



Linking combat blast events with TBI and injury patterns



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Introduction: The Deputy Secretary of Defense 2024 Memo “Department of Defense Requirements for Managing Brain Health Risks from BOP” identifies Blast Overpressure (BOP) as a major area of concern [1], but current medical treatment guidelines don’t include protection measures because BOP exposure/injury is not fully understood. It is important to define the problem set and better understand how such exposures correlate with injuries to develop predictive mitigation techniques [2].

Acronym List:

AIS – Abbreviated Injury Scale	BOP – Blast Overpressure
DAI – Diffuse Axonal Injury	JTS – Joint Trauma Services
MAIS – Maximum AIS	TBI – Traumatic Brain Injury
SM – Service Member	TDAC – Transformation Decision Analysis Center

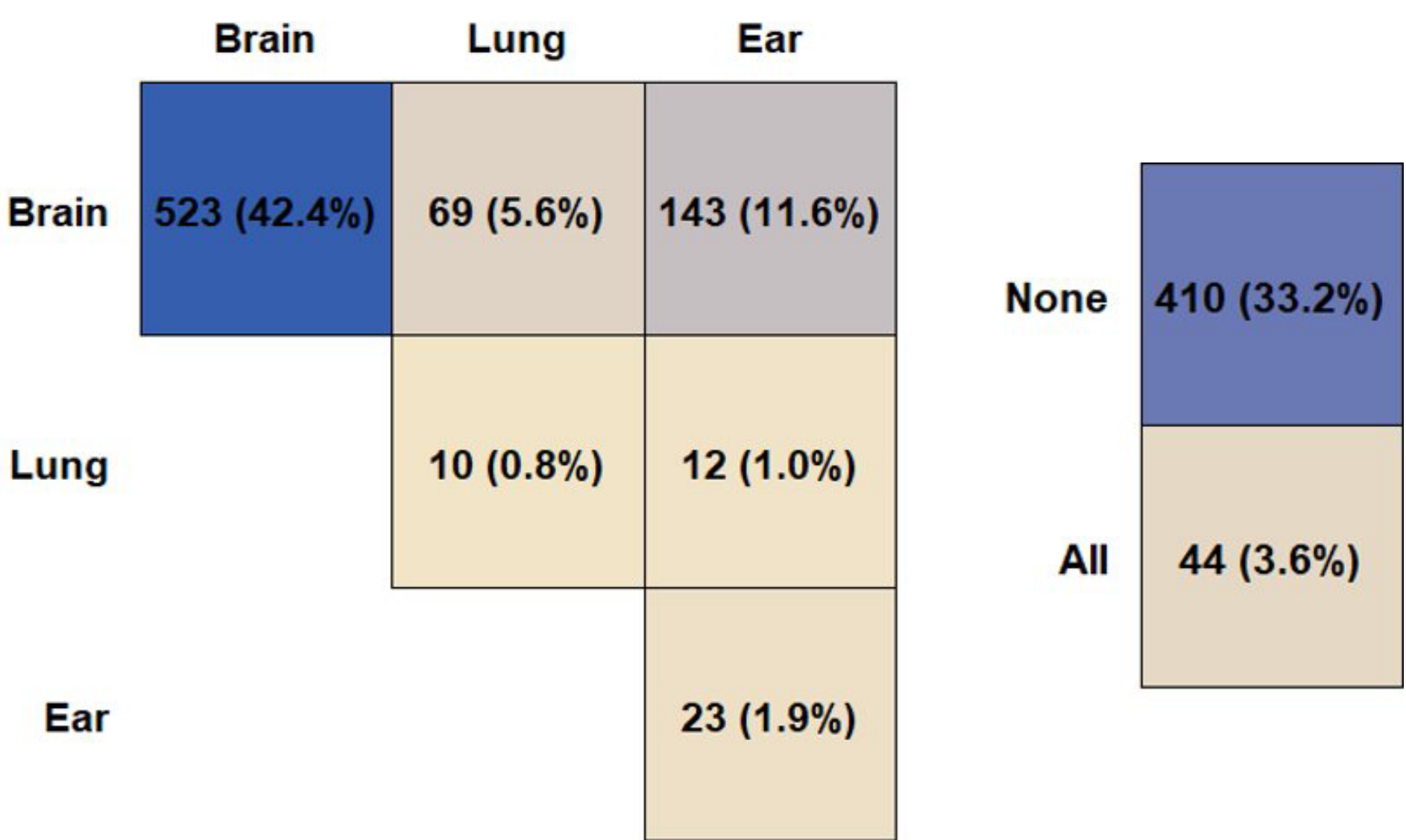
Objective:

Establish a link between known blast events and subsequent injuries using historical theater data to inform predictive mitigation techniques within the larger BOP research and analysis community.

