PTSD

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406

Learning Problems, Impaired Short-Term Memory, and General Intelligence in Relation to Severity and Duration of Disease in Posttraumatic Stress Disorder Patients

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There are scarcely published studies that have addressed the relationship between posttraumatic period, and severity of PTSD in relation to the short-term memory and the general intelligence. The first hypothesis was that the longer the posttrauma period, the lower the short-term memory and general intelligence scores; and the more severe the disease, the lower the scores in these tests. The second hypothesis was that impaired short-term memory would predict difficulties with reading and writing in the PTSD group, and would reveal differences between the PTSD group and the control group with regard to learning difficulties. Thirty males with PTSD, and 20 males without PTSD participated in the study. Both groups were Arab and Kurdish refugees from Iraq who had recently settled in Sweden. The nonverbal short-term memory and intelligence tests were administered. Clinician-assessed interview for PTSD (CAPS), the Harvard Trauma Questionnaire (HTQ), and the General Health Questionnaire (GHQ) were

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applied. The following partial correlations were found in the PTSD group ($n = 30$) between duration of PTSD and (a) Block Design Test ($r = -0.42$, $p = 0.04$); and (b) Benton Visual Retention Test (BVRT; number of rotation errors: $r = 0.42$, $p = 0.04$; number of distortion errors: $r = 0.41$, $p = 0.05$); and between Raven's Standard Progressive Matrices (RSPM), and Severity of PTSD ($r = -0.42$, $p = 0.04$). RSPM predicted Severity of PTSD. BVRT predicted Difficulties with Reading and Writing in the PTSD group. The results of the present study show that PTSD patients have learning difficulties and cognitive problems in proportion to the duration and severity of perceived life events and trauma.

INTRODUCTION

The Prevalence, Severity, and Duration of PTSD and Cognitive Outcomes

Studies consistently confirm a 50–80% prevalence rate of physical abuse afflicting persons who later acquire diagnoses of mental illness (Beck and Van der Kolk, 1987; Craine et al., 1988; Breyer, 1987; Rose et al., 1992; Stefan, 1996). While many professionals in the field still deny the validity of work documenting these histories, the mental health system is beginning to catch up with traumatized refugees with severe long term PTSD in which clearly point at connections between trauma and later difficulties in the host country with regard to, e.g., learning the new language.

The high prevalence of PTSD among refugees is not surprising. Previous research suggests that the symptoms of PTSD usually decrease substantially within a few months after a trauma. However, the ongoing threat in homeland and the constant reminders of the events may affect both the severity and duration of PTSD among refugees in Sweden. The clinical course is variable. Symptoms may emerge immediately and disappear after several months, or they may take longer than six months to appear and last indefinitely. In prevalence studies, one half of those suffering from PTSD have been estimated to still meet the criteria of the *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. (DSM-IV) after one year, and up to one third still have weekly symptoms 10 years after the trauma (Solomon and Davidson, 1997). Review of the literature on the epidemiology of trauma reveals that traumatic events are common: According to Solomon and Davidson (1997), 5% of men and 10% to 12% of women will suffer from PTSD sometime in their lives, and for victims of traumas such as rape, the rate may be as high as 60% to 80%. For at least a third of sufferers, PTSD is a persistent condition lasting many years (*ibid*).

In the present study some measures of general intelligence and short term memory are used in PTSD and control groups. RSPM, BDT, Thurstone's

Picture Memory Test (TPMT), and BVRT are presented for number of life events in the PTSD group, because of the great importance placed upon the etiological agent, the traumatic stressor. However, the event in itself does not cause trauma. It is the subjective perception of the event, which can be perceived as trauma. In fact, one cannot make a PTSD diagnosis unless the patient has actually met the "subjective stressor criterion" which means that he or she has been exposed to an event that is perceived to be traumatic. Clinical experience with the PTSD diagnosis has shown, however, that there are individual differences regarding the capacity to cope with catastrophic events so that while some people exposed to overwhelming events do not develop a sense of helplessness and PTSD, others feel helpless, and go on to develop the full-blown syndrome. Then, the event is experienced as trauma.

Such observations have prompted recognition that trauma, like pain, is not an external phenomenon that can be completely objectified. It should be either subjectively or objectively identified. Like pain, the overwhelming experience is filtered through cognitive and emotional processes before it can be appraised as a traumatic threat. Because of individual differences in this appraisal process, different people appear to have different trauma thresholds, some more protected and some more vulnerable to developing short term memory, learning problems, and impaired general intelligence such as those studied in the present study after exposure to extremely stressful situations.

