procedure

Before the formal start of the questionnaire, explain to the participants the purpose of this study and show the school ethics committee's opinions on the examination and approval of this study. Then, the informed consent form was signed by the participants. The basic situation of the participants, including the age of the patients, the history of major diseases, the time of illness and the history of taking medicine, was investigated, and the participants who did not meet the requirements of the study were eliminated. Through the "questionnaire Star" app program, the participants were recommended to enter the questionnaire program to answer the questions of the questionnaire with their mobile phone. The operator in the study ensured that the participants could clearly and accurately understand each guiding word in the questionnaire. Once the participants finish the answers, thank them and ask if there is any discomfort in the process of answering the questions. Then, we explained the significance and function of the study in detail and answered the participants' doubts, which eliminated the potential adverse effects of the study. Finally, the questionnaire results were uploaded to "questionnaire Star" software and saved for verification. In this study, a total of 204 valid questionnaires were obtained, including 115 depression patients in the control group and 89 healthy subjects in the reference group, with an effective recovery rate of 96%.

4 Measures

4.1 Measuring tools

(1) The Life Events Scale (Selye, 1969) was used to measure stress. The scale is suitable for people over 16 years old and includes three dimensions. The first is family life (28), the second is work and study (13), and the third is social and other aspects (7). A total of 48 items were scored on a 5-point Likert scale, from no influence to extremely severe scores of 0, 1, 2, 3, and 4, that is, no influence = 0, mild = 1, moderate = 2, severe = 3, and extremely heavy = 4. The higher the total LES score, the greater the mental stress. The Cronbach's α coefficient is 0.947 in this study.

(2) The STAXI-2 scale developed by Spielberger in 1999 provides a simple, easy and objective scoring measurement tool for the experience, expression and control of anger. The scale is divided into three dimensions, including state anger, trait anger and anger expression scale, with a total of 57 questions. Trait anger scale consists of two

dimensions: temperament trait anger and reactive trait anger, with a total of ten items, with a score from 1 (not at all) to 4 (totally). The higher the score, the higher the level of trait anger. Anger expression consists of 31 topics in three dimensions, namely, outburst of anger (anger-out), inward outbreak of anger (anger-in) and anger control (anger-control). Outburst of anger means that after experiencing anger, individuals vent this emotion to each other or other environment; inward anger refers to suppressing anger into their own hearts; anger control means that individuals can consciously and effectively control and reduce the intensity of anger after experiencing anger. The scale adopts a 4-point Likert scoring method, and the numbers 1, 2, 3 and 4 stand for "almost never", "sometimes", "often" and "almost always", respectively. The subjects with higher scores on the scale will have strong feelings of anger, which can be suppressed or vented through extreme behavior, or both, which represents the full expression of anger. In this study, the Cronbach's α coefficient of internal consistency of the trait anger scale was 0.899, and the Cronbach's α coefficient of anger expression was 0.785.

(3) The Beck Depression Inventory (BDI), compiled by Beck in 1967, is a self-rating scale for investigating individual depression. The scale is divided into three dimensions: negative attitude and suicide, somatic symptoms and difficulty in operation. It contains 21 items on a 4-point scoring scale: asymptomatic (0), mild (1), moderate (2) and severe (3). The higher the score, the higher the degree of depression. The standard score was 0–10 points without depression, 10–15 points with mild mood disorders, more than 15 points with depression, and more than 25 points with severe depression. The scale has high reliability and validity, and the Cronbach's α coefficient is 0.919 in this study.

4.2 Statistical Analyses

4.2.1 The mediating effect of trait anger on depression with life events as a mediating variable

Using IBM SPSS Statistics26.0 and SPSS macro program PROCESS.V3.5, the collected data of the reference group and the control group were collated and analyzed as follows:

1 Descriptive statistics of trait anger, life events, depression and anger expression of the control group and the reference group. The independent sample t test and Pearson product correlation analysis were used to test the data distribution and significance of each variable.

2 Using the PROCESS.V3.5 macro program and bootstrap method to analyze and verify the mediating effect of variables in the control group and the reference group, trait anger takes life events as mediating variables on depression.

