Training Matters

Psychiatric Outcomes Following Blast Exposure are Different Across Military Occupational Specialty

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Disclaimer

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The authors declare no conflicts of interest

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MID-ATLANTIC MIRECC POST DEPLOYMENT MENTAL HEALTH

Long-term Effects of Blast

Psychiatric Symptoms

- Posttraumatic Stress
- Depression
- Neurobehavioral

Brain Structure and Function

- Lower Hippocampal Volume
- Blast mild TBI alters functional connectome

Cognitive Function

- No independent effects beyond PTSD or mild TBI
- Exacerbates effects of mild TBI on attention

Martindale et al., 2020; Martindale et al., 2021a; Martindale et al., 2021b; Rowland et al., 2021

Characterization of Blast

TBI Interviews with Blast Measurement

Boston Assessment of TBI – Lifetime (BAT-L)
Mid-Atlantic MIRECC Assessment of TBI (MMA-TBI)
Virginia Commonwealth University (VCU) retrospective Concussion Diagnostic Interview, Blast version (VCU-rCDI-B)

Occupational Blast Measures

Blast Exposure Threshold Survey (BETS)
Blast Frequency and Symptom Severity (B-FASS)
Blast Ordnance and Occupational Exposure Measure (BOOM)
SOCOM Assessment of Blast Exposure (SABE)

Proxy Measures

Military Occupational Specialty (MOS)
Explosive Ordnance Disposal (EOD) Training

Blast Sensors/Gauges

Definition of Severity

Frequency
Distance
Pressure
Risk Level
Direct Measurement of Force

Belding et al., 2020; Bliese et al., 2008; Fortier et al., 2014; Kuchinsky et al., 2021; Rowland et al., 2020; Sours Rhodes et al., 2022; Walker et al., 2015

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MID-ATLANTIC MIRECC POST DEPLOYMENT MENTAL HEALTH

MOS Blast Risk

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ORIGINAL ARTICLE CLINICAL STUDIES

Validation of Military Occupational Specialty as a Proxy for Blast Exposure Using the Salisbury Blast Interview

Sarah L. Martindale,[1,2,*,**] Jennifer N. Belding,[3] Cameron D. Crawford,[1] and Jared A. Rowland[1,2]

Abstract

Evaluating large data sets precludes the ability to directly measure individual experiences, instead relying on proxies to infer certain constructs. Blast exposure is a construct of study currently in its infancy, resulting in diverse definitions and measurements across studies. The purpose of the present study was to validate military occupational specialty (MOS) as a proxy for blast exposure in combat veterans. A total of 256 veterans (86.33% male) completed the Salisbury Blast Interview (SBI) and Mid-Atlantic Mental Illness Research Education and Clinical Center (MIRECC) Assessment of Traumatic Brain Injury (MMA-TBI). MOS was collected through record review and categorized into low and high risk for blast exposure. Chi-square analyses and *t* tests compared SBI metrics between MOS categories. Receiver operating characteristic (ROC) analyses evaluated the diagnostic accuracy of MOS category in determining blast exposure severity. Veterans in high-risk MOS were more likely to have experienced blast and deployment TBI ($ps < 0.001$) than were those in low-risk MOS. ROC analyses indicated good specificity (81.29–88.00) for blast and deployment TBI outcomes, suggesting that low-risk MOS is generally associated with an absence of blast and deployment TBI outcomes. Sensitivity was low (36.46–51.14), indicating that MOS risk level was not a good predictor of the presence of these outcomes. Results demonstrate that high-risk MOSs will identify individuals with blast exposure and deployment TBI history whereas low-risk MOSs will capture a highly variable group. Accuracy of MOS categorization was not acceptable for diagnostic-level tests; however, results support its use as a screening measure for a history of exposure to blast, use in epidemiological studies, and considerations for military policy.

Keywords: blast; measurement; military; military occupational specialty; traumatic brain injury; veteran

Introduction

Despite advances in the conceptualization of blast exposure, the ideal way to measure blast exposure has not been established. A recent review[1] highlighted the measures currently available to characterize low-level blast (LLB) (overpressure from outgoing munitions) exposure, most of which are instruments that quantify the frequency of an individual's exposure to specific munitions and occupational events. Though these are effective at estimating potential cumulative exposure to non-concussive overpressure across a military career, these instruments are largely restricted to quantifying frequency of LLB

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**Please contact the corresponding author for a comprehensive list of publications from the present study.

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Risk Category	Examples
High-risk category	
Ammunition and explosive ordnance disposal	2311; EOD Support
Field artillery	0811; Cannoneer
Infantry	0311; Machine Gunner
Tank and assault amphibious vehicle	1812; M1A1 Tank Crewman
Moderate-risk category	
Airfield services	7011; Aircraft Recovery
Aviation ordnance	6531; Aviation Ordnance Tech
Chemical, biological, radiological, and nuclear (CBRN) defense	5711; NBC Chief
Combat camera	4612; Combat Videography
Engineer, construction, facilities, and equipment	1345; Heavy Equipment Operator
Ground ordnance maintenance	2111; Small Arms Repairman
Marine air-ground task force (MAGTF)	0511; Civil Affairs
Military police	5811; Detainee Ops
Motor transportation	3521; Motor T Mechanic
Navigation officer and flight crew	7314; UAV Operator
Public Affairs	4341; Combat Correspondent
Low-risk category	
Air control and support	7234; Air Traffic Control
Aircraft maintenance	6019; F/A 18 Airframe Mechanic
Aviation logistics	6672; Aviation Supply Clerk
Avionics	6317; Avionicsman
Communications	0612; Radio Operator
Electronics maintenance	5939; ATC Radar Technician
Financial management	3432; Disbursing Clerk
Food service	3381; Cook
Ground electronics maintenance	2823; Calibration Technician
Intelligence	0211; Intel Operations Specialist
Legal services	4421; Legal Clerk
Linguist	2799; Translator
Logistics	0411; Embarkation Specialist
Marine corps community services (MCCS)	4133; PX
	6842; METOC Forecaster
	8012; Career Planner
	5519; Musician
	0151; Admin Clerk
	2611; Crypto Tech
	3043; Warehouseman
	3112; Traffic Management Specialist
	0931; Trainer
	1141; Basic Hygiene Operator
	0311/5811; Logistics and Martial Arts Instructor
	0000; Platoon Sergeant
	13130; Expeditor
Total	

