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The Impact of Captivity and Posttraumatic Stress Disorder on Cognitive Performance Among Former Prisoners of War: A Longitudinal Study

Roy Aloni, MA[a,*]; Laura Crompton, MSW[a]; Yafit Levin, MA[a]; and Zahava Solomon, PhD[a]

ABSTRACT

Objective: War captivity is a potent pathogen for various aspects of mental health, including cognitive impairments. However, little is known about the long-term impact of war captivity and posttraumatic stress disorder (PTSD) on cognitive functioning among former prisoners of war (ex-POWs). This study assesses the effect of captivity, PTSD trajectories, and the accumulating differential effect in the prediction of cognitive performance.

Methods: This longitudinal research includes 4 assessments (1991 [T1], 2003 [T2], 2008 [T3], 2015 [T4]) of Israeli ex-POWs and comparable combatants from the 1973 Yom Kippur War. Accordingly, 95 ex-POWs and 26 comparable combatants were included in this study. PTSD was assessed according to the *DSM-IV,* and cognitive performance was assessed using the Montreal Cognitive Assessment (MoCA).

Results: Ex-POWs reported higher levels of PTSD symptoms compared to controls ($P = 0.007$). No difference was found between the groups regarding MoCA total score. Ex-POWs with chronic PTSD were found to have more difficulty in overall cognitive functioning, compared to ex-POWs with delayed, recovery, and resilient trajectories ($P = 0.03$). Finally, physical and psychological suffering in captivity and intrusion symptoms predicted cognitive performance ($P < .001$, $R^2 = 37.9\%$). These findings support the potent pathogenic effects of war captivity on cognitive abilities, more than 4 decades after the end of the traumatic event.

Conclusions: Our results showed captivity to be a unique and powerful traumatic experience, leading to PTSD and long-lasting and enduring neuropsychological implications. These findings highlight the importance of viewing ex-POWs, in particular those suffering from chronic PTSD, especially as they age, as a high-risk population for cognitive disorders. This requires the appropriate diagnosis and cognitive therapy as a way to preserve cognitive abilities among this population.

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War captivity is one of the most severe human inflicted traumas to which an individual can be subjected. Prisoners of war (POWs) endure deliberate cruelty through physical and psychological torture, isolation, systematic humiliation, starvation, and psychological tactics aimed at breaking and altering their psyche.[1,2] Suffering during captivity is implicated in psychological distress, often evident in former captives' psychopathology after release.[3] Hence, ex-POWs may experience long-term mental health disorders, particularly posttraumatic stress disorder (PTSD)[4,5] and profound personality changes,[6] as well as higher rates of mortality and deteriorated physical health.[7–9]

Another possible negative impact of captivity is cognitive impairment,[10,11] which may be influenced by various experiences during captivity. Previous studies have inconsistent findings regarding cognitive impairments among ex-POWs. On the one hand, ex-POWs have been found to perform significantly worse than controls,[10,12] which was explained by weight loss during captivity.[13,14] On the other hand, another study refuted this explanation when it found no difference in cognitive function due to weight loss[15] and conversely found better cognitive performance among ex-POWs compared to controls.[11]

One explanation for the inconsistent findings may be that it is not the trauma itself, but rather the resulting PTSD, that has an impact on an individual's cognitive abilities.[16,17] Following trauma, PTSD is known to be the most common mental health outcome and is characterized by the specific symptom clusters of intrusion, avoidance, alterations in cognitions and mood, and arousal and reactivity.[18] Hence, it is unsurprising that PTSD is the most prominent sequela among ex-POWs[4,19] and perhaps the most significant factor affecting cognitive impairment beyond the experience of captivity.

In addition, the literature suggests that PTSD is a significant risk factor for cognitive deficits. A meta-analysis found that PTSD had a large effect on neurocognition among combat veterans, reflected in multiple aspects of cognitive impairments.[20] Despite this, there are 2 important gaps in the literature. First and foremost, there is a lack of understanding regarding the influence of PTSD patterns over time[21–24] and the possible relation to cognitive functioning. Of the 4 common PTSD trajectories identified in traumatic populations (ie, chronic, delayed, recovered, and resilient[4,25]), generally, the broadest pattern of pathology has been found to be the chronic trajectory, which, in turn, has been related to cognitive deficits.[26,27] In long-term assessment among Israeli ex-POWs, delayed PTSD has been reported to be the most prominent trajectory, with suffering in captivity

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Clinical Points

- War captivity is a potent pathogen for cognitive impairments, even decades after the trauma. However, the impact of trajectories of posttraumatic stress disorder (PTSD) on cognitive performance has not been investigated.
- Appropriate diagnosis and cognitive therapy are necessary when treating former prisoners of war (POWs), especially when chronic PTSD is present, as these measures have far-reaching implications for preventing decline and preserving ex-POWs' cognitive capacities.

as the variable that best distinguished the resilient group from the PTSD groups.[4] Hence, there is a need to further explore the cognitive deficits among ex-POWs alongside PTSD trajectories over time to better understand the possible interactions and clinical implications, particularly as veterans age.[28]

The second gap refers to the fact that although specific cluster symptoms relate to cognitive performance,[29] studies among veterans have referred to PTSD only as a monolithic diagnosis.[28,30] Therefore, the effects of each symptom cluster on its own are, as of yet, not fully understood despite the possible influence. For example, intrusion symptoms, as reflected in the inability to inhibit the traumatic recollections, weaken cognitive performance due to the incapacity to prevent irrelevant stimuli.[31] In addition, hyperarousal symptoms, as reflected in irritability, constant anxiety, and difficulties concentrating, could influence attention abilities.[32] Such evidence raises questions as to what contribution PTSD symptom clusters may have when examined individually.

