

# PERSONALITY MODIFIES THE EFFECT OF POST-TRAUMATIC STRESS DISORDER (PTSD) AND SOCIETY SUPPORT ON DEPRESSION-ANXIETY-STRESS IN THE RESIDENTS UNDERGONE CATASTROPHIC FLOODING IN HENAN, CHINA

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## ABSTRACT

**Background:** To analyze the impact of the flood disasters, social support and personality on the mental health of residents in Henan Province, China, providing fundamental knowledges for making measuring strategies to improve the psychological protection and anti-stress ability of the residents after the disaster. **Material and Methods:** A cross-section study was conducted via an online survey platform “questionnaire star,” which included 572 residents in Henan Province, which underwent the history of ever flood disaster on July 20. The questionnaires of *Impact of Event Scale-Revised Edition* (IES-R), *Perceived Social Support Scale* (PSSS), the *Depression Anxiety Stress Scales* (DASS-21) and the scales of *Eysenck Personality Questionnaire-Revised* (EPQ-R) version in Chinese were also administered to each participant. Generalized linear regression model was performed. **Results:** The residents who live in the flooding areas, are male and married had a significantly higher post-traumatic stress disorder (PTSD) score than their counterparts. The scores of depression-anxiety-stress in the residents with stable emotion were significantly lower than those with unstable emotion ( $p < 0.001$ ). Machine learning showed that PTSD ranked the top risk factor, followed by neuroticism for Depression-Anxiety-Stress after disaster. The PTSD was negatively correlated with social support ( $p < 0.01$ ), while it was positively correlated with depression-anxiety-stress and emotional stability ( $p < 0.01$ ). There was a statistically significant interaction between PTSD, social support and neuroticism on depression-anxiety-stress ( $p < 0.001$ ), with an independent effect of 1.4% on depression-anxiety-stress. Emotional stability showed the largest association with depression-anxiety-stress. **Conclusions:** Residents living in the catastrophic flooding areas had significant post-traumatic mental health issues, and the severity of mental problems was differently affected by post-traumatic stress disorder and social support in individuals with different personalities. Introvert and PTSD were the major risk factors for depression-anxiety-stress after the disaster. *Med Pr.* 2022;73(4):305–14

**Key words:** PTSD, personality, machine learning, flooding, society support, depression-anxiety-stress

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## INTRODUCTION

A history-of-ever catastrophic flooding occurred in Zhengzhou city, the capital of Henan province and its around areas, China on July 20, 2021, affecting 150 counties, which led to 302 deaths and 50 missing [1]. In addition to the loss of lives and properties, and physical injuries, the natural disasters brought in a huge impact on the mental health of individuals who survived

through the disaster. When facing an unexpected disaster, individuals are susceptible to a series of adverse physical, emotional, cognitive behavioral reactions. These adverse responses are manifested by such as headache, insomnia, anxiety, nervousness, fear, sadness, depression, anger, irritability, inattention, memory loss and even life changes in beliefs and personality [2].

Post-traumatic stress disorders (PTSD) is a common mental health disorder that are associated with

traumatic events. For example, approximately one third individuals had PTSD when they had motor cycle crashes or road traffic crash, and this disorder could persist over time [3,4]. A major earthquake disaster occurring in Sichuan several years ago led to a high percentage of orphan survivors with PTSD [5–7]. Preventing chronic psychological injury in the early post-trauma period is needed to alleviate or prevent the occurrence of PTSD. Accumulating evidence suggest that social support plays an important role in the prevention of post-traumatic stress disorders (PTSD). Social support may help alleviate job-related burnout in professional health workers [8,9]. A negative correlation was observed between the severity of PTSD in individuals living in the disaster area and the overall perception of social support [10]. Similarly, social support was reported to significantly reduce the severity of trauma symptom in patients suffering from rheumatoid arthritis and low back pain [11].

Several previous studies have shown that personality is associated with the severity of PTSD [12,13]. Individuals with low neuroticism had relatively weaker PTSD than those with high neuroticism when they suffered the same trauma event [12]. Marked impulsivity, aggression and a susceptibility to anti-sociality and substance abuse was observed in persons who had high negative emotionality and low constraint/inhibition when they experienced traumatic events [13]. The positive association between personality of neuroticism and PTSD is also validated, whereas a negative correlation between extroversion and PTSD exists, in the meta-analysis studies [14,15].

