

COGNITIVE FUNCTIONING IS IN NEGATIVE CORRELATION WITH SEVERITY OF TRAUMATIC EXPERIENCES, WITH SEVERITY OF SYMPTOMS OF PTSD, DEPRESSIVENESS AND ANXIETY OF WAR VETERANS IN BOSNIA AND HERZEGOVINA AFTER THE 1992-1995 WAR

Nerminka Aljukić, Mevludin Hasanović, Izet Pajević, Mitra Mirković Hajduković, Admir Alispahić, Sabrina Aljukić, Aron Mulahalilović

© by Acta Medica Saliniana
ISSN 0350-364X

Type of manuscript:
Original papers

Title:
COGNITIVE FUNCTIONING IS IN NEGATIVE CORRELATION WITH SEVERITY OF TRAUMATIC EXPERIENCES, WITH SEVERITY OF SYMPTOMS OF PTSD, DEPRESSIVENESS AND ANXIETY OF WAR VETERANS IN BOSNIA AND HERZEGOVINA AFTER THE 1992-1995 WAR

Authors:
Nerminka Aljukić^{1,2}, Mevludin Hasanović^{1,2}, Izet Pajević^{1,2}, Mitra Mirković Hajduković^{1,3}, Admir Alispahić^{2,4}, Sabrina Aljukić⁵, Aron Mulahalilović⁶

DOI: 10.5457/538

Affiliations:

¹Department of Psychiatry, University Clinical Center Tuzla, ²School of Medicine, University of Tuzla, 75000 Tuzla, Bosnia and Herzegovina, ³Faculty of Philosophy in University of Tuzla, 75000 Tuzla, Bosnia and Herzegovina, ⁴Department of Radiology, University Clinical Center Tuzla, ⁵Primary Health Care Center Banovići 75290 Banovići, ⁶Primary Health Care Center Gradačac 76250 Gradačac

Received:
27.12.2019.

Accepted:
21.05.2020.

Corresponding author:
Nerminka Aljukić
Email: nerminkaaljukic@yahoo.com

Acknowledgements: We would like to thank all the participants in the study and all colleagues who helped in any way to carry out this study. We are also thankful to all the families of our war veterans who participate in their psychological suffering during and after the war together with them. We also thank all individuals and institutions who understand and assist war veterans in any way, the people with high merit, but who are often unjustifiably forgotten and neglected by the community and political authorities.

Conflict of interest: The authors claim that there is not any conflict of interest.

Objective: The objective was to examine correlations between a level of cognitive functioning and severity of symptoms of post-traumatic stress disorder (PTSD), depression symptoms and anxiety symptoms.

Subjects and Methods: PTSD presence was tested on 104 war veterans together with depression and anxiety symptoms and a level of cognitive functioning. We applied Harvard Trauma Questionnaire (HTQ) to access traumatic experiences and intensity of PTSD symptoms and Hopkins Symptom Scale (SBCL 25) for depression and anxiety severity while Mini mental status (MMSE) was applied for aggravated cognitive functioning.

Results: The average age of tested war veterans was 50,6 years (standard deviation -SD = 5,2 years). Cognitive functioning level was in a negative correlation with traumatic experiences severity (Pearson's $r = -0,310$, $p = 0,001$), with the intensity of PTSD symptoms and the intensity of depression and anxiety symptoms (Pearson's $r = -0,649$, $p < 0,001$; $r = -0,606$, $p < 0,001$, $r = -0,566$, $p < 0,001$, respectively).

Conclusion: Severity of traumatic experiences, severity of PTSD symptoms as well as the severity of depression and anxiety symptoms decreased cognitive functioning of war veterans seventeen years after the 1992-1995 war in Bosnia and Herzegovina (B&H).

Key words: War Veterans, Bosnia and Herzegovina, Traumatic Experiences, PTSD, Depression, Anxiety, Cognitive Functioning.

INTRODUCTION

Current theories about post-traumatic stress disorder (PTSD) agree about the fact that abnormalities in memory primarily contribute to a set of symptoms [1,2,3]. Individuals with PTSD often experience intrusive, vivid, traumatic memories through "flashbacks" and nightmares and, somewhat paradoxically, have difficulties with recalling traumatic experiences voluntarily [4].

Pre-clinical and clinical studies indicated changes in memory function caused by traumatic stress [5]. Presence of cognitive dysfunction in patients with PTSD has been documented in many studies [6-11], with reports describing various cognitive deficits with PTSD, including attention deficit and impairment of memory and performance functions. Evidence shows that the correlation between PTSD and impaired cognitive function is two-way. For example, researches show that low intelligence and poor cognitive function before a trauma increase a risk of development of PTSD [12-14]. Actually, prospective analyses on a sample of male soldiers recruited in the war showed that a poor visual memory before recruitment was correlated with

increased severity of PTSD symptoms after the recruitment [15].

After consulting literature, it was noted that the main discussion was about the correlation of PTSD and the generalized cognitive dysfunction outside of memory impairment specific for trauma and episodic memory [14, 16-19].

Through a long-term clinical activity at the Department of Psychiatry in University Clinical Center Tuzla during the post-war period we noted that war veterans with PTSD manifested certain cognitive deficits, though we decided to define their relation to trauma experiences applying psychometric tests.

Research goals

To define the level of correlation between the degree of cognitive functioning in relation to the intensity of PTSD symptoms, depressive symptoms and anxiety in war veterans in Bosnia and Herzegovina (B&H) after the 1992-1995 war.

Working hypothesis

There is a statistically significant negative correlation of the degree of cognitive functioning with the intensity of PTSD symp-

toms, and the intensity of depressive symptoms and the intensity of anxiety symptoms in war veterans in Bosnia and Herzegovina (B&H) after the 1992-1995 war.

