TÜBİTAK

Turkish Journal of Medical Sciences

http://journals.tubitak.gov.tr/medical/

Research Article

Turk J Med Sci
(2021) 51: 2502-2509
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doi:10.3906/sag-2008-282

Prediction of posttraumatic stress disorder by acute stress disorder in traffic accident survivors

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Received: 29.08.2020 • **Accepted/Published Online:** 22.06.2021 • **Final Version:** 21.10.2021

Background/aim: To investigate the predictive effect of different symptoms of early acute stress disorder (ASD) on posttraumatic stress disorder (PTSD) in traffic accident survivors.

Materials and methods: A total of 206 traffic accident survivors were assessed with the acute stress disorder scale (ASDS) within 2–23 days after accidents, as well as with 17-item PTSD checklist-specific stressor version (PCL-S) during 4–12 months after accidents. All into the first group of subjects by senior surgeon assessment, based on the clinical, radiological and laboratory examination, excluded traumatic brain injuries, and mild brain injury. And then, assessment by clinical psychological practitioner.

Results: The severity of ASD can significantly predict the severity of PTSD symptoms. ASD reexperience symptoms and avoidance symptoms can significantly predict PTSD reexperience symptoms and avoidance symptoms. ASD hyperarousal symptoms can significantly predict PTSD hyperarousal symptoms.

Conclusions: ASD and PTSD are common psychological disorders among traffic accident survivors. ASD can predict the symptoms and severity of PTSD.

Key words: Acute stress disorder, posttraumatic stress disorder, prediction, traffic accident

1. Introduction

Traffic accidents are a kind of serious sudden stressful life events, which may not only cause different degrees of physical injury to the survivors but also trigger strong psychological stress responses and a series of serious psychological disorders. Acute stress disorder (ASD) and posttraumatic stress disorder (PTSD) are the most typical severe mental disorders with the highest incidence.

ASD refers to the stress symptoms in survivors within 2 days to 4 weeks after exposure to natural disasters, wars, violent attacks, or major traffic accidents, with the main symptoms as dissociation, reexperience, avoidance, and hyperarousal [1]. PTSD refers to a series of clinical syndromes manifested by a series of psychological and physiological stress reactions after an individual experiences a life-threatening event or a serious injury to the individual's body. Its diagnostic model includes three clusters of symptoms: reexperience, avoidance, and hyperarousal (PTSD) [2–6]. With the rapid development of psychology, there are more and more studies on ASD and PTSD caused by traffic accidents [7–9]. However, relevant research in China started relatively late; although some data have been accumulated, it is still far from enough to guide clinical practice and construct an effective prevention and treatment system, which requires systematic and in-depth research. In this study, the prevalence of ASD and PTSD in 206 road traffic accident survivors were investigated for the first time, aiming to provide basis for predicting late PTSD symptoms by different early symptoms of ASD.

2. Materials and methods

2.1. Objects

The research objects were the 206 traffic accident survivors admitted to the Department of emergency and orthopedic ward, from October 2017 to May 2018. There were no brain trauma or mild brain injury in all the patients, a total of 314 questionnaires were returned, of which 87 questionnaires were questionnaires such as unclear test date, multiple options, 21 people with brain trauma and mild brain injury, a total of 206 valid questionnaires were

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returned, and the recovery rate was 65.6%, a total of 206 people (See Table 1 for details). The age range is 16–72 years old. See Table 2 for specific demographic information. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Weifang Medical University. Written informed consent was obtained from all participants.

The assessment of participants' trauma exposure included the severity of injuries at the time of assessment, whether the participant witnessed injuries in traffic accidents, and the degree of fear/helplessness/terror at the time of traffic accidents (using 0–3 points for the 4-Grade assessment, 0 point referred to "no", 3 points referred to "strong"). The international injury severity score (ISS) was used to assess the severity of injury. ISS is divided into six areas, including head and neck, face, chest, abdomen and pelvic viscera, limbs, pelvis and shoulder girdle injuries, body surface injuries; ISS is the square sum of the highest AIS scores in the three most serious injured areas of the body; AIS scoring is divided into six grades: 1, mild, 2, moderate, 3, comparatively severe, 4, severe, 5, critical, and 6, lethal; ISS < 16 points is defined as mild injury, ISS [3] 16 points is defined as severe injury, ISS < 25 points is defined as critically severe injury; The effective range of ISS is 1–75 points. The trauma exposure of the objects is shown in Table 3.