A higher incidence of negative emotions such as anxiety and depression frequently occur during the emergency of major public health issues. The higher the degree of anxiety or depression is, the greater the perception of stress. Natural disasters may add additional stress on persons particularly who are in the suffer, increasing their anxiety and depression. Flooding has been shown to significantly increase depression (adjust odds ratio (OR) = 7.77, 95% confidence interval (CI): 1.51–40.13) and anxiety (OR = 4.16, 95% CI: 1.18–14.70) in a previous study conducted in England [16]. In China, an intervention study showed that a systemic planned intervention, including planned settlements, intensive health service and environmental interventions, could significantly reduce depression, anxiety and flooding-associated PTSD [17].

The flooding disaster recently occurring in Henan Province has led to the huge loss of lives and properties in the local area. Attention is worthy of being paid

to the mental health of the residents living in the disaster-affected area. Keeping calm emotion and offering social support to the population are important in helping the individuals to walk out of the disaster-induced psychological injuries. Yao et al. [8] has reported that professional health workers with different personality characteristics had significant performance and different outcomes when they faced job-related stress. However, it is yet to be determined how personality affects the mental health in the residents who experienced catastrophic flooding in Henan, China.

The purpose of this study was to analyze the associations between residents' traumatic stress disorder, social support, mental health status, and personality type after experiencing the natural disasters. This study hypothesized that individuals with different personality had different psychological responses when they faced the natural flooding disaster, which occurred in Henan, China.

## MATERIAL AND METHODS

### Participants

This study was approved by the Ethics Committee of Zhengzhou Normal University, Henan Province, China. During the period of July 30–August 4, 2021, a cross-section study was conducted in which a total of 572 residents living in Henan Province and experiencing the “July 20” devastating flood disaster were finally included, who completed the questionnaires. All the questionnaires were administered through an online survey platform named as “questionnaire star,” and informed consents were obtained from all participants online when they took part in the study. The information of the study with the link of the online questionnaire was distributed through social media (e.g., wechat). In the introduction part of the questionnaires, the demographic information include age, gender, marital status, flooding involvement, home address (e.g., zip code), properties and personal loss and so on. Of the total of 572 residents who completed the questionnaires (also known as valid questionnaires), 89 (15.6%) were men and 483 (84.4%) were women. The age of the participants ranged 16–62 years old, with an average age of 25.8 years.

### Methods

#### *Impact of Event Scale-Revised* (IES-R) questionnaire

To assess the psychological effect of the flooding disaster on the residents in Henan Province, an *Impact of Event Scale-Revised* (IES-R) questionnaire was used to obtain the information on residents' response

to the traumatic stress. This questionnaire in Chinese version has a good reliability and validity in evaluating psychological stress in PTSD studies conducted in China [18]. The questionnaire is consisted of 3 dimensions of intrusion, avoidance and hyperarousal symptoms with a total of 22 items. Each item is scored using Likert 0–4 grade method, from 0 (never) to 4 (always). The total score for each individual is summed up of the score of each item, which ranges 0–88. A higher score indicates that the stress is more severe. According to the total score, the stress disorder was classified into 0–23 (normal), 24–32 (mild), 33–36 (moderate), and >37 (severe). The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.962.

#### Social Support questionnaire

The *Perceived Social Support Scale* (PSSS) questionnaire was used to measure the social support that the participants could obtain. The PSSS is a scale measuring social support, which is assessed based on the individual's self-understanding and self-feeling. It measures the degree of social support from such as family, friends, and others [19]. There are 12 items for self-assessment in the questionnaire, and each item uses Likert 7-level scoring method. The sum score of each item was calculated for each individual. A higher sum score reflects that an individual feels more supports from the society. The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.954.

#### Mental health status

In this study, a concise version of the *Depression Anxiety Stress Scales* (DASS-21) questionnaire was used to evaluate the mental health status of the participants. The questionnaire was compiled by Lovibond and Lovibond [20], which is composed of 21 items, measuring the 3 negative emotional dimensions of depression, anxiety, and stress. Among them, depression factors are related to pathological dysthymia, low self-esteem, and low-level positive emotions. Anxiety factors are related to the physical and subjective experience of anxiety arousal, and stress factors are related to negative emotions such as stress, worry, and conflict. The scale uses Likert 0–3 grade scoring method (0 – completely disagree, 1 – partially agree, 2 – mostly agree, 3 – completely agree). Scores were determined by summing the individual items and multiplying them by 2. A higher score indicates a stronger negative emotion experience. The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.975.