Wen Zhong Lin et al. (2022) summarized the methods of directly testing the product of coefficients of mediating effect, including the Sobel test, multiplicative integral distribution method, bootstrap method and Bayesian method. The nonparametric bootstrap method relies on sample data. By constantly taking bootstrap samples and calculating the estimates of an and b, the bootstrap interval estimation of ab is obtained. If the interval estimation does not contain 0, then the mediating effect is significant (Wen Zhong Lin et al., 2022). In this study, trait anger was taken as an independent variable, depression as a dependent variable, life events as a mediating variable, and gender and age as control variables. First, continuous variables were centralized, and then the nonparametric percentile bootstrap method (Model 4) of deviation correction by the SPSS macro program PROCESS.V3.5 was used to test the mediating effect model.

4.2.2 On the basis of the mediating effect of trait anger on depression, the moderating role of anger expression was tested by the PROCESS macro program, and the interaction between anger express and the effect of trait anger on life events was analyzed by the Johnson-Neyman method. Wen Zhong Lin & Ye Bao Juan (2014) noted that the nonparametric percentile bootstrap method is used to test the product of coefficients. If at least a pair of products is significant, the mediating effect is moderated. The mediating effect value is reported at the mean value of the moderating variable and the next standard deviation above the mean value.

4.2.3 Common method bias analysis:

Because this study only uses questionnaires to collect data on five variables, namely, trait anger, age, gender, life events, and depression, to avoid affecting and interfering with the research results and to make the results more objective and effective, the subjects, samples and test process are controlled to a certain extent in the test process. In the process of data analysis, Harman single factor analysis is used to test the unrotated exploratory factor analysis. The results of exploratory factor analysis show that there are 35 factors with eigenvalues greater than 1, which can explain 75.75% of the variation, and the first factor can explain 17.46% of the variation, which is much less than 40% of the critical value. Therefore, there is no serious common method deviation in this study.

5 Results

The variables in the reference group and the control group were tested by independent sample t test.

Independent sample t tests were performed on the four variables in the reference group and the control group, such as trait anger, depression, life events and anger expression. First, we perform the variance homogeneity test of the data and then perform the independent sample t test. The results showed that trait anger (F = 3.66, P = 0.06 > 0.05) indicated that the condition of homogeneity of variance was established, and trait anger was significantly different between the reference group and the control group (t=-4.53, df = 202, P < .0001). There was a significant difference in depression (F = 14.28, P < 0.001) between the reference group and the control group, which indicated that the condition of homogeneity of variance was not acceptable. The reference group and the control group were not supposed to have equal variance data. Therefore, there was a significant difference in depression between the reference group and the control group (t=-9.70, df = 118.33, P < .0001). The life event item F = 11.29, P< 0.001, reached a significant level, indicating that the condition of homogeneity of variance is not valid, and we chose tactile from the equal variance data, so there was a significant difference in life events between the reference group and the control group (t=-5.04, df = 174.16, P < .0001). There was significant difference in age between the reference group and the control group (P< 0.001), indicating that the condition of homogeneity of variance was not tenable. The anger express item (F = 0.76, P > .05) indicated that the condition of homogeneity of variance was established, and the trait anger was significantly different between the reference group and the control group (t=-4.15, df = 202, P < .0001), so there was a significant difference between the reference group and the control group. Through the independent sample t test of the data of trait anger, anger expression, depression, and life events between the reference group and the control group, it was found that there were significant differences between the two groups (t=-4.55, df = 144.28, P < .0001). As a result, it can be concluded that the subjects of the control group and the reference group are heterogeneous, which lays a foundation for the control conditions and design premise of this study.

5.2 Descriptive statistics and correlation analysis

The correlation analysis of trait anger, depression, life events and age in the reference group is shown in Table 1. Pearson product correlation analysis showed that there was a significant positive correlation between life events (M = 57.26, SD = 9.67) and trait anger (M = 17.76, SD = 3.98), (r = 0.23*, p < 0.05) and between depression (M = 4.97, SD =

2.98) and life events ($r = 0.22^*$, $p < 0.05$). There was a significant negative correlation between age *(M* = 39.37, *SD* = 14.96) and trait anger (r=-0.39**, $p < 0.01$).

The correlation analysis of trait anger, depression, life events and age in the control group is shown in Table 1. Pearson product correlation analysis showed that trait anger *(M* = 23.46, *SD* = 11.34) and depression ($r = 0.84^{***}$, $p < 0.001$) and trait anger and life events ($r = 0.33^{***}$, $P < 0.001$). There was a significant positive correlation between depression (*M* = 27.35, *SD* = 24.50) and life events (*M* = 67.87, *SD* = 19.71) ($r = 0.36^{***}$, $p < 0.001$). There was a significant negative correlation between anger express (*M* = 75.93, *SD* = 11.09) and trait anger (*M* = 67.87, *SD* = 19.71) (r=-0.27, $p < 0.01$). There was a significant negative correlation between anger expression (*M* = 75.93, *SD* = 11.09) and depression (*M* = 27.35, *SD* = 24.5) (r=-0.27**, $p < 0.01$).