MATERIAL AND METHODS

A cross-sectional study conducted at the Department of Psychiatry from May 2011 to December 2012 involved 104 war veterans:

- **War veterans with PTSD:** The observed group consisted of 50 men under the age of 60. The group consisted of war veterans treated at the Department of Psychiatry for post-traumatic stress disorder; 115 patients were participated. All were tested with Harvard Trauma Questionnaire (HTQ). Excluding factors were: absence of PTSD on HTQ, presence of psychiatric comorbidity, addiction to alcohol, severe physical diseases, severe wounding which resulted in physical invalidity, injuries caused by detonations with post-concussion and post-contusion consequences. Every participant was informed about the objective of the research and asked for a voluntary consent. Of the 115 patients who responded to testing and completed the test, 65 of them, who met the exclusion criteria were excluded, so the group of 50 veterans with PTSD was formed.

- **War veterans without PTSD:** The control group involved 54 men younger than 60. The group involved war veterans who were not treated for post-traumatic stress disorder. War veterans were contacted through a collaboration with colleagues from other health institutions from Tuzla Canton and 80 of them agreed to participate. They were all tested with HTQ too. Excluding factors were: presence of PTSD on Harvard trauma questionnaire, presence of psychiatric comorbidity, addiction to alcohol, presence of severe physical diseases, severe wounding which resulted in physical invalidity, injuries caused by detonations with post-concussion and post-contusion consequences. Every participant was informed about the objective of the research and asked for a voluntary consent. Of the 80 war veterans who responded to testing and completed the test, 36 of them who met the exclusion criteria were excluded, so the group of 54 veterans without PTSD, who met the inclusion criteria for in the study, was formed.

Psychological methods

A general questionnaire created by us for an evaluation of socio-demographic data

All examinees filled the general questionnaire created by us. The questionnaire contains data about age, family status, marital status, educational degree, profession, employment, economic status, years spent in the war, somatic and mental disorders, previous treatments, usage of alcohol and nicotine. The questionnaire was created for this research.

Harvard trauma questionnaire

A level of presence of PTSD symptoms and presence of PTSD during the interview were assessed by Harvard trauma questionnaire (HTU) – the version for Croatian

veterans. It is a check list made by the Harvard Program in Refugee Trauma-HPRT, which searches for various traumatic experiences and emotional symptoms which are concerned as exclusively related to a trauma. This version was made for fighters who survived the war on the Balkans while Bosnian version was made for civilians who survived this conflict. The questionnaire has 4 parts. The first part includes 48 traumatic events and a participant simply answers with YES or NO. The second part contains a description of extremely painful and terrifying traumatic events. The third part- brain injury- is adopted to Croatian and Bosnian versions and contains questions about events which could lead to a brain injury or damage. The fourth part includes 40 symptoms. First 16 items were deducted from DSM IV criteria for PTSD. Other 24 symptoms are focused on influences of a trauma on one's personal perception of one's personal ability to function in daily life. These symptoms are very important because traumatized people are mainly more interested in social functioning than in emotional distress. A scale for every question in part IV includes four categories of answers: "Not at all", "Little", "A lot", "Very", ranging from 1 to 4. Persons from PTSD scale with total result = and/or > 2,5 are deemed symptomatic [20].

Mini-Mental State Examination (MMSE)

Mini-Mental State Examination (MMSE) is a screening test initially intended for an assessment of severity of dementia. Due to its simplicity and short application (5 to 10 minutes) it has been widely applied. The test is composed of several simple tasks with maximum score of 30. Result less than 24 indicates presence of cognitive decline. MMSE is a test which examines several neuropsychological functions. Those are orientation in time and space, speech, attention, concentration, mental flexibility (working memory), short-term memory as well as construction praxis. Tasks are mostly verbal and include the following: orientation in time and space (five points each, 10 points in total), immediate repeating of three words (three points), postponed remembrance of those three words (three points) with an inserted distraction of serial deduction "100-7" (five points; every correct answer gets one point), speech tests – performance of triple verbal order (three points), naming two objects (two points), repeating a phrase which pronunciation is difficult (one point), reading a written order and its execution (one point), writing a sentence (one point) and coping a picture of crossed pentagons (one point). A cognitive decline of persons with 8-year education is indicated by a score less than 21 while for persons with 12-year education the score is less than 23 and for highly educated persons the score less than 24 [21].

Hopkins symptom check list (HSCL-25)

Hopkins symptom check list (HSCL-25) is a famous and widely used instrument which history dates back to the 1950s. It was initially designed by Parloff, Kelman and Frank at John Hopkins University [22]. HSCL-25 is a list of symptoms which examines anxiety and depression symptoms. It contains 25 items: Part I of HSCL-25

contains 10 items regarding anxiety symptoms; Part II of HSCL-25 contains 15 items regarding depression. A scale for every question includes four categories of answers: "not at all", "very little", "somewhat", "very much", ranging from 1 to 4, respectively. Two results are calculated: a total score is an average of 25 items and the result of depression is an average of 15 depression items. Evidence indicates that the total result is very related to severe emotional difficulties of an undefined diagnosis and the depression result is correlated with a great depression as defined in the Diagnostic and Statistical Manual of the American Psychiatry Association, IV version (DSM-IV).

Statistical procedure

Data were processed in SPSS 10.0 (SPSS, Chicago, IL, USA). Descriptive statistics will show category variables in percentage and values of continuous variables will be shown by Mean and Standard deviation. To compare values of continuous variables among groups one will apply Student's t-test and Chi-square test for comparison of category variables. To analyze interrelation of category values we applied Spearman's test of correlation and for an analysis of interrelation of continuous variables Pearson's correlation test. A logistic regression was used to determine and quantify

the impact of anxiety, depression, and the number of traumatic events on cognitive impairment. To determine the existence of a correlation between the number of traumatic events and group affiliation, a chi-square test of the interdependence of two markings and the contingency table was used. Statistical significance of difference of results among groups of veterans is set on $p < 0.05$ for all tests.