To the best of our knowledge, only 2 studies have examined PTSD and cognitive impairments among ex-POWs; however, neither individual PTSD symptom clusters nor trajectories were included. The first study, which included 25 ex-POWs,[33] found general cognitive functioning to be significantly higher in ex-POWs who did not develop PTSD. The second, a longitudinal study with a larger sample of ex-POWs, suggested that the risk for a cognitive disorder, namely dementia, was more than double in older veterans who survived captivity and had PTSD compared to veterans who were without PTSD and were not held in captivity.[34] Although these findings have suggested that captivity and PTSD may be implicated in cognitive functioning, there are still many unanswered questions. Limitations of previous studies such as sample size, lack of a control group, PTSD as a monolithic diagnosis, and, in particular, the absence of the long-term impact of PTSD limit the possibility of making definitive conclusions regarding the impact of PTSD trajectories and symptom clusters on cognitive status. Furthermore, the differential effect of captivity and PTSD clusters on cognitive performance remains unclear.

We attempted to fill these gaps in the literature by conducting a longitudinal prospective study in order to (1) compare cognitive performance among ex-POWs and controls, (2) compare ex-POWs' PTSD trajectories in relation to cognitive performance, and (3) assess the cumulative effect of captivity trauma and PTSD symptoms in predicting cognitive performance.

METHODS

Participants and Procedure

Before participating in the study, participants received an explanation of the study and then signed an informed consent form. This study was approved by the institutional ethics committee of the Sourasky Medical Centre (Tel Aviv, Israel) for human use according to the Declaration of Helsinki.

The present study is part of a prospective longitudinal study[4] on the implications of war and captivity with assessments at 4 time points: 1991 (T1), 2003 (T2), 2008 (T3), and 2015 (T4). Two groups, both of whom participated in the 1973 Yom Kippur War, were a part of this study: ex-POWs and control veterans (Figure 1).

No significant differences were found between ex-POWs (mean = 63.6 [SD = 3.6] years) and controls (mean = 63.4 [SD = 3.5] years) in age ($t_{119} = -0.23$, $P = .83$) or education ($t_{119} = 1.37$, $P = .17$) (ex-POWs: mean = 13.7 [SD = 3.9] years and controls: mean = 14.8 [SD = 3.2] years).

Measures

PTSD Inventory (PTSD-I)[35] is a well-validated Hebrew self-report questionnaire tapping the 17 PTSD symptoms listed in *DSM-IV*.[36] The participants were asked to rate their experiences about combat or captivity (eg, "When I see or hear things that recall my combat/captivity, I have more severe sleep disturbances or oversensitivity to noise") via a 4-point Likert scale from (1) *least* to (4) *greatest*. The PTSD-I has strong reliability and convergent validity when compared with diagnoses based on structured clinical interviews.[35] This screening tool had high internal consistency at T1, T2, T3, and T4 ($\alpha = 0.95$, $\alpha = 0.92$, $\alpha = 0.93$, $\alpha = 0.90$, respectively). Participants were identified as having PTSD if they endorsed at least 1 intrusive symptom, 3 avoidant symptoms, and 2 hyperarousal symptoms, in accordance with the *DSM-IV* criteria.[36] In addition, we assessed the mean number of PTSD symptoms as well as the mean number of symptoms in each cluster. The criteria of the *DSM-IV* were used as they were the standard during the initial measurements of this study and maintained for consistency.

PTSD trajectories were based on *DSM-IV* criteria according to reports from the 4 waves of assessment, as follows: *chronic PTSD*—individuals who endorsed PTSD at all 4 measurements; *delayed PTSD*—individuals who did not report PTSD in the first assessment, but did suffer from the disorder at the second and/or the third and/or the fourth measurement; *recovery*—individuals who reported PTSD in the first or second or third measurement, but not at the fourth measurement; and *resilient*—individuals who did not report PTSD at any of the 4 measurements.

