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## BACKGROUND AND RATIONALE

The Concussion in Sport Group (CISG) introduced tools for assessment and management of concussion in 2004.<sup>1</sup> Age-appropriate, child-specific tools were introduced in 2012.<sup>2</sup> The most recent iteration, the Child Sport Concussion Assessment Tool 5 (Child SCAT5) was introduced in 2016,<sup>3</sup> and has been determined to be most effective in the acute stage following sport-related concussion (SRC), and up to day 7 post-injury.<sup>4</sup> Based on feedback from clinicians, the CISG scientific committee determined that a tool for assessment and management of SRC in the subacute period (beyond 72 hours post-injury) would be useful, and established the process for development of the Sport Concussion Office Assessment Tool 6 (SCOAT6).<sup>5</sup> Consistent with the approach for the SCAT and Child SCAT, the requirement for an age-appropriate version of the SCOAT6 for children aged 8–12 years led to the development of the Child SCOAT6.

## PROCESS FOR DEVELOPMENT

As part of the process for the 6th International Conference on Concussion in Sport held in Amsterdam, in October 2022, a systematic review<sup>6</sup> was performed to guide the development of the SCOAT6 and Child SCOAT6. This process is described in detail elsewhere.<sup>5–7</sup> During the Amsterdam meeting, an Expert Panel conducted a workshop to deliberate on the recommended components of the Child

SCOAT6, and specifically, which components required modification, removal from or addition to the SCOAT6, such that the tool would be age-appropriate for children aged 8–12 years. The SCOAT6 should be used for athletes aged 13 years and over.

## CONTENT OF THE CHILD SCOAT6

The components of the SCOAT6 are described by Patricios,<sup>5</sup> and here we only describe those components that required modification to, removal from or addition to the SCOAT6 to develop the Child SCOAT6. The addition of multiple tests required that the recommended tests are contained within a single document, and the optional tests are contained in a separate supplementary document. These additional tests are performed on an individual case basis depending on clinical presentation and clinical findings.

## Items modified in the Child SCOAT6

### Symptom checklist

The child and parent symptom reports (the Health and Behaviour Inventory (HBI)) contained in the Child SCAT6 are modified for the Child SCOAT6 with the addition of 11 new items<sup>8</sup> from the Melbourne Paediatric Concussion Scale. The symptom list from the HBI<sup>9</sup> is scored separately from the additional items to enable comparison to normative data and to previous administrations of the Child SCAT (note: neck pain in the Child SCAT has been moved to reside with the 11 new items).

### Digits backwards

The first level is a two-digit string, and the final level is a six-digit string.

### Days in reverse order

This is used in children in lieu of months in reverse order. A new timed component is added, such that both time to complete and number of errors are recorded.

### Orthostatic test

The modified methodology described by Pearson *et al* is used,<sup>10</sup> with blood pressure and heart rate recordings after 2 min supine, then 2 min after standing. An optional middle assessment 2 min after sitting is also included.

### Dual-task tandem gait

The cognitive tasks within the SCOAT6 are modified to age-specific tasks.

### Visio-vestibular examination

These tests are used instead of the abbreviated vestibular ocular motor screening. This paediatric-specific methodology has been described by Corwin *et al*.<sup>11</sup>

## Items added to the Child SCOAT6

The PACE Self-Efficacy Questionnaire—Self Report<sup>12</sup> is included, and indicates the degree of the child's confidence in their thoughts, feelings and actions affecting recovery.

The Symbol Digit Modalities Test<sup>13</sup> is included as a measure of psychomotor processing speed.

Several paediatric mental health tools are included:

1. Paediatric Anxiety—Short Form 8a<sup>14,15</sup>
2. Paediatric Depressive Symptoms—Short Form 8a.<sup>14,15</sup>
3. Paediatric Sleep Disturbance—Short Form 4a<sup>16</sup>
4. Paediatric Sleep-Related Impairment—Short Form 4a.<sup>16</sup>
5. The Paediatric Fear Avoidance Behaviour after Traumatic Brain Injury Questionnaire<sup>17</sup> is included. This is a measure to identify fear avoidance behaviour, which may contribute to poorer outcomes/persisting symptoms post-concussion. These symptoms may benefit from psychological intervention.