5.4 Analysis of mediating effect between control group and reference group.

5.4.1 Analysis of mediating effect in reference group

The results are shown in Table 2. It can be seen from the table that the influence of trait anger in the control group in the path of life events (*Coeff* = 0.23) because the bootstrap 95% confidence interval can be seen from the table (0.05 1.06) does not include 0, indicating that there is a significant existence of this path, which is a condition for the establishment of mediation. Then, we examined the influence of life events on depression from the path of life events to depression (*coefficient* = 0.18). The bootstrap 95% confidence interval (-0.01 0.12), including 0, the path model (P = 0.06 > 0.05), there is obviously no significant difference in this path. From this intermediary effect test, we can obtain the intermediary effect, which does not accord with the hypothesis of the model. In addition, the indirect effects of mediation are tested, Effect = 0.03 because its 95% confidence interval is (-0.01 0.09), the value of 0 is in this interval but not significant. As a result, it can be concluded that the mediating effect of trait anger on depression with life events as mediating variables in the reference group is not valid.

Table 2
Mediating effect analysis between the control group and reference group

Group	Variable1	Variable2	*Coeff*	*SE*	*T*	95%CL			*F*	*P*
						LLCI	ULCI			
Reference (n = 89)	Life events	Constant	0	1	0	-1.2	1.2	0.05	4.80*	0.01
		Trait anger	0.23	0.25	2.19	0.05	1.06			
	Depression	Constant	0	0.31	0	-0.61	0.61	0.07	3.02	0.05
		Life events	0.18	0.03	1.71	-0.01	0.12			
		Trait anger	0.14	0.08	1.33	-0.05	0.27			
Control(n = 115)	Life events	Constant	0.00***	1.74	0	-3.44	3.44	0.05*	6.30*	0.01
		Trait anger	0.23*	0.05	2.51*	0.16	1.40			
	Depression	Constant	0.00***	0.95	0	-1.89	1.89	0.13***	8.02***	0.0006
		Life events	0.27**	0.05	2.97**	0.05	0.26			
		Trait anger	0.18	0.18	1.94	-0.01	0.70			

5.4.2 Analysis of mediating effect in control group.

As Table 2 shows, trait anger has a significant effect on life events in the control group (*Coeff* = 0.23 *), and the 95% confidence interval is (0.16 1.40), and the 0 value is not in this range; life events have a significant effect on depression (*Coeff* = 0.27), and the 95% confidence interval is (0.05 0.26), and the 0 value is not in this range. The effect of trait anger on depression was not significant (*Coeff* = 0.18) because its 95% confidence interval was (− 0.01 0.70), and the 0 value was in this range. From this, we can infer that the mediating effect of trait anger on depression with life events as mediating variables is established. Because the direct effect is not significant, it is concluded that the mediating effect is complete. The results of further analysis of the mediating effect. The confidence interval of total effect = 0.46, 95% is (0.11 0.81), the 0 value is not in this range, so it is significant; direct effect = 0.34, the proportion of relative mediating effect is 73%, its 95% confidence interval is (− 0.01 0.69), a value of 0 is in this range, so it is not significant. Indirect effect = 0.12, the relative mediating effect accounts for 26.09%, and its 95% confidence interval is (0.04 0.29), the value of 0 is not in this range, so it is significant. It can be seen from the above that this model is a complete mediating effect of trait anger on depression with life events as mediating variables, and its mediating effect.