The educational system, and housing situation for newly settled refugees with PTSD, who have been tortured in the past, and try to learn the new language of the new country, are other examples. If this kind of stress experience can cause dysfunction of brain areas involved in learning and memory, it would put these people at a serious academic disadvantage in ways and for reasons that the existing educational system may be unable to address. Studies confirm this (Söndergaard and Theorell, 2003). In war-torn Beirut, traumatized adolescents with PTSD, as compared to non-traumatized adolescents who were without PTSD, lagged behind in academic achievement (Saigh, Mroweh, and Bremner, 1997).

In the present study, the first hypothesis was that the longer post trauma period, the lower short term memory and general intelligence scores, and the more severe the disease the lower scores in these tests. The second hypothesis was that the impaired short term memory would predict difficulties with reading and writing in the PTSD group, and to reveal differences between the PTSD group and the control group with regard to learning difficulties.

In PTSD, the typical emotional, and cognitive state is reflected in either hyperarousal or numbing of responses (Litz and Keane, 1989), intense emotional reactions, sleep problems, learning difficulties, memory disturbances, dissociation, aggression against self and others, and psychosomatic

reactions. Many brain and hormonal changes may occur as a result of prolonged trauma, and these changes contribute to difficulties with memory, learning, and regulating impulses and emotions. Combined with a disruptive psychosocial environment that does not foster healthy interaction, these brain and hormonal changes may contribute to severe cognitive difficulties (van der Kolk and van der Hart, 1989, 1991).

METHOD

Participants

Participants were 23 male patients (mean age 38.65 +/− 6.23 years) and 17 healthy male controls (mean age 37.88 +/− 8.58 years). Participants were of Iraqi and Kurdish origin and recently resettled in Sweden.

Participants were eligible for the study if they had the diagnosis of PTSD. They were recruited from a trauma clinic, referred by clinicians, while the healthy controls with the same ethnic background were recruited from language classes for refugees. Diagnostic criteria of PTSD were examined by an experienced clinician using CAPS (clinician-assessed interview for PTSD; Keane, Kaloupek, and Weathers, 1996). General health was assessed through the General Health Questionnaire (GHQ) (Goldberg and Hillier, 1979).

The controls were recruited on the basis of being from the same ethnic group as the PTSD participants and of being in a similar phase of the migration process (i.e. recently resettled). Those who considered themselves well were asked to register for participation as controls. They were offered a small reimbursement for participating. All control participants were screened for PTSD and examined by the same clinician who assessed the PTSD participants, and were also assessed using the CAPS interview (Mollica et al., 1992).

Demographic Data

Number of years of education, alcohol consumption, and medication or other drugs were recorded. This has been presented in the results section.

Inclusion and Exclusion Criteria

Exclusion criteria for both groups included lifetime history of major medical or psychiatric diagnoses: schizophrenia, bipolar disorder, mental retardation, organic brain syndrome, obsessive-compulsive disorder, head trauma with loss of consciousness, seizures, neurological disorder. We excluded patients with histories of substance or alcohol *dependence*. No subject with a distant history of alcohol *abuse* was included.

Ethics

After explaining study procedures, all participants agreed an informed consent approved by the Ethic Committee. This study was conducted at the Karolinska Institute and the National Institute for Psychosocial Factors and Health-IPM. Subjects with PTSD were recruited from a trauma clinic, referred by clinicians, while the healthy controls with the same ethnic background were recruited from language classes for refugees. After explaining study procedures, all participants agreed an informed consent approved by the Karolinska Institute Ethic Committee.

Data Analysis

The distribution of all continuous variables was tested. In order to use parametric analysis, a normal distribution with skewness and kurtosis ≤ 1 was required. Two-tailed statistical tests were used throughout, with a minimum significance level of $p < 0.05$ required. One-way and two-way ANOVA were used. Linear regression analysis was used to develop models containing non-collinear variables which best predicted a number of defined endpoints. Data analysis was made in a blinded fashion. When analysing the data, the assessor did not know if the subject belonged to the patient category or the control group. The analysis of a given test variable was performed without any reference to other test variables.

Five variables, which have shown to be frequent in PTSD—difficulties with concentration, difficulties with reading and writing, difficulties sitting without moving, often having headaches, and often having stomach aches—were assessed in both the PTSD group and the control group, using the following questions:

1. Do you generally have difficulties with concentration?	1) No	2) Yes
2. Do you generally have difficulties with reading and writing?	1) No	2) Yes
3. Do you generally have difficulties sitting without moving?	1) No	2) Yes
4. Do you often have headaches?	1) No	2) Yes
5. Do you often have stomach aches?	1) No	2) Yes

Administration and Scoring of the Tests

The tests were administered and scored using the standard published instructions. These non-verbal memory tests were administered initially beginning in 2000, and ended 2003. Candidates were screened with a medical and psychiatric interview, and physical examination.