#### Eysenck Personality Questionnaire-Revised (EPQ-R)

The personality type was determined using the version of the *Eysenck Personality Questionnaire-Revised* (EPQ-R) in Chinese, which is translated and revised by Qian Mingyi, a professor of psychology at Peking University, which has been shown with good reliability and validity [21]. Two dimensions, *Introversion-extroversion* (E) and *Neuroticism-emotional stability* (N), were used to assess the personality type. The *Neuroticism/stability* scale (EPQ-N) was for emotional stability when facing negative affect such as depression and anxiety, and the *Introversion and extroversion vector* scale (EPQ-E) for the demand of external stimulation. There are a total of 24 items each with a score of either 0 or 1. Based on the score cut offs of 43.3 and 56.7 for the E and N dimensions, respectively, 4 personality types were defined: stable introvert, stable extravert, unstable introvert, and unstable extravert. The Cronbach's  $\alpha$  coefficient of the EPQ-E and EPQ-N in this study was 0.818, 0.874.

#### Statistical analysis

All statistical analyses were performed using SPSS 18.0 software in this study. The numerical variables showed an approximate normal distribution after normality test (the absolute values of skew and kurtosis are both <1), and  $M \pm SD$  were used to represent its average and standard deviation. Pearson correlation analysis was performed for the correlation between traumatic stress disorder, social support, depression-anxiety-stress and personality characteristics. Machine learning of generalized linear algorithm (GLM) was performed using H2O.ai to analyze the importance of the factors in depression-anxiety-stress, respectively, in which the subjects were randomly (ratio = 0.70) divided into training and validation datasets. The GLM was fitted to estimate the set of parameters by maximizing the loglikelihood of the data for the best model. The ternary interaction of traumatic stress disorder, social support, and emotional stability on depression-anxiety-stress were also examined. The difference was considered statistically significant when a  $p < 0.05$  at the 2-sided  $\alpha$  level.

## RESULTS

#### Common-method variation test

The common-method variance of variables was first analyzed using Harman's single factor method. There were 14 factors with eigenvalues >1, and 28.19% of the variance was explained by the first factor. This result

indicates that no severe common-method variance exists in this study based on the critical threshold of 40%.

**Distribution of traumatic stress disorder, social support and depression-anxiety-stress in the participants**

Table 1 shows the associations of the traumatic stress disorder, social support, and depression-anxiety-stress with several analyzed variables in the residents of Henan province. The individuals who live in the flooding areas had a significantly higher score of traumatic stress disorder than those who do not ( $p < 0.05$ ). Similarly, significantly higher scores of traumatic stress disorder and depression-anxiety-stress were pronounced in male than female participants ( $p < 0.01$ ). There was a significant association between marital status and the scores of traumatic stress disorder measured by IES-R and stress measured by DASS-21, with a higher level in married vs. single ( $p < 0.01$ ). The differences were significant in the scores of traumatic stress disorder, social support and depression-anxiety-stress among individuals with different personality types ( $p < 0.001$ ). Further pairwise comparisons showed that the score of traumatic stress disorder measured

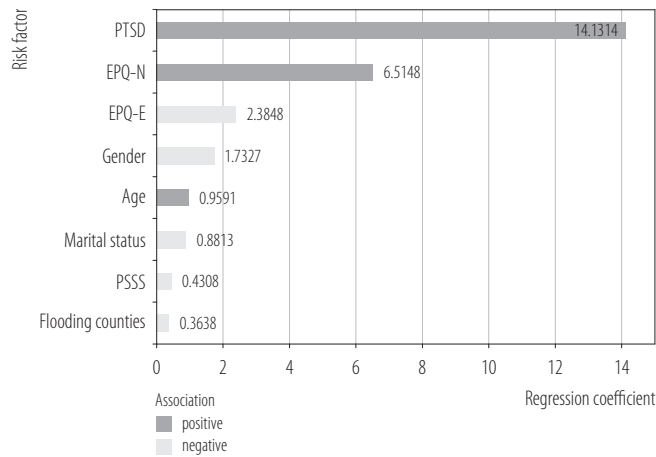
by IES-R was the highest for the individuals with residents with unstable extravert personality, followed by unstable introvert, stable introvert and stable extravert personality. Those with stable extravert personality had the highest scores of social support, followed by stable introvert, unstable extrovert and unstable introvert. The individuals with stable extravert personality had the lowest scores of depression-anxiety-stress, followed by stable introvert, unstable introvert and unstable extrovert personality.