RESULTS

War veterans from B&H with PTSD were of average age (Mean \pm Standard Deviation) 50.3 ± 6.0 years, and veterans without PTSD were aged 50.9 ± 4.4 ; there was no statistically significant difference between the study groups ($F^{(ANOVA)} = 0.337$; $p = 0.563$).

Among participants we found statistically significant difference in the level of education ($p = 0.002$). The most of war veterans without PTSD were of those with secondary school education 45 (83.3%), with three men (5.7%) with 2-year university education and one man (1.9%) with 4-year university education. Slightly more than half of war veterans with PTSD completed secondary school education (56 %) and about 2/5 (42%) completed primary school education only (Table 1).

Table 1. Level of education of war veterans with and without PTSD in B&H

	Veterans with PTSD (n=50)	Veterans without PTSD (n=54)	χ^2 test	df	p
Education:	N (%)				
Completed 8 years of Primary school	21 (42.0)	5 (9.3)	16.677	4	0.002
Secondary school	28 (56.0)	45 (83.3)			
2-yrs university education		3 (5.5)			
4-yrs university education	1 (2.0)	1 (1.9)			

According to the structure and distribution of traumatic event survivors, the control group was dominated by subjects with up to 10 traumatic events, while the experimental group was dominated by subjects with 11-20 and 21-30 events (Table 2). According to the re-

sults of the chi-square test and its associated P-value ($P < 0.05$) shown in Table 2, it can be concluded that the number of traumatic events depends on whether or not the subjects have PTSD.

Table 2. Structure of war veterans in BiH by the number of traumatic events experienced and by group belonging to the sample

Number of traumatic events:	War veterans in the sample								
	With PTSD		Without PTSD		Total				
	f	%	f	%	f	%	χ^2	df	p
up to 10	0	0.00	16	29.63	16	15.38	28.78	3	< 0.001
11 to 20	24	48.00	31	57.41	55	52.88			
21 to 30	21	42.00	7	12.96	28	26.92			
over 30	5	10.00	0	0.00	5	4.81			
Total	50	100.00	54	100.00	104	100.00			

χ^2 =Chi square test, df=Degree of freedom, p=level of significance

The analysis of MMSE showed that war veterans with post-traumatic stress disorder had statistically significantly lower total score of cognitive functioning related to war veterans without post-traumatic stress disorder (Figure 1).

In war veterans with PTSD there was statistically significant negative correlation of the total result on MMSE related to the avoidance symptom severity ($p < 0,001$), to hyperarousal symptoms severity ($p = 0,001$) and to re-experiencing symptoms severity ($p = 0,004$). The

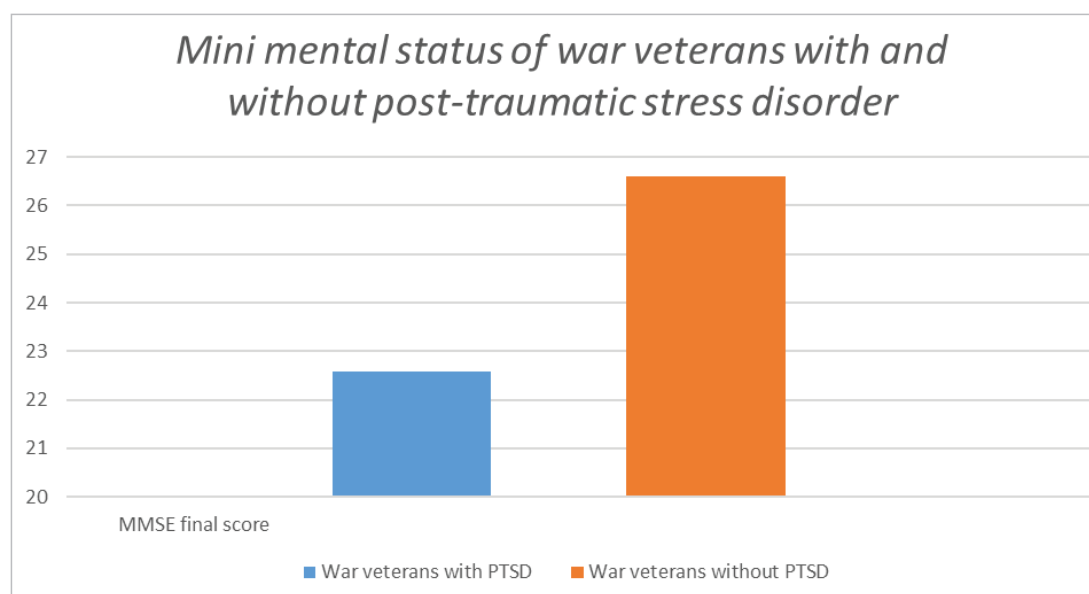


Figure 1. Mini Mental Status of war veterans with and without post-traumatic stress disorder

cognitive functioning level of war veterans with PTSD was in a significant negative correlation with the symptom's severity of functional damage in clusters "skills and talents" ($p = 0,004$), "physical damage" ($p = 0,004$), and "emotional condition" ($p = 0,008$). Cognitive functioning level in war veterans with PTSD was in a statistically significant negative correlation with total scores of PTSD-16, PTSD-24 and PTSD-40 ($p < 0,001$) (Table 3).

War veterans without PTSD had significantly negative correlation of cognitive functioning level related to the re-experience symptoms severity ($p = 0,018$). There

were no significant correlations between cognitive functioning level related to avoidance and hyperarousal symptoms severity ($p > 0,05$). Regarding functional damage symptoms, there were significant negative correlations of total MMSE score with clusters; "skills and talents" ($p = 0,048$), "intellectual functioning" ($p = 0,024$) and "social relations" ($p = 0,024$). Total cognitive functioning level (MMSE score) in war veterans without PTSD was in a significant negative correlation with total score of PTSD-16 ($p = 0,046$), PTSD-24 ($p = 0,024$) and total score of PTSD-40 ($p = 0,024$) (Table 3).