## HOW TO USE THE CHILD SCOAT6

The Child SCOAT6 provides the clinician with multiple tools that can be used in the subacute period following SRC (beyond 72 hours post-injury). This tool guides clinical management, including assisting in the identification of children who may require referral to other specialists and/or multidisciplinary clinics. It is not intended that every optional component of the Child SCOAT6 be used in every

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consultation, but rather, the clinician will use the clinical information on an individualised basis, and determine which tests and measures are required for each individual child. The child and parent symptom lists are valuable in assisting in this decision-making process.

A consistent finding from the systematic reviews and panel discussions during the 2022 Amsterdam meeting was the limited data available on SRC in children aged 5–7 years. Developmentally, these younger children are quite different from 8 to 12 years old children, and thus the Child SCOAT6 was determined to be most appropriate for children aged 8–12 years. While the CISG did not develop a separate tool for children aged 5–7 years, we acknowledge that some health practitioners experienced in the management of paediatric SRC may continue to use some elements of the Child SCOAT6 in 5–7 years old children, making modifications to the assessment as required. Importantly, no validated or normative data are available to support use in this age group, and caution is required in its use in younger children.

The Child SCOAT6 is for use in all children aged 8–12 years; however, many items within the tool have not been validated in children with disabilities, or across diverse cultural and language groups. During the Amsterdam meeting, considerations related to the para athlete were emphasised, and the paucity of data on the paediatric para athlete suggests that significant work is required to develop age-appropriate tools for the para athlete in school, community and elite sport settings.

The Child SCOAT6 is available for free, unrestricted distribution for use by health-care professionals worldwide in the assessment of childhood SRC, provided that no modifications are made to the tool. The development of the tool is evidence informed, and we encourage its widespread distribution and use by medical professionals worldwide.

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**Acknowledgements** The authors acknowledge the assistance of Vanessa C Rausa with the neuropsychological components, and Meeryo C Choe with the orthostatic components of the Child SCOAT6.

**Contributors** GAD served as the primary author and responsible for all aspects of the project, including initial preparation, coordination, review, editing and final preparation of the manuscript and Child SCOAT6 tool. JSP served as the primary author of the systematic review and development of the SCOAT manuscript and tool. All coauthors contributed to the development and critical review of the manuscript and Child SCOAT6 tool and approved the final version of the manuscript and tool.

**Competing interests** GAD is a member of the Scientific Committee of the 6th International Conference on Concussion in Sport; an honorary member of the AFL Concussion Scientific Committee; Section Editor, Sport and Rehabilitation, NEUROSURGERY; and has attended meetings organised by sporting organisations including the NFL, NRL, IIHF, IOC and FIFA; however has not received any payment, research funding or other monies from these groups other than for travel costs. JSP: Editor BJSM (honorarium), Member of World Rugby Concussion Advisory Group (unpaid), Independent Concussion Consultant for World Rugby (fee per consultation), Medical consultant to South African Rugby (unpaid), Co-chair of the Scientific Committee, 6th International Conference on Concussion in Sport (unpaid), Board member of the Concussion in Sport Group (unpaid), Scientific Board member, EyeGuideTM (unpaid). LKP: CASEM Board Member, President-Elect 2022-2023NIH R34 Grant for EPICC Study (Eye Problems In Concussed Children), Site PI, Speaker at various conferences. VA: Financial: Australian National Health and Medical Research Council and Medical Research Future fund: research grants. Royalties: Pearson Publishing (Test of Everyday Attention) Collaboration: Australian Football League (Partnership agreement to fund research – funds go to my institute) Boards: Editorship: Journal of Neuropsychology, Neuropsychology, Journal of Clinical & Experimental Neuropsychology. GAG reports grant funding from CDC TEAM and OnTRACK grants, NIMH APNA grant, royalties from PAR, consulting fees from NFL Baltimore Ravens, Zogenix International and Global Pharma Consultancy and travel support for professional meetings. He is a member of USA Football Medical Advisory Panel. CCG: Grants/Research Support: Hit-IQ (2022-2023); NIH NINDS (R01 NS110757 2019-2024); NINDS (U54 NS121688 2021-2026); UCLA Brain Injury Research Center, UCLA Steve Tisch Brain SPORTprogram, Easton Clinic for Brain Health Clinical Consultant (provide clinical care to athletes): NBA, NFL-Neurological Care Program, NHL/NHLPA, Los Angeles Lakers Advisory Board (Non compensated): Major League Soccer, National Basketball Association, US Soccer Federation. Advisory Board (Compensated): Highmark Interactive MedicoLegal: One or two cases annually Speaker's Bureau: None. Stock Shareholder: Highmark Interactive stock options (2018). Other Financial or Material Support: Book royalties – Blackwell/Wiley Publishing: Prioritized Neurological Differential Diagnosis Other: None. KOY: is Editor-in-Chief of the journal Neuropsychology and receives an editorial stipend from the American Psychological Association. He is an unpaid consulting editor for the journals Archives of Clinical Neuropsychology and Journal of Head Trauma Rehabilitation. He is an unpaid member of the Scientific Advisory Committee for Brain Injury Canada. He is the chair of the Canadian Concussion Network, which is funded by a grant from Canadian Institutes of Health Research (CIHR) to his institution; he is principal applicant on the grant but receives no income from it. He is a principal investigator on another grant from CIHR from which he derives no income. He is a coinvestigator on research grants from CIHR, the US National Institutes of Health (NIH), Brain Canada Foundation and National Football League Scientific Advisory Board; he derives income only from the grant from NIH. He