To further assess the importance of these factors in depression-anxiety-stress, the generalized linear model algorithm (GLM) was performed using machine learning in H2O (H2OFlow of H2O.ai), and the results are shown in the Figure 1. Among the risk factors of depression-anxiety-stress measured by DASS-21, the traumatic stress response measured by IES-R ranked the first, followed by EPQ-N, EPQ-E, gender, age, marital status, social support and flooding counties. The traumatic stress response, EPQ-N and age, were positively associated with depression-anxiety-stress, while EPQ-E, gender, marital status, social support and flooding counties were negatively associated with depression-anxiety-stress (Figure 1).

**Table 1.** Traumatic stress response, social support and depression-anxiety-stress in residents, study conducted in 2021 in Henan, China

Variable	Participants (N = 572) [n]	Factor								
		traumatic stress disorder (M±SD)	t	F	social support (M±SD)	t	F	depression- anxiety-stress (M±SD)	t	F
Flooding counties			2.713*			1.665			0.961	
yes	278	28.32±17.66			61.14±13.82			20.49±25.42		
no	294	25.27±15.92			59.22±13.79			18.54±22.96		
Gender			3.193**			-1.424			2.991**	
male	89	31.94±19.39			58.24±14.94			28.13±30.82		
female	483	25.79±16.17			60.51±13.60			17.90±22.43		
Marital status			-3.015**			-1.665			-1.782	
single	446	25.63±16.52			59.64±13.92			18.53±23.32		
married	126	30.71±17.41			61.96±13.38			22.87±26.86		
Personality				15.321***			23.301***			28.926***
introvert										
stable	45	24.69±17.25			59.64±14.55			13.16±19.45		
unstable	62	31.68±15.15			49.89±13.81			35.13±27.25		
extravert										
stable	64	20.53±14.46			68.88±10.41			5.19±10.53		
unstable	47	40.70±19.25			53.77±15.31			38.81±30.67		

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .



EPQ-E – Introversion and extroversion vector scale, EPQ-N – Neuroticism/stability scale, PSSS – Perceived Social Support Scale, PTSD – post-traumatic stress disorders.

**Figure 1.** Importance of risk factors in depression-anxiety-stress, study conducted in 2021 in Henan, China

**Correlation between traumatic stress response, social support, neuroticism and depression-anxiety-stress**

Neuroticism refers that an individual has low emotional stability and strong reaction when facing stress. The *Emotional stability* (N) score was used in the *Neuroticism/stability* scale (EPQ-N) as the degree of neuroticism hereafter in the analyses. Pearson correlation analysis showed that traumatic stress response was significantly negatively correlated with social support (correlation coefficient  $-0.176$ ,  $p < 0.01$ ), while it was significantly positively correlated with depression-anxiety-stress (correlation coefficient  $0.694$ ) and neuroticism (correlation coefficient  $0.379$ ) ( $p < 0.01$ ), respectively (Table 2). Social support was negatively correlated with depression-anxiety-stress (correlation coefficient  $-0.343$ ). Neuroticism was significantly positively correlated with depression-anxiety-stress

(correlation coefficient  $0.522$ ). Extroversion was significantly positively associated with social support (correlation coefficient  $0.303$ ), whereas it was significantly correlated with depression-anxiety-stress (correlation coefficient  $-0.110$ ) and neuroticism (correlation coefficient  $-0.107$ ).

**Interaction of traumatic stress disorder, social support and neuroticism in depression-anxiety-stress**

Table 3 shows the results of the main effect of 3 variables and their interactions. In model 1, gender, age, traumatic stress response, social support, neuroticism and extroversion were included. It showed that 56.8% of the total variance of depression-anxiety-stress scores was explained by 6 variables. Traumatic stress response and neuroticism had a significantly positive association with depression-anxiety-stress, while extroversion and women showed a significantly negative association. No significant associations were found for social support and age with depression-anxiety-stress. In the model 2, a 2-way interaction term of traumatic stress disorder, social support, extroversion and neuroticism was added beyond the model 1. The main effects of gender, traumatic stress disorder, neuroticism and extroversion variables remained significant. A significant interaction was observed between traumatic stress disorder with either social support ( $p < 0.001$ ) or neuroticism ( $p < 0.001$ ), or extroversion ( $p < 0.001$ ). However, there was no interaction between social support and either neuroticism ( $p > 0.05$ ), or extroversion ( $p > 0.05$ ), and between neuroticism and extroversion ( $p > 0.05$ ). In the model 3, a 3-variable interaction term was added to the model 2. Similarly, the main effects of all variables except age and the interaction between traumatic stress disorder and either neuroticism or extroversion remained significant. The 3-variable interaction