Table 3. Parametric correlation (Pearson's "r") of cognitive function (MMSE) and intensity of symptoms by clusters, intensity of symptoms of functional damage grouped by areas and according to total score (PTSD-16, 24, 40) by HTQ, in war veterans with PTSD (n=50) and war veterans without PTSD (n=54)

Trauma and PTSD Harvard Trauma Questionnaire		MMSE, total score	
		war veterans with PTSD (n=50)	war veterans without PTSD (n=54)
Total number of traumatic events	r	0.129	-0.194
	p	0.372	0.161
Symptoms of re-experiencing the trauma	r	-0.403	-0.322
	p	0.004	0.018
Avoidance symptom	r	-0.530	-0.229
	p	<0.001	0.095
Symptom of increased arousal	r	-0.444	-0.247
	p	0.001	0.072
PTSD 16	r	-0.519	-0.273
	p	<0.001	0.046
Skills and talents	r	-0.398	-0.270
	p	0.004	0.048
Physical damage	r	-0.404	-0.209
	p	0.004	0.129
Intellectual functioning	r	-0.251	-0.308
	p	0.078	0.024
Emotional condition	r	-0.373	-0.01
	p	0.008	0.027
Social relations	r	-0.267	-0.306
	p	0.061	0.024
Spiritual and existential condition	r	-0.165	-0.198
	p	0.253	0.152
PTSD 24	r	-0.454	-0.307
	p	<0.001	0.024
PTSD 40	r	-0.482	-0.307
	p	<0.001	0.024

In the whole group of war veterans there is a statistically significant negative correlation of the total MMSE score and an intensity of the symptom of re-experiencing the trauma ($r=-0,623$, $p<0,001$), the avoidance symptom ($r=-0,650$, $p<0,001$) and the increased arousal symptom ($p<0,001$). Also, there is statistically significant negative correlation of the total MMSE score and the total PTSD-16 score ($p<0,001$), PTSD-24 ($p<0,001$) and PTSD-40 ($p<0,001$) score.

Correlation of the total MMSE score with the intensity of functional damage symptoms in war veterans indicates statistically significant negative correlation with all items: "skills and talents" ($p<0,001$), "physical damage" ($p<0,001$), "intellectual functioning" ($p<0,001$), "emotional condition" ($p<0,001$), "social relations" ($p<0,001$), "spiritual and existential condition" ($p<0,001$)

There is a significant negative correlation of the total MMSE score with the total number of traumatic events ($p=0,001$). In a group of veterans there is a statistically significant negative correlation between anxiety and cognitive functions by MMSE ($p<0,001$) and a statistically negative correlation between depressiveness and cognitive functions by MMSE ($p<0,001$). (Table 4).

Association of traumatic experiences severity with the level of cognitive impairment

We used regression analysis to find out the effect of predictors: the total number of traumatic events on the cognitive impairment existence (MMSE), the results are presented in the following tables. The dependent (criterion) variable, which is a dichotomous variable, is coded in two values (0 = without cognitive impairment; 1 = with cognitive impairment). Up to 10 traumatic events is seen to be the reference category (Table 5).

Table 4. Parametric correlation (Pearson's r) of cognitive functions by MMSE and total number of traumatic events, intensity of symptoms of post-traumatic stress disorder by clusters and by total score (PTSD-16; PTSD-24; PTSD-40) by HTQ, intensity of functional damage symptoms grouped by areas, anxiety and depressiveness by HSCL-25 in war veterans ($n=104$)

Trauma and PTSD (Harvard Trauma Questionnaire)		MMSE (total score)
Total number of traumatic events	r	-0.310
	p	0.001
Symptom of re-experiencing the trauma	r	-0.623
	p	<0.001
Avoidance symptom	r	-0.650
	p	<0.001
Symptom of increased arousal	r	-0.622
	p	<0.001
Total PTSD (first 16 questions)	r	-0.649
	p	<0.001
Skills and talents	r	-0.598
	p	<0.001
Physical damage	r	-0.582
	p	<0.001
Intellectual functioning	r	-0.522
	p	<0.001
Emotional condition	r	-0.592
	p	<0.001
Social relations	r	-0.564
	p	<0.001
Spiritual and existential condition	r	-0.521
	p	<0.001
Total PTSD (last 24 questions)	r	-0.642
	p	<0.001
Total PTSD (all 40 questions)	r	-0.650
	p	<0.001
Anxiety (HSCL-25)	r	-0.566
	p	<0.001
Depressiveness (HSCL-25)	r	-0.606
	p	<0.001

Table 5. Coding of categorical variables

Number of traumatic events:	Number of participants	Encoding method		
		(1)	(2)	(3)
up to 10	16	0.000	0.000	0.000
11 to 20	55	1.000	0.000	0.000
21 to 30	28	0.000	1.000	0.000
Over 30	5	0.000	0.000	1.000

The model proved statistically significant ($X = 28.58$; $df = 5$; Cox & Snell = 0.240; Nagelkerke = 0.344; $P < 0.001$) and explained between 24.00% and 34.4% of the variance for cognitive impairment manifestation.

Table 5. Logistic regression in relation to the number of traumatic events, anxiety and depression, among war veterans where the reference category is up to 10 traumatic events

Variables	B	S.E	Wald	df	Significance	Exp (B)
Number of traumatic events			2.501	3	0.475	
Number of traumatic events(1)	-0.056	1.503	0.001	1	0.970	0.946
Number of traumatic events(2)	-0.400	1.570	0.065	1	0.799	0.670
Number of traumatic events(3)	1.470	1.893	0.603	1	0.437	4.349
Anxiety	1.809	1.201	2.268	1	0.132	6.101
Depression	1.838	1.198	2.355	1	0.125	6.287
Constant	-3.731	1.384	7.265	1	0.007	0.024

The model for predicting cognitive impairment was statistically significant. MMSE logistic regressions show that subjects with 30 or more traumatic events have a 4.34 times greater chance of experiencing cognitive impairment than subjects with a number of traumatic events between 0 and 10 events.