SBI Pressure Change/Gradient Scale	
0	none
1	slightly, noticeable but not uncomfortable
2	noticeable and uncomfortable
3	moderately, results in minor pain or alteration of function
4	resulted in minor injury
5	strongly, resulted in greater than minor injury

Belding et al., 2020; Martindale et al., 2023; Rowland et al., 2021

MOS Blast Risk

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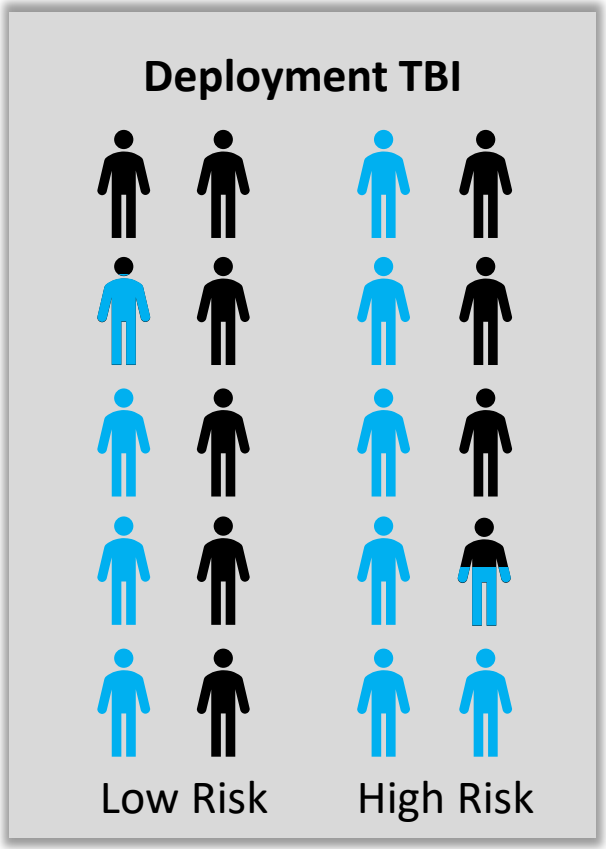
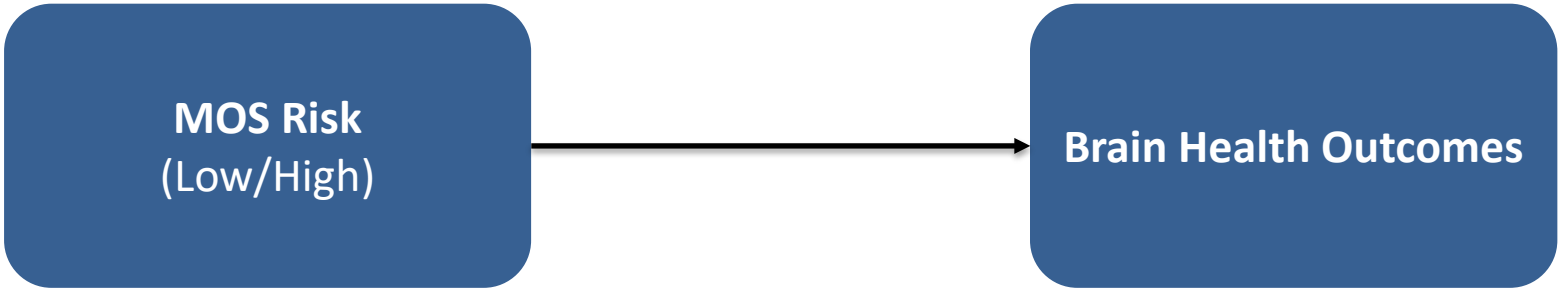
24% of low risk MOS
60% of high risk MOS



38% of low risk MOS
65% of high risk MOS

Purpose

Determine how differences in brain health outcomes (psychiatric symptoms, sleep quality, and quality of life) across MOS risk categories are influenced by TBI and blast exposure history.



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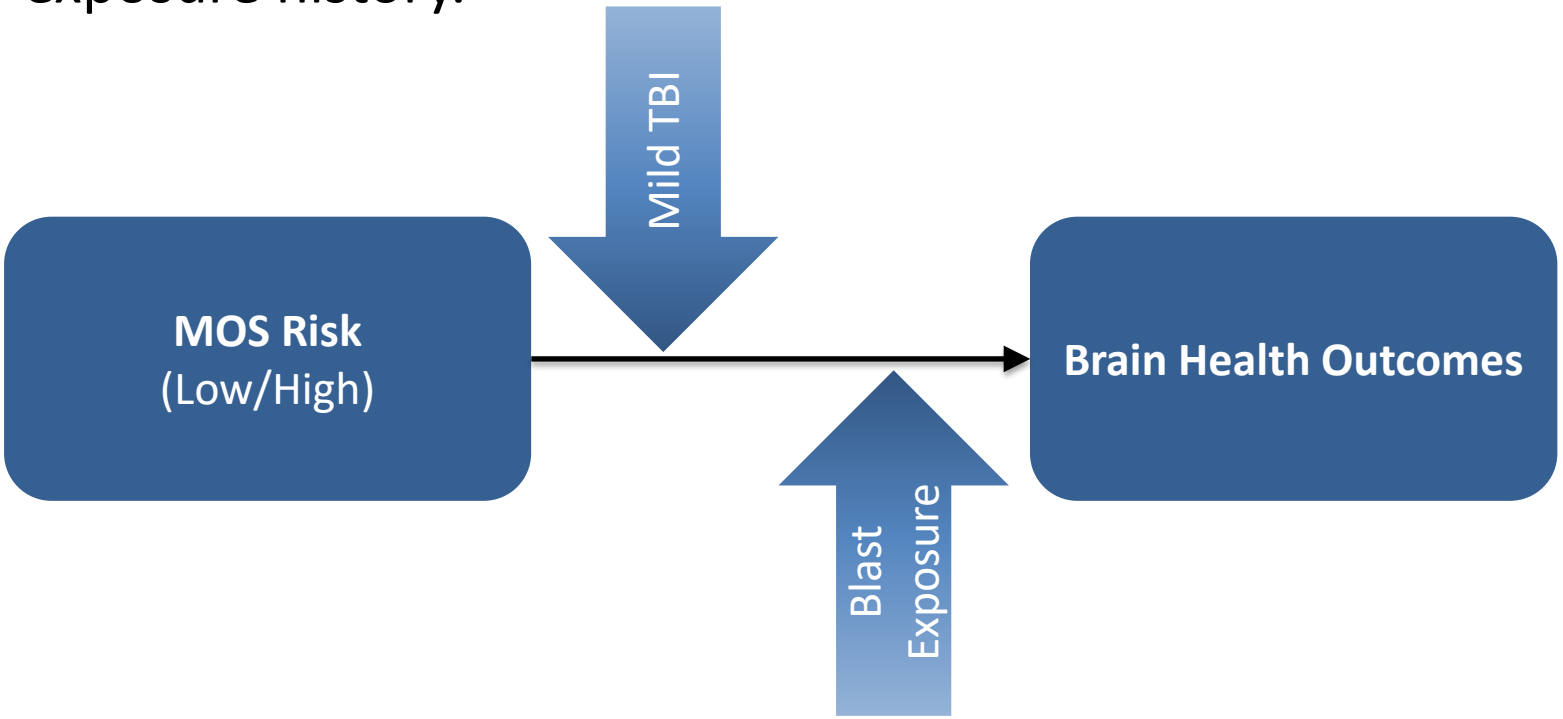