Injury Patterns Resulting from Theater Blast Events of Dismounted Service Members

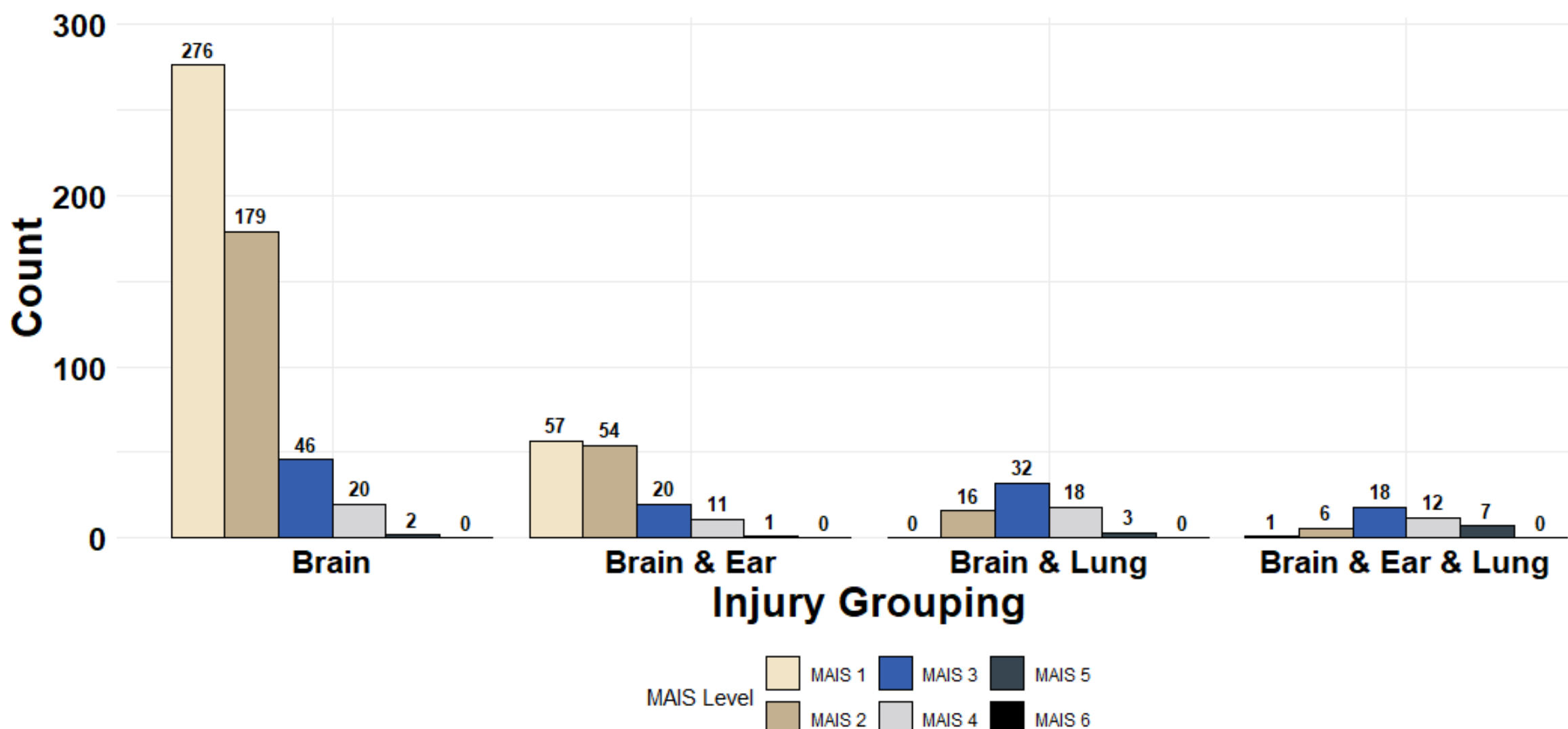
Analysis: Dataset of U.S. Service Members (SM) injured in combat blast events from 2006-2024 treated at Role 1 or 2 hospitals and designated by Joint Trauma Services (JTS) as a Traumatic Brain Injury (TBI) case. Injury analysis was completed using AIS08 [3] codes assigned to each injury, where brain injury included cerebrum, cerebellum, and diffuse axonal injury (DAI) (excluding penetrating codes), lung injury included thoracic structures: lung and respiration, and ear injuries included internal ear injuries.

