

# Systematic review of Scat 2 and SCAT 3 (Sport Concussion Assessment Tools)



UNIVERSITY OF CALGARY  
CUMMING SCHOOL OF MEDICINE  
Department of Family Medicine

Roger E. Thomas,<sup>1</sup> Jorge Alves,<sup>2</sup> Marcus M. Vaska,<sup>3</sup> Rosana Magalhaes<sup>4</sup> <sup>1</sup>Department of Family Medicine, Calgary; <sup>2</sup>CEREBRO - Brain Health Center, Braga, Portugal; <sup>3</sup>Knowledge Resource Service, Alberta Health Services, <sup>4</sup> Clinical Academic Center, Braga, Portugal

## Introduction

**PROBLEM:** Before this review no summary data available on:

- Outcomes of the most widely used concussion tool, the Sport Concussion Assessment Tool (SCAT)
- SCAT component scores or between and within sample heterogeneity
- Non-collegiate adult contact sport athletes, elementary students or professional leagues
- Definitive normative baseline and post-concussion scores of SCAT athlete performance

**PURPOSE:** Assess risk-of-bias and summarize outcome data world-wide for the SCAT

## Methods

**SEARCH:** 18 databases, 9 grey literature resources searched for SCAT2/3 data. No date/language restrictions.

9,150 articles identified, titles/abstracts assessed and data-entry independently by two reviewers.

**RISK-OF-BIAS:** Newcastle-Ottawa risk-of-bias scale:

- for studies with maximum possible score of four, 85% scored 3 or 4;
- for studies with maximum possible score of six, 75% scored 5 or 6.

## Findings

**Finding 1:** 21 studies provided SCAT 2/3 assessments and included 4,978 athletes (1,067 females, 3,831 males and 80 gender not stated)

- Only one study reported SCAT data for a professional league (Finnish ice hockey players), there are minimal data on elementary students and no data on adult non-collegiate athletes
- Only two studies reported both pre- and post-concussion SCAT scores, and the studies reporting only partial or post-concussion scores are too limited to provide weighted average scores. There is a considerable number of unwitnessed concussions

**Finding 2:** No study reported perfect average scores on all components of the SCAT (either due to some players having pre-existing symptoms (e.g. headache) or difficulty with testing components (e.g. repeating serial digits backwards))

- **High Schoolers Weighted averages:** for symptoms 18.31 (22=no concussion symptoms); BESS 26.13 (30 = perfect balance); SAC 25.99 (30 = no cognitive problems) and SCAT2 Total 88.63 (100 = perfect score).
- **Collegiate players weighted averages:** symptoms 20.09, BESS 25.54, SAC 27.51 and total SCAT2 91.20. Between- and within-study variability similar to those of the high schoolers. Limited variability between genders.

**Finding 3:** Unwitnessed and unrecognized concussions are frequent. During a series of amateur rugby union matches 5 concussions were identified by a nurse at the pitch but 17 identified later by the King-Devick pencil and paper test, and in another series 8 witnessed and 44 unwitnessed concussions.

**Finding 4:** There is no uniformity across sports in pre-season SCAT testing, numbers of observers to increase the likelihood of detecting concussions during play, or using King-Devick tests to detect unwitnessed concussions. There is an urgent need for systematic adoption of continuous follow-up assessments including complete SCAT testing in all age ranges of amateur and professional athletes participating in sports with risk of concussion and follow them if concussed until fully recovered.

## Conclusions

There are SCAT data for 4,978 athletes from 21 studies (1,067 females, 3,831 males, 80 gender not stated) but for only one professional league (ice hockey players), minimal data for elementary students and no data on adult non-collegiate players.

- Only 2 studies provided pre-and post-concussion data (only for 151 athletes). The studies reviewed here reported considerable numbers of unwitnessed concussions detected post game by King-Devick tests.
- Athletes and groups do not have perfect component or total SCAT scores pre-season or pre-game because some have pre-existing symptoms (e.g. headache) or because they have problems with test items (e.g. repeating serial numbers backwards).
- Thus it is important to test players at least pre-season and also during the season to detect unwitnessed concussions.
- Minimum Clinically Important Differences in SCAT scores have not been defined, and would need to be based on careful assessments by several assessors with minimal intra- and inter-observer variability and detailed follow-up of athletes to determine full recovery and appropriate return to play.