Method

Study 34 – Chronic Effects of Neurotrauma Consortium (CENC)

N = 256

Inclusion: combat exposure during deployment in support of OEF/OIF/OND, able to provide informed consent, and able to comply with instructions to complete study tasks

Exclusion: moderate to severe TBI, penetrating head injury, non-deployment TBI with LOC, neurologic disorder, psychotic symptoms, symptom validity failure (SIMS), neuroimaging contraindications

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Military Occupational Specialty (MOS) Risk Level (Belding et al., 2020)

Salisbury Blast Interview (SBI) (Rowland et al., 2020a)

Mid-Atlantic MIRECC Assessment of TBI (MMA-TBI) (Rowland et al., 2020b)

NSI

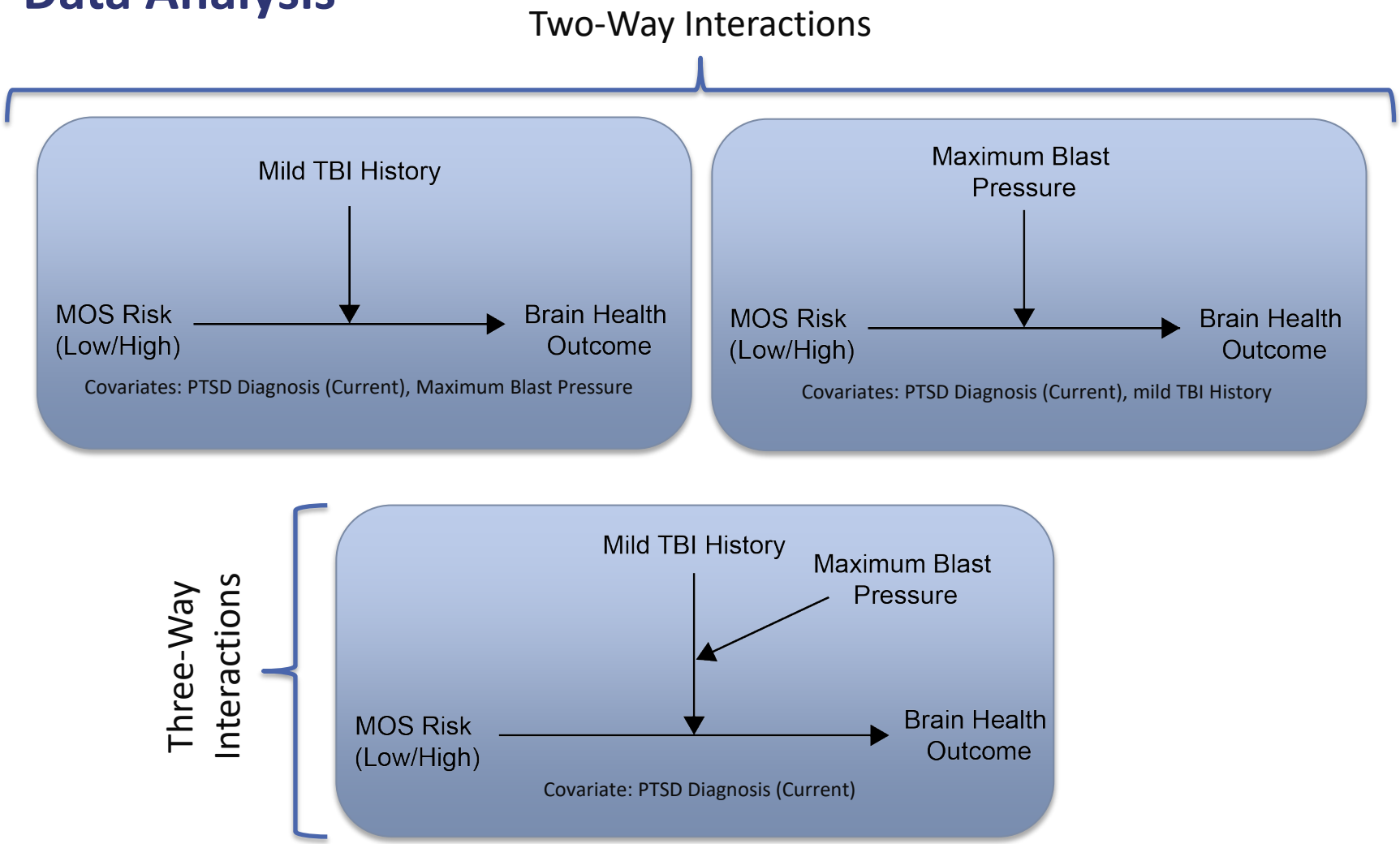
PCL-5

PHQ-9

PSQI

QOLIBRI

Data Analysis



Results

Table 1. Sample Characteristics ($n = 256$)

