Retrospective and Prospective Associations of Introspective Dysfunction Ratings with Injury Occurrences among College Athletes

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disclose.



- \Box The crucial first step of injury prevention is identification of injury risk 1
- □ The biopsychosocial model recognizes injury risk as multi-factorial²
- Seemingly healthy athletes often report some degree of dysfunction³

Introduction

- \Box Introspective dysfunction ratings have been related to strength asymmetries,⁴ as well as response to training load⁵
- □ Injury history, sleep, and psycho-affective status are highly interrelated²
- Pre-season assessment should include self-ratings of perceived problems⁶



To assess the potential value of introspective dysfunction ratings and self-reported injury history for classification of sport injury risk level among college athletes through both retrospective and prospective associations with injury occurrences.

Methods

- Electronic administration of the Global Well-Being Index (GWBI)
 - Research Electronic Data Capture (REDCap) system
 - 5 categories of Introspective Dysfunction Ratings (IDRs: 0-10)
 - Self-report of any time-loss injury sustained during prior 12 months
 - Self-report of lifetime history of sport-related concussion (SRC)
 - Items pertaining to Negative Life Events and Repetitive Head Impacts
- Prospective injury surveillance for duration of fall sport season
 Core or lower extremity injury (CLEI): joint sprain or muscle strain (chronic or acute) that limited sport participation to any extent



IRB #23-052

2024 Fall Sport Data

Sport	Athletes	HxCLEI*	CLEI	HxSRC*	SRC
Football	97	33	36	30	3
Soccer	26	13	14	12	4
Volleyball	20	5	9	6	5
Total	143	51	59	48	12

20.1 ±1.6 Years (Range: 18-24) 68% (97/143) Male 185.8 ± 5.8 cm 102.4 ±19.9 kg 32% (46/143) Female 172.4 ± 8.9 cm 67.8 ± 9.9 kg

* HxCLEI: Prior 12 Months HxSRC: Lifetime

Global Well-Being Index

Check ($\sqrt{}$) each of the problems listed below that have affected your ability to function or derive maximum enjoyment of life activities in the past couple of years.

1. General Pain or Discomfort

□ Headaches/Pressure in Head □ Neck Pain □ Non-Specific Body Discomfort

2. <u>Sleep-Related Problems</u>

Trouble Falling Asleep

Sleeping Less

□ Fatigue/Drowsiness

- 3. Mood-Related Problems
 - Nervousness/Anxiety
 Sadness/Depression
 Irritability/Stress

Global Well-Being Index

Check ($\sqrt{}$) each of the problems listed below that have affected your ability to function or derive maximum enjoyment of life activities in the past couple of years.

4. <u>Musculoskeletal Problems</u> (During Activities of Daily Living)

□ Aching Discomfort □ Joint Stiffness □ Muscle Spasms/Tightness

5. High-Intensity Performance Limitations

□ Running Speed Limitation □ Explosive Power Limitation □ Endurance Limitation

Global Well-Being Index

Follow-up questions appear if at least 1 problem selected within a given category:



Additional Items Included on GWBI Survey

Negative Life Events

OVER THE PAST 12 MONTHS, to what extent have personal life events created emotional responses, such as SADNESS, DEPRESSION, AND/OR ANXIETY that have interfered with your enjoyment of life, ability to concentrate, and/or fulfillment of routine daily responsibilities?

○ Never ○ Rare ○ Infrequent ○ Occasional ○ Frequent ○ Persistent

Symptoms of Repetitive Head Impacts or Concussions

To what extent have you EVER experienced HEADACHES, VISION PROBLEMS, LOSS OF BALANCE, and/or DIFFICULTY CONCENTRATING as a result of REPEATED HEAD IMPACTS and/or CONCUSSIONS?

○ Not at all ○ Insignificant ○ Marginal ○ Moderate ○ Substantial ○ Severe

Methods: Statistical Analyses

□ Univariable

Receiver operating characteristic and cross-tabulation analyses

- Retrospective: Self-reported SRC (lifetime) and time-loss CLEI (12 mo)
- Prospective: Electronic documentation of any CLEI by athletic trainer

Multivariable

Cox regression (time-to-event) analysis of binary predictors

GWBI-IDR: CLEI Retrospective – Prospective Associations

Retrospective Hx CLEI (12 mo) 36% (51/143)



Prospective CLEI (2024 Season) 41% (59/143)



GWBI-IDR: Retrospective – Prospective Associations

History of Core or Lower Extremity Injury

Previous 12 months (HxCLEI)

		HxCLEI (12 mo)		
		Yes	No	Prevalence
Sleep Problem	≥2	19	15	56%
(0-10)	<2	32	77	29%
	Total	51	92	

Sensitivity: 37% Specificity: 84%

OR = 3.05 (95% CI: 1.38, 6.73)



OR = 2.52 (95% CI: 1.23, 5.18)

Core or Lower Extremity Injury (CLEI)

2024 Season

		CL		
		Yes	No	Incidence
Sleep Problem	≥4	18	13	58%
(0-10)	<4	41	71	37%
	Total	59	84	

Sensitivity: 31% Specificity: 86%

OR = 2.40 (95% CI: 1.07, 5.39)



OR = 2.22 (95% CI: 1.09, 4.51)

Cox Regression Time-to-Event Analysis

Adjusted for Starter Status



Days to CLEI Occurrence



GWBI-IDR: Retrospective – Prospective Associations

History of ≥2 Sport-Related Concussions

Lifetime (HxSRC ≥2)