Block design test (BDT): making colored cubes match patterns presented on card

The Block Design Test (BDT; Kohs, 1923) is a performance test, which is less a test of manual dexterity and more dependent on abstract intelligence. BDT is designed as "performance tests that have been standardized to measure intelligence. BDT has been associated with integrity of frontal lobe, posteroparietal regions, particularly those involving the right cerebral hemisphere (Chase et al., 1984). In point of fact, the test appears to require visuospatial processing in the form of translation, rotation or other transformations of visual mental images.

Raven's standard progressive matrices (RSPM)

Non-verbal assessment of general intelligence in people with average capacity on the basis of educative thinking; applicable to people aged 5 years and over. Raven's Standard Progressive Matrices (RSPM) assesses the ability to recognize a certain order in an apparent disorder, in other words: the ability to recognize and think clearly. Spearman and other psychologists showed that the educative ability (educative capacity) is one or two main components of general intelligence or the g-factor (Raven, Raven, and Court, 1998).

Details pertaining to Benton visual retention test (BVRT)

The Benton Visual Retention Test (BVRT; Benton, 1974) has a standard criterion for scoring (Benton, 1974, Small et al., 1995; Zonderman et al., 1995). The test assesses short-term visual memory for graphic designs. There were four administrations of forms C, D, and E, varying exposure time and delay between exposure and recall. In the present study Administration D was used. D provides an interval between the encoding process and the execution of the drawing. It requires the examinee to retain the percept for a brief period of time. Ten cards, each consisting of one or more simple geometric designs, were exposed for 10 seconds, then each subject drew what he saw 15 seconds after its removal. For the number error score, the number of errors is recorded, and each error is classified and recorded by type. This specific types of errors are grouped into six major categories: Omissions, Distortions, Perseverations, Rotations, Misplacements, and Size Errors.

Interrater reliability with respect to BVRT in the present study

Interscorer agreement with respect to total scores on the BVRT is very high. In a study of a large sample of normal, elderly examinees, Swan, Morrison, and Eslinger (1990) found interrater reliability coefficients of 0.98 and 0.97 for the total Number Error Score and the Number Correct Score, respectively.

In the present study, a behavioral researcher expert in the field did the analysis of the data. To assess the reliability of his scoring, four variables were chosen randomly for scoring by another investigator. Using the SPSS program, the intraclass reliability was calculated to assess agreement between these two investigators.

Details pertaining to Thurstone's Picture Memory Test

Thurstone's Picture Memory Test (TPMT) tests participants' recognition memory of 28 drawings of common items such as a truck and a table (Dureman et al., 1971). The test measures visual learning, figure logic, and one's ability to identify one figure among four that are different. Respondents are shown each picture for 5 s; their responses are not timed. Participants use a recognition paradigm to assess visual immediate and delayed memory.

RESULTS

The intraclass reliability showed significant agreement between the two investigators. Interscorer agreement with respect to total scores on the BVRT was very high ($r = 0.96$, $p = 0.0001$). To assess the reliability of scoring, four error categories were chosen randomly for scoring by another investigator: 1) Part C, number of total distortions: $r = 0.92$, $p = 0.000$; 2) Part E, number of perseverations: $r = 0.93$, $p = 0.0001$; 3) Part D, number of size errors: $r = 0.93$, $p = 0.0001$; and 4) Part D, number of rotation errors: $r = 0.95$, $p = 0.000$.

There was not any significant difference between the PTSD group and the Control group with respect to number of years of education, alcohol consumption, and medication or other drugs. The PTSD group was on average two years older than the Control group (PTSD group: $n = 31$, $M = 39.77$, $SD = 6.23$), (Control group: $n = 19$, $M = 37$, $SD = 8.97$), but this difference was not significant. There was not any significant correlation between age and the BVRT, or RSPM in the PTSD group and the Control group.

There was not any significant correlation between number of cigarettes smoked, alcohol consumption, medication and the BVRT, or RSPM in the PTSD or the Control group. There was not any significant correlation between number of years of education and the BVRT, or RSPM in the PTSD group.

