Introducing the Sport Concussion Assessment Tool 6 (SCAT6)

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BACKGROUND AND RATIONALE
The recognition, evaluation, diagnosis and management of sport-related concussion (SRC) is complex, dynamic and multidimensional. It is viewed by many as one of the most complex injuries faced in sports medicine.1 Historically, several standardised, empirically derived, brief screening tools were available to acutely evaluate concussion signs and symptoms, cognitive functioning, and postural stability.2,3 Each of these instruments existed in isolation. The Concussion in Sport Group (CISG) integrated these measures into one multimodal tool designed to assist clinicians by standardising an acute assessment across several domains of functioning. The original Sport Concussion Assessment Tool (SCAT) was published in 20054 and contained educational information, a concussion symptoms scale and information on management of concussion.

In the years that followed several iterations of the SCAT have been published, informed by empirical data, systematic reviews and clinical experience. Each iteration of the SCAT evolved along with the scientific literature, with each version increasingly representing the complexity and multimodal nature of SRC assessment.

DEVELOPMENT PROCESS
The systematic review pertaining to the SCAT65 was asked to: (1) review and evaluate the literature related to the identification and evaluation of sports concussion in the acute phase of injury (<7 days) among children, adults, and adolescents and (2) use this information to provide recommendations for improving the SCAT tools. The volume of research for this search necessitated a priori creation of six overlapping content subdomains: cognition, balance/postural stability, oculomotor/cervical/vestibular, emerging technologies, neurological examination/autonomic dysfunction and paediatric/child.

The results of the search were compiled into a draft paper forwarded to the expert panel for review in advance of the sixth International Conference for Concussion in Sport (27 October 2022–30 October 2022—Amsterdam). The primary outcomes were presented by the lead author at the open meeting. These outcomes were voted on and approved by the expert panel and became the focus of a workshop to discuss the tools on the final day of the conference. The final version of the SCAT6 was created by a group of systematic review coauthors between November 2022 and March 2023.

CONTENT OF THE SCAT6
Overall, the data in the systematic review supported modifications to the SCAT5 in creating the SCAT6 to further enhance its clinical utility. The SCAT6 contains an enhanced athlete demographic section that includes annotation of language preference and a recognise and remove section that identifies key points for the healthcare professional.

Box 1 presents a summary of changes that were made to the SCAT6. The immediate memory/neurological examination contains six steps to be completed sequentially: (1) enhanced observable signs, (2) Glasgow Coma Scale, (3) cervical spine assessment, (4) revised coordination and ocular/motor screen, (5) memory assessment/Maddocks questions, and (6) an enhanced Red Flags section.

The off-field assessment contains revised athlete background questions and symptom evaluation, which was revised to remove the requirement for the athlete to read the instructions aloud. The cognitive screening section contains orientation questions and immediate memory, which now omits the 5-word option and only contains the 10-word lists. The concentration section contains digit span and months in reverse, now modified to include a timed component.

The coordination and balance examination underwent the most changes. There was sufficient evidence to consider tandem gait measures of dynamic postural control as meaningful additions to the acute assessment paradigm within the SCAT6. The recommended sequencing of measures begins with static balance (eg, mBESS or BESS) and then progresses to single-task and dual-task tandem gait measures. The dual-task tandem gait adds complexity by including a cognitive component that requires the athlete to count backwards by 7s while walking heel-to-toe.
The SCAT6 is intended to be an aide during the acute phase of injury. It is not intended to be used as a stand-alone diagnostic tool but rather to inform clinical assessment and diagnosis.

- It is important to underscore that ‘concussed’ athletes may perform within normal ranges on the SCAT6 (false negative) just as ‘normal’ individuals may perform poorly (false positive).

- Interpretation of SCAT6 data is a clinical endeavour that includes examining the athlete in the context of personal, psychological, social, cultural, athletic, medical, injury characteristics/mechanism and educational history/factors.

- Clinicians must familiarise themselves with best practices in the administration of standardised tests, use of appropriate normative data, interpretation of postinjury scores, psychometric test properties and the proper analysis of multiple tests used simultaneously (eg, population base rates) when using the SCAT6.

- Clinicians who choose to use baseline data must familiarise themselves with reliable change metrics and base rates of reliable change scores.

- Baseline testing may be useful when resources (eg, financial, personnel, time) permit, such as at the professional or elite level, but the evidence does not support compulsory use at other levels of sport, such as at the child and adolescent level.

- When a baseline assessment is given, test users should be familiar with identification of performance invalidity on the SCAT6.

- Performance well below emerging normative standards should trigger repeat and/or additional cognitive evaluation to establish an accurate baseline and/or rule out true cognitive impairment.

- The SCAT6 is not intended to be used in isolation for making return-to-sport decisions.

- Skates should not be worn during the mBESS.

- The mBESS is most accurate if administered by the same person at baseline and postinjury.

- Differences have been found on SCAT performance due to demographic variables (eg, age, sex, education), as well as cultural and linguistic differences.

- The cultural/linguistic differences underscore the need to create approved, well-developed and validated approaches to different language versions of the SCAT6.

- Simple literal translation of the SCAT6 is neither adequate nor valid. Translation coupled with cultural/linguistic adaptation of the tools, particularly immediate memory, is imperative.

- There was insufficient evidence to guide modifications of the SCAT6 for para athletes. Modifications may be needed for both content and modes of administration.

In closing, the development and promotion of the SCAT tools by the CISG has led to worldwide dissemination over many years and have been useful in the evaluation and management of acute SRC. We are committed to the free and broad distribution of the SCAT6 in its present form. Minor modifications of the tool for research purposes are permissible, as are minor formatting changes for internal non-commercial organisation use. However, any modification to the tools including translations and other alterations of the SCAT6 are not permitted without the approval of BMJ and the CISG.

The SCAT6 is an easily deployable multimodal tool to be used in the acute evaluation of SRC by healthcare professionals. Importantly, the diagnosis of concussion remains a clinical endeavour, of which information from the SCAT6 is only one part of the overall diagnostic process.

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**References**


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