The Montreal Cognitive Assessment (MoCA)[37] is a cognitive screening test, widely used in clinical and

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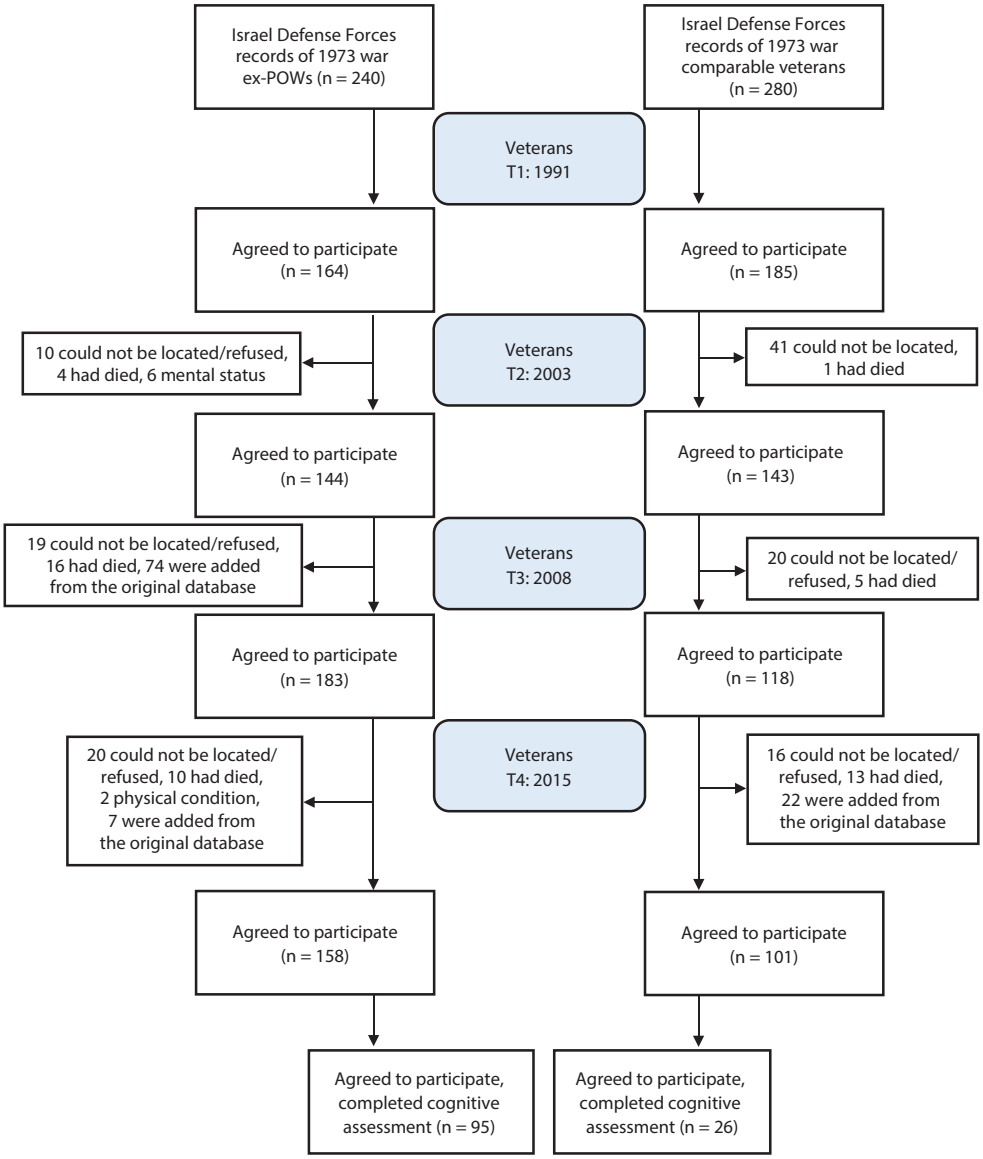
Figure 1. Study Flow Diagram



Abbreviation: ex-POWs = former prisoners of war.

experimental settings with a variety of disorders. It evaluates 7 cognitive subscales: executive functions, naming, attention, language, abstraction, delayed memory, and orientation. Potential scores range from 0–30, with a higher score meaning better cognitive performance. The MoCA was administrated at T4. For the purpose of the current study, we used the MoCA total score as a continuous variable. The current Hebrew version[38] (www.mocatest.org) has a high sensitivity of 94.6% and specificity of 76.3% for identifying mild cognitive impairment compared to the Mini-Mental State Examination, which is another common cognitive screening tool.[38]

Suffering in captivity assessment was administered at T1 and composed specifically for the purpose of this study.[3] It consists of 4 components: weight loss in captivity, severity of physical abuse, severity of mental abuse, and severity of humiliation. Each of the 4 questions is rated on a scale from 1 (*very low suffering*) to 5 (*very high suffering*). Cronbach α for the total score was 0.73.

Data Analysis

To examine the long-term ramifications of war captivity on PTSD and cognitive performance, we conducted 2 analyses. First, we compared the number of PTSD symptoms endorsed by ex-POWs and controls by conducting a multivariate analysis of covariance (MANCOVA). Then, an analysis of covariance (ANCOVA) was conducted for the MoCA total score. Both analyses were conducted with education and age as covariant factors.