2.2. Research tools

ASDS was used to assess individual acute stress symptoms. ASDS was compiled by Bryant in 2000, which contains 19 items directly corresponding to ASD standard items in DSM-IV. Each item is scored by 5 points (1: totally no – 5: very severe) [2]. The research shows that this scale has good measurement quality, so it's the most widely used evaluation tool in this field. The Chinese version of the scale is revised by two-stage translation and back-translation. It has good reliability and validity among Chinese population. In this study, the internal consistency coefficient of ASDS was 0.91, with the dissociation subscale as 0.73, the reexperience subscale as 0.67, the avoidance subscale as 0.97, and the arousal subscale as 0.80.

The 17-item PTSD checklist-specific stressor version (PCL-S) was used to evaluate the clinical symptoms of individual's PTSD. This scale is relatively short and easy for self-evaluation. It contains 17 items that directly

Table 1. Statistical analysis of the recovery of the 206 questionnaires.

Include in the questionnaire	N	%
Total return questionnaire	314	100%
Culling questionnaire	87	27.7%
Traumatic brain injury and mild brain injury questionnaire	21	6.7%
Total elimination questionnaire	108	34.4%
Total return of valid questionnaires	206	65.6%

Table 2. Demographic characteristics of the 206 traffic accident survivors.

Demographic variable	N	%	M±SD
Sex			
M	168	81.6	
F	38	18.4	
Age (years)			39.8 ± 12.5
Marital status			
married	158	79.8	
Single (unmarried, divorced, widowed)	40	20.2	
Education level			
Junior high school and below	142	71	
High school and above	58	29	

Note: Due to the lack of basic information, the sum of each item in the table does not necessarily equal the total number of research objects.

Table 3. Trauma exposure-related characteristics of 206 traffic accident survivors.

Trauma exposure item	N	%
Severity of injury on assessment		
Mild	158	78.2
Severe	30	14.9
Critically severe	14	6.9
Witness of injury in traffic accidents		
Yes	50	24.8
No	152	75.2
Degree of fear/helplessness/terror in accidents		
No	56	29.0
Appreciably	48	24.9
Obvious	41	21.2
Strong	47	24.4

Note: Due to the lack of basic information, the sum of each item in the table does not necessarily equal the total number of research objects.

correspond to the PTSD diagnostic criteria in DSM-IV. Each item is scored by 5 points (1: totally no – 5: very severe) to reflect the severity of symptoms in each individual. Previous psychometric studies have shown that the scale has good quality, and the scale is currently the most widely used evaluation tool in this field [7,8,10]. The Chinese version of the scale is revised by two-stage translation and back-translation and has good reliability and validity among the Chinese population. In this study, the internal consistency coefficient of PCL-S was 0.91, with the intrusion as 0.75, the avoidance as 0.80, and the hyperarousal as 0.80.

2.3. Research procedure

All the participants were excluded from brain injury and mild brain injury by experienced surgeons based on individuals' clinical manifestations, as well as imaging and laboratory examinations, and then assessed by psychiatrist, according to the diagnostic criteria of ASD and PTSD in DSM-IV. Traumatic events involved in the assessment referred specifically to traffic accidents that participant experienced. The clinical evaluation of ASD was within 2–23 days (M = 7, SD = 4) after accidents, and the clinical evaluation of PTSD was within 4–12 months (9.20 + 1.49) after accidents.

2.4. Statistical analysis

SPSS v. 19.0 was used for data collation and analysis. The statistical methods used included descriptive statistical analysis, t-test, correlation analysis, and regression analysis.

3. Results

3.1. Descriptive statistics

The positive rate of ASD and the scores of each item are shown in Table 4. According to the criteria established by Bryant, when the score of dissociation symptom subscale was greater than (equal to) 9 points, and the total score of the other three subscales was greater than (equal to) 28 points, the individual can be judged as a possible ASD patient. In this study, 61 participants (29.6%) met this criterion.

According to the criteria suggested by Fuglasang et al. [9] in previous studies, we used the following clinical diagnostic criteria: when the total PCL score of the subject was greater than (equal to) 44 points, the individual can be judged as a possible PTSD patient [9]. In this study, 51 participants (24.8%) were potential PTSD patients (Table 5).

3.2. The relationship between demographic variables, classification variables in trauma exposure characteristics, and severity of PTSD

For the four classification variables (sex, marital status, educational level, and witness of injury or not), the differences in the severity of PTSD symptoms in different groups were tested by the t-test, Table 6. The results showed that the severity of PTSD symptoms in females was significantly higher than males ($p < 0.05$), and the severity of PTSD symptoms in married persons was significantly higher than single persons ($p < 0.001$). Education and witness of injury had no effect on the severity of PTSD symptoms.

