Neuropsychological Assessment in Special Operations Forces

Scott Sorg, PhD,

Neuropsychology Team Lead, Home Base, MGH &
Harvard Medical School

Disclosure

- NEITHER I NOR MY SPOUSE/PARTNER HAS A RELEVANT FINANCIAL RELATIONSHIP WITH A COMMERCIAL INTEREST TO DISCLOSE.

Overview

Neuropsychological assessment in the conceptualization of brain health in US Military Service Members and Veterans:

- Discuss relevant cognitive risk factors and assessment considerations in this population
- Provide an overview of the extant findings on neuropsychological outcomes in SOF
- Present recommendations to advance clinical practice and targets for future research efforts

Neuropsychological Assessment

Aims

- assess cognitive functioning
- determine cognitive strengths and weaknesses
- evaluate for possible neurocognitive disorder
- inform treatment recommendations (e.g., targets for cognitive rehabilitation)

Process

- Integration of data from self-report, medical records, clinical interview, and, results of cognitive testing

Neuropsychological Testing

Normatively informed application of performance-based assessments of various cognitive domains.

- Age, years of education, gender

Cognitive Domains:

- Memory
- Attention
- Processing speed
- Executive functions (reasoning, judgment, and problem-solving)
- Spatial cognition
- Language functions

Harvey, 2012 (Dialogues Clin Neurosci.)

Factors Potentially Impacting Cognitive Functions in US Military Service Members and Veterans

Head injuries and concussions

Blast Exposure

Other Medical factors

- Sleep difficulties and obstructive sleep apnea
- Cerebrovascular Risk Factors (HTN)

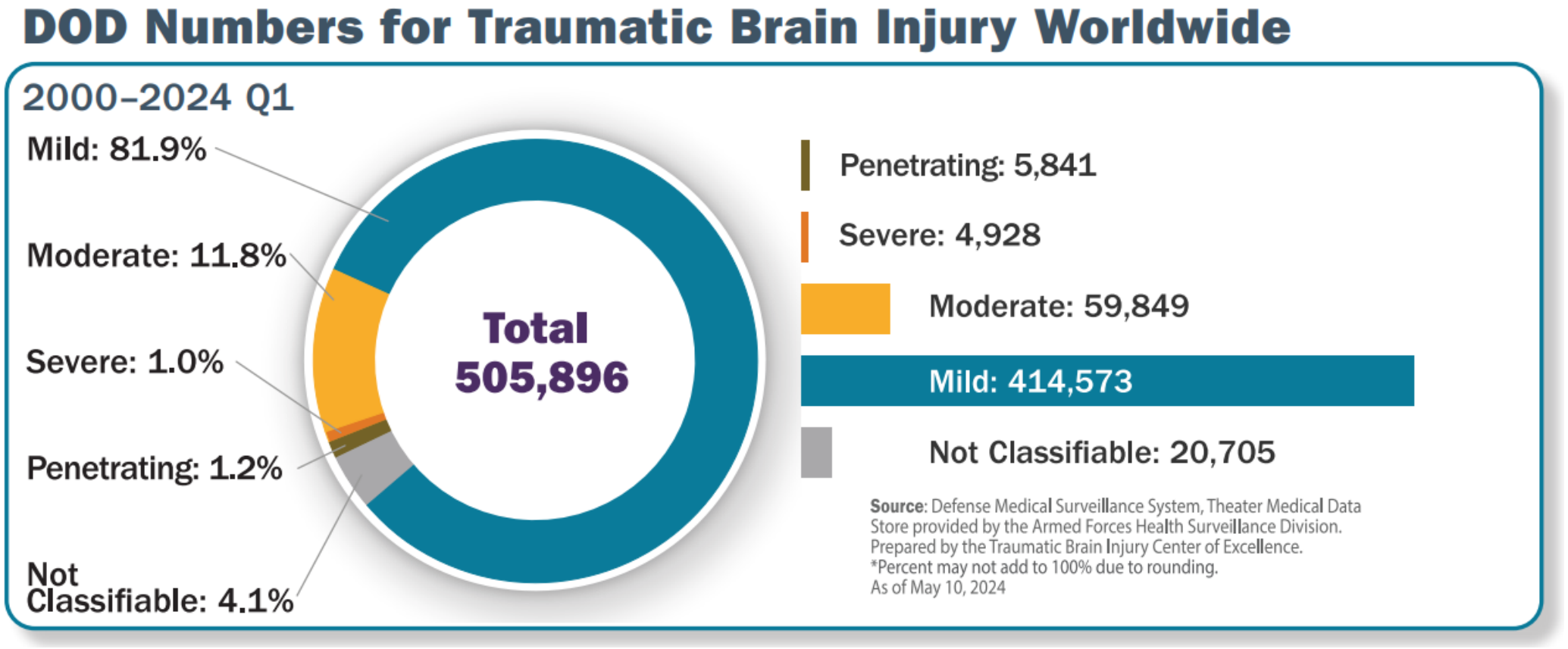
Psychiatric Factors

- Depression, PTSD

Substance Use

- Alcohol

Mild TBI is most common



https://health.mil/Reference-Center/Reports/2024/08/29/2000-2024-Q1-DOD-Worldwide-Numbers-for-TBI

Special Operations Forces

Greater exposure to blast forces

Increased rates of TBI exposure

Selected Research Findings: Imaging

Longitudinal multimodal MRI analysis of brains of breachers (Glikstein et al., 2024) reported over a 5-year span:

"significant deterioration.. in brain MRI for volume loss, white matter changes and enlarged VR spaces in military personnel exposed to multiple repeated blast exposure."