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Injuries in Young Athlete; and from Wolters Kluwer for working as an author for UpToDate. His research is funded, in part, by philanthropic support from the National Hockey League Alumni Association through the Corey C Griffin Pro-Am Tournament and a grant from a grant from the National Football League. PO'H is an employee of Marker Diagnostics UK Ltd. He has worked on a sessional basis for the English RFU and FA. He has previously received research funding from the English RFU, ECB and The Drake Foundation. ZP: No COI to declare. MP declares the following: Consultant, CMO, Major League Soccer, Senior Advisor, NFL Head, Neck & Spine Committee, FA Research Task Force Committee member, UK Concussion Foundation Protocol Forum, US Soccer Medical Advisory Committee, CDC Concussion Consultant, Concussion in Sport Group expert panel, NOCSAE Scientific Advisory Committee, IOC Mental Health Working Group, USOPC Mental Health Advisory Committee, Team Physician, US Soccer, Received funding for research; NCAA-CARE-DoD 2.0, ended 2020, have received honoraria and reimbursement for travel for speaking and conferences attended, have written chapters for UpToDate and received royalties for the Netter's Sports Medicine textbook, have provided work as an expert for cases involving concussion, team physician and other sports medicine topics. IJS does not have any conflicts of interest to disclose. MT is employed full-time as the CEO and Medical Director of ICHIRF – a paid post he has held since April 2015. Honorary Medical Adviser to the Professional Riders Insurance Scheme (PRIS) – discretionary honorarium Member of the Premier League Head Injury Advisory Group (HIAG) – no remuneration Director of ICHIRF Ireland Ltd – no remuneration Honorary Medical Adviser to the Concussion Foundation Ltd – no remuneration Member of the expert panel for the Dept of Digital, Culture, Media and Sport review into concussion in amateur sport – no remuneration Attendance at conferences or meetings as a guest speaker – reimbursement of travel expenses, complimentary registration and payment of hotel accommodation and meals by the organising committee. No stocks or options in any concussion-related company. No consultancies, board or editorial positions related to concussion. KV has no conflicts of interest to disclose. NW: Chair, British Paralympic Association (voluntary) IPC Medical Committee Member (voluntary) Concussion in Para Sports (CIPS), founding member (voluntary) BJSM Editorial Board member (voluntary) Sports Horizon, Board of Directors – equity share – see <https://www.sportshorizon.co.uk>. KJS: has received grant funding from the Canadian Institutes of Health Research, National Football League Scientific Advisory Board, International Olympic Committee Medical and Scientific Research Fund, World Rugby, Mitacs Accelerate, University of Calgary) with funds paid to her institution and not to her personally. She is an Associate Editor of BJSM (unpaid) and has received travel and accommodation support for meetings where she has presented. She is coordinating the writing of the systematic reviews that will inform the 6th International Consensus on Concussion in Sport, for which she has received an educational grant to assist with the administrative costs associated with the writing of the reviews. She is a member of the AFL Concussion Scientific Committee (unpaid position) and Brain Canada (unpaid positions). She works as a physiotherapy consultant and treats athletes of all levels of sport from grass roots to professional.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** Not applicable.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data sharing not applicable as no data sets generated and/or analysed for this study.

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**To cite** Davis GA, Patricios JS, Purcell LK, et al. *Br J Sports Med* 2023;**57**:668–671.

Accepted 28 March 2023

*Br J Sports Med* 2023;**57**:668–671.  
doi:10.1136/bjsports-2023-106858

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