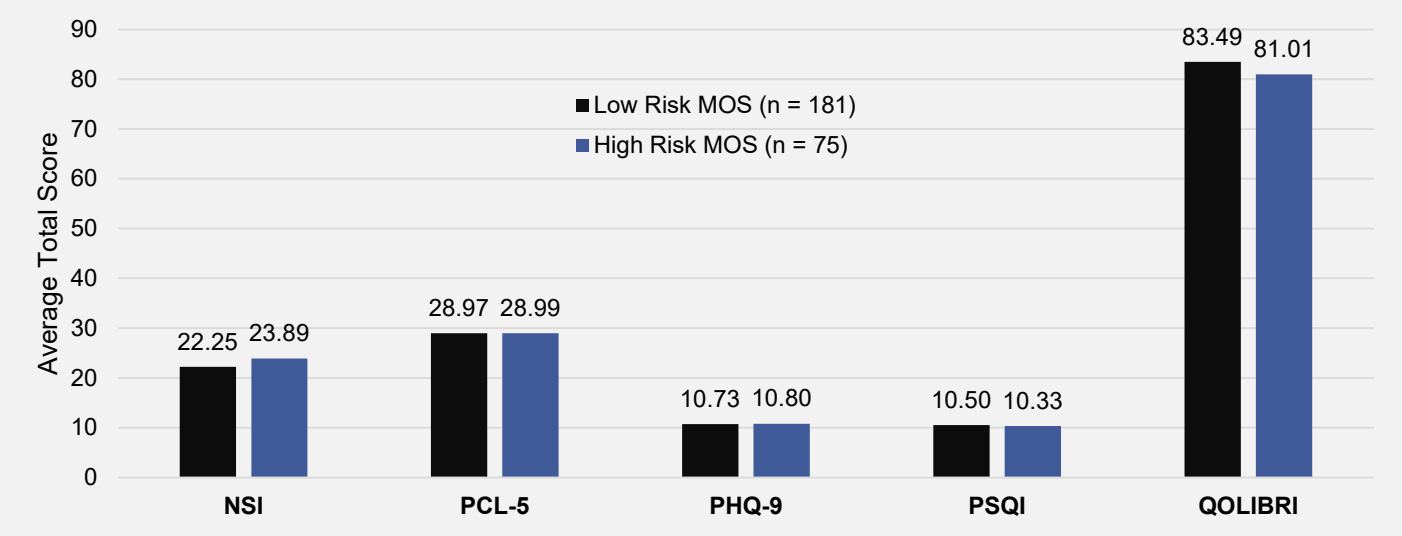
	Total (n = 256)		*Low risk MOS (n = 181)*		*High risk MOS (n = 75)*		
	n	%	n	%	n	%	p
Branch of service							0.002
Air force	26	10.16	25	13.81	1	1.33	
Army	182	71.09	124	68.51	58	77.33	
Marines	28	10.94	15	8.29	13	17.33	
Navy	20	7.81	17	9.39	3	4.00	
Sex							0.001
Male	221	86.33	148	81.77	73	97.33	
Female	35	13.67	33	18.23	2	2.67	
Race and ethnicity[a]							< 0.001
Asian	1	0.39	1	0.55	0	0.00	
Black or African American	96	37.50	83	45.86	13	17.33	
Hispanic or Latino	14	5.47	12	6.63	2	2.67	
Native American	4	1.56	3	1.66	1	1.33	
White	150	58.59	90	49.72	60	80.00	
Years since deployment (M, SD)	9.56	3.65	9.61	3.87	9.46	3.06	0.780
Combat exposure (M, SD)	38.39	17.63	31.59	13.62	46.28	14.95	< 0.001
Blast exposed	181	70.70	115	63.54	66	88.00	< 0.001
Greater severity blast exposed	89	34.77	44	24.31	45	60.00	< 0.001
Deployment TBI	117	77.73	68	37.57	49	65.33	< 0.001
Blast TBI	88	34.38	43	23.76	45	60.00	< 0.001
Lifetime PTSD diagnosis	152	59.38	105	58.01	47	62.67	0.521

[a]Categories are not mutually exclusive.

P values are provided from χ^2 analyses or independent samples *t* tests. Combat exposure is represented by the total score of the Deployment Risk and Resiliency Inventory, Second Edition, Section D (DRRI-2-D); Blast exposed is positive if subject experienced a blast with pressure of ≥1. Greater severity blast exposed is positive if subject experienced a blast with pressure of ≥3. MOS, military occupational specialty; M, mean; SD, standard deviation; TBI, traumatic brain injury; deployment TBI, history of experiencing a TBI during a deployment; blast TBI, deployment TBI caused by primary blast forces; PTSD, post-traumatic stress disorder.

