Longitudinal Neuropsychological Functioning in Gulf War Veterans Exposed to Neurotoxicants and War-Related Trauma

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INTRODUCTION

- During the 1990-1991 Gulf War (GW), deployed veterans were exposed to various neurotoxicants.
- Exposures included: chemical warfare (such as sarin nerve gas from the Khamisiyah depot demolition), combustion byproducts (from oil well fires and diesel fuels from tent heaters), pesticides, and prophylactic anti- nerve gas pyridostigmine bromide (PB) pills; all of which have been associated with both cognitive and mood concerns.[1]
- Our cohort, the Ft. Devens Cohort (FDC), is the longest running population-based cohort of GW veterans, who have been surveyed multiple times over the past 30 years. (**Figure 1**)
- Neurotoxicant exposures, in conjunction with exposure to traumatic events have been reported to exacerbate and prolong PTSD symptomatology.[2]
- GW veterans with PTSD have previously performed more poorly on neuropsychological measures of memory and attention than GW veterans not meeting criteria for PTSD.[3]
- Military service itself has been found to be linked to accelerated aging due to numerous confounding variables such as harmful exposure to combat, injury, and environmental contaminants.[4]

METHODS

- This study utilized a subset (n=37) of the FDC who endorsed experiencing a traumatic event during GW deployment and completed the PTSD Checklist (PCL)[5] and neuropsychological assessments at both timepoints, 1997-1998 and again in 2019-2022. (**Figure 3**)
- Analyses were stratified into 2 groupings; those meeting PTSD criteria (n=15), with a PCL cutoff score of 36 or greater, and those who did not (n=22).
- Repeated linear and logistic regression using generalized estimation equations (GEE) were used to conduct analysis of neuropsychological assessments over time.
- Each model contained time, Trails B, and neurotoxicant exposure as factors, with PCL score Time 1 as covariate.
- Heard chemical alarms was used as an indicator of probable exposure to sarin nerve gas.
- P values < .05 were considered significant. All analysis were performed using SPSS version 28.

Figure 1. Timeline

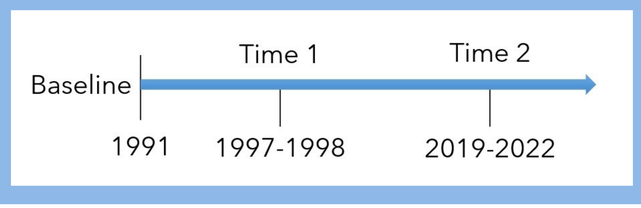

Figure 2a.

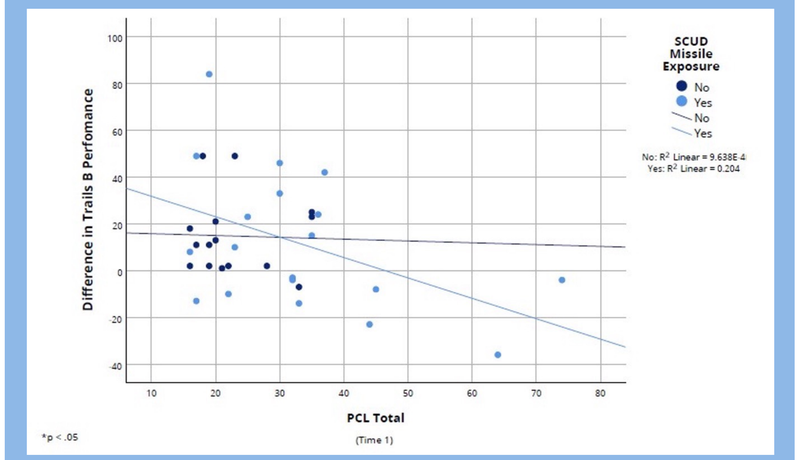

Figure 2b.