To examine the effect of the longitudinal trajectories of PTSD on cognitive performance, first, we computed the prevalence of these trajectories among ex-POWs. Next,

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Table 1. Comparing Ex-POWs and Controls in MoCA and PTSD in T4

	Ex-POWs (n = 95), Mean (SD)	Controls (n = 26), Mean (SD)	F^a	P	η^2
PTSD total	9.4 (4.4)	4.8 (4.7)	11.6***	.000	.10
Intrusion	2.8 (1.9)	1.8 (1.5)	5.7***	.000	.05
Avoidance	3.4 (2.1)	1.9 (1.8)	11.7***	.000	.10
Hyperarousal	3.2 (1.7)	2.0 (1.4)	8.8***	.000	.07
MoCA total score	24.07 (3.8)	24.5 (2.9)	0.57	.99	.00

[a]For PTSD scores, $df = 1,120$; for MoCA score, $df = 1,119$.
***$P < .001$.
Abbreviations: ex-POWs = former prisoners of war, MoCA = Montreal Cognitive Assessment, PTSD = posttraumatic stress disorder.

to examine the effect of PTSD trajectories on cognitive impairment, we conducted a MANCOVA (with age and education as covariates), with PTSD trajectories as the independent factor and MoCA total score and its subscales as the dependent variables.

Finally, we conducted a hierarchical regression analysis with 3 steps to predict the MoCA total score. In the first step, we entered participants' age and education (as measured in T4). In the second step, we entered the captivity characteristics of weight loss, physical suffering, psychological suffering, and humiliation (as measured in T1). In the last step, we entered the subscales of PTSD: intrusion, avoidance, and hyperarousal (as measured in T4).

RESULTS

Cognitive Impairment in Ex-POWs Compared to Controls

We found significant differences between the groups with respect to the simultaneous factor of PTSD ($F_{3,117} = 4.2$, $P = .007$, partial $\eta^2 = 1$). Separate examination of each dependent variable showed that ex-POWs reported higher total PTSD as well as intrusion, avoidance, and hyperarousal symptoms.

Analysis of the MoCA total score showed no significant effect ($F_{1,70} = 1.94$, $P = .37$). Age yielded no significant effect ($F_{1,70} = 1.42$, $P = .24$), while education significantly contributed to the MoCA total score ($F_{1,70} = 11.23$, $P = .001$). Since the total score was not different between the groups, we did not analyze the subscales. See Table 1.

PTSD Trajectories and Cognitive Outcomes

Regarding the prevalence of longitudinal PTSD trajectories, 48% of the ex-POWs were classified as having "delayed PTSD," which was found to be the most common trajectory. Nine percent were classified with "chronic PTSD," 23% as recovered, and 20% had no PTSD at any of the measurements (Table 2).

Regarding the covariance variables, education was significantly related to the simultaneous factor of MoCA ($F_{7,81} = 3.11$, $P = .006$, partial $\eta^2 = .21$). Age was not related to the MoCA scores. The simultaneous factor of MoCA differentiated significantly across groups ($F_{7,83} = 2.37$, $P = .02$, partial $\eta^2 = .17$).

Assessment of each of the dependent variables revealed differences across the groups in the MoCA total score, executive functions, and delayed memory (Table 2). Post hoc analyses revealed that the "chronic PTSD" group scored lower on the MoCA total score, compared to the other 3 groups. Post hoc analysis revealed that those with a "chronic PTSD" trajectory scored lower on the delayed memory subscale compared to the "delayed PTSD" trajectory group and that the "chronic PTSD" group scored lower on executive functions than the resilient group. No other differences were found.

Prediction of Cognitive Impairment in Ex-POWs

The regression analysis yielded a significant model ($F_{9,85} = 7.37$, $P < .001$, $R^2 = 37.9\%$). There was a significant effect for education, but not for chronological age (Table 3), meaning that more education contributed to a higher MoCA total score. As for captivity characteristics, physical and psychological suffering contributed significantly to the MoCA total score, but weight loss and humiliation did not. In other words, the higher the physical and psychological suffering in captivity, the lower the MoCA total score. The third step (adding the PTSD subscales) yielded no significant change to the model; however, the intrusion subscales contributed significantly to the MoCA total score. Higher intrusion contributed significantly to predicting a lower MoCA total score.

DISCUSSION

The current longitudinal study examined the impact of war captivity and PTSD on the cognitive performance of ex-POWs and comparable controls. First, we found that ex-POWs suffered from more PTSD symptoms than controls. No differences were found between the groups regarding cognitive performance. Second, ex-POWs with chronic PTSD were found to have more difficulty in overall cognitive functioning compared to ex-POWs with delayed, recovery, and resilient PTSD trajectories. Finally, education, physical and psychological suffering in captivity, and intrusion symptoms predicted cognitive performance. These findings further support the potent pathogenic effects of war captivity, more than 4 decades after the end of the traumatic event, in particular regarding cognitive abilities.[10,33]

Ex-POWs were found to suffer from more PTSD symptoms than controls. Although the number of symptoms was not high in comparison to other ex-POW populations,[1] this may be attributed to the shorter duration and lesser severity of the Israeli soldiers' captivity. In addition, the total MoCA score was not different between the groups. This is consistent with 1 previous study,[15] but not consistent with other findings that documented cognitive impairments among ex-POWs.[13,14] There are several possible explanations for this finding. First, as mentioned, the different conditions of captivity can lead to different results. For example, previous studies have pointed to weight loss as the cause for cognitive differences between ex-POWs and controls[13,14]; however, this variable