Table 4. Positive rate of ASD and item scores of 206 traffic accident survivors.

Variable	N	%	M ± SD
Diagnostic results of ASD			
Yes	61	29.6	
No	145	70.4	
Total score of ASD			37.50 ± 11.70
Item score of ASD			
Dissociation			8.23 ± 2.95(5.00–18.00)
Reexperience			7.30 ± 2.81(4.00–17.00)
Avoidance			7.66 ± 3.84(4.00–16.00)
Hyperarousal			14.33 ± 4.77(6.00–24.00)

Table 5. Positive rate of PTSD and severity of symptoms in 206 traffic accident survivors.

Variable	N	%	M ± SD
Diagnostic results of PTSD			
Yes	51	24.8	
No	155	75.2	
Total score of PTSD			27.70 ± 8.10(17–47)
Item score of PTSD			
Dissociation			7.68 ± 2.55(5–17)
Reexperience			10.24 ± 3.28(7–19)
Avoidance			9.82 ± 3.17(5–18)
Hyperarousal	51	24.8	

Table 6. T-test of PTSD severity and classification predictive variables in 206 traffic accident survivors.

Item	Classification variables	N	PTSD score ($\bar{X}$±S)	t	p
Sex	M	168	26.9 ± 7.7(17–47)		
	F	38	31.46 ± 8.87(18–45)	–3.19	0.002
Marital status	Married	158	28.72 ± 8.07(17–47)		
	Single	40	23.00 ± 5.47(17–45)	5.29	<0.001
Education level	Junior high school and below	142	28.22 ± 7.88(14–47)		
	High school and above	58	25.87 ± 7.61(18–45)	1.94	0.054
Witness of injury	No	155	28.26 ± 8.16(17–47)		
	Yes	51	26.60 ± 8.19(19–47)	1.25	0.21

3.3. Relationship of demographic variables, trauma exposure characteristics, time interval from trauma to assessment, and continuous variables of physical rehabilitation status with severity of PTSD

For five continuous variables (age, severity of injury, fear/helplessness/panic experience in car accidents, time interval from trauma to assessment, and physical recovery status), the correlation analysis was used to analyze the relationship between them and the severity of PTSD symptoms (Table 7). The results showed that age and time interval from trauma to assessment were positively correlated with the severity of PTSD symptoms

(Pearson correlation coefficient was 0.34 and 0.14), and physical recovery status was negatively correlated with the severity of PTSD symptoms (r = –0.72), but the severity of PTSD symptoms was not significantly correlated with the severity of injury and experience of fear/helplessness/panic in accidents (skin). The correlation coefficients were 0.13 and 0.06.

3.4. Regression analysis of demographic variables, trauma exposure characteristics, time interval from trauma to assessment, and physical rehabilitation status with severity of PTSD

Taking the severity of PTSD symptoms as the dependent variable, as well as the demographic variables, trauma exposure characteristics, time interval from trauma to assessment, and physical rehabilitation status as the predictive variables, the multiple regression analysis (the classification variables were transformed into virtual variables) revealed that the regression equation was significant (F = 44.312, p < 0.001). All predictive variables can explain 56% of the variation of dependent variables. Females and physical recovery status were significant predictors (Table 8).

3.5. Regression analysis of severity of ASD with severity of PTSD

Taking the severity of PTSD symptoms as the dependent variable, the variables that can predict PTSD and the severity of ASD in Study 2 were included in the regression equation for multivariate regression analysis. The results showed that the regression equation was significant (F = 106.939, p < 0.001), and all the predictive variables can explain 63% of the variation of PTSD severity. The severity of PTSD symptoms can be predicted by sex, physical recovery status, and severity of ASD (Table 9).

3.6. Regression analysis of severity of PTSD with different symptom clusters of ASD

In order to further understand the different impact of ASD symptom clusters on the severity of PTSD, the severity of PTSD symptoms was set as the dependent variable, and the variables that can predict PTSD in Study 2 and the scores of different ASD symptom clusters were included in the regression equation for multivariate regression analysis (Table 10). The results showed that the regression equation was significant (F = 56.16, p < 0.001), and all the predictive variables can explain 65% of the variance of dependent variables. Among them, sex, physical recovery status, ASD reexperience, and hyperarousal cluster had significant predictive effect on the severity of PTSD, but dissociation and avoidance cluster of ASD had no significant effect on predicting dependent variables (Tables 11–13).