**Table 2.** Correlation analysis between variables, study conducted in 2021 in Henan, China

Variable	Respondents (N = 572)		Correlation				
	M	SD	traumatic stress disorder	society support	DASS	neuroticism	extroversion
Traumatic stress disorder	26.75	16.84	1.000				
Society support	60.15	13.83	$-0.176^{**}$	1.000			
DASS	19.49	24.17	$0.694^{**}$	$-0.259^{**}$	1.000		
Neuroticism	5.12	3.75	$0.379^{**}$	$-0.343^{**}$	$0.522^{**}$	1.000	
Extroversion	7.31	3.22	0.010	$0.303^{**}$	$-0.110^{**}$	$-0.107^*$	1.000

DASS – Depression Anxiety Stress Scales.

\*  $p < 0.05$ , \*\*  $p < 0.01$ .

**Table 3.** Effect of traumatic stress disorder, society support, neuroticism and extroversion on depression-anxiety-stress, study conducted in 2021 in Henan, China

Variable	Depression-anxiety-stress					
	model 1		model 2		model 3	
	$\beta$	p	$\beta$	p	$\beta$	p
Gender	-0.068	0.022	-0.060	0.036	-0.066	0.020
Age	-0.003	>0.05	-0.003	>0.05	0.000	>0.05
Traumatic stress disorder	0.574	<0.001	0.555	<0.001	0.578	<0.001
Society support	-0.033	>0.05	-0.039	>0.05	-0.082	0.008
Neuroticism	0.280	<0.001	0.269	<0.001	0.273	<0.001
Extroversion	-0.081	0.006	-0.082	0.005	-0.081	0.005
Stress disorder $\times$ society support			0.116	<0.001	0.051	>0.05
Traumatic stress disorder $\times$ neuroticism			0.178	<0.001	0.184	<0.001
Society support $\times$ neuroticism			-0.041	>0.05	-0.047	>0.05
Traumatic stress disorder $\times$ extroversion			-0.128	<0.001	-0.105	0.001
Society support $\times$ extroversion			0.026	>0.05	0.019	>0.05
Neuroticism $\times$ extroversion			0.042	>0.05	0.047	>0.05
Traumatic stress disorder $\times$ society support $\times$ neuroticism					0.145	<0.001
Traumatic stress disorder $\times$ society support $\times$ extroversion					0.018	>0.05
Adjusted R <sup>2</sup>	0.568		0.601		0.614	
$\Delta R^2$	0.572	<0.001	0.037	<0.001	0.014	<0.001

Model 1 – gender, age, traumatic stress response, social support, neuroticism and extroversion were included.

Model 2 – a 2-way interaction term of traumatic stress disorder, social support, extroversion and neuroticism was added beyond the model 1.

Model 3 – a 3-variable interaction term was added to the model 2.

term of traumatic stress disorder, social support and neuroticism but not traumatic stress disorder, social support and extroversion was also significant ( $p < 0.001$ ), explaining 1.4% variance of depression-anxiety-stress score. Traumatic stress disorder showed the largest positive main effect on depression-anxiety-stress ( $\beta = 0.578$ ).

To more directly visualize the interaction of traumatic stress disorder, social support and neuroticism (also emotional stability) in depression, a 3-variable interaction diagram of depression was constructed based on the method described by Dawson and Richter. Figure 2 shows that as the traumatic stress response increases, the depression-anxiety-stress of the affected residents gets worse. Residents with the same level of traumatic stress disorder, high social support and low neuroticism had a lower depression-anxiety-stress score compared to those with low social support and high neuroticism. Compared with social support, neuroticism has a more obvious effect on depression-anxiety-stress when experiencing high traumatic stress; individuals with low neuroticism had a lower depression-anxiety-stress score than those with high neuroticism.