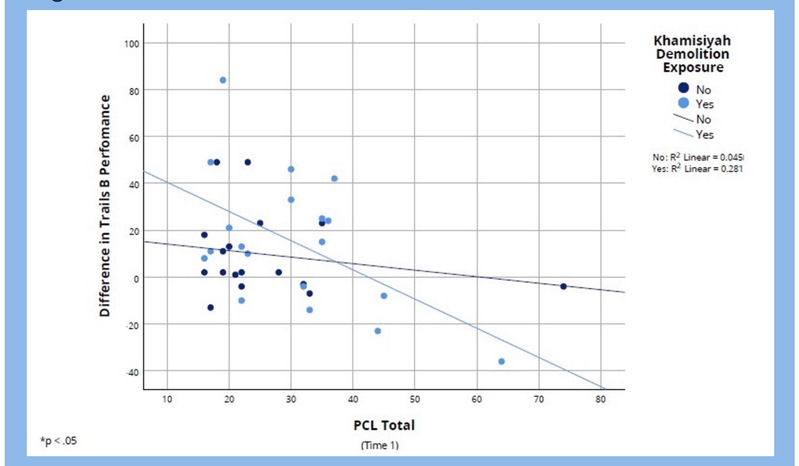

Figure 2c.

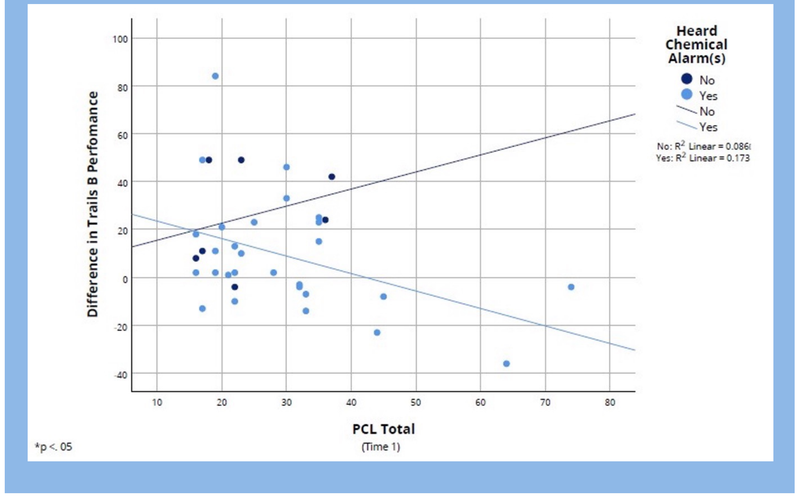

Figure 3. Demographics Table

Demographics/Characteristics	Baseline	Time 1	Time 2	Study Sample
	(n=247)	(n=176)	(n=52)	(n = 37)
Age, years	32.3	34.56	58.62	59.6
Male, n (%)	87.4	54.5	71.2	62.2
Meets PTSD Criteria, (%)	15	31.3	50	40.5

DISCUSSION

- Our sample showed faster Trails B performance in those with PTSD than those without. (**Figures 2a,b,c**)
- It could be deduced that the symptom cluster of hyperarousal in the PTSD group could be contributing to an increased performance speed.
- Many GWVs were exposed to sarin nerve gas, an acetylcholinesterase inhibitor resulting in chronic hyperexcitability due to excess acetylcholine in synapses.[6]
- This symptom of hyperarousal is the most frequently reported in other studies investigating PTSD among individuals with exposure to neurotoxicants such as sarin nerve gas.[2]
- Exposure to both neurotoxicants and traumatic events may be resulting in a multiple hit proinflammatory response, thereby exacerbating or extending symptoms of PTSD.

LIMITATIONS & FUTURE DIRECTION

- Participant drop out between timepoints contributed to our small sample and limited the ability to compare individuals over time.
- Due to the COVID-19 pandemic, the majority of neuropsychological assessments were done via video conferencing at the latest timepoint.
- Future longitudinal studies should utilize a larger population. One limitation of our study was the small sample size, a greater sample size would increase statistical power.
- Going forward, neurotoxicant research should investigate the performance of acetylcholinesterase inhibition and its impact on executive function and attention in neuropsychological assessments.

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