3.7. Summary

In this study, we found that 61 of 206 traffic accident survivors were potential ASD patients, with the incidence of ASD as 29.6%, and 51 were potential PTSD patients, with the incidence as 24.8%. The severity of ASD can

Table 7. Correlation between PTSD severity and continuous predictive variables in 206 traffic accidents survivors.

Item	1	2	3	4	5	6
1. Age	-					
2. Severity of injury	0.01	-				
3. Degree of fear/helplessness/panic in accidents	0.21**	–0.12	-			
4. Time interval from trauma to assessment (weeks)	0.11	0.08	–0.16*	-		
5. Physical recovery status	–0.27**	–0.16*	0.03	–0.01	-	
6. Total score of PTSD	0.34**	0.13	0.06	0.14*	–0.72**	-

Note: Significant level, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 8. Multivariate regression analysis of PTSD severity in 206 traffic accident survivors.

Prediction variable	B	SE B	β	t	*p*
Sex (male = 0, female = 1)	3.03	1.04	0.15	2.92	<0.001
Age	0.01	0.04	0.02	0.36	0.72
Marital status (single = 0, married = 1)	–2.24	1.20	–0.11	–1.86	0.06
Time interval from trauma to assessment	0.24	0.27	0.05	0.91	0.37
Physical recovery status	–6.95	0.56	–0.66	–12.37	<0.001

Table 9. Multivariate regression analysis of ASD severity with PTSD severity in 206 traffic accident survivors.

Item	B	SE B	β	t	*p*
Sex	2.03	0.95	0.10	2.15	0.03
Physical recovery status	–5.72	0.56	–0.52	–10.30	<0.001
Severity of ASD	0.26	0.04	0.37	7.26	<0.001

Table 10. Multivariate regression analysis of severity of PTSD with different symptom clusters of ASD in 206 traffic accidents survivors.

Prediction variable	B	SE B	β	t	p
Sex (female)	1.82	0.94	0.09	1.94	0.05
Physical recovery status	–5.72	0.55	–0.52	–10.34	0.00
ASD-Dissociation	0.21	0.15	0.07	1.42	0.16
ASD-Reexperience	0.64	0.19	0.22	3.36	<0.001
ASD-Avoidance	0.02	0.12	0.01	0.15	0.88
ASD-Hyperarousal	0.27	0.13	0.16	2.08	0.04

Table 11. Regression analysis of different symptom clusters of ASD with PTSD reexperience symptoms in 206 traffic accidents survivors.

Prediction variable	B	SE B	β	t	*p*
Sex (female = 1)	0.50	0.36	0.08	1.41	0.16
Physical rehabilitation status	–1.34	0.21	–0.39	–6.40	<0.001
ASD-Dissociation	0.08	0.06	0.09	1.43	0.15
ASD-Reexperience	0.42	0.07	0.46	5.82	<0.001
ASD-Avoidance	-0.09	0.05	–0.13	–1.91	0.06
ASD-Hyperarousal	0.00	0.05	0.00	0.02	0.99

significantly predict the severity of PTSD. The main manifestations included ASD reexperience symptoms and hyperarousal symptoms can predict the severity of PTSD. As for the impact of ASD symptoms on PTSD symptoms clusters, ASD reexperience symptoms and avoidance symptoms can significantly predict PTSD reexperience symptoms and avoidance symptoms, and ASD hyperarousal symptoms can significantly predict PTSD hyperarousal symptoms.

4. Discussion

Since ASD was incorporated into DSM-IV, the predictive validity of ASD for late PTSD has been a hot topic in the field of stress-related disorders, but the results of such research have been controversial and have not reached consensus [9,11,12]. Therefore, on the basis of understanding the prevalence of ASD and PTSD and their respective predictive factors, the relationship between ASD and PTSD was analyzed in details. 1 Prediction of severity of PTSD by severity of ASD.

This study finds that the severity of ASD can significantly predict the severity of PTSD, consistent with some previous studies [12–17]. Harvey and Bryant [1] found that 78% of ASD individuals had PTSD after 6 months of trauma, and compared with non-ASD individuals, ASD individuals were more likely to have secondary PTSD. Bryant et al. [5] report that 80% of ASD patients due to moderate brain injury after traffic accidents were diagnosed with PTSD after 2 years of trauma.

