Base Rates of Concussion-like Symptoms in Healthy Collegiate Athletes: a Predictive Tool for Post-Concussive Recovery Time

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Introduction

Subjective symptom reporting scales are an essential component of sport-related concussion management, particularly in the absence of more objective methods of assessment and diagnosis. The symptom scales are meant to characterize an athlete's acute symptomology in an effort to monitor post-concussion recovery. Symptoms are grouped in several domains: physical/somatic, insomnia/sleep-related, emotional/mood, and cognitive. These symptom clusters are also identified in the World Health Organization International Classification of Diseases 10 Revision (ICD-10) diagnosis of "Postconcussional Syndrome."

Conceivably, a core assumption of an ICD-10 postconcussional syndrome diagnosis is that the presenting symptoms are directly attributable to the concussion. Evidence suggests this may not always be true. Concussion symptoms are non-specific and are present in a broad range of medical conditions with similar symptomology, as well as in individuals considered medically healthy. If athletes display such symptoms in the pre-injury period or at baseline, they may be at risk for protracted recovery.

Objectives

- Investigate concussion-like symptom reporting at baseline in non-concussed collegiate student athletes
- Determine the relationship of baseline symptom reporting with sex and previous medical conditions, including learning disability (LD) and attention deficit-hyperactivity disorder (ADHD), previous treatment for psychiatric disorder (depression or anxiety), and concussion history (0, 1, or 2+)
- Evaluate the effects of baseline symptom reporting on post-concussion recovery time in a subset of concussed athletes

Methods

Analyzed data came from the University of Florida Concussion Databank (UFCD).
738 collegiate athletes (452 males, 286 females, mean ± SD age 19.3 ± 1.3 years)

- Pre-participation concussion baseline battery (2008-2015)
  - Post-Concussion Scale (PCS; N=361)
  - SCAT3 Symptom Evaluation (S3SE; N=377)
- Self-report medical history form
  - Inquired about relevant conditions such as LD, ADHD, current or past treatment for depression or anxiety, and number of previously diagnosed concussions at the time of baseline evaluation (0,1, or 2+)

Symptoms from the S3SE and PCS were used to determine prevalence rates for ICD-10 postconcussional syndrome-like symptoms at baseline (see **Table #1**).

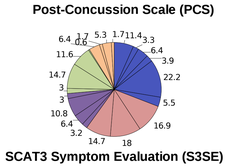
S3SE and PCS data were combined for analyses when symptoms were classified as physical, insomnia, emotional, or cognitive domain. Chi square analyses were used to investigate associations of sex and medical history factors with symptom reporting. Using data available in the UFCD, an independent samples t-test was used to compare post-concussion recovery time for concussed athletes whose baseline symptom reports resembled ICD-10 postconcussional syndrome (N=13) to all other concussed athletes (N=104). An odds ratio and chi square analysis was then used to determine the likelihood of normal (7 or fewer days) versus prolonged recovery (8 or more days) based on baseline ICD-10 postconcussional syndrome symptom status.

Results

SCAT3 Symptom Evaluation (S3SE)				Post-Concussion Scale (PCS)			
Symptom	All S3SEs	Males	Females	Symptom	All PCSs	Males	Females
	N=377	N=192	N=185		N=361	N=260	N=101
Headache[a]	19.1	14.1	24.3	Headache[a]	11.4	8.5	18.8
Pressure in Head[a]	17.0	14.6	19.5	Nausea[a]	3.3	3.1	4.0
Neck Pain[a]	17.2	14.1	20.5	Vomiting[a]	0.6	0.4	1.0
Nausea or Vomiting[a]	2.4	2.1	2.7	Balance Problems[a]	6.4	7.3	4.0
Dizziness[a]	4.0	4.2	3.8	Dizziness[a]	3.9	3.1	5.9
Blurred Vision[a]	3.7	3.1	4.3	Fatigue[a]	22.2	19.6	29.7
Balance Problems[a]	3.4	3.1	3.8	Trouble Falling Asleep[b]	16.9	16.2	18.8
Sensitivity to Light[a]	6.4	4.7	8.1	Sleeping More[a]	6.4	5.8	7.9
Sensitivity to Noise[a]	5.0	3.1	7.0	Sleeping Less[b]	18.0	16.9	20.8
Feeling Slowed Down[a]	12.5	10.9	14.1	Drowsiness[b]	14.7	13.5	17.8
Feeling like "in a fog"[a]	7.2	7.8	6.5	Sensitivity to Light[a]	5.5	6.4	5.9
"Don't feel right"[a]	5.6	5.7	5.4	Sensitivity to Noise[a]	2.5	1.9	4.0
Difficulty Concentrating[d]	14.9	14.6	15.1	Irritability[c]	3.2	4.2	4.0
Difficulty Remembering[d]	11.4	8.3	14.6	Sadness[c]	6.4	5.4	8.9
Fatigue or Low Energy[a]	43.0	36.5	49.7	Nervousness[c]	10.8	8.8	15.8
Confusion[d]	2.4	2.1	2.7	More Emotional[c]	3.0	3.1	3.0
Drowsiness[b]	20.7	19.8	21.6	Numbness or Tingling[e]	1.7	1.5	2.0
Trouble Falling Asleep[b]	13.3	10.4	16.2	Feeling Slowed Down[a]	5.3	5.4	5.0
More Emotional[c]	10.1	3.6	16.8	Feeling mentally "foggy"[a]	3.0	3.1	3.0
Irritability[c]	10.1	6.8	13.5	Difficulty Concentrating[d]	14.7	14.2	15.8
Sadness[c]	5.8	2.6	9.2	Difficulty Remembering[d]	11.6	13.1	7.9
Nervous or Anxious[c]	10.1	4.7	15.7	Visual Problems[e]	1.7	1.2	3.0
Total Scores		Mean (SD)		*Total Scores*		Mean (SD)	
Total Symptoms	2.4 (3.1)	2.0 (3.0)	2.9 (3.1)	Total Symptoms [Mean(SD)]	1.7 (2.5)	1.6 (2.3)	2.1 (3.1)
Total Severity	4.4 (6.5)	3.2 (5.3)	5.6 (7.4)	Total Severity [Mean(SD)]	3.6 (5.8)	3.4 (5.7)	4.0 (5.9)