In Table 1, nonverbal general intelligence tests, Raven's Standard Progressive Matrices, and Block Design Test mean correct scores for successive months with PTSD are presented. In Table 2, nonverbal short term memory tests, TPMT mean correct scores, and BVRT mean error scores for successive

TABLE 1 Nonverbal General Intelligence Tests: Raven Standard Progressive Matrices, and Block Design Test Mean Correct Scores for Successive Months with PTSD

	Raven standard							
	Progressive matrices				Block design test			
Number of months with PTSD	n	M	SD	Range	n	M	SD	Range
1–20	2	50.50	0.71	1	2	31.50	7.78	11
21–100	10	32.00	12.60	33	10	23.40	14.59	41
101–180	13	33.15	11.02	41	14	11.71	10.93	35
181–260	2	29.00	19.80	28	2	10.00	0.00	–
>260	–	–	–	–	28	17.18	13.40	41

months with PTSD are presented. In Table 3, Raven's Standard Progressive Matrices, Block Design Test, Thurstone's Picture Memory Test, mean correct scores, and the Benton Visual Retention Test mean error scores for number of life events in the PTSD group are presented.

Univariate Analysis of Variance

There were significant differences between the PTSD group and the Control group with respect to the following individual variables: Difficulties with Reading and Writing (PTSD group: $n = 30$, $M = 1.67$, $SD = 0.48$; Control group: $n = 20$, $M = 1.15$, $SD = 0.38$; $F = 18.07$, $p = 0.00$); Concentration Difficulties ($n = 30$, $M = 1.97$, $SD = 0.18$ for those with PTSD versus $n = 20$, $M = 1.10$, $SD = 0.31$ for the Controls, $F = 156.4$, $p = 0.000$); Difficulties Sitting without Moving (PTSD group: $n = 30$, $M = 1.90$, $SD = 0.31$; Control group: $n = 20$, $M = 1.06$, $SD = 0.25$; $F = 10.09$, $p = 0.00$); Often Having Headaches (PTSD group: $n = 30$, $M = 1.79$, $SD = 0.42$; Control group: $n = 20$, $M = 1.04$, $SD = 0.20$; $F = 69.08$, $p = 0.00$); Often Having Stomach Aches (PTSD group: $n = 30$, $M = 1.65$, $SD = 0.49$; Control group: $n = 20$, $M = 1.09$, $SD = 0.20$; $F = 21.85$, $p = 0.00$).

TABLE 2 Nonverbal Short Term Memory Tests: Thurstones Picture Memory Test Correct Scores, and Benton Visual Retention Test Error Scores for Successive Months with PTSD

	Thurstones picture memory				Benton visual retention			
	Test correct scores				Test error scores			
Number of months with PTSD	n	M	SD	Range	n	M	SD	Range
1–20	2	19.50	2.12	3	2	4.50	0.71	1
21–100	15	14.80	9.31	28	10	16.60	8.10	25
101–180	13	16.15	8.96	28	13	16.15	6.96	24
181–260	2	6.00	8.49	12	2	19.50	7.78	11
>260	–	–	–	–	27	15.70	7.66	26

TABLE 3 Raven Standard Progressive Matrices, Block Design Test, Thurstones Picture Memory Test, Mean Correct Scores, and Benton Visual Retention Test Mean Error Scores for Number of Life Events in the PTSD Group

Number of life events	n	M	SD	Range	n	M	SD	Range
	Nonverbal general intelligence tests							
	Raven standard progressive matrices				Block design test			
20–30	1	48.00	–	–	1	8.00	–	–
31–40	2	47.00	4.24	6	2	33.50	10.61	15
41–50	2	43.00	8.49	12	2	24.50	19.09	27
51–60	7	34.14	11.55	38	7	16.57	14.79	37
61–70	5	24.20	11.08	29	6	9.50	10.77	24
71–80	4	31.00	14.07	33	4	13.50	15.78	36
	Nonverbal short term memory tests							
	Benton visual retention test				Thurstones picture memory test			
20–30	1	10.00	–	–	1	28.00	–	–
31–40	2	8.00	4.24	6	2	23.00	2.82	4
41–50	2	13.50	6.36	9	2	12.00	8.49	12
51–60	7	13.57	10.00	25	7	13.71	7.59	24
61–70	5	23.80	4.21	11	5	20.00	5.00	13
71–80	4	13.50	7.72	18	4	11.00	8.83	21

Partial Correlations

The following partial correlations, controlling for number of years of education, alcohol consumption, and use of medication and drugs, were computed in the PTSD group ($n = 30$): There was a significant negative correlation between the Block Design Test and Duration (months with PTSD) of PTSD ($r = -0.42$, $p = 0.04$), a positive, correlation, between BVRT, Number of rotation errors, from form C and Duration of PTSD ($r = 0.42$, $p = 0.04$); a positive significant correlation between BVRT, Number of distortion errors, from form C and Duration of PTSD ($r = 0.41$, $p = 0.05$), a significant negative correlation, between Raven's Standard Progressive Matrices, sum of set A, B, C, D and Total CAPS (sum of B, C, and D symptoms)" ($r = -0.42$, $p = 0.04$); a positive significant correlation between Raven's Standard Progressive Matrices, sum of set A, B, C, D, and Thurstone's Picture Memory Test ($r = 0.44$, $p = 0.03$).