		HxSRC ≥2		
		Yes	No	Prevalence
Sleep Problem	≥2	8	26	24%
(0-10)	<2	11	98	10%
	Total	19	124	

Sensitivity: 42% Specificity: 79%

OR = 2.74 (95% CI: 1.00, 7.51)



Sensitivity: 32% Specificity: 87%

OR = **3.12** (95% CI: 1.04, 9.37)

Sport-Related Concussion (SRC)

2024 Season



Sensitivity: 33% Specificity: 90%

OR = **4.54** (95% CI: 1.20, 17.16)



Cox Regression Time-to-Event Analysis



Global Well-Being Index: Bivariate Correlations Matrix

		Pain	Sleep	Mood	ADLs	Peak
Pain	Pearson Correlation	<u>ُ</u> *	.298 ***	.367 **	.438 ***	.169
	Sig. (2-tailed)		<.001	<.001	<.001	.044
	Ν	143	143	143	143	143
Sleep	Pearson Correlation	.298 **	`*_	.550"	.306 ^{**}	.276**
	Sig. (2-tailed)	<.001		<.001	<.001	<.001
	N	143	143	143	143	143
Mood	Pearson Correlation	.367 ***	.550 ^{**}	1	.244 ***	.243**
	Sig. (2-tailed)	<.001	<.001		.003	.003
	Ν	143	143	143	143	143
ADLs	Pearson Correlation	.438 ^{**}	.306**	.244	<u>ُ</u> ۲	.449**
	Sig. (2-tailed)	<.001	<.001	.003		<.001
	Ν	143	143	143	143	143
Peak	Pearson Correlation	.169	.276**	.243	.449**	۲, ۲
	Sig. (2-tailed)	.044	<.001	.003	<.001	
	Ν	143	143	143	143	143

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

To what extent have you ever experienced <u>headaches</u>, vision problems, loss of balance, and/or difficulty concentrating from repeated head impacts or concussions?



Retrospective		HxSF		
		Yes	No	<u>Prev.</u>
RHI Symptoms	≥1	7	13	35%
(0-6)	0	12	111	10%
	Total	19	124	
	Sensitivity: 37% Specificity: 90%			
OR = 4,98 (95% CI: 1,67, 14,89)				

Prospective		2024		
FIOSPECTIVE	Yes	No	<u>Prev.</u>	
RHI Symptoms	≥1	5	15	25%
(0-6)	0	7	116	6%
	Total	12	131	
Sensiti		vitv: 42%	Specific	itv: 89%

OR = 5.52 (95% CI: 1.56, 19.62)

Clinical Relevance

- □ Retrospective associations of IDR item-specific scores with CLEI or SRC history suggests incomplete recovery of pre-injury status⁷
 - Item-specific IDRs provide more information than a standard preparticipation injury history inventory (Yes/No responses)
- □ Prospective associations of IDR item-specific scores with CLEI or SRC occurrence indicates that high-risk athletes can be identified
 - Item-specific IDRs might be used to guide delivery of individualized preventive interventions

Clinical Relevance

- \Box Our findings are consistent with those of recent research that has linked sleep duration/quality to injury risk and overall well-being⁸
 - Poorer perceptual decision-making and motor control may affect risk⁹
 - Moderate to severe insomnia prospectively associated with SRC: RR=3.13
 - Daytime sleepiness prospectively associated with SRC: RR=2.86
 - Effect of insufficient sleep on cognitive performance similar to SRC¹⁰
 - Either issue may elevate risk for musculoskeletal injuries
 - Survey responses may distinguish primary source of dysfunction

Clinical Relevance

Administration of a properly designed survey that yields a quantifiable level of self-perceived psychological and physical status can provide an actionable means to deliver individualized interventions for optimized sport performance and well-being.



- 1. Roach MH, et al. Musculoskeletal injury risk stratification: A traffic light system for military service members. *Healthcare* (Basel). 2023;11(12):1675, doi:10.3390/healthcare11121675.
- 2. McClean, ZJ, et al. A biopsychosocial model for understanding training load, fatigue, and musculoskeletal sport injury in university athletes: A scoping review. *J Strength Cond Res*, 38(6), 1177-1188.
- 3. Keogh JA, et al. Monitoring lower limb biomechanical asymmetry and psychological measures in athletic populations—A scoping review. *Scand J Med Sci Sports*. 2023;33(11):2125-2148.
- 4. McClean ZJ, et al. Lower extremity asymmetry values derived from multiple strength testing modes are associated with perceived functional capabilities among university athletes. *Transl Sports Med.* 2024, doi:10.1155/2024/5589056
- 5. Saw AE, et al. Monitoring the athlete training response: subjective self-reported measures trump commonly used objective measures: a systematic review. *Br J Sports Med*. 2016;50(5):281-91.
- 6. Sciascia A, et al. Preseason perceived physical capability and previous injury. J Athl Train. 2015;50(9):937-943.
- 7. Wilkerson GB, et al. A sport fitness index for assessment of sport-related injury risk. Clin J Sports Med. 2016;26(5):423-428.
- 8. von Rosen et al. Multiple factors explain injury risk in adolescent elite athletes: applying a biopsychosocial perspective. *Scand J Med Sci Sports*. 2017;27(12):2059-2069.
- 9. Raikes AC, et al. Insomnia and daytime sleepiness: risk factors for sports-related concussion. Sleep Med. 2019;58:66-74.
- 10. Riegler KE, et al. Sleep deprived or concussed? The acute impact of self-reported insufficient sleep in college athletes. *J Int Neuropsychol Soc.* 2021;27(1):35-46.