No control group, small sample, unclear whether age was controlled for

Multimodal MRI analysis of blast exposure on US SOF (Gilmore et al., 2024) reported

Higher blast exposure was associated with increased cortical thickness in the left rostral anterior cingulate cortex (rACC), a finding that remained significant after multiple comparison correction. In uncorrected analyses, higher blast exposure was associated with worse health-related quality of life, decreased functional connectivity in the executive control network, decreased TSPO signal in the right rACC, and increased cortical thickness in the right rACC, right insula, and right medial orbitofrontal cortex—nodes of the executive control, salience, and default mode networks.

In a 5-year longitudinal study of breachers, no differences were found in MRI measures or cognitive measures at low-level blast exposure (Kamimori et al., 2018)

A study of breachers reported lower gray matter volume in breachers vs controls (Vartanian et al., 2021)

Selected Research Findings: Cognitive Testing

- Comparison of high and low blast exposure in 30 SOF personnel (Gilmore et al):
  - “level of cumulative blast exposure was not associated with cognitive performance”
- Analysis of breachers reported no significant associations with objective measures of cognitive performance (Vartanian et al., 2021; Kamimori et al., 2018)

Prelimenary Findings from Home Base

- In an analysis of a subsample of 60 SOF personnel who completed the ComBHaT program
  - Significant Age X Blast Exposure Interaction on a measure of processing speed: In those under age 44, patients reporting high blast exposure performed worse on coding than the low blast group (younger, low-blast mean=82.4, SD=12.6, n=17; younger, high-blast mean=71.7, SD=14, n=14; p=.04).

  - Higher blast exposure (as indexed by the GBEV) was associated with poorer performance on a test of executive functions and verbal memory.
    - However, mean scores for the high blast group were still within normative limits and few participants scored beyond 1 SD of the age-corrected normative sample.

Future Directions: Improve Clinical Accuracy

- Longitudinal study examining neuroimaging, neurocognitive, and other biomarkers of brain health of SOF personnel.
- Increase sensitivity to acquired cognitive disruption and diagnostic accuracy in SOF personnel
  - Investigate the utility of developing SOF-specific norms for a standardized battery of commonly used neuropsychological tests and develop such norms
    - Similar norms recently developed for a brief computerized test battery (ANAM, Belanger et al., 2022).
  - Investigate use of more novel measures in mode of collection (e.g., digitally acquired data) or cognitive domain (e.g., prospective memory) which have greater sensitivity to the relatively mild levels of cerebral dysfunction in repetitive blast exposure.

Collaborations Welcome

Thank you.

References

- Glikstein, R., Melkus, G., Portela de Oliveira, E., Brun-Vergara, M. L., Schwarz, B. A., Ramsay, T., Zhang, T., & Skinner, C. (2024). Five-Year Serial Brain MRI Analysis of Military Members Exposed to Chronic Sub-Concussive Overpressures. Journal of magnetic resonance imaging : JMRI, 10.1002/jmri.29419. Advance online publication. https://doi.org/10.1002/jmri.29419
- Vartanian, O., Coady, L., Blackler, K., Fraser, B., & Cheung, B. (2021). Neuropsychological, Neurocognitive, Vestibular, and Neuroimaging Correlates of Exposure to Repetitive Low-Level Blast Waves: Evidence From Four Nonoverlapping Samples of Canadian Breachers. *Military medicine*, *186*(3-4), e393–e400. https://doi.org/10.1093/milmed/usaa332
- Gilmore, N., Tseng, C. J., Maffei, C., Tromly, S. L., Deary, K. B., McKinney, I. R., Kelemen, J. N., Healy, B. C., Hu, C. G., Ramos-Llordén, G., Masood, M., Cali, R. J., Guo, J., Belanger, H. G., Yao, E. F., Baxter, T., Fischl, B., Foulkes, A. S., Polimeni, J. R., Rosen, B. R., … Edlow, B. L. (2024). Impact of repeated blast exposure on active-duty United States Special Operations Forces. *Proceedings of the National Academy of Sciences of the United States of America*, *121*(19), e2313568121. https://doi.org/10.1073/pnas.2313568121
- Kamimori, G. H., LaValle, C. R., Eonta, S. E., Carr, W., Tate, C., & Wang, K. K. W. (2018). Longitudinal Investigation of Neurotrauma Serum Biomarkers, Behavioral Characterization, and Brain Imaging in Soldiers Following Repeated Low-Level Blast Exposure (New Zealand Breacher Study). *Military medicine*, *183*(suppl_1), 28–33. https://doi.org/10.1093/milmed/usx186
- Vartanian, O., Coady, L., Blackler, K., Fraser, B., & Cheung, B. (2021). Neuropsychological, Neurocognitive, Vestibular, and Neuroimaging Correlates of Exposure to Repetitive Low-Level Blast Waves: Evidence From Four Nonoverlapping Samples of Canadian Breachers. *Military medicine*, *186*(3-4), e393–e400. https://doi.org/10.1093/milmed/usaa332
- Belanger, H. G., Vincent, A. S., Caserta, R. J., Biggs, A. T., & Yao, E. F. (2022). Automated neuropsychological assessment metrics (v4) military expanded battery: Normative data for special operations forces. *The Clinical neuropsychologist*, *36*(8), 2300–2312. https://doi.org/10.1080/13854046.2021.1933191