5.5 Analysis of moderated mediating effects

The moderation test was carried out by using PROCESS software (model 14), and the results are shown in Table 3. Prior trait anger has a significant predictive effect on life events (β = 0.78 *), with a 95% confidence interval of (0.16 1.40), which is significant because the 0 value is not within this interval, and the model fitting parameter $R^2 = 0.05*. F = 6.30*.$

Table 3
Moderated mediating test with anger expression as a moderating variable

n = 115	Life events			95%CL		Depression			95%CL	
Predictive variable	β	SE	T	LLUI	ULUI	β	SE	T	LLUI	ULUI
Trait anger	0.78*	0.31	2.51*	0.16	1.40	0.31	0.17	1.82	-0.03	0.64
Anger express						0.05	0.09	0.53	-0.13	0.23
Anger express Life events						-0.02**	0.01	-0.33	-0.03	-0.01
Life events						0.24***	0.06	4.20***	0.13	0.35
R^2	0.05*					0.22***				
F	6.30*					7.54***				

Life events can significantly predict depression (β = 0.24***). with a 95% confidence interval of (0.13 0.35), which is significant because the 0 value is not in this range. The prediction of trait anger to depression was not significant (β = 0.31), with a 95% confidence interval of (− 0.03 0.64), which was not significant because the 0 value was in this range. Trait anger has a complete mediating effect on depression with life events as mediating variables. The interaction item of anger express x trait anger (β = -0.02* *) has a significant effect on life events. The 95% confidence interval (-0.03 -0.01) is significant because the 0 value is not within this range. As shown in the figure, the interaction between the anger express variable and trait anger has a positive moderating effect on the back of the mediating model of this study. To further explore the influence of the anger express of the moderating variable on the mediating effect, the anger express of the moderating variable was analyzed by the significant interval analysis of the Johnson-Neyman diagram. When the anger express of the moderating variable is greater than the critical value of 26.41, as Fig. 2 shows, the slope is negative and significant, indicating that the anger express of the moderating variable has a significant negative moderating effect on the mediating effect. However, when the anger express of the moderating variable is less than the critical value of 7.26, as Fig. 2 shows, the slope is positive and significant, indicating that the anger express of the moderating variable has a significant positive moderating effect on the mediating effect.

The results of moderated mediating effects tested by the bootstrap method. The moderated mediation index Index=-0.02 has a confidence interval of 95% (-0.03 -0.002), which is significant because the value of 0 is not in this range. As Fig. 1 shows, a moderated mediating model with anger expression as a moderating variable can be obtained.

6 Discussion

6.1 The differences between the control group and the reference group in establishing the mediating effect of trait anger on depression were compared.

According to the data in Table 2 of the results of this study, the reference group failed to construct the mediating effect model of trait anger with life events as mediating variables on depression, but the control group successfully constructed the above mediation model. The main reason for this difference is that compared with the general healthy population, the vulnerability of emotional regulation and cognition in patients with depression is related to the susceptibility to negative bias. Emotional disorder is the hallmark of depression (Ian, H.G. &Jutta, J., 2010). Patients with depression use maladjustment strategies more frequently when regulating their emotions, and it is difficult to

implement effective adaptation strategies (Jutta, J. &Colin, H.S., 2016). Depression is characterized by an increase in the description of negative information with difficulty in getting rid of negative materials and cognitive control defects due to negative emotional states and negative life events when dealing with negative information. (Ian H.G. &Jutta J., 2010). Depression patients have lower activation in the prefrontal lobe and greater activation in the amygdala. This defect may make it difficult for depressed patients to detach or suppress their attention to negative stimuli, making them prone to depression when they encounter negative events in life (Ming tian Zhong et al., 2011). Therefore, the bias in attention processing of negative information may be an important cognitive vulnerability factor in the occurrence and maintenance of depression (Lemkeleyman, Rudideraedt, Rikschacht, &Ernsth W.K., 2007). The vulnerability-stress hypothesis explains that the occurrence of depressive disorders is due to the interaction between psychological vulnerability (for example, certain cognitive or specific information processing methods) and induced stressors (such as negative life events or other environmental factors). (Ian H.G. &Jutta J., 2010). The results of the control group in this study show this process. That is, when subjects have depression, high trait angry individuals will experience more anger, and anger as a negative emotion makes it more difficult to separate the subjects' attention from the negative materials of psychological stress caused by life events. The defect in inhibition control leads to the further aggravation of depression. On the other hand, the normal healthy participants in the reference group have the flexible ability of emotional regulation and the treatment mode of strong reaction and inhibition of negative materials that attract attention, which can make the behavior and emotional response constantly adapt to the psychological stress in order to alleviate and relieve depression.