Linear Regression Models

A linear regression model, controlled for co-linearity, was performed to assess the variables which, independently of each other, would predict CAPS: Total Severity of PTSD.

GHQ: Social dysfunction, Age, and Raven Standard Progressive Matrices were incorporated in the model. GHQ: Social dysfunction, and Age were not significant, but Raven Standard Progressive Matrices, (Unstandardized B = −0.64, $t = -2.82$, $p = 0.01$) predicted CAPS: Total severity of PTSD.

Linear regression models were also performed to assess the variables which independently of each other would predict Difficulties with Reading and Writing and Often Having Stomach Aches. Age, Number of years of education, alcohol consumption, medication and drug consumption and the Benton Visual Retention Test were incorporated in the model. Age, Number of Years of Education, Alcohol Consumption, and Medication and Drug Consumption, were not significant predictors of Difficulties with Reading and Writing, but the Benton Visual Retention Test, number of error scores (Unstandardized B = 0,03, $t = 2,79$, $p = 0.01$) predicted Difficulties with Reading and Writing in the PTSD group (Figure 2).

Often Having Stomach Aches. Age, Alcohol Consumption, Medication and Drugs Consumption, and Often Having Headaches were incorporated in the model. Age, Alcohol Consumption, and Medication and Drugs Consumption, were not significant predictors of Often Having Stomach Aches, but Often Having Headaches (Unstandardized B = 0,52, $t = 2,41$, $p = 0.02$) predicted Often having Stomach Aches in the PTSD group.

DISCUSSION

There was no significant difference between the PTSD group and the Control group with regard to alcohol consumption, medication or other drugs, and number of years of education. The participants in the PTSD group as well as those in the Control group had been settled recently in Sweden, and many in the Control group were waiting for permission to stay. The present study is the first to use a relatively large sample of PTSD patients and controls with very low alcohol and drug consumption and with the same ethnic background, using culture-neutral, nonverbal cognitive tests.

PTSD is diagnosed to be acute (i.e., comes on quickly, severe symptoms normally for a short period, but not chronic) if the duration of the symptoms is less than three months and chronic (long or drawn out) and the duration of symptoms is three months or more. PTSD is diagnosed as delayed onset if the onset of symptoms is at least six months after the traumatic event. Symptoms of PTSD can take months or sometimes years to manifest themselves. In Table 1, nonverbal general intelligence tests, Raven's Standard Progressive Matrices, and Block Design Test mean correct scores for successive months with PTSD are presented. Those with the longest duration of PTSD showed the lowest scores in the RSPM. With regard to the Block Design Test, the same category of patients, with the same number of months with the disease, showed the lowest scores in this intelligence test. There was also a

significant negative correlation between the duration of PTSD and the Block Design Test.

In Table 2, nonverbal short-term memory tests TPMT mean correct scores and BVRT mean error scores for successive months with PTSD are presented. Those with the longest duration of PTSD showed the lowest scores in the TPMT, and those with the highest error scores in the BVRT had the longest duration of PTSD. There was also a positive correlation between the duration of PTSD and the BVRT. This shows that memory for facts and events accessible to conscious recollection, as well as memory for things that one can recall and declare, was impaired in the PTSD group. The duration of PTSD has a direct relationship with general intelligence and short term memory in these patients.

A growing body of data from a small group of human patients with discrete lesions in the amygdala highlight the importance of this brain region for the production of negative affect with regard to long duration of PTSD (Davidson and Irwin, 1999). The amygdala is also involved in the formation of enhanced declarative memory for emotionally arousing events (Cahill, Weinberger, Roozendaal, and McGaugh, 1999) but not for emotionally neutral stimuli (Hamann and Adolphs, 1999). Interestingly, stress hormones, among others, interact with the amygdala complex during periods of emotional arousal to modulate memory storage processes occurring in other brain regions (Cahill and McGaugh, 1998).

In Table 3, nonverbal general intelligence tests, RSPM, and BDT mean correct scores for number of life events are presented. Those with the highest frequency of life events showed the lowest scores in the RSPM and the BDT. There was also a negative correlation between RSPM and the total CAPS (Figure 1). RSPM predicted also the total CAPS in the patients. Table 3 shows also the short-term memory tests, TPMT and BVRT, for number of life events in the PTSD group. Those with the highest frequency of life events showed the lowest scores in the TPMT, and those with the highest error scores in the BVRT showed the highest frequency of life events.