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Table 2. Comparing PTSD Trajectories Among Ex-POWs in MoCA Total Score and Subscales at T4[a]

	Resilient (n = 19), Mean (SD)	Recovered (n = 21), Mean (SD)	Delayed (n = 45), Mean (SD)	Chronic (n = 8), Mean (SD)	$F_{3,87}$	*P*	η^2
PTSD symptoms	1.7 (2.07)	4.3 (3.08)	12.6 (2.5)	11.7 (5.8)			
MoCA							
Total score	24.6 (2.9)	24.2 (3.5)	24.5 (3.4)	20.6 (5.1)	3.02*	.03	.10
Executive function	4.2 (0.98)	3.8 (1.1)	3.6 (1.2)	2.0 (1.0)	3.12*	.02	.10
Naming	3.0 (0.0)	2.9 (0.4)	2.9 (0.38)	3.0 (0.0)	0.31	.84	.01
Attention	5.2 (1.2)	5.1 (1.2)	5.2 (1.4)	4.1 (1.7)	1.73	.11	.06
Language	2.2 (0.98)	1.8 (1.0)	1.8 (1.1)	1.2 (1.3)	0.76	.62	.02
Abstraction	1.8 (0.5)	1.9 (0.3)	1.6 (1.0)	1.2 (0.89)	1.72	.27	.06
Delayed memory	2.8 (1.7)	2.2 (1.5)	3.1 (1.7)	1.6 (1.8)	2.45*	.04	.08
Orientation	5.9 (0.2)	5.9 (0.3)	5.9 (0.5)	5.7 (0.71)	0.32	.75	.01

[a]Two subjects were excluded from the analysis because they did not participate in all 4 measurements.
*$P < .05$.
Abbreviations: ex-POWs = former prisoners of war, MoCA = Montreal Cognitive Assessment, PTSD = posttraumatic stress disorder.

Table 3. Standardized and Unstandardized Coefficients for Predicting MoCA Total Score as a Function of Captivity Characteristics and PTSD Clusters, Controlling for Age and Years of Education

	b	SE (*b*)	β	*t*	*P*	*F* Change	R^2 Change	*P*
Model 1						12.06***	21%	.00
Age	−0.12	.08	−0.11	−0.13	.26			
Education	0.43***	.08	0.45	5.52	.00			
Model 2						7.03***	19%	.00
Age	−0.17*	.08	−0.17	−2.08	.04			
Education	0.33***	.07	0.35	4.47	.00			
Weight loss	−0.00	.01	−0.02	−0.21	.84			
Physical suffering	−1.01***	.31	−0.26	−3.38	.00			
Psychological suffering	−1.21***	.36	−0.29	−3.33	.00			
Humiliation	0.07	.49	0.01	0.15	.88			
Model 3						1.96	4%	.29
Age	−0.06	.11	−0.06	−0.57	.57			
Education	0.26***	.08	0.28	3.07	.00			
Weight loss	0.00	.01	0.03	0.36	.72			
Physical suffering	−1.07***	.32	−0.28	−3.39	.00			
Psychological suffering	−1.14***	.41	−0.28	−2.88	.00			
Humiliation	0.27	.55	0.05	0.49	.62			
Intrusion	−0.54*	.25	−0.29	−2.18	.03			
Avoidance	0.20	.22	0.11	1.01	.32			
Hyperarousal	0.19	.26	0.10	0.74	.47			

*$P < .05$.
***$P < .001$.
Abbreviations: MoCA = Montreal Cognitive Assessment, PTSD = posttraumatic stress disorder.

may not be consistent across studies. Second, MoCA is a cognitive screening tool and may not be sensitive enough to detect milder impairments due to "ceiling effect." When we conducted a separate analysis of the MoCA subscales, we found that ex-POWs performed worse than controls in attention. Perhaps more sensitive neuropsychological tests might have allowed for the discovery of further differences between the groups. Finally, the relatively low number of participants in the control group may have influenced the possibility to find significant differences.

Ex-POWs with chronic PTSD were found to have overall lower cognitive functions, compared to ex-POWs with delayed, recovery, and resilient trajectories. Our findings are in line with previous studies and further the understanding that those individuals with a chronic PTSD trajectory are the most vulnerable to cognitive impairments.[26,27] This may be explained by the effects of the chronicity of PTSD, which has been found to be a prominent predictor of cognitive disability in late life.[20] A PTSD diagnosis includes significant functional impairment.[18] In our sample, ex-POWs with chronic PTSD had fewer social interactions and less employment.[4] Limited participation in social and occupational activities can lead to the "disuse" of cognitive abilities.[39] For those with chronic PTSD, this may occur earlier than for others. It has been suggested that disuse of cognitive abilities is associated with low cognitive performance and that this relationship may become stronger with age.[40]

Another possible explanation lies in biological changes, as suggested by the allostatic load model.[41] This model refers to the physical reactions activated during stressful situations. Hence, chronic PTSD has been found to be related to a unique set of biological alterations[42] as a result

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of the continuous activation of stress symptoms. In such circumstances, the effects of allostatic load are cumulative and evident during the process of aging. This leads to an increased risk for various physical declines, including cognitive impairments.[43] Alternatively, brain abnormalities, such as neural mechanisms and brain structures, associated with chronic PTSD have also been known to impact cognitive abilities.[44,45]

Finally, our findings indicated 4 significant factors that predicted cognitive performance: education, physical and psychological suffering in captivity, and intrusion symptoms. Ex-POWs with worse cognitive performance were less educated, experienced higher physical and psychological suffering during captivity, and were characterized by higher levels of intrusion symptoms.