Furthermore, subjects with marked anxiety symptoms were 6.10 times more likely to experience cognitive impairment than subjects without anxiety symptoms. Also, subjects with marked depressive symptoms were 6.28 times more likely to experience cognitive impairment than subjects without depressive symptoms (Table 6).

DISCUSSION

A great number of studies which examined correlations between severity of PTSD symptoms and neurocognitive ability, found significant correlation [9,17,23-29]. In this research, the analysis of Mini mental status showed that the examinees with post-traumatic stress disorder had statistically significant lower total score in regard to war veterans without post-traumatic stress disorder. In the group of veterans with PTSD, one defined presence of statistically significant negative correlation between the total result of MMSE and the intensity of the avoidance symptom. A negative correlation between the total MMSE score and the intensity of the symptom of increased arousal and the intensity of the symptom of re-experiencing the trauma was also found. Cognitive functioning of war veterans with PTSD, assessed by the MMSE scale, is in a statistically significant negative correlation with the total PTSD-16 and PTSD-40 score and in a significant negative correlation with the total PTSD-24 score.

These results support the fact that a severe traumatic experience with a developed PTSD has a significant influence on decreasing of ability to remember and that memory damage is in a correlation with severity of a traumatic stress and a degree of PTSD. This is in accordance with some of previous researches which results showed memory damage among other neurocognitive functions in persons with PTSD [30]. A research con-

ducted by Clouston et al. [31], which involved 1193 examinees who participated in the rescue action in the World Trade Center, showed that 14,8% of examinees from the sample did have a cognitive dysfunction. The results of this research also showed a correlation between PTSD symptoms and cognitive dysfunction. In a sample of the Vietnam war veterans, severity of PTSD was negatively correlated with cognitive performance, even when cognitive abilities were adjusted to previous assessments of intelligence [9]. In a study by Sumner et al., [32] which involved a great sample of civilian middle- aged women indicated that increased symptoms of PTSD during life was related with poor cognitive function. Skimming through literature indicates that studies of war-related trauma indicate greater negative effects of PTSD on cognitive functioning [33,34].

MMSE has been criticized for its insensitivity to forms of cognitive dysfunctions which include impairment of performance and execution abilities [35,36], abnormality which, by its etiology, probably includes a frontal of frontal-subcortical circuit [37,38]. Previous evidence showed that damaged memory could be a higher priority in regard to other performance and execution functions of persons with PTSD [19].

A previous meta-analysis defined that a damaged verbal memory is the most consistent cognitive damage related to PTSD [39]. The authors noted that most of consulted studies included the Vietnam war veterans with chronic long-lasting PTSD. These findings may suggest that memory damage is partially related to duration of a disease. Furthermore, another meta-analysis discovered a greater damage of verbal memory than of visual one in persons with PTSD [40] while a meta-analysis by Scott et al. [41], which included data from 60 studies, showed that analyzing neuro-psychological functioning in the domain of attention, verbal memory and information processing speed, might have important consequences for an effective clinical management of persons with PTSD.

War veterans without PTSD show a significant negative correlation between the symptom of re-experiencing the trauma and the total MMSE result, while other two groups of symptoms do not have significant correlation

value with MMSE. The total MMSE score in war veterans without PTSD is in a significant statistically negative correlation with the total PTSD-16, PTSD-24 and PTSP-40 score. In the complete group of war veterans, one found a statistically significant negative correlation of the total MMSE score with all groups of cluster symptoms and with the total score of PTSD-16.

According to researchers conducted with Croatian war veterans, there is presence of PTSD in 16.2% while a partial PTSD was defined in 25% [42]. On a sample of 300 war veterans from B&H, Pavlović defined presence of PTSD in 37% and incomplete PTSD in 12.3% [11]. On a sample of 114 war veterans employed in the Armed Forces of B&H, Hasanović et al., found 22 (19.3%) of them who satisfy DSM criteria for PTSD, 11.5 years after the 1992-95 war in B&H [43]. Our research involved 50 veterans with PTSD and 54 veterans without PTSD. Results obtained in the research confirm the previous statement - that traumatic stress is related to memory deficient, both in partial and in disguised PTSD, which is in accordance with previous researches conducted in this area [11].

Cognitive functioning assessment in war veterans with PTSD by MMSE is in a significantly negative correlation with an intensity of functional damage symptom in groups "skills and talents", "physical damage", "emotional condition". A significant negative correlation of the total number MMSE score with items "skills and talents", "intellectual functioning" and "social relations" in war veterans without PTSD. In the whole group of veterans a correlation of the total number of MMSE score with the intensity of symptoms of functional damage in war veterans indicates a statistically negative correlation with all items: "skills and talents", "physical damage", "intellectual functioning", "emotional condition", "social relations", "spiritual and existential condition". The feeling that one is less skilled than before, that one is not able to cope with new situations, that one's memory is poor, that one has difficulties with keeping attention, that one is worried about physical problems, feeling of pain, feeling that one finds out that one did something which he cannot remember, being under the influence of traumatic stress are all related to memory deficient. It is important to underline that these cognitive disadvantages precisely anticipate current social and professional functioning of war veterans with PTSD [44] and are related to occupational functioning and the quality of physical condition [45]. Cognitive deficient is one of the main causes of invalidity in patients suffering from PTSD [46] so that improvement of cognitive dysfunction by current treatments deserves more attention. Besides this, previous researches indicate that a greater effectiveness of inhibitory control and poorer verbal memory anticipate an answer to cognitive inhibitory therapy of persons with PTSD [47,48].

Results obtained on the whole sample of veterans indicate that a level of cognitive functioning in veterans is in a negative correlation with severity of symptoms of depressiveness as well as with presented anxiety of tested

veterans. One of excluding criteria in our research was diagnosed psychotic depression, but we cannot exclude presence of mild forms of depressive conditions. Results obtained by Hart et al., suggest that PTSD itself is not enough to result in some of cognitive deficits, but they occur only when examinees have PTSD and comorbid psychiatric disease[49]. Depression symptoms may explain certain cognitive deficits with persons with PTSD [8,27,50,51].