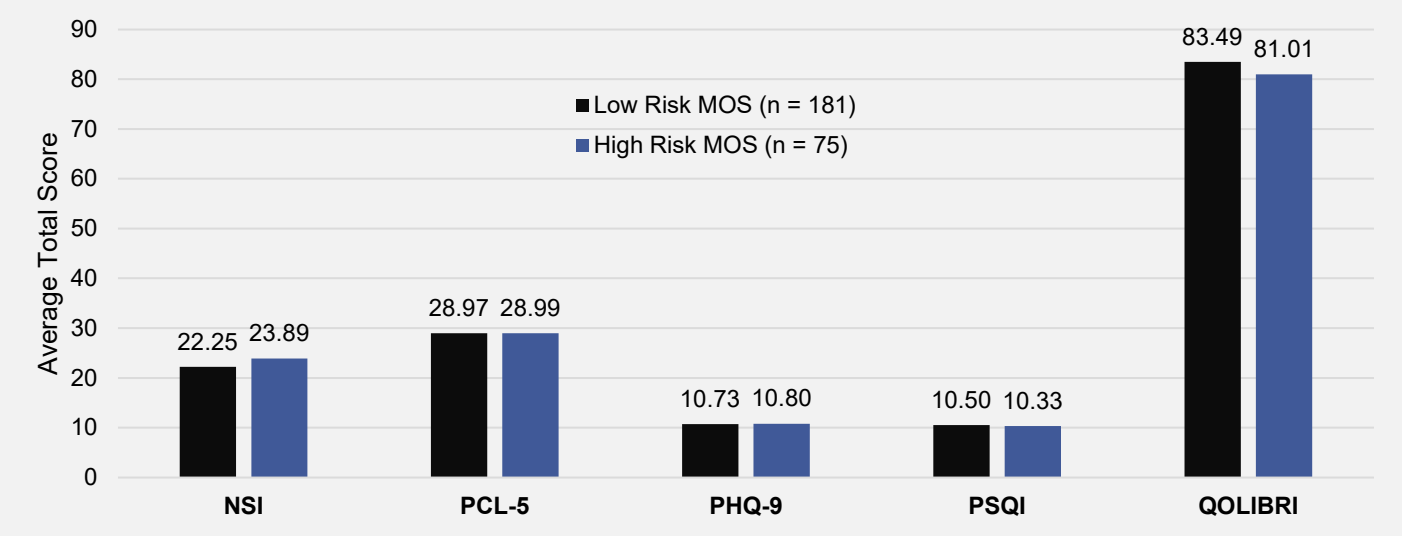
Martindale et al., 2023

Results
Comparing MOS Risk Categories



Brain Health Outcomes	Low Risk MOS (*n* = 181)		High Risk MOS (*n* = 75)		*t*	*p*
	M	SD	*M*	SD		
NSI	22.25	15.81	23.89	14.66	-0.77	.440
PCL-5	28.97	18.94	28.99	17.58	-0.01	.996
PHQ-9	10.73	6.62	10.80	6.92	-0.08	.939