Injuries of Interest (N=1,234 SM)



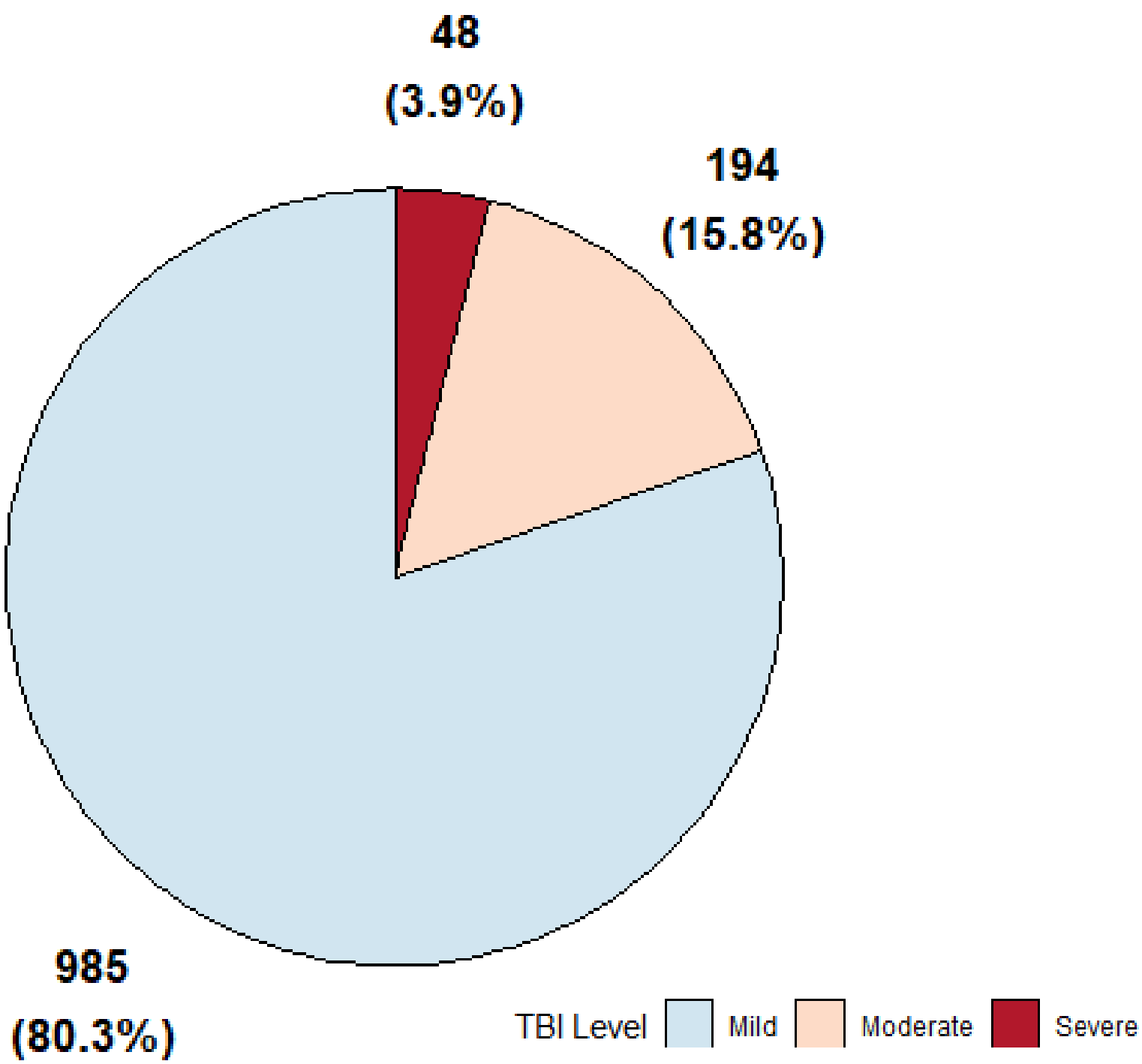
Over 66% of TBI cases sustained an AIS08-coded brain, lung, and/or ear injury.

Maximum AIS (MAIS) Severity and Injuries of Interest (N=779 SM)