Neylan et al., for example, did not manage to find a lack of memory related to PTSD after exclusion of veterans with psychiatric comorbidities [52]. In order to solve the issue of comorbidity, researchers adjusted PTSD and controlled subjects for comorbidity condition [23,53,54], due to usage of alcohol or depression [17] or they examined sub groups with and without comorbid disorders [9] and they continued with discovering neuro-psychological deficit related to PTSD.

During this research, seventeen years after aggression on B&H, an average age of our veterans was 50 years. The study of survivors of September 11 discovered that current PTSD, as well as depressive disorder diagnosis, is related to a double increase of cognitive abilities damage; 12.8% of examinees showed 1,2% cognitive damage level with diagnosed dementia. These results are surprisingly high from the database of participants whose average age is only 53 years [55]. It turned out that survivors of Holocaust suffering from PTSD are aging with great speed in comparison with survivors of Holocaust without PTSD and "healthy" control examinees [56]. A research conducted by Rafferty et al., which included six empiric studies (most of which are from the USA), claim that veterans with a diagnosis of PTSD or depressive disorder have a significantly higher risk of development of dementia in regard to a "healthy" control group [57]. A research by Bhattarai et al. conducted on a sample of 4800 veterans older than 56 defined that PTSD and depressive disorder were related to almost double risk of development of dementia [58]. One surely has to bear this in mind in regard to our population and perform researches in this field [59-62].

Limitations of research

In this research, the sample is composed of examinees, veterans, who experienced and participated in the war. We believe that the significance of this research would be greater if one had a control group without experience and participation in the war. Eight years ago, when this study conducted, PTSD was diagnosed according to ICD10, and DSM IV. Accordingly to that the Questionnaires were used. The participants in the study were not tested for presence of any early trauma during their childhood, which can be related to cognitive functioning in adult age. Also, one has to bear in mind that war veterans took psychopharmacological medications which may affect cognitive abilities. In addition to psychopharmacological therapy, supportive psychotherapy was used, but its association with cognitive functioning was not investigated. Given that we selected PTSD inpatients who has been treated at the Department of

Psychiatry, we could not influence the result obtained in relation to their education. Therefore, it was impossible to match patterns related to vocational education, which is a weakness of this study. The relatively small number of research participants limits the generalizability of the results.

CONCLUSIONS

Application of MMSE shows that war veterans with PTSD have greater cognitive deficit in regard to veterans without PTSD. Cognitive deficit is related to all cluster symptoms and intensity of PTSD. Anxiety and depressiveness in war veterans with PTSD is related to cognitive deficit. With an assumption that cognitive damage may be related to aging process, exposure to

fight, duration of disease and presence of PTSD symptoms may have a great impact on acceleration of additional damage of cognitive processes.

Recommendations for further researches

Neuro-psychological functioning of persons with PTSD has an important role in clinical management of people with PTSD so that adjustment of a treatment to specific cognitive functioning may be useful for increasing of effects of a treatment. Since those are war veterans, further examining of risk factors specific for this population, their inter-relation and a possible impact on cognitive functioning would be significant for a better understanding of specific pathology. Besides this, further researches may be oriented to examining of effects of a cognitive rehabilitation training on neuro-psychological deficits related to PTSD.

REFERENCES

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5. Arlington, VA: American Psychiatric Publishing 2013. .
2. Brewin CR, Gregory JD, Lipton M, Burgess N. Intrusive images in psychological disorders: characteristics, neural mechanisms, and treatment implications. *Psychological Review* 2010; 117(1):210–232.
3. McNally RJ. Cognitive abnormalities in post-traumatic stress disorder. *Trends in Cognitive Sciences* 2006; 10(6):271–277.
4. Brewin CR. Autobiographical memory for trauma: update on four controversies. *Memory* 2007; 15(3):227–248.
5. Elzinga BM, Bremner JD. Are the neural substrates of memory the final common pathway in PTSD? *J Affect Disord* 2002; 70:1–17.
6. Begić D. Aggression in posttraumatic stress disorder. *Social psychiatry* 2000; 28:105–111.
7. Koenen KC, Driver KL, Oscar-Berman M, Wolfe J, Folsom S, Huang MT, Schlesinger L. Measures of prefrontal system dysfunction in posttraumatic stress disorder. *Brain Cogn* 2001; 45:64–78.
8. Brandes D, Ben-Schachar G, Gilboa A, Bonne O, Freedman S, Shaley AY. PTSD symptoms and cognitive performance in recent trauma survivors. *Psychiatry Res* 2002; 110:231–8.
9. VasterlingJJ, DukeLM, BraileyK, ConstansJI, AllainJRAN, SutkerPB. Attention, learning, and memory performances and intellectual resources in Vietnam veterans: PTSDandnodisorder comparisons. *Neuropsychology* 2002; 16:5–14.
10. Murray B. The higher the IQ, the less likelihood of PTSD, study suggests. *Monitor on Psychology* 2002; 33(4):12.
11. 1Pavlović S. Cognitive and emotional changes in post-war war veterans in Bosnia and Herzegovina. Ph.D. Faculty of Philosophy, University of Sarajevo, Sarajevo 2003.
12. Macklin ML, Metzger LJ, Litz BT, McNally RJ, Lasko NB, Orr SP, Pitman RK. Lower precombat intelligence is a risk factor for posttraumatic stress disorder. *J Consult ClinPsychol* 1998; 66:323–326.
13. Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J Consult ClinPsychol* 2000; 68:748–766.
14. Parslow RA, Jorm AF. Pretrauma and posttrauma neurocognitive functioning and PTSD symptoms in a community sample of young adults. *The American Journal of Psychiatry* 2007; 164(3):509–515.
15. Marx BP, Doron-Lamarca S, Proctor SP, Vasterling JJ. The influence of pre-deployment neurocognitive functioning on post-deployment PTSD symptom outcomes among Iraq-deployed Army soldiers. *J IntNeuropsycholSoc* 2009; 15:840–852.
16. Danckwerts A, Leatham J. Questioning the link between PTSD and cognitive dysfunction. *Neuropsychology Review* 2003; 13 (4):221–235.
17. Gilbertson MW, Gurvits TV, Lasko NB, Orr SP, Pitman RK. Multivariate assessment of explicit memory function in combat veterans with posttraumatic stress disorder. *Journal of Traumatic Stress* 2001; 14(2):413–432.
18. Horner MD, Hamner MB. Neurocognitive functioning in posttraumatic stress disorder. *Neuropsychology Review* 2002; 12(1):15–30.
19. Wisdom NM, Pastorek NJ, Miller BI, Booth JE, Romesser JM, Linck JF, Sim AH. PTSD and cognitive functioning: importance of including performance validity testing. *ClinNeuropsychol* 2014; 28: 128–145.
20. Allden K, Franciškovic T, Lavelle J, Mathias M, McInnes K, Mollica RF, Moro L. Harvard Trauma Questionnaire: Croatian Veterans Version. Cambridge: Harvard Program in Refugee Trauma (Available in English and Croatian) 1998.
21. FolsteinMF, FolsteinSE, McHughPR. Mini-mentalstate. A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975; 12(3):189–98.
22. Parloff MB, Kelman HC, Frank JD. Comfort, effectiveness, and self-awareness as criteria for improvement in psychotherapy. *American Journal of Psychiatry* 1954; 3:343–351.
23. Bremner JD, Scott TM, Delaney RC, Southwick SM, Mason JW, Johnson DR, Charney DS. Deficits in short-term memory in posttraumatic stress disorder. *The American Journal of Psychiatry* 1993; 150(7):1015–1019.
24. Bremner JD, Vermetten E, Afzal N, Vythilingam M. Deficits in verbal declarative memory function in women with childhood sexual abuse-related posttraumatic stress disorder. *The Journal of Nervous and Mental Disease* 2004; 192(10):643–649.

