evaluation tool used by clinicians to evaluate athletes with suspected concussions.
Objective To describe normative baseline SCAT5 scores among United States Olympic athletes.
Design Retrospective descriptive epidemiology.
Setting United States Olympic and Paralympic Sports Medicine Centers.
Participants Two hundred fifty-seven Olympic athletes (48.2% female, mean age ± standard deviation (SD) = 22.5±4.8 years) representing 19 sport federations underwent baseline SCAT5 testing between April 2018 and July 2019.
Main Outcome Measurements Baseline SCAT5 scores of healthy Olympic athletes. T-tests were used to compare scores by sex.
Results Athletes reported a mean of 4.0±4.9 symptoms (median=2, IQR=0–6) with an average severity score of 7.9 ±12.3 (median=2, interquartile range=0–10). Most (71.8%) athletes reported never having sustained a concussion prior to testing; 17.5% reported one prior concussion (range=0–10 reported concussions). Mean scores ± SD for major components of the SCAT5: 4.8±0.53 for orientation, 20.7±4.0 for immediate memory, 3.8±1.3 for concentration, 4.0±4.2 for balance, 6.9±1.9 for delayed recall, and 12.4±3.0 for Standardized Assessment of Concussion. No sex differences were observed for concussion history or the number and severity of current symptoms. Females scored higher than males in the immediate memory (21.7 vs. 19.8, p<0.001), orientation (4.9 vs. 4.8, p=0.047), and delayed recall tasks (7.3 vs. 6.5, p=0.001).
Conclusions Normative values for baseline SCAT5 performance are presented for a population of healthy Olympic athletes. This information can be considered by clinicians interpreting SCAT5 results in athletes who do not have a known baseline score.

165 ABSTRACT WITHDRAWN

166 HOW DO WE DO BETTER? MANAGING COMMUNITY RUGBY CONCUSSIONS IN A PRIMARY CARE SETTING

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Background Concussions in rugby are of a global player welfare concern. To address this challenge New Zealand Rugby has employed a social ecological model to develop a concussion management pathway (CMP). Following a suspected concussion, the pathway encourages compliance and supports the relevant stakeholders (e.g. players, coaches, physiotherapists, doctors) throughout the recovery process.
Objective To examine (i) user uptake of technology that operationalises the CMP and (ii) stakeholder experiences.
Design Prospective mixed-methods multi-centre study.
Setting Community rugby in three New Zealand provincial unions.
Patients (or Participants) Community rugby male and female players (n=1893) were invited to participate of which 1540 provided pre-season baseline data.
Interventions (or Assessment of Risk Factors) Pre-season, players were baseline tested using a modified SCAT5. In season, suspected concussions were logged on an App, notifying relevant stakeholders and entering the player into the CMP. Players were referred to a doctor who assessed them for a concussion while comparing to the player's baseline assessment via a customized online portal. This information was also used by the doctor at the time of medical clearance. To gain a deeper understanding of the participants' experience with the CMP, 130 stakeholders were interviewed post-season.
Results Two-hundred suspected concussions were logged, of these 154 saw a doctor for a diagnosis, 171 obtained medical clearance following completion of GRTP, and 17 were referred on for further investigation/treatment by a doctor involved in the pilot.

Stakeholders agreed that having a clearly defined pathway facilitated an efficient and informed management process for concussions and encouraged compliance with seeking medical advice/clearance.
Conclusions The CMP provides an electronic platform for monitoring compliance with medical visits and the safe RTP while ensuring all stakeholders are aware of the player's status. The system provides controlled access to centrally stored baseline information to help inform medical decisions. Stakeholders supported the use of the CMP.

167 PRELIMINARY EXPLORATION OF BASELINE CONCUSSION MEASURES AMONG PREMIER LEAGUE FOOTBALL ATHLETES IN ZAMBIA

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Background Concussion is a global sport injury, however, in Africa this public health concern has yet to be studied. Currently, there are no concussion management programs implementing baseline or post-concussion measures among football clubs in the Football Association of Zambia (FAZ). Furthermore, it is unknown if tests such as the Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) Quick Test (QT) would be culturally appropriate measures for implementation as part of a concussion screening protocol in Zambia or other African nations.
Objective To determine baseline neurocognitive percentile ranks among Zambian football athletes on the ImPACT QT.
Design Cohort study.
Setting Premiere league football clubs based in Lusaka, Zambia.
Patients (or Participants) Male premier league football athletes from Zambia (n=119) aged 24.48±5.41.
Interventions (or Assessment of Risk Factors) The ImPACT QT (5–7min) neurocognitive assessment administered on an iOS/Apple iPad prior to a preseason team practice.
Main Outcome Measurements Outcome measures were average performance on 3 factor scores: Motor Speed, Memory, and

Attention Tracker, presented as percentile ranks using normative data built-into the ImPACT QT.
Results Zambian athletes scored nearly two standard deviations below the mean on Motor Speed (7th percentile), when compared to North American normative data. However, performance on Attention Tracker (44th percentile) and Memory (56th percentile) among Zambian athletes was well within the average range.
Conclusions This data is the first to explore Zambian athletes' performance on any concussion measure. Zambian athletes performed poorly on the ImPACT QT factor score related to motor speed. These results suggest that Zambian athletes may be unfamilar with testing on an iPad device or there may have been cultural barriers in the interpretation of test directions. Further, understanding these preliminary performance measures are a starting point that could aid in understanding which concussion measures would be culturally appropriate to implement in the prevention, diagnosis, and care of concussion among Zambian athletes.

