

Military History and Post-Traumatic Stress in Former American Football Players: Modeling Contributions to Clinical Outcomes

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Background

- Repetitive head impact (**RHI**) exposure through contact sports (American football) or other sources (military service) is associated with later-life cognitive decline and neurobehavioral dysregulation
- Understanding the overlapping contributions of multiple RHI exposure sources is critical

Objective

Investigate associations among military history, years of American football play, post-traumatic stress disorder (**PTSD**) and cognitive and neuropsychiatric function.

Methods

Sample

- Male former American football players (aged ≥ 40) enrolled in the Head Impact & Trauma Surveillance Study (**HITSS**)
 - Included players with and w/o history of military service
- HITSS**: online longitudinal observational study that leverages the Brain Health Registry (BHR)

Measures and Outcome Domains

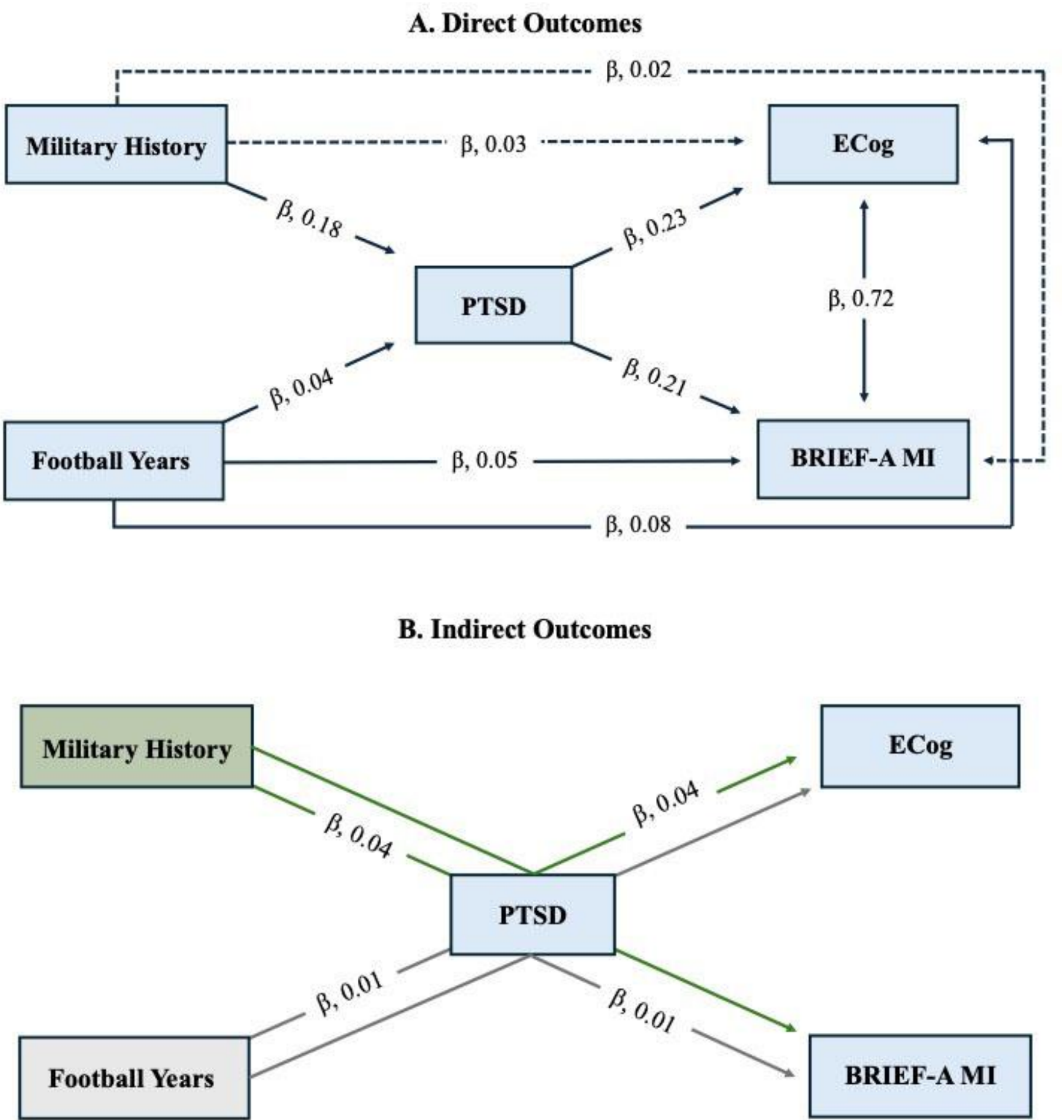
- Boston University RHI Exposure Assessment (BU-RHIEA)
- (1) Self-Report Cognitive Outcomes**: ECog, BRIEF-A MI
- (2) Computerized Cognitive Outcomes**: CANTAB PAL (First Attempt Memory Score [FAMS], Total Errors Adj.)
- (3) Self-Report Neuropsychiatric Outcomes**: GDS-15, BRIEF-A BRI