In relation to education, it has been widely reported that worse cognitive performance has been found among those with lower education levels.[46,47] It may be assumed that more educated ex-POWs are working in professions requiring higher cognitive skills. Furthermore, the daily need to engage in high cognitive functioning may serve as an important influence in life-long cognitive performance. However, the opposite effect may have occurred, such that the experience of captivity impacted the ability of ex-POWs to continue their education, due to the trauma.

Moreover, ex-POWs who reported high subjective suffering from physical and mental abuse during captivity performed worse on cognitive testing. Subjective suffering during captivity may be defined in 2 possible ways. First, it may indicate the intensity of the physical and psychological conditions experienced during captivity. Although there is no objective measure for suffering in captivity, self-reports may denote the conditions that the POWs endured.[48] POWs often experience physical torture,[1,2] which has been known to lead to neurologic sequelae, including inter alia cognitive impairments.[49] This highlights that the harsher the conditions of captivity, the more significant the long-term consequences not only in psychological distress, but also in cognitive functioning. Moreover, ex-POWs have been reported to suffer from chronic stress due to the compounded trauma of both combat and captivity.[50] In general, chronic stress has consistently been found to be associated with poorer cognitive functioning[51,52] and accelerated cognitive decline.[53] Specifically, Meziab and colleagues[34] have suggested that extreme stress among ex-POWs can cause changes in the activity of cortisol, which is implicated in cognitive impairments.

Alternatively, subjective suffering may reflect a personal appraisal of trauma, with higher levels of perceived stress being related to lower cognitive functioning and accelerated cognitive decline. Although previous studies have suggested that cognitive impairments are associated with trauma-induced weight loss,[13,14] our study did not support this finding. Furthermore, our interviewees were in captivity from 6 weeks to 8 months, shorter than other ex-POWs who have been studied from World War II, Korean Conflict, and the Vietnam War, some of whom were held for a number of years.[9] Therefore, it may be difficult to compare the conditions of captivity due to the differences in duration and environmental circumstances.

Although our finding that intrusion symptoms were related to cognitive performance should be taken with caution, it suggests a possible influence regarding the tendency to relive and ruminate over previous stressful events on cognitive performance. It seems that those with PTSD may be unable to inhibit intrusive traumatic recollections, which may weaken cognitive performance, as can be expressed for example by slow information processing.[31]

This study has several limitations. First, the use of self-report measures, although common in trauma studies, entails a risk of a reporting bias. Second, the lack of precombat cognitive ability assessments and the cognitive assessment at only 1 time point strongly limit our ability to consider earlier conditions that may have influenced current performance. Third, the MoCA assessment may be insensitive to milder levels of impairments. Future studies should consider the administration of more sensitive neuropsychological tasks, such as computerized tests that include objective measures. Moreover, it is important to assess the validity of responses in future research examining cognitive functioning in individuals with PTSD to account for any possible bias in performance, which can lead to a misinterpretation of the findings. Finally, we recommend that future studies consider implementing data-driven analysis for PTSD trajectories with the purpose of better characterizing patterns of PTSD.

Nonetheless, the present study has important theoretical and practical implications. First and foremost, to the best of our knowledge, this is the only longitudinal prospective study assessing the influence of captivity and the components and trajectories of PTSD on cognitive performance among ex-POWs. Our unique study design covered the span of over 4 decades, thereby allowing for an in-depth comprehensive examination of the experience in captivity and various aspects of PTSD on cognitive performance. Overall, our results showed captivity to be a unique and powerful traumatic experience, leading to PTSD and long-lasting and enduring neuropsychological implications, even decades after release. These findings may have significant implications. First, as the ex-POW population ages, it is important to view them as a high-risk population for cognitive disorders. This should be taken into account by those creating policy and working with aging ex-POWs—there must be an awareness of the potential for neuropsychological impairments, which requires an appropriate diagnosis and cognitive therapy. In the future, we suggest continuing this line of research by integrating biological indicators alongside the neuropsychological measures that are involved in cognitive impairments among ex-POWs.