The results of this study show that the depression of normal people can also be measured in the form of a depression questionnaire, and sometimes there may be a high depression index, but it is a different concept from the depressive symptoms measured by patients with depression. The treatment and intervention of depression should be set according to the emotional regulation and cognitive characteristics of patients. According to Beck's depression theory, the influencing factors of depression can be divided into two categories: endogenous and reactive (exogenous). In this study, trait anger should belong to a relatively stable personality tendency and be an endogenous influencing factor of depression. However, the psychological stress caused by life events to the subjects should belong to the source of stress and the reactive factors of depression. The results of this study show that in the control group, endogenous trait anger affects depression in the form of complete mediation through reactive life events. This process reflects the strong conduction effect of endogenous factors on depression through reactive factors. This proves a unique mechanism of endogenous and reactive factors affecting depression. According to this mechanism, the path of intervention for depression can be designed. As the result of this study is a complete mediation, we only need to consider intervening in the back part (life event to depression) of this mediation model to block the transmission of the above pathways to depression and alleviate depression.

6.2 The moderating effect of anger expression on the mediating effect

Reviewing the early psychoanalytic classical representative Freud thought that depression was the result of anger turning to the mind, put forward catharsis theory and applied this theory to the treatment of depression. The theory holds that anger suppression is a crucial factor in depression, so the solution is to release a person's anger. However, many psychologists have shown that anger expression usually increases anger, while more studies emphasize that anger suppression and anger expression are positively correlated with depressive symptoms (Fatemeh &Mohammad,2011; Inga, Bryndis, Gisli &Jon, 2013). There are many contradictions in previous studies on the effects of anger expression on depression. This is determined by the complexity between anger expression and depression. In this study, we construct a moderated mediation model with anger expression as a moderating variable to prove the

moderating effect of anger expression on mediation. As shown in Table 3, there was an interaction between anger expression and life events, that is, anger expression x life events (β =-0.02 **), which had a significant negative moderating effect on depression. When we further explore its moderating effect on the mediating effect, as shown in Fig. 2, when the moderating variable anger expression is less than the critical value of 7.26, anger expression has a significant positive moderating effect on the mediating effect. This means that the more anger is expressed, the more severe depression can be made by moderating the intermediary effect at this time. This is in line with the conclusion of previous studies that there is a positive correlation between anger and depression. When the moderating variable anger expression is greater than the critical value of 26.41, anger expression has a significant negative moderating effect on mediation. A larger anger expression value and fuller anger expression allow depression to be relieved by moderating the mediating effect at this time. This is in line with the conclusion of the "catharsis theory" that anger expression is beneficial to the treatment of depression. The value of anger expression depends on the direction and intensity of depression regulation. Therefore, an interesting conclusion can be drawn: depression benefits from greater anger expression, but less anger expression hurts their emotions. Because the main effect of anger expression on depression is not significant (β = 0.05), its 95% confidence interval is (− 0.13 0.23), in which the value of 0 is in this range, there is no significant difference. The moderating effect of anger expression is mainly reflected in its interaction with life events. According to the principle that depression is moderated by the interaction between anger expression and life events, the moderating effect of anger expression can be explained as follows: when anger is expressed in a low value area, more anger may be suppressed because it cannot be fully expressed, and when in a state of anger repression, increased anger expression cannot relieve the stress caused by anger. In contrast, it will be more sensitive to the psychological stress caused by life events, thus making depression more serious. When anger is expressed in the high value area, more anger may be fully expressed so that anger can be vented and channeled, which forms a passivation effect and relief effect with the psychological pressure caused by life events. and then play a role in alleviating depression.

The traditional theory of traditional Chinese medicine is about "anger beyond depression" in the interaction of emotions theory, that is, the use of the relationship of emotions to promote, restrict and influence each other to treat diseases caused by excess emotion in the clinical field. As seen from the results of this study, the regulars summarized by ancient Chinese doctors in long-term clinical practice, that is, under certain conditions, the expression of anger can be used to treat and alleviate depression and its complications caused by excessive worry.

This study is aimed at the complete mediation model of how the endogenous factors of depression, trait anger (personality tendency) and life events (reactive factors), affect depression. Anger expression is used as a moderating variable to moderate the mediating effect. The results showed that the value range of anger expression was different and that the moderation direction and intensity of anger expression showed different effects. This also reflects the complexity and uncertainty of the treatment of depression. Due to the heterogeneity of patients with depression and the complexity of the disease itself, the results of this study should be applied in clinical practice in the future. The key is to confirm the applicable conditions of treatment and intervention, the path of intervention, the node and the degree of anger expression, as well as the patient's own personality traits (trait anger), to further develop a specific treatment and intervention plan suitable for personalized treatment. Of course, the expression of anger in patients with depression should be carried out on the premise of ensuring personal and property safety for the patient and others. There are still some technical problems with the precise manipulation of anger expression; for example, anger expression is difficult to measure objectively. With the continuous progress of psychological measurement technology and the continuous objectification of emotion measurement, it should be believed that this technology will be continuously improved in the future.