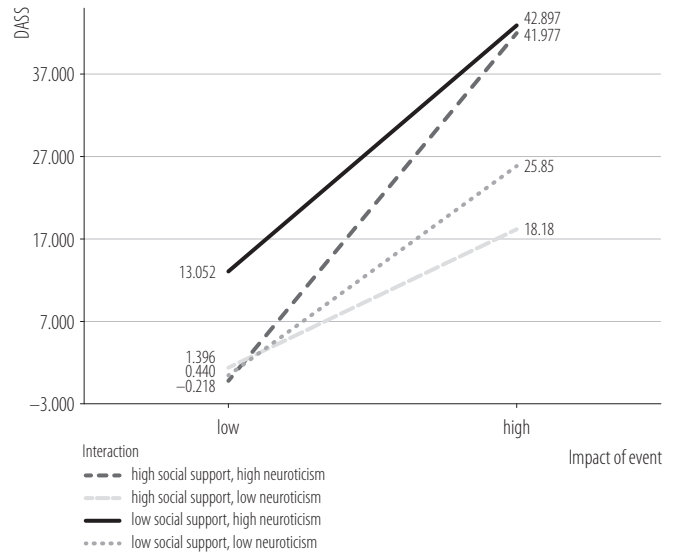
## DISCUSSION

This study demonstrated the effect of history-of-ever catastrophic flooding in Henan province on depression-anxiety-stress in residents with different personality. The residents who suffered flooding attack had a significant post-traumatic stress disorder (PTSD) compared to those who did not. They had significantly higher depression-anxiety-stress than those who did not suffer the disaster. The findings in this study are in consistent with previous report that natural disasters can lead to a severe impact on people's psychology, mainly manifested as depression, stress, anxiety and fear [5]. A high prevalence of PTSD exists in many orphan survivors after a major earthquake disaster several years ago in Sichuan [5–7]. The risk of depression and anxiety significantly increase in residents who experienced flooding in UK [16]. Intensive health support could significantly reduce depression, anxiety and flooding-associated PTSD [17]. These findings suggest that psychological aids are needed to this population who suffered the disaster on time to resolve the PTSD. The reason is that if these short-term

psychological problems cannot be effectively resolved via all kinds of intervention programs on time, long-term mental illnesses will be caused [5].

There is a significant gender disparity in the traumatic stress disorder with a higher score in men than in women. This finding seems inconsistent with some other studies, which reported that women had higher lifetime prevalence of PTSD than men [22]. One possibility may be due to the traditional belief that men should take more responsibilities in the family and society, and they usually have greater psychological pressure. A previous study performed in China also demonstrated that men were more susceptible to psychological problems such as depression-anxiety-stress after a natural disaster [5]. A higher score of traumatic stress disorder and stress was also observed in married individuals compared to those singles in this study. Married individuals usually have more family responsibility, there may have both kids, parents and siblings to take care, more economic burden on shoulders [23], and will always worry about the safety and situation of family members during emergencies. In addition, there is a positive correlation between the traumatic stress disorder and depression-anxiety-stress. This finding is in agreement with the previous observation that the traumatic stress burden resulted in uncontrollable worries in individuals, and stress could directly trigger negative emotions such as anxiety and depression [24].

It has been reported that when facing emergency and stress, individuals with different personalities take different actions and have different responses. Those with stable emotion could calmly challenge the stress and emergency situations, displaying less fluctuations in their physiological response under stress, and showing strong self-adjustment ability [25]. Emotional unstable individuals are more likely to be impulsive and anxious than those with stable emotion [26], while extrovert individuals usually have more social networks, often participate in group activities, and get more social supports from friends and relatives. The individuals who are extroverted and stable emotion usually can keep calm in stress or emergency, and can deal with various difficulties more rationally. In contrast, those with instable emotion may have anxiety and stressful feeling under these situations. Individuals with neuroticism or unstable emotion have higher PTSD compared to those with extrovert and stable emotion [15]. It can be found that the interactions existing between traumatic stress disorder, social support and neuroticism (emotional stability) in depression-anxiety-stress when they faced the natural disaster. When the individuals faced the flooding-caused damage



DASS – Depression Anxiety Stress Scales.

**Figure 2.** Interaction of traumatic stress disorder, social support and neuroticism in depression-anxiety-stress, study conducted in 2021 in Henan, China

and loss, those with high social support and stable emotion had the best mental health status. Regardless of social support, those with stable emotions had better mental health than those with unstable emotion particularly at high PTSD. These findings suggest that emotion management and psychological aids may be an important measurement in prevention of PTSD and disaster-related depression-anxiety-stress or mental health problems.

