Establishing 3-Day and 7-Day Symptom Clusters for Hawaii High School Student Athletes during the First Week of a Sport-Related Concussion

Oshiro JY*, Oshiro RS†, Uyeno RK‡, Tamura K*, Furutani TM*, Wahl TP†, Kocher MH*, Murata NM*

*Department of Kinesiology and Rehabilitation Science, University of Hawaii at Manoa, Honolulu, HI, †State of Hawaii Department of Education, Honolulu HI, ‡University of Hawaii Honolulu Community College, Honolulu, HI

Context
Post concussion symptom reports are useful for assessing sport-related concussions. The Post-Concussion Symptom Scale (PCSS) allows clinicians an objective measurement of subjective symptoms. Previous studies have used the 22-item PCSS to group the symptoms into related factor structures, however these studies have been limited to specific populations.

Objective
The purpose of this study was to examine factor structures of high school athletes' symptoms during the acute (0-3 days) and subacute (4-7 days) stages of a sport-related concussions.

Design
A retrospective analysis was conducted using Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) from School Years 2010-2012 in a statewide comprehensive Concussion Management Program (CMP).

Setting
Sixty-three (63) high schools in the State of Hawaii reported concussions using injury tracking software and a comprehensive CMP. The CMP was implemented by all athletic trainers and funded by the State of Hawaii Department of Health.

Participants
Six hundred sixty-eight athletes in 11 various sports sustained a concussion throughout SY 2010-2012. Each participant was diagnosed, treated, and followed until return to full participation by the high school athletic trainer. Participants were divided into two groups based on when ImPACT was administered. The Acute Stage (group one) who were given the PCSS within three days of the injury, and the Subacute Stage (group two) who were given the PCSS within four to seven days of the injury [Table 1].

Table 1: Participant Demographics

Acute Stage (0-3 Days): Group One		Subacute Stage (4-7 Days): Group Two	
Mean Days	1.88 ± 0.91	Mean Days	5.16 ± 1.31
Mean Age	15.49 ± 1.33 yrs	Mean Age	15.55 ± 1.33 yrs
N=437	Males = 292	N=231	Males = 139
	Females = 145		Females = 92

Interventions
Post concussion assessment was conducted and reported by the athletic trainers utilizing ImPACT, postural stability tests and a graduated return to participation protocol. The PCSS was extracted from the ImPACT from each group.

Main Outcome Measures
Exploratory Factor Analysis (EFA) was applied to the PCSS of both groups. Factors were extracted using the principal component analysis with orthogonal rotation (Varimax with Kaiser normalization).

Results
An EFA provided two 4-factor structure models constructing cognitive-migraine, emotional, physical and sleep clusters. The factors explained 57.08% of variance for group one and 66.01% for group two. The items within each cluster are represented in the Acute Stage (0-3 Days) [Table 2] and the Subactue Stage (4-7 Days) [Table 3] with associated loading values.

Conclusions
Post concussion symptoms of group one and group two loaded into four-factor structures: cognitive-migraine, emotional, physical and sleep clusters. Between the two groups, the cognitive-migraine clusters differed in symptoms loading. Group one symptoms included fatigue, headache, vomiting, and dizziness. Group two symptoms included difficulty concentrating, feeling mentally foggy, sensitivity to light, difficulty remembering, and trouble falling asleep. These changes in symptom loading between the acute (0-3 days) and subacute (4-7days) stages suggest different accommodations should be considered between these two time periods. Awareness of these changes in symptom clusters allows athletic trainers to make appropriate classroom accommodations and treatment during the first week of recovery as well as through full recovery.

Table 2: Hawaii's Post-Concussion Clusters during the Acute Stage (0-3 Days)

Cognitive-Migraine	Emotional	Physical	Sleep
Drowsiness (.775)	Feeling More Emotional (.826)	Nausea (.786)	Sleeping More Than Usual (.559)
Fatigue (.734)	Sadness (.791)	Trouble Falling Asleep (.694)	Numbness or Tingling (.500)
Feeling Slowed Down (.697)	Irritability (.659)		
Headache (.620)	Nervousness (.621)		
Vomiting (.612)			
Dizziness (.585)			
Sensitivity to Noise (.518)			

The items with high loading (>.500) were retained for each cluster.

Table 3: Hawaii's Post-Concussion Clusters during the Stubacute Stage (4-7 Days)

Cognitive-Migraine	Emotional	Physical	Sleep
Difficulty Concentrating (.751)	Feeling More Emotional (.887)	Vomiting (.817)	Sleeping Less Than Usual (.732)
Feeling Mentally Foggy (.718)	Nervousness (.873)	Numbness or Tingling (.692)	
Sensitivity to Noise (.705)	Sadness (.873)		
Sensitivity to Light (.698)	Irritability (.576)		
Difficulty Remembering (.683)			
Feeling Slowed Down (.670)			
Drowsiness (.666)			
Trouble Falling Asleep (.653)			

The items with high loading (>.500) were retained for each cluster.

2013 NATA Annual Meeting and Clinical Symposia
Las Vegas, NV