Alterations in memory form an important part of the clinical presentation of patients with PTSD. PTSD patients report deficits in declarative memory (remembering facts or lists, as reviewed below), fragmentation of memories (both autobiographical and trauma-related) and dissociative amnesia (gaps in memory that can occur for minutes to days and are not due to ordinary forgetting). On the basis of clinical reports and the tentative results of Everly and Horton (1989), Gil, Calev, Greenberg, Kugelmass, and Lerer (1990) hypothesised that there are memory deficits in PTSD patients. In their study, PTSD patients were male combat veterans and victims of terrorism or vehicle accidents who had abused alcohol or other substances, yet had been drug-free for at least two weeks. Before a traumatic experience, PTSD patients had a similar IQ to that of controls, but their IQ deteriorated more quickly than in Control subjects after a traumatic experience. As often noted in

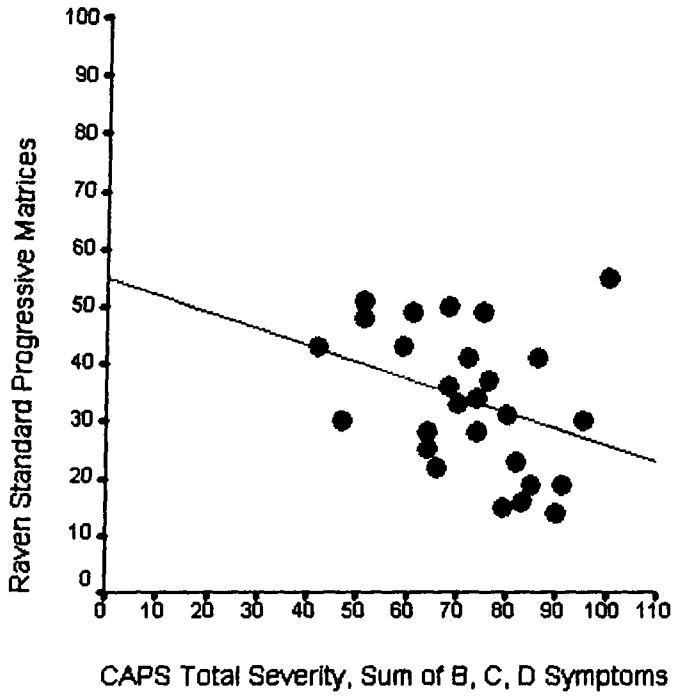

FIGURE 1

clinical reports, PTSD patients reported subjective awareness of more difficulties with attention and memory than did Controls.

Lonigan and colleagues (Lonigan, Shannon, Finch, Daugherty, and Taylor, 1991; cited in Almqvist and Brandell-Forsberg, 1997), and Pynoos, Steinberg and Wraith (1995) in their investigations have also shown a correlation between the amount of traumatic exposure and PTSD prevalence. The association between severity of exposure in terms of number and proximity of experienced events and the presence of PTSD has been supported in different cultures including Bosnian (Papageorgiou et al., 2000); Vietnamese (Mollica et al., 1997); Cambodian (Sack, Clarke and Seeley, 1996); and Palestinian (Garbarino & Kostelny, 1996).

The literature with regard to diminished volume of hippocampus in PTSD comes from combat veterans (Bremner et al., 1995; Gurvits et al., 1996) and from individuals with a history of childhood abuse (Stein, Koverola, Hanna, Torchia, and McClarty, 1995). These are not traumas of brief duration, but of months to years. As the most explicit example of this, in one study (Gurvits et al., 1996) the extent of atrophy was predicted by the severity of the combat exposure, a measure reflecting repeated trauma (with questions such as "How often were you in danger of being injured or killed in the line of duty?"; Keane et al., 1989). All stressors and all stimuli of glucocorticoid secretion are not the same, and duration of stress is certainly relevant.