To a certain extent, the amount of social support depends on social networks an individual owns. Personality usually can affect the plenty of social networks; those with extrovert and stable emotion may have more social networks and may actively seek help from friends and relatives, whereas those with introvert and unstable emotion may be shameful to seek help from others or may have difficulties in making friends. Thus, when they faced the difficulties or the disaster-induced stress, individuals with different personalities had different outcomes in mental health. The findings in the interaction between traumatic stress disorder, social support and personality in mental health are in agreement with the previous observations that extrovert individuals with stable emotion often adopt active coping styles to solve problem and seek help when they encounter difficulties and emergencies, and they receive higher social support.

Social support and friendship help play an important role in maintaining the mental health [27]. Similarly, the prevalence of depression (suicide thoughts and behaviors) increased in the building-collapse survivors

when they felt desperate with less social supports [28]. Another nightclub fire disaster study also showed a positive association between negative emotion personality and PTSD [29]. Thus, social support to those who suffer natural disasters on time is an effective measurement to prevent PTSD, and improve their mental health, making them feel warm from society, relatives and friends, and fill their heart with full hope of live, they are not alone. Interestingly, in this study, there is a significant interaction existing between traumatic stress disease (PTSD), social support and neuroticism but not between PTSD, social support and extroversion in depression-anxiety-stress. One possibility is the most likely when people face such a large scale natural disaster, it is a challenge for everybody no matter how extrovert they are. However, the disaster-causing stress may deteriorate the mental health problem for those neuroticism. Thus, neuroticism individuals should be granted with high priority more social support to prevent mental problem.

In this study, 2 scales of IES-R and DASS-21 were applied to detect psychological disorder for PTSD and depression-anxiety-stress, respectively. Both IES-R and DASS-21 have been shown suitable for use in clinical and compensation setting to detect PTSD and major depression disorder in a motor vehicle crashes study, demonstrating both scales with acceptable sensitivity and specificity in an injured individuals engaged in compensation [3]. However, 2 scales were applied in this study based on their applications initially designed, IES-R specifically for PTSD and DASS-21 for depression-anxiety-stress, respectively. The IES-R has 3 sub-scale measurements: *Intrusion* (i.e., intrusive thoughts, nightmares, intrusive feelings and imagery), *Avoidance* (e.g., avoidance of feelings, situations and ideas, responsiveness numbing) and *Hyperarousal* (e.g., anger, irritability, hypervigilance) [30]. This scale was used for traumatic stress disorder measurement after the flooding. The DASS-21 assesses 3 dimensions: *Depression* (e.g., hopelessness, lack of interest or involvement, inertia), *Anxiety* (e.g., autonomic arousal, anxious), and *Stress* (e.g., irritable, upset, over-reaction, nervous), and this scale was used to measure the comprehensive depression-anxiety-stress (not only from the flooding, but also due to other factors). Interestingly, there is a significant interaction existing between neuroticism, social support and traumatic stress disorder, suggesting that personality could modify the effect of PTSD and social support on depression-anxiety-stress in the residents living in the flooding area in Henan, China.

Some limitations exist in this study. First, the cross-section study design was applied for the survey, and it is a time point snapshot for all variables. Thus, it could not be inferred a causal relationship except the association, which may be accompanied only. A longitudinal or intervention study may help to address the causal inference. Secondly, the participants voluntarily signed in to fill the online questionnaires, the selection of subjects may have a bias, e.g, women are far more than men in the number (or proportion), and the samples may not well represent the population. Moreover, although 2 different psychological stress questionnaires (IES-R vs. DASS-21) were used, and could not be clearly dissected each other. However, one of the strengths of this study is that the sample size is relatively large. In addition, this study was conducted immediately after the flooding, and it may limit some recall bias and different intervention measurement effects in the survey.

## CONCLUSIONS

In summary, this study demonstrated the effect of traumatic stress disorder, social support and personality on their interactions in the mental health of the residents in Henan province, where recently suffered a history-of-ever flooding. It showed that personality modified the effect of traumatic stress disorder and social support on mental health. Individuals who have stable emotion had a better mental health compared to those who have unstable emotion even when they are at the same level of traumatic stress disorder. These findings suggest that personality consideration may be helpful in improvement of mental health after the disaster when psychological aids and social support reach out. However, further follow-up studies are warranted to investigate the effect of different strategies or measurements on the prevention of post-traumatic stress disorder.

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