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REFERENCES

1. Ursano RJ, Rundell JR. The prisoner of war. *Mil Med*. 1990;155(4):176–180.
2. Herman JL. Complex PTSD: a syndrome in survivors of prolonged and repeated trauma. *J Trauma Stress*. 1992;5(3):377–391.
3. Solomon Z, Dekel R. Posttraumatic stress disorder among Israeli ex-prisoners of war 18 and 30 years after release. *J Clin Psychiatry*. 2005;66(8):1031–1037.
4. Solomon Z, Horesh D, Ein-Dor T, et al. Predictors of PTSD trajectories following captivity: a 35-year longitudinal study. *Psychiatry Res*. 2012;199(3):188–194.
5. Speed N, Engdahl B, Schwartz J, et al. Posttraumatic stress disorder as a consequence of the POW experience. *J Nerv Ment Dis*. 1989;177(3):147–153.
6. Mikulincer M, Solomon Z, Shaver PR, et al. Attachment-related consequences of war captivity and trajectories of posttraumatic stress disorder: a 17-year longitudinal study. *J Soc Clin Psychol*. 2014;33(3):207–228.
7. Solomon Z, Greene T, Ein-Dor T, et al. The long-term implications of war captivity for mortality and health. *J Behav Med*. 2014;37(5):849–859.
8. Page WF, Brass LM. Long-term heart disease and stroke mortality among former American prisoners of war of World War II and the Korean Conflict: results of a 50-year follow-up. *Mil Med*. 2001;166(9):803–808.
9. Hunt SC, Orsborn M, Checkoway H, et al. Later life disability status following incarceration as a prisoner of war. *Mil Med*. 2008;173(7):613–618.
10. Sutker PB, Winstead DK, Galina ZH, et al. Cognitive deficits and psychopathology among former prisoners of war and combat veterans of the Korean Conflict. *Am J Psychiatry*. 1991;148(1):67–72.
11. Williams D, Hilton SM, Moore J. Cognitive measures of Vietnam-era prisoners of war. *JAMA*. 2002;288(5):574–575.
12. Sutker PB, Allain AN Jr. Assessment of PTSD and other mental disorders in World War II and Korean Conflict POW survivors and combat veterans. *Psychol Assess*. 1996;8(1):18–25.
13. Sutker PB, Allain AN, Johnson JL, et al. Memory and learning performances in POW survivors with history of malnutrition and combat veteran controls. *Arch Clin Neuropsychol*. 1992;7(5):431–444.
14. Sutker PB, Galina ZH, West JA, et al. Trauma-induced weight loss and cognitive deficits among former prisoners of war. *J Consult Clin Psychol*. 1990;58(3):323–328.
15. Sulway MR, Broe GA, Creasey H, et al. Are malnutrition and stress risk factors for accelerated cognitive decline? a prisoner of war study. *Neurology*. 1996;46(3):650–655.
16. Vasterling JJ, Duke LM, Brailey K, et al. Attention, learning, and memory performances and intellectual resources in Vietnam veterans: PTSD and no disorder comparisons. *Neuropsychology*. 2002;16(1):5–14.
17. Qureshi SU, Long ME, Bradshaw MR, et al. Does PTSD impair cognition beyond the effect of trauma? *J Neuropsychiatry Clin Neurosci*. 2011;23(1):16–28.
18. American Psychiatric Association. *Diagnostic and Statistical Manual for Mental Disorders*. Fifth Edition. Washington, DC: American Psychiatric Association; 2013.
19. Dekel S, Solomon Z, Ein-Dor T. PTSD symptoms lead to modification in the memory of the trauma: a prospective study of former prisoners of war. *J Clin Psychiatry*. 2016;77(3):e290–e296.
20. Schuitevoerder S, Rosen JW, Twamley EW, et al. A meta-analysis of cognitive functioning in older adults with PTSD. *J Anxiety Disord*. 2013;27(6):550–558.
21. Orcutt HK, Erickson DJ, Wolfe J. The course of PTSD symptoms among Gulf War veterans: a growth mixture modeling approach. *J Trauma Stress*. 2004;17(3):195–202.
22. O'Donnell ML, Elliott P, Lau W, et al. PTSD symptom trajectories: from early to chronic response. *Behav Res Ther*. 2007;45(3):601–606.
23. Chopra MP, Zhang H, Kaiser AP, et al. PTSD is a chronic, fluctuating disorder affecting the mental quality of life in older adults. *Am J Geriatr Psychiatry*. 2014;22(1):86–97.
24. Pietrzak RH, Feder A, Singh R, et al. Trajectories of PTSD risk and resilience in World Trade Center responders: an 8-year prospective cohort study. *Psychol Med*. 2014;44(1):205–219.
25. Maercker A, Gäbler I, O'Neil J, et al. Long-term trajectories of PTSD or resilience in former East German political prisoners. *Torture*. 2013;23(1):15–27.
26. Sachinvala N, Von Scotti H, McGuire M, et al. Memory, attention, function, and mood among patients with chronic posttraumatic stress disorder. *J Nerv Ment Dis*. 2000;188(12):818–823.
27. Gurvits TV, Lasko NB, Repak AL, et al. Performance on visuospatial copying tasks in individuals with chronic posttraumatic stress disorder. *Psychiatry Res*. 2002;112(3):263–268.