25. Cohen BE, Neylan TC, Yaffe K, Samuelson KW, Li Y, Barnes DE. Posttraumatic stress disorder and cognitive function: findings from the mind your heart study. *The Journal of Clinical Psychiatry* 2013; 74(11):1063–1070.
26. Lindauer RJL, Olff M, van Meijel EPM, Carlier IVE, Gersons BPR. Cortisol, Learning, Memory, and Attention in Relation to Smaller Hippocampal Volume in Police Officers with Posttraumatic Stress Disorder. *Biological Psychiatry* 2006; 59(2):171–177.
27. Olff M, Polak AR, Witteveen AB, Denys D. Executive function in posttraumatic stress disorder (PTSD) and the influence of comorbid depression. *Neurobiology of Learning and Memory* 2014; 112:114–21.
28. Twamley EW, Allard CB, Thorp SR, Norman SB, HamiCissell S, Hughes Berardi K, Stein MB. Cognitive impairment and functioning in PTSD related to intimate partner violence. *Journal of the International Neuropsychological Society* 2009; 15(06):879–887.
29. Vasterling JJ, Brailey K, Constans JI, Sutker PB. Attention and memory dysfunction in posttraumatic stress disorder. *Neuropsychology* 1998; 12(1):125–133.
30. Jung Eun Shin, Chi-Hoon Choi, Jun Soo Kwon, So Hee Lee, Hyun-Chung Kim, Na Young Han, Soo-Hee Choi, So Young Yoo. Association between memory impairment and brain metabolite concentrations in North Korean refugees with posttraumatic stress disorder. *PLoS One* 2017; 12(12).
31. Clouston S, Pietrzak RH, Kotov R, Richards M, Spiro M, Spiro A 3rd, Scott S, Deri Y, Mukherjee S, Stewart C, Bromet E, Luft BJ. Traumatic exposures, posttraumatic stress disorder, and cognitive functioning in World Trade Center responders. *Alzheimers Dement (NY)* 2017; 3(4):593–602.
32. Jennifer A. Sumner, Kaitlin Hagan, Fran Grodstein, Andrea L. Roberts, Brian Harel, Karesten C. Koenen. Posttraumatic stress disorder symptoms and cognitive function in a large cohort of middle-aged women *Depress Anxiety* 2017; 34(4):356–366.
33. Polak AR, Witteveen AB, Reitsma JB, Olff M. The role of executive function in posttraumatic stress disorder: a systematic review. *Journal of Affective Disorders*. 2012;141(1):11–21.
34. Qureshi SU, Long ME, Bradshaw MR, Pyne JM, Magruder KM, Kimbrell T, Kunik ME. Does PTSD Impair Cognition Beyond the Effect of Trauma? *The Journal of Neuropsychiatry and Clinical Neurosciences* 2011; 23(1):16–28.
35. O'Sullivan M, Morris RG, Markus HS. Brief cognitive assessment for patients with cerebral small vessel disease. *Journal of Neurology Neurosurgery and Psychiatry* 2005; 76(8):1140–1145.
36. Pachet A, Astner K, Brown L. Clinical utility of the mini-mental status examination when assessing decision-making capacity. *Journal of Geriatric Psychiatry and Neurology* 2010; 23(1):3–8.
37. Hoops S, Nazem S, Siderowf AD, Duda JE, Xie SX, Stern MB, Weintraub D. Validity of the MoCA and MMSE in the detection of MCI and dementia in Parkinson disease. *Neurology* 2009; 73(21):1738–45.
38. Popović IM, Serić V, Demarin V. Mild cognitive impairment in symptomatic and asymptomatic cerebrovascular disease. *Journal of Neuroscience* 2007; 257(1–2):185–93.
39. Johnsen GE, Asbjørnsen AE. Consistent impaired verbal memory in PTSD: a meta-analysis. *J Affect Disord* 2008; 111: 74–82.
40. Bae SM, Hyun MH, Lee SH. Comparison of Memory Function and MMPI-2 Profile between Post-traumatic Stress Disorder and Adjustment Disorder after a Traffic Accident. *Clin Psychopharmacol Neurosci* 2014; 12:41–7.
41. Scott JC, Matt GE, Wrocklage KM, Crnich C, Jordan J, Southwick SM, Krystal JH, Schweinsburg BC. A quantitative meta-analysis of neurocognitive functioning in posttraumatic stress disorder. *Psychol Bull* 2015; 141(1):105–140.
42. Folnegović-Šmalc V. Epidemiology of posttraumatic stress disorder. In: Grekurek R, Klain E (eds). *Posttraumatic stress disorder, Croatian experiences*. Medicinska naklada. Zagreb, 2000.
43. Hasanović M, Pajević I, Avdibegović E, Hodžić R. Psychological problems of war veterans employed in military forces of Bosnia and Herzegovina. Summaries of the 2nd Congress of Psychiatrists of B&H with international participation The first HUNDRED years of psychiatry in Bosnia-Herzegovina . *Med Arh* 2007; 61(2).
44. Geuze E, Vermetten E, de Kloet CS, Hijman R, Westenberg HGM. Neuropsychological performance is related to current social and occupational functioning in veterans with posttraumatic stress disorder. *Depression and Anxiety* 2009; 26(1):7–15.
45. Wrocklage KM, Schweinsburg BC, Krystal JH, Trejo M, Roy A, Weisser V, Scott JC. Neuropsychological functioning in veterans with posttraumatic stress disorder: Associations with performance validity, comorbidities, and functional outcomes. *Journal of the International Neuropsychological Society* 2016; 22(4), 399–411.
46. ErenKoçak E, Kılıç C. Cognitive Dysfunctions in Posttraumatic Stress Disorder *Türk Psikiyatri Dergisi* 2017; 28(2):124–131.
47. Falconer EM, Allen A, Felmingham KL, Williams LM, Bryant RA. Inhibitory neural activity predicts response to cognitive-behavioral therapy for posttraumatic stress disorder. *The Journal of Clinical Psychiatry* 2013; 74(9):895–901.
48. Wild J, GurRC. Verbal memory and treatment response in post-traumatic stress disorder. *The British Journal of Psychiatry* 2008; 193(3):254–255.
49. Hart J Jr, Kimbrell T, Fauver P, Cherry BJ, Pitcock J, Booe LQ, Tillman G, Freeman TW. Cognitive dysfunctions associated with PTSD: evidence from World War II prisoners of war. *J Neuropsychiatry Clin Neurosci* 2008; 20(3):309–16.
50. Burriss L, Ayers E, Ginsberg J, Powell DA. Learning and memory impairment in PTSD: Relationship to depression. *Depression and Anxiety* 2008; 25(2):149–157.
51. Johnsen GE, Kanagaratnam P, Asbjørnsen AE. Memory impairments in posttraumatic stress disorder are related to depression. *Journal of Anxiety Disorders* 2008; 22(3):464–474.
52. Neylan T, Lenoci M, Rothlind J, Metzler TJ, Schuff N, Du AT, Franklin KW, Weiss DS, Weiner MW, Marmar CR. Attention, learning, and memory in posttraumatic stress disorder. *J Trauma Stress* 2004; 17:41–46.
53. Bremner JD, Randall PR, Capelli S, Scott TM, Delaney R, McCarthy G, Charney DS. Deficits in short-term memory in adult survivors of childhood abuse. *Psychiatry Res* 1995; 59:97–107.
54. Jenkins MA, Langlais PJ, Delis D, Cohen R. Learning and memory in rape victims with posttraumatic stress disorder. *Am J Psychiatry* 1998; 155:278–279.
55. Clouston SA, Kotov R, Pietrzak RH, Luft BJ, Gonzalez A, Richards M, Ruggero CJ, Spiro A 3rd, Bromet EJ. Cognitive impairment among World Trade Center responders: long-term implications of re-experiencing the 9/11 terrorist attacks. *Alzheimers & Dementia (Amst)* 2016; 4, 67–75.
56. Golier JA, Yehuda R, Lupien SJ, Harvey PD, Grossman R and Elkin A. Memory performance in holocaust survivors with posttraumatic stress disorder. *American Journal of Psychiatry* 2002; 159, 1682–1688.
57. Rafferty LA, Cawkill PE, Stevelink SAM, Greenberg N. Dementia, post-traumatic stress disorder and major depressive disorder: a review of the mental health risk factors for dementia in the military veteran population. *Psychol Med* 2018; 48(9):1400–1409.

