

**Objective:** More than 30 years after the 1990-91 Gulf War (GW), approximately 200,000 veterans are still suffering from Gulf War Illness (GWI). Veterans who have this multi-symptom disorder experience impaired cognition, chronic pain, sustained fatigue, and gastrointestinal issues. GWI is believed to be associated with neurotoxicant exposures during the war. Prior research has shown cognitive deficits in combined samples of male and female GW veterans with GWI. These studies have shown that veterans with GWI have cognitive decrements in memory, learning and sustained attention. Studies have yet to compare neuropsychological outcomes by sex. This is mainly due to the lack of collected data on women GW veterans in the past. This study aims to analyze neuropsychological differences in males compared with female veterans with GWI and in those with neurotoxicant exposures from the Boston, Biorepository and Integrative Network (BBRAIN) for GWI repository dataset.

**Participants and Methods:** The total sample included 297 veterans with GWI (women  $n=50$ , men  $n=247$ ) who were deployed to the 1990-91 Gulf War with an average age of 52 years. GWI case status was defined by the Kansas GWI criteria. Neuropsychological data including the Conners Continuous Performance Test Third Edition (CPT3), Delis-Kaplan Executive Function System (D-KEFS) Color-Word Interference Test, and the California Verbal Learning Test (CVLT-II) were combined from the BBRAIN repository datasets. War-related exposures, including chemical weapons, anti-nerve gas pills and pesticides were measured by a self-reported survey. Multiple linear regression was used to analyze the association between sex, war-related exposures, and neuropsychological test score outcomes.

**Results:** After adjusting for age, education level and PTSD, men had a significantly lower number of words correct in the CVLT-II learning Trials 1-5, short delay recall and long delay recall compared with women veterans ( $p<0.05$ ). The two groups also differed significantly in CPT3 commission scores, and total time on the D-KEFs Color-Word Inference total times in Trials 1 and 2 with men performing worse ( $p<0.05$ ). Reported exposure to chemical weapons, pesticides, pyridostigmine bromide (PB) anti-nerve gas pills or smoke from oil well fires were all significantly associated with fewer words correctly recalled on all learning trials of the CVLT-II, long delay, and short delay to a greater degree in men as compared to women

( $p<0.05$ ). Reported exposure to chemical weapons or smoke from oil well fires were significantly associated with more commission errors on CPT3 in men with GWI ( $p<0.05$ ). Chemical alarms, smoke from oil well fires and PB were associated with slower response time on the Color-Word Interference test Trial 1 in men compared with women veterans.

**Conclusions:** In this study, men with GWI demonstrated significantly poorer performance in verbal memory, learning, response speed and attention. Male veterans reporting neurotoxicant exposures during the war also showed worse learning and verbal memory, impulsivity and response speed decrements compared to exposed women veterans. Future research should consider men and women separately when examining outcomes from war-related exposures.

**Categories:** Drug/Toxin-Related Disorders (including Alcohol)

**Keyword 1:** neurotoxicity

**Keyword 2:** cognitive functioning

**Correspondence:** Dylan Keating Boston University, School of Public Health, Department of Environmental Health [dmk13@bu.edu](mailto:dmk13@bu.edu)

### 23 The Impact of Parental History of Substance Use on Preadolescent Rewarding Processing in the ABCD Study

Gabriella Y Navarro, Elizabeth Ashley Stinson, Ryan Sullivan, Krista Lisdahl  
University of Wisconsin Milwaukee, Milwaukee, WI, USA

**Objective:** Parental history (PH) of problematic substance use has been identified as a risk factor for adolescent substance use, which can lead to increased use in adulthood. Researchers hypothesize that individuals with PH exhibit premorbid differences in their reward processing, increasing their likelihood of engaging in reward-driven behavior. Studies have shown that preadolescents with PH have greater activation in their putamen and nucleus accumbens (NA); however, most research has only investigated PH of alcohol use (PHA), not PH of drug use (PHD). Additionally, limited research has assessed whether reward processing develops differently among youth

with (PH+) to youth without (PH-). The present study utilizes the national, prospective Adolescent Brain Cognitive Development SM (ABCD) Study to examine whether reward anticipation in the nucleus accumbens (NA) differs in preadolescents with and without parental substance use history and whether patterns of reward anticipation change over time during a two-year follow-up period. Further, it will also examine whether PHA and PHD predict similar activation patterns.