PSQI	10.50	4.28	10.33	4.23	0.28	.780
QOLIBRI	83.49	28.81	81.01	29.01	0.62	.533

Results
Comparing MOS Risk Categories



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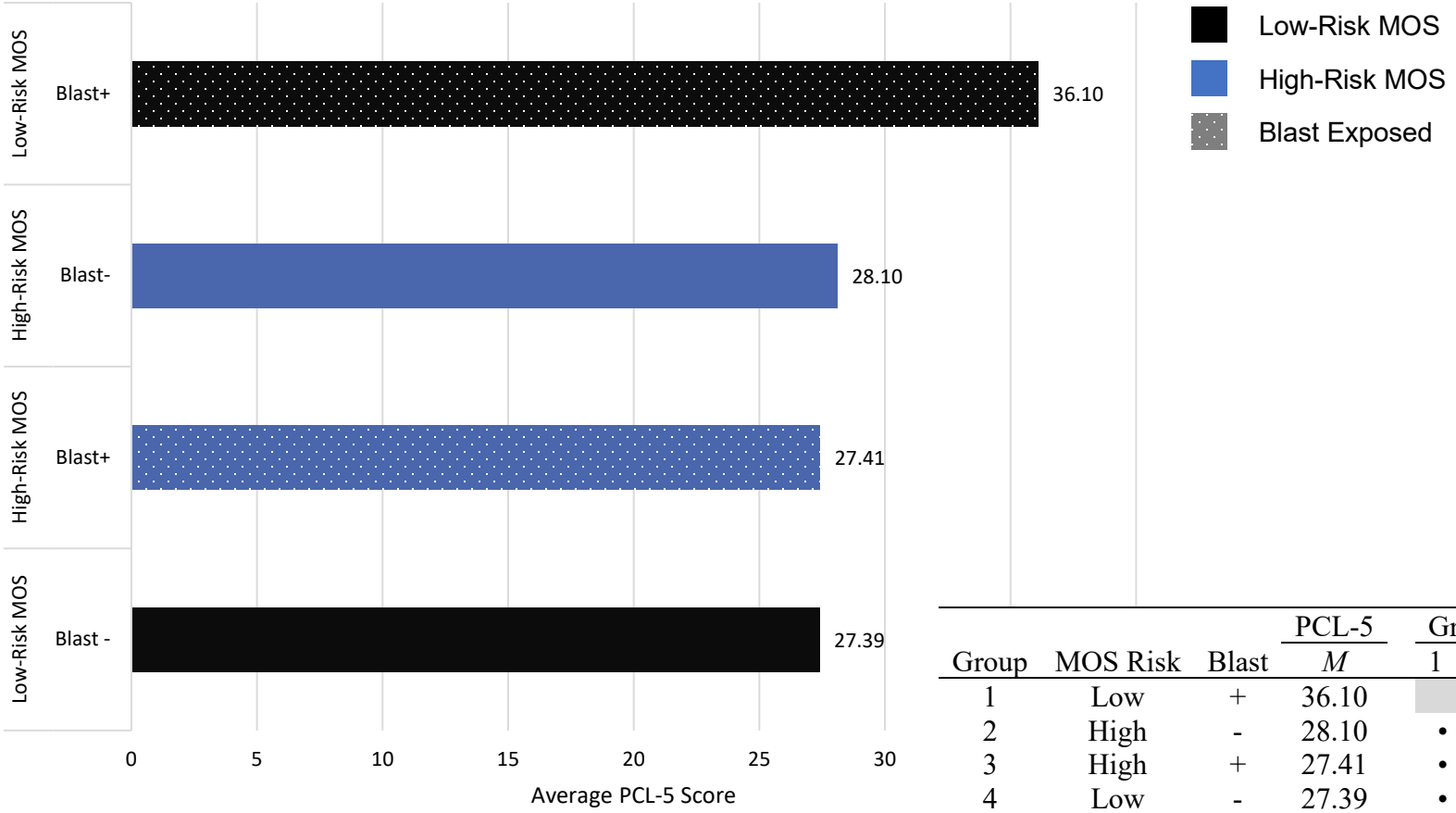
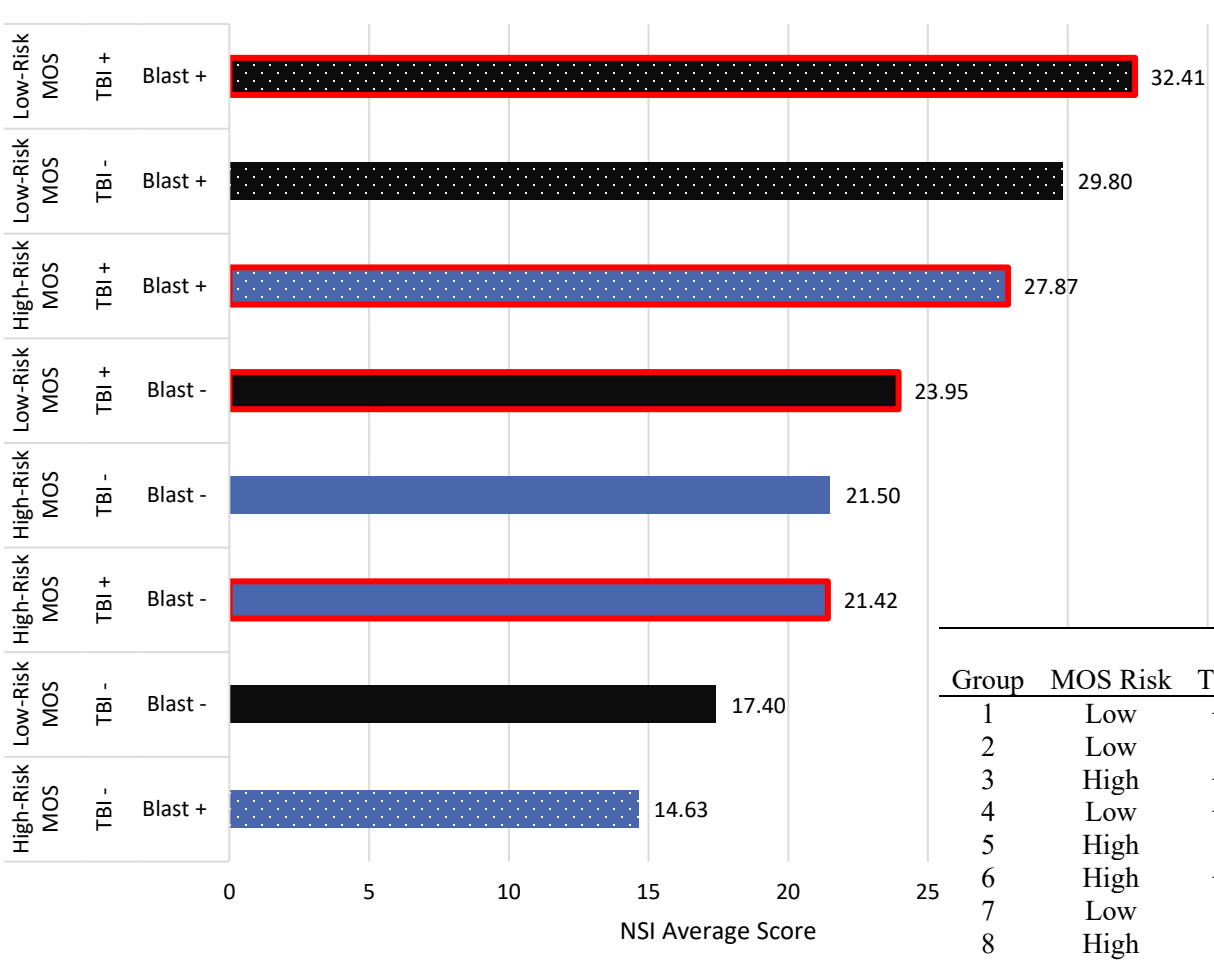
Results
Two-Way Interaction: PCL-5