28. Qureshi SU, Kimbrell T, Pyne JM, et al. Greater prevalence and incidence of dementia in older veterans with posttraumatic stress disorder. *J Am Geriatr Soc*. 2010;58(9):1627–1633.
29. Bomyea J, Amir N, Lang AJ. The relationship between cognitive control and posttraumatic stress symptoms. *J Behav Ther Exp Psychiatry*. 2012;43(2):844–848.
30. Wrocklage KM, Schweinsburg BC, Krystal JH, et al. Neuropsychological functioning in veterans with posttraumatic stress disorder: associations with performance validity, comorbidities, and functional outcomes. *J Int Neuropsychol Soc*. 2016;22(4):399–411.
31. Kertzman S, Avital A, Weizman A, et al. Intrusive trauma recollections is associated with impairment of interference inhibition and psychomotor speed in PTSD. *Compr Psychiatry*. 2014;55(7):1587–1594.
32. Cuffe SP, McCullough EL, Pumariega AJ. Comorbidity of attention deficit hyperactivity disorder and post-traumatic stress disorder. *J Child Fam Stud*. 1994;3(3):327–336.
33. Hart J, Kimbrell T, Fauver P, et al. Cognitive dysfunctions associated with PTSD. *J Neuropsychiatry Clin Neurosci*. 2008;20(3):309–316.
34. Meziab O, Kirby KA, Williams B, et al. Prisoner of war status, posttraumatic stress disorder, and dementia in older veterans. *Alzheimers Dement*. 2014;10(3 suppl):S236–S241.
35. Solomon Z, Benbenishty R, Neria Y, et al. Assessment of PTSD: validation of the revised PTSD inventory. *Isr J Psychiatry Relat Sci*. 1993;30:110–115.
36. American Psychiatric Association. *Diagnostic and Statistical Manual for Mental Disorders*. Fourth Edition, Text Revision. Washington, DC: American Psychiatric Association; 2000.
37. Nasreddine ZS, Phillips NA, Bdirian V, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *J Am Geriatr Soc*. 2005;53(4):695–699.
38. Lifshitz M, Dwolatzky T, Press Y. Validation of the Hebrew version of the MoCA test as a screening instrument for the early detection of mild cognitive impairment in elderly individuals. *J Geriatr Psychiatry Neurol*. 2012;25(3):155–161.
39. Salthouse TA. Theories of cognition. In: Bengtson VL, Schaie KW, eds. *Handbook of Theories of Aging*. New York, NY: Springer Publishing Company; 1999:196–208.
40. Hultsch DF, Hammer M, Small BJ. Age differences in cognitive performance in later life: relationships to self-reported health and activity life style. *J Gerontol*. 1993;48(1):P1–P11.
41. Friedman MJ, McEwen BS. Posttraumatic stress disorder, allostatic load, and medical illness. In: Schnurr PP, Green BL, eds. *Trauma and Health: Physical Health Consequences of Exposure to Extreme Stress*. Washington, DC: American Psychological Association; 2004:157–188.
42. Yehuda R. Biology of posttraumatic stress disorder. *J Clin Psychiatry*. 2001;62 (suppl 17):41–46.
43. Juster RP, McEwen BS, Lupien SJ. Allostatic load biomarkers of chronic stress and impact on health and cognition. *Neurosci Biobehav Rev*. 2010;35(1):2–16.
44. Shin LM, Rauch SL, Pitman RK. Amygdala, medial prefrontal cortex, and hippocampal function in PTSD. *Ann N Y Acad Sci*. 2006;1071(1):67–79.
45. McNally RJ. Cognitive abnormalities in post-traumatic stress disorder. *Trends Cogn Sci*. 2006;10(6):271–277.
46. Rossetti HC, Lacritz LH, Cullum CM, et al. Normative data for the Montreal Cognitive Assessment (MoCA) in a population-based sample. *Neurology*. 2011;77(13):1272–1275.
47. Morgado J, Rocha CS, Maruta C, et al. Cut-off scores in MMSE: a moving target? *Eur J Neurol*. 2010;17(5):692–695.
48. Sledge WH, Boydstun JA, Rabe AJ. Self-concept changes related to war captivity. *Arch Gen Psychiatry*. 1980;37(4):430–443.
49. Moreno A, Grodin MA. Torture and its neurological sequelae. *Spinal Cord*. 2002;40(5):213–223.
50. Zakin G, Solomon Z, Neria Y. Hardiness, attachment style, and long term psychological distress among Israeli POWs and combat veterans. *Pers Individ Dif*. 2003;34(5):819–829.
51. Andel R, Crowe M, Kreholt I, et al. Indicators of job strain at midlife and cognitive functioning in advanced old age. *J Gerontol B Psychol Sci Soc Sci*. 2011;66(3):287–291.
52. Korten NC, Sliwinski MJ, Comijs HC, et al. Mediators of the relationship between life events and memory functioning in a community sample of adults. *Appl Cogn Psychol*. 2014;28(5):626–633.
53. Aggarwal NT, Wilson RS, Beck TL, et al. Perceived stress and change in cognitive function among adults aged 65 and older. *Psychosom Med*. 2014;76(1):80–85.

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