4.1. Prediction of severity of PTSD by different symptom clusters of ASD

Fuglsang et al. [9] found that early reexperience symptoms play an important role in predicting PTSD in later stage. We also find that ASD reexperience symptoms can predict the severity of PTSD and have a strong predictive effect, consistent with previous research results [18–21]. In

Table 12. Regression analysis of ptsd avoidance symptoms with different symptom clusters of ASD in 206 traffic accidents survivors.

Prediction variable	B	SE B	β	t	p
Sex (female = 1)	0.81	0.42	0.10	1.94	0.05
Physical rehabilitation status	−2.26	0.25	−0.52	−9.14	<0.001
ASD-Dissociation	0.10	0.07	0.09	1.60	0.11
ASD-Reexperience	0.20	0.09	0.17	2.35	0.02
ASD-Avoidance	0.16	0.06	0.19	2.88	<0.001
ASD-Hyperarousal	−0.02	0.06	−0.03	−0.41	0.69

Table 13. Prediction and analysis of different symptom clusters of ASD with hyperarousal symptoms of PTSD in 206 traffic accidents survivors.

Prediction variable	B	SEB	β	t	p
Sex (female = 1)	0.50	0.38	0.06	1.32	0.19
Physical rehabilitation status	−2.12	0.23	−0.49	−9.41	<0.001
ASD-Dissociation	0.02	0.06	0.02	0.39	0.70
ASD-Reexperience	0.02	0.08	0.02	0.26	0.80
ASD-Avoidance	−0.05	0.05	−0.06	−1.01	0.31
ASD-Hyperarousal	0.29	0.05	0.43	5.54	<0.001

addition, our study also finds that hyperarousal symptoms of ASD can also predict the severity of PTSD. Studies have shown that hyperarousal plays a central role in the symptoms of PTSD, which seems to affect subsequent symptoms and can predict the development of disease [19]. In the implementation of the evaluation, we found that some accident survivors who looked directly at the car causing the accident and roaring directly toward them often described obvious feeling of reexperiencing. In addition, for the study objects in this study, not only simple psychological trauma, pain of physical trauma, and repetitive treatment, such as debridement, surgery, traction, or plaster fixation can bring pain to participants, but also the effect of long-term absolute bed rest may affect the self-care ability and normal life of patients and will increase patients' reexperience of traumatic events, as well as hyperarousal symptoms such as anxiety, irritability, irritability, or sleep disorders.

This study also finds that although ASD dissociation symptoms play an important role in diagnostic criteria, the cluster of such symptoms can't predict the overall severity of PTSD, consistent with some previous research results. Studies have found that there is no significant correlation between traumatic dissociation symptoms and PTSD [13]; Harvey and Bryant [1] found that 60% of sub-ASD subjects developed PTSD six months after trauma, but most of these sub-ASD subjects did not meet the criteria of ASD dissociation. This result also arouses our thinking: (1) Whether the relationship between dissociation symptoms and PTSD is confused by more variables, (1) For example, some scholars have shown that the independent predictive value of dissociation symptoms in the traumatic phase is related to the mental health problems in the first few days or weeks after the traumatic event., Dissociation symptoms do not have independent predictive value. Dissociation symptoms may be related to other predictors of PTSD. For example, some scholars believe that the significant relationship between dissociation and PTSD may be due to the extreme arousal in the transient response of trauma. Therefore, the conventional construction of dissociation symptoms needs to incorporate more special factors, such as distortion of the sense of time, decreased alertness, and so on; (2) whether we should emphasize the existence of dissociation symptoms in ASD diagnostic criteria; (3) whether we put "high expectations" for the predictive role of ASD dissociation symptoms; (4) whether we should also emphasize the dissociation symptoms in the population of traffic accident survivors. Therefore, we are skeptical about the emphasis on the dissociation symptoms in the diagnostic criteria of ASD [20,21], which needs to accumulate more evidence in future empirical studies.

4.2. Prediction of different symptom clusters of PTSD by different symptom clusters of ASD

This study finds that ASD reexperience symptoms and avoidance symptoms can significantly predict PTSD

reexperience symptoms and avoidance symptoms; ASD hyperarousal symptoms can predict PTSD hyperarousal symptoms, and the relatively ideal corresponding predictive effects among symptom clusters again prove the predictive power of ASD on PTSD in traffic accident survivors.

As the first study in China for predicting the severity of PTSD in traffic accident survivors by the severity of ASD, the findings of this study not only provide important empirical data for relevant studies in the field of traumatic stress in China but also enable clinical staff to realize that effective prevention and treatment of ASD in the early stage of trauma is the key to prevent PTSD or alleviate its symptoms in the late stage of trauma.

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