In short, the results of this study not only provide new ideas for the treatment and intervention of depression in the future but also provide more options for patients with depression to need more targeted and personalized treatment solutions.

7 Study limitations and future directions

From the perspective of psychological research on the effect of anger on depression, many theories appear alternately in their arguments, and there are many contradictions and conflicts. This is due to the complexity of the relationship between anger and depression. Due to the lack of empirical research evidence that different emotional titers influence each other, it is difficult to clarify the exact relationship between anger and depression. A series of problems, such as the deep regulation mechanism and the determination of the causality of age embodied in the model, are still worthy of further exploration in the future.

7.1 Individual differences in the effect of anger on depression

First, there are differences in the determination of the degree of anger in existing studies. For example, Gabrielle et al. (2016) explored the relationship between irritability and temper loss by taking community and clinical samples. Research shows that there are differences in the understanding of the terms "irritability" and "frequent temper tantrum" in different sources and types of samples. It is not difficult to see that due to the lack of objective evaluation criteria for idiosyncratic anger and anger expression, although this study takes into account the heterogeneity of the subjects, the subjects are divided into the reference group and the control group according to whether they suffer from depression. The inclusion and exclusion criteria of the subjects were properly controlled, but individual differences within the test group were inevitable. Therefore, it has a certain influence on the reliability and validity of the research results.

Second, there are individual differences in the effect of anger on depression. The emotional environment insensitivity (ECI) hypothesis holds that patients with depression have a weak response to both positive and negative stimuli. This is quite different from previous studies that believe that patients with depression are biased and susceptible to negative emotions (Rottenberg et al., 2005; Thompson et al., 2012; Wingenfeld et al., 2013). ECL is based on an evolutionary model that holds that depression promotes a person's defensive disengagement from the environment and that the interaction between depression and environmental adaptation in the environment can explain inconsistent findings about differences in anger responses among groups (Jennifer, et al., 2011).

As a result, there are great individual differences in the influence of anger, psychological stress and emotional control as intermediaries on depression. This is closely related to individual personality factors and personality traits. Nicole, Vliege & Patrick (2008) believe that the relationship between depression and anger is influenced by dependence and self-criticism. Dependence is related to the state of anger of nondepressed subjects who are highly dependent on others and point their anger more by themselves. Self-criticism is associated with high levels of trait anger against oneself and others but low levels of anger control. Therefore, these personality factors should be taken into account in the research and treatment of depression anger. Again, individual cognitive differences also affect the relationship between anger and depression. The study examined contemplation of anger and sadness to assess their unique relationships with aggression and depression, respectively. Path analysis confirmed the unique relationship between angry contemplation and aggressiveness, sad meditations and depression (Maya, Marlene &Moretti, 2010). Because of the great differences in cognitive style, adaptability and personality characteristics of the subjects, future research should focus on the control of individual difference variables. On the premise of obtaining good homogeneity, it

would be supplemented by objective indicators of the effects of emotion on endocrine physiology and neurophysiology. The experimental results will not have a large deviation in the data.