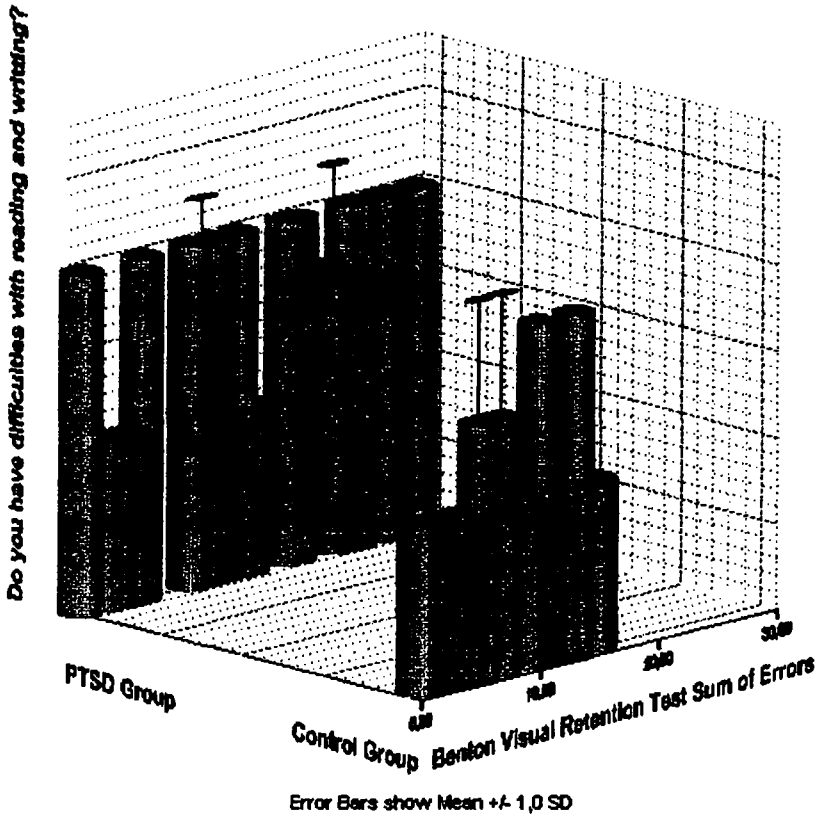

FIGURE 2

In a study by Gilbertson et al. (2002), disorder severity in PTSD patients who were exposed to trauma was negatively correlated with the hippocampal volume of the patients. Animal research has provided compelling evidence that exposure to severe and chronic stress can damage the hippocampal formation (McEwen, 1995; Sapolsky, Uno, Rebert, and Finch, 1990) a region best known for its role in declarative memory (Squire, 1992; Zola-Morgan and Squire, 1993). Such studies point to a neurotoxic role for corticosteroids, elevated levels of which cause atrophy and/or cell death in hippocampal neurons.

This has led to the proposal that a similar process may occur in humans, and thereby mediate specific stress-related disease processes. Of particular relevance is PTSD that arises in some individuals who experience severe psychological trauma such as combat, sexual abuse, or natural disaster. Indeed, several structural magnetic resonance imaging (MRI) studies report smaller hippocampal volume in patients diagnosed with chronic forms of PTSD (Bremner et al., 1995; Bremner et al., 1997; Gurvits et al., 1996; Stein, Koverola, Hanna, Torchia, and McClarty, 1997).

However, the results of the present study together with the results of previous studies with regard to the decreased hippocampus volume (Emdad et al., 2003, submitted for publication), and lack of blood pressure recovery to the MRI exposure (Emdad, Söndergaard, Agartz, and Theorell, 2004), might be a sign of impaired central coherence in these patients compared to the control group.

In Table 3, nonverbal short-term memory test, TPMT mean correct scores, and BVRT, mean error scores for number of life events are presented. The experience of trauma is common to all mankind. The degree of PTSD that develops is proportional to the severity and duration of the perceived trauma. One controversy noted throughout the literature relating to PTSD in refugees is whether it is the totality of exposure to war-related stress that affects short-term memory, or whether in fact trauma responses are related to the nature, type, amount, or duration of exposure to stress experienced (see Athey and Ahearn, 1991; Jensen and Shaw, 1993). Reviews of such studies indicate evidence for the suggestion that the more severe the nature and extent of exposure, the poorer one's psychological outcome in terms of onset and severity of PTSD symptoms (Papageorgiou et al., 2000). Extending their diagnostic approach to trauma symptomology, Almqvist and Brandell-Forsberg (1997) also investigated whether the amount of trauma exposure is related to the prevalence and stability of PTSD over time.

Macksoud and Aber (1996) examined the relationship between the number and type of war traumas and psychosocial development among 224 Lebanese children aged 10–16. Using measures of war exposure, war trauma, mental health, PTSD, and adaptation, these investigators assessed ten categories of war exposure. As predicted, the number and type of traumatic exposure were positively related to PTSD symptoms. Those who were bereaved, victimized by or had witnessed violent acts, showed more PTSD symptoms than those who had not witnessed such acts.