Statistical Analyses

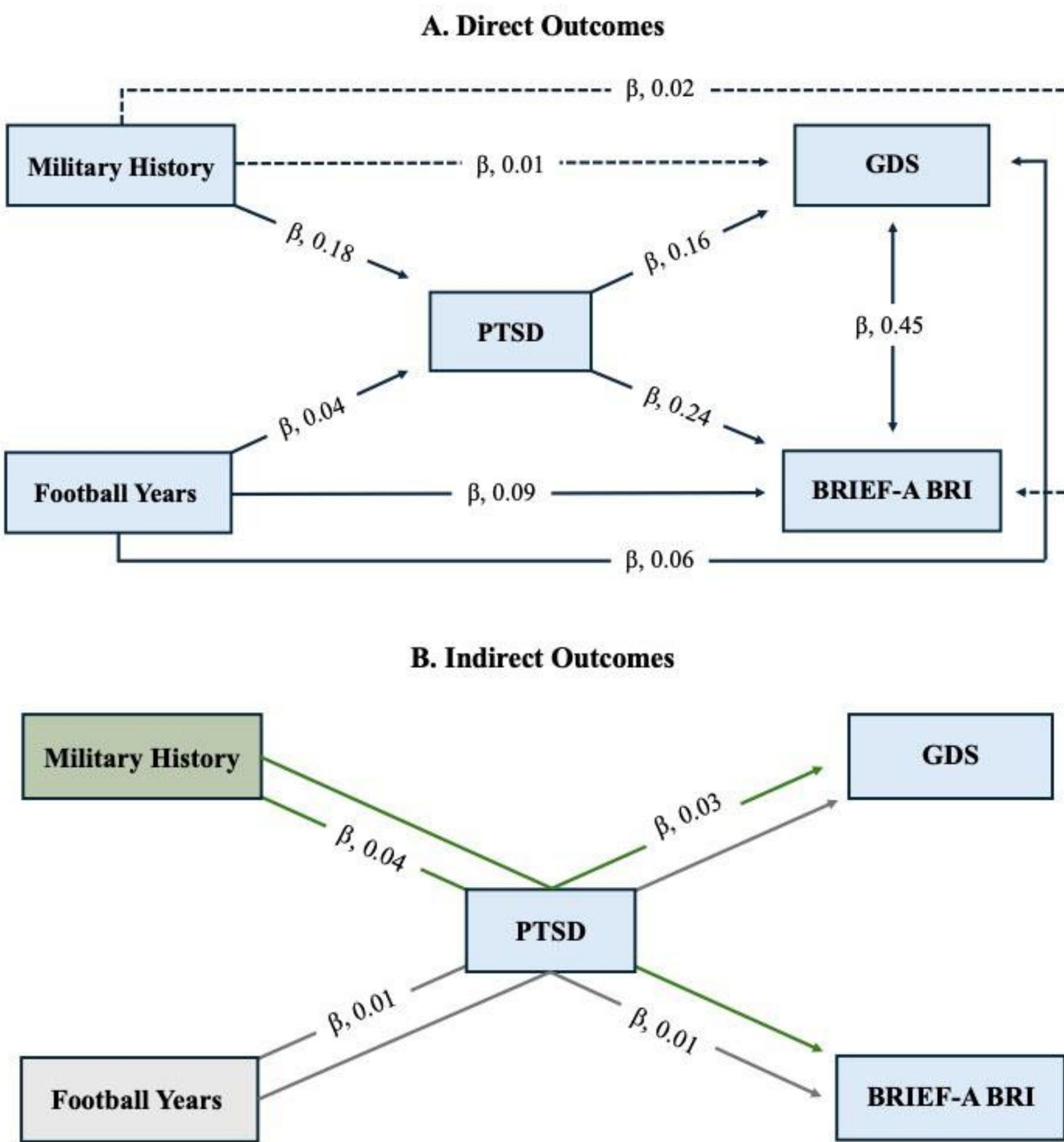
- Simultaneous equation modeling (SEM) examined direct and indirect associations of football years of play (*primary*) and military participation (*secondary*) with outcome domains.
 - PTSD as a correlated intermediate clinical factor
 - Covariates*: age, self-identified racial group, education, vascular composite
- Models fit across three outcome domains. Z-scores used.
- Follow-Up*: military participation replaced with military-related RHI exposure metrics