aPhysical Symptoms bInsomnia Symptoms cEmotional Symptoms dCognitive Symptoms eUngrouped

Table 1. Percentage of collegiate athletes reporting at least "mild" experience (≥1 on Likert 0-6 scale) of each symptom evaluated by the SCAT3 Symptom Evaluation (S3SE) and Post-Concussion Scale (PCS) during baseline concussion assessment. Corresponding symptom domain classifications are denoted with a-e superscripts. "Ungrouped" symptoms were not used to classify ICD-10 postconcussional syndrome symptom status but are included in overall Total Scores.



Results

	Total Sample	All Males	All Females	LD	ADHD	Psychiatric Disorder	Concussion History		
Missing Data (N)		0	0	66	64	71	68		
	N=738	N=452	N=286	N=40	N=57	N=22	**0** N=472	**1** N=131	**2+** N=67
Symptom Domain									
Physical	46.1	40.7	54.5	60.0	54.4	59.1	49.4	41.2	46.3
Insomnia	30.5	28.8	33.2	30.0	35.1	45.5	31.6	32.8	22.4
Emotional	18.6	13.3	26.9	15.0	21.1	45.5	18.4	16.0	23.9
Cognitive	21.0	20.8	21.3	35.0	43.9	27.3	22.7	11.5	25.4
ICD-10 Criteria Met[a]	16.3	12.8	21.7	22.5	22.8	31.8	17.2	13.7	16.4

Table 2. Percentage of collegiate athletes reporting at least "mild" experience (≥1 on Likert 0-6 scale) of at least one symptom within each of the four domains associated with the ICD-10 postconcussional syndrome diagnosis evaluated by either the S3SE or PCS. For example, 46.1% of collegiate athletes reported a baseline score of at least 1 on at least one symptom classified into the "physical symptoms" domain.

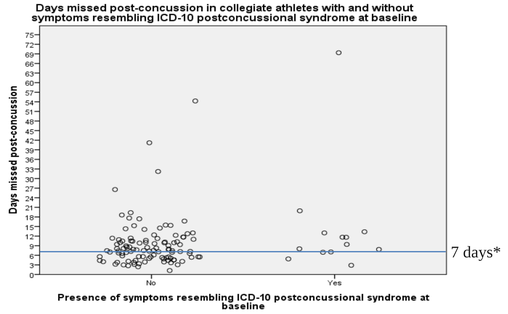


Figure 1. Graphical representation of days to recovery for athletes with and without baseline symptom reports resembling ICD-10 postconcussional syndrome. Concussed athletes with this symptom pattern took significantly longer to recover than all other concussed athletes (t[115]=2.35, p=.020). The chi square association of ICD-10 status and days missed by group was also significant (Odds Ratio=2.05, X2[1,117]=7.22, p=.007, φ=..251).

Findings and Conclusions

- Substantial numbers of collegiate athletes experience concussion-like symptoms in the absence of a sustained trauma, with 12.8% of males and 21.7% of females reporting symptoms resembling ICD-10 postconcussional syndrome.
- Females report more concussion-like symptoms than males.
- The most commonly reported symptoms for both males and females were related to problems with sleep.
- Athletes with LD/ADHD and previously treated psychiatric conditions were more likely to report cognitive and emotional symptoms, respectively.
- Symptom profiles resembling ICD-10 postconcussional syndrome at baseline may predict protracted post-concussion recovery.

Future Directions

- Further investigate the impact of pre-existing symptoms, in particular poor sleep quality, on post-concussion sequelae as a possible targets for intervention.
- Explore symptom profiles resembling ICD-10 postconcussional syndrome using baseline symptom scales as a means to help clinicians identify undiagnosed or poorly managed comorbid medical conditions.
- Examine physiological (i.e. blood-based biomarkers) correlates of baseline symptom reporting.
- Consider the differences in baseline symptom reporting when athletes are asked to report current feelings compared to when they are asked to report general feelings.

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This project was funded, in part, with support from the Grand Alliance Concussion Assessment, Research, and Education (CARE) Consortium, funded, in part by the National Collegiate Athletic Association (NCAA) and the Department of Defense (DOD). The U.S. Army Medical Research Acquisition Activity, 820 Chandler Street, Ford Detrick MD 21702-5014 is the awarding and administering acquisition office. This work was supported by the Office of the Assistant Secretary of Defense for Health Affairs through the Psychological Health and Traumatic Brain Injury Program under Award NO W81XWH-14-2-0151. Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the Department of Defense (DHP funds.)