58. Bhattarai JJ, Oehlert ME, Multon KD, Sumerall SW. Dementia and Cognitive Impairment among U.S. Veterans with a History of MDD or PTSD: A Retrospective Cohort Study Based on Sex and Race. *J Aging Health* 2019; 31(8):1398-1422.
59. Aljukić N, Hasanović M, Pajević I. Cognitive functioning negatively correlated with severity of trauma experiences, and symptoms severity of PTSD, depressiveness and anxiety in bosnia-herzegovina war veterans after 1992–1995 war. *European Psychiatry*, 2013; Vol. 28, p1. P-2118.
60. Pavlović S, Hasanović M, Kravić-Prelić N. Changes in intellect of war veterans with developed PTSD. *European Psychiatry*, 2013; Vol. 28, p1. P– 2110.
61. Aljukić N, Hasanović M, Pajević I. Severity of trauma experiences, cognitive impairs, depressiveness and anxiety of war veterans who suffer from PTSD. *European Psychiatry*, 2013; Vol. 28, p1. P-2111.
62. Hasanović M, Sinanović O, Pajević I, Avdibegović E, Frančičković T. Quality of life of war veterans with posttraumatic stress disorder in Bosnia-Herzegovina. *European Psychiatry*, 2013) Vol. 28, p1. P 1258.