168 NORMATIVE BASELINE SCAT5 SCORES IN A POPULATION OF UNITED STATES PARALYMPIC ATHLETES

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Background The Sport Concussion Assessment Tool 5th Edition (SCAT5) is the most recent version of the concussion evaluation tool used by clinicians to evaluate athletes with suspected concussions.
Objective To describe normative baseline SCAT5 scores among United States Paralympic athletes.
Design Retrospective descriptive epidemiology.
Setting United States Olympic and Paralympic Sports Medicine Centers.
Participants Fifty-eight Paralympic athletes (60.3% female, mean age±standard deviation (SD) = 30.2±10.6) representing 7 sport federations underwent baseline SCAT5 testing between April 2018 and July 2019.
Interventions None.
Main Outcome Measurements Baseline SCAT5 scores of healthy Paralympic athletes. T-tests were used to compare scores by sex.
Results Athletes reported an average of 5.0±5.4 symptoms (median=2.5, IQR=1.0–8.5) with an average severity score of 11.0±14.3 (median=6.0, IQR=0–17.5). Over half of athletes (59.3%) reported having sustained at least one concussion prior to testing (range=0–16 reported concussions). Mean scores ± SD for major components of the SCAT5: 4.8±0.74 for orientation, 21.0±3.7 for immediate memory, 3.9±1.1 for concentration, 6.7±6.4 for balance, 6.9±2.2 for delayed recall, and 15.7±2.8 for Standardized Assessment of Concussion. No sex differences were observed for any component scores of the SCAT5.
Conclusions Normative values for baseline SCAT5 performance are presented for a population of healthy Paralympic athletes. Future research should focus on the development of normative data for specific Paralympic disability classifications.
Clinical relevance Knowledge of normative scores may aid clinicians' interpretation of baseline and post-injury SCAT5 scores.

169 THE TOP 1% OF HEAD IMPACTS CAUSE VISIBLE SIGNS AND 'CHECK ENGINE' RESPONSES IN ATHLETES AND MILITARY SERVICE MEMBERS

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Background For the past ~20 years, the scientific literature, based on data from inaccurate helmet/head-mounted sensors, has reported that there is little link between head impact magnitude and location and visible signs (VS). The current study found that VS were seen only in impacts in the top 1% as measured by head impact acceleration, velocity and/or energy.
Objective Head impacts were measured with an accurate head impact monitoring mouthguard and confirmed through video and data trace analysis. The athlete/military service member behavior was observed for a visible sign post-impact.
Design Retrospective meta-analysis from military parachute, boxing, mixed martial arts, weapons firing, as well as American football, Boxing, Ice Hockey, Karate, Lacrosse, Mixed Martial Arts, Rugby, Tae Kwon Do, Football.
Setting Sporting field or Military training activity.
Participants 50,000 verified impacts over 10,000 person-days.
Assessment of Risk Factors Visible signs post-impact.
Main Outcome Measurements Kinetic energy transfer (KE), peak scalar linear acceleration (PLA), peak scalar linear velocity (PLV), impact location, impact direction, type of VS.
Results There were fifty (50) single head impacts that caused visible signs. The most common visible signs were loss of consciousness, posturing, dazed, imbalance and ataxia. All visible signs impacts were in the top 1% by magnitude (40–100g, 3–8 m/s and 30–150 J). A total of 90% of the VS impacts were to the side or rear of the head.
Conclusions Visible signs do not occur often, but always occurred in the top 1% of head impacts by magnitude, and 90% of these were to the rear and the sides of the head. By monitoring head impacts with an accurate device, clinical staff can have access to data that identifies head impacts most likely to cause visible signs.

170 RISK FACTORS FOR POST-CONCUSSION SUBSEQUENT MUSCULOSKELETAL INJURIES

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Background Elevated rates (1.5 to 3.0 times) of musculoskeletal (MSK) injuries in the first year post-concussion have been recently identified in diverse athletic populations; however, clinically feasible risk factors have received limited attention.
Objective To identify clinical predictors of post-concussion subsequent musculoskeletal (MSK) injuries.
Design Prospective longitudinal.
Setting U.S. Intercollegiate Athletics .