In the present study, there were significant differences between the PTSD group and the Control group with respect to Often Having Headaches, Difficulties with Reading and Writing, Often Having Stomach Aches, Difficulties with Concentration, Difficulties Sitting without Moving, and Difficulties with Reading and Writing. PTSD can cause those who suffer with it to act as if they are still being threatened by the trauma that caused their illness. People with PTSD may become irritable; they may have trouble concentrating or remembering current information, and may develop insomnia. Because of their chronic hyper-arousal, many people with PTSD have poor work records, trouble with their bosses, and poor relationships with their family and friends. The persistence of a biological alarm reaction is expressed in Difficulties Sitting without Moving.

War veterans may revert to their war behavior, diving for cover when they hear a car backfire or a string of firecrackers exploding. At times,

those with PTSD suffer panic attacks, whose symptoms include extreme fear resembling that which they felt during the trauma. They may feel sweaty, have trouble breathing, and may notice their heart rate increasing. They may feel dizzy or nauseated. Many traumatized adults have physical symptoms, such as stomach aches and headaches, in addition to symptoms of increased arousal.

Other bodily systems that have been shown to be associated with PTSD include the gastrointestinal and musculoskeletal systems. Studies using self-report and physician diagnosis have found PTSD related to illness in these systems, but neither has been as extensively researched in relation to PTSD as the cardiovascular system. Additional research is needed to learn more about these and other bodily systems that may be related to PTSD.

The results showed that Difficulties with Reading and Writing predicted poor performance on the BVRT, and a poor RSPM score predicted Difficulties Sitting without Moving in the PTSD group. Learning disabilities have to do with specific impairments in the processes of learning new material or utilizing previously learned material. The categories are not simple and it can be difficult to test directly for a specific ability because usually a combination of abilities is utilized for any one task in PTSD.

Crisis reactions can be "triggered" by certain events. Most PTSD victims find that their symptoms gradually diminish and disappear, though certain situations, sights, sounds, and/or smells may spark a memory or flashback of the event. During a flashback, the survivor may experience intense feelings of fear, or a panic attack, in which the heart races, the throat tightens, or the person becomes physically ill. The results show that "Often having headaches" predicted, "often having stomach aches" in the PTSD group. Triggers of somatic symptoms may be internal or external, are different for different victims.

People with PTSD will avoid things or situations that trigger memories or flashbacks of the traumatic event. If untreated, the victim's life may become dominated by attempts to avoid situations that remind him or her of the event. "Difficulties to sit without moving" is one official criterion for acute stress disorder. It belongs to a group of significant symptoms of anxiety or arousal (e.g., difficulty sleeping, feeling irritable, poor concentration, hypervigilance, being easily startled, feeling restless or unable to sit without moving). Physiological, neuroimaging, and neuropsychological research have led to significant advances in knowledge of the neurobiological correlates of posttraumatic stress disorder (PTSD) that collectively point to dysfunction of frontal limbic neural circuits (see Bremner, Southwick, and Charney, 1999; Friedman, Charney, and Deutch, 1995; Pitman, Shalev, and Orr, 2000, for reviews). Many PTSD patients cannot selectively attend to some stimuli—they attend to everything in the environment. This results in a tendency to wander all over the room, they cannot sit without moving.

Gray, Chabris, and Braver (2003) used an individual-differences approach to test whether general fluid intelligence (gF) is mediated by brain

regions that support attentional (executive) control, including subregions of the prefrontal cortex. Forty-eight participants first completed a standard measure of gF (Raven's Advanced Progressive Matrices; Raven et al., 1998). Participants then performed verbal and nonverbal versions of a challenging working-memory task (three-back) while their brain activity was measured using functional magnetic resonance imaging (fMRI). Multiple regression analyses indicated that lateral prefrontal and parietal regions may mediate the relation between ability (gF) and performance (accuracy despite interference), providing constraints on the neural mechanisms that support gF.

The BVRT has shown sensitivity to the presence of abnormalities in the brain of PTSD patients; future research may find sensitivity to diverse therapeutic methods and to the effects of various psychoactive medications as well. Finally, broader longitudinal application of these tests in normal patients, compared to PTSD patients, might contribute to our understanding of specific aspects of cognitive function in PTSD. More research is needed for the determination of causes of short-term memory impairment in PTSD patients and its association with measures of educative ability.

CONCLUSION

The results of the present study show that the PTSD patients have learning difficulties and cognitive problems in proportion to the duration and severity of perceived trauma. The results show that trauma exposure and PTSD are linked to adverse health outcomes, dysfunctions in general intelligence, and short term memory. It was also argued that a significant amount of the associations between general intelligence and memory are due to the presence, severity, and duration of PTSD. Some of the cognitive and psychological abnormalities associated with the duration and severity of PTSD were listed. These may explain how PTSD promotes adverse learning outcomes.

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