7.2 The adaptation of anger to depression

Previous studies have shown that there is a positive correlation between anger and depression, but in fact, there is a more complex relationship. Anger has a more complex moderating mechanism for depression; in fact, it is also a mechanism of adaptation to the environment and situation in biological evolution (Jose M. F. & Susan Kashubeck 2000).The moderating effect of anger on depression reflects the self-psychological regulation and self-protection mechanism of organisms in a complex living environment. However, the mechanism of emotional adaptation will also have an impact on the study. The emotional brightening (MB) effect suggests that the negative effect (NA) of patients with depression on positive events decreases more. People with depression "benefit" more from positive events than healthy people. Therefore, three emotion regulation strategies (contemplation, distraction and expression inhibition) are often used in clinical practice to benefit patients with depression from positive emotional events (Vanessa et al.,2018). Most researchers study the regulation of depression from the perspective of positive emotion regulation, but depression and anger are inseparable in life or clinical practice. This gives us the problem of how to solve the adaptation of anger to depression. Stephanie et al. (2012) studied the inappropriate expression (hostility) and adaptive form (direct anger) of anger. The results showed that direct anger was negatively correlated with subsequent depressive symptoms, while hostility was positively correlated with subsequent depressive symptoms. The results revealed that adaptive and inadaptive anger expression had different effects on depressive symptoms. Therefore, when studying the effect of anger on depression, full attention should be given to emotional adaptability. In the experimental design, we need to fully consider the means to stimulate or activate anger, and experimental materials should be multiangle, multichannel to improve the ecological nature of experimental materials. In addition, the establishment of a random sampling control group can also balance the emotional adaptability problems caused by random factors. Emotion has two important dimensions: potency and arousal. Anger has a high degree of physiological arousal, under what conditions, how to achieve the moderating effect on depression, and how the quantitative degree of anger matches the adaptation of depression regulation. These problems also need empirical research and in-depth discussion in future research. This will be conducive to the intervention and treatment of depression to provide a set of new ideas and methods.

Declarations

NOTE:

Transparency and Openness: We affirmed that the de-identified data on which the study conclusions were based are available and the link to access of information is provided. It is responded with the author with his email: hanzhe316@hotmail.com.

My study design and hypotheses have been not preregistered, either the analytic plan has been not preregistered.

Statement of prior dissemination : My manuscript never was submitted to any print or electronic format.