Group	MOS Risk	Blast	PCL-5 *M*	Group Contrasts 1	2	3	4
1	Low	+	36.10		•	•	•
2	High	-	28.10	•			
3	High	+	27.41	•			
4	Low	-	27.39	•			

• = significant differences between means at $p < .05$

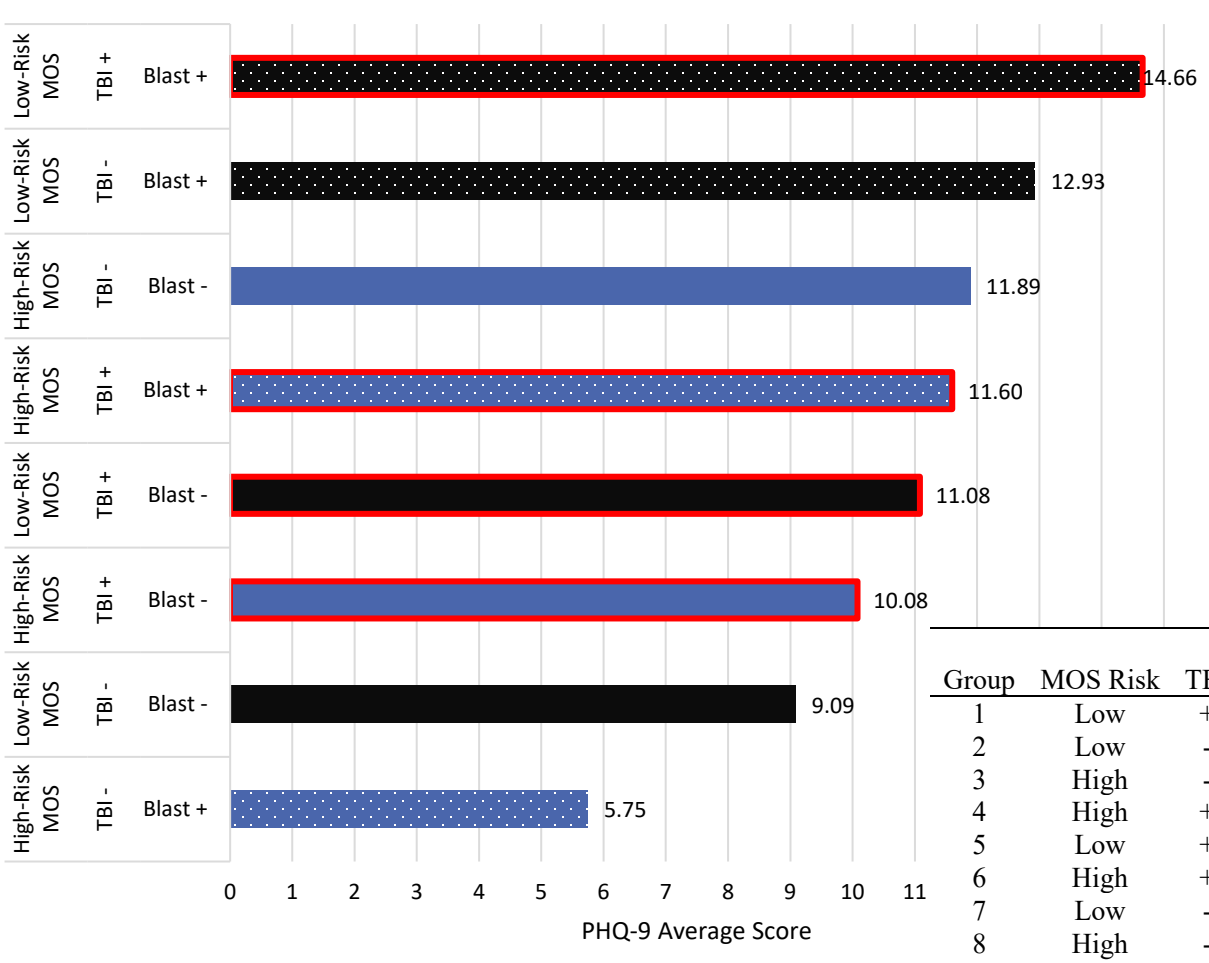
Results
Three-Way Interactions: NSI

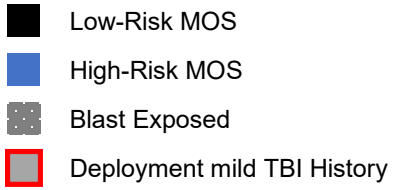


Group	MOS Risk	TBI	Blast	NSI *M*	Group Contrasts 1	2	3	4	5	6	7	8
1	Low	+	+	32.41				•	•	•	•	•
2	Low	-	+	29.80							•	•
3	High	+	+	27.87							•	•
4	Low	+	-	23.95	•						•	
5	High	-	-	21.50	•							
6	High	+	-	21.42	•							
7	Low	-	-	17.41	•	•	•	•				
8	High	-	+	14.63	•	•	•					

• = significant differences between means at $p < .05$

Results
Three-Way Interactions: PHQ-9

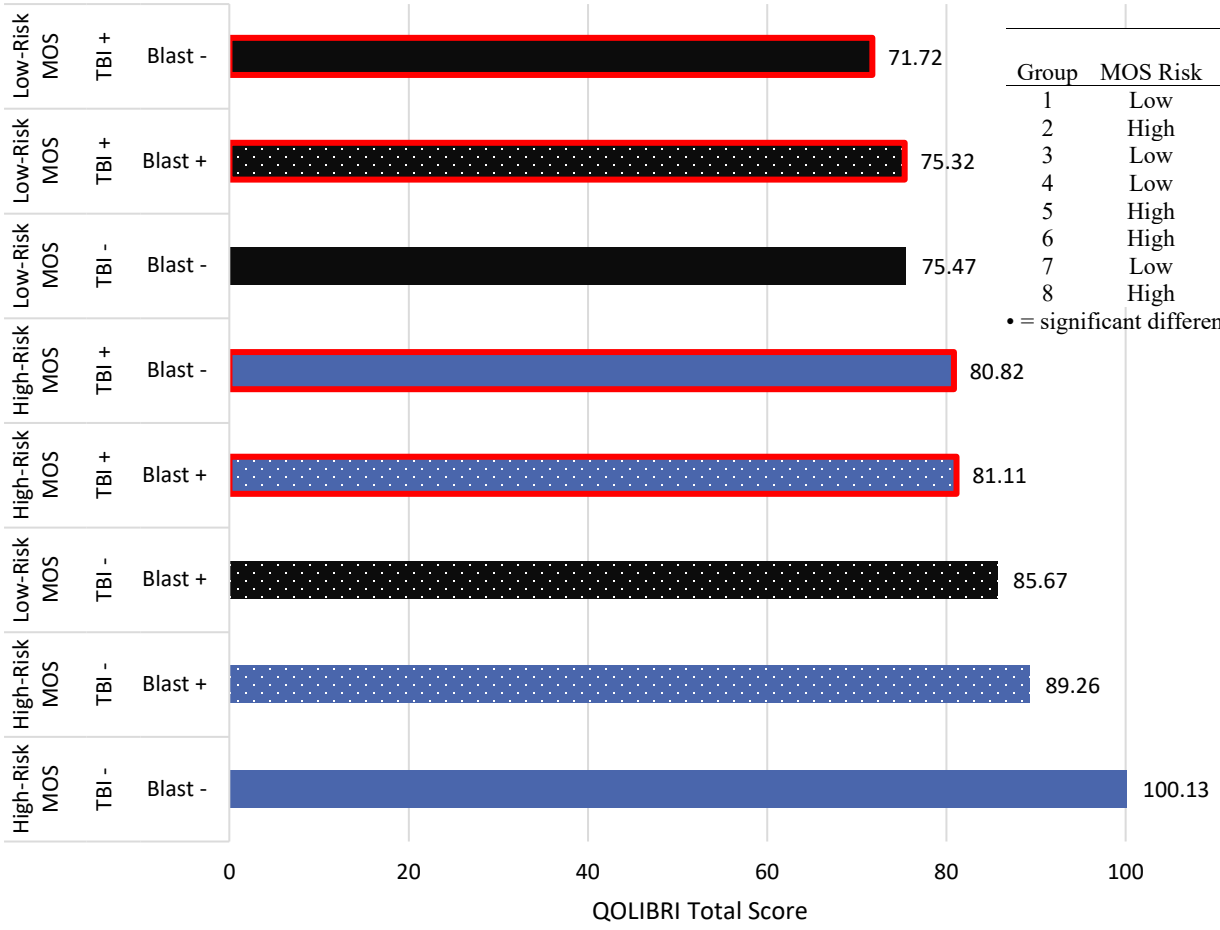




Group	MOS Risk	TBI	Blast	PHQ-9 *M*	Group Contrasts 1	2	3	4	5	6	7	8
1	Low	+	+	14.66					•	•	•	•
2	Low	-	+	12.93							•	•
3	High	-	-	11.89								•
4	High	+	+	11.60							•	•
5	Low	+	-	11.08	•							•
6	High	+	-	10.08	•							
7	Low	-	-	9.09	•	•		•				
8	High	-	+	5.75	•	•	•	•	•			