Results

(1) Self-Report Cognitive Outcomes



(3) Self-Report Neuropsychiatric Outcomes



(2) Computerized Cognitive Outcomes

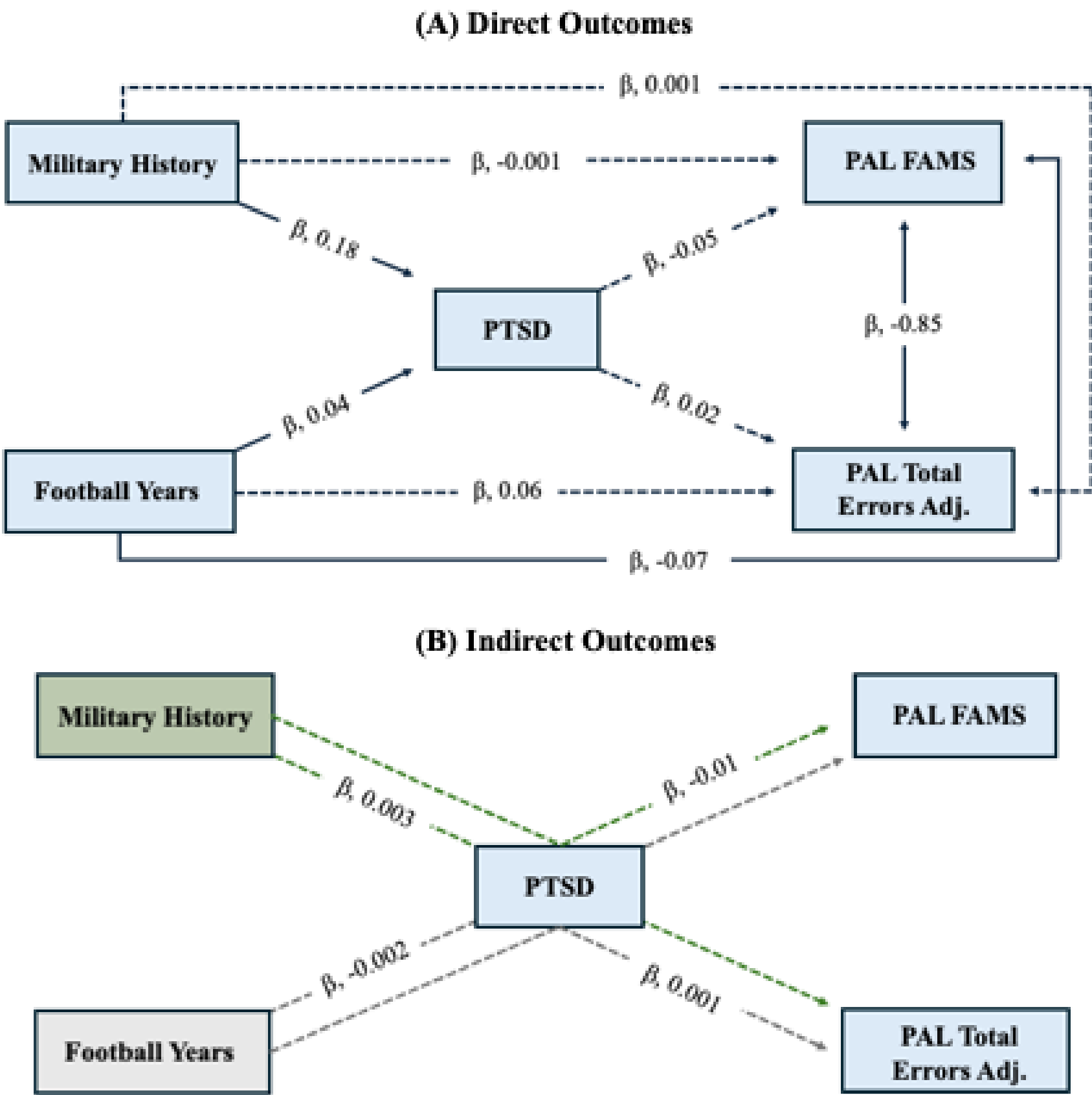


Figure Interpretation

- β values**: standardized estimates, interpreted as changes in SD units.
- Dashed lines**: not significant relationships
- Solid Lines**: statistically significant relationships
- (A)** Direct findings; **(B)** Indirect findings

Findings

- Greater years of football play directly associated with higher self-reported cognitive **(1)**, neuropsychiatric **(2)** scores and PAL FAMS **(3)**.
- Military participation not directly associated with any outcome.
- Military history indirectly associated with self-reported cognitive **(1)** and neuropsychiatric **(2)** outcomes.
- Military-related metrics of RHI exposure (combat history, breaching training, combatant training, counter-IED training) mirrored overall military participation.