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Author Contribution

All the work about the research

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Figures

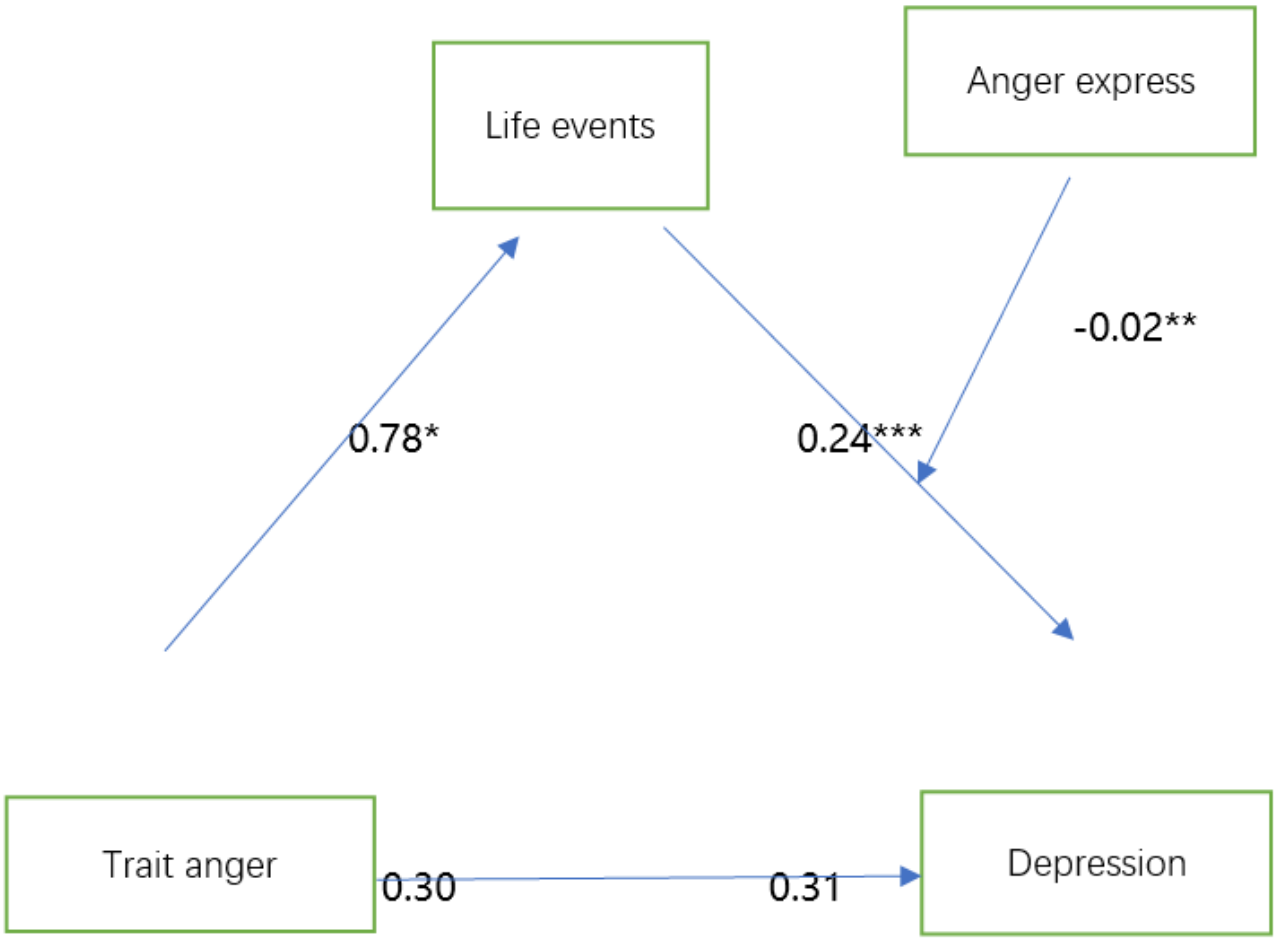


Figure 1

A moderated mediation model with anger expression as a moderating variable

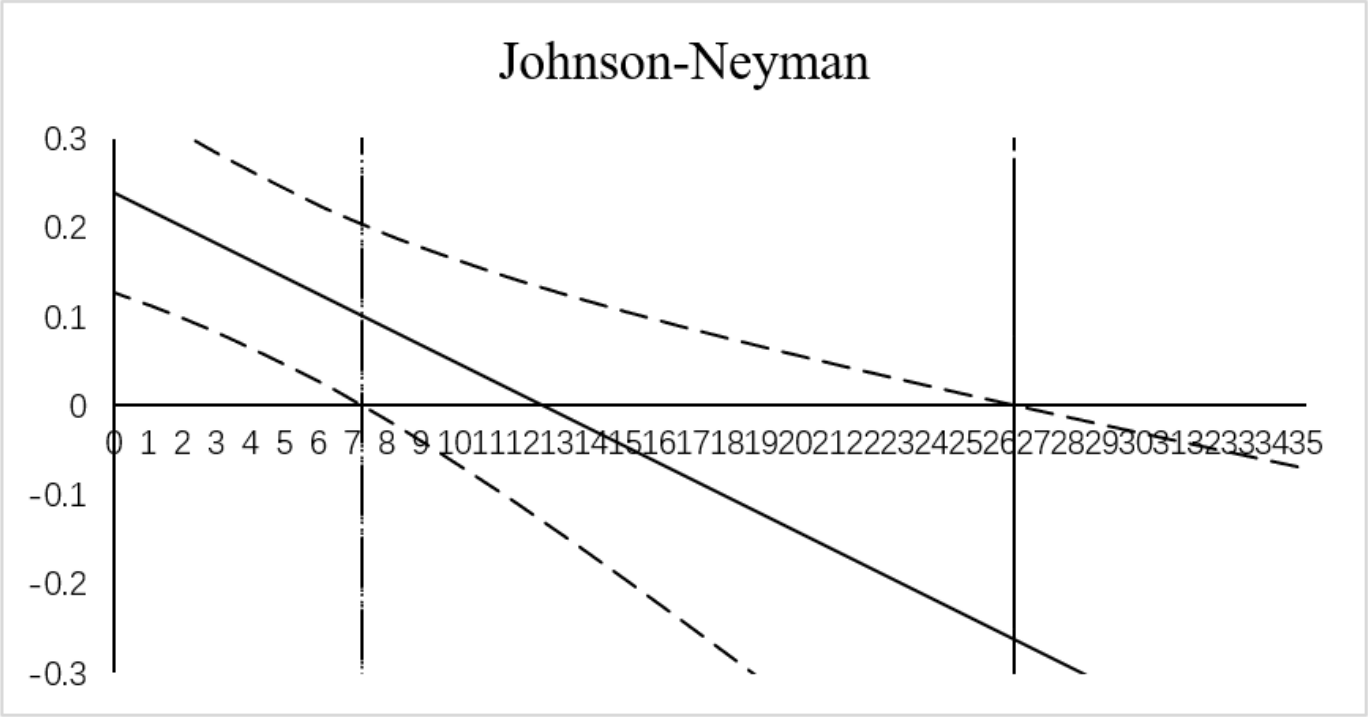


Figure 2

Significant interval distribution of anger expression as a moderating variable Johnson-Neyman