• = significant differences between means at $p < .05$

Results
Three-Way Interactions: QOLBRI

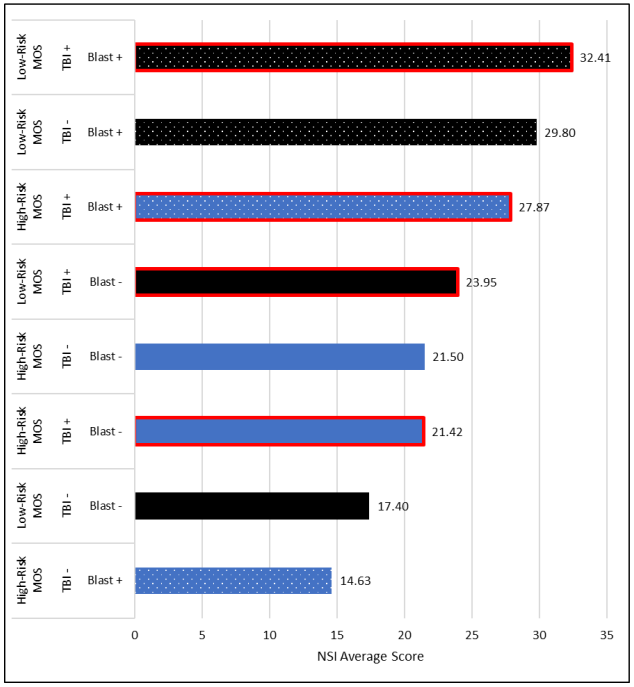


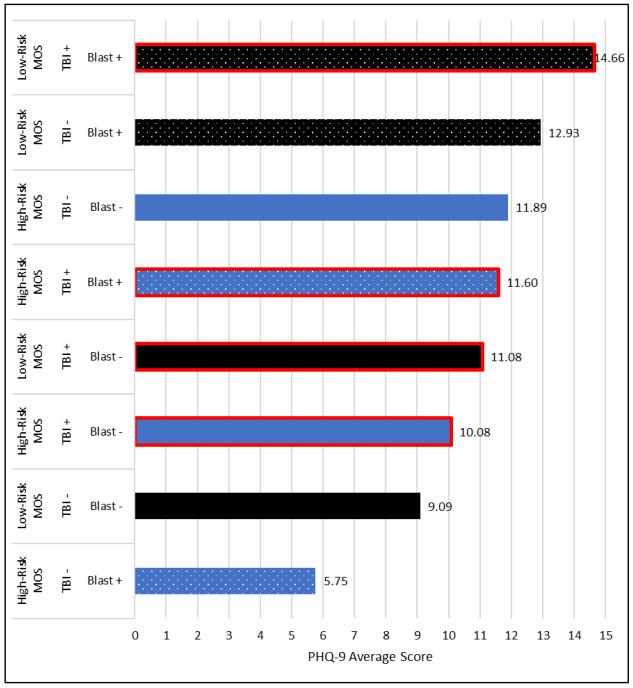
Group	MOS Risk	TBI	Blast	QOLIBRI *M*	Group Contrasts 1	2	3	4	5	6	7	8
1	Low	+	+	71.72							•	•
2	High	+	+	75.32							•	•
3	Low	-	+	75.47								•
4	Low	+	-	80.82								
5	High	-	-	81.11								
6	High	+	-	85.67								
7	Low	-	-	89.26	•	•						
8	High	-	+	100.13	•	•	•					

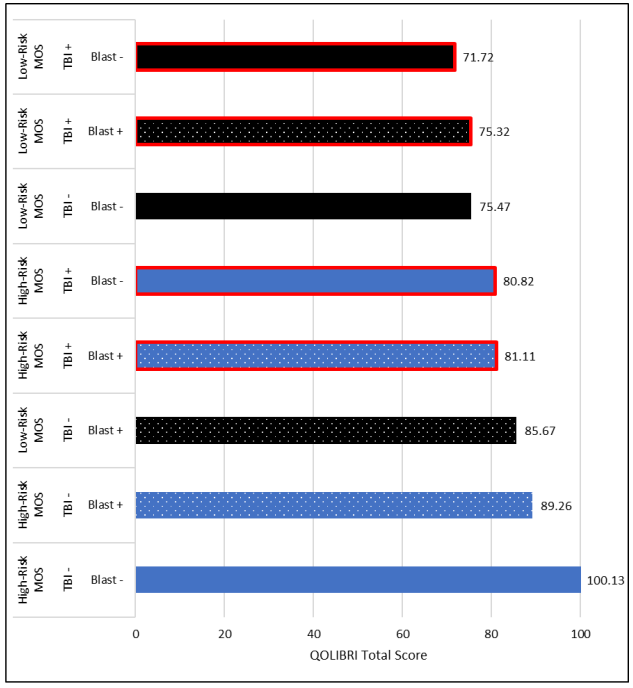
• = significant differences between means at $p < .05$

Low-Risk MOS
High-Risk MOS
Blast Exposed
Deployment mild TBI History

Results
Three-Way Interactions







Low-Risk MOS High-Risk MOS Blast Exposed Deployment TBI History

Take-Home

Service members in Low-Risk MOS may be vulnerable to long-term *psychological* effects of blast exposure.

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MID ATLANTIC MIRECC POST DEPLOYMENT MENTAL HEALTH

Discussion

Sample

- *N* = 256
- Combat Veterans
- Majority Army

Discussion

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Risk Level
Direct Measurement of Force

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- Preparation
- Education
- Policy

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Training

- Preparation
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- Policy

Treatment

- Screening
- Identification
- Monitoring
- Intervention

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