**Participants and Methods:** The current sample (N=6,600, Mage = 10.9; range = 9-13.8 years old; 46.7% female) was drawn from the national ABCD Study. To assess reward processing, the Monetary Incentive Delay Task (MID), a fMRI task-based paradigm, was administered at baseline and 2 year follow-up. The primary regions of interest (ROI) were the left and right NA and neutral vs anticipation of large rewards was the selected contrast. The Family History Assessment was used to assess problematic parental alcohol and drug use for both parents, with scores ranging from 0-2, with two indicating that both parents demonstrate problematic use. Three PH contrasts (PH- vs.PH+1, PH- vs.PH+2, & PH+1 vs. PH+2) were created for each group (PHA and PHD) (Martz et al., 2022). Separate linear mixed-effect models with predictors variables (parental contrasts, timepoint, and parental contrasts-by-time-point) and covariates (age, sex, race/ethnicity, income, parental education, parental warmth, parental monitoring, and the random effects of MRI model, family status, and subject) were run to predict reward anticipation.

**Results:** Results indicated that PHA and ,not PHD, was predictive of reward anticipation. PHA+1 youth showed greater activation in the l-NA (b= .02827, p= .03) and r-NA (b= .03476, p=.005), compared to PH- youth. Additionally, PHA+1 youth showed greater activation in the r-NA (b=-.07029, p=.008) compared to PHA+2 youth, but not in the l-NA. Those with PHA+2 demonstrated blunted activity in both the l-NA (b= -.07244, p=.02) and right nucleus accumbens (b= -.1091, p=001) when compared to those with PH-. No interactions with time were found.

**Conclusions:** Preadolescents with a PHA+ for both parents had blunted activity in reward anticipation, conferring a unique risk not seen in youth with only one parent with problematic alcohol use, or in youth with a PH of drug use. Future research should attempt to disentangle both genetic and environmental factors that may

explain these discrepancies in reward processing, as well as the protective factors that may mitigate it. The current study found no interaction between PHA+ and time, suggesting that during preadolescents, the pattern of reward functioning remains consistent, but future work should assess if this pattern holds up across adolescence

**Categories:** Drug/Toxin-Related Disorders (including Alcohol)

**Keyword 1:** substance abuse

**Keyword 2:** neuroimaging: functional

**Keyword 3:** adolescence

**Correspondence:** Gabriella Navarro, University of Wisconsin- Milwaukee, navarrog@uwm.edu

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

Kathryn A Price<sup>1,2</sup>, Leah A Orlinsky<sup>1,2</sup>, Clara G Zundel<sup>3</sup>, Kimberly Sullivan<sup>2</sup>, Maxine H Krenzel<sup>1,4</sup>  
<sup>1</sup>VA Boston Healthcare System, Boston, MA, USA. <sup>2</sup>Boston University School of Public Health, Boston, MA, USA. <sup>3</sup>Wayne State University School of Medicine, Detroit, MI, USA. <sup>4</sup>Boston University School of Medicine, Boston, MA, USA

**Objective:** Gulf War (GW) veterans were exposed to many neurotoxicants during the 1990-1991 Gulf War. Neurotoxicants included: chemical warfare such as sarin nerve gas, combustion byproducts from oil well fires and diesel fuels from tent heaters, pesticides, and prophylactic anti- nerve gas pyridostigmine bromide pills (PB); all of which have been associated with both cognitive and mood concerns. There are few longitudinal studies that have examined cognitive functioning regarding these toxicant exposures. In our longitudinal Fort Devens cohort, we found decrements over time in the area of verbal learning and memory but no differences in measures of nonverbal memory and executive function. To describe changes more accurately over time in this GW veteran cohort, we examined cognitive functioning in those with probable Post-Traumatic Stress Disorder (PTSD) versus those without.