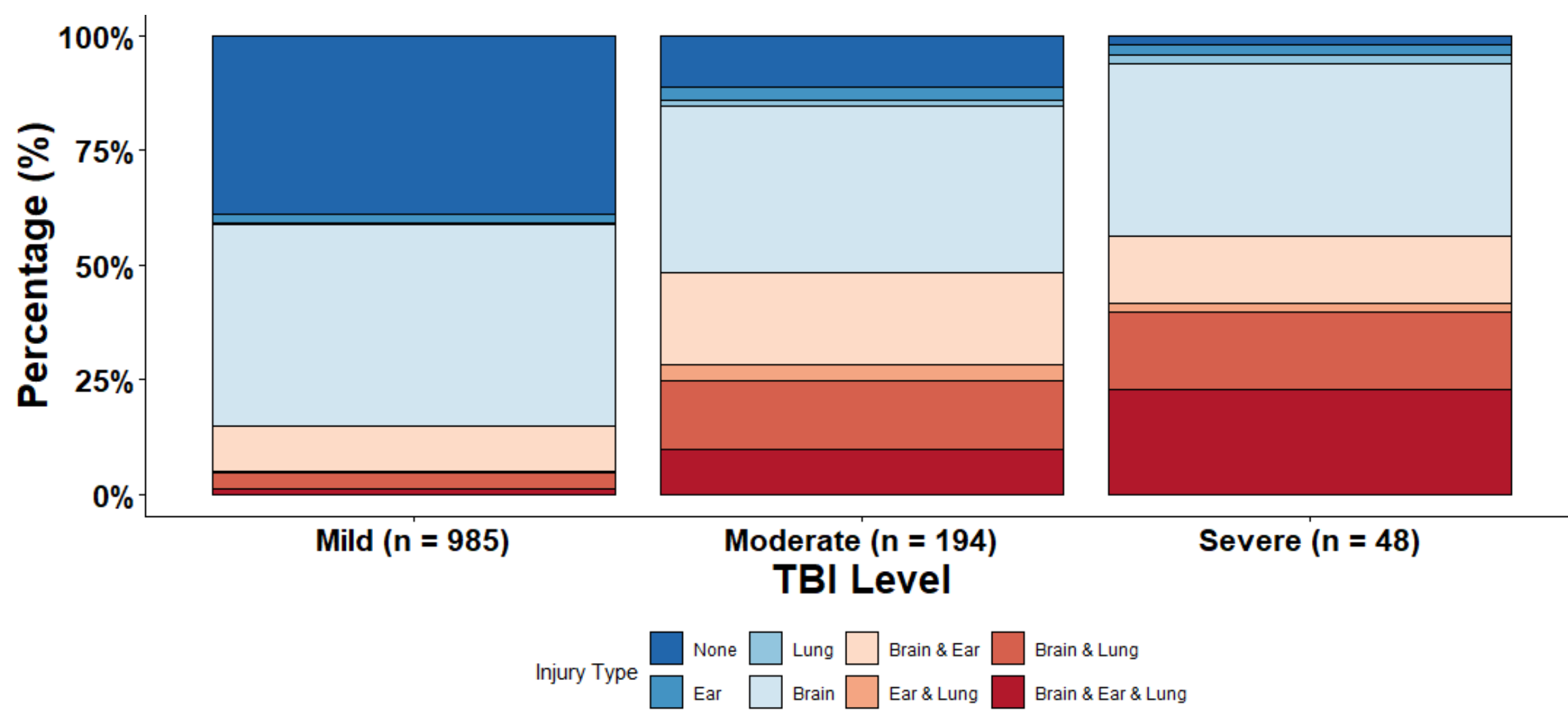
While isolated brain injuries were frequent among the injuries of interest, the majority occurred in SM with overall low injury severity (MAIS=1 or 2).

TBI Levels (N=1,227 SM)



The majority of cases (80%) designated as TBI within the JTS dataset were denoted as mild.

Distribution of TBI Levels and Co-occurring Injuries of Interest



As the TBI level increased, so did the percentage of SM with multiple injuries of interest, with the highest number of co-occurring “brain & ear & lung” injuries occurring in the severe TBI group.

Summary and Key Findings:

- Just over 1/3 of Service Members injured in blast combat events and treated at Role 1 or 2 hospitals from 2006 to 2024 were denoted as TBI cases.
 - Of these: 80% were mild TBI, 16% moderate TBI, and 4% severe TBI.
- Of the Service Members denoted as TBI cases with a brain injury coded with AIS08, 14.5% sustained a co-occurring lung injury and 24% sustained a co-occurring internal ear injury. Alternatively, there were only 3% of SM with internal ear injuries and no brain injury.
 - Therefore, ear injuries such as ear drum rupture and tinnitus are useful indicators of higher severity blast injury and TBI exposure. Quickly identifying SM with ear injuries for additional screening/treatment may aid in TBI identification and may offer insights in the mitigation of brain injuries from BOP.

Acknowledgements:

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References:

- [1] U.S. Department of Defense, Office of the Deputy Secretary of Defense. "Department of Defense Requirements for Managing Brain Health Risks from Blast Overpressure." Memorandum, August 9, 2024.
- [2] U.S. Marine Corps, Naval Safety Command. Ground Warrior: The Marine Corps Ground and Naval Expeditionary Warfare Safety Magazine. "Blast Overpressure." Winter 2024 Issue.
- [3] Association for the Advancement of Automotive Medicine. Abbreviated Injury Scale (c) 2005 Update 2008. (T. Gennarelli, & E. Woodzin, Eds.). Chicago, Illinois, 2008.