Conclusions

- Years of football play were directly associated with later-life cognitive and neuropsychiatric outcomes.
- History of military service may contribute to long-term cognitive/neuropsychiatric vulnerability in former football players, potentially through mechanisms involving PTSD
- Helps clarify risk factors and patterns of vulnerability underlying cognitive and neuropsychiatric outcomes.
- Lays the groundwork for future clinician guidance for assessing and managing individuals with complex RHI exposure histories.

Sample

Demographics

	n	Total (n=3,055)	No Military History (n=2,680)	Military History (n=375)	p-value ²
Demographics					
Age (years) ¹	3,055	56.76 (10.18)	56.30 (9.95)	60.01 (11.14)	<0.001
Self-Reported	3,055	213 (7.0%)	185 (6.9%)	28 (7.5%)	0.69
Race: Black n(%)					
Education ¹	3,055				0.25
Up to High School		87 (2.8%)	78 (2.9%)	9 (2.4%)	
Some College		1,736 (57%)	1,508 (56%)	228 (61%)	
Advanced Degree		1,234 (40%)	1,094 (41%)	138 (38%)	
Medical History					
Vascular Composite Score	3,055				0.002
0		1,013 (33%)	914 (34%)	99 (26%)	
1		875 (29%)	775 (29%)	100 (27%)	
2		682 (22%)	584 (22%)	98 (26%)	
3		385 (13%)	326 (12%)	59 (16%)	
4		100 (3.3%)	81 (3.0%)	19 (5.1%)	
PTSD	3,055	348 (11%)	247 (9.2%)	101 (27%)	<0.001

RHI Exposure

	n	Total (n=3,055)	No Military History (n=2,680)	Military History (n=375)	p-value ²
Football History					
Total Years Played	3,055	9.36 (6.13)	9.40 (6.10)	9.09 (6.34)	0.10
Highest Level	3,025				<0.001
Pro/Semi-Pro		370 (12%)	325 (12%)	45 (12%)	
College		1,128 (37%)	1,035 (39%)	93 (25%)	
High School		1,324 (44%)	1,114 (42%)	210 (56%)	
Youth		203 (6.7%)	179 (6.10%)	24 (6.5%)	
Military History					
Age Entered	374	20.21 (3.87)	NA	20.21 (3.87)	
Total Years in Military	3,055	1.04 (4.13)	0.00 (0.00)	8.46 (8.72)	<0.001
Breaching Training	3,003	115 (3.8%)	0 (0%)	115 (36%)	<0.001
Counter-IED Training	3,037	84 (2.8%)	0 (0%)	84 (24%)	<0.001
Combatant Training	3,034	247 (8.1%)	0 (0%)	247 (70%)	<0.001
Combat	3,043	105 (3.5%)	0 (0%)	105 (29%)	<0.001
Years of Combat	83	2.42 (3.36)	NA	2.42 (3.36)	

Outcome Measures

	n	Total (n=3,055)	No Military History (n=2,680)	Military History (n=375)	p-value ²
Cognitive Outcomes					
ECOG Raw Score*	2,200	58.87 (20.46)	58.39 (20.09)	62.37 (22.76)	0.008
ECOG Z-Score	2,200	0.00 (1.00)	-0.02 (0.98)	0.17 (1.11)	0.008
BRIEF-A MI Raw Score	2,912	63.85 (17.00)	63.56 (16.93)	65.94 (17.36)	0.015
BRIEF-A MI Z-Score	2,912	0.00 (1.00)	-0.02 (1.00)	0.12 (1.02)	0.015
PAL FAMS	986	12.45 (4.18)	12.55 (4.10)	11.75 (4.62)	0.077
PAL FAMS Z-Score	986	0.00 (1.00)	0.02 (0.98)	-0.17 (1.11)	0.077
PAL Total Errors Adj.	986	15.87 (13.62)	15.56 (13.33)	18.07 (15.44)	0.15
PAL Total Errors Adj. Z-Score	986	0.00 (1.00)	-0.02 (0.98)	0.16 (1.13)	0.15
Neuropsychiatric Outcomes					
GDS-15 Raw Score	2,509	6.37 (1.89)	6.36 (1.89)	6.48 (1.88)	0.24
GDS-15 Z-Score	2,509	0.00 (1.00)	-0.01 (1.00)	0.06 (1.00)	0.24
BRIEF-A BRI Raw	2,912	47.01 (12.46)	46.84 (12.37)	48.25 (12.98)	0.060
BRIEF-A BRI Z-Score	2,912	0.00 (1.00)	-0.01 (0.99)	0.10 (1.04)	0.060

Acknowledgements

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Contact